Architecture in the Fourth Dimension
Methods and Practices for a Sustainable Building Stock

Proceedings of the Joint Conference of CIB W104 and W110
November 15 – 17, 2011 – Boston, Massachusetts, USA

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WELCOME

It is our pleasure to welcome friends and colleagues from every continent to this international conference on ***Architecture in the Fourth Dimension***. This is the third conference of the CIB W104 Open Building Implementation to be held in the United States, the first one having been organized in Washington DC twelve years ago at the National Building Museum and the second in Muncie, Indiana at Ball State University, focused on Education for an Open Architecture.

We are pleased that members of the CIB W110 Informal Settlements and Affordable Housing group could join us. We are all aware of the impact that informal settlements have in our urban fabric and the importance of intersecting the benefits and challenges posed by informal urbanization with open building concepts and principles. Both CIB groups are inherently focused in the challenges of the long view.

The papers submitted by members of both CIB groups and by friends of both represent a wide and deep range of ways of seeing the role of the building industry in supporting a sustainable, accommodating and equitable built environment that balances the values of the community and the values of individuals.

For the first time we are broadening our focus to include the design of adaptable healthcare facilities in the dialogues of open building. This sector is facing tremendous challenges of balancing the critical variables of rapidly changing modes of health maintenance and curative practices, and the equally critical importance of investing in assets that have long useful lives. Distinguishing long-lived physical infrastructures with the unforeseeable needs of specific healthcare functionality is the key.

More broadly, we are interested in moving the discourse in architecture beyond the now-100-year era of functionalism, toward an ethic – and congruent methods – based on the concept of capacity.

We are particularly pleased that the first and second place winners of the first international student design competition on the conference theme can attend the conference to receive their awards. Their talent and enthusiasm makes us very hopeful about the future of our disciplines.

We want to thank the many architecture practices, client organizations, product manufacturers and construction companies that contributed funds for the conference. We also want to thank most particularly the Boston Society of Architects – and especially Billy Craig, Director of Business Development for the BSA - for showing early confidence in our ability to generate an attractive and audience-generating conference program.

We hope that the content of this proceedings and our interaction with colleagues and friends during the conference will stimulate us towards an ever growing level of commitment to a sustainable built environment - accommodating all the natural variety and change that dynamic societies exhibit.

Stephen Kendall, PhD (MIT'90)
College of Architecture and Planning
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November 2011

Acknowledgements

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- Ascension Health

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- Shinichi Chikazumi*, Architect, Shu-Koh-Sha Architecture and Urban Design Studio, Tokyo*
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- Phil Astley, *UCL/Bartlett, London, UK*
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- Michael Gibson
  Competition coordinator and author of the competition brief and Assistant Professor, Kansas State University
- Stephen Kendall, PhD, *Professor, Ball State University; Joint Coordinator, CIB W104*
- Angela Watson
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- David Hanitchak
  Consulted on Competition Brief and Competition Q@A; former Director of Facilities, Partners HealthCare System/MGH

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- Shin Murakami, PhD, *Professor, Sugiyama Jogakuen University, Nagoya; Joint Coordinator, CIB W104*

Joint Coordinators W110 Informal Settlements / Affordable Housing

- Happy Ratna Santosa,Dr. Ir., *Professor, Department of Architecture, Institute of Technology Sepuluh Nopember (ITS), Indonesia*
- Dr. Amira Osman, *University of Pretoria, South Africa*

Conference Chairs

- Stephen Kendall, PhD, *Professor, Department of Architecture, Ball State University*
- Michael Gibson, *Assistant Professor, Kansas State University*

Conference Support

The conference chairs would like to thank the following individuals for their support and hosting of the conference:

- The Boston Society of Architects
- Billy Craig, Director of Business Development at the Boston Society of Architects
- The Build Boston 2011 Staff, *for their support with registration, conference space and equipment, accommodations, volunteers, publicity and overall conference organization*

Introduction to the CIB, the CIB W104, and the CIB W110

CIB

CIB is the acronym of the abbreviated French (former) name: "Conseil International du Bâtiment" (in English this is: International Council for Building). In the course of 1998, the abbreviation has been kept but the full name changed to: INTERNATIONAL COUNCIL FOR RESEARCH AND INNOVATION IN BUILDING AND CONSTRUCTION.

CIB was established in 1953 as an Association whose objectives were to stimulate and facilitate international cooperation and information exchange between governmental research institutes in the building and construction sector, with an emphasis on those institutes engaged in technical fields of research.

CIB has since developed into a world-wide network of over 5000 experts from about 500 member organizations active in the research community, in industry or in education, who cooperate and exchange information in over 50 CIB Commissions covering all fields in building and construction related research and innovation. CIB Members are institutes, companies and other types of organizations involved in research or in the transfer or application of research results. Member organizations appoint experts to participate in CIB Commissions. An individual also can be a member and participate in a Commission. CIB Commissions initiate projects for R&D and information exchange, organize meetings and produce publications. These meetings can be Commission meetings for members only or international symposia and congresses open to all. Publications can be proceedings, scientific or technical analyses and international state of the art reports.

CIB W104

CIB W104 Open Building Implementation is an international network of researchers, educators and practitioners who subscribe to the Open Building approach to the design of the built environment. In doing so we seek to understand the behavior of the built environment and to develop methods of design, construction and education compatible with it. (*www.open-building.org*)

Open Building is the term used to indicate a number of different but related ideas about the making of environment, for instance:

- *The idea of distinct levels of intervention in the built environment, such as those represented by 'support' and 'infill', or by urban design and architecture;*
- *The idea that users / inhabitants may make design decisions as well as professionals;*
- *The idea that, more generally, designing is a process with multiple participants also including different kinds of professionals;*
- *The idea that the interface between technical systems allows the replacement of one system with another performing the same function - as with different fit-out systems applied in a base building;*
- *The idea that built environment is in constant transformation and change must be recognized and understood;*
- *The idea that built environment is the product of an ongoing, never ending design process in which environment transforms part by part. (http://www.habraken.com/john)*

Open Building provides tools and methods for sustainable buildings and neighborhoods. Designing buildings using Open Building methods enables these buildings to last because they can adjust, meeting changing technical requirements and occupant preferences. This is accomplished in part by decoupling physical elements (building product to urban tissue) in to minimize their mutual interference. Open Building's most important goal is to combine the freedom of choice and dignity of individuals in their work places, dwellings and communities, with the coherence and stability of culturally appropriate buildings and neighborhoods. This is accomplished in part by decoupling physical elements (from the scale of building product to urban tissue) in order to minimize their mutual interference.

Four basic objectives of the W104 Open Building Commission:

- *To increase awareness of the principles of Open Building among professionals who shape the built environment, and among the people who live in that built environment.*
- *To support initiatives at national, regional and local levels that improve the efficacy of building construction and facility adaptation following Open Building methods.*
- *To be a platform for research and information dissemination among professionals committed to improving Open Building practices and methods.*
- *To exchange experiences in teaching methods supportive of an open architecture.*

Joint Coordinators:

- Stephen Kendall, PhD, *Professor of Architecture, Ball State University*
- Jia Beisi, PhD, *Associate Professor of Architecture, University of Hong Kong*
- Shin Murakami PhD, *Professor of Architecture, Sugiyama Jogakuen University, Nagoya*
- *Outgoing:* Kazunobu Minami, PhD, *Professor of Architecture, Shibaura Institute of Technology, Tokyo*

The Commission has a relationship with the CIB Encouraged Journal OHI - Open House International (http://www.openhouse-int.com)

CIB W110

The objectives of W110 Informal Settlements and Affordable Housing are to define means of creating sustainable livelihood in informal settlements, incorporating the inhabitants' participation, and to define how the stakeholders can transfer technology to assist such communities in the development or improvement of the settlement's physical, social and economic conditions.

The detailed objectives are:

- *To investigate informal settlements, that has not previously been adequately researched and propose for their improvement to create sustainable livelihoods incorporating people participation.*
- *To transfer technology, education and technical information and guidance on healthy settlements and housing and social economic improvements, from the universities and scientific institutes, the NGOs or other stakeholders to the communities.*
- *To create an international focal point for the collection, organisation and dissemination of research results and demonstration related to enabling the provision of affordable housing and informal settlements world wide.*
- *The scope of the research on informal settlements and housing include; government regulations, informal settlements and housing policies and programmes, social-economic issues and people participations, housing design, housing delivery system, building technology transfer and guidance, land development, site planning and housing for special need groups, such as elderly, women widows, disaster victims.*

Joint Coordinators:

- Dr Amira Osman, *Senior Researcher: Sustainable Human Settlements, Built Environment Unit, CSIR, Pretoria, South Africa*
- Prof. Happy Ratna Santosa, *Institut Teknologi Sepuluh Nopember, Indonesia*

OPEN BUILDING

A4D: Architecture in the fourth dimension

NOVEMBER 15–17, 2011

This year, Build Boston is pleased to host the International Open Building Conference.

One of the most pressing challenges facing us in designing the built environment is to go beyond narrow functionalism – to make buildings that are enduring, lovable, energy effective and adaptable for the very long haul.

To help address the challenges, this international conference will promote information exchange and dialogue among architects, clients, construction experts and academic industry researchers on methods and practices for a sustainable building stock. The conference focuses on healthcare and residential architecture but seeks to go beyond functional types to discuss open architecture as such.

For more information about Open Building, please refer to the conference website:

open-building.org/conference2011

Our focus is on several dominant trends in the contemporary built environment:

- Ever-larger buildings are now normal, often providing space for thousands of users.
- These large projects are almost inevitably designed as architectural infrastructures, with a hierarchy of levels of intervention applied to manage their complexity and their varied and changing patterns of use.
- The availability of and demand for an increasing array of adaptable equipment and facilities serving the inhabitant user offer new business opportunities.
- Social trends toward individualism mean that functional specification is increasingly varied and personalized, making simultaneous design of the base building and the user level impractical.
- A clear distinction is emerging between what is to be done on the user level as compared to what is part of the traditional long-term investment and functionality of the building.

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A4D CONFERENCE PROGRAM

Register for the Full Conference Pass or select workshops a la carte. For pricing, see page 46.

TUESDAY PROGRAM

Exchange Conference Center, Fish Pier, Boston

Registration
8:00 AM – 8:45 AM
The Tuesday Program is free and open to all. Registration required.

Welcome and opening of the conference
8:45 AM – 9:15 AM
Stephen Kendall, conference chair, professor Ball State University

Keynote speech
9:15 AM – 10:15 AM
Dietmar Eberle, Honorary Fellow, AIA, partner, Baumschlager Eberle, Vienna, Vaduz, Hong Kong

Keynote speech
11:00 AM – NOON
Stephen Kieran AIA, Kieran Timberlake Architects and professor, University of Pennsylvania

NOON – 1:00 PM LUNCH (on own)

Presentation by and awards to the winners of the international student design competition
1:30 PM – 2:30 PM

Presentation and review of the Charrettes by Payette, Shepley Bulfinch and Cannon Design
3:00 PM – 5:30 PM
Paul Lukez FAIA (chair)
Angela Watson AIA, Shepley Bulfinch
Peter Hourihan LEED AP, Principal, director of research, Cannon Design
Sho-Ping Chin FAIA, Payette

WEDNESDAY PROGRAM

Seaport World Trade Center

Two keynote speeches
8:00 AM – 10:00 AM
Giorgio Macchi, Dipl. Architect ETH/SIA, Canton Bern, Switzerland Chief Architect of Properties and Buildings
Phil Nedin PE, ARUP global leader in healthcare architecture

OB1

Panel: Achieving sustainability in high performance buildings
10:30 AM – NOON | 1.5 SD
We will discuss approaches that can be taken now to prepare high performance buildings for the long haul, without waiting for larger and eventually critical political consensus.
Sarah Slaughter PhD, associate director for buildings and infrastructure, MIT Energy Initiative (chair)
Stephen Wooldridge PE, FACHE, US Army Health Facility Planning Agency
Phil Nedin, PE, ARUP global leader in healthcare architecture
Randy Kray AIA, director of Laboratory Architecture, Merrick & Company

NOON – 1:00 PM LUNCH (on own)

Parallel paper session 1
1:00 PM – 3:30 PM

3:30 PM – 4:30 PM BREAK

OB2

Parallel seminar 1: Open planning for healthcare, part 1
4:30 PM – 6:00 PM | 1.5 HSW
Phil Astley, UCL/Bartlett-London (chair)
Lindsay McCluskie, Salford Royal NHS Foundation Trust, Manchester, UK
David Hanitchak, Partners HealthCare System Inc, Boston, MA

OB3

Parallel seminar 2: Efficient customization of housing
4:30 PM – 6:00 PM | 1.5 HSW
Jia Beisi, University of Hong Kong (chair)
Dr. Kazunobu Minami, Japan
Frans van der Werf, Holland
Mr. Liu Yanhui, Gong Tiejun and **Yang Xiaodong, Ms Lou Ni,** China

THURSDAY PROGRAM

Seaport World Trade Center

Two keynote speeches
8:00 AM – 10:00 AM
Tedd Benson, Bensonwood Homes
Liu Yanhui, China Architecture Design and Research

OB4

Panel: Beyond functionalism
10:30 AM – NOON | 1.5 CR
Looking at the extent to which the modernist principle of "functionalism" is obsolete and more seriously thwarts a needed paradigm shift to the concept of capacity.
William Porter FAIA (chair)
George Thrush FAIA, director, School of Architecture, Northeastern University
Ann Beha FAIA, Ann Beha Architects
Luciana Burdi, Division of Capital Asset Management, State of Mass

NOON – 1:00 PM LUNCH (on own)

Parallel paper session 2
1:00 PM – 3:30 PM

3:30 PM – 4:30 PM BREAK

OB5

Parallel seminar 1: Open planning for healthcare, part 2
4:30 PM – 6:00 PM | 1.5 HSW
Prerequisite: Open planning for healthcare, part 1
Phil Astley, UCL/Bartlett-London (chair)
Lindsay McCluskie, Salford Royal NHS Foundation Trust, Manchester, UK
David Hanitchak, Partners HealthCare System Inc, Boston, MA

OB6

Parallel Seminar 2: CIB W110 Low-income Housing and Informal Settlements
4:30 PM – 6:00 PM | 1.5 SD
Amira Osman, CSIR, South Africa (chair)
Gopal Dharmaraja, India
Jorge Andrade, Mexico
Happy Santosa, Indonesia

OB7

Farewell dinner at the Seaport World Trade Center for registered guests
7:30 PM
Closing Remarks by **Kairos Shen,** chief planner of the City of Boston

New Challenges for the Open Building Movement: Architecture in the Fourth Dimension

The Open Building Implementation network (www.open-building.org) was formed in 1996, under the auspices of the CIB (International Council for Research and Innovation in Building and Construction). Members of the CIB W104 now come from many countries - including the incubators of open building Japan and the Netherlands – as well as the USA, the UK, Finland, Spain, Iran, France, Italy, Switzerland, Korea, China, Taiwan, Indonesia, Mexico, Brazil and South Africa.

Its original purpose was twofold. First, we intended to document developments toward open building internationally. Second, we would stimulate implementation efforts by disseminating information and by convening international conferences at which government and university researchers, practitioners and others could exchange information and support local initiatives. These activities focused largely on the technical and methodological aspects of residential open building. There was interchange between colleagues in the less developed countries and developed countries, but the dominant focus was the latter.

During the intervening years, we met at least 17 times, in Delft, Tokyo, Taipei, Washington, DC, Mexico City, Brighton (UK), Helsinki, Paris, Hong Kong, Muncie, Indiana (USA), and Bilbao, Spain, on a few occasions with other CIB Commissions, and at several of the triennial CIB World Congresses. The most recent conferences focused on education and sustainability. Each included an international student competition, with winners from Korea, China, Germany, the UK, Singapore and the USA.

Each conference has produced a published book of proceedings, containing a total now of over 300 peer-reviewed papers. A book titled Residential Open Building was published (Spon, 2000) and later was translated into Japanese. A second book, reporting on many new examples of open building is in preparation. A number of books have been published specifically on the subject and dozens of technical reports have been produced in several languages. Open building is referred to in countless books, scholarly papers, disertations, and articles in professional journals, and in-depth country reports and studies have emerged in Finland, the Netherlands, the USA and Japan. (http://en.wikipedia.org/wiki/Open_building)

In the last few years, developments internationally suggest that the commission – and the open building movement more generally - needs to both continue its focus and expand its arenas of investigation. Residential open building is no longer a speculative idea of a few pioneer practitioners and theorists. It has or is poised to become mainstream. While disseminating information in professional journals, books and scholarly publications about the technical and methodological dimensions of residential open building still makes sense, there is reason to pose new questions or reexamine old ones. In fact, in 2009 at our meeting in the Netherlands, a new subgroup of W104 was initiated focusing on open building in the healthcare facilities sector.

State of the Art

Open Building is the term used to indicate a number of different but related ideas about the making of environment, for instance:

- *The idea of distinct levels of work in the built environment, such as those represented by 'support' or 'base building' or 'core and shell', and 'infill' or 'fit-out' or 'tenant-work'. Urban design and architecture also represent two levels of action.*
- *The idea that users / inhabitants may make design decisions in their sphere of control, as well as professionals;*
- *The idea that, more generally, designing is a process with multiple participants, among whom are different kinds of professionals;*
- *The idea that the interface between technical systems allows the replacement of one system with another performing the same function - as with different fit-out systems capable of being installed in a specific base building;*

- *The idea that built environment is in constant transformation, and that, as a consequence, change must be recognized and understood;*
- *The idea that built environment is the product of an ongoing, never ending design process in which environment transforms part by part. (www.habraken.org)*

Many observers have recognized for some time that shopping centers and office buildings exhibit the characteristics of open building. As far as we know, no theoretical or methodological work preceded their coming of age. Their first appearance and subsequent evolution progressed pragmatically, as a response to new realities, led by real estate developers and business entities of all kinds. Architects and contractors learned how to provide the needed services, often producing work of exceptional quality. Product manufacturers and their supply chains began introducing suitable products, fabrication and construction methods. New standards, regulations and financing tools were developed to match the new realities. These developments are international in scope, crossing economic, political, cultural and technical boundaries.

We now see that many parties – public and private - are asking for residential open building on a regular basis. This is evident in Finland, Poland, Japan, and the Netherlands. In other countries, residential open building – known by many names – is no longer seen as particularly unusual. We see evidence of this in Russia, Switzerland, Germany, China and to a lesser extent in the United States. New examples of housing designed by professionals to be incrementally upgraded in an informal user-controlled process come to light constantly, whether in Chile, Mexico, or South Africa. There is good reason to think that members of the Open Building network have contributed in some ways to this new coming of age of residential open building.

Mainstreaming of open building is apparently a response to the pressures, conflicts and waste caused by continued adherence to rigid functionalism – that is, defining functions and designing buildings to fit. Open building is also a pragmatic answer to a state of technical entanglement in buildings that has resulted from the incremental addition, over a long period of time, of new technical systems and the claim to these new systems by different trades who rarely cooperate. These pressures are forcing all parties to reconsider and realign their procurement and investment practices, their accounting methods, and their regulatory systems. In mass-consumer societies, attitudes toward the control exercised by inhabitants in the making and transformation of environments are changing vis-a-vis the control exercised by the many experts hired by large corporations, governments and communities. The idea that investments should consider long-term asset value is also forcing all parties to learn to make buildings – especially but not limited to multi-occupant buildings - that can adjust as technologies, social patterns, and preferences – both individual and community – evolve.

These changes in attitude and priorities are now taking the force of law. In part this can be explained by the widespread – and parallel - adoption of a sustainability agenda. For example, the Japanese parliament passed new laws in 2008 mandating 200 year housing, accompanying the legislation with enabling tools for use by local building officials who have the responsibility to evaluate and approve building projects. Projects approved under the new law receive a reduced rate of taxation. Other incentives may be added. In Finland, one of the largest real estate companies is regularly developing open building projects for their residential portfolio. In the Netherlands, a number of companies – from product manufacturers to developers to architects – are doing open building, by other names. In Warsaw, Poland, open building is known as the "Warsaw Standard". In San Francisco, residential developers build "bulk" housing, ready to be fitted out individually. Around the world, old office buildings, retained their social and economic value, are being converted to residential occupancy, after being "gutted" to prepare them for new uses and layouts.

We also see that in many countries, under the pressure of a rapidly evolving health care sector, hospitals are moving toward open building. We see this in the United States, Switzerland, Germany, Belgium, the United Kingdom, and the Netherlands. Similar developments are undoubtedly happening elsewhere, under the radar screen. Hospital clients can no longer afford to let short-term functional programs drive facilities procurement methods and investment decisions. They are demanding "change-ready" facilities, assessed by their accommodation capacity over time, rather than by short-term functional performance. But significant regulatory and financing barriers remain.

These projects - often large and complex, providing space for housing, offices, commercial, health care and other uses - have the systemic properties of large private (or public) infrastructures. They involve many decision-making bodies and users over long time periods and often implicate numerous territorial claims. As such, they present technical, economic, political and cultural questions that go far beyond the dominant architectural discourse that still tends to emphasize the special case, breathless excitement over formal gymnastics, and the self-expression and self-aggrandizement of the designer and client. Generally speaking, these developments toward open building are not taking place for their ideological purity but for pragmatic reasons. In some cases, advocates of these new ways of working write and speak about them, but most simply get to work in daily practice, and meet new realities without much fanfare.

An important task to continue

While much remains to be done to make open building projects come about with architectural excellence, to improve coordination, and to make long-term adaptation take place without fuss and at high quality, those in the trenches have little incentive or time to report on and generalize from their work. A role continues to exist, therefore, for academics interested in detached and careful observation of what happens in the world of practice, with the expectation that new insights and sound generalizations may emerge to serve the built field.

Much remains to be done – on a continuing basis – in reporting on and accounting for developments toward open building. This effort should aggressively encompass not only residential but other ordinary classes of projects such as hospitals, schools, retail/commercial and office buildings and mixed-use properties and sites. The recent interest in new urbanism and other movements seeking thematic coherence of urban tissues will undoubtedly produce a building stock designed to accommodate varying occupancies.

Now that evidence is mounting that open building is not an aberration but a norm, we can expect building economists to develop data on the economic advantages of this way of working and to study the migration of economic activity toward the fit-out level. It should be possible for studies of buildings-in-use to track and evaluate user response to varying cycles of building and equipment change. Building information modeling software will soon enable designers and researchers to keep good records of how buildings change, enabling clients to make better decisions on their next investments. These signs of the evolution of the building stock should be carefully studied and general principles sought.

Some questions within the scope of the open building are:

BASE BUILDING ARCHITECTURE

Interior public space and the urban façade are two architectural issues that demand new thought.

John Habraken, Denise Scott Brown and others have written about the importance of interior public space as part of larger patterns of space in urban tissues. Both have used the Nolli Map of Rome to articulate a view of the connectivity of urban design and architecture. Next 21 in Osaka – one of the most significant open building projects to date - was conceived as three dimensional urban design, challenging old assumptions about where the city ends and the building begins, raising new questions about territorial hierarchy.

Form-based codes are showing how rules and themes defining building envelopes that shape public space can supersede traditional functionalist zoning and abstract form making. Property developers are instructing their architects' - each hired to do an individual building - to adhere to thematic agreements in the design of the facades of new buildings in large urban extensions.

These developments are not limited to open building, but nevertheless are defining the skill sets, attitudes, methods and knowledge needed to make high quality base buildings and lively urban tissues that exhibit variety-in-coherence. Open building advocates must take the lead by pointing out these and related developments not as random events but as signs of new understandings of an open architecture.

AN INFILL INDUSTRY

A new kind of business entity with a new customer value proposition is needed to meet the demand of variable fit-out in open building projects.

Base buildings do not cost more. This was established by sound economic analysis decades ago for the residential sector, most clearly by work done in the Netherlands. Recently, a developer in Amsterdam built an open building project, accepting an initial up-charge of 5%, but recouped that investment within 2 years. This return on investment is evident in the office building and retail sectors, even though little or no building economics' evaluations have been done to prove empirically what is already a matter of course. Base buildings in the health care sector will soon become the norm, albeit with little in the way of theory or economic analysis to back it up, out of the force of necessity. While there is much to be done in improving the design and construction of sustainable and energy efficient base buildings, we can reasonably say that these developments are already well on their way.

Research conducted in the United States in the early 1980's showed that an increasing percentage of value added in the building sector was moving to investments in equipment and away from construction. Equipment is the classification of products that – in the United States - are depreciated on a short cycle, as opposed to the 30-year depreciation schedule of real property (base buildings). Equipment constitutes the kinds of products governed by standards such as those used by the Underwriters Laboratory in the United States and their counterparts elsewhere. Other countries have probably experienced the same shifting investment phenomenon, although little or no research exists to prove this. From an Open Building perspective, these trends signal the growth potential of an infill industry.

The customarily disjointed and quality-plagued way of filling in the empty spaces in open building projects is no longer excusable. There are exceptions, such as the high cost product bundles manufactured and installed by multi-national companies such as Steelcase, Haworth, Herman Miller and similar systems furniture companies. These companies are now moving outside of their traditional market niche of premier office space and are investing heavily in the health care sector. Other companies have learned how to deliver just-in-time fit-out for branch banks, chain stores, and even branded kindergartens, from central warehouses using local certified installation crews. But these represent a very small percentage of total fit-out investments. Aside from these, current practices produce high costs, scheduling complexity, conflict and limited user-choice.

In the residential open building market, no fully integrated fit-out companies exist. Early business ventures such as Matura in the Netherlands (1990-95) provided important technical and business models that deserve careful analysis. That infill system is now being upgraded and is reentering the market as a related kit-of-parts rather than a fully integrated system. NEXT-Infill is finding a market for its integrated infill for the new construction and renovation market in Japan. Developments in Finland will almost certainly evolve into fully integrated logistics and infill delivery. Time will tell if these business ventures will succeed in displacing the conventional, disintegrated fit-out delivery process and if similar developments will take root in other countries.

But in general, a mature infill industry has yet to be born. In this arena, open building knowledge is crucial, and here, too we can be useful.

INCREMENTAL HOUSING IN DEVELOPING SOCIETIES

In developing economies, in which the informal sector is a vital part of the housing process, open building principles are evident.

New housing, designed by professionals, is incrementally adjusted, added to, and modified over time by the action of each household. This, too, is not new. New forms of public/private partnerships emerge, old technologies are used in new ways, and informal settlements become stable in ways that can only be understood by long-term observation. Recognition of the role of the user in the creation of environment is alive and well, if too often forgotten as part of the future of architecture. In developing economies, as in developed economies, experts in large bureaucracies and corporations are usually loath to relinquish control. But some learn to make money and protect the public interest by careful repositioning of their ways of working, harnessing the often invisible but complimentary economic engine of individual and local initiative in the housing process.

OPEN BUILDING FOR HEALTHCARE

The dynamics of the healthcare sector present tremendous challenges for which open building principles may be useful.

Many experts now recognize that hospitals and medical facilities, more than any other building type, are functionally diverse and technically complex, and never finished. Changes in demographics, diseases, treatment procedures, equipment, doctor's preferences, and regulations – with their demands for new spatial adjacencies and configurations - are forcing the emergence of a shorter use-life "fit-out" level of investment in more stable base building infrastructures, in which facilities

1) Are characterized by fine-grained functional units (many organizationally distinct functional units per building, often with different budgetary and accounting criteria) that change over time;
2) Have intricate and densely entangled MEP (mechanical, electrical and plumbing) systems that operate across accounting and investment boundaries, and
3) Have systems and spatial layouts characterized by varying life cycles measured not only by technical criteria but also in terms of the rapidly changing conditions within the health care sector.

Addressing the granularity of functional units, rate of change and systems entanglement according to varying life-cycle profiles are two of the major research tasks now facing medical facilities design under dynamic social and financial conditions. These are directly related to patient care and comfort, as well as to facility performance from the perspective of building users, managers and owners.

The focus on varying life cycles of technical and management systems is important because of changes in medical practices, insurance, demographics, regulations and other dynamics in 21st century society. Medical facilities are under unremitting pressure to adapt – physically and organizationally. But, most medical buildings procured following conventional practices have less than optimum capacity to adjust appropriately to these dynamic conditions. Given the extreme technical and organizational complexity of medical facilities, new insights are needed to manage these dynamics. Simply "tweaking" existing paradigms may not solve the problems.

The literature on the architecture of care environments is unambiguous in respect to the importance of patient-centered theory and practice. More than 40 years of methodical research in the "environment- behavior" field has produced useful insights, a good deal specifically related to medical facilities and users. The recent focus on "evidence-based" design practice is a sign that this research literature is finally being taken seriously.

Less recognized in the literature, however, is the fact that – given the dynamics of 21st century society – the functionalist approach to facility design is obsolete. While this way of thinking has been the norm, we can no longer assume that if we determine a program of uses and design a hospital to suit, the future functionality of such a facility is assured. The opposite is more often true; that is, buildings designed according to the functionalist paradigm perform poorly, while those designed to accommodate varying functions gain value over time.

These experiences are not restricted to any one geographic region – they are ubiquitous. Studying these widespread instances in depth and over time may well lead us to recognize general principles. These in turn may help us develop better methods to cope with the new realities facing all those involved in the design, management and use of health care facilities of all kinds.

EDUCATION FOR AN OPEN ARCHITECTURE

From the perspective of open building, a renewal of the education of architects is urgently needed. The schools need to catch up with a profession already taking part in addressing the new realities of an open architecture, and may be able to assist in developing the knowledge, methods and the tools needed for the job.

Open architecture calls for new ways of teaching and perhaps new kinds of courses outside the studio, aimed to teach design skills per se, liberated from functionalism. The most durable but most problematic fact of life in contemporary architectural education internationally is the assumption that every design project in the studio must begin with a program of functions. If we now see that programs of functions are inherently fleeting, we need a new basis for making architectural design decisions and assessing quality. Capacity – and methods to assess capacity – is one key concept that must find its place in the lexicon and tools of architectural design education. But this may not fit well in the typical studio, where function is in the driver's seat.

Some studios should be crafted to teach the skills needed to handle form making in support of an open architecture. This has to do with handling form as such, under varying conditions – considering cooperation among designers, working on levels of intervention, and dealing with issues such as territory, working in a context set by others, and setting themes that others will follow. Building systems, building technology and structures courses all teach similar skills of a technical sort. There, exercises in technical thinking are most often assigned independent of specific uses or sites. The same is needed in architectural thinking and methods, not only for open building, but more generally.

Faculty in schools of architecture should be encouraged to make room for open building principles, methods and attitudes in studios and in other support courses. This is not easy in already crowded university curricula. There is no question that these skills and attitudes are developed in an ad-hoc fashion on-the-job, in offices all over the world. Architecture schools need to catch up and provide sensible leadership in improving the skills and knowledge needed in handling the new challenges.

Written By:
Stephen Kendall, PhD (MIT '90)
Professor of Architecture
Ball State University, Muncie, Indiana

Joint Coordinator, CIB W104 Open Building Implementation
skendall@bsu.edu

Keynote Lecturers
[By Order of Appearance]

Stephen Kendall, PhD
Professor of Architecture
Ball State University

Dr. Stephen Kendall is Professor of Architecture at Ball State University. He is a registered architect, with a professional degree from the University of Cincinnati and a Masters of Architecture and Urban Design degree from Washington University in St. Louis. His PhD is from the Massachusetts Institute of Technology where he studied with John Habraken and Donald Schön.

Dr. Kendall is an internationally recognized speaker, educator and scholar in the field of open building. He has published more than 40 refereed papers, co-authored several books, authored book chapters and technical reports, and has taught in the United States, Taiwan, Italy, and Indonesia. His research, teaching and writing focus on the application of open building principles and practices in both residential and health care architecture.

Dietmar Eberle
Honorary Fellow, AIA,
Director, Baumschlager Eberle, Vienna, Vaduz, Hong Kong (since 1985)
Professor (and the Dean 2003-2005) of the Architectural Department, ETH-Technical University Zurich since 1999.

"Nachhaltigkeit" (Sustainability) in German language has to do with continuity, but also with the confidences of high quality of buildings. The buildings of Baumschlager Eberle are therefore not noted for making formal, individual statements. On the contrary, they are the product of the considerations to optimize the quality of the site, material and construction, to minimize of energy and resource consumption, and to open the structure for neutral use possibility. The office of Baumschlager Eberle engages with the complex facts of economy, ecology, resources and society, with together form the cultural context of the world we live in. This kind of approach takes place on a large number of levels, attainable through rational and emotional intelligence. Always with the eyes firmly on the goal of introducing architecture as something concrete, they believe the realization of sustainability has an impact on value.

Representative buildings include ETH e-Science Lab Zurich (Green Building Award of Austria 2010), Vienna Airport City and Terminal Extension, Hospital AZ Goreninge in Belgium, Lohbach Housing (International Green Housing Award 2004), and Moma and Pop Moma in Beijing

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Keynote Lecturers
[continued]

Stephen Kieran AIA
Principal, Kieran Timberlake Architects and
Professor, University of Pennsylvania

Stephen Kieran is a partner at KieranTimberlake, an American architecture firm internationally recognized for its beautifully crafted, thoughtfully made buildings that are holistically integrated to site, program and people. KieranTimberlake is noted for its fusion of research with architecture, receiving over one hundred design citations including the 2008 Architecture Firm Award from the American Institute of Architects, and the 2010 Cooper-Hewitt National Design Award for Architecture from the Smithsonian Institution.

Established in Philadelphia in 1984, KieranTimberlake has produced a diverse body of work for clients drawn to its environmentally ethical and innovative design. Their client list includes the Sidwell Friends School in Washington, DC; Yale University in New Haven, CT; Make It Right in New Orleans, LA; and The Museum of Modern Art in New York, NY. They are currently engaged in projects across the United States in California, North Carolina, Pennsylvania, Texas and Washington, DC, and internationally in Malaysia and Singapore. In 2010 the firm won a high profile competition to design the United States Embassy in London.

Stephen and his partner, James Timberlake, received the first Benjamin Latrobe Fellowship for architectural design research from the AIA College of Fellows in 2001. Kieran has co-authored several books, including Manual, The Architecture of KieranTimberlake, refabricating Architecture, and Loblolly House: Elements of a New Architecture. KieranTimberlake's latest book, Cellophane House™ was released as an eBook in early 2011, and a new monograph is due out in September 2011.

Mr. Kieran received a Bachelor of Arts degree from Yale University, and a Master of Architecture degree from the University of Pennsylvania. He is a recipient of the Rome Prize.

In addition to his architectural practice he teaches a graduate research studio at the University of Pennsylvania, School of Design. He has also held professorships at the University of Washington, Yale University, the University of Michigan, and Princeton University.

KieranTimberlake
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Keynote Lectures
[continued]

Giorgio Macchi
Dipl. Architect ETH/SIA
Canton Bern, Switzerland Chief Architect of Properties and Buildings

Director and chief architect of the Office for Real-Estate and Public Buildings of the Canton Bern
Facts: portfolio-value: 5 billion CHF; 2000 public buildings; investments p.a. 200 millions CHF; average building status 80%; staff members 80; population of Canton Bern - 1 million
Studies: Architecture at the Swiss Federal Institute of Technology Zürich - ETH 1968-74

Professional activities: since 1999
Director and chief architect of the office for real-estate and public building-constructions of the canton Bern. Main entrepreneurial objective: promote buildings that are useful for a very long time, efficiently maintainable, effectively transformable and feature cultural identity.
2004 Change Management: merger of the public building office and the real-estate administration; design and development of a professional organization with owner and construction competences.
Certification ISO 14001 with specific targets in renewable energy, timber construction, concrete recycling.
Implementation of strategic principles for sustainable development of the real-estate portfolio and for sustainable design and realization of building-construction with special regard to the programmatic concept of system separation (structural separation of components, flexibility of primary systems, availability of building areas.
2001 Change Management: implementation of three core competences: portfolio management; facility management and project management.

Professional activities: 1974 - 1999
Project director at the office for public buildings of the Canton Bern
Consulting in healthcare projects and planning
Associated lecturer at the Bern University of Applied Sciences 1977-78
Chief assistant at the Swiss Federal Institute of Technology Zürich - ETH 1990-91

Keynote Lectures
[Continued]

Phil Nedin PE
ARUP Global Leader in
Healthcare Architecture

Phil is a chartered engineer and a director of Arup and is responsible for Arup's global healthcare business. This role has taken him to many regions in the world to investigate best practice solutions in healthcare engineering.

He has been with Arup for more than 20 years and is currently based in the London office. Prior to joining Arup he worked for the National Health Service in a regional health authority design group in London.

A past President of the Institute of Healthcare Engineering and Estate Management (IHEEM), Phil currently sits on their international committee. He is also a member of the International Federation of Hospital Engineering publication advisory panel and a member of the UK Department of Health design review panel.

Phil is an advisor for the International Academy for Design and an advisor to World Architecture. He has also been involved in the Centre of Health Design US Green Building Research Group.

Phil was instrumental in creating a major 12 weeks healthcare design module at Cardiff University which is a multidiscipline course aimed at final year masters students. In the six years since its commencement, it has seen almost 600 students successfully complete the module.

He has research links with a number of universities including Cambridge, Leeds and London's Southbank Universities and was on the recent Design Council advisory panel for Patient Privacy and Dignity.

Tedd Benson
Author and Founder of Bensonwood Homes

Since 1974, Tedd Benson has been the founding owner of Bensonwood Homes. During that time, Tedd has championed high-performance, sustainable homebuilding—always with an emphasis on innovation, quality, and social responsibility. He and the company have been featured on a number of shows in the PBS series, This Old House, as well as Good Morning America, and the Today Show. In addition, Tedd has authored four seminal books on timberframing, the first of which, Building the Timber Frame House, (Scribner's Sons, 1980, Simon & Schuster, 1995) was instrumental in the revival of this centuries-old form of building with heavy timber. Over the past decade, Tedd's unwavering search for a new and better way to build has resulted in an exclusive design/build system called Open-Built®. Open-Built acknowledges what actually happens with buildings over time and seeks to eliminate inefficiencies and waste during construction. In 2011, Tedd fulfilled one of his lifelong goals of making quality homes more affordable through his introduction of the 3B Matrix™, a series of Open-Built components that offer a myriad of design possibilities while greatly reducing the design and engineering costs normally associated with high quality construction. In 2011, Bensonwood received a "TOP 10" Green Building Products award for their sustainable, R-35 OB PlusWall.

Keynote Lectures
[Continued]

Liu Yanhui
Vice President, China Architecture Design and Research Group
Deputy Chief Architect of China Architecture Design and Research Group
Chief Architect of China National Engineering Research Center for Human Settlements
Vice Chairman of Architectural Society of China, Architects Branch
Chairman of China's Sustainable Development Research Committee of the living environment

Mr. Liu Yanhui has been long engaged in construction design and urban& rural construction research. He has extensive engineering practice in Residential and Sports constructions with Suitable, complete and clear design and construction methods for local Chinese.

Mr Liu Yanhui with his team start from the architectural planning research, comprehensively analyzing the relationship between the residential use functions and living space, diagnosing the constructions' function, researching and developing specific technology, and use targeted technical means in the project then evaluate the whole process, so that the residential design vocabulary and construction techniques continue to be optimized.. He presided over a number of national scientific and technological development issues, involved in the development of relevant technology national policy documents, which in the technical level he play an important role in promoting residential development.

Mr Liu Yanhui recently mainly focused on the following residential development:

1. Housing Industrialization. As housing industrialization is a systematic project, it needs to integrate an enormous amount of parameters to achieve the goal. In this area it focuses on how to select the appropriate means of building design and residential supporting components in the industrialized housing production system.

2. High quality living environment. Through physical planning, architectural design means we can achieve high quality living environment, absorbing the traditional Chinese construction wisdom and the current trend of green building tendency. Mr. Liu hosted the State "15" Science and Technology Research Projects called Residential Area and its Environment Plan and Design Study which won the first prize in China Construction Science and Technology Prize 2006. He participated the drafting of national standards “"urban residential planning and design specifications” as the third author which won the second prize in China Construction Science and Technology Prize 2004. He hosted the design of Kaiyuan City project in Linyi Shandong Province which received the14h Outstanding Engineering Beijing Fourteenth third prize 2009 and also chaired the Xinxin Jiayuan first-stage project in Beijing, winning the silver awards of 9th National Excellent Engineering Design.

3. Aging social housing construction. He hosted the drafting of National Standard “Residential building design standards for elder people”, receiving the third prize in China Construction Science and Technology Prize 2004. His research about elderly housing and related facilities won third prize in Beijing Science and Technology Progress Award 2000. He managed the Yang Guang Jia Yuan project in Dalian which received the first prize in Beijing 10th Excellent Design Award 2002.

CHINA ARCHITECUTURE DESIGN & RESEARCH GROUP
No.19 Chegongzhuang St.
BEIJING CHINA
100044

Conference Panels

Refer to schedule for meeting times, locations, AIA Continuing Education training units

Achieving Sustainability in High-Performance Buildings

Panel Topic: We will discuss approaches that can be taken now to prepare high performance buildings for the long haul, without waiting for larger and eventually critical political consensus.

Panel Chair:

Sarah Slaughter PhD, President, Built Environment Coalition (former Associate Director for Buildings and Infrastructure, MIT Energy Initiative)

Panelists:

Stephen Wooldridge PE, FACHE, US Army Health Facility Planning Agency

Phil Nedin PE, ARUP Global Leader in Healthcare Architecture

Randy Kray AIA, Director of Laboratory Architecture, Merrick & Company

Beyond functionalism

Panel Topic: Looking at the extent to which the modernist principle of "functionalism" is obsolete and more seriously thwarts a needed paradigm shift to the concept of capacity.

Panel Chair:

William Porter FAIA

Panelists:

George Thrush FAIA, director, School of Architecture, Northeastern University

Ann Beha FAIA, Ann Beha Architects

Luciana Burdi, Division of Capital Asset Management, State of Mass

Seminars

Refer to schedule for meeting times, locations, AIA Continuing Education training units

Open Planning for Healthcare (Part 1 and 2)

Note: Must be attended in sequence.

Seminar Chair:

Phil Astley, UCL/Bartlett-London

Seminar Leaders:

Lindsay McCluskie, Salford Royal NHS Foundation Trust, Manchester, UK

David Hanitchak, Partners HealthCare System Inc, Boston, MA

Marianus de Jager, Sharp-Shop Architects, South Africa

David Hanitchak (formerly Director of Facilities), Partners HealthCare System/MGH, Boston, MA

Efficient Customization of Housing

Seminar Chair:

Jia Beisi, University of Hong Kong

Seminar Leaders:

Dr. Kazunobu Minami, Japan

Frans van der Werf, Holland

Mr. Liu Yanhui, Gong Tiejun and Yang Xiaodong, Ms Lou Ni, China

CIB W110 Low-income Housing and Informal Settlements

Seminar Leaders:

Amira Osman, CSIR, South Africa

Jorge Andrade, Mexico

Happy Santosa, Indonesia

W104 Young Researcher Awards

The organizers of the conference are pleased to recognize the following researcher-authors with "Young Researcher Awards" to recognize their contribution to the conference and to Open Building research.
Those recognized are younger than 35 and were authors or co-authors of accepted papers written for the W104-Open Building paper call.
Awards will be presented during the conference.
In the Table of Contents, authors receiving this award have been highlighted in **bold** typeface.

The Award Winners

Eric Bellin, The University of Pennsylvania, USA
"Life's Net(or) A Framework for Growth and Change"

Griffin, Corey, Portland State University, USA
"Ordering the Structure of Light Wood Framed Row Houses to Sustainably Accommodate Change: San Francisco's Sunset District as a Cautionary Tale"

Basem Eid, McGill University, Montreal, Canada
"A Computer-Based System for User Participation towards Mass customization of Housing"

Isabel Glogar, ETH Zürich, Switzerland
"A House for Eternity? Durability Through Change: A Study on the Adaptation History and Appreciation of Buildings in the Urban Context"

Sameedha Mahadkar, Loughborough University, UK
"Open Infrastructure Planning for Emergency and Urgent Care"

Dinh Quoc Phuong, Swinburne University of Technology, Australia
"The Impact of "informal" Building Addition on Interior/Exterior Space in Hanoi's Old Apartment Blocks (KTT)"

Huang Qiong, Department of Architecture, Tianjin University, China
"Comparison of Residential Plumbing Solutions of Open Building Approaches with the Chinese Conventional Approach"

Ghazaleh Safarzadeh and Somayeh Mousazadeh, University of Calgary, Canada
"Exploring Connectivity + Seeking Integration: A Framework for Heightened Agility and Adaptability"

Ilkka Törmä, Aalto University Department of Architecture, Finland
"Diversity and Connectedness as the Flexibility of Built Environments"

Aditya Vipparti, CEPT University, Ahmedabad, India
"Adapting to a Culture of "Transience" – Design Methodology for the 21st Century City"

Jiang Yingying, the University of Hong Kong, China
"Customization with the User Friendly Housing Technology"

The Mid-Polis:
The 2011 Open Building Design Challenge
Student Competition and Collaborative Charettes

Sponsors:

The competition organizers would like to thank the following sponsors for their support of the competition and the conference:

Baumschlager&Eberle, *supporting the Eberle Open Building Award of $3000 (first prize)*

Sunty, *supporting the Sunty Open Building Award of $2000 (second prize)*

Siemens

CannonDesign

HOK

Ascension Health

Herman Miller

Paul Lukez Architecture

Jury

A distinguished, international jury selected the winning entries from a pool of over 80 entries:

- Andres Mignucci FAIA
  Andrés Mignucci Arquitectos, Puerto Rico
- Renee Y. Chow, *Associate Professor of Architecture, U of Cal. Berkeley; Principal of Studio URBIS*
- Paul Lukez, FAIA
  Principal of Paul Lukez Architecture
- Shigeru Aoki, *Architect, Professor, Tokyo Metropolitan University*
- Shinichi Chikazumi*, Architect, Shu-Koh-Sha Architecture and Urban Design Studio, Tokyo*
- Jaehoon Lee, PhD, *Professor, Head, Department of Architecture, Dankook University, Korea*
- Phil Astley, *UCL/Bartlett, London, UK*
- Paul Strohm, *HOK Architects and Planners, USA*

Awards

The competition recognized first, second, and third place entries, as well as two additional citations. Students received a monetary award and, if travel to Boston was possible, a travel stipend in the amount of $800.

The Design Challenge

As metropolises around the world continue to mature, the zones between their inner (historic) core and their outer (suburban) fringe evolve and mutate in many forms. This *mid-polis* condition represents a fruitful opportunity to re-define urban connections between center and edge. With that in mind, we have selected a site that is ripe for such a new intervention. The site is located in Somerville, Massachusetts, an "inner suburb" also closely tied to the City of Boston through history, future transit connections and existing infrastructure. This is the context for the competition challenge.

The competition asks entrants to consider how familiar and new urban patterns and building typologies can serve to redefine this mid-polis site. The selected urban pattern and building types for this site will face significant challenges in the 21st century. They must be at the same time stable, lovable, energy effective infrastructures of space and form, adaptable to inevitable changes of use or function. How will the proposed urban morphology and building types support changing programmatic, economic and societal forces over time while maintaining a coherent built form that does not become functionally and stylistically obsolete in 30 – 50 years? Thus, the key issue in this competition is the design of an urban fabric and more detailed design of one building type of enduring quality – so excellent that over 50 or more years, the uses and functions in the urban spaces and inside the buildings can change as cells are replenished in a living organism. That is the design challenge.

Designing in the Fourth Dimension

The competition challenge is focused on two important functions of contemporary neighborhoods: housing and healthcare/wellness. In the Somerville site, the housing stock requires greater variety and levels of affordability. Furthermore, the current social structure demands conveniently located built spaces and open spaces to support health care and wellness. Both housing and healthcare, however, are expected to undergo constant change, and thus require architectural and urban infrastructures that offer a high degree of flexibility over time. The challenge is to conceive an urban architecture independent of specific functions - an ordinary high quality architectural typology with its own character, sense of place and morphology that can effectively and happily accommodate changing uses on the variable cycles of urban transformation. In considering this imperative, we expect that strong consideration will be given to natural illumination deep inside built space the result being that a narrow-floor-plate building morphology may be the dominant built-form theme.

The challenge asks entries to envision an initial scenario of uses and functions, and another that will gradually transform this site. These are articulated in the “Competition Program” below. One scenario will be implemented in the initial build-out of the site. The second scenario is envisaged for 30 - 50 years in the future. In the first instance, there will be a very strong focus on healthcare facilities (see details below), because the aging population is increasingly in need of a wide range of health and wellness services, not corralled in large stand-alone institutions but woven into the fabric of the everyday environment. In the second scenario, 30 – 50 years in the future, these healthcare functions will have been dispersed or consolidated to other locations, and housing and other urban uses will have replaced the healthcare functions in the same urban spaces and buildings. In this transformation of uses, the building stock itself will remain largely intact, mutating incrementally and partially to accommodate the changes of use. Boston’s Fort Point Channel district, the Wharfs along the Boston Harbor and Boston’s Back Bay in Boston are both excellent examples. Other examples in other countries include the fabric of Amsterdam’s historic center, the historic fabric of Paris, or Bern, Switzerland, or the historic fabric of Kyoto, all of which have been subject to incremental and piece-meal transformation while retaining their traditional, thematic characteristics.

We recognize that living urban tissues constitute our enduring physical reality and only come into wholeness in time. Meanwhile, modes of living and technology are as dynamic as society in general. Therefore, what we build today will be extended and adjusted (and sometimes demolished). Buildings that are initially planted in the built field may change before the fields’ structure. The same happens in buildings – we are learning once again to build a sustainable stock, while accepting that patterns of inhabitation change more quickly. As a result, use functions are becoming distinguished from architectural form. Therefore, some qualities of this ordinary built fabric are more stable and long-lived. An environmental hierarchy reveals itself when we observe these patterns of change, a hierarchy that makes it possible for this dynamism to be managed. This is the theory of the competition challenge.

The Site

The competition focuses on a triangular site of 48 acres (19.4 hectares) in Somerville, an "inner ring" suburb of Boston, with dense housing built around the turn of the 19th century. Somerville is a city whose topography has been altered repeatedly over time, as a way of accommodating new infrastructure systems and districts. Rivers, hills, wetlands etc. were re-configured through land filling and excavation, creating a new landscape, in many ways far removed from its bucolic past. Somerville's history is rich, and plays an important role in the American revolutionary war, as General Washington surveyed the position of British cannons protecting Boston from the heights of neighboring Prospect Hill. Much of Somerville is occupied by a dense mat of multifamily housing and mixed-use buildings dating from the 19th to the early 20th century, with ‘double-decker’ and ‘triple-decker’ housing serving as the primary typologies for housing alongside traditional row buildings in mixed-use nodes (such as Davis, Union, and Porter Squares). In the last decades, these low-cost apartments all over the greater Boston area have been converted into owner-occupied condos as neighborhoods become gentrified and property values have increased. Greater property values have lead, in turn, to increased density in new construction and many new highly dense, mixed-use buildings have been built, especially in Cambridge. Boston is a city well-served by its mass transit system (the Massachusetts Bay Transit Authority, or MBTA), and transit-oriented development is common in the city and its surrounding communities served by the transit system.

Today the McGrath Highway, a major route to Cambridge and downtown Boston, is elevated on concrete piers as its cuts through the competition site; the highway divides the neighborhoods yet is an important economic feeder. In the near future, this highway will be rebuilt as a ground-level “boulevard” with landscaping and pedestrian-friendly features.

Perhaps in response to the construction of the elevated highway, the adjacent neighborhoods of housing changed during the 20th century to industrial and big-box uses. The exceptions are a handful of brick industrial buildings that occupy the southern and eastern edges of the site, presumably built to take advantage of the railroads. Already some of these industrial buildings have transformed from industrial use to mixed use (loft housing, creative arts, and high-tech manufacturing) as modern occupants have taken over the buildings.

The scenario that will play out in the future of the site will begin with the demolition of the elevated highway. When it becomes a boulevard, land use patterns will change drastically as the accessibility to the core of the site changes and the value of the land increases in response to new connections to the main fabric of Somerville. A new extension to the MBTA's Green Line (a rail-based transit line that is a combination subway/surface light rail/street car in various parts of the city) will serve the east edge of the site (marked on the map) and will result in increased pedestrian traffic between the nearby Union Square and the site, as well as a new demand for housing and services on the site itself.

Competition entrants are asked to consider these facts as part of their proposal. The existing street network within the site can be retained or reconfigured. The existing buildings within the site boundaries can also be demolished or some retained. Traffic access points to the surrounding streets must remain as they are shown on the site diagram below.

MAP KEY

1. FUTURE MBTA GREEN LINE STATION
2. BERMED RAIL (ELEVATED ON EARTH EMBANKMENT)
3. ELEVATED HIGHWAY (TO BE REPLACED BY ON-GRADE 4-LANE BOULEVARD W/ 3m PLANTED MEDIAN
4. INDUSTRIAL AREAS
5. COMMERCIAL AREAS
6. RESIDENTIAL NEIGHBORHOODS

NOTE: MAPS ARE NOT SHOWN AT SCALE

The Competition Program

Submission Requirements
Each submission must show an urban tissue weaving the Somerville site into the surrounding urban fabric, addressing transport, public services and private development. This can be designed in some detail, or alternatively, submissions can propose a "form-based code." In all cases, question of "front" and "back" must be addressed; the problem of the "margin" between public space and private territory must be considered carefully; and the principle that deep floor-plate buildings are generally to be avoided must be followed (or said another way, natural light must be able to penetrate into at least 50% of each floor plate)

From the urban tissue, one or more building types must be selected and developed with the dominant criteria being a demonstrated capacity to accommodate a variety of inhabitations (patterns of use) over time. Designers are asked to develop at least one of these building types in greater detail, showing how built form and architectural technology serve dual spheres of action: the shared architecture that is responsive to long-term community values and imperatives, and the individual interventions of use that are function-specific and thus more changing, such as interior fit-out (infill or tenant work) and elements of the facade. Because utility systems are a key part of such capacity, common utility systems must be designed with provisions for connectivity to changing individual use areas within the building type selected for more detailed design.

The building type (or types) developed in detail and sited in the tissue should accommodate the following program/space scenarios, intended to occur at two periods during the life of the building(s):

First scenario space requirements for the first 30 years:
• Medical office space: 80,000 sq ft in 4 units of 20,000 sq ft each with:
1000 sq ft public space
1000 sq ft service space
18,000 sq, ft clinical space
• Assisted Living: 60,000 sq ft in 3 units of 20,000 sq ft each with:
3000 sq ft public space
15,000 sq ft residential space
2000 sq ft support space
• Specialty clinical: 80,000 sq ft in 4 units of 20,000 sq ft each with:
1000 sq ft public space
1000 sq ft service space
18,000 sq, ft clinical space
• Fitness/wellness/rehab center: 20,000 sq ft.
• Retail: 20,000 sq ft
• General office: 60,000 sq ft
• Parking: One car for each 1000 sq ft of occupied space
• Residential Dwelling units in buildings of generally 4 to 5 floors
• Appropriate public and private green space/parks/public amenities

Second scenario space requirements for beyond 30 years:
• Medical office and specialty clinical space is reduced by 50% (i.e. 80,000 sq ft becomes 40,000 sq ft)
• Assisted living and other residential, office, retail, entertainment, educational uses fill the space vacated by the departing medical office and clinical functions. It is up to the designer how to adapt these newly introduced uses into the retained building shells; it may be necessary to rethink the way in which these uses (residential, office, etc.) share space, while allowing public and private spaces to remain clearly defined.

Entrants should consider how fit out and façade adaptations meeting the needs of both the first and the second scenarios can be accommodated in the architectural design of the building type.

In meeting the challenge, entrants are encouraged to investigate, adapt and re-invent the principles of Open Building as a point of departure: change, levels of intervention, and distributed design.

Collaborative Charette
In the week prior to the conference, the firms of **Cannon Design, Payette, and Shepley Bulfinch** will be collaborating with Boston-area architecture students and open building affiliates to examine the competition problem in a collaborative setting. Work during the charettes is expected to reveal new insight into the problem of design in the 'fourth dimension' and the results will be shared in a special session during the conference.

The Competition Winners

The Eberle Open Building Award
First Prize: $3000

Title:
Magnetic Field

Student Design Team:
Sun Xiao
Wang Xiaochen
Cai Meng

School:
Qingdao Technological University
Qingdao, China

The Competition Winners
[Continued]

The Sunty Open Building Award
Second Prize: $2000

Title:
The Urban Oasis

Student Design Team:
Wang Jing
Xia Ji
Zhu Siqi

School:
Tianjin University
Tianjin, China

The Competition Winners
[Continued]

Third Prize: $750

Title:
Filling the Gab

Student Design Team:
Wu Hairong
Hai Liang

School:
Tianjin Institute of Urban Construction
(Wu Hairong)
Tianjin University (Hai Liang)
Tianjin, China

The Competition Winners
[Continued]

Citation: $250

Title:
The Cell

Student Designer:
Chen Rong

School:
Tsinghua University
Beijing, China

The Competition Winners
[Continued]

Citation: $250

Title:
Big Box Landscape

Student Designer:
Soo Young Park

School:
Yonsei University
Seoul, South Korea

Architecture in the Fourth Dimension: The Papers

The Paper Call

It is no longer adequate for society to expect architecture in only three dimensions. The urgency of an across-the-board societal commitment to build for the long term is the dominant theme we will address. Evidence for the urgency of this task is ubiquitous – as is evidence of pioneering built environments in consonance with it. But implementation of new methods and practices needed to address the inevitable tensions, varying cycles of change, and new patterns of responsibility and control are far from being uniformly understood, taught or implemented.

Our conference will have keynote speeches and panel discussions; academic paper sessions; exhibits of built projects around the world; display of the student competition winners and; hands-on design exercises using local sites, hosted by local architects, with practitioners, researchers and students from the region and around the world taking part. This immersive learning experience will search for consilience in here-to-fore fragmented concepts and ways of working. The conference's two subthemes – health care and residential architecture – will be the foci, but other use-types as well as overlapping and shared principles will also be probed, all with the light focused on the fourth dimension of architecture.

Major Subthemes of the Conference

CUSTOMIZED COLLECTIVE HOUSING

Rapid urbanization is a dominant reality in Asia and developing countries around the world – and also in developed countries. Meanwhile, collective (multi-family) housing design and construction are trending toward improvements in the quality and personalization of housing. In the best cases, living spaces can be directly responsive to evolving preferences of residents. In the worst cases, higher cost but still rigid buildings with false "variety" are produced, soon to become obsolete. The idea of "custom home" has to be reinvented and implemented into a more dense, environmentally responsive and economical collective housing process. This is a new challenge for architects, policy makers, developers and housing institutions, and product manufacturers around the world. Much has been learned and realized in pioneering open building projects, but the job is not finished. New ideas, processes, policies, building methods and products are needed and are welcomed for presentation and discussion at the conference.

ADAPTABLE HEALTH CARE ARCHITECTURE

How can clients get the kind of agile, long-lasting and yet change-ready facilities they need and want, balancing long term asset value and the fine-grained patterns of change in medical practices, demographics, technology and policy that are so much part of today's health care systems world-wide? Can the need for efficiency, security and infection-free spaces be balanced with the need for a healing and humane environment? Public, private and academic clients and projects, from neighborhood clinics to large hospital campuses and geographically distributed health care systems will be considered.

EFFICIENT, CONTINUOUS CUSTOMIZATION IN OTHER USE-TYPES

Other use types such as office and retail architecture, as well as laboratories and educational facilities, also aspire to stability while experiencing change at varying cycles, on many levels of intervention, also involving distributed responsibility and many technical and organizational ripple effects that are difficult to account for and manage. Papers addressing these themes are welcomed.

Learning on Flexibility from Experiences Revisiting Housing Estates after 25 years

Ib Steen Olsen, External Associate Professor
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Sten Bonke, Associate Professor, Head of Section
DTU Management, Technical University of Denmark

Abstract
In the wake of the Second World War the Danish government tried to increase the capacity of the building industry by establishing new research facilities, stimulating the housing sector and developing a framework for industrialization. The dominating building method during this period became multi storey housing with cross bearing walls. Within multi storey housing the developed system design appeared to be less adaptable to later alterations. Therefore The Danish Ministry of Housing and Building in 1983 issued an initiative to stimulate technology development of residential non-profit housing in three to five storeys the target being "to focus on the possibilities to create buildings which in the future can be adapted to new user demands and applications that we do not know of to day - and in the short term add flexibility which can create possibilities for individual housing projects" (The Ministry of Housing, 1984,1)

During spring 2011 DTU Management at The Technical University of Denmark has initiated an evaluation with the aim of showing how the ideas from the original competition have been applied during the 25 years period. Thus this paper will review the above governmental policy aiming at stimulating the development of new building designs with an improved technological adaptability to new demands and flexibility.

The data input to this review is extracted from 15 residential areas with a total of about 1000-1200 apartments which were built in the 1980s after a competition which attracted the leading building companies. This paper is based on the provisional results from the evaluation and will conclude in a "top six" for most successful steps in the planning and construction of buildings with capacity for incremental change.

Keywords: housing, flexibility, user needs, experiences, evaluation

INTRODUCTION

During the last years a new aspect of the design and planning of a housing project has been given higher priority: planning for future changes as a fourth dimension to supplement the interplay between economy, architecture and durability of the construction. This development reflects the fact that wishes from tenants, new technology and altered requirements from society after some years will be constituting new conditions for user well being and – with a generic term – for sustainability.

The traditional planning process has by and large been ignoring the need for future changes. While in the best of projects there have been some considerations concerning flexibility and possibilities to replace appliances with new ones - in the worst (and majority of cases), however, it is not unusual that even new buildings must undergo basic alterations with costly consequences shortly after handing over of the building.

As indicated this paper will be looking at the empirical data from a governmental point of view as adaptability to alterations in the housing estates in the fourth dimension perspective was an essential and deliberate part of the governmental trial to influence the housing sector. Furthermore the paper is focussing on how a governmental institution in collaboration with a research institute can contribute to the development of new types of housing design. Have the specified solutions been successful - and if yes, how can they be utilized in future building projects?

BACKGROUND TO THE EXPERIMENTAL BUILDING COMPETITION

The basic philosophy behind the Danish efforts since World War Two, called the Danish Open System Approach, was to create an open market for factory produced – dimensionally coordinated – building components that could be combined in a variety of individual building estates. In accordance with this basic policy, it was the government's task to establish the framework for a development within which the building trade itself could create the necessary technical innovations, see figure 1.

For multi storey housing the developed system appeared to be rigid for later alterations. Therefore the Danish Ministry of Housing and Building in 1983 took the initiative to stimulate the innovation within residential non profit housing in three to five storeys. The target was "to focus on the possibilities to create buildings which in the future can be adapted to new user demand and applications that we do not know of to day - and in the short run to add flexibility which can create possibilities for individual housing projects"(The Ministry of Housing, 1984,2).

Flexibility was furthermore considered an important quality in connexion with urban renewal because new estates in cities must be adaptable to the architecture of existing buildings.

This governmental initiative was taken with the intention to push the industry in the direction of more flexible housing and buildings, open to incremental changes - but not to interfere directly with the production technology and businesses of the individual companies. An essential tool therefore was to create a market for new products and processes.

In Denmark since WW2 the non profit housing associations have constituted a useful instrument for realizing public housing and building policy thus having a significant impact on the development of the building industry. The associations act as clients who engage private firms for design and construction – and as a consequence of their accumulated, continuous building activity these housing associations has clearly been playing a decisive role in the long term development of industrialized housing (Bonke et al., 2001).

The above initiative and the competition marked a general wish to question and challenge the design and technology hitherto applied to industrial multi-storey housing. Since the collaboration and interplay between the industry, research institutions and the Ministry of Housing and Building started back in the 1960s the efforts had been concentrating on an effective use of prefabricated concrete load bearing cross walls and floor slabs with a minimum of component variants.

The main principles in the industrialisation approach consisted of

- Use of modular coordination
- Use of standardized components in the project
- Unconplicated buildings
- Not to focus only on the carcass but all trades
- Coordination between different clients

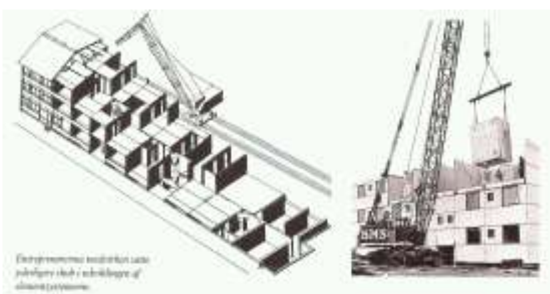

Figure 1: *The principles of industrialization in Denmark in the 1960s*

As a consequence of this policy a dominating characteristic in Danish housing industry since WW2 became an extensive use of prefabricated components (see above) which – because the development took place in an open innovation framework - without serious impediments entered all areas of the building industry and substituted traditional building technologies.

THE COMPETITION AND THE PROPOSALS

The competition was open only to groups comprising architects, engineers, contractors and, if applicable, sub-contractors and manufactures. An important feature was the requirement for a close cooperation between designers and contractors and in this way an exchange of experiences and ideas at an early stage with the aim of coming up with new ideas and innovations.

After a preliminary pre-qualification phase with 40 participating teams, representing leading Danish companies, six groups were selected in April 1984 for the actual competition.

The six groups submitted their project proposals in late 1984, and the jury's evaluation was available in December 1984.

The proposals for the competition indicated that the demand for greater flexibility in future multi storey housing, both during the planning and the occupation stages, points to changes in the structural system. A general innovative feature thus encompassed use of columns instead of load bearing walls.

Specifically concerning the technical services the competition produced a variety of possible developments. One innovation was about an improvement of existing radiator systems. For example, radiators could be combined with injection of pre-heated air. Another possibility involved the use of hot air heating. For example, heat produced within the individual dwelling by means of a unit which also produces hot domestic water.

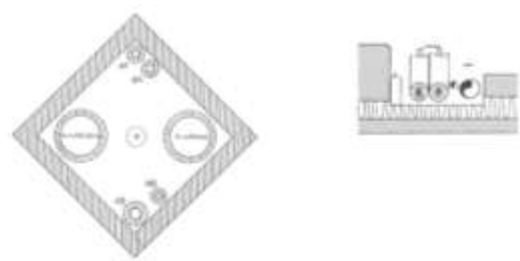

Figure 2: *Two proposals concerning the placing of a unit for installations: in the middle or at the façade of the building. In both cases is it possible to change the connections to the individual flats during the construction phase as well as during the use of the building. In some proposals it is furthermore possible to place the pipes for heating, electricity and water supply in factory produced concrete elements designed as an U, thus offering the same flexibility as above.*

In the winning project the ground floor may be used for common facilities and the upper floors can contain two-storey flats. An access deck on the floors and wide corridors provide a transition zone between the public and private areas. The building can be adapted to existing, high density urban areas or may be designed as unattached housing blocks in open suburban surroundings.

The structure is based on a column/deck system. The columns may be round or square in section and visible on the exterior or interior of the building. The solid, square deck elements can be prefabricated in vertical shuttering.

The proposal follows the above described general development towards use of prefabricated components in Danish housing industry and is at the same time inspired by thinking from Habraken (Habraken, 1982). Furthermore the partition walls and the façade elements are kept free from bearing parts of the carcass. In this way they are easy to substitute, also by new contractors and manufactures.

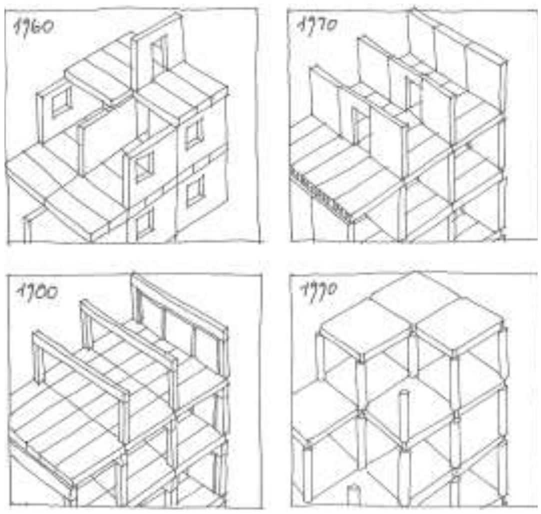

Figure 3: *The development of the structural systems since the 1960s and the vision for the 1990s (left), showing how the winning project proposes a system consisting of prefabricated components (right).*

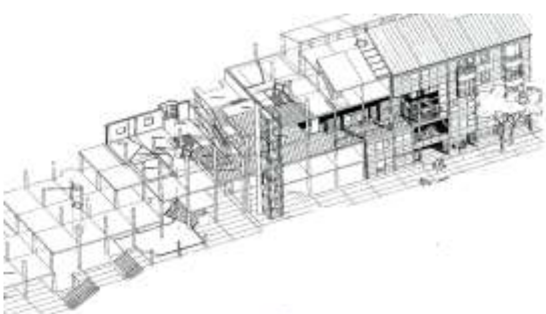

Figure 4: *A view of the winning project proposed by Arkitektgruppen i Aarhus A/S, architects, Viggo Michaelsen A/S, consulting engineers, and Højgaard & Schultz A/S, contractors.*

During the second half of the 80s the selected teams constructed 15 residential areas with a total of about 1000-1200 apartments (as shown in figure 5 below). Elements of the innovative ideas were furthermore used in other residential projects.

EVALUATION

In Denmark the normal practice is to evaluate a building after one and after five years but only concerning technical defects. These evaluations are elements in the standardized conditions for contracts between clients and companies.

There is an increasing interest for evaluations which go beyond those evaluations and take into account user experiences as well as opinions concerning the architectural aspects and the operation of the finished buildings. And at the same time also an interest to make evaluations after a longer period of time.

Figure 5: *The first estate based on the project*

The above described development initiative was evaluated after about ten years in 1994 by the Danish Building Research Institute to see whether the short term flexibility goals has been reached and used. This evaluation focused mainly on technical topics such as the building system, architecture and user value, indoor climate and installations, construction elements and building technique plus market and economy.

DTU Management at the Technical University of Denmark has now initiated an evaluation with the aim of showing how the development results of this experimental building programme have been exploited after app. 25 years (say during 25 – 50 % of the expected lifetime of the buildings. This evaluation will include topics such as alterations due to new user demands during the 25 years, modernization, technical replacements, maintenance and the development of the surroundings.

EXPERIENCES - GATHERING OF DATA

In the early evaluation from 1994 the Danish Building Research Institute found that the flexibility in the winning system had been used to create many different and new forms of dwellings, of accesses to the dwellings and of common areas and surroundings, see figures 4 & 5.

Some excerpts from the evaluation: 'It would seem from the housing projects completed that by transferring the quality of low-dense housing to multi-storey buildings, the latter have been added with important new qualities'. And furthermore: 'architecturally as well as in terms of use, the projects on Ålekistevej and Engen in Rødovre, (see figures 4 & 5), serve to widen the concept of multi-storey building' (The Danish Building Research Institute, 1994).

On the technical front the competition has shown new ideas concerning structural elements mainly based on prefabricated components and new form of installations with an eye on sustainability (The Ministry of Housing, 1984, 2).

In this way it actually seemed possible to change the normal design of multi storey housing, hitherto used in the non-profit housing sector.

The use of columns which was a main element in the competition has been applied in different ways. Based on development work and testing it became possible to create new principle for joints between columns and slabs and in some cases also beams.

A leading principle for installations was use of pipes in special shafts in the interior of the building or at the facade – vertically and in some cases horizontally, see figure 2. But otherwise the proposals contained different forms of heating – from traditional use of radiators to heating based on hot air and in some cases adjustments with electrical heating plates.

The 1994 evaluation concluded that 'There is no doubt that, together with the considerable flexibility, their design and layout will affect the future design of multi-storey residential housing'.

Focus in the DTU Management evaluation of 2011 is on the subsequent utilization of the innovations for greater flexibility. The evaluation has taken its starting point in a division of the overall flexibility and possibility for incremental changes within the following 9 themes:

- Which bigger alterations have been executed?
- Which types of alterations have not been feasible?
- To which extent have dwellings and common areas been altered?
- Which alterations concerning connections to public supply and sewage services have been executed?
- To which extent and when have installations been altered or replaced?
- Have there been alterations in the surroundings?
- Have there been barriers to the operation of the finished building?
- Have elements in the building carcass been altered?
- Other alterations

Furthermore the evaluation will draw upon the guidelines for value stability, as defined in the German system for environmental evaluation DGNB, which is due to be introduced in Denmark. The main points here are effectiveness of the use of the area, adaptability (modularity and connections to public services) and possibilities for change to other uses.

In the 2011 evaluation answers about experiences have been collected from five building owners, a member of the 1994 evaluation team plus a civil engineer from the winning project, still occupied in the same company. As the prize winner constructed 5 of the 15 estates the gathering of data has been focusing on those projects. The answers were procured by telephone interview with the responsible estate manager for the daily operation and maintenance. In the coming work it is considered also to ask the users about their opinions. Finally an option is also to investigate how the involved construction companies have utilized their learning.

Figure 6: *The estate shows how the winning project, see the figures 4 and 5, due to the in-built flexibility can be adapted to existing surroundings of a city.*

The question in focus is whether the innovations developed in connexions with the competition have made it easier, compared to traditional industrialised housing design, to make alterations and incremental changes to adapt the estates and buildings to new demands. It is important to note that a feature in the selected projects in the competition also was the flexibility of the proposed building system to be adapted to different surroundings as for example the architecture of an existing city as well as in new areas, see figures 4, 5 and 6.

The experiences can be summarized in the following statements:

- It is possible to use and adapt the developed building systems and the innovations to different surroundings in inner cities as well as new areas. They are open systems.
- The technical innovations in the structural system have up to now not been exploited. There have been some alterations within the individual dwellings, made possible by the new system.

Up to now there has been no interest for changes in the façade, apart for maintenance purposes. However, such exterior changes are not particularly difficult to execute even in traditional designs when the facade elements are not load bearing

The outside tower for the elevator in the winning project, as well as the elevator itself, is a vulnerable construction.

There have been some smaller problems with the heating system installations due to their innovative character. In some cases it has been necessary to compensate with new installations and the in-built flexibility has not foreseen such problems.

More considerations on the operation during design and construction phases would have made the cleaning and maintenance tasks easier.

DISCUSSION

In the design and construction phase of new buildings the normal practice has been to focus on the execution phase. An example is concerning costs. In this way the operation of the finished building and to some extent also the use of the building has been neglected. For the moment in Denmark there is a growing interest to involve the coming tenants in the design phase. But a problem here is that it can be very difficult for the users to anticipate up to100 years – or more – which is a normal lifetime in Denmark for a building.

Therefore experiences from existing estates can be valuable. Especially in this case as the buildings are the results of a competition with the target to challenge professional owners and companies to come up with new ideas and suggestions concerning in-built flexibility.

From the research perspective, a method of evaluation of finished buildings can give numerous possibilities for further studies. For example, the preliminary findings presented in this paper could be extended through more contacts to the involved parties – administrators as well as users and companies. Doing so may further help to understand how buildings can be designed and constructed to make incremental changes possible and thereby more sustainable.

CONCLUSIONS

On the basis of the competition and preliminary experiences from the cases it may be concluded more generally that clients, designers and contractors have to take the following six steps into consideration when targeting design of buildings with capacity for incremental change:

- In the overall design of the estates as well as of the individual buildings and dwellings considerations shall contain possibilities for flexibility in the use of the space.
- The structure in the individual dwellings can be based on columns which permit use of light weight partition walls with the possibility to later alterations. A solution is also large floor elements supported by heavy wall elements.
- For walls between dwellings it is more convenient to use heavy elements due to demand of reduction in noise and costs.
- The installations shall take into account possibilities for replacements and new systems of energy, electricity, garbage and sewage.
- It is important to consider operation and maintenance aspects of the finished building during the design and construction phase.
- Special care must be taken for the possibilities of replacement of exposed and vulnerable parts of the structure as use of timber in the façade and steel construction for lifts.

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Life's Net [or] a Framework for Growth and Change

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ABSTRACT
Over the decades following its construction, Le Corbusier's Quartier Modernes Frugés (QMF) in Pessac, a suburb of Bordeaux, began transforming. Built in the early 1920's, the QMF housing development consisted of fifty units, stripped-down modernist boxes in four formal variations, built to house working-class families. The machine aesthetic of Le Corbusier's design was, however, poorly received and residents immediately began altering their new environment. Gradually, buildings were re-surfaced and repainted, walls were demolished and new ones constructed, ribbon windows were partially in-filled—thus the QMF continued to grow and change over the next half century, a process that calls into question the very notion of an architectural project's "completion".

Although the "desecration" of Le Corbusier's QMF was denounced by many architects, others would find it a source of inspiration. Constructed in 1970, Lima's experimental Previ Housing sought to harness the sort vitality and spontaneity embodied in the adaptation of housing at Pessac, qualities also native to the ubiquitous informal settlements of Latin America. At Previ, a team of renowned architects—Aldo Van Eyck, James Stirling, Fumihiko Maki, and others—provided families with a framework of structures intended to support growth, increasing density, and change over time, a proposal that drew upon the contemporary discourses of Team X and the Metabolists. Decades later, similar ideas are being tested in the public housing projects of the Chilean group, Elemental, who's principle architect, Alejandro Aravena, has dubbed the strategy "infrastructure as housing".

While these examples present valuable case studies of architectural models that provide a framework for growth and change, questions remain as to the relationship of each case to its cultural, regulatory, and socio-economic context. This paper discusses each of the aforementioned projects, the conditions of their successes and failures, and the potential for their inspiration of future proposals.

Keywords: Housing, Informal, Growth, Change, Adaptability, Framework

PROLOGUE

At CIAM's ninth congress, held in Aix-en-Provence in the summer of 1953, Alison and Peter Smithson presented their Golden Lane Housing Project, a scheme explicitly intended to offer an anthropocentric counterpoint to what was perceived as the sterile authoritarianism of Athens Charter urbanism. The Smithsons' presentation included images by Nigel Henderson, their friend and associate, who had photographed children happily playing in the streets of London's East End slums. Henderson's images glorified 'life as lived', beautiful and rich in its unpolished reality, an element the Smithsons and their like-minded colleagues amongst 'Team X' found lacking in Athens Charter urbanism's reductive characterization of the city in terms of four functions—dwelling, work, recreation, and circulation. For Team X, the fields of sociology, anthropology, and ecology were of critical importance to the practice of architecture and urbanism, and these concerns led them to idealistically assert that "life falls through the net of the four functions" (Smithson 1991: 9).

With this anthropocentric viewpoint focused upon 'life', there was also a recalibration of values that called for architectural production to be founded upon "an examination of the whole problem of human associations and the relationship that building and community has to them" (Smithson 1993: 241). It was clear that societies of the post-war era were experiencing momentous change, catalyzed by increasing mobility, accelerating technological progress, and the transformation of traditional social structures. If the disciplines of architecture and urbanism were to be focused on shaping environments in response to new, emergent patterns of dwelling, what were our cities to become?

The 1960's-70's bore witness radical urban proposals—designs such as those of Archigram, the Metabolists, and Constant projected fantastic visions of urbanity, and one theme that emerged amongst others was the possibility of amplifying urban environments' ability to grow and change. While it is self evident that all cities indeed transform over time, these proposals envisioned architectures which actively engaged the process. Peter Cook's Plug-In-City (1964) envisioned a framework with mobile living pods which could be inserted anywhere within an urban network of technological transformability. Kenzo Tange's Plan for Tokyo (1961) imagined an immense structure spanning Tokyo Bay which would house ten million inhabitants. His project was predicated on the need for evermore speed and communication, and he imagined the city as a "living organism subject to a continuous cycle of growth and change… a form of organization responsive to dynamic patterns of urban flow and changing function" (Ockman 1993: 325). And Constant's New Babylon (1959-74) offered a vision not only of an alternative urban structure but also of an entirely new social and ethical order, one which would unfold in a massive structure spanning the Earth's surface, and within which humanity would live in an endless environment of complete and perpetual stimulation and change.

While these 'megastructural' proposals have and will continue to impact architectural discourse, the realization of projects which exemplify their theme of providing an urban framework for growth and change has not been particularly common. Kisho Kurokawa's Nakagin Capsule Tower (1970) in Tokyo is perhaps one of the most obvious and best known examples of their legacy. The tower consists of two service cores with attached living capsules, designed such that with the removal of just a few bolts any capsule could be disconnected, discarded, and replaced by a new and improved capsule—a process intended to be analogous to the growth, life and reproduction of a biological cell. But despite the architect's intentions, none of the capsules have ever been replaced (Vanderbilt 2008: 179) and the tower has amounted to little more than a representation of the idea of architecture as a framework for growth and change. We are, however, not without other and perhaps more successful examples of this theme's realization.

ACT I: EXPECT THE UNEXPECTED

In1924 the French industrialist Henry Frugés hired Le Corbusier to design a worker's housing development, to be known as the Quartiers Modernes Frugés (QMF), at Pessac, a suburb of Bordeaux. Frugés had read passages of Corbusier's writing in L'Esprit Nouveau and was intrigued by the architect's ideas on embracing new constructive techniques, materials, and modes of standardization in the production of modern housing. The client's need for affordable workers housing paired with Corbusier's stripped-down 'machine aesthetic' seemed a perfect match, for both agreed that if they "wished to offer the houses to the public at the lowest possible price, [they] could not afford to spend money on any unnecessary luxuries" (Boudon 1972: 9).

As per the client's explicit wishes, the QMF "was to be regarded as a laboratory, in which Le Corbusier would be able to put his theories into practice and carry them to their most extreme conclusions" (Boudon 1972: 2). Floor plans were to be more-or-less standardized, and all fixtures, components, and details were to be installed in Taylorist fashion, an exercise in serial production. In the end, Corbusier's design produced a neighborhood of over 130 dwellings, distributed amongst six housing typologies. The concrete, steel, and glass structures were composed of pure geometric volumes, equipped with Le Corbusier's requisite ribbon windows and roof terraces, and were devoid of any sort of decoration. While the architect argued for the structures to be rendered a pristine white, he eventually consented to the client's desire to paint the facades different colors to appeal to prospective buyers. Yet still, those behind the QMF understood that its modernist aesthetic would offer an unfamiliar vision of dwelling to most, and they even went so far as to state in a marketing brochure that at the QMF "the external appearance is not always pleasing at first sight; but experience has shown that the eye very soon grows accustomed to these simple and pure forms and, before long, finds them more beautiful than the complicated and cumbersome forms found in sculptures and ornaments" (Boudon 1972: 17). But in reality this proved little more than wishful thinking.

Figure 1: Dwellings at Pessac before (1926 - above) and after (1982 - below) renovations.

Almost universally, residents considered Corbusier's design an utter failure that demanded alteration, while on the other hand those in the architectural community condemned the QMF's transformation as a process of desecration. Curiously, the very facets of the project that were criticized, may in fact have been its greatest strengths. That exterior spaces were incorporated within the bounds of the architecture's structural system made their enclosure and modification an easy proposition. That facades were devoid of ornament made them blank slates for residents' personalization. That the QMF was altered to such an extent was an unintended product of its architecture's design. In his reduction of dwellings to the absolute minimum, Le Corbusier offered residents a neutral framework, an incomplete structure that served as an armature for the growth and accumulation of future development specifically tailored to the needs and desires of residents. About the QMF's modification Le Corbusier once remarked that "it is always life that is right and the architect who is wrong." But if life is always right, then why shouldn't the architect play along?

Shortly after its occupation by residents, the QMF began to change (Figure 1). Spaces were partitioned, patios enclosed, terraces covered with pitched roofs, ribbon windows in-filled, and surfaces were repainted and adorned with ornaments. While some of these alterations were aesthetic, many others were meant to better adapt dwellings both to the environment and residents' ways of life. Roofs over patios were constructed to accommodate for leaks, terraces were seen as 'wasted space' and enclosed to expand the interiors, and ribbon windows' were replaced with smaller, more traditional apertures that provided for both increased privacy and greater ease of repair. The residents of the QMF were for the most part poor and secured their dwellings at little-to-no cost through a governmental program, and before long much of the neighborhood fell into a state of disrepair.

ACT II: STRUCTURED INFORMALITY

Throughout Latin America, informal housing has been both a ubiquitous and problematic phenomenon. Lack of sufficient housing and extensive poverty have led millions to construct their own dwellings on whatever land available and with whatever materials can be found. This has led to the emergence of extensive squatter communities that often lack proper services and leave their populations in both unhealthy and unsafe conditions. And yet, in the informality of these settlements, residents benefit from being able to easily adapt their surroundings to their needs and to be in close proximity to large-scale social networks within the community's dense environment. One might argue that these aspects of informal housing have helped render it a Latin American cultural institution. There is little doubt that while such communities are lacking in some respects, the barrios, campamentos, and favelas of South America are replete with the gritty vitality of everyday life.

In 1965, a joint venture was launched in collaboration between the Peruvian government and the United Nations to develop a large experimental housing project in a suburb of Lima, to be known as PREVI. The development was to consist of over 1500 dwellings and its objective was threefold. First, the housing was to be low-cost for low-income families, provided as an alternative to informal settlements. Second, to meld local technical and cultural knowledge with the imagination of the avant-garde, the project would bring together a team of over forty architects, half of them Peruvian and the remainder a collection of foreign designers of international renown—James Stirling, Fumihiko Maki, Kisho Kurokawa, Aldo Van Eyck, Christopher Alexander, and the firm Candilis, Josic, and Woods amongst others—some of whom were members of Team X. And last but most important, PREVI housing was to be considered an organizational structure within which informal development could proceed, one that would insure its meeting of proper standards of health and safety, while harnessing the virtues of "self-managed transformation' (Garcia 2008: 32).

At PREVI the notion of a house was conceived not as an object, but rather as a process. Designs were "focused on practicality, economy, and appropriateness for local resources, labor and environmental realities in Lima" (Garcia 2008: 17), and all dwellings were produced with a surplus of buildable surface area. Essentially, each project was constructed as a structural and service core that would initially satisfy the minimum requirements for dwelling, but support unit expansion either into the area surrounding the dwelling or through the construction of additional stories. While this strategy, referred to by some as the provision of "slack space", is by no means unique within the larger context of late 20th century housing, the magnitude of its implementation at PREVI does seem somewhat unprecedented. Where projects such as Herman Hertzberger's Diagoon Houses have provided for modest increases in interior volume, and UN Studio's Flexible Housing in Almere allows for the addition of prefabricated modules to provide for 25% gains, some dwellings at PREVI have expanded their volume by as much as 200-300%. Further, PREVI offered twenty six different housing typologies, designed by those amongst a group of over fifty architects, all of which provided for extensive expansions that have since been realized. Single storey structures have developed into multi-storey apartment buildings. Monotonous rows of houses have transformed into textured streetscapes. And within this stark framework of public housing, a vital and layered neighborhood has grown.

Over the decades of PREVI's life in time, one of the more highly sought after dwellings has been that designed by James Sterling. His design, square in plan and centered on an exterior courtyard, has proved particularly well suited to expansion due to the ease of providing sufficient access to light and ventilation as building massing is increased. In one case, that of the Zamora Family, the original one-storey dwelling for a single family was gradually expanded into a three-storey structure that incorporated tenant spaces—a small shop, clinic, and legal office—transforming what began simply as a humble, single-family house into both a dwelling and a significant source of income. At PREVI such adaptations have been the norm rather than the exception.

While PREVI housing has by most accounts been a success, it is not without problems. While the quality of the original construction was carried out by professionals and properly executed to provide for resident's safety, the same cannot necessarily be said for dwellings' growth over time. Some additions have suffered from both poor construction quality and overcrowding which negatively impacts the environment. Originally, the PREVI design team stipulated for the provision of an on-site center for technical assistance where residents could seek guidance in maintaining their homes and planning expansions, and this might have helped avoid problematic outcomes, but unfortunately the Government never put the center in place as planned.

In terms of its 'openness', PREVI housing makes for an interesting study as rather than providing solely for the flexible configuration of interior spaces, or the modest expansion of a small set of houses. Its primary strategy was to provide a spatial and physical framework for the expansion of dwellings far beyond the bounds of the original structure, and this was mobilized at the scale of an entire neighborhood. Instead of imposing a completed form upon the patterns of residents' lives, PREVI's designers provided them with an ordered foundation for informal development, granting their lives as lived the authority to guide the growth and emergence of their dwellings over time. While Le Corbusier stated after the fact that "life is always right", the architects of PREVI admitted it from the start.

Figure 2: Plans of a dwelling at PREVI designed by James Stirling. Resident additions are shown in red.

ACT III: HALF A HOUSE

Elemental, the office of architect Alejandro Aravena, was formed as a joint venture by the Catholic University of Chile and the oil company COPEC with the mission of creating and undertaking projects of public interest and social impact. In 2003, Chile Barrio, a governmental agency charged with the task of improving living conditions in the nation's poorest areas, contacted Elemental with the proposal that they undertake a social housing project in Iquique, a city in the north of Chile.

The site, known as the Quinta Monroy, was a 54,000sqft parcel in the center of the city, occupied by 150 families in a dense informal settlement where, as could be expected, living conditions were poor. The budget for the project was extremely limited—only $7500 per dwelling for land, site development and construction. Elemental looked to PREVI housing as a precedent.

Aravena felt the budget would only allow them to build half a house of proper quality and size per family, so Elemental's strategy was to design the housing as an open system providing utilities and a solid structure for the whole, but enclosure for only half of the volume of each dwelling. Aravena saw this as the most difficult half of a house for a family to build, and the rest—partitions, interior finishes, and the remaining enclosure would be left for families to build on and by their own time and means, allowing both for customization and pragmatic growth. Aravena has dubbed this process "infrastructure as housing".

Moreover, Elemental saw the Quinta Monroy project as more than simply providing residents with homes, but also as offering a vehicle to help residents overcome poverty, whereby a home's expansion might be a means of accumulating value and accessing capital by property improvements or using it to secure a loan to start a businesses. This strategy clearly draws upon the successes of PREVI, but Aravena and his team did well to learn from some of its failures as well.

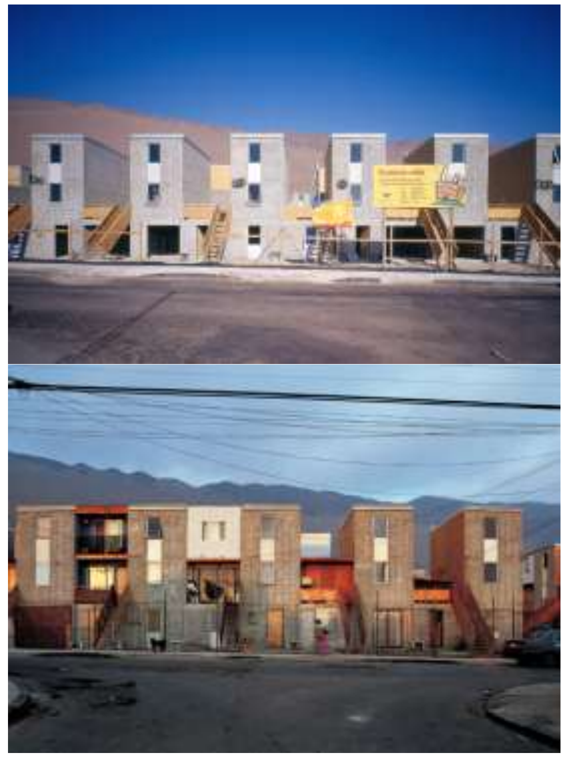
Figure 3: Quinta Monroy before and after resident's additions.

An important component of Elemental's process was their active community engagement by various means. Workshops were held with residents early on, and the concepts and strategies were discussed with them so that would understand the designers intentions. Children were given drawings of the basic dwelling unit, and asked to imagine what their homes might become over time. In coordination with the residents, Elemental developed a strict building code to guide modifications, and the community elected a team of representatives to enforce the agreed upon requirements. Throughout this process, residents were also advised on suitable modes of unit expansion and maintenance. And finally the Quinta Monroy's 'openness' took on an additional dimension, as in some instances even fragments of the residents old, disassembled dwellings were re-incorporated into their new homes.

The success of Quinta Monroy is, without doubt, intimately connected to its social and cultural context.

As residents were accustomed the do-it-yourself mentality of squatters camps, the self organizational strategies employed at Quinta Monroy were both familiar and pragmatic. Further, with the requisite low cost and reduction of dwellings to the absolute minimum, the living conditions provided seem low by the standards of developed nations, but if understood in context, the degree of improvement is striking. While the residents of Quinta Monroy still live in poverty, one must compare the result of Elemental's effort to alternative social housing projects produced for the same per-unit cost (Figure 4). In this light, it becomes clear that in providing infrastructure for housing to grow within and upon rather than a finished product, what has been achieved at the Quinta Monroy is something truly extraordinary.

Figure 4: Comparison between typical social housing in the outskirts of Iquique (above) with the Quinta Monroy project (below).

EPILOGUE

In each of the cases here discussed the 'final' architectural result emerged from the interplay between life as lived and the neutral structures within which it unfolded. This deference to 'life' as the final authority in architectural production, will seem in opposition the impulse of many architects. In their inability to shape the final result, if there even is such a thing, a level of control is removed from architect's hands, and one must accept that such a work of architecture is less an object and more a process unfolding in time. But what is to be learned from this?

At Pessac, we've seen that the impulse of residents to modify their surroundings to fit their needs lies latent in many situations, and if the architecture supports it, modifications are likely be made. The crucial component in this situation, however, is that beyond reconfiguring internal layouts, the voids within the bounds of Corbusier's initial structure—terraces, carports, and the like—allowed for volumes of interior space to be significantly expanded. This sort of flexibility does more than simply allow for spatial reorganization and adaptability in cases of reuse. It provides for the possibility of substantially increasing the value of a dwelling by growing its interior volume.

Capitalizing on this aspect of the QMF, was one of the greatest successes at PREVI. Here, we've seen that the strategy of "self-managed transformation" is particularly well suited to third-world contexts, and that the degree of unit growth possible, if properly planned for, may be far greater than many would propose. Again, this offers the potential for an extraordinary growth in value, a particularly important realization in relation to public housing. Often, public housing projects can be compared to buying a new car—as soon as you drive off the lot, its value quickly depreciates. This has not been the case at either PREVI or the Quinta Monroy, where residents structures have served a vessel for the accumulation of value. But even in these successful cases, if growth proceeds unregulated and unassisted, it is inevitable that problems will arise.

And herein lies an important realization of Elemental at the Quinta Monroy: that intense community involvement can greatly contribute to the success of a time and growth based strategy for housing. By involving residents throughout the process and offering them guidance and guidelines in the expansion of their dwellings, they were able engage residents and make them feel truly invested in the project. Houses weren't simply given to them, but rather residents played an active role in their homes' production, serving as a source of intense pride and allowing them to truly take ownership of their dwellings. Thus, it seems crucial that in any proposal that employs such a extensive strategy of self-managed construction should surely establish some organizational entity to both engage the community and provide guidance in matters of future growth.

Still, it is important to acknowledge that as can be told from these examples, the quality of expansion seems almost inevitably low and, while we've seen undeniable improvements upon living conditions in third world contexts, it is questionable how effective these strategies might be in developed nations where standards of living are higher and regulatory environments are more strict. But again, it would seem that Elemental's approach offers hope. In developed contexts it would be all the more important to provide residents with guidance, maintaining a close dialog with qualified professionals to guide them in their dwellings continued construction. And one can envision scenarios where groups of students or volunteer workers might assist residents in carrying out the work to expand and change their dwellings, not unlike existing programs such as Habitat for Humanity or Auburn's Rural Studio.

The projects here discussed—PREVI and the Quintay Monroy in particular—offer valuable examples of the possibilities open housing, beyond the reconfiguration of interiors, to the true growth of structures via time-based methods. Not only does this offer an increased opportunity to accumulate value in one's home, but also provides for a home's ability to expand in step with the needs and means of a family. Examples such as these serve to remind us that we build above all else for people, and the strategies here discussed offer possibilities for conceiving of housing as a true framework for growth and change, an armature that supports the emergence of patterns of life as lived, and an architecture that both shapes and is shaped by our ways of dwelling within the world.

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A House for Eternity? Durability Through Change: A Study on the Adaptation History and Appreciation of Buildings in the Urban Context

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ABSTRACT
The research presents different aspects of durability and variability of buildings. The study and comparison of three existing buildings leads to the identification of possible strategies for buildings of the future. The objective of the project is to obtain the factors for the long-term appreciation of buildings. Which factors are relevant for a long lifespan of a building and how is it possible to design a building for different uses and an enduring practice. The study of models for future buildings considers the building's ageing process, the organizational models, the possibility of change of users, and the structural adjustments: an examination of the entire life cycle of a building in its social, cultural and economical contexts. Thus, the process of living is the focus of the project.

The paper proposes transformation and appreciation as long-term strategies for long-lasting buildings. Under these circumstances, a sustainable building structure should provide both an incentive for investors, as well as a possibility to provide space for multiple models of society and thus to guarantee a continuous life cycle of a building: an architecture of future buildings.

Keywords: durability, change, adaptation, appreciation, lifecycle, values, economical and cultural appreciation, user-perspective

INTRODUCTION

> "To seek the timeless way we must first know the quality without a name. (...) The fact is that the difference between a good building and a bad building, between a good town and a bad town, is an objective matter.(…) But it is easy to understand why people believe so firmly that there is no single, solid basis for the difference between good building and bad. It happens because the single central quality which makes the difference cannot be named. (…)All things and people and places which have the quality without a name, reach into the realm of "eternal". Some are "eternal" in almost a literal sense: they are so strong, so balanced, so strongly self-maintaining, that they are not easily disturbed, almost imperishable. Others reach the quality for no more than an instant, and then fall back into the lesser state, where inner contradictions rule. The word "eternal" describes them both. For the instant they have this quality, they reach into the realm of eternal truth. At the moment when they are free from inner contradictions, they take their place among the order of things which stand outside of time." (Alexander, C., 1979, p.17-38)

"A house for eternity" relates to the building of houses that are designed not only for a short duration, but will remain for several generations. This "house" does not refer to single-family homes in rural areas or indestructible fortresses, but to the question what factors maintain the economical and cultural value of a building. Which qualities people appreciate in buildings? And is durability connected to the adaptability of a house?

The focus of this research is the integration of the user-perspective in the planning process to achieve a more socially sustainable development of buildings. Users have certain ideas how utilize their environment: Buildings that provide ample open space for individual adaptation can develop over time. The paper provides a profound insight into the different factors of durability and adaptability.

STARTING POSITION

The lifespan of buildings differ according to their location. In Asia, the average lifetime of a building amounts to 17 years. The American building's lifespan averages 55 years. Finally, European buildings reach an age of approximately 80 years (Brand, St., 1994, p.113; Paulus, A., 2011). Hence, the concept of building for more than just one generation is most common in the European context. In Europe, a building must be "solid" and its planning involves higher costs and more expensive materials. Consequently, the present research focuses mainly on the European context, since the opportunities for evolution and thus lifecycles of buildings are strongly influenced by the cultural contexts.

The function of a building determines the possible changes within a building, whether it be a residential, an office or a public building. The paper proposes transformation and mix of usages as long-term strategies for converting existing buildings. Historically, a strong differentiation of building types has evolved following the separation of functions in the modernity. In the postmodern society housing typologies have become more specific to the markets needs and the family model has dominated the housing market since. Currently requirements for residential buildings are changing, so that housing is becoming more individual and comfortable and so, an associated increase in demand for housing is becoming important in the western world.

OBJECTIVES AND GOALS

The aim of the research is a study of the factors influencing the long lifetime, appreciation and the usage of buildings. Starting from the design to the construction and occupancy until the demolition of a building, the adaptation history and appreciation of a building is considered. The aim is to present the factors influencing the appreciation, utilization and lifetime of buildings.

Objective 1

Demonstrating the reciprocal connections between the material (physical) and immaterial (social) factors on the durability and hence on the long-term use and value of buildings.

Objective 2

Evaluation of the position and influence of the users on the longevity and value of buildings, documenting their use and maintenance of buildings by analyzing their adaptation history.

Objective 3

Goal is the assignment of the factors influencing the value of buildings (economical and cultural circumstances and conditions of use).

Methods

The first part of the research gives an introduction and definition of the research terms. Existing definitions and principles of the life cycle of buildings are presented. Crucial for the research is the consideration of the overall lifecycle of buildings, from the construction, the occupation, until the demolition. Further strategies are identified to analyze existing case studies and the processes that create durability and change in architecture.

In the second part the appreciation and adaptation history of three case studies within a cultural context are examined. The analytical grid is based on material and immaterial levels and a timescale to show the development of the projects over time. The analytical parameters are divided into quantitative and qualitative parameters to obtain the connections of the material and immaterial factors of the building.

ANALYSIS INSTRUMENT

The Case Studies are analyzed and compared on two levels, based on the quantitative and qualitative parameters. The quantitative parameters illustrate the material characteristic of a building by showing actual plans and descriptions of the construction and give data regarding the economic development. The qualitative parameters present information based on interviews and statistics. The time frame allows the presentation of the development of projects, from planning to the current condition of use of the building.

Each case study belongs to a category which focuses a special characteristic to show different which factors of adaptability and durability are more relevant. The categories are:

* use
* structure
* organization

CONTEXT ANALYSIS

Durability

> "In its multiplicity, time presents a diversity that architecture has to accept - the linear, the cyclical, the personal, the instant explosion of the event, the long dureé - and, in order to do that, has to relinquish its mythology of stability and strength. (...) Architecture needs to be a setting that allows these diverse temporal conditions to coexist. (...) In its connectedness, time places architecture in a dynamic continuity, aware of the past, projecting to the future." (Till, J., 2009, p.95)

The basis of architecture is permanence. Buildings are solid and rigid, few are mobile and respond to the changing circumstances of the users. On the other side houses must undergo different modifications during their lifespan. Nevertheless many buildings are planned without the possibility to adapt and to allow multiple uses. In this research a building is understood as a composition of individual components with different time lines. The physical building on the one hand and the immaterial building on the other hand form the entire life cycle of a building.

"(…) in architecture the relationship between habitat and resident is dynamic or changeable, and it includes factors which may remain unresolved over a relatively long period of time. " (Lawrence, R., 1987, p.51)

In this paper the term durability is introduced for long-lasting, successful and appreciated buildings. A permanent building is appreciated it is economically successful and popular, and the components complete their expected lifespan and thus is sustainable.

Adaptability

Adaptation relates directly to durability, the structure remains, new requirements can be implemented, it includes repair and maintenance work. These adaptations relate to changing needs and to necessary modifications. It is important to consider possible adaptations already in the planning process to reduce costs. The earlier change is being considered, the better you can react to altering conditions during the construction and operation of a building (Fig.1). This is relevant to the hypothesis, long-term appreciated buildings allow changes, and there is a direct correlation between time and change.

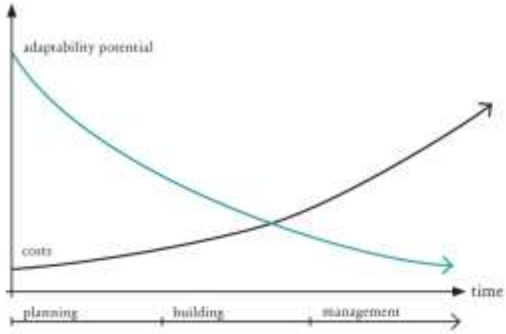

Figure 1: adaptability potential of buildings according to planning phases, source: Plagaro Cowee, N., Schwehr, P., 2008, p.63 (graphic altered by the author)

The following definitions distinguish possible forms of adaptability in the structural, social and organizational level. They are relevant for the following case studies and analysis.

Use Adaptability – Utilization

A solid construction enables a specific use (Friedrich, K., 2009) by the customers. This means a possibility of appropriation and openness in buildings "building the unfinished" (Lerup, L., 1989, p.24). These buildings include space for adaptation and appropriation. The material is solid and allows changes by the users. Neutrality of space is a necessity for this multi-functionality. Neutrality of space permits in connection with adequate proportions and design different uses. Adaptations by the users are so possible. Structural change is not necessary. The building becomes the background to changing sceneries.

Constructive Adaptability - Structure

The structural adaptability includes openness. The planning of future changes through the user is considered in the building. The "constructive adaptability" refers to the separation of the components (Fig.2). The buildings consist of structurally independent layers, which can accommodate future modifications. The constructive adaptation refers to physical and economical changes of the building.

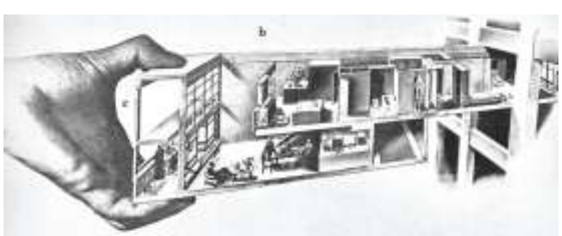

Figure 2: „de bouteiller", Le Corbusier for the Unité d'Habitation, source: Archives de la Fondation Le Corbusier, Paris. (Sbriglio, J., 2004, p.155)

Social adaptability - Organization

This term refers to changes that are regulated through collective organization models. This form of adaptability can be observed in buildings that were developed by a collaborative planning and support an organization of a social network. Adaptations take place through social communication, not by structural changes.

Appreciation

"From the first drawing to the final demolition, buildings are shaped and reshaped by changing cultural currents, changing real-estate value, and changing usage." (Brand, St, 1994, p.2)
Buildings are assigned different values, including the "economic value, the esthetic value and the value of use. There is also the sentimental value and the symbolic value of a home. The first can be quantified, the latter two cannot. Therefore buildings are valued differentiated by the individual and the community"(Lawrence, R., 1987, p.49). It can be observed that descriptions of buildings and its components transmit large differences in the understanding of their values. Appreciation is very individual; everybody has different expectations of values. These divergences could also be observed in the interviews of the research.

The research focuses specifically on two values, the economic value, a quantifiable component, and the cultural value that can be measured by the appreciation of the individual and society.

ANALYSIS

Analysis levels

The material house – the physical analysis
"Space is a product" (Till, J., 2009, p.125)
This modified quote of Lefebvre (compare original "social space is a social product", Lefebvre, H., 1991, p.26).) is introduced to define the physical components of a house. Space and the building itself are products of different factors. A house is the product of building space, building components, building levels and its surrounding. The structural levels of a building can be divided into seven functional levels (Fig.3) according to their different lifetimes. It consists of: the environment, the structural core, the facade, the installations, the program, the furniture (see six layers of change, Brand, S., 1994, p.13) and the economic value. These factors contribute to part of the physical structure of a building and are changing at different rates, depending on their durability. So it would make sense to take this already into consideration in planning to respond according to the lifespan of the components of the structure. To keep future repair costs low, the quality of the individual components is important.

In the planning process the separation of the construction elements is paramount. If all components are connected the entire lifecycle of a building is dependent on the weakest part of the system. The additive design, in which individual components independently can be replaced, is crucial.

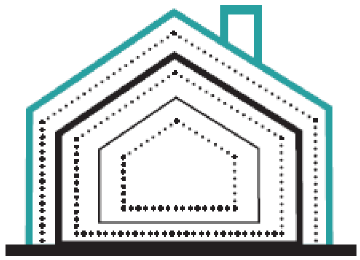

Figure 3: the material house, six levels of the physical building, source: the author

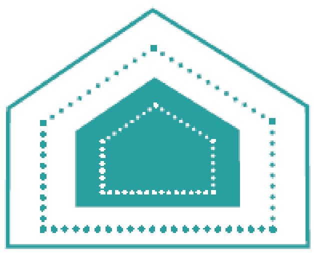

Figure 4: the immaterial house, source: the author

The immaterial house – the social analysis

"Social space is a social product." (Lefebvre, H., 1991, p.26)

The description of the qualitative components of a house is based on the quote of Lefebvre. Space is the product for his descriptions of several levels of the triad, consisting of "perceived, conceived and lived space". "Space is a product of the representation, the economic interests, the social practices of the individual and the collective political practices." (Lawrence, R., 1987, p.81)

An immaterial house is the result of different actors, from the architects to the users; it consists of various interacting social levels. The immaterial house should be examined at four levels (Fig.4), on the socio-cultural context, social structure, the use of history and cultural appreciation. Thus, the building consists of four levels of structural change performing on different timescales. The socio-cultural context considers the surrounding neighborhood and its history. The social structure demonstrates the social level of the building itself, the social groups of a house are analyzed. The adaptation history identifies the distribution of space, the interior life and how the inhabitants use the space. The cultural appreciation describes the society. These four layers form the immaterial house, which together with the physical structure of a building forms the entire house. The immaterial house is not quantifiable; it is analyzed in a qualitative method in the form of interviews with inhabitants, architects and management of buildings.

CASE STUDIES

The research compares three case studies in Switzerland focusing on different characteristics. For the category of use the residential building Nordstrasse in Zurich was chosen. It can look back to 125 years of enduring use and shows a long appreciation by its inhabitants. For the category structure the condominium l'Immeuble Clarté in Geneva was selected because it shows more than 80 years of intense history, from the threat of demolition in the 1960s to the current debate of declaring it an UNESCO world heritage site. Above all, it represents one of the earliest examples of separation of constructive levels. For the category organization the cooperative Kraftwerk 1 was selected because it is a successful example of collective participatory organizations. At the moment a second project is being built in Zurich. In this category, a newer building specifically was chosen, not only because of the model of a collective housing, but also because it takes into account economic and ecological aspects as long term strategies.

Usage – CS1 Nordstrasse, Zürich, Switzerland

How architecture should be designed to allow appropriation and durability? A suitable example for this study seems to be Nordstrasse 242 built by an anonymous architect in 1896 in Zürich.

Figure 5: CS1, Nordstrasse, source: the author

Figure 6: floor plan, source: Schliep Holdener Architekten

Figure 7: usage and appropriation, source: the author

Figure 8: kitchen before and after rehabilitation, source: the author

Structure – CS2 L'Immeuble Clarté, Genève, Switzerland

An example for an adaptable structure demonstrates L'Immeuble Clarté built by the architects Le Corbusier and Pierre Jeanneret and the engineer and developer Edmond Wanner in 1931 in Geneva. This case study was selected to analyze the development of separated structural elements over time and how inhabitants deal with the idea of flexibility.

Figure 9: CS2, L'Immeuble Clarté, source: the author

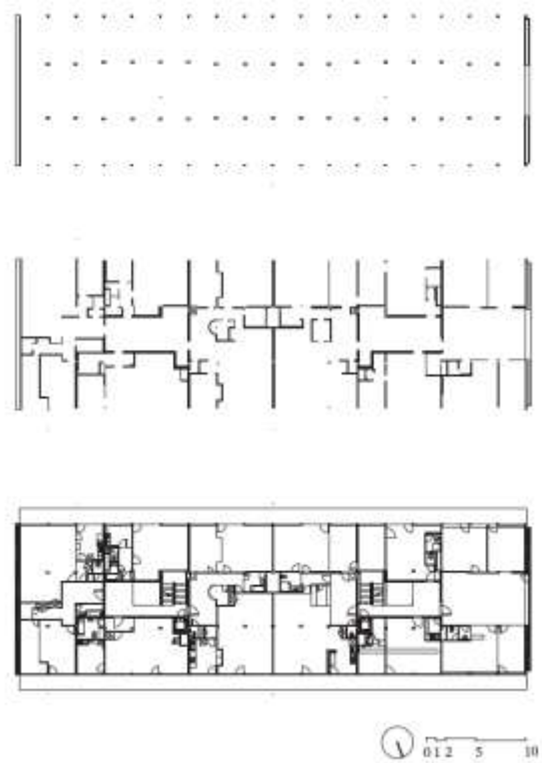

Figure 10: structural elements, floorplan, source: J.-L. de Chambrier

Organization – CS3 Kraftwerk 1, Zürich, Switzerland

A suitable example for social adaptability is the cooperative Kraftwerk 1 planned by Stücheli Architekten in cooperation with Bünzli und Courvoisier Architekten. The project started as a social utopia in 1993. A private group published the book Kraftwerk 1 based on the idea of a self-governed community for 700 people. The cooperative was founded in 1995 and the project was completed in 2001. Now it is a cooperative housing for 258 people in three houses.

Figure 11: CS3, Kraftwerk 1, source: the author

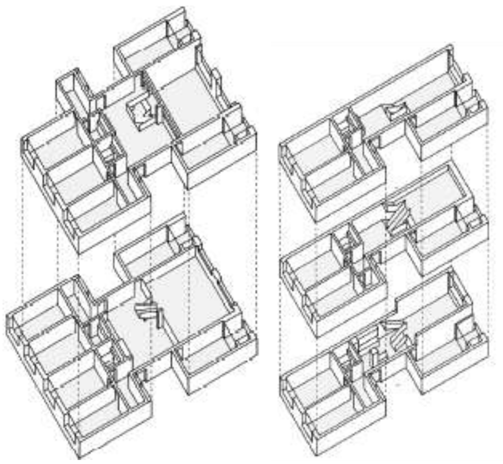

Figure 12: flat typologies, "Loos" (left), "Corbusier" (right), source: Claudia Thiesen, lecture ETH, 07.10.2010

Figure 13: floorplan, source: Stücheli Architekten

FINDINGS

Durability

The direct relationship between material and immaterial factors on the durability of buildings is essential. Crucial for the long-term success of economic and cultural appreciation is social and technological adaptability.

Thus, the factors for durable buildings:

- Durable buildings need social, architectural and economic strategies to guarantee an enduring use.
- The economic value in the form of financial return is essential for a positive economic management and respect.
- The Cultural appreciation is shown by the maintenance and care of residents, the company and the owners.
- The location, amenities and price determine the durability of buildings.
- The equivalent observation of the material and immaterial factors and its impact on the entire lifecycle of a building must be considered in planning as a continuous process. * Mixture: long-term successful buildings demand social, architectural and economic strategies to endure over a long time. The durability is achieved only through the equivalent balance of all three components.
- Governmental regulations can encourage or restrict long-term developments.

Adaptability

Usage is directly related to durability, it allows the preservation of the structure by implementing the changed requirements.

Factors for the persistent potential for change are:

- The possibility of maintenance must be given, an early replacement of parts of buildings, or the entire system must be avoided.
- New technical innovations must be used. Comfort and new technologies require an ability for changes in the building.
- Separation of structural levels is important to maintain or replace individual components, which is saving resources.
- Social adaptability has to be encouraged. Networks help to enforce internal strategies for adaptations in buildings. Social adaptations can contribute to internal changes, such as Rochades (changes of flats by inhabitants) within the building, that have to be supported.
- Residents have a great potential for adaptability, as they are strongly involved and attached to their surounding. Therefore intense communication between all participants is essential.
- The financial return and economic change have to be observed on a long scale.
- Changes in infrastructure and the environment have a connection to the development of a building.
- The professional care of a building is important in order to achieve positive adaptations, thus a good management of a building is crucial for the development.
- The users through to the maintenance have an impact on the lifespan of a house.
- The possibility of change of use should already be taken into account in the planning phase of the building.

Appreciation

- An appreciated building must take into account both material and immaterial factors. They should be valued economically and socially.
- The cultural appreciation determines the lifetime and enduring use of a building.
- A good image, the location, comfort and standard, and the price are the key factors for the appreciation of the inhabitants.
- Old buildings are valued, because they have proven to be of value. It is not the age, it is the quality of these buildings that makes them a long-term success. Thus, not all old buildings are valued.

- Users, through their use and maintenance of buildings, have an impact on the lifespan. This identification with the building leads to a more intense and more active care and maintenance.
- The cooperation of all stakeholders, from administration to the residents plays a vital role in the appreciation and preservation of a building.
- The economic value reflects the appreciation of the value of building insurance. The maintenance cost and appreciation is visible in the insurance value.
- Appreciated building must take into account both material and immaterial factors.

CONCLUSION

The cooperation of all project participants – the principals, the planners, the management, and the residents - is crucial for the permanence of a building. For future planning the communication of new strategies must be enforced: strategies for social structures have to be implemented in the planning and maintaining process.

The perspective of a building as an entire reciprocal material and immaterial structure is important. To obtain long-lasting and thus sustainable solutions, both economic value and cultural value must be considered. Onesided considerations such as the current material-related or environmental considerations are no solutions for a long-term appreciated building. Future buildings have to integrate the separation of the constructive elements have to be planned incorporating economically feasible long–term strategies in terms of management and refurbishment and have to be “gebrauchbar”, so to be useable by the current and future users, that means to be built in high quality, and leave space to appropriate and adapt to future needs. The conservation and maintenance of buildings by the users should thus also be of interest for the investors and the construction industry.

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Re-planning: Tabula Non Rasa Strategies for Postwar Modernist Housing Estates

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ABSTRACT
Post-war modernist housing estates exemplify a technocratic hegemony in understandings of the built environment, which still dominates the building industry today. Such considerations of production economies and techniques set standardized conditions for use and environments. However, some problems arise from such technocratic ambitions of creating static adequate living conditions, as this approach can undermine people's productive involvement with issues of resistance inherent in the built environment and inevitably arising over time.

Planners and architects work stages as defined by Fri and DanskeArk in the 'Danish Service Description for Building and Planning' begins with a feasibility study and ends at the time of completion. In an ecological perspective this time frame extends to meet in a feedback loop. Hence, development means at the least an opportunity to recollect and reconceptualise existing settlements. The term Tabula non Rasa was coined by architects Lacaton, Vassal and Drout to describe spatial strategies that employ such opportunities by adding to, appropriating and transforming existing built environments, as opposed to the familiar term Tabula Rasa meaning absense of preconceived ideas.

Departing from a phenomenological and hermeneutical theoretical framework this paper applies an interpretative approach to three Scandinavian housing estates in the Øresund region of Denmark and Sweden. The paper explores the relevance of academic research in a Tabula non Rasa framework to ongoing sustainable planning praxes and to resident's involvement with three post-war modernist estates. Local planners and residents have in qualitative interviews raised awareness of spatial and material dimensions that may assist the technocratic settlements to meet current challenges through values of open-endedness and responsiveness.

Keywords: architecture, sustainability, modernism, heritage, transformation, participation

INTRODUCTION
People more or less think that what was built in the [1960's and] 70's is rubbish. Therefore there is a risk that we treat some areas, as if they are all rubbish; but you have something to take care of, and you have proven that you are doing so, stated Westerberg, a local planning officer, to his peer in a dialogue. I had invited planners engaged in the redevelopment of the three post-war housing estates: Albertslund Syd outside Copenhagen, Lindängen on the periphery of Malmö, and Drottninghög in Helsingborg – to discuss the relevance of academic research about Tabula non Rasa strategies to praxis. Whilst post-war modernist housing estates by some stakeholders are considered to be superfluous, as Westerberg points out, a growing ecological concern simultaneously values the superfluous, values waste to be reinterpreted in cyclic processes as outlined in the three councils' waste management strategies. To regard the estates from this perspective raise demands to account for the existing spatial and material dimensions, in order to understand their both obvious and latent potential.

Post-war modernist housing estates were built and funded on conditions of industrial pre-fabrication. At the time this was a real-life large-scale testing ground, for what has become the dominant practice of the building industry. This technocratic practice places demands for utilitarian knowledge that value good results over good intentions. Consequently the technocratic built environment is characterised by production economies and production techniques that standardise conditions for use and environments. Hence current knowledge on sustainability in architecture and planning has advanced technical and service structures to minimise energy consumption and to produce renewable energy, for example, through passive house design and energy renovation. However, some problems arise from such technocratic ambitions of creating static adequate living conditions, as this approach undermines people's productive involvement with issues of resistance inherent in the built environment and inevitably arising over time. The process of aging through wear and tear is for example here rarely a positive attribute. Though aesthetic processes of this kind are complexly related to users' sensory experience and empathy, and it is within such involvement with the physical environment that users' understanding for material, construction and climate can be developed. When these opportunities are suppressed and not played out, the users' ability, chance and desire to maintain and appropriate the physical environment are reduced. A different approach to sustainability in the built environment could be based on, not utilitarian values, but on values of openness and responsiveness that are resilient in part due to their sensory material and spatial dimensions. In this perspective this paper explores various approaches to re-interpretations of the three housing estates.

Albertslund syd, Drottninghög, Lindängen
The Swedish government implemented in the period 1965-74 one million dwellings to address the substantial housing need in what was called the Million Programme. Here and in Denmark, extensive

mass-housing was financed on terms of rational, functionalist and industrialised principles. The mass-produced housing constructed from large concrete panel systems took form both as low-, medium and high-rise buildings. The vast number of dwellings offered new open, spacious as well as well-facilitated and serviced spaces compared to the cramped inner city conditions most tenants had moved from.

Albertslund Syd (DK) is a low-dense housing estate with approximately 6000 residents built in the late 1960's as part of a new town in the Copenhagen 'Fingerplan' of 1947. The estate that covers an area of 60 hectares is within close proximity to the Albertslund town centre and surrounded by large recreational areas. Drottninghög is an estate 3 km north of Helsingborg's town centre. It forms an island of approximately 1114 flats in 3 storey high blocks between wide roads. Lindängen, a mix of medium- and high-rise housing, borders Malmo's inner ring road as part of the larger city district Fosie. Particular to Lindängen as well as Albertslund Syd is the proximity to the extensive recreational areas beyond its southern edge. All three estates are planned with adjoining zones for institutions, recreation, services and shops and both have separated pedestrian and car infrastructures. The three estates are characteristic for the periods traffic planning, as they separate cars from pedestrian and bicycles in path- and road systems.

COLLECTIVE CASE STUDY

This paper employs a collective case study method. It explores three post-war modernist housing estates in the Oresund Region. Each study area demonstrates aspects of change over time both in terms of past experiences and through current strategies for sustainable development. I explore transformation processes through up-close exemplars across the three estates in a holistic view.

The material and data for this paper is composed of studies of maps, architectural propositions and planning documents, archive material, and on-site observation with reference to the architectural feasibility study. Alongside this I explore the inherent values of the physical environment in explorative semi-structured interviews with local planners and with residents, carried out by myself in the winter and spring 2010/11. The interviews aim to challenge and expose critique to my pre-understanding of the Tabula non Rasa thematic and as such to define relevance and raise questions to inform further research. This paper does not aim to be a methodological reflection, but rather aims to open for phenomenological and hermeneutical approaches to re-interpretations of the post-war modernist housing estates. The strategy of enquiry is, throughout a three year research period, to bring findings from the physical sites in the form of physical registration (drawing, photograph and model) and interviews into discussion with questions raised by theory and practice.

The qualitative interviews, I refer to in this paper, are elements of a wider field work in line with Faubions methodological discussion within the field of anthropology. Faubion states: …a concatenation of legs – some passed in what we still customarily expect a site to be, but others no less integral a part of the project itself, passed at the library or in conversation…legs in which the primary but still altogether integral activity is not that of encounter but instead that of the evaluation, articulation, thinking and rethinking of what one has already encountered and what one is likely to encounter on the next go. (p. 354, Faubion quoted by Marcus, G.)

I have, at this time of writing, interviewed both planners and residents. The residents, I spoke to, are of mixed ethnic backgrounds, and they are equally split between senior residents with a long-standing experience of the estates, and families with still changing desires and needs. Through the interviews I registered different dwelling types as I visited the residents in their homes in different parts of the estates. In this paper, I have tried to weave both planners' and residents' impressions into the narrative text to illustrate the multi-layered simultaneous interpretation of the estates that future development will respond to.

TABULA NON RASA

Architects Lacaton, Vassal and Drout (L, V & D) has with their recent redevelopment of the housing estate Tour Bois le Prêtre in Paris concretised the term Tabula Non Rasa. The spatial strategy for this transformation is developed in performative contextualist relation to the existing, both physical and non-physical parametres. In the introduction to Plus – a study by L, V & D that opposes the French governments demolition policy of the post-war large-scale housing estates – Ilka and Andreas Ruby writes: Druot, Lacaton & Vassal consciously apply the contextualist ethic of preservation to the modern city, which the contextualists branded as the incarnation of the anti-urban. In contrast to contextualism, which seeks to continue weaving the fabric of context in as homogeneous a way as possible, the protagonists of Plus apply new pieces of a different material to it, producing a kind of patchwork quilt as a result. By preserving the old they avoid modern architecture's ignorance of history. By designing the expansion in a radically modern way they liberate themselves from the hegemony of the existing fabric, which is, in fact, the central problem of contextualism, as it forces every new intervention into the formal pattern of the existing fabric. The relationship of Drout, Lacaton & Vassal to the context is never formal, but always performative: the role of the new intervention does not lie in simulating what already exists, but in reanimating it and exploiting its latent potential [my emphasis]. (p. 23, Introduction by Ilka & Andreas Ruby in Lacaton, Vassal, Drout).

The Tabuala non Rasa approach to development means opportunities to look back. In one regard addressing current demands for change in the master-handling of the vast substances of post-war modernist housing. In another regard this approach reflects the challenges the profession of architects, planners and landscape architects meet, when they are introduced to series of up-close personal encounters with the spatial and material dimensions of existing built environments. Planning and designing in this respect is a process of involvement rather than a practice that seeks immediate effect. Under the umbrella term Tabula Non Rasa I therefore draw together a number of architectural theories and practice based strategies concerned with reconceptualisation of architecture and planning. Amongst others I refer to a number of architects who, through practice and theory, have contributed to a critique of the dominating technocratic, or strong, building industry. Ignasi de Sola-Morales has amongst others provoked this shift in paradigm with the essay Weak Architecture. In this he refers to weak thought (il pensiero debole), which Gianni Vattimo and others introduced in the 1980's as a philosophical contribution to the critique of the Western authoritarian concept of rationality and technocratic culture. Sola Morales writes: …weak architecture is always decorative…there is nonetheless a clear need to go back and reflect on the significance of the term and on the fundamental meaning of the notion of decorum that underlies that of decoration…It is that which presents itself not as substance but as accidents: something complementary that will even lend itself, in Walter Benjamin's terms, to a reading that is not attentive but distracted, and which thus offers itself to us as something that enhances and embellishes reality, making it more tolerable, without presuming to impose itself, to be central, to claim for itself that deference demanded by totality. (p.69-70 Sola Morales). In line with this definition of architecture in an assisting role, I examine the collective case to define spatial and material dimensions that may assist to connect the user to the place where they live through times. The fact that architecture responds to contextual change over time does not result in an ephemeral architecture, but in architecture that through its weak values is resilient to contextual changes.

FROM PLANNING TO RE-PLANNING

The enquiry by architects Lacaton, Vassal and Drout into spatial transformation of the large-scale housing estates of differing architectural quality from the 1960s and '70s in France occured simultaneously to a study of the Brunswick Centre in London by anthropologist Clare Melhuish. In the article Towards a Phenomenology of the Concrete Megastructure: Space and Perception at the Brunswick Centre, London she critiques the conservationist approach held by English Heritage, and points instead to the unstatic potential of Brunswick's ability to appeal to the imagination of its users ranging from residents to the filmmaker Antonioni.

In political decision-making this value, an appeal to the imagination, is perhaps unattractive, as it does not put an immediate closure to the social problems many of the periods housing estates are attained with. However, this unstatic interpretation reveals the possibilities for each individual's sensory impressions of their home and neighbourhood to assist them in positioning themselves in relation to others, and to creatively and critically engage with the surroundings. In the qualitative interviews, I have conducted with residents, it is also apparent that material and spatial dimensions do trigger involvement, as I will exemplify later on. Participation and involvement is in sustainability initiatives such as Local Agenda 21s seen as means to implement sustainable measures. Hence, values such as imaginative and creative involvement meet the notions of the Welfare State. In such alternative interpretation of the Welfare housing model the collective concerns of the Welfare State have (again) become the shared concerns of the individual. But what can academic research offer planning praxes in this shift from top-down static models to up-close performative contextualism?

In the early 20th century biologist, sociologist and urban planner Patrick Geddes referred to two schools of urban planners, architects and landscape architects. In 'Patrick Geddes in India' edited by Jacqueline Tyrwhitt, Geddes writes that the first and most popular school considers the immediate effect. As a more long term involved planning model he continues to describe the second school as that which: investigates and considers the whole set of existing conditions; that studies the whole place as it stands, seeking out how it has grown to be what it is, and recognizing alike its advantages, its difficulties and its defects…City improvements of this kind are both less expensive to the undertaking and productive of more enjoyment to all concerned. (p. 24-25, Geddes). This second school, as Geddes himself abided to understands the unstatic built environment through continous up-close involvement.

In the scale of the city, Malmo employs both of Geddes schools. The first, the dominant masterplanner, subdivides and triggers new iconic development for city expansion and new major roads to connect alongside public transport. The latter school is represented in the environmental programs that re-develop five Million Program Areas, of which Lindängen belongs to one, Fosie. These schemes are complementary: densifying, adding green corridors and so on. In the quest for identity and brands the first school is considerably higher rated in the political hierarchy than the second. There is a conflict of interest, as planner Stellan Westerberg refers to: Fosie [and within this Lindängen]; this area is in many ways isolated, hard to orientate in as a cyclist. They really miss the corridors that many think one should work with today. Instead if you hold it up against one another, it is these big car oriented developments that are realised. That is really sad. We wouldn't like anything better than joining up the city, but we are not really successful. Like in Lindängelund, the big park, a big new fine park south of Fosie, there one would prefer to go by car, but shouldn't we do the other things first before we build this big park, finish the structures inside Fosie? Westerberg describes how the masterplan culture prioritises the overriding structures, the forming of new districts rather than the matter of the districts themselves.

In the process of re-planning the neighbourhoods for both major and minor change, there are uncertainties of finances, future user groups and so forth. This would also be the case when planning a development on a clean slate, however in re-planning the uncertain parametres are contested by what is already there. What Geddes present as an either-or, Ilka and Andreas Ruby describe, in reference to Lacaton & Vassals works, as a both-and strategy that leaves room for major change to tackle the vast challenges the Welfare model meets in a period of recession, and to re-animate and exploit the potential of the existing conditions.

THE COLLECTIVE: NOT A PROTAGONIST BUT A COLLECTOR OF DETAILS

While the masterplan is important in enabling both radical change and sustaining cohesiveness, the culture of local redevelopment is perhaps even more important in the light of shrinking resources. If we are to become increasingly self-sustainable in local developments then it is of interest to consider how the local planning structures can act free of the masterplan. Weak architecture and urban theory may be suggestive for strategies that concentrate investment in smaller radiating initiatives across administrative boundaries. In 1999 Simon Hubacker described weak urbanism with reference to Sola-Morales essay on weak architecture, as an open-result, participatory and thematically independent practice and culture of planning. The design potential of weak planning processes Hubacker writes is closely related to the suggestive power of these images and scenarios [by architects, urbanists and landscape planners]. As prototypes, they seek imitation; as structural models, they await application and dissemination. (p. 17, Hubacker). Thus, planning is fragmented propositions each one locally negotiated. Local stakeholders take initiatives and collaborate and co-ordinate change in pin-pointed projects. These independent projects radiate into the urban structures.

The London based practice muf architecture/ arts exemplifies a weak planning model. This differs from the processes of most urban practices who moves from the general to the detail. In the Urban Design Framework for Westham and Plaistow New Deal for Communities muf starts with the detail extracting general strategies that finally are demonstrated through a close-up exemplar. This project concretises the method outlined by Katherine Shonfield in 'This is What We Do – a muf manual'. She explains this method in the formula d/s = D (detail/strategy = Detail) and describes the two takes considered in tandem: 1. The close interrogation of the up close and personal (detail) 2. The extraction of what the personal can tell you about the general (strategy) 3. The reformulation of the strategy in the here and now: a small-scale construction of a future What if… (DETAIL). (p. 14-15, Shonfield). Radical change and modernisation in this model is introduced to the smaller segments, the Detail. Each individual segments role is considered in relation to a collectivity, which can then be seen to consist of a series of small-scale constructions. The role of the collective then is no longer that of the protagonist, as in a masterplan. Rather here it recollects the specificity of Details. As such muf's urban design framework can be seen as a conglomerate of many micro-site specific projects that compliment each other but can operate independently over time, as is seen in the strategy for Westham and Plaistow adopted in 2002, where urban design projects were and still are implemented according to availability of funding.

Figure 1.: Areas of ownership and/or steering.
From left to right Albertslund Syd, Drottninghög and Lindängen. Drawing by author.

Albertslund Syd, Drottninghög and Lindängen were all quickly erected on former agricultural land according to unitary masterplans in the 1960's and 70's. Since then, the unitary plans have developed into plots of interests now owned and/or administrated by different housing associations, developers, steering groups and the council. The subdivision caused by ownership and administrative structures remain in large true to the zoning of programmes, as they were originally intended, and consequently activities remain largely unchanged. The authoritarian planning in the post-war period aimed at a cohesive city planning in part enabled through ownership of large areas of land and in part through intensified planning regulation. Drottninghög exemplifies such a masterplanned formation cut off the city by wide roads. It consists of many cheaply built flats and community facilities and is inhabited by low earners and 70% residents of other ethnic background than Swedish. The isolation and the demographic make-up are in part reasons for the estate to have become stigmatised by the city population as an isolated community. However, amongst some residents the isolation is seen to strengthen the community. The technocratic nature of the development means in close-up that the resident's rights of disposal are at large limited to choice of wallpapers and flat swapping according to a framework defined by the housing association. Residents, I have met, do to a certain extend enjoy these ties, as it comforts them to be looked after. They describe that people from the housing association show up when you need them, and the maintenance levels are good in the communal areas. However poor conditions of the buildings as well as financial pressures and sustainability challenges introduce demands for change.

In Albertslund Syd residents have in the past had very open rights of disposal over the individually rented flats and houses. That includes freedom to do their own electric works, tiling in the bathrooms and moving walls. Now they have to bring the dwelling back to how they found it when they moved in unless the work has been approved by the housing association. The decision-making for major changes to include for example exterior walls has been and still is based on democratic steering processes. The ongoing renovation works of Albertslund Syd are planned in stages according to the housing stock divided according to type and organisation. Albertslund Syd is particular for its large number of repetitive configuration of single family garden houses; consisting of about 1000 enclosed garden houses and 550 terrace houses. There were 631 flats in 3 storey blocks along the canal street that crosses the estate east-west. The renovation of these blocks of flats were completed in 2009 with approximately 150 of the smaller flats joined into large flats and the introduction of smaller commercial units on the ground floor. Terraces are currently being renovated and a funding application for the renovation of courtyard houses is being processed. In the future the now identical terrace houses will in differ in accordance to the sub-divison based on the organisation of democratic steering. For example, some rows will have windows overlooking the back gardens; some will not. These examples of collective rights of disposal within a subdivided plan contribute to the collective involvement on the estate. The smallest steering groups consist of 226 households. In renovation work each of these 226 households would have to place their vote for or against the proposal. It is a large number of people to include in a dialogue, and the decision-making processes have been lengthy.

I spoke to Mr and Mrs B, who have been actively involved in the steering processes. They are now experiencing beginning fatigue, and consequently consider moving away from the estate. Mr and Mrs B, who initially returned to the estate with the renovated flat in sight, have now lived in their flat for two years without hanging pictures on the walls in their living room or having build the partition wall, they need upstairs. They participate in the slow problem solving changes of 550 terrace houses, but at the same time they hold back appropriating their own one house to their own needs. The strength of the collective steering appears to have pitfalls in the individually motivated involvement. In acknowledgement of the problem of consultation fatigue Muf's work introduces premature gratification. Smaller projects the best, most sensual and seductive bit first- and fast (p.18, Shonfield) are introduced whilst generalisations settle in a slower pace in the orthodoxy of planning. This strategy does not only deal with the difficulties of involving people in democratic processes, it also offers insight into how change is adopted by users, and can as such inform generalisations.

NEW AGAIN and New again and new again…

Only few years after the estates were built, renovation work began to overcome the technical failures of the experimental construction techniques. In Albertslund Syd the roofs leaked. The inhabitants, who moved in, were predominantly young families. Changing family patterns at the time, with more and more families desiring two incomes, resulted in new demands for childcare. Foundation schools and kindergartens were introduced. In the 1980's facades were renovated and landscaping made-over. In the 1990's changes were done to the shared realm, for example to urban design and public transport. More recently Albertslund Syd has seen yet another renovation program that again employs technocratic ambitions to the buildings in regards to current energy standards. Simultaneously to the ongoing renovation works there has been a growing awareness of the cultural and architectural heritage of the area. As Björn Jensen in Albertslund puts it: When we make in example a district plan for the terrace houses, we are not reinventing the architectural identity. In example a bright living room and a dark first floor will carry through into how the dwellings will appear after a renovation. So it is a re-thinking or re-interpretation of the existing architecture that can still be recognised only in a new way. What is evident here is that this understanding also rests on an understanding of buildings as static objects.

The estate was designed by the Danish architects firm 'Fællestegnestuen' as the first of several low-dense housing areas. Assembly parts were lifted in by cranes along the network of roads and paths that define smaller enclaves of communities. The houses have heavy closed facades to the communal spaces. The facades were originally white rendered, but they were in the 1980's replaced by timber and fibre-cement boards. The enclosed garden houses' inner facades open up to a private enclosed garden of approx 50 m2. The light inner structure contrasts the outer heavy concrete structure. The enclosed garden houses of 92m2 have three bedrooms in two main types of arrangement. The terrace houses of 98m2 have a ground floor with bath, kitchen and living room and a first floor divided into 3 bedrooms. The terrace houses have private front and back gardens.

The current energy renovation works of the terrace houses, that Jensen refers to, strip everything away beyond concrete panels, strip foundations and layout. Roofs, partitions, doors, kitchens, bathrooms, plumbing, lawns, trees, windows, sheds, rendering, insulation and so on are all to be replaced. Residents are temporarily rehoused on the estate during construction work and as such keep their tenancy agreement. However, on return many residents, such as elderly and other people on low income, will have difficulties paying the rent increase of approximately € 250 per month. Of course they do not want to evict people, but in the end it means that people cannot afford living here. It is not everybody who gets housing benefit from the council. So it is a way of clearing out, stated Mr B, a local resident. Lost for evidence and trace of inhabitation this re-conceptualisation of the architectural heritage, implemented by Nova 5 architects, will in some ways bring the estate to a state prior to it's initial time of conception. However, while this energy renovation is still ongoing alongside multiple initiatives in the councils Climate Agenda, the council now begins to address questions of sustainable development in a more holistic view to include social and cultural sustainability. This shift could mean a change from a static view to a view of performative contextualism, in which the spatial and material dimensions would be examined in relation to social and cultural parameters over time.

APPRECIATION AND CARE

When demands change over time, the value of a product or space may therefore change accordingly. Mr X in Albertslund Syd describes the changing uses of his living room 'and contrary to most, I guess, I sleep in here. I don't know why architects always make the bedrooms as a small stifling space…there used to be many concerts here – outside and in here. I held chamber nights then. So, the bed was turned around and made into a tribune where they could sit and play. It has been fun and delightful, I must say. At the most there were 30-45 people in this room. That was lovely.' Mr X's description exemplifies how we re-use stuff, materials and spaces all the time. We may have acquired them with a particular use in mind, but as time change we put things and spaces to new uses. To begin to understand how space and material may trigger sustained involvement, I asked residents about how they take care of these. Mr X exclaimed: 'I will never forget, when I first moved in here from Toldbodgade. I wanted to screw a can opener into the wall, you know the kind, where you put the cans in and turn a handle – and it went through the wall. I wasn't used to cardboard walls.' The sensory experience in this intimate relation with the cardboard wall exemplifies how involvement with the physical environment may develop users' understanding for issues of materiality and structure. Such understandings increase the users ability, possibility and potentially desire for taking care of the physical environment. Mr X's experience with the can opener made him understand the fragility of the cardboard wall in contrast to the sturdy concrete walls on the outer side of his enclosed garden house. He hangs pictures in adjustable strings from a few fixed masonry nails on the concrete wall, and directly on the nail on the cardboard walls. The light walls have been torn down, cut arches in and so on – here, and in other enclosed garden houses.

Figures 2. and 3..: Albertslund Syd, Mr X's appropriations of his rented enclosed garden house, 2011. Mr X. held chamber nights in both the shared garden and living/ bedroom. There used to be a single bedroom at the far end of the living room. Inside, on the concrete wall pictures hang in a system of strings and masonry nails. Outside, pictures are hung on nails fixed to the horizontal timber battens. Photograph by author as instructed by resident.

In Lindängen a resident spoke about the sensory qualities of sand-covered ground. She, a Chilean immigrant and another woman, had one day been sitting in the sand. Here, they imagined being in Copacabana. The resident explained that this experience demonstrated an ability to look forward and outward, and in this way to cope with the daily hardship she meets on the estate.

This suggests that up-close involvement indeed has a potential to enrich the technocratic characteristics of the existing architecture. It is noteworthy that such aesthetic processes are also appreciated by Tyge Arnfred, the architect of Albertslund Syd, in his review of the estate in a publication from 1998: We did not follow against our will, but found it both fascinating and meaningful to make our contribution to the industrialisation. This was at the time, when there was still a general believe in solving problems by technical means and people did not speak much about environmental problems. It was quickly revealed that the homogenous character did not mean a lack of acknowledgment of the resident's natural desire to give their house particular characteristics. It is even so that the calm facades make it easy to perceive and appreciate even the smallest signals of individual kind. A plant by the entrance, a hand painted door sign, a curtain, a rose climbing the fence – one can enjoy all those little expressions plenty fold because they quietly appears from within rather than being an artifice of the architects. (p.17-22, Arnfred, HSK translation).

The ways in which the spatial and material dimensions can inform involvement is central in the discussion of weak architecture. In this approach to architecture involvement will, alongside weathering, wear and tear, condition the openness and responsiveness. Juhani Pallasmaa wrote in the essay Hapticity and Time in 2000: we can speak of…architecture of weak structure and image, as opposed to an architecture of strong structure and image. Whereas the latter desires to impress through an outstanding singular image and consistent articulation of form, the architecture of weak image is contextual and responsive. It is concerned with real sensory interaction instead of idealized and conceptual manifestations. This architecture grows and opens up, instead of the reverse process of closing down from the concept to the detail. (Pallasmaa, Architectural Review) In a lecture in the Copenhagen Business School in May 2011, Pallasmaas described this reading of weak architecture through his concern with the whole image of architecture. The findings from the interviews I conducted differ to this concern with the whole image. Through interviews with residents, I learned about potential for details of weak values, within whole images that indeed are of an opposite strong technocratic character. Mr X's up-close encounter with the can opener and cardboard wall = detail provoked him to develop a particular display system for all walls in his house = whole image. Patios to keep and grow stuff in, enclosed balconies without functions, windows that open and through which you can speak to someone on the street, own entrance and low hedges are other assisting details that residents have pointed to. It might seem petty when I, for example, refer to a patio and it's not so pretty appearance. However, the relations between the landscape and the interior of the dwelling that in the functionalist configuration happens predominantly through framed views and the inclusion of light into more open interiors, are in this addition redefined. Now domestic activities spill into the park structures, and blur the boundaries between the collective structures and the individual. The ground floor patios were introduced to the blocks of flats in Lindängen as successful means to attract residents in the early 1990s. In Drottninghög my attention was brought to the patio extensions. Here, the ground floor façades that face the green are now lined with timber fences, as opposed to the initial small areas immediately outside the living rooms. Seasonal changes in inhabitation and materiality are exposed in these rooms and bear witness of varied and intense use. This importantly suggests some degree of respect for private initiative and social cohesion on the estate.

Illustration 4. (top): Drottninghög 1967 or '68. Photographer unknown. The patios were limited to the area in front of the livingrooms. Copyright (tbc)
Illustration 5. (bottom): Drottninghög 2011. Patios have been extended. The boy, who took the photograph during the interview, wanted to show the vehicles used to ride in close-by open spaces. Outside the frame of the photograph is the part of the patio, where the boy's grandmother grows flowers.

TOWARDS A CONCLUSION

In this paper I have explored multi-layered interpretations of three post-war modernist housing estates. These interpretations open up for alternative understandings to the technocratic perspectives that dominate this field within architecture and planning. The discussions I present draw on examples from both theory and practice, and offer strategies for both performative and formal intervention that are open for development over time.

The purpose of qualitative study is foremost description and interpretation. As such this research project can contribute to planning praxes by enriching the understanding of the multiple relations between inhabitation and the physical environment over time. The findings presented here – and those to follow – are informed by processes beyond those defined by the administrative time frame of architects and planners work stages. This extended time frame includes pre-conceptions, use, decay, repair, reconceptualisation, re-use and recycling.

The initial findings presented here point to spatial and material dimensions that has ability to bear sensory information, and as such contribute to increase residents' involvement. These have been described through example as: material decorum (cardboard/ concrete wall, sand), territorial implication (patio) and spaciousness (flexible living/ bedroom). These details exemplify concretisations of 'weak' values. In the technocratic housing models these details can explicitly reveal potentials for the individual to become increasingly involved in reconceptualisation of the collective structures. Rather than defying the demands given by technocratic built environments, it is possible that such 'weak' material and spatial dimensions can assist a continuous liberation here from.

AFFILIATION

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The Mediation of Information Aligned with Open Building: An Approach to Shared Decision-Making Processes of Housing Production

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ABSTRACT
It is known there is a formal housing production, structured by society, State and real state market, with rare examples of design and construction processes based on shared decision-making procedures. On the contrary, the informal housing production faces the low-income families demand: people decide by themselves about when, how, where and what costs to build. However, the dwellers involved in such processes generally do not benefit from technical, financial and legal resources. The aim of this paper is to discuss practices in which the decision-taking processes in the design and production of housing are built through attempts to share actions with all actors evolved. The debate is brought up from experiences, even partial ones, in Belo Horizonte, Brazil, based in the mediation of information aligned with the open building approach.

KEYWORDS
mediation, information, housing, autonomy, open building.

INTRODUCTION
The analyses to be presented here cover the essential assumption: residents progress from victim to an active participant; public agents act beyond welfare programs; and the university becomes an important mediator of information and transformation supporter. The mediation aspect is related to processes in which decisions are socially negotiated through the communication of information – this means that social integration, dialogue, autonomy and communicative capacity of dwellers, public agents and academics are restored. The open building aspect is brought up in order to absorb the mediation context in the design and production of social housing.

It is hoped that the present discussion shall enable housing agents to design guidelines for future production process aligned with the open building premises since it is known much work still needs to be done in order to implement Open Building strategies within housing policy.

HOUSING PROCESSES IN BELO HORIZONTE, BRAZIL
Rigid typological models, resulting from formal, constructive and technical determinations from the construction industry or the State, are still presented as a solution to the housing shortage. There is no understanding in such cases that the residents do not wish finished products with any possibility of absorbing social and physical changes over time. Furthermore, the ability for users to manage and assess their needs so that the house is an expression of everyday life, socially diverse, is completely neglected.

The effective population participation in the housing processes is mostly indirect and remains around a deliberative (but not alterable) process, in which people are heard without real guarantee of being answered. The illusive participation and its result of limited concessions are evident compensatory and manipulative policies, which might be used to guarantee social stability and to sustain a democratic image of the State. The decisions continue to be taken not by the user but by the government and its technicians, directed by the private sector impositions, within a fake participative mask.

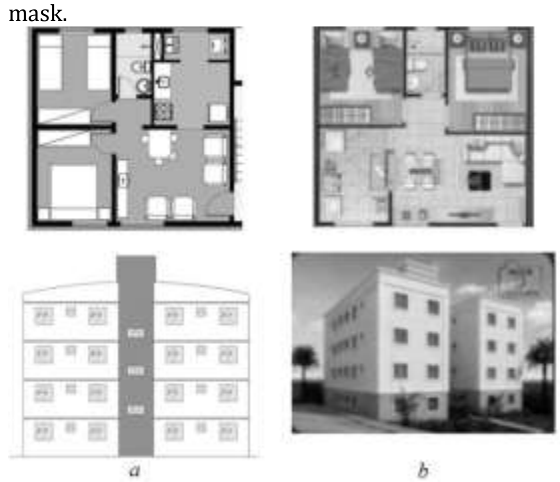

Figure n. 1: Two bedrooms' flat (approx. 48 m2): the buildings are four floors high, built with concrete blocks with no possibility of previous interference or posterior design changes from the residents. 1a: buildings built by Urbel, the local housing agent of Belo Horizonte's City Hall. 1b: buildings built by private market.

Accordingly, there is a significant slice of the residential construction that is represented by users who make their decisions on housing in isolation, without interference or participation by those who have codified knowledge (whether technical, legal, social, environmental, political, economic and cultural). A study by Booz Allen Hamilton, and commissioned by the *Associação Brasileira da Indústria de Materiais de Construção* - Brazilian

Association of Building Materials (2005), reveals that, in Brazil, 84% of building materials are sold to individuals who build and reform their homes by themselves. The same study shows that the estimate of total housing units produced, expanded or renovated in Brazil, whether formal or informal, 77% on average, are autoconstruction regime; which means without the participation of specialized professionals.

An important aspect concerning consumption of construction materials is that about 75% of generated construction and demolition waste in Brazil come from informal events, characterized by small construction and reforms, usually performed by the user of the property (Silva, 2007).

The generation of waste in construction may occur at different stages of the life cycle of buildings. During construction, the generation is related to losses in the construction process, while during maintenance and refurbishment is related to corrective actions in buildings, renovations or upgrades of part or of entire building and the disposal of components that have reached the end of life. In Belo Horizonte, Brazil, 4255 ton/day of solid waste were produced in 2004 and 42% refers to construction and demolition waste (Cunha Junior, 2005).

The generation of construction and demolition waste is visible through the massive presence of dumpsters around the city of Belo Horizonte. The dumpsters, generally understood as a solution to the containment of construction and demolition waste in the urban perimeter, are daily present and in increasing numbers, to the point they begin to compete with parking spaces and sidewalks.

Other important data refer to the *Pesquisa de Orçamento Familiar* 2008-2009 (Household Budget Survey 2008-2009). The data present the housing expenses of the Brazilian people due to acquisition, renovation, service and rental. In the period from Jul./2008 to Jun./2009, expenditure on housing reached R$105.4 billion (69% corresponds to the acquisition and 31% expenditure on renovation), which corresponded to 3.4% of GDP on average over the period. Of this amount, 40.8% were the responsibility of families with income above R$6,225, which represent only 9% of Brazilian society. The families with incomes averaging between R$2,490 and R$6,225, which represent 22.6% of the population, accounted for 32.6% of the investment. The families of lower middle income or low income, representing 68.4% of the population, accounted for 16.3% of the investment (FGV/Abramat, 2010).

Numbers from 2008 show further growth in construction is possible; 80% of households in Minas Gerais, Espírito Santo and Rio de Janeiro need some kind of renovation especially in the living room, bedroom, kitchen and bathroom (Anamaco/Latin Panel). Families indicate that the changes will be made on their own (40%) or by hiring constructors (36%) - that is, autoconstruction without the participation of professionals. If we consider the low-income families, the expense to be made to reform is extremely significant in the composition of household expenditure, which, instead, should or could be allocated to other expenses such as food, education and health.

Although the above data reveal a wide range of market to be captured we could read the same data with another look. The right to housing is the basic pillar if we want to combat poverty and minimize socio-spatial inequality. As the numbers say that the classes D and E use substantial financial resources for renovation work, the urgency to create other processes (design and construction) of housing that would absorb the diversity of social structures and the continuous transformations of environments is understood. On the horizon of this debate is to minimize the building materials waste, to use and to conserve natural and physical resources available. Beyond that, it is to allow dwellers to be part of the housing production processes.

THE AUTOCONSTRUCTION AND OPEN BUILDING LESSONS

Academic researches generally attest the great ability of people to find solutions to housing but the self-builders are categorized as one that does not have enough knowledge to build houses with planning, without waste and of good quality. Moreover, the researches suggest the development of the project and the pre-definition of the building system as guarantees for more effective results.

However, the housing provision through controlled processes, characteristic of mass production and of intense capital injection by the governments and the construction industry, has historically proved to be ineffective (Hamdi, 1995).

From the early nineteenth century, the displacement of practical knowledge of the worker-contractor for the technical expertise of the architect-engineer has consolidated the interests of the formal production (building controlled) rather than the interests of autoconstruction (user needs). It should be remembered that 'good', 'right' or 'ideal' housing standard is the one which the working class thinks it can be achieved within the political, social and economical conditions they face, which are the determinants of formal production (Villaça, 1986).

The autoconstruction or the informal way in which people construct, improve, add or improvise their homes - a social process in constant evolution and transformation, indicates that there is undeniably lucidity and criticism by self-builders in the selection and evaluation of options which can respond with flexibility, their individual needs and aspirations, whether in relation to construction, financing, ownership or management.

Open Building is not an approach that aims to merely transfer responsibilities. The residents, for example, are not expected to design the project or manage the worksite to the extent that those responsibilities should be directed to others. However, Open Building aims to include residents in decision-making processes due to the housing production, whether in collective instances (support), whether in individual instances (infill).

Thus, the decision-making process goes beyond the choice of pre-established alternatives by others. Rather, it refers to an inclusive process where those involved not only participate effectively in the identification of the issue to be discussed as well as the definition of criteria for decision about the issue. This might be possible through the balanced organization of the processes of design and construction, to be shared by users, architects, builders, designers, suppliers, developers and public officials. How could we align Open Building and autoconstruction together?

BELO HORIZONTE EXPERIENCE

We believe Open Building methodology can be applied through the design and building processes organization but mainly through the possibility of a balanced intervention of the participants in the decision-making processes due to the autoconstruction – essentially residents, but also architects and public power.

Our aim here is to present our experience which comes from the research named *Dialogues*. Since June 2010, we have been working with 75 families from the Irmã Dorothy Community, an urban occupation located in the sectional Barreiro, Belo Horizonte, Brazil, excluded from access to basic rights in consequence of the lack or insufficiency of housing programs.

Figure 2: Irmã Dorothy Community's overview.

The area occupied was abandoned for more than 10 years without fulfilling its social function, and is currently the subject of juridical dispute of ownership. Since we are there, we have been testifying the power public's resistance in working with or dealing with people from an irregular occupation and its autoconstruction processes. Due to this, the public housing agents did not participated in the Dialogues' research since they don't politically recognize the Irmã Dorothy Community as part of the local housing policies' universe.

Although the power public, university and residents' approximation has not been possible, it can be said that a main benefit would be expected if complete shared processes happened: the understanding of housing as a process to be constantly transformed along time.

Dialogues embrace:

- An encounter place where people together search information and knowledge;
- A communicative, reciprocal and desired process;
- The deconstruction of the existent hierarchies between the codified or scientific knowledge from the academy and the practical knowledge from the residents, inserted into their daily lives;
- Transference and communication of information about the housing universe (production and use), which will feed a better making-decision process;
- The preservation of judgment, opinion and experience from the residents, regarding their prevalence on their own decision;
- The understanding of housing as a process and not a product;
- The promotion of the communicative capacity and of the autonomy of all the involved.

Dialogues, which is mediation of information process, is a research project structured for families with incomes up to 3 minimum wages who demonstrate desire and commitment to its essential premise: work together. Or in other words, it means to share decision-making processes. The practice described here includes the academy into the social housing reality through a consistent and critical action towards the housing processes. It consists in the establishment of a social place in which residents can associate their practical and experimental knowledge to the technical one, which comes from architectural students and professors. It is essentially based on the mutual commitment to the process in order to form a third knowledge that would be resulted from both the practical knowledge and the technical knowledge. It's an attempt to face one of the main premises of Open Building: include residents in the decision-making processes due to the housing production.

How is the work consisted of? What have we learned?

The socio-physical characteristics of the Irmã Dorothy Community were taken into account in order to prepare ourselves to the collective meetings and the issues to be discussed, which should not follow a formal structure with "speakers and listeners" but a casual conversation format. After the understanding of the research development by the Community, it was agreed that the collective demands (support) would be prioritized and the individual ones (infill) would be parallely worked.

Following, three steps were carried out. Using GPS, streets and plots were mapped. In the interview phase, collective and individual demands of each family were identified and, after, the house's characteristics, such as sewage and solid waste disposal, electricity, water supply and materials were identified.

Then, the meetings about the collective demands (support) were structured due to three issues: garbage, sewage and drainage. The research group developed posters that illustrated answers to such problems, and, most importantly, a physical model was built to assist residents in understanding the operation of a sewage system. The georeferenced map was also an important instrument to gather all together in the discussion about the sewage system.

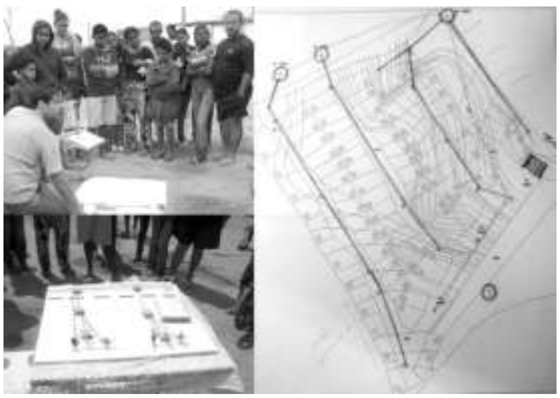

Figure 3: Irmã Dorothy Community's sewage disposal debate.

In the end, it was agreed that residents would be organized into groups, by each street, to decide how to buy and to implement the sewage system, while the Dialogues' group would be responsible for calculating, budgeting, layouting and dimensioning conventional and alternative systems. After many collective discussions, a condominium system was chosen even tough many questions regarding its operation remained. The Dialogues' team developed a "how to build a sewage system guide", distributed among the residents.

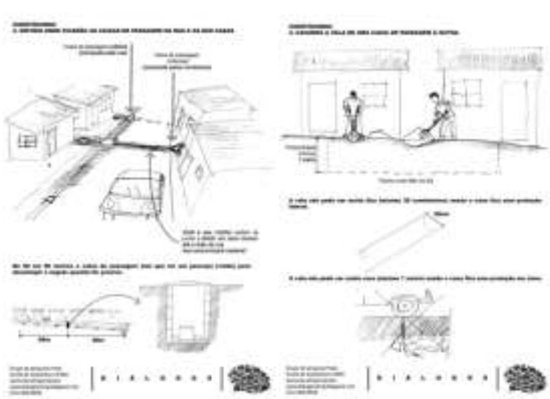

Figure 4: How to build a sewage system guide – examples of pages.

The residents and academy together also decided that the garbage problems would be discussed through the leaders' action since everybody agreed it would improve the image of the occupation, and especially the health of the population.

Following, a "cleaning day" was established. It was a good opportunity to talk to residents and to better understand how the community organize themselves. This is meant that their organization capacity was much more stronger when the academy were present. In the sewage system execution day, only after our presence, residents and volunteers came together to execute the first fragment.

Our work was then directed to individual demands (infill), helping them with constructive improvements or renovations. Posters were delivered to announce our presence in the community. However, once we arrived, we realized that the collective issues (support) still were the main topic. Some residents wanted to work upon the agreed decisions but complained about the lack of dialogue between them. We encourage them to talk among themselves, as an attempt to promote their autonomy. Some other small groups organized themselves and discussed about other possibilities, so they could decide the most appropriate.

Figure 5: The execution day of the sewage system in Irmã Dorothy Community

The participation of the university in the decision-making process about the sewage system has been very important to facilitate negotiations among the residents, to reduce costs and to allow access to technical information (rather than point solutions). Furthermore, to promote autonomy to all involved in the housing process. At the end, an important part of the sewage system was executed following the collective decisions.

WORKING WITH OPEN BUILDING

The following diagram, based on the Open Building's principle of environmental levels, describes the relation between the involved agents, concerning two approaches: the actual shared process in the Irmã Dorothy Community (architects and residents relations) and the desired shared process (if public agents participate).

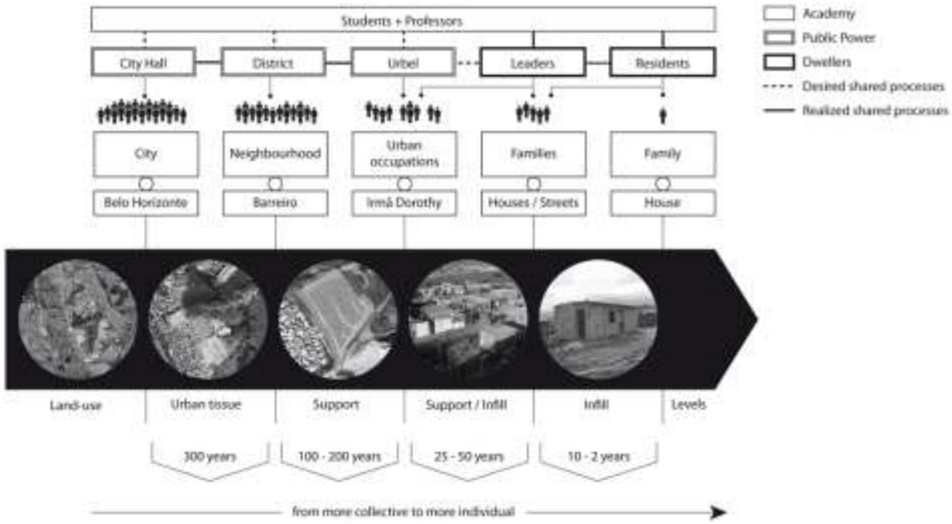

Figure 6: Open Building's environmental levels aligned with Dialogues' processes in Irmã Dorothy Community.

The first aspect to be considered is the land-use and urban tissue levels. Law, by the City Hall, defines the rules of the Use and the Occupation of Land in Belo Horizonte. The Irmã Dorothy Community is located in an industrial expansion area, in a plot of approximately 15,000 m²; this is meant that the plot is not considered as a residential place. The community's leadership divided the whole area in 75 lots of 60 m² each, aligned in three parallel internal streets.

It is desirable that the urban tissue is inserted in a participative process, involving not only the families but also the technicians, responsible for housing policy (Urbel), and students and university professors. If so, problems related to drainage, garbage and sewage disposal had been minimized over time. Since no technical expertise was shared with the residents, until the university came in June 2010, the basic issues of urban infrastructure currently represent the biggest problem faced by families.

Another significant aspect is the limitation of the common areas, which were also defined by the leadership in order to enable the social gathering as well as political protest since the occupation is linked to national and local movements fighting for housing. Thus, indications of green areas with a view to environmental protection of the land or the leisure of children, to be discussed jointly with the municipality or the academy, were not carried out.

Since Irmã Dorothy is an illegal urban occupation, the need for better visualization of the community to society is urgent. In this sense, ceramic bricks and fibrocement tiles quickly replace canvas or wooden boards, which are the most conventional and accessible building materials today in Brazil. Here, the sharing of information taking place between the families, the students and professors improved the decision process of the resident. Thus, the mediation process accepts the principles of open building to the extent that the house (infill) is built according to the sole responsibility of the resident, through autoconstruction, but benefited from shared technical resources.

Through the diagram above we intend to show that the environmental levels proposed by the Open Building approach are recognized; due to this, we can affirm that the autoconstruciton can be benefited by the open building concepts as we believe the academy can be benefited by the autoconstruction. Residents can be included in the decision-making processes due to the housing production.

FINALLY…

The Dorothy Community experience confirms the possibility of putting together Open Building and autoconstruction through the mediation of information. It also enforces the need to integrate once again these concepts in the academic syntax.

The OB is based on the use of levels to order decision-making and parts, for that reason it enables to reduce conflict among residents, owners, technical staff and decision-makers, in order to diminish and progress towards a better and sustainable environmental.

The main conclusion is connected to the principle of reducing conflicts and distributing responsibilities, which will support a more hospitable dwelling and a subsequent better neighborhood. Further research and work should concentrate on: (i) a more organized and coordinated work between parties and levels; (ii) reorganize technical and governmental interfaces and change political culture in order to reduce conflict and ease replacement and substitution of parts; (iii) production of flexible, sustainable and friendly components to be used in the buildings and neighborhoods; (iv) additional research and change at the academic level, in order to incorporate OB in the housing program and urban design projects.

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Resonance Based Design Method for Preventive Architecture
Learning from Evolutionary Principles and their Key Success Factors

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ABSTRACT
The Resonance based Design Method (RbD_Method) is a tool that can be used to plan buildings that are fit for the future and retain their value over a long period of time. In analogy to evolution, resonance and cooperation play a decisive role. The model is based on the recognition that built systems are more than the sum of their building components. What distinguishes a building as a living space from the addition of all its individual elements is constant cooperation and resonance from the outside in, and the inside out. Examples of this are the interrelation of sub-systems within the building, interaction between the building and its users or its location, collaboration in planning teams etc. This approach leads to a systematic understanding of a building in which various tangible and intangible sub-systems are in constant interaction with each other. The building as "an active programme" calls for planning methods (interdisciplinarity, participation, etc.) based on cooperation and resonance. Developed using health care facilities as case studies, the RbD_Method offers future-oriented strategies for buildings. These strategies are adaptable to change, have high user acceptance and retain their value over a long period of time. With the help of the RbD_Method, buildings are recorded and compared with each other. Knowledge gained on their strategies may also be applied to other designs in a similar context.

KEYWORDS:
Evolution, Cooperation, Resonance, Adaptation, Flexibility, Open Building, Health care

INTRODUCTION
In architecture, change is a reliable constant. Dealing with this requires strategies in planning, constructing, and operating buildings. Demands for a building stock that is both attractive and functional over a longer time period call for its ability to adapt to new requirements. The aspired (not only monetary) long-lasting value retention of the building stock lies at the heart of sustainable construction.

For this reason, a project cycle was initiated at CCTP with the aim of creating a theoretical basic model to develop planning recommendations for adaptive, i.e. reactive, and "active" buildings and neighbourhoods.

To establish the essential theoretical fundamentals, evolution theories were intensively analysed and evaluated. Theories discussed by evolutionary and molecular biologists provide indications on the principle mechanisms of development and adaption. By taking the Darwinian evolutionary algorithm, comprising of variation, selection and reproduction, it could be proved in a preliminary study that the algorithm could in principle, also be applied to architecture. [1]. However, it also showed that important phenomena of changes relevant to architecture could not be explained:

In Darwin's theory, development occurs as an unfocussed, slow moving and seemingly random process, whereas architectural design is usually a deliberate and purposeful process in which knowledge is applied and passed on. Furthermore, Darwin's theory gives the impression that the species are in continuous competition and struggle for survival, and can only successfully occupy an ecological niche when the competition has been forced out. The latest research results in molecular and evolutionary science do not dispute the validity of Darwin's evolutionary algorithm, but contradict the "struggle for life" and random mutation as an evolutionary principle [2].

“Evolution is not the development of lone warriors, it is the development of biological systems" [3] and further: "The «behaviour» of living systems to try out new (.....) variations in a creative manner, and in doing so, become more and more complex, is inherent in itself.” Organisms are equipped with a biological sensorium that enables them to "adapt themselves and, triggered by changes in their particular environment («stressors»), change themselves”. [3]. In doing so, the biological principles of cooperation and resonance are applied. This process is contrary to Darwin's theory of natural selection, not random, but a controlled and creative activity.

LIVING SPACE BUILDING AS A COOPERATIVE PROJECT

Applied to architecture, according to Bauer, [3] it is apparent that the built systems are more than the sum of their building components. What distinguish a building as living space from the addition of all its individual elements are constant cooperation and resonance from the outside in and the inside out. Examples of this are the interaction between users and planning teams, reactions to the location, interrelation between building parts etc. This approach leads to a systematic understanding of a building, not as a static object, but as living space in which various tangible and intangible sub-systems are in relationship with each other. The building as an "active programme": According to John Habrakens "open buildings", we must demand that our buildings "as a material form be brought to life"[4] and suddenly, a complicated building planning problem becomes a complex living space planning problem.

As an "open system", the architectural living space is an "adaptable" system, i.e. the behavioural possibilities of the system are variable and diverse. That is why a problem in this living environment cannot be finitely solved despite time and effort spent, and adequate knowledge. It is a complex system that can be planned and controlled only to a certain extent. Planners are faced with the dilemma, in spite of it being impossible, to achieve the highest possible level of certainty in their planning process. This uncertainty can only be overcome by gathering specific information. Core element in the design process is consequently to obtain correct information, and to evaluate and compare it. In the process, the entire planning team, including the users involved, is reliant on cooperation and resonance based planning method.

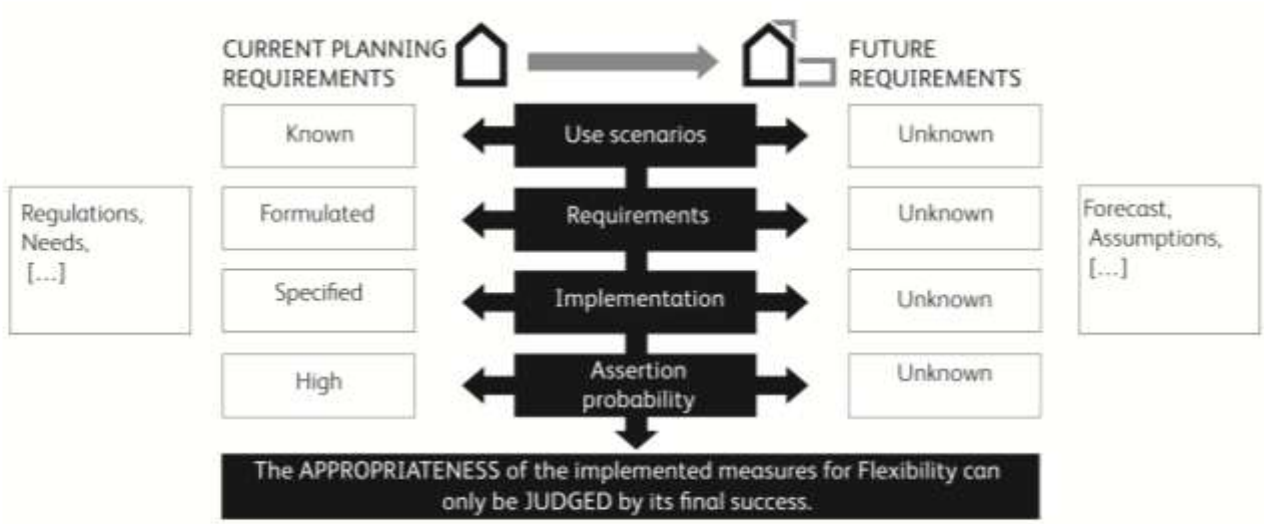

Figure 1: Dilemma of evaluating flexible measures [8]

BASIC EVOLUTIONARY PRINCIPLES OF COOPERATION AND RESONANCE IN THE DESIGN PROCESS OF PREVENTIVE BUILDINGS

Like genetic systems in evolution, buildings can also, "only fulfil their function in close cooperation with their environment" according to Bauer [5] and because of this, are significantly influenced by environmental factors. Changes in environmental factors trigger stressors that constantly pressurise our buildings to adapt. We distinguish between stressors at context level (e.g. a new road in the neighbourhood), at use level (e.g. the desire for more space), and at building element level (e.g. normal wear and tear - windows not sealed). The stressors are often combined and overlapped.

In the conception of adaptable buildings, we must take into account the interaction between the stressors and the entire building system. The pressure applied by the stressors on designed and constructed buildings requires cooperative planning understanding of teamwork and building combined with the target to achieve the highest possible resonance between the building and its users. In current evolutionary research, genetic systems are seen as a unit formed by "gene and environment, relationship experiences and physical biology" which is "part of a cooperative project" [5]. The building as a "cooperative project" is perceived by its users upon completion. This is when successful planning becomes evident. If the users succeed in establishing a positive relationship to the building and the architectural space develops into a living space, the measures have achieved a positive effect, i.e. a resonance. The question of effect is strongly linked to resonance.

In a physical sense, resonance is defined on the one hand as a) oscillation excitation of sound waves of the same frequency, reverberation of another object or other system capable of resonance (phys.); b) Amplification and refinement through vibration in the overtones (for every fundamental tone, scarcely audible, resonating, higher-pitched partial tones which produce a sound (mus.); and on the other hand reactions (e. g. discussions, remarks) that have been triggered or suggested by something and which relate to it; echo, approval, understanding, effect. [6]

Applied to architecture, resonance should not only be seen as fulfilling a function in the sense of a reaction to the requirements, but also includes the viewer's subjective emotional perception. Both assume the presence of a sender and receiver, and the ability to establish contact with one another. Without these requirements, no resonance can take place between the sender (building) and the receiver (user). The aim of future-oriented architecture must be to generate positive resonance from the users in order to achieve highest possible acceptance. Special attention is therefore to be giving to activating and reinforcing the latent resonance potential during the planning process.

"The resonance potential of the senses can be best understood by considering our complex sense of smell. Our nose does not have a different cell membrane protein as receptor for every conceivable molecular structure of a scent. The perception of scents overlaps in a similar way to the characteristics of waves. Human beings perceive scents as positive or negative according to personal taste, or dependent on the judgement of their purpose." [7]

This phenomenon is often noticed during discussions with nonprofessionals on building projects. If the person cannot develop a positive relationship to the project, be it only to understand the design concept, he will often only find it "ugly" (e.g. brutalist buildings). Lack of user "calibration" or absence of "excitation" can lead to aggression toward the built environment.

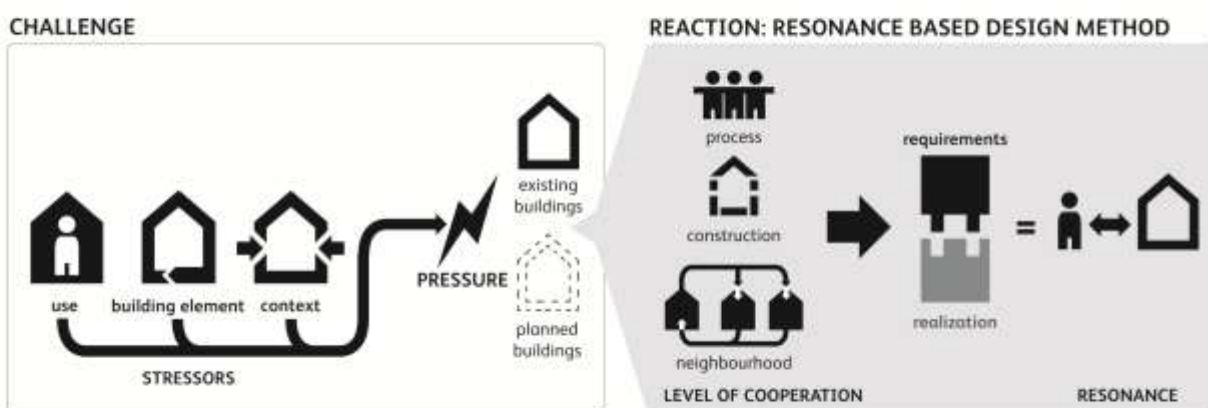

Figure 2: The basic evolutionary principles of cooperation and resonance in the design process of preventive buildings.

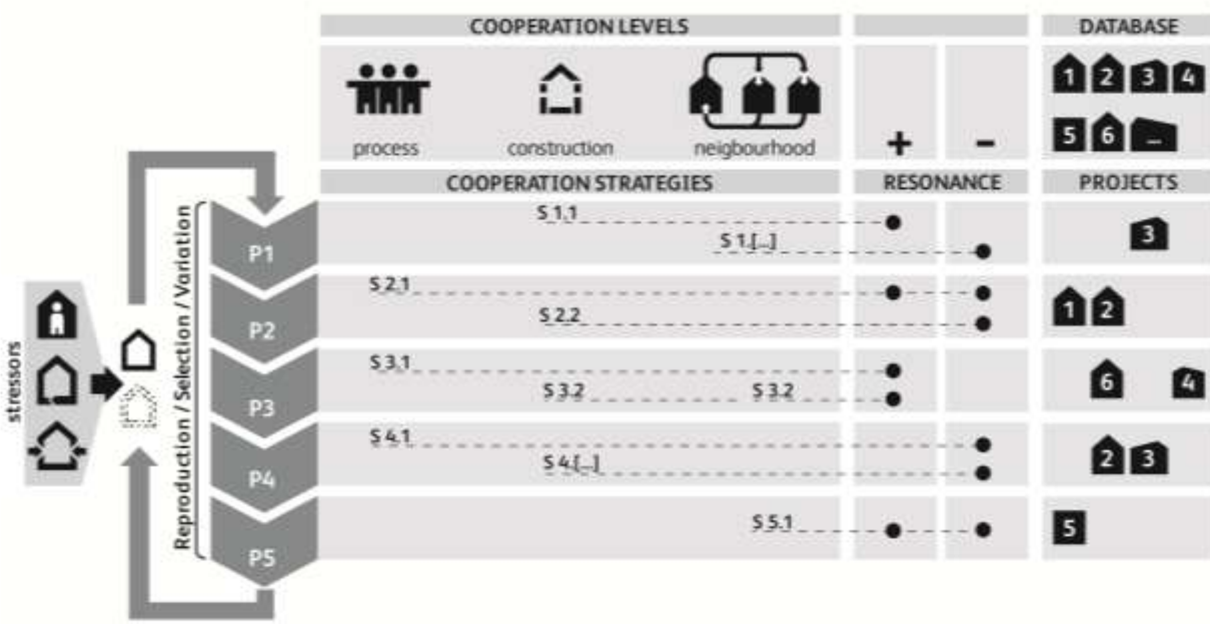

Figure 3: Basic structure RESONANCED BASED DESIGN METHOD

RESONANCE BASED DESIGN METHOD - MOTIVATION AND STRUCTURE

These considerations lead to the conviction that cooperation and resonance should be a decisive planning maxim when planning future-oriented and sustainable buildings. Sustainability is strongly linked to user acceptance and in turn, with the adaptability of the building. Therefore, buildings designed to be sustainable are able to react to changing requirements, achieve high acceptance and lasting value retention.

«Adaptability is an indicator for long retention of value. The building is able to react to new requirements with reasonable cost, time, and effort. » [8]

The Resonance based Design Method tool based on evolutionary basic principles of cooperation and resonance, aims to ensure that during the entire planning process the necessary information is made available, and that scenarios can be created from it. This process from design to realization of the building and its transmittal is an iterative process in which solutions are produced and selected. At the end of this sequence of creating and evaluating, the alternative appearing to be the most appropriate solution is selected - the planning result codification. This procedure is not unlike the process in evolution comprising variation, selection, and reproduction, and is divided into five phases (programme formulation, building design, planning result codification, realization, and reproduction) [1].

The tool for the Resonance based Design Method uses a matrix to correlate the five phases of the planning process with the three cooperation levels: process, construction, and neighbourhood. From this, specific cooperation and resonance based strategies and building measures are generated, and at the same time, formulating opportunities as well as risks. The tool is designed as an "open system", a "smart system", in which the available criteria can be extended or even modified. The model can be used in planning and for the evaluation of existing designs and buildings that successfully withstand the pressure of selection because of their high adaptability potential and user orientation. The resulting classification system makes it possible to analyse and record existing buildings according to the stored cooperation and resonance criteria. These buildings are compared with each other and are available as possible solutions for other designs. The recorded designs and buildings are catalysts in encouraging and leading discussions. The system allows different interpretations and offers no hard truths.

RESONANCE BASED DESIGN METHOD - PRINCIPLES AND STRATEGIES BASED ON HEALTH CARE FACILITIES EXAMPLES

The following strategies are part of a current research project at the Competence Centre Typology and Planning in Architecture. The table is based on the evaluation and analysis of different health care facilities and interviews with planners. It is in a trial phase and is being constantly revised and expanded.

Phase 1 - Programme formulation The vision and programme of the building to be planned are formulated. At the end of this phase, the requirement profile and target agreements for the building have been defined.		
Strategy	+	-
S1.1 Joint vision The involved parties formulate a vision under the supervision of persons responsible for feasibility and finance. [I 1] Keywords: Create a vision in a participatory process / Freedom and limitation / Feasible targeting / Determination of fixed parameters / Information transfer / Information exchange / Coordination vs. Cooperation [9] / Regulatory feedback / Artificial controlled selection / Data fitting / Prioritization / Sufficiency / Sharing a Vision	Joint vision	Group size can be excessive Time consuming Concealing information
S1.2 Contrasted target specifications Target specifications are made transparent through repeated distribution to all concerned parties and are compatible after repeated reviews. [I 2] Keywords: Structures created through collaborative construction [9] / Joint decisions / Optimal and stable group size [9] / Efficient networking efficiency / Advantages of collective / Avoidance of conflict / Repeated interaction / Consensus	Consensus	Time consuming Inappropriate specifications

Phase 2: Building design Variations are produced, selected, and developed in the design phase. In the process, ideas are created, reviewed, and compared with the formulated target agreement. At the end of this phase, the favoured design has been determined.		
Strategy	+	-

S2.1 Flexible repositioning The floor plans are set over a square grid that allows repositioning of the programme units throughout planning. This strategy facilitates the easy, quick, and effortless production of multiple scenarios. [I 1] Keywords: Overall system / Rapid modifications / Flexibility / Speed and accuracy [9]	Flexibility	
S2.2 Development of appropriate scenarios Participative procedure in development and selection within multiple scenarios. Keywords: Evolutionarily stable decisions [9] / Targeting future resonance / Integrating use and external forces / Variation as an opportunity / Appropriateness / Feasibility / Prediction	Wide choice	
S2.3 Prototyping and simulating Maximising the number of digital spatial simulations and the number of prototypes (room, corridor, waiting areas, etc.) reduces failure risk. [I 2] Keywords: Grasping partial reality / Testing / Evaluating resonance / Rectification opportunity / Adaptation to feedback	Avoiding future failures	Cost increase Time increase

Phase 3: Planning result codification The design is documented in an objective, comprehensible and clear manner, which enables discussion and comparison. At the end of this phase, neutral, definite building plans exist.		
Strategy	+	-
S3.1 User friendly means of communication Facilitating understanding during the planning process. [I 1] Keywords: Evolutionarily stable choices [9] / Communication / Understanding / Interaction / Formalizing the process	Increase of acceptance Facilitating understanding	
S3.2 Value retention Retention of value and quality during the building's life cycle. [Fig.CS2], [Fig.CS3], [I 2] Keywords: Fitness of building parts / Preservation of resources / Not only long life cycle but also high quality	Extension of life cycle and quality	
S3.3 Facilitating renovation Decisions that facilitate future renovation work. [Fig.CS2], [I 1] Keywords: Smart renovation reducing effort, time and cost	Reduction of disturbance	
S3.4 Reduction of risk of disturbance Strategies to minimise the need of repair and/or disturbance. [Fig.CS1], [Fig.CS2]. [I 1] Keywords: Sufficient mechanisms with low maintenance / More with less [11]	Increase of resonance	

Phase 4: Realization The planning result codification is realized according to the building plans. Stressors such as costs and time pressure lead to reviewing feasibility. At the end of this phase, the building has been constructed.		
Strategy	+	-
S4.1 Enhancement through synergies Benefitting from the combination of several parts and their interaction which reaches better results than the performance of each individual part. [Fig.CS1], [Fig.CS2]. Keywords: Synergistic interaction / Dynamic spatial patterns [9]	Higher performance	

Phase 5: Reproduction The wide range of information stored in each realized or documented building offers potential for future solutions. At the end of this phase, these patterns are adopted for other buildings or designs and consequently distributed throughout the building stock.		
Strategy	+	-
S5.1 Systematic evaluation Systematic evaluation for new adaption and maintenance of resonance. [I 3] Keywords: Identification of failure and success factors / Open survey / Rectification measures	Constant increase of resonance	
S5.2 Satisfaction questionnaire Questionnaires allow detection of shortcomings and defects that need to be eradicated in future developments as well as success factors to be reproduced. [I 3] Keywords: Collaborative construction and reproductive success [9] / Constructed building as reference for future constructions	Multiplication of resonance patterns	

Fig.CS 1: Institute for pathology and forensic medicine, county hospital, St. Gallen. Fixed louvers were calculated and designed to reduce mechanism complexity This solution reduces maintenance and disturbance.[10]

Fig.CS 2: Institute of Pathology and Forensic Medicine, County Hospital, St. Gallen. A PU floor was chosen because it allowed an easy and quick refurbishment, reducing disturbance and increasing acceptance [10]

Fig.CS 3: Institute of Pathology and Forensic Medicine, County Hospital, St. Gallen. Metal partition walls can be repositioned and recycled. The reflexion of light contributes to optimal distribution of illumination [10]

Fig.CS 4: Cantonal Hospital Zug and Care Centre. By constructing the facilities next to each other, high synergies are achieved through sharing services, staff, and underground mechanical engineering [I 3]

CONCLUSION

The evolutionary principles of cooperation and resonance hold great potential for the planning and evaluation of future-oriented, sustainable buildings. Demands to boost resonance forces us, as planners, to take a holistic view, consider the user's perspective, and to work with scenarios for use, operation, and maintenance: The architectural object becomes a complex living space to be planned. In this process, we rely on information that can be gained only through cooperative understanding of planning and building. To achieve this, the grid of the RbD-Method provides a basic structure to record, evaluate, and store information in terms of cooperation and resonance. Buildings are compared with each other in the grid. The information stored in the grid provides possible solutions for future designs.

OUTLOOK

The grid of the RbD_Methode is undergoing an intensive test phase. Apart from collecting case studies, the greatest challenge will be to develop the tool designed as an "open und smart system" so that criteria can be changed, whilst the tool retains a coherent basic structure. Our interest in being able to collect, retrieve and store information on buildings in a simple and interesting manner and make it available to designers and planners means that the contents can be prepared for various didactic events (workshops, seminars, lectures and tutorials). The tool is therefore being developed and implemented using different media during the test phase.

This paper is a project of the research cycle "Evolutionary principles in architecture". More extensive research on selection and variation is already being done. Further publications on this theme are in progress.

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Diversity and Connectedness as the Flexibilty of Built Environments

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ABSTRACT
The paper re-examines the uncomplicated initial postulates of flexibility. Extending them diversifies the field of the application of flexibility. Fundamentally one can change one's environment not only through modification but also by changing one's location. Therefore, flexible environment is both adaptable as well as diverse, accessible and networked. This notion couples flexibility with ensembles larger than a flat or a building. Considering movement a source of flexibility opens new development possibilities especially in the scale of a city block. It can e.g. provide one solution to the contradictory aims of housing design to build economically efficient housing on one hand and roomy multipurpose flats on the other hand. This kind of flexibility could be particularly applicable in e.g. cooperative building and co-housing. Moreover, movement-related flexibility may be useful in the design of densely built mixed-use blocks and contemporary public facilities the use of which modern information and communication technologies have changed.

KEYWORDS
Flexibility, housing, urban planning, system, type, pattern, diversity, accessibility

INTRODUCTION
Flexibility is the capability to adapt to a variety of circumstances. Regarding variety, there is a mathematically proven law called Ashby's law of requisite variety (Ashby, 1956). It states that a system can absorb variety from its environment only if it has variety in itself. Looking at a housing environment as a system, a dweller can seek variety fundamentally in two ways: either by modifying his or her surroundings or by moving to different surroundings. Modifying presumes adaptability and toleration both in physical structures and legal codes. Variety by moving presumes diverse environments from the immediate surroundings to farther distances and accessibility to those places.

21st century planning has explored both modification flexibility and movement flexibility although not necessarily realising that they can both be applied and combined in a balanced way. In modernist urban planning, movement flexibility and efficient transportation has been primary goals of while, simultaneously, cities have been zoned and plot sizes and development parcels have grown. This has led to a city structure with a larger grain that may be more difficult to adapt (Habraken & Teicher, 1998). In building design, flexibility has been predominantly viewed as modifiable spaces or structures. More recent is the rediscovery of combining spaces for housing, work, commerce, culture and leisure in a compact area or even in the same building. At best, a cocktail of different activities complement each others thus creating new kinds of well-serviced and lively environments where various amenities are easily available by moving around. Such an environment is flexible in the sense that it provides access to a variety of spaces and enables a variety of actions.

Flexibility is a pervasive concept and it should appear more or less in all qualities of the built environment. Five qualities characterizing residential environments, as categorized by Jos Smeets (2007) are listed in the first column of figure 1. Three interlinked qualities, the physical, the functional and the social, are in the core. Their symbolic features constitute the cultural quality of the environment. The normative institutional framework regulates all the others. Adding the two means, modification and moving around, by which a dweller can change his or her environment, to the above-mentioned qualities produces a matrix of different aspects of flexibility in the residential environment. This paper examines firstly some theoretical concepts by which those aspects can be tackled, and secondly some discourses from the 20th century that promote such concepts, accompanied by concrete examples.

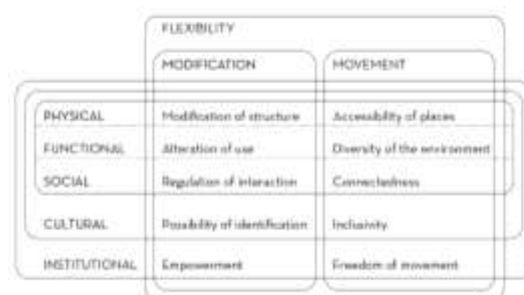

Figure 1: Aspects of flexibility in the built environment

STRATEGIES TO PROCESS VARIETY
All aspects of flexibility can be regarded in various ways. Let us think of the residential environment as a system that residents, builders and other actors and agents try to affect. Their impacts may or may not change the system but in any event the attempts give feedback of the workings of the system to the actors and agents as they try to affect the system again. Consequently, this feedback system forms a kind of an evolutionary process. Magoroh Maruyama (1963; Trappl, 1983) has identified three types of feedback systems:

The stochastic process homogenizes the initial conditions through the conditional probability of trial-and-error.

The deviation-counteracting process balances dissimilar initial conditions to the equilibrium of similar end conditions.

In the deviation-amplifying process, a small kick in similar initial conditions sparks an evolution of differentiation.

Drawing rough analogies from these process types to planning of built environments, we can try formulating some general design-technical strategies. The stochastic process could be compared to standardization strategies (e.g. when certain dimensions of rooms or certain use patterns of these rooms turn out to be favourable or statistically optimal thus becoming standards). The deviation-counteracting paradigm could be compared to the modulation strategy (e.g. modularly dimensioned structural elements or room layouts that allow certain use alternatives). The deviation-amplifying paradigm could be compared to the customization strategies (e.g. houses that can be extended).

The three strategies have parallels to the three levels of architectural form suggested by Habraken & Teicher (1998) as well as the three conceptions of a user, a dweller in this case, suggested by Hill (2003). Standardization establishes patterns, i.e. fixed, recognizable and duplicable elements or ways of using. A standardized environment allows or constrains the user to remain passive in affecting his or her environment. Modulation allows variation in certain frame. In a modular environment, the user can react to an array of options. Customization requires a set of parts and their interactions, a system. Customization possibilities enable the user to shape his or her own environment. Figure 2 synthesizes the above-mentioned tripartite categorizations.

Figure 2: Strategies, means and aims in the planning of flexibility

Standardization reduces variety and uncertainty in the environment, customization increases it and modulation alternates between certain options. All three approaches play a role in producing efficiency and flexibility. The standardization process is able to produce a result out of randomness; customization is initially flexible but may persist to develop to certain direction. Through having a balance of all three approaches, or having them working simultaneously on different levels, we can have an environment that is both efficient and flexible. "It can search for all possibilities. It can try to amplify certain ideas in various directions. It can stay at a relevant idea (which may change from time to time during the invention) and bring back to it other ideas for synthesis. In fact, openness to strange hunches, ability to elaborate on them and to bring them back to a synthesis are what is found in the process of human creative minds." (Maruyama, 1963, pp. 178, 179).

The reasoning above leads to a hypothesis that each cell in figure 1 could be elaborated further based on the three levels of figure 2. For instance, a standardization strategy applied on the structural modification aspect produces concepts such as utilization of standardized building elements and detailing, while modulation and customization strategies lead to the implementation of construction types such as the well-known support and infill solutions and smart exploitation of the whole production system of the building industry as Habraken (1972) envisaged. These concepts have been studied and continue to be experimented.

The whole field of flexibility based on modification seems quite well addressed when it comes to building technologies and design processes. However, a rigorous examination of movement-based flexibility, i.e. questions of diversity and accessibility with the frameworks presented here can perhaps open new possibilities. Major part of urban life takes place outside the home and almost all the advantages of apartments in apartment blocks are anyhow on the outside: services, connections, views and urban ambiance. The boundary surfaces of a dwelling and its external usability are therefore key issues in the development of urban dwelling (Mäenpää, 2011, refers to Lehtonen and Mäenpää). We look at this field particularly in the subsequent chapters. The scope of this paper is focuses on the scale of an urban block and to its physical, functional and social issues; what ideas have been put forward, how and in which cases this field could be developed further.

FLOWS AND CONFIGURATIONS

Movement is an elemental part of architecture and inseparable from the architectural experience and functionality. In pre-modern residential architecture, the introduction of corridor plans in the 17th century marks an important functional and mental change; before that one proceeded directly from room to room, palace-like hall plans excepted (Hill, 2003 cites Evans 1997). The corridor enables the independent use of rooms and parallel circulations such as those of masters and servants. Nonetheless, in the 19th century bourgeois apartments the emphasis is on the principle of reception: rooms are a sequence from the various social premises, vestibules, libraries and smoking rooms towards the masters' private studies and boudoirs. Functionalism aimed to dissolve rigid sequencing, congested corridor plans and even rooms. Likewise, urban spaces were to be cleared and aired. New societal ideologies as well as the enormous housing demand of the working classes after the World Wars necessitated reforms which gave rise to new housing standards. Modernist planning culminates in compacted, functionally predetermined working class units and in free flowing limitless urban landscapes, where city streets are done away with and replaced by motorways. Consequently the public-private interface fades (Habraken & Teicher's, 1998). Variety, however, develops on interfaces and thus spatial and functional variety diminishes, too. Nevertheless, functionalists experimented on some new ways of implementing diversity, although strictly planner-controlled: Le Corbusier with his collaborators incorporated shops as well as sporting, medical and educational facilities to the Unité d'Habitation housing block in Marseille.

The structuralist architectural movement that emerged in the 1960s criticized rationalist functionalism and strove to revive urban diversity born of coincidences rather than pre-planning. The structuralists saw space-configurational knowledge as a focal instrument in the planning of communities. They sought inspiration from archaic vernacular forms such as the dense Islamic town centres, the casbahs that formed labyrinthine organizations from few simple building types. From these influences the structuralists developed generic architectural language that could express individual ways of usage. The principle was to create a continuous, modulated space: an organized casbah. Such a space matrix would be able to produce complexity from clear initial order and liberate from the functional programming as well as empower the user (Oxman et al., 2002). Density would generate differentiation of places and diverse urban community.

The structuralists' approach became a formalistic tool for planning complex structures and master plans; the inherent idea of modulated spaces easily turns against its own original principles of avoiding monotonous large-scale environments. Nevertheless, the view on continuous urbanism and repetition patterns in different scales is noteworthy. It includes the idea that a house can be a city and a city can be a house (Oxman et al., 2002), an age-old idea found already in Alberti's books on the art of building from the year 1450. Having studied urban environments meticulously, Jan Gehl too, in a similar way is of the opinion that a "private living room in the home can serve as a model for integration of activities on any other scale." (Gehl, 2006, p.107). The idea suggests a kind of fractal organization of spaces: whether zooming in or zooming out, there are always familiar characteristics. The concept of fractality is useful in a sense that it combines features of both focality and distribution reciprocally.

A living room-like quality in the stair halls of apartment buildings could perhaps substitute the compactness of flats and thus provide an alternative approach to spatial efficiency to that of compressing room sizes according to functions and omitting circulatory spaces. Distribution of common facilities to each floor or around stairwells would make them club rooms, laundries, storage rooms etc. more usable for the residents. Secondly, they would be controlled by smaller group of people and their use or use could be more easily agreed on thus decreasing the risk of desolation. Thirdly, they would become not only secondary service rooms, but also socio-functional spaces that would enrich the social environment of the housing block. Focality of some spaces and facilities would in turn increase their semi-public or public visibility and accessibility: a clubroom on the public street side could better work for instance as a distance work office for the residents, or it could be rented out. Obviously the fractality concept brings a case-specific balancing of focality and distribution to the planners' attention.

An implication of avoiding both strict functional programming and dull neutrality is to couple programming with use scenarios. Together they lead to a strategy instead of a plan (Brand, 1994). As Stewart Brand (1994, p. 178) put it "All buildings are predictions. All predictions are wrong." When it comes to spatial diversity and accessibility issues, concepts of spatial control and territory are a useful tool in scenario-based planning. According to Habraken & Teicher (1998), people interpret and inhabit buildings through territorial behaviour. Control defines the central operational relationship to all matter around us. Buildings enable spatial control and they are frameworks for territories. Nevertheless, territory does not strictly obey architectural limits. While control is a hierarchical system, territory is an area that may overlap levels of control just like a courtyard and an apartment can be one's territory while only the apartment is in one's possession. In fact, a building type, when it does not refer to prescribed functions, denotes characteristic possibilities of territorial formation and control levels in the building.

Key questions considering building types are therefore accesses and interfaces in the public-private gradation. They enable nested control zones and overarching territories. Halls, corridors, stairways, and other circulation spaces as well as various intermediating zones and buffers between public and private therefore have a highlighted strategic meaning. They relate not only to accessibility and diversity but also connectedness, the social dimension of movement-based flexibility (figure 1). Jan Gehl (2006) observes that outdoor life in urban environment represents mainly the passive low-intensity contacts that appear significant but are valuable per se as well as prequisites for more complex interactions. A private or semi-private outdoor space margin between the building and a more public space works as a soft edge, an intermediating zone that allows physically and mentally easy access between the two realms. The balance of privacy and the wish for contact is made up of small, delicate details. A soft edge allows lingering between comings and goings; lingering, according to Gehl, is what counts for most of the outdoor activities (Gehl, 2006). If there is no space for it, life concentrates on indoors or on other more privatised environments.

Concepts of movement-based flexibility

As a summary, three themes related to flexibility and movement arise: permeability of structures, fractal organization of spaces in the structures and interfaces between the spaces. While the three themes are interlinked and overlapping, permeability is primarily a feature of a general system, organization a feature of typology and interfaces relate mostly to patterns. Combining now the previous figures 1&2 produces the following figure 3

Permeability

Permeability is about fine granulation of a city block structure and ample circulation spaces inside it. Fine granulation allows for both a maximal amount of interface surface between public and private, as well as the shortest distances between places thus creating a dense network of places. Good circulation allows different residents' territories to overlap which increases social connectedness. All these qualities of permeability contribute to the development of diverse, accessible and connected, i.e. flexible neighbourhoods.

Fractal organization

Fractal organization allows various territorial formations to develop, i.e. areas that a resident can identify with and that can be usable to him or her. Fractal organization means that a housing block has focal points and distributed facilities, characters of both a micro-town and a macro living room in regard to gradation of publicity, accessibility and visibility. This is to make the residents' territories functionally and socially versatile and connected, i.e. flexible.

Interfaces

An interface is a recognizable articulation between spaces and it demarcates the public-private gradation. Different interfaces enable social connectedness and its regulation: opening or closing of the private rooms to more public realms thus making the use options of the rooms more versatile. Multiple entries support the division of the premises to several control levels thus increasing the versatility of rooms. Adding depth to an interface makes it a soft edge; the interface becomes usable space itself, again contributing to diverse territories. Such soft edges can allow a public expression of the residents' identity thus contributing to a socially diverse urban environment.

	ACCESSIBILITY	DIVERSITY	CONNECTEDNESS
PERMEABILITY OF SYSTEM	Granularity of blocks	Density of places	Overlapping of territories
ORGANIZATION TYPE	Focal places	Distributed facilities	Gradated control levels
INTERFACE PATTERN	Multiple entrances	Intermediating zones	Soft demarcations

Figure 3: Concepts of movement-based flexibility

FIELDS OF APPLICATION

The above-mentioned concepts necessitate a certain trust in neighbours or passers-by, a little willingness to share facilities and a certain engagement to the home surroundings. That may be a utopia in typical housing developments, but there are cases in which those conditions exist or emerge. The following examples describe contexts where flexible environment based on one's moving around could be an applicable strategy.

Cooperative development, co-housing and the case of Kraftwerk1 housing block in Zürich

Cooperative building or group building are housing development models that are now being experimented and promoted in Helsinki, Finland, with hopes that they would diversify the housing markets dominated by a small number of developer companies (Norvasuo et al., 2008). While this is still rare in Finland, Switzerland, and especially Zürich has a long tradition of cooperative housing. Kraftwerk1 block in Zürich is a well-known example. It is a product of an initial group of community-minded people that yielded exceptional solutions. While Kraftwerk1 is a special case, it is nonetheless considered to have contributed to more diverse housing planning and the breaking out of the rigid family flat model (Norvasuo et al., 2008).

Suitable residents were advertised for already in the planning phase and that way the cooperative was able to establish a participatory planning process. Interested members of the cooperative were organized in groups where they worked on various themes for the purpose of common discussion and decision-making. The themes were architecture, ecology, children, cultural and infrastructural services, social matters of housing, communication, outdoor spaces and commercial spaces. Some theme groups continued after the completion and some tasks were later outsourced. The participation complicated the project but also identified the first residents. Initial aims of the space program that came to fruition were (Norvasuo et al., 2008):

- Open and flexible space solutions for various households such as big communities, families, couples and singles. For this purpose, flats ranging between two and twelve rooms were realized. The majority of the flats are four to five rooms.
- A diverse facility and infrastructure supply the aim of which is to extend the private living space, ease the everyday and facilitate contacts and communal operations. The facilities include a laundry, a bar, a co-operative shop, a guest room, a cooking club, a kindergarten, a restaurant and a car pool, among other things.
- Workplaces in commercial and office premises.
- Low energy standard building (Minergiestandard), adjustable air-conditioning, the use of renewable energy sources and the reduction of electromagnetic radiation.

Additional aims that came to fruition were:

- Affordable rent despite the architectural quality and sustainable solutions (20% under the average rent).
- The openness of expenses and an integrated decision-making process to avoid the discrimination of minorities.

Kraftwerk1 is example of a community of like-minded people gathered together and bonded by the building process and cooperative way of dwelling. Such a community has the willingness and the ability to agree on sharing facilities; therefore the concepts of flexibility presented here can be used in cooperative housing developments to create a spatially efficient yet satisfying neighbourhood. There are also other cases of co-housing, such as senior housing and health care environments where residents are confined to smaller spheres living and where all necessary amenities should be therefore available and carefully considered.

Ubiquitous information networks, public facilities and the case of State Library of Queensland in Brisbane

Wireless networks cover public buildings and places more and more. To some extent they liberate people from predefined routes, functions and ways of behaving. They support spontaneous and individual occupation of spaces and furniture and activate spots that would otherwise be empty (Mackenzie, 2009, refers to Hill).

Dan Hill (Mackenzie, 2009, refers to Hill) analysed the wireless Internet provision of the newly finished State Library of Queensland and found that it was being used almost round-the-clock every day. Even though there are designated places to access the Internet, the network pervades around the building and Hill noted that people would seek out nooks, crannies, floors, tables and other furniture to create spaces for themselves and their laptops. They worked individually and in groups and used the wireless networks for business, study and networking. Nearly all of the people Hill surveyed told that the provision of free wireless network encouraged them to use the library.

Hill (Mackenzie, 2009, refers to Hill) argues that information and communication technology nowadays a strategic driver that is changing the culture and services. Because the technology is pervasive and leaks through the physical limit of buildings, Hill cautions against programming buildings too precisely. Hill's remarks suggest that designing libraries should be perhaps designed as a network of diverse places and facilities, some of which are also protected from the wireless Internet access. Movement-based flexibility concepts can therefore be applicable in contemporary public infrastructure.

SUMMARY AND CONCLUSIONS

There are two fundamental ways of affecting one's immediate surroundings: modifying it or moving to another place. The first option is well covered in regard to building design e.g. in many of the open building discourses. The latter option seems less addressed in the building design or in a neighbourhood scale although there are some iconic building concepts such as the Unité d'Habitation model by Le Corbusier, and considerable academic inputs particularly from the proponents of the structuralist planning ideology such as Habraken & Teicher's (1998) formulations of form and control. Nonetheless, urban living is a more than just dwelling. A dwelling is an interface to the urban everyday and therefore the external usability of a dwelling should be studied more closely.

The categorization of the facets of flexibility presented here aims at crosschecking that flexibility is considered in various aspects of built environment, crystallizing the methods of its application and revealing concepts of its design. The paper focuses on studying the necessary features of an environment that can be used in flexible way by moving around. The point of view is limited to the scale of an urban block and its physical, functional and social qualities.

A flexible environment based on one's moving around assumes that there is variety of places catering to different needs of the residents and that these places are accessible for the residents and connected to each other, thus creating a landscape of diverse conditions and use options.

There are three strategies to design accessibility, diversity and connectedness:

1. Creating a system of permeating circulation in a neighbourhood that networks its different places and allows individual residents to include those places in their own sphere of dwelling, their personal territory.
2. Developing a block type where various spaces and places are organized so that there are both publicly accessible focal points as well as facilities distributed conveniently adjacent to the private residential quarters; between the public and private areas there is a gradation of semi-public areas that can have a second order of focal points and common facilities. This results in a fractality of spatial organization, giving the focal places an air of a living room and the more private quarters a sense of community.
3. Introducing interface patterns that can be passed at ease by those whose have the right to enter and that can be passed in various ways so that different spatial configurations can develop: this can be realized by opening multiple entrances or by connecting the different places with intermediating zones that enhance circulation. Such intermediating zones can moreover work as auxiliary zones contributing to the structure of the building type. Softly demarcated interfaces meaning a delicate boundary between the private and the public realms, provide chances of seeing through and being seen, casual

encounters and expressing one's identity publicly.

The above-mentioned flexibility strategies could be applicable especially in cooperative building and co-housing where various shared uses can be better agreed on, or in some special cases of housing such as senior housing where residents are confined to smaller spheres a living where all necessary amenities should be available. Furthermore, the expanding coverage of wireless networks contributes to a more mobile style of living and more a spontaneous and individual use of public places. A network of diverse places and facilities, i.e. considerations of flexibility and people's movement, can better enhance the functionality of such public places than rooms programmed wall-to-wall. Public services tend to be mixed with housing and business in densely built cities nowadays. The issues discussed here could be beneficial in the planning of such neighbourhoods so that the various activities would add value to each other and form an engaging environment.

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An Adaptability Assessment Tool (AAT) for Sustainable Building Transformation: Towards an Alternative Approach to Residential Architecture in South Africa

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ABSTRACT

The CSIR Built Environment and their partners have been investigating the concept of sustainable building transformation within the South African housing context. These investigations have relied heavily on theories such as Habraken's Supports, Open Building levels, concepts of disentanglement as presented by Stephen Kendall, as well as theories of material/component re-use. These studies have culminated in the development of an Adaptability Assessment Tool (AAT), which aims to broadly assess the adaptability potential of new and existing buildings and to assist relevant stakeholders in decision making during the development of new buildings and refurbishment/upgrading of building stock – with a particular focus on housing. It is proposed that the tool form part of a larger framework for assessing residential buildings. This paper provides a concise background to the research work already undertaken and its critical outcomes. It then presents a continuation of work and the current status of the tool.

The ultimate aim will be a computable tool so the qualitative assessment of a building's attributes will need to be presented both numerically as well as graphically. In this process the authors have brain-stormed various approaches and attempted to base the tool on a critical study of precedents. Four residential case studies were previously considered – after further analysis and site visits, the K206 government-subsidised housing project in Johannesburg was selected for more intensive scrutiny. Occupants of the housing project were informally interviewed to determine which building attributes they would most like to adapt and what they have already adapted. The buildings were also further studied and attributes ranked to facilitate future consideration in the development of the tool.

The research aims to better facilitate the process of designing residential buildings with the aim of sustainable transformation as it is believed that this will increase the overall quality of new buildings and ensure long-term value and sustainability.

KEYWORDS:
South African housing, case studies, open building, adaptability, assessment tool

INTRODUCTION

This Adaptability Assessment Tool (AAT) is being developed with a view to assisting architects during the design process (to assess a design before implementation), developers and government (to assess an architect's design for a new development or to help in decision-making when existing buildings are to be bought for transformation into another function). This would be applicable to any building type.

While the particular interest is in residential developments, it is acknowledged that many times buildings with other functions are converted into housing – therefore the tool is developed with the housing practitioner in mind with a view to the long-term viability of housing developments and the improved quality of housing stock in the market. Other stakeholders in housing who would benefit from such a tool would be financiers (banks and others) and government departments who would assess projects for subsidy funding, as an example. Individual owners and Social Housing Institution/Associations would benefit from having residential building stock that may be adapted throughout the years to address changed personal circumstances and market demand.

The tool therefore ultimately aims to achieve a numerical and graphical portrayal of the adaptability and transformability qualities of a residential development. It needs to be easily accessible by a layperson and is, in essence, a decision-making tool. It is intended for use in individual buildings – or a cluster of buildings. This may include various typologies ranging from a detached house on an individual site to a multi-storey residential development (noting of course that the building function, of the building under assessment, is not necessarily residential).

While ideally, the tool will be used before actual implementation of a building to ensure that a building is developed with future adaptation and change in mind, it is important to note that many times the tool will be used to make decisions about which buildings could be bought for re-development.

The AAT assesses all levels of a building development – however, it does not currently aim to look at a block or neighbourhood level (which does not mean it might be considered in future editions/variations) and it does not attempt to include any other factors, such as cost of adaptability. However, ease of adaptation or transformation is perceived to imply less disruption to an existing building and therefore less cost. However, this will need to be studied separately.

FINDINGS OF PREVIOUS INVESTIGATIONS

Need for change
It has been argued that ownership and rental housing stock needs to be more adaptable (Osman 2006; Osman & Sebake 2010; Osman et al. 2011). While the argument is easier accepted for ownership housing, it is also explained that, in rental developments "…change is important for new tenants, old tenants and for the institution that owns and manages the residential properties – thus making the building stock more viable in the long run, more able to adapt to changes in market demand and allows easier maintenance by disentangling building systems and components." (Osman et al. 2011)

Reference has also been made to Dutch research which shows that 25% of the housing budget is spent on renovation and another 25% on maintenance (Osman et al. 2011). A recent CSIR study on Medium Density Mixed Housing found that some residents in government subsidised housing complained about the small residential unit size citing that this restricted comfort and privacy and also limited the potential for addition in order to accommodate extended families. In addition to unit size, some residents found that paints used for external finishes were dull or boring and other perceived the internal wooden stairs as too dangerous for the youngest and older users (Landman et al. 2009; Osman et al. 2011).

Parameters for assessment of adaptability/transformation capacity
The parameters that will be used to assess the adaptability/transformation capacity within buildings vary. These may include the separation of buildings into a number of levels by considering both the building and individual components within a building. The relationship between the various levels (and the degree of entanglement between them) may be defined and the ease/complexity of the adaptation/transformation articulated. The critical parameters may be presented at overall building level (whether a building is spatially designed to allow for re-use) and in terms of the building construction (if the components can be disassembled and reconfigured or re-used). The amount of effort that is needed to do this becomes vitally important in assessment.

These factors should ideally be based on a set of weighted performance standards which could then be presented graphically. Categorization of the performance standards is deemed necessary and could be done based on either:
the function of the evaluated constructional component structure, skin, partitioning, finishing
the intended benefit from altering the built form
While diverse parameters and variation in weighting or relative importance would complicate assessment for adaptability/transformation, it is inevitable that this complexity be acknowledged to increase the potential accuracy and benefits of the tool. It has been argued elsewhere that Design for Disassembly (DfD) and detailing (for disentanglement) should be a separate category. It has also been explained that "priority" and "potential user benefits" need to be determined and considered in any assessment tool.

Design for Disassembly (DfD)
The term "disassembly" was favoured to describe construction detailing for adaptability/transformation. It was seen to be a terms that combined both "Deconstruction" and "Dismantling" thus putting more emphasis on correct detailing, procedure and the use of sub-assemblies.

In assessing for DfD, buildings and building components would be considered in terms of potential to be disassembled and reassembled part per part (Durmisevic 2006). The three aspects of materials used to manufacture a building's components, the components themselves, and the building as an entity would need to be considered.

While other DfD design guides have been developed, it was found that these focus on the process of removing building components and materials from a built structure and the requirements for reprocessing the salvaged components and materials, in order to reintegrate them into a built structure (Sassi 2002). Since most of these guidelines specifically aim to decrease waste production, most guides focus on the environmental impact of DfD, and not necessarily on the necessity of adaptable architecture from the building user's point of view. Some guidelines include assessment methods (Durmisevic 2006; Nordby et al. 2007; Sassi 2002; Thormark 2001) which focus either solely on the disassembly potential of a building component or on a combination of disassembly standards, environmental implications and guidelines that enable easy sorting, checking and reintegration of salvaged constructional components.

The determination of priority and the addition of potential user benefit
The authors have considered the concept of "priority" when it comes to change in the built environment, with specific reference to Nordby (Nordby et al. 2006; 2007) who attributes priority to parts of a construction by looking at turnover rate of a building part versus its embodied environmental impact or social impact. The advantages of prioritizing are that it helps identify the attributes of a building that result in the highest cost-benefit when conceived with adaptability in mind. Priority therefore keeps assessment processes manageable through categorizing these attributes and determines the weighting factor for the attributes. Potential user

benefit was also considered as an important factor as impacts may be social, functional or economic and could again further influence the weighting of the performance standards for a building.

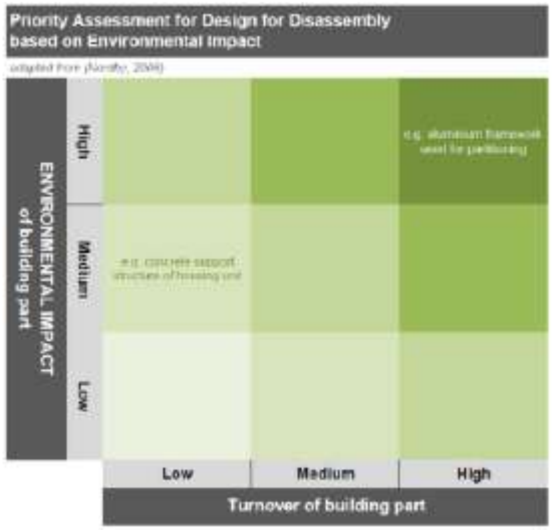


Figure 1: The determination of Environmental Impact

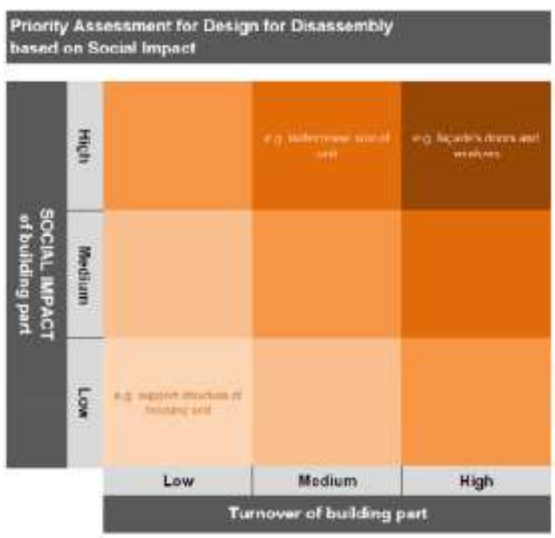


Figure 2: The determination of Social Impact

Environmental impact and the determination of potential user benefit

This has been presented in Figure 1, where an aluminium framework, as an example, is seen to have a high turnover with simultaneously high environmental impact (thus high priority for disassembly) when compared to concrete structures which have a lower turnover and medium environmental impact (thus less priority for disassembly).

system with a high turnover
+ use of components with a high embodied energy
= high level of priority

This is further showcased in Figure 1.

Social impact and the determination of potential user benefit

It is generally perceived that elements with high social impact would have a high turnover rate and vice versa:

high social impact = high turnover

Finishes, windows and doors would fall into this category. However, it is perceived that achieving actual improvement in functional performance (usually implying spatial change) or deriving economic benefits (either from the increased value of the building or from its potential to be used for income generation purposes), may only be achieved through more intensive adaptation/transformation involving components with lower turnover rates.

High functional/economic impact = lower turnover

This is further showcased in Figure 2.

Levels of adaptation

The parameters presented above will be assessed in terms of their degrees of adaptation. Langford et al. (2002) provide three levels of adaptability; including low, medium and high. These are further defined by Langford et al. (2002) as follows:

Low adaptability – design features are appropriate for minor changes within the same use (e.g. organisational);

Medium adaptability – design features are appropriate for more complex changes within same use (e.g. technological) and for similar use (e.g. from student residences into a hotel);

High adaptability – design features are appropriate for complete change of use (e.g. industrial building into a library).

Based on the above, and for the purposes of the research project, the degree of adaptability is summarised and further described in the table 1:

It has been argued that most aspects of adaptability come into play when trying to implement moderate-/medium-term changes – thus achieving increased adaptability for moderate-/medium-term changes the most important, with the feasibility of change being linked to the complexity of the construction (whether components are functionally independent or interdependent) and it may be assessed by the degree of professional involvement necessary to implement the changes.

ADAPTABILITY ASSESSMENT TOOL (AAT)

A basic format for an Adaptability Assessment Tool was developed and the general assessment of the adaptability potential of several attributes of selected case studies was attempted in previous research. The outcome of this process has been a list of possible adaptations and comparisons between buildings with regards to the ease with which these adaptations may be achieved. In order to be directly usable for housing practitioners, the presented tool lists possible adaptations, impact on other features/components of the building and categorises these ranging from easy to intensive adaption potential. The tool theoretically allows for scoring and computation, though this is to be done in the future and has not yet been achieved. The tool as it is simply presents when change in an attribute of a building component breaks or serious alters another component/s, when there is possibility of re-using removed components, when a component can be removed and substituted without breaking anything else and when there is absolutely no impact on other components. Thus, the degree of entanglement is assessed by the number of features/components affected indicated by the number of circles on the diagram that are marked in a grey, dotted or black circle – this indicating the degree of damage to attached features/components.

Table 1: Descriptions of levels of adaptability for housing developments

	Easy adaptability	Moderate adaptability	Intensive adaptability
Frequency	Short-term	Medium-term	Long-term
Areas affected	Individual units, components or total developments (such as regular maintenance activities).	Individual units, components or total developments (such as changed image of functioning of unit or building sections).	Individual units, components or total developments (more drastic interventions that might involve complete re-design, change of major components or complete change of building function).
Type of change/adaptation/transformation	Mostly cosmetic: appearance of units and (regular) maintenance.	Mostly functional: change in the spatial or technical attributes of a building influencing functional performance.	Cosmetic and functional: entire buildings or projects need to be changed in major ways.
Benefits	Benefit the users through having high social value (status symbols, recognition, uniqueness, etc).	Benefit the users through having high functional value (improvement of functional space, comfort, etc.).	Long-term viability and sustainability of projects – including adaptation to market demand, functional performance criteria, new technologies and changed lifestyles.

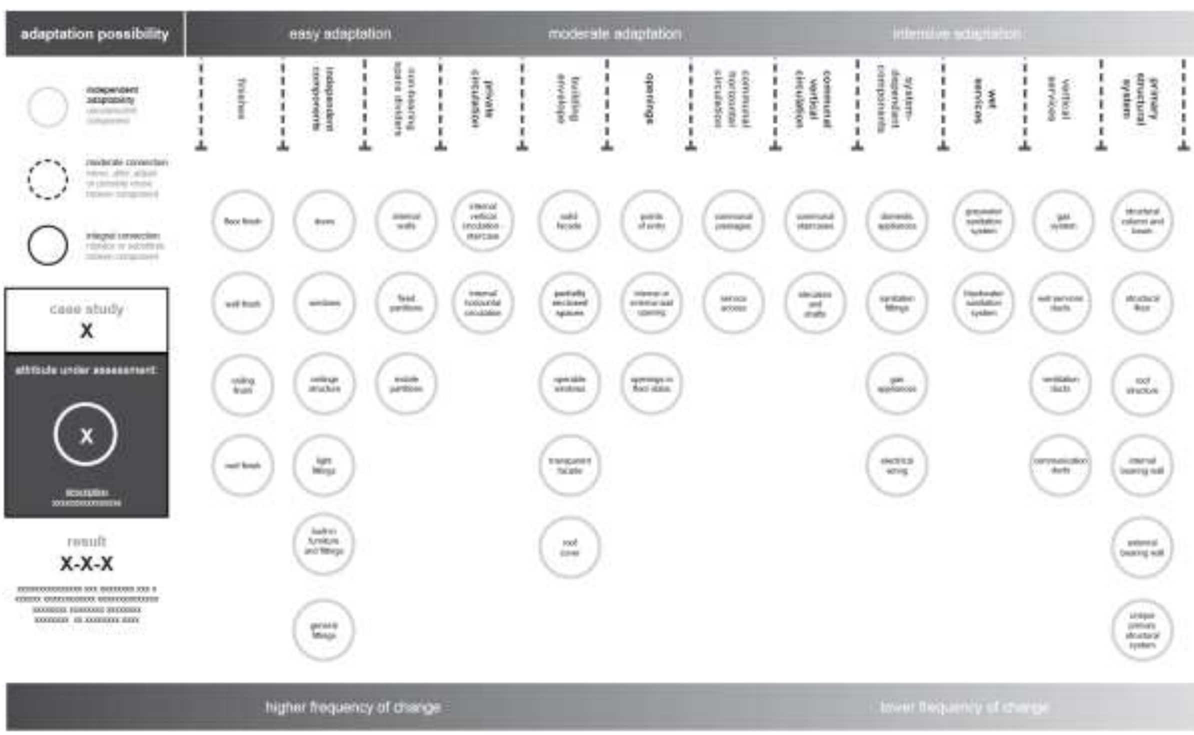


Figure 3: Preliminary format of the Adaptability Assessment Tool

CRITICAL ASSESSMENT AND A WAY FORWARD IN THE DEVELOPMENT OF THE TOOL

While the need for the adaptability/transformation has been established and a preliminary tool developed, it was established that a step back needs to be taken for the further development of the tool so that it is more accurate and more user friendly while also being structured in such a way so as to allow for computation. The tool was therefore critically interrogated and a planned structure was compiled to facilitate the development of a third draft of the AAT. Categorization of features/components was also undertaken as well as further articulation of the adaptability levels.

Categorization of building features and components

The paper brings recollection of Stewart Brands 6 S's in 'How Buildings Learn'. Brand makes mention of site, skin, structure, services, spatial layout and stuff composing a building's components (Brand 1995). The attributes in the first draft of the AAT were then restructured and the degree of entanglement and interdependency between components assessed. The components (and relationships between them) still need to be assigned a weight factor.

The revised structure of the tool

The AAT was revised and a new structure developed based on categories, building elements, adaptability potential and ease of change which then permits a scoring of the adaptability potential. A section of the framework is presented below:

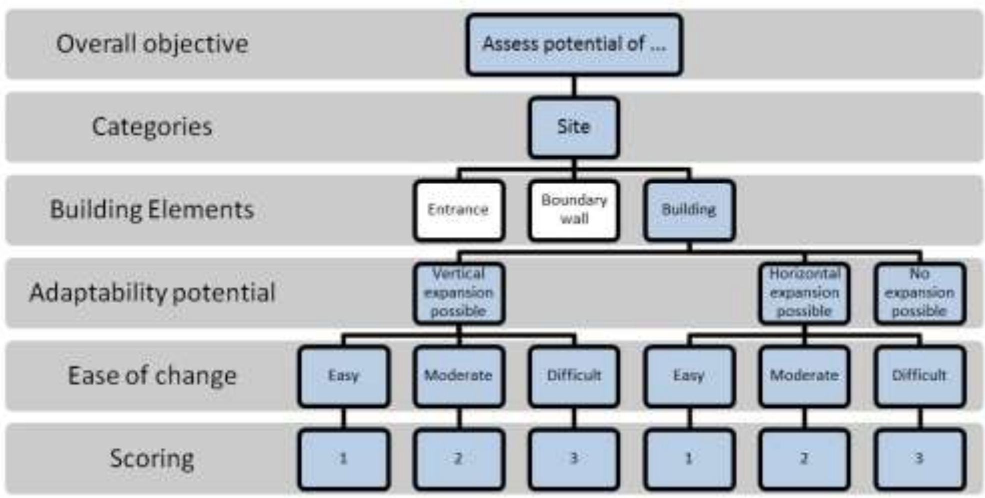


Figure 4: A section of the revised Adaptability Assessment Tool

With this revised format in mind the next step in the process has been to reconcile the different factors presented in this paper with the final AAT format. The case study areas were then revisited to test out the criteria through rapid and unstructured assessments and interviews. This is presented in the following section.

REVISITING THE CASE STUDIES

In previous case-study analysis, the main reasons for change noted were: to improve, expand, grow, enhance and ameliorate. Ultimately the occupants have sought to improve their way of living, way of subsistence, way of profit, health, efficiency and status. The building have either supported or restricted these processes. It was found that several features of the buildings were already undergoing change, by the owners or Social Housing Institutions, with no professional input and no requirement for complex approval processes. These changing attributes were therefore assessed as being easier to modify, adapt or change. These features with "easy adaptability" potential are also perceived to have high social value (such as the replacement of steel doors with timber doors in one case) or high functional value (such as the incorporation of theft- and vandal-proof features or the replacement of carpets with "easier-to-maintain" tiles in rental projects).

While some features may have social as well as functional value, it is perceived that some features which will truly enhance functional performance are more difficult to implement as these would involve spatial alterations and the disruption of major building components which implies higher technical impact. Some high level adaptations, such as changing the facades may also have a high level of social impact, especially when a facade is considered low quality. However, it was found that change in facade material mostly implies breaking down a structural wall.

However, it should also be remembered that the components that undergo frequent change and that are easier in a technical sense to change, may also have very high environmental impact due to:

- re-use potential
- disposal options
- embodied energy

“Easy adaptation” may thus encourage greater “frequency of adaptation” resulting in higher environmental costs.

The process of data collection from the case study sites
The below section of the paper presents a continued investigation into one of the 3 case studies previously studied – this was carried out through informal/random interviews. The case studies have been published previously (Osman et al. 2011). Residents were approached and those willing to impart information were engaged in a conversation. The aims were to investigate the need, potential and desire for change as well as to document changes which have already been undertaken, and by whom. The questions were as follows:

General questions about the residential units:
What are the positive and negative attributes about the unit designs? What changes have been made (in terms of spatial layout, room sizes, finishes, staircases, ablutions, etc)? Can they extend, expand or adapt the apartment units?
Neighbourhoods [social impact]: Do the houses/apartments stimulate a positive environment? Is there a positive community spirit amongst the residents of the houses/apartments? Do they share communal areas?
Wish list: What do the residents feel could be added to the houses to make them more convenient? What would they remove? What would they change?

The case study presentation: K206
From the interviews conducted it became evident that many residents have been relocated from the surrounding informal settlements and also have 'tribal' homes in other provinces. Therefore the units under investigation function as a base from which to live nearer to work and economic opportunities. In most cases, large families inhabit a single room, functioning as bedroom, kitchen, lounge, etc. Units are ill-equipped, with deficient lighting, electrical and sanitary fittings. The occupant’s income determines ability to insert additional services, such as more lights, a bath or shower – there were a number of cases where such modifications had occurred. This was perceived to have greatly improved the social well-being of the occupants. Occupants are currently only allowed to extend within the given threshold. Some stated that the intention to open new windows or doors on the facades has been denied by the relevant authorities despite the fact that the windows are believed to be too small – the interviewers also observed that the windows were incorrectly orientated to allow enough natural light in. The shared wet services (toilet and sink) are inadequate for 2 households and in some circumstances has caused disputes due to confusion as to who maintains the ablutions. One resident plainly stated 'it is un-healthy'.

Informal washing of clothes occurs along the street and communal driveways due to the fact that the sinks have not all been connected to a water supply. This is problematic when washing of dishes is concerned; however this has also stimulated social relationships of the micro-communities and has increased safety of the neighbourhoods due to eyes on the street. In some cases, a strong relationship has been established by immediate neighbours. Some of this is summarised in Table 2.

Community interaction and negotiation
The following was noted by the researchers:
The idea whereby one owner owns a double-storey unit and rents the two additional auxiliary ground floor rooms does not seem to work successfully. None of the ‘tenants’ of the ground floor rooms which were interviewed pay rent to the ‘owner’. Their argument is that they all came from the same situation and in some cases were neighbours in the squatter camps from which they were relocated. They argue it was ‘luck’ which determined who obtained the unit to own or to rent. This relates to the government housing programme where some are labeled as “qualifiers, for a housing subsidy, and others are therefore non-qualifiers – this determined who got to own the unit which includes a rental facility and who would inhabit the rental units thereby having to pay rent to the owner. This is a source of constant conflict.

The internal courtyards shaped by the communal driveway have stimulated micro communities ... external washing areas, even though they are problematic due to poor construction and no connection to drainage system, have also stimulated social relationships and have increased safety of the neighbourhoods. In some cases, a strong relationship has been established with immediate neighbours.
The passage way along the two rental units is in most cases enclosed and occupied by the rental unit closest to the driveway. Enclosing this space requires the occupants of the other rental unit to reposition their door opening. Their window also is also blocked off. Some residents have embraced this change and have accommodated their neighbour’s extension as they have said they understand the need for space.

This wishlist was compiled from the informal discussions:

- Larger windows and more natural light
- A cancellation of a '5 year rule' that prohibits any major change to units for that duration of time
- More adequate and better positioned sewage connections to facilitate change and additions to unit
- Protection against storm-water ingress at base building design
- More artificial light fixtures

- Better bathing and shower facilities
- Private ablution facilities
- Desire to extend vertically
- Safer environments, better street lighting and secured areas
- Better public open spaces
- More space, dividable space
- More rooms

Limitations to adaptation

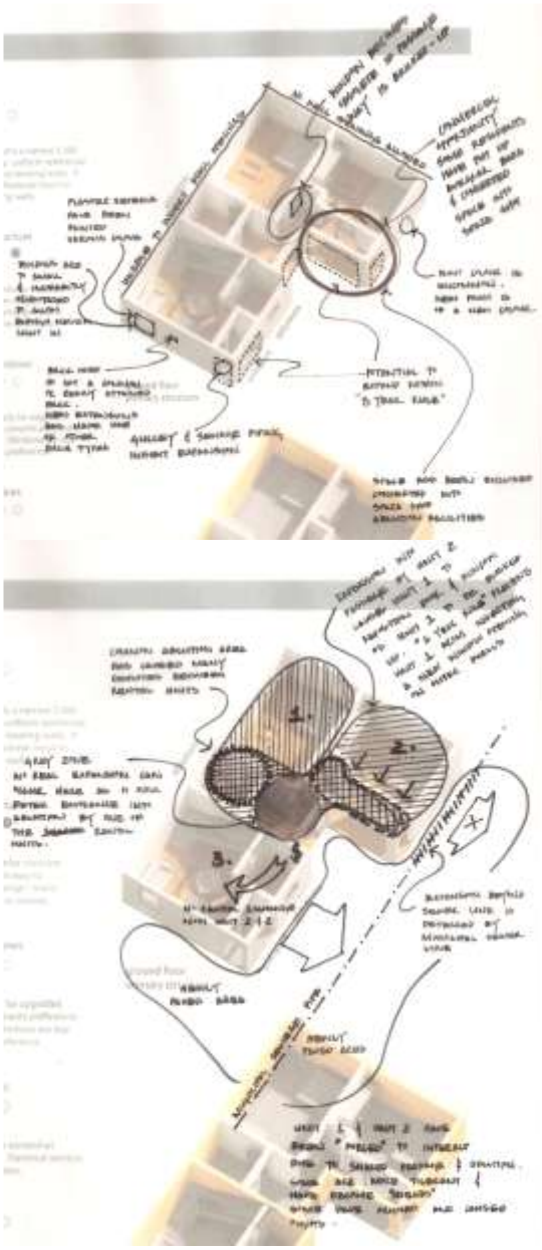
This text may be read in conjunction with Figures 5 and 6. Though space is limited and more rooms are needed in most cases, there are limitations to achieve that. In the case of the double storey 'owner' unit, extension to the edge of the threshold has been prevented by the location of the gulley within this area. Extension to the ground floor units has been limited by adjacent units and by a municipal sewerage line running along either length of the communal driveway.

Table 2: Changes already done by the residents themselves at the K206 project

CATEGORIES	SITE	SKIN	SERVICES	SPACE
	ENTRANCE Some occupants have paved the front garden areas and some have tiles and painted the interior floors and walls.	EXTERNAL WALL FINISHES Facelifts, exterior plastering, painting and cladding, is a common occurrence. Some residents have plastered and painted the external walls and in one case the occupant has clad the lower storey of his/her unit with stone cladding.	FITTINGS Many occupants have or are currently installing sanitary fittings such as baths or showers; this seems to be one of the first changes undertaken	NON LOAD-BEARING WALLS Limited breaking through walls.
	BOUNDARY WALL Internal courtyards shaped by communal driveway – in some areas, immediate neighbours have enclosed the perimeter by means of a steel palisade fence in a response to crime.	EXTERNAL DOORS AND WINDOWS Burglar bars have also been installed as a security measure. Timber doors have replaced the original steel doors increasing the social value. Plaster surrounds of the windows and doors have in some cases been repainted with a new colour. Similarly so to have some thresholds/entrance patios.	LIGHTING Insertion of more lights.	SUB-DIVISION OF SPACE Some upper storey spaces have been sub dived by a brick wall resulting in very small, but private, sleeping spaces.
	BUILDING In many cases the threshold has been enclosed (by brick, glass, steel sheeting or burglar bars) to extend one of the ground floor rooms for additional living space or alternatively transform it into some or other business front (spaza shop, hair salon, etc).	SEMI-ENCLOSED EXTERNAL SPACES The passage way along the 2 rental units is in most cases enclosed and occupied by the rental unit closest to the driveway...this requires the occupants of other rental unit to reposition door opening and their window also is also blocked off.		

The potential to extend vertically exists and has been considered by occupants, however this option is expensive and prevented by the authorities. The opportunity to change within/out the units of K206 exists and is undergoing, however any major structural additions and alterations beyond the original building footprint has been limited by a law whereby the owners/tenants are only given the title deeds to the unit after 5 years after occupation. Some additional constraints faced by residents are:

- The bricks used are not common or easily attainable. They bare a distinct rough curved outer surface. All new extensions have made use of more common brick types.
- The paint used is also an uncommon colour, and not easily attained.
- The position of the gulley and sewage piping has inhibited expansion 'into' the undercover entrance of the double storey main unit.
- Occupant’s financial limitations are also a deterrent.
- Extension to the ground floor units has been limited by adjacent units and by a municipal sewerage line running along either length of the communal driveway.
- The potential to breakthrough walls separating the rooms exist, however these room/units belong to differing owners/tenants. As the units have been subsidized and given to most of the occupants, serving as their only home close to work, the chances are slim the occupants will release or 'sell' the units.
- The potential to extend vertically exists and has been considered by occupants, however this option is expensive and prevented by the '5 year rule'.
- The potential to breakthrough walls separating the rooms exist, however these room/units belong to differing owners/tenants.



Figures 5 and 6: Sketches showing the limitations to change at the K206 project

DISCUSSION AND CONCLUSION

This on-going project has been presented and involves a number of components:

- Developing a rating tool, the Adaptability Assessment Tool (AAT) for measuring the degree of adaptability potential in buildings.
- Focusing on residential buildings.
- Relating the concepts to a particular residential market in South Africa.
- Developing the tool by constant reference to existing needs and dynamics in the low-cost residential sector in South Africa.

The AAT is being developed both as a tool/method to analyse and strategically plan developments of existing building stock into a residential function as well as to aid in the design of new buildings design to be viable in the long term by permitting ease of adaptability of critical elements and components that have a high degree of social and environmental benefits.

The tool is in process of critical review and the aspects identified through case-study analysis need to inform further development. The results of a literature review on the topic also need to better inform the tool and reconciling/weighting of the different aspects affecting adaptability potential better articulated – the tool needs to ultimately have the capability of being generic enough for wide-scale application, specific enough to be useable in the South African residential sector and accessible and easy to use while addressing the inherent complexity of the real built environment.

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Exploring Connectivity + Seeking Integration: A Framework for Heightened Agility + Adaptability

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ABSTRACT
Fragmentation and separation are omnipresent challenges in our modern world, and especially so in building design and construction. The concept of 'open building' is influenced by the notion of flexibility – buildings, similar to ecological systems should be able to adapt themselves to changing states of affairs, pressures and demands. In the context of architecture, 'change' can be interpreted as neighborhood lifecycle, environmental circumstances, and occupants' desires, spatial needs and lifestyle choices. Space that is reacting, responding and transforming then empowers users, as opposed to more conventional approaches whereby users must adapt to space and conditions however uncomfortable such accommodations may bear out. The authors critically reviewed the prevailing theories and prevalent practices pertaining to the concept of 'open building'. In response to issues culled from said studies a framework was developed. Building from Sinclair's holistic design strategy (2009) the new approach focuses on 'agility'. This framework celebrates the two more conventional areas of 'spatial' and 'functional' while innovatively introducing the third notion of 'aesthetic' flexibility. Each of these three notions of spatial, functional and aesthetic flexibility fosters a greater richness of 'open building'. Each category on its own may not be able to more fully resolve the paradox of stability – with respect to long term community interests – and change – with respect to individual preferences. A futuristic architecture ideally proves a hybrid of spatial, functional and aesthetic flexibility - being able to adapt to more readily + successfully adapt to changes in 'real time'. Agility and adaptability arguably benefit from, and demand, such a connective and integrative strategy. The present framework promotes an inclusive and holistic approach intended to encourage a more responsive, resonant and resilient architecture. A 'responsive architecture' has enough elasticity to be able to respond to environmental conditions, deploy emergent technologies, meet users' needs + desires and perhaps generate energy from renewable resources. A 'resonant architecture' is designed with a meaningful balance between spatial, functional and aesthetic aspects. Resonance between building spaces, systems, users, context, culture and conditions must be aggressively sought. A 'resilient architecture' is designed with the capacity to cope with future changes with minimum demolition, cost and waste and maximum robustness, mutability and efficiency. In summary, the current research and resultant framework considers progress to date, builds from an established conceptual model, and envisions steps to more accessible and meaningful agility and adaptability in environmental design.

KEYWORDS
agility, adaptability, flexibility, integration, conceptual framework, holism

INTRODUCTION

> "Above all, architects should think before they create hardware."
> Kisho Kurokawa

Architectural design in our current times has tended to generate buildings which, despite their artistic qualities, frequently prove static, rigid and intractable. The intense and significant production of architecture around the planet has created a situation whereby modification of the existing building stock is costly, difficult and at times implausible. Our trajectory needs shifting. Sustainability is essential, with agility and adaptability proving central to this goal.

Beginning in the mid-twentieth century architects began to explore more open, mutable and responsive ways of building. Visionary architects such as the late Kisho Kurokawa and the late Cedric Price, in an effort to envision more resilient & robust solutions, explored methods of design and construction that provided greater user control, more modification, and heightened customization of environments. As opposed to buildings in which users needed to adapt to environmental constraints, these progressive designers imagined spaces that interactively adjusted to user needs. A significant challenge to these design innovators was a serious lag between thinking and technology – quite simply at the time construction proved unable to address concept. Today however the world has changed in dramatic ways, with advancements in technology, expectations of society, and a quest for greater sustainability all driving a push for more agile, adaptable and appropriate Architecture. Into this intense milieu architecture and environmental design must provide spaces and places, which better accommodate the needs of increasingly diverse and pluralistic communities.

Flexibility is a vital quality in any adaptive system. Flexibility is also an important term in the Open Building (OB) glossary. It describes structures which can be adapted to the dynamic processes of habitation (Eldonk & Fassbinder, 1990). Notions such as 'spatial' and 'functional' flexibility have been present in OB literature since the beginning of twentieth century. These ideas advanced OB theory and, subsequently, the quality of life in places they were implemented; however, replication & standardization within the exemplars resulted in arguably predictable and repetitive projects. The authors advocate for a third notion of 'aesthetic flexibility' as a way to mitigate banality of the 'infill' and 'support' systems. The notion of 'aesthetic flexibility' is a novel dimension holding promise to celebrate 'identity' and 'customization' within the design equations and built outcomes.

The current paper expands on the notion of 'flexibility' from different perspectives and, through the introduction of a toolbox (framework) for designers to consider in crafting and creating cities, communities and buildings. The framework promotes an overarching mindset whereby all three pillars of 'spatial', 'functional' and 'aesthetic' flexibility cooperate as a more integrated and sustainable system for the design of buildings that endure and excite. 'Resilient' design as a hybrid of 'spatial', 'functional' and 'aesthetic' flexibility responds to a user's needs and desires to reimagine + reconfigure space, as they wish, in real time. The framework aims to shift the user's role in architectural design and practice. A sense of control over space psychologically enables users whereas being unable to modify one's surroundings can result in anxiety, distress and discomfort.

Practicing 'open building' requires an increasing technicality that is well addressed by design & construction professionals and related industries. This research endeavors to reconsider the concept of 'open building' through a more 'designerly' perspective and postulates a novel model & new philosophy for realizing a more responsive, responsible and fitting Architecture for the 21st Century. The approach, while acknowledging the rich & remarkable developments in the field of 'open building' over many decades, proposes a distinct lens through which to view and tackle agility, adaptability and appropriateness of design in our current, complex and ever-so complicated era.

One of the authors (Sinclair, 2009 & 2010) has previously delineated a Holistic Integrated Framework for Design + Planning. This innovative approach, being operationally deployed & tested across multiple scales internationally, considers the symbiotic interplay of Fitness, Agility, Diversity and Delight. The present paper, building from this compelling & encompassing foundational model, aims to expand and explore ways of especially considering Agility, with a particular focus on re-conceptualising the manner in which Architecture might heighten its reverberation with user needs, demands, desires and expectations.

RESPONSIVE | RESONANT | RESILIENT

At the core of the proposed OB framework are dynamic and inter-related aspects pertaining to a building's, and an architect's, obligations and opportunities -- the authors cast these qualities as responsiveness, resonance and resilience. All three, potently cast at the core of the framework, should operate in force and in unison.

Image 1: Sinclair's Holistic Integrated Framework for Design + Planning

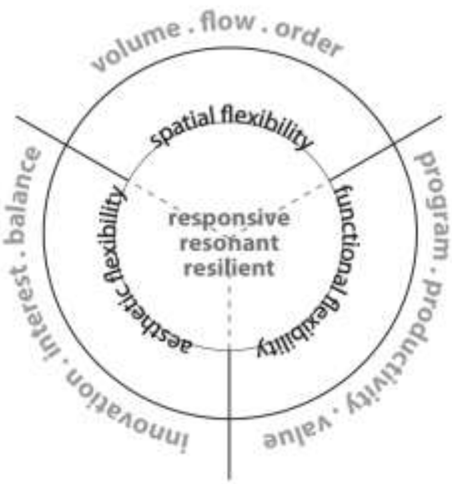

Image 2: Integrative Agility Framework

The 'futuristic' architecture envisioned via the present framework proves a hybrid of spatial, functional and aesthetic flexibility -- being able to effectively & efficiently respond to the needs to intuitively reconfigure the space, adapt to future changes in program and reflect the users' desires in real time. Each of the following three categories of spatial, functional and aesthetic flexibility contribute to the richness of an expanded + reconsidered 'open building' concept; however, each on its own will not be able to resolve the paradox of permanence (stability) – in respect to long term community interests – and change (mobility) – in respect to individual preferences. Spatial Flexibility enables rooms to grow and shrink or to be subdivided differently to respond to the users' need for space. Functional Flexibility allows different functions to unfold within the 'support' but it fails to fully respond to temporal needs to spatially change the layout. Aesthetic flexibility is more about the interplay & interface between interior + exterior -- it is only rational if it reflects the greater adaptability, react-ability and synergy between inside (infill|fit-out) and outside (skeleton|shell).

Our future architecture, considering all the current environmental, social and economic issues at play, calls for designing structures that are fully adaptable from inside out and across manifold scales. Mutability and malleability ideally overarch all dimensions. In order to do so, the best designs can be defined as those that spatially, functionally and aesthetically accommodate change. In this kind of architectural practice, collaboration among all the stakeholders is strategic and essential. Design, construction and building systems, in this methodology, are not distinct entities that develop independently. Rather, they are all inspired by the latest developments in art, science, technology, theory and practice that should be thought of and integrated from beginning to end and throughout the process. It is illustrative to further consider responsiveness, resonance and resilience vis-à-vis the new framework.

Responsive

The skin, structure and infill should be equipped with enough elasticity to be able to respond to environmental conditions, adjust to users' needs|desires, and generate energy from renewable sources to which the building may be exposed. This means that the building is not neutral and stand-alone relative to its users and context. Rather, it is alive and ecologically synergistic with its surroundings.

Resonant

'Open' buildings should be designed with a meaningful balance between interior + exterior and between spatial, functional & aesthetic aspects. Focusing on the reconfigurable 'infill' should not overshadow the potentials of dynamism, customization and energy generation in the design of an exterior shell. Ideally resonance needs to be meaningfully & operationally active over multiple scales and successfully realized system-wide.

Resilient

The building systems should be designed with the capacity to cope with future changes with minimum demolition, cost and waste and with maximum robustness, mutability and efficiency.

As noted, the new framework acknowledges the fundamental dimensions of spatial and functional flexibility, while concurrently introducing an equally essential feature of aesthetic flexibility. Like a three-legged stool, all of these flexibilities are called upon to maintain, support and sustain the enterprise. It is valuable to consider each in turn as pertains the new framework.

SPATIAL FLEXIBILITY

Spatial flexibility, as an architectural theme, was among the first drivers of the 'open building' concept. It refers to the capacity of change in the spatial structure of a building. Its historical roots can be traced back to the traditional Japanese single family dwelling - an open cubic structure that was subdivided into smaller spaces by means of sliding walls in a ratio of 'tatami' mats. Early multi-family dwellings with spatial flexibility appeared in Dutch housing projects. The idea behind this theme was initially introduced by the Stichting Architecten Research (SAR) and through influential architects like N. J. Habraken in the 1960s. Habraken distinguishes between 'support' and 'infill' -- where support refers to what the individual user cannot change, while the infill is what the individual user can freely decide and act upon (Eldonk & Fassbinder, 1990). In this analogy, the structure and exterior shell is fixed and designed to accommodate the flexible and changeable infill systems based on users' needs and desires. Plans tended toward large rectilinear or square layouts that are subdivided to smaller spaces by moveable interior partitions. Similar to Japanese traditional houses, flexible infill is achieved by means of sliding interior panels and foldable partitions. A related methodology deploys lightweight interior walls that were not coupled or, as Stephen Kendall (1999) notes, 'entangled' with structure. Therefore, each household was able to layout the interior prior to occupation based on its own spatial needs with no disturbance in the main structural layout. In the beginning of the 1980s, the Japanese took this concept further by differentiating ownership of 'infill' from 'support'. In the 'two step housing supply system' or 'century housing system' (CHS), the 'support' is built in the first step by the public entity with high quality and durable materials; in the second step, it is delivered to small regional construction companies to be rented to occupants. Local companies are then responsible for preparing the planning 'sheets' in which the occupants determined their desired layout, which was then constructed using lightweight materials that, while manageable, may not necessarily prove durable. This methodology rationalized a sequential construction and addressed the practice in addition to the design (Kendall, 1999). The present paper views spatial flexibility as basic to agile, pliable + progressive Architecture.

Guideline

In the design of buildings, spatial flexibility realizes the user's needs and desires to make changes in the composition & arrangement of the space. It provides the building with greater flexibility and open systems, which ultimately afford users with more control over the configuration and utilization of space(s).

Elaboration
Conventional approaches to design and construction of spaces tends to be very fixed and static. For each activity, a distinct space is crafted that may not be efficient especially across the fourth dimension. Delegation of a separate and largely immutable space to each function unnecessarily grows the size of the building. It results in spending more money and consuming more materials for construction as well as more incurring higher costs for maintenance, operation and energy after construction. Another threat of static spaces is that, given they are physically arranged according to very specific parameters, they resist adapting to other uses that may happen in the space over time. In other words, fixed spaces are often single function and usually prove too rigid. Spatial flexibility considers the capacity of change in the spatial structures of buildings both in the long-term and the short-term. Spatial flexibility is responsive to momentary changes in users' needs and wants; therefore it accommodates change in the short-term. Spatial flexibility allows unfolding of different functions within a singular space; therefore, it considers long-term change in spatial needs. In this system, the plan should be divided into spaces that change and spaces that do not. The alterable spaces are divided with the use of sliding, folding, retracting, collapsing and moveable walls that can be reconfigured and rearranged according to user's wishes. This idea overlaps with Japanese traditional housing where the large rectangular plan may be easily & readily subdivided into smaller space with different mutations possibly (with minimal effort and limited disruption). Consideration needs to be given to geometries beyond the rectilinear and to constructions beyond the orthogonal. Contemporary building technologies offer extraordinary potential.

Volume
Spatial flexibility is, traditionally, achieved in 'plan' while often the third dimension is downplayed or dismissed; however, it is essential to consider 'volume' in our approach. In other words, spatial flexibility can happen (xyz coordinates) between the levels in addition to within one level. This consideration allows for greater flexibility and considers the potentials of spatial possibilities also in the forth dimension (i.e., across time).

Flow
It is crucial to consider the flow between the spaces when users alter and adjust the spatial layouts. It is important to consider flow of space in all iterations, to delineate which space is being shared, and to pay attention to the circulation between those spaces.

Order
In a flexible plan, there should be little or no definite hierarchical order between the spaces. In spatial flexibility the focus is on the three dimensional (horizontal & vertical) organization and sequencing the spaces in a way that allows for differing compositional arrangements. The spatial order changes as the users alter the plan and volumetric configurations to match their needs.

FUNCTIONAL FLEXIBILITY
Functional flexibility refers to the capacity of the infill to allow different functions to unfold and be accommodated. The very first attempts to account for future changes in program with minimum demolishing can be traced back to Gerrit Rietveld's practice, in the 1920s. His goal was to prefabricate a block in which all the services such as plumbing, sinks, toilets and chimneys were concentrated (see Eldonk & Fassbinder, 1990) with the rest of the plan then able to be freely composed and modified. In the post-war boom the demand for social housing dramatically increased with the 'open building' movement meeting the need for spaces with functional flexibility. This was coincident with the escalating land values and scarcity of land in cities, which meant smaller and more efficient dwelling units contained in multi-residential buildings. In the Netherlands, architects concentrated on the social housing sector, which had enormous effect on the architectural development of thoughts and theories related to 'open building' and 'flexible architecture'. In many buildings of the mid-20th century, the plan was divided into equally large rooms that were multifunctional. They were bedrooms at night, living rooms in the evening and on weekends, and study areas during the day for children and teenagers of the family. Mies van der Rohe specifically studied the day and night cycles in dwellings. He was interested in the fact that diurnal rhythms affect the function of the spaces. Many architects addressed this concept by integrating built-in and transformable furniture in the buildings so that the rooms could be easily reconfigured for different purposes at different times. The functional aspect of the Support and Infill was so crucial that the form was sacrificed and standardization was inevitable. In Japan, this idea was experimented in Kodan Experimental Project (KEP). In the KEP project, the building was divided into five subsystems of: "structure, skin, interior finishes, service or sanitary systems, and air conditioning equipment" (Kendall, 1999). For each subsystem, very specific performance was defined and manufacturers were assigned to develop suitable components therein. The 300mm grid - a standard for modular coordination of building interior systems - is the product of this significant undertaking to increase interchangeability in the interface. The present paper views functional flexibility as basic to agile, mutable + appropriate Architecture.

Guideline
In the design of buildings, functional flexibility allows different activities|uses to unfold and be accommodated within the same structure with minimum amount of difficulty, disruption and demolition.

Elaboration
Functional flexibility is one remedy to confined space contained in especially small structures. In such buildings, the functions may become limited because of the spatial limitations and confinement. Functionally fixed spaces can limit the change in the program of the building over the long run. As the spaces in conventional buildings are subdivided into smaller enclosures to accommodate current functions, demolition proves inevitable to accommodate a next-generation and expectedly different program within the same structure. In our functional flexibility approach, plans|volumes should be designed in ways that are adaptable and mutable to different needs. This can be achieved by means of specific furniture|fixtures|fittings such as stackable units and reconfigurable assemblies -- space can be easily rearranged to accommodate different functions. In this methodology, the rooms can easily adapt to any future changes in program with minimum or no demolishing, as they programmatically remain neutral.

Program
Functional flexibility accommodates a wide range of programs in a singular space. This accommodation is achieved through larger divisions incorporating stackable furniture, mutable fittings, and reconfigurable fixtures. Assemblies and systems, at a human scale and ergonomically sensitive, prove central to the equation.

Productivity
Buildings with functionally flexible plans are productive as they address day and night cycles, ever-changing number of occupants, different age groups' spatial requirements and different programs' need for|of space. They promote constant & optimal usage of space, which is specifically efficient in terms of a plethora of operational considerations, such as for example energy use.

Value
Functional flexibility appreciates the users of space. It respects the dynamic nature of occupants and the fact that their spatial requirements change over time – in case of residential sector, the spatial requirements change even from day to night. Rooms designed with this mindset are bedrooms at night, living rooms in the evening and study rooms during the day. Functional flexibility also preferences value above cost; considering life cycle impacts and extending the financial efficiency and project viability beyond more conventional approaches.

AESTHETIC FLEXIBILITY
While the terms 'spatial' flexibility and 'functional' flexibility are relatively established in the OB glossary; we advocate the arrival and deployment of a third, complementary and perhaps provocative facet of 'aesthetic' flexibility. Aesthetic flexibility refers to the capacity of altering the form, façade arrangement and identity of the building. Concerns of rigidity in form and character, as well as lack of identity, were first raised as a protest against standardization and mass production in the 1960s. Hertzberger (1962) disagreed with the repetitive nature of such Architecture, suggesting that without changing such environments could not serve different functions. In his mind, the static nature of the 'support' is in paradox with the dynamic nature of dwelling. Functionally flexible design by its own cannot solve this paradox. A mindset is warranted that seeks a more intricate relation between form and function and abandons the "collective interpretation of individual life pattern" (Hertzberger, 1962). This idea reintroduces the user as an actor for whom the building should facilitate the performance. The actor should be able to determine the character of the surroundings from exterior to interior inclusive. Concepts advocated by a new generation of architects in the 1960s seem perhaps closer to contemporary and emerging approaches to 'open building', whereby widespread adaptation and 'on-demand' customization assume a paramount position. In the new approach, there are barely any fixed and static elements in the building other than the primary structure -- the new approach is more about being able to tailor the building to suit the current uses and users as well as any future changes in either or both of the two.

Aesthetic flexibility also changes the clients' roles in design processes; it requires more public participation during design phases. Future tenants, in this approach, can participate in designing the infill as well as influencing the disposition and appearance of forms & façades. This participatory approach encourages the greater regulatory milieu to reduce its role as much as possible and to let regional authorities and local companies perform to a greater extent in bona fide decision-making. Today, there are globally a growing number of projects that are far more flexible in character & expression - public participation is playing a key role in the planning and design of such projects. Advancements in technology have opened up new opportunities around this concept. The idea of 'cybernetics' and 'mechatronics' allows for highly responsive and interactive skins and infills. By the means of sensors, the responsive architecture can today more readily react to users' desires and wishes as well as responding to variable environmental conditions.

By introducing this insistent idea of 'aesthetic' flexibility the authors add another layer to the 'infill' and 'support' system. Distinguishing the exterior shell from the 'support' as well as the interior lining from the 'infill' provides the opportunity for even greater adaptability. Technically defining & designing this external layer with even more flexibility and dynamism allows users to more easily and frequently 'characterize' their environment as they desire and demand. Traditionally, this outer layer has been conceived as 'skin'; nonetheless, with the advancement of technology, this surface layer can assume and consume space, be volumized, be occupiable, blend the borders between spaces, and ultimately be far more deployable than has been conceivable to date. The authors have been testing this idea through the design of prototypes for malleable and occupiable skins – that is, envelopes which provide additional space in existing set structures for informal occupation and social interaction. The present paper views aesthetic flexibility as basic to agile, sensible + sensitive Architecture.

Guideline
In the design of urban structures, applying aesthetic flexibility provides the building with a sense of character and quality of expression that can change, that can communicate with neighbours, and that can more meaningfully animate not only interiors but equally the greater community context and metropolitan fabric.

Elaboration
Flexible design approaches of the mid-20th century, most notably developed in Europe and Asia, were successful in resolving numerous issues of housing demand that especially emerged post World War II. Flexible infill within fixed structures could reform and shift to create different spatial configurations according to users' needs and wants. The 'open concept' also allowed different programs and functions to unfold within the same structure with minimum demolition and costs. However, the 'open building' guidelines soon produced repetitive plans within monotonous structures as primary attention was paid to developing reconfigurable infills. Monotonous buildings and aggregate communities with a lack of identity are not merely by-products of 'open building' practice; in North America, for example, suburban houses arising via cookie cutter practices are undeniably boring, banal and "unidentifiable". What is common is perhaps oversimplification|repetition resulting from the need to manage complexity by limiting 'formulas' and by routinizing 'solutions'. Aesthetic flexibility envisions|espouses the capacity of change in form and façade; it brings about unique identity that can reflect the users' personalities, communicate with surroundings and activate the context. Advancements in digital technology and next generation cybernetics have now enabled extremely dynamic façades that are often married with clean energy generation techniques and sculptural shifts in form, which further rationalizes this approach. High performance skins that harness solar energy, provide shading and at the same time allow for appropriate day lighting are becoming more available|accessible. Digital façades that act as urban-scale messaging vehicles or 'building-as-billboard' attractions are a trend. Façades populated with minuscule wind turbines and equipped with LEDs and small photovoltaics contribute energy into the system while creating a more performative milieu within the city.

Innovation
'Aesthetic flexibility' deploys recent innovations in science and technology to characterize the building and provide icons for cities. We now see façades in which the automated shading apertures constantly change; not only to provide comfort for the users but also to create interesting dynamic & poetic patterns. Small wind collectors populate whole façades to generate energy while their aggregation and moving wings animate building skins. LEDs, charged via small photovoltaic cells, constantly change a building's color while proving civic destinations and popular attractions.

Interest
Creating buildings with adaptable character and expressive flexibility is of interest to many stakeholders. Not only are building users more satisfied, as they are given tremendous control to realize their preferences, but also the broader community and greater urban realm beyond benefit from the rich aesthetics and imaginative dynamism of such buildings. There are, of course, many questions raised around architectural controls, decision management, and the balance between authority|control and democracy|choice.

Balance
'Aesthetic flexibility' provides a balance between standardization of dwelling patterns and individual interpretation of living and working. Such 'aesthetic flexibility' is about 'customization' and 'design-on-demand' which is not necessarily more expensive than the status quo – such inventive systems provide remarkable accessibility and further empowerment to users. Mechanisms for customization & characterization introduce tremendous design opportunities and ensure more flexibility over time (both short and longer term).

APPLICATIONS | IMPLICATIONS

As Open Building continues to develop the authors suggest an even stronger push towards holism and integration of design, planning, site, structure, infill, inside, outside, systems, users|uses, flexibility and adaptability. Internationally, but especially within the North American context, the design + construction sectors are deeply fractured and frequently ineffective. Industry integration and design innovation must be addressed in order to advance on open building and agile architecture fronts. In the interior of buildings stable and accommodating infrastructure should allow for a diverse infill capable of greater mallability & elasticity. Such diversity affords the ability for the occupants to adapt to various lifestyles and therefore creates spaces that can be functionally flexible. Buildings should take into account different 'needs' and 'time' aspects both in terms of inhabitation & occupation and also re|assembly & re|construction. Building elements need to be clearly divided into two categories: 1. long-life elements that comprise main structures such as columns, beams and floor, and, 2. short-life elements, such as nimble walls, that shape the interior|exterior (non-loadbearing) aspects of spaces with the idea that they can be easily adjusted without disturbing the overall integrity|fitness of system. Structural components, however, need to be strategically positioned and designed in a manner that affords an optimal number of reasonably achievable interior|exterior permutations. Walls (internal & external) need to be modularized|systematized|operationalized in ways that permit deployment|redeployment within predetermined grids to meet individuals' desires and needs. While mutability of internal spaces is vital, also creating exterior walls as independent systems that can be simply reconfigured, revised and|or replaced provides users the ability to freely transform the appearance of the façade and to modify numerous qualities of space (e.g., size, views, indoor versus outdoor, look & feel, etc.).

In an effort to further define, delineate and test the present array of ideas, the authors have been exploring the physical, cultural, social and psychological implications of their framework in an array of forward-thinking, creative and catalytic projects. Through the vehicle of sinclairstudio, and the consideration of a spectrum of building types, the authors have been testing the frameworks capacity to foster changes in mindsets, methods and materials. From cultural buildings and spiritual centers to educational facilities and super-tall buildings, the authors have considered and examined how greater adaptability and agility can be realized. Within the realm of tall buildings various explorations have considered how the envelope|skin can transcend convention to serve in energy generation (e.g., micro-wind, hydro power, solar panels, nano-technology, etc.), in perceptual stimulation (e.g., skin as computer system), and in broad communication (e.g., building as digital billboard). In considering such potential, the authors have designed a prototype for a socially interactive skin that responds to the users' occupation by expanding or retracting -- as the result creating occupiable volumes for informal social interaction. This modulated system proves potentially flexible enough to be attached to existing structures, thereby adding space to otherwise existing rigid conditions. In this conceptual design and prototyping work not only are spatial and functional flexibilities considered but also and importantly aesthetic flexibility. This latter flexibility is achieved as the skin is highly dynamic and deliberate -- constantly morphing to accommodate shifting circumstances, conditions, needs and desires.

Over a plethora of different scales the authors have explored other conceptual ideas that seek a balance between spatial, functional and aesthetic flexibility. As a building's interior follows agility principles in terms of spatial and functional flexibility, on the exterior the building greater responsivity and adaptability to the immediate environment is sought via the use of kinetic energy. In the case of a super-tall tower design the tips of the 100+ story structures, in unoccupied zones, move freely with the wind to generate electricity for the building. This dynamic movement not only contributes to energy self-sufficiency but critically animates the skyline -- speaking to the capabilities of emerging technologies, to the direction + velocity of wind, but also to the power of aesthetic flexibility to redefine Architecture and the city in novel, creative and innovative ways.

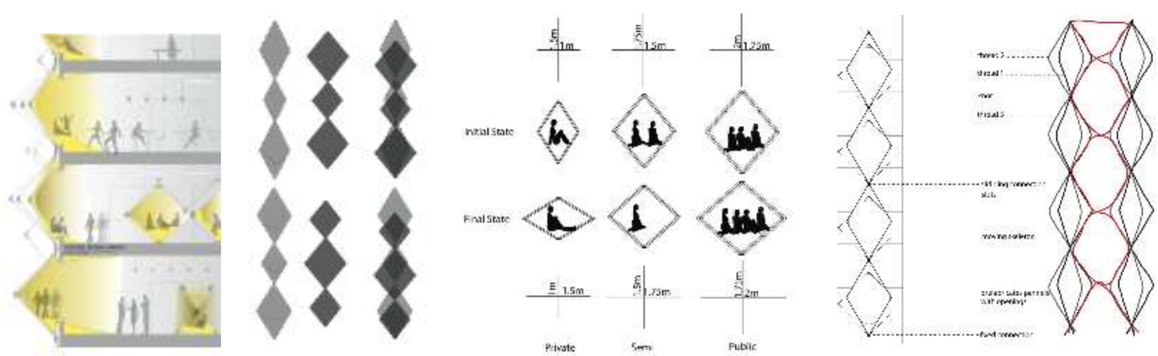

Image 3: Exploration of Occupiable, Mutable and Agile Skin

Given less than ideal efficiencies in the global building sector, coupled with the development of new theory and deployment of new technologies, the authors believe the timing is right for major advancements in open building and agile architecture. Comprehensive participation across an expanded range of a building's workings (wholly within x,y,z coordinates & over time) should lead to greater choice over spatial, functional and aesthetic dimensions and will arguably find greater resonance with occupants' needs, desires, expectations and aspirations. The present paper, and associated design framework, does not deny the long history and rich development of the Open Building Movement. To the contrary the framework acknowledges, respects and builds upon a remarkable foundation of theory, research and practice. Our framework urges a far more aggressive advancement of concepts and constructions based upon emerging technologies, changing demographics, growing expectations, concerns around sustainability, heightened open-mindedness, and absolute attention to & pursuit of systems, integration and holism.

SYNOPSIS + MOVING FORWARD

> "People are very open-minded about new things - as long as they're exactly like the old ones." Charles Kettering

Architecture in the 21st Century, a period already understood through its dramatic movement + intense change, must be far more responsive, resonant & resilient than designs for days long past. Rather than requiring users to shift, twist and surrender to fit into static environments, a new Architecture reacts, adjusts & accommodates. The present paper postulates a conceptual, conceivably contentious, framework with which to more aggressively and more fruitfully consider, create and construct such design. It aims to transition mindsets + methods of Architects + Architecture, in the spirit of the late Kisho Kurokawa, from an age of the machine to the age of life. In our proposition for reconsidered and more appropriate Architecture, people must reside centrally and the dynamic, responsive & meaningful must eclipse the static, staid & stale. Ingenuity, creativity, imagination + open-mindedness prove valuable and vital. Spatial, functional AND aesthetic flexibilities must be considered collaboratively and cooperatively as we seek more agile, adaptable, sustainable and successful buildings, neighborhoods and cities. The status quo is insufficient.

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Situation-Based Housing:
Urban Dwellings Suitable for Changing Life Conditions

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ABSTRACT
In the Nordic countries, there is a century-old tradition for dwellings that can be adapted, rebuilt and recycled regardless of time and place. Functionalism broke with this tradition and created the function-determined dwelling, which was planned on the basis of functional analyses and analyses of the average family's lifestyle. These dwellings were ground-breaking when they were built, but today are clearly a product of their time. The reaction to functionalism and the postwar mass production gave rise to flexible dwelling with possibilities for room divisions – focus shifted from functional to structural organization principles. But the housing of this period has characteristics which in the long run have proven to be unfortunate both in terms of durability and architectural quality. Today there is a focus on the development of more open and functionally non-determined housing. A number of new housing schemes in and around Copenhagen reveal a variety of approaches to these goals. This working paper reviews not only a selection of new housing types, but also dwellings from the past and new international examples, which each contain an aspect of changeability. Our study is based on information from users in the selected housing schemes, gathered from questionnaires, information about personal furnishing and zoning as well as interviews. The study is also based on analyses of the architectural configurations of space, light and materiality. Our main question is: Can the goal of architectural quality be maintained together with greater possibilities for individual development and influence?

In our observations we have found three fundamental conditions each connected to different measurements of time. The static condition of the inhabitation is constituted by the dwelling's permanent entities fitting a determined function, or by space that has the ability to embody different needs for living. The suitable condition consists of the dwelling's ability for physical displacement, spatial changes that can suit changing life styles. The situational condition is the not defined, the unfinished and the transitory, which continuously challenges the imagination and calls for the experiment. Our research results will be employed to create a categorization of housing suitable for changing life conditions and with a strong emphasis on high architectural quality. Our focus is shifting from functional to conditional in the organization principles.

KEYWORDS
typology, changeability, design tools, architectural expression

This project is a search for dwellings that can be adapted, rebuilt and recycled over time. The project reviews a selection of new Danish housing types build in the center of or close to Copenhagen, but also dwellings from the past and international references, which each contain an aspect of changeability. Our research results are employed to create a categorization of housing and spatial forms suitable for changing life conditions and with a strong emphasis on high architectural quality.

The research question is: What does the dwelling do to you – and what do you do with the dwelling? The hypothesis of the project is that a more distinct architectural form - unbound to function and meaning of home but to meanings of architecture in it self and to movements in space - can provide an open form in which the goal of the architectural quality can be expressed. And this generates greater possibilities for individual development and influence, spontaneous activities and needs arising from today's changing family patterns. The hypothesis connects an architectural view to an anthropological one and opens to a third view, a philosophical one: the open work.

THEORETICAL LAYOUT
The architectonic view is based on the artistic experiences of Peter Zumthor about the special character and possibilities of architecture. That the architectural work has a weight established by the process of creation, the materiality and durability. This weight can put up a resistance to - and basis for - the transient and picture dominated life of the post industrial communication society.(1) In these experiences concepts are laid out about the artistic search such as envelope for life, the sought-for object, inner tension, desire and consciousness of time - deep melancholy.

The anthropologic view is based on the theory of Bror Westman about how the movements of the dwellers - to, from and inside the home - constitute an understanding of the dwelling as a special place, the home. A home consists of happenings taking place – around and inside the dwelling. Repeated movements between these places can over time produce a cultural value.(2) In this theory structural concepts are laid out such as place, boundary, movement and ritualizing, symbol, reproduction and cultural variation.

The philosophic view is based on the theory of Umberto Eco about the open work, formulated on studies of modern instrumental music - compositions assuming the interpreter to intervene and decide some characters in the form of the work.(3) In this theory are structural concepts laid out such as combined structure, montage, duration and a field of possibilities to choose from.

In an interview the Japanese architect Toyo Ito has given us a poetic expression of the links between the three views in an iconic drawing and explanations of the traditional Japanese house: the deep melancholy of the architectural concept, the ritual movement and the field of possibilities for personal expressions of the dwellers. The drawing shows the movement from the balcony, through the paper doors and back to the balcony symbolizing the movement from birth to death. The movement is layering visual impressions on different scales and concepts of time such as garden views, wall paintings and the combined decoration of an ikebana and a paint roll – this combination in itself a picture of personal moods, the shift of season and the devotion to nature formed in the artistic composition and choice of flower material.

CONCEPTUAL LAYOUT

The study Situation Based Housing (4) is based on information from users in three housing schemes, Pærehaven, Fionia-House and M-House gathered from questionnaires, drawings and photos done by the users as well as interviews. The study is also based on analyses of the architectural configurations of space, light and materiality: Is the architecture setting a stage for an unexpected creativity, or for a relatively predictable arrangement?

The interview technique is qualitative, and we have emphasized the interviewer as a traveler (Kvale, 1997). The dwelling is seen as the frame around everyday life and exists as its own self-contained culture, with its own aesthetics, symbols, ideas and possibilities for expressivity. Questions are asked that stimulate the dwellers to tell their own stories and describe their life. The interviews are supplemented with drawings and photos done by the dwellers, telling stories about changes, personal furnishing and priorities in their organization of the dwelling.(5)

The architectonic analysis of the housing schemes characterizes the morphology of the building form and the relations of the dwelling, defining the possibilities of zoning and spatial configuration – open or closed, access, light and view.(6) In the scale of the dwelling we focus on the flexibility of the structures. The form of organization, alternative positions of the walls and lighting conditions are examined. On the basis of the research question and the cases we have developed of a model of analysis characterizing the dwelling in time and space.

In our observations we have found three fundamental conditions of time. The static condition of the inhabitation is constituted by the dwelling's permanent entities fitting a determined function, or by space which has the ability to embody different needs for living. The suitable condition consists of the dwelling's ability for physical displacement, spatial changes suiting changing life styles. The situational condition is the not defined, the unfinished and the transitory, which continuously challenges the imagination and calls for the experiment.

The condition in space is regarded as a series of dichotomies involving:

- Planes - the space's form as opposed to the furniture's spaces, zones, hierarchies and domains
- Volumes - the core's form and placement as opposed to the storage space
- Walls - openings in the outer walls, the light and the view, as opposed to the dividing walls' form and utilization
- Lines - entrance rooms and axes as opposed to movements and points of focus in the room's use.(7)

The three by four concepts form a "field" of themes. Some of these themes include special possibilities and problems in relation to the hypothesis of the project. Based on findings and interviews in the cases, we comment on - and develop - this further in the following text.

LEARNING FROM COPENHAGEN

Pærehaven: Settlement as a dynamic project

The dwellers of Pærehaven are energetic; don't talk much about identity, but about their own efforts in the establishment and the importance of social life in between the dwellers. Most of the dwellers have an average income and regard the settlement as a dynamic project:

> "I believe the site will be very attractive, also because there are many young people out here. Of course there are also some elderly people, but we all talk to each other. You must be kind of social. Naturally you can close the door, but many people are strolling around out there…"

The dwellers are born and grow up in the local region. It's not their first own dwelling, ages are between 28 and 38, singles or couples - some with children and several have a craftsman-like experience.

The relatively cheap dwellings have motivated the buyers, allowing a possibility for a new beginning and a private ownership – even with a single income. In average 20–30.000 Euros are invested to complete the dwelling.

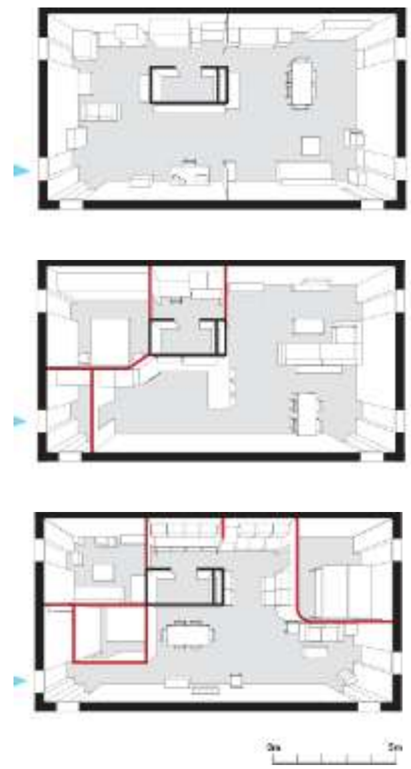
Almost all of them have replaced the kitchen unit with a much larger kitchen – and dreams are lived out in the kitchen design - it's the focal point.

The inner space of the dwelling is designed as a basic, loft-like space of 12 x 6,5 m with a free standing bathroom core and a basic kitchen unit. The space has a classical, introvert character with defined corners, large planes of walls and narrow openings formed as doors symmetrically placed in the corners. The walls are bill boards for the life and history of the dwellers, and time in the dwelling follows the rhythm of the human generations.

The space is not separated in zones for living or bedrooms. But when separated with interior walls the situation calls for transparency and zones connecting the different relations in the surroundings. Access is from open balconies forming small terraces in front of the dwellings. Materials and details are simple, well formed but of short-term durability.

The research documents a general lack of spatial quality in the organization of most dwellings, and many are not organized according to fundamental building regulations. The design is lacking basic conditions and guide-lines - the dwellers are seen to be "lost in translation" of the architectural possibilities and have little or no support at all in the process:

> "Things just happened, we didn't exactly think about it - except that I personally thought it should be different from all the others…"



A few households typically with one or two inhabitants keep the dwelling as an entity with one room, leaving the core as a free standing element on the plane. The movements are forming clear lines from entrance leading to the light of a window, a parallel line behind the core from a window to a window and a circular movement around the core. Spatial divisions are formed as semi transparent set pieces of textile or shelves. In these cases the architectural articulation of the basic space is well expressed, daylight is sufficient and differentiated, and the horizon can be perceived. As well the static, suitable and situational condition is present in the architecture. But the volumes offer problems. The bathroom core dominates although it's intimate content, and contests the validity of the informal attitude to living presented in many dwellings. The volumes for storage are typically lined up along the closed wall, but an architectural order and integration of these functions are missing. In these - as in all the flats of Pærehaven - dwellers are left on a tabula rasa regarding the essential function of storage.

However most of the households have divided the space into a living space and one or more bedrooms. In a few dwellings we find a well organized hierarchy of spaces – and even a few examples of innovative strength. But in most of the dwellings severe problems are presented in the space proportion and lines of movements - circulations are cut and the ability for furnishing and lighting is poor:

> “The most difficult is how to break up the long space … to make it evident to us that we have an entrance hall here, a dining room and a living room - connected but divided. We wanted the scenic effect, starting in the narrow and then widening out…”

The problem is the 6.5 m basic width of the space, too narrow for a living room and a bedroom side by side.

> “The spaces are organized according to the furniture I wanted, and where they should stand”.

The daylight of the inner zone of the dwelling is very bad when dividing walls are established, and space for storage is reduced to an unacceptable minimum:

> “This thing about light… it’s really, really difficult for me, I really need light… I can really go crazy. I put on the light as soon as I get up!”

The dwellers ability of to conceive space is much differentiated. For some the starting point is their need for bedrooms, others rely on intuition. Some are copying the neighbor’s way of furnishing/organizing – and some are doing the direct opposite. A few have the ability to design well proportioned spaces and to clear flows of space, but most are lost. They are all fighting, capitalized by the builder and pressed by the housing market.

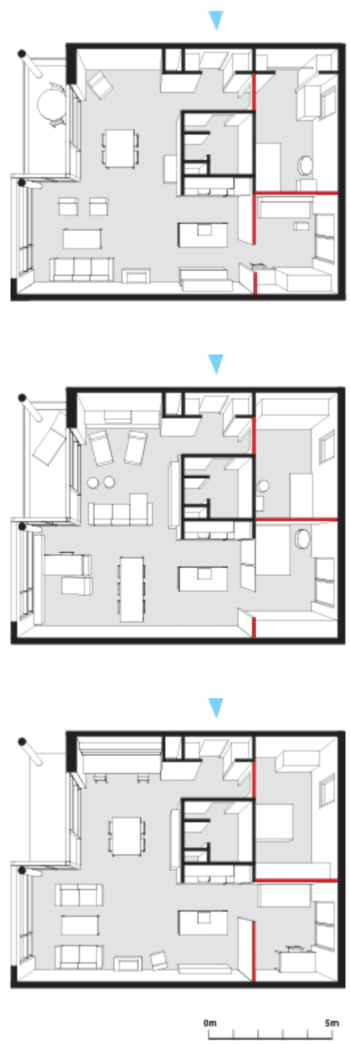
Fionia-House: Settlement forming identity
The dwellers of Fionia-House are mostly young couples with a baby or expecting parents. Some are elderly couples, with an income over average. They have achieved the frame of life, they dreamed of. Focus is on quality and safety. They feel trendy to live here, expecting good finish and durability – and don’t want to spend time or energy to complete the dwelling. The dwelling is spacious, tidy and functional:

> “To me it is a kind of identity - I want the dwelling to reflect who I am. It must be new, white and clean, and things put up systematically.”
> ”... and you can’t hear… not because, it’s fine when you live in the city, you know you have people around. But you can’t hear them argue upstairs, or smell what they are cooking for dinner next door. And it is actually cool – it’s private you could say.”

Some have moved in to the city from the provinces. They expect to live here for a few years and then move to a single family house in the suburbs. The dwelling is an investment for the future.

> ...I think it’s a fancy house – nice bricks and so... I also think, the materials are top quality, except we don’t know anything about this....... of course it means something to have made the investment. It offers security…”

Fionia-House is structured by short blocks in an undivided landscape – a park estate interpreting a modern tradition. The dwellings are flats in one floor, extrovert with a clear orientation to the sunny side with glass from wall to wall and smaller windows to the back.



The dwellings are an open plan, zoned between two closed walls in a spacious living room towards the view and a more intimate zone to the back – organized hierarchically in scale from inside out. In between these two zones there is a third zone with a lower ceiling height including a bathroom core, an open kitchen and an entrance hall. Access is in the middle of the block from a staircase to the hall.

Movements are clearly organized along the core, and from the back passing the darker zone in the middle to the light of the front and the infinity of the horizon. A private balcony adds a fourth room to the sunny side of the dwelling. Materials and details have strength and are of high standard.

The dwellers see the quality of being together in the open living room - you feel the human presence and have control:

> "We give more space to each other... you can see all of it in one glimpse."
> "One of the reasons for having it in one big space is that, what ever we do, when we are at home, we are together."
> "If we had three living rooms en suite and a kitchen, it would end up with one sitting here and the other sitting some where else."

The architectural articulation of the space is well expressed, daylight is sufficient and differentiated, and the horizon can be clearly perceived. As well the static, suitable and situational condition is present in the architecture of all dwellings. The view is splendid - you don't need the television at all. The walls are of less importance – typically bare. Time follows the rhythm of the day and seasons. The dwelling represents an individual world, from which you can meet the city:

> "It is the light and air… a lot to look at… life and light. On the other side, you have the Metro. Even if the apartment is not so big, you have an incredible width, because you can look out even in the evening."
> "… we look at the sky almost every morning… have got the nature closer."

The dweller has got an open plan with well known and defined possibilities for separations. All the dwellings are organized in the same way with small differences in - and attention to - the details. In all the dwellings there are two bedrooms separated from the kitchen and entrance zone with additional walls. The positions of the openings are varied, but typically badly positioned in regards to lines of views to the windows in the back. The materials and colors of the kitchen elements offer a choice between three design lines.

The original architectural design showed a storeroom integrated in the whole length of the two closed walls to the neighbors. This would have opened up for an even greater freedom in the organization of the flat. It has since been reduced to minor storages integrated in the wall along one of the bedrooms and the hall. This is typically supplemented with use of the balcony for storage and free standing closets in one of the bedrooms creating furnishing problems here.

M-House: Settlement as an open challenge

The dwellers of M-House are young, smart and ambitious, age around 35. Above 45 you are regarded as being old. Income is above average and rising. They have been looking for something different – a little below market prize:

> "… right now we want something a little funny to live in. That is more important, than if it is practical. The focus of our parents is very practical. We just want something funny, and we can just move, if we get other needs…"

The dwelling is for show. It is often arranged without walls at all in a complete transparent frame for life between the glass facades. When you are inside, you are simultaneously outside – in the mono cultural city and until now a very quiet urban space. The diversity only exists in the plane of the glass.

The dwelling is a scene - reality is becoming an image. You are exposed and positioned freely in the dwelling, floating, looking up for the challenge of the edge, the light – and for a pullback. The mirror of the glass melts into an image of a shuttling metro in the horizon - a timeless synchronism in the present:

> ”We look forward to a thunder storm - have been talking about this for a long time, but still it has not happened. Then we would sit in the sofa and drink red wine and look at the storm.”

M House is structured by short, folded blocks in an undivided urbanized landscape – an urban park estate. The dwellings are flats in one, two or three floors typically with great depth, stretching out between the opposite facades between two closed walls to the neighboring dwellings. Some dwellings are partly completed or completed entities with closed walls on three sides:

> “Something is happening where ever you turn to… in other apartments, you look into the walls – and have to make the walls interesting. Here we have the windows. And we didn’t hang anything on the walls – there is a lot to look at.”

Access is in the middle of the dwelling is from an internal corridor, crossing the building on every third floor. There is a private balcony is on the sunny side.
The inner space of the dwelling is not separated in zones, but in several places of the dwelling the complexity and displacement of the form opens for a flexible organization of living spaces or more intimate spaces.

Some have put up a single wall, often transparent. The movements in space are narrative and opens to differentiated views in terms of volume, light, internal and external relations.

The problem of the dwellings is the crossing lines of access and movement in the interior, limiting the possibility of furnishing – and the difficulty of finding privacy, if you wish:

> “It took a long, long time to decide… we wanted to keep the openness upstairs…I believe, we have decided more than seven times that the bedroom should be at the other end.”

The dwellings are architecturally well expressed with independent layers, sequences and cuts: load bearing heavy constructions, walls, facade elements and complementary elements of great simplicity like internal stairs and kitchen. Bathrooms and storage are hidden away in recesses of the form. It can be seen as a kind of arranged and re-arranged expression of the computerized process – a bricolage. The walls, floors and sometimes even the ceilings are subsequently furnished by the dweller to express a certain importance and a character of a site in the dwelling – often followed by a scenic lightening. In this way all three conditions - the static, suitable and situational condition are present – or even called for in the architecture.

CONCLUSION
The project is pointing out qualities and problems in the three Copenhagen cases to be considered for future research and planning of dwellings with open possibilities for interpretations of form and meaning. Focus is on materiality and durability, movements and volumes and on architecture with a stringent and readable architectural language as well in the static, suitable and the situational condition. Problems are related to the use of poor and vulnerable materials, large dept of buildings and consequently bad lighting conditions – and to limitations for furnishing due to unclear zoning and bad access to - and movements in – the space. The examples document a basic contradiction to be solved between the wish for general openness and transparency in the architectural space and the need for functional definition of space and privacy. A few dwellers meet the challenges of the open space and are lacking the guidelines and an architecture, which is prepared for this. This is further developed and discussed in relation to examples from the Nordic building culture and international architecture focusing on conditional based organizations in the spatial layout and understanding of housing architecture.

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Flexible Building:
A Response to the New York City Building Boom

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ABSTRACT
During the building boom and coincidental rezoning of much of New York City from 2003-2008, 20% of property zoned for manufacturing was converted to residential, commercial, or mixed use. The logic was simple – the property was worth more in the current market as a new use than as manufacturing, and within 5 years the conversion would reap large financial benefits. In the latter stages of this building boom, however, there was a growing indecisiveness of many property owners in committing time and money to fringe properties – parcels that were in neighborhoods either predicted to be on the upswing or neighborhoods anticipating rezoning. This bred an interest in a new building type, the flexible building. It was an indicator of a shift in thinking about property value from short term return to long term potential. To realize this, the planning flexibility of the structural frame became the guiding factor, maximizing cost efficient use of material with a frame spacing that allows for various configurations of space according to use. The trend in New York City has been for manufacturing buildings to be torn down and replaced; in this case the transformation will be relatively simple and efficient, with the flexibility allowing the building to respond to varying markets and possible futures.

KEYWORDS
Flexible, Zoning, Multiple-Use, Structure

SITUATION
During the building boom and coincidental rezoning of much of New York City from 2003-2008, 20% of property zoned for manufacturing was converted to residential, commercial, or mixed use (Fig.1). The logic was simple from the point of view of the city – there was a great need for additional housing - and from the point of view of the property owners as well: due to poor tax incentives and cheaper rents in more suburban areas, the flight of manufacturing had been steady since the early 1980s. The property was worth far more in the current market as residential use rather than as manufacturing, and within 5 years the conversion would reap large financial benefits.

The building stock that fell under the rezoning was typically of lesser quality and thus inherently disposable. This disposable market drove a trend for the new buildings to be constructed for a single use for immediate short term market efficiency. These buildings were equally disposable as the ones they were replacing. This one-way programming decreased the future flexibility of the building, and ultimately, of the city itself. In the latter stages of this building boom, however, there was a growing indecisiveness of many property owners in committing time and money to fringe properties – parcels that were in neighborhoods either predicted to be on the upswing or anticipating rezoning. This indecisiveness grew out of the increasingly flooded market and fear of lengthy holdups in the rezoning process. This included those properties where the buildings would have to be torn down rather than reused.

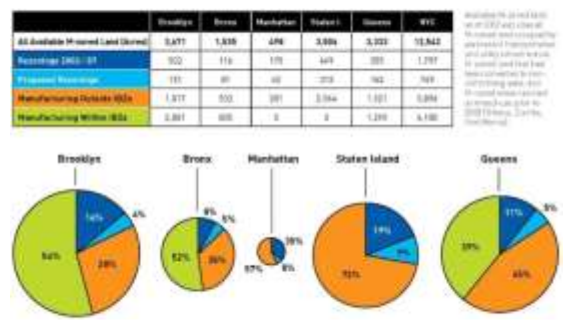

Figure 1: Rezoning of Manufacturing Land (from Pratt Center Issue Brief)

Shortly after the enactment of the 1961 New York City Zoning Resolution, the fringe areas of Brooklyn, and in particular Greenpoint, have seen a consistent reduction in manufacturing bulk and property. In particular, the encroachment of special use districts allowed a variety of non-manufacturing uses in M Zones as early as 1981. Given the increased concerns of the city with waterfront access and the connectivity between the Mixed Use Zones of Long Island City and Greenpoint, there was strong belief that inevitably all the M zoning there would change. (Fig.2)

BOX STREET
41 Box Street, a small manufacturing property in northern Greenpoint, was caught between this shift in the zoning. What becomes clear from looking at the changes in the city zoning is that properties in fringe areas beyond special overlay zones were being used as buffers for newly established zoning districts from the manufacturing zones. In the context of the fifty years of zoning changes, 41 Box Street will inevitably become zoned for more than manufacturing. The decision by the owner, a successful plumbing contractor, to go forward with a flexible building type was an indicator of a shift in thinking about property value from short term return to long term potential, especially in light of the neighborhood changes driven by zoning. The site and the adjacent properties

had gone from a single zoning designation, M3-1, to include M1-1, M1-2, R6, and MX within the span of fifty years.

1961

2008

Figure 2: NYC Zoning Maps, 1961-2008, with black dot indicating site. Note the influx of special districts (grey hatch) and residential zoning (R), reducing the manufacturing zones (M).

The Block Building, designed and built from 2006-2008, was made with the future potential in mind, while keeping the present use operational. The building massing would not exceed the M1-2 manufacturing bulk (FAR=2.0) because one could not be certain of changes to the zoning map; however the way in which the bulk was realized was considered "use flexible" to allow for easy transformation to housing, live/work, or conventional office space. Each of these programs was either already a possibility under the existing zoning (M1-2) or was possible under rezoning being implemented on adjacent blocks (R6, MX).(Fig.3)

STRUCTURAL RESPONSE

Zoning considerations are one aspect of building design, but the New York City Building Code has vastly different structural parameters for different uses. These became the guiding factor in the next stage of development for the building. The most telling difference is to the uniform live load and the concentrated live load. Residential use requires 40psf/200psf, while manufacturing requires 100psf/2000psf. The difference, a factor of 2.5 and 10, was further exacerbated by the need to have the ground floor continue to function as a plumbing contractor facility during the construction. Additionally, the arrangement of columns had to allow for the potential of parking for both the plumbing contractor and the residential component in the future. (Fig. 4)

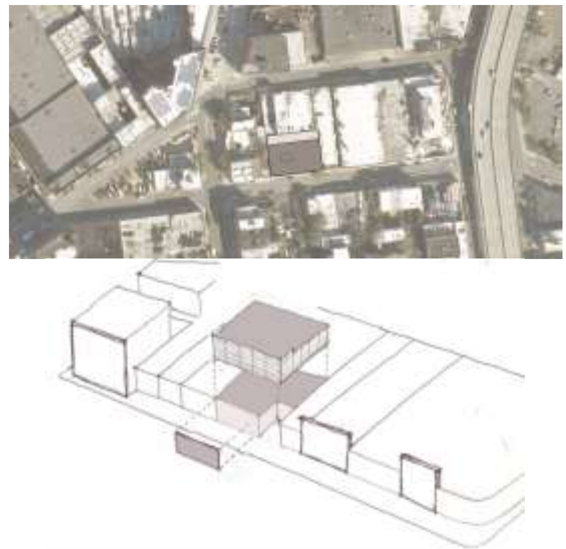

Figure 3: Aerial view of 41 Box Street and concept diagram of addition

The steel frame inserted into the existing one story masonry structure was optimized to elaborate this potential. The columns all align on the east-west structural bays of the building, engaging existing bearing walls; for the parking level we relied on these bearing walls to give the frame stiffness, minimizing steel and its expense. (Fig. 5) The column grid was located to allow a maximum number of parking spaces to minimize the difficulty and cost of off-site or on-street parking for the vehicles of the plumbing contractor. This grid also allows for various scenarios of parking requirements for the future use, accommodating the potential mix of plumbing contractor vehicles and vehicles for the residential and office spaces above.

In its current configuration, the manufacturing continues to operate on the ground floor while the upper floors are rented as office and commercial spaces. (Fig. 6) The W12x65 columns were sized to meet NYC Building Code impact requirements. In each east west structural bay, an additional 18" beam is brought in to assist the load transfer of the addition above and to stiffen the 16'-0" columns which were not simple extensions of the column grid from above.(Fig.7) Above the parking level, the steel frame became an equal bay structure 24'-0" x 20'-0", the first level beams are W24x44 and the rest are W18x35. The columns remain W12x65, and are 10'-6" high. (Fig.8)

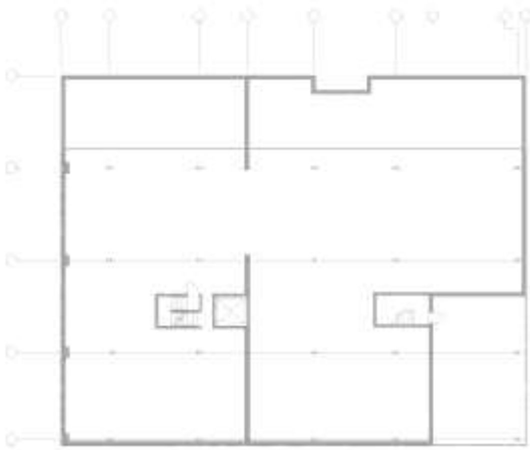

Figure 4: Ground level structural plan

Figure 5: Steel Frame at ground level

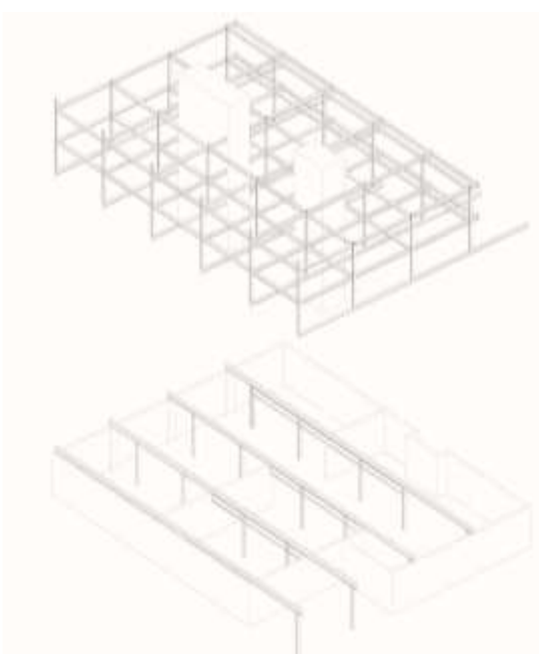

Figure 6: Two Steel Frame Systems

Figure 7: Images of the Frame above and below

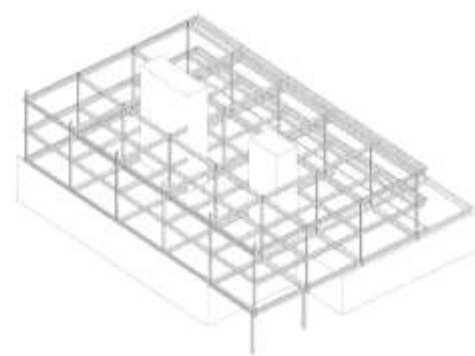

Figure 8: Two-Story Steel Frame on Base of existing building

Within this steel frame, one could easily place a more conventional metal decking that would need 48" o.c. spacing to support the deck. We used 16" o.c. Metal C-channels, 3.125x12". (Fig.9) This construction was easier and cost only 5% more, but met the structural requirements of both the residential and manufacturing uses. This "overstructuring" opened the door to meeting with the code requirements of multiple uses and adding a layer of flexibility and potential to the building for the future.

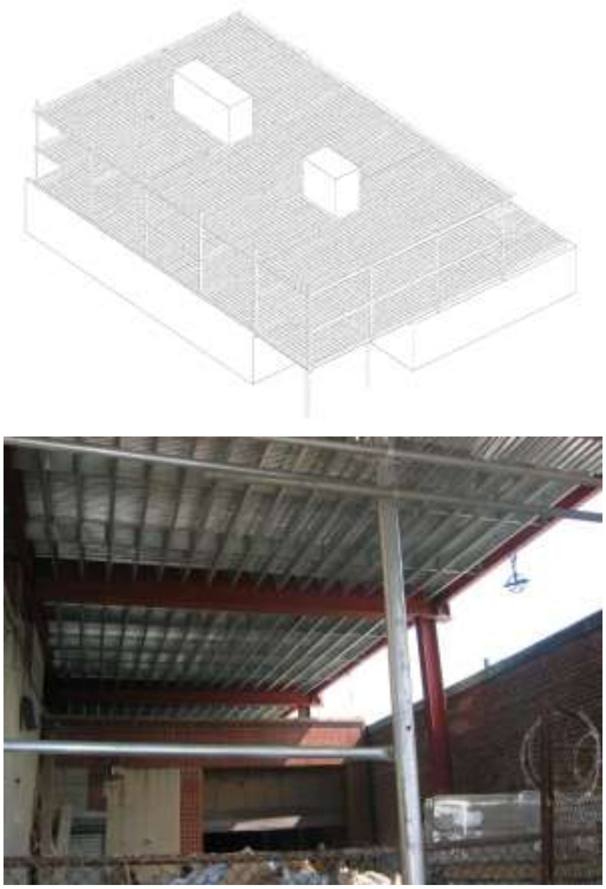

Figure 9: Axonometric of Steel Frame infill and photographs

SPACE AND USE
Two planning modules are possible within the structure and enclosure of the building, and each allows for a variety of functional development possibilities. The minimum office size is 500 sq. feet within the 12'-0"/12'-0" planning module, while the 7'-0"/10'-0"/7'-0" planning module allows rooms to achieve minimum bedroom widths required by the Multiple Dwelling Law. This enables a variety of conversion possibilities to housing should the predicted rezoning take effect. (Fig.10)

DETAIL AND SYSTEMS
In principle, the simplest conversion means no substantial change needs to take place to the floors and they can be subdivided into a variety of single floor 1 and 2 bedroom units. The implemented joist subdivision, however, allows the plan to be converted into duplexes with easy removal of the floors in specific areas. (Fig.11)

Kitchens and baths must be located in the area immediately adjacent to the central hallway, minimize horizontal piping distances. This 6'-0" wide zone on either side of the central hall to. All vertical venting occurs within the hallway walls to the roof. The zone of the floor structure is understood as belonging to both the tenant below and the tenant above, allowing for individual variations of conditioning and plumbing equipment.

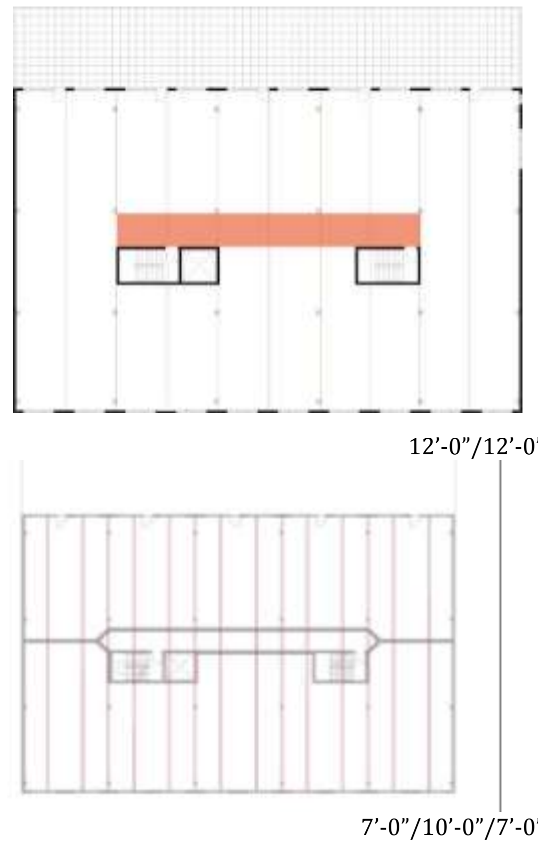

Figure 10: Planning Modules of the Building

BUILDING EXTERIOR
As noted above, the subdivision of the façade allows for the 24' east-west bay to be subdivided into 2- 12'-0" modules or 7'-0"/10'-0"/7'-0" modules. This mirrors the modules articulated in the building plan. (Fig.10,11) The fiber-cement board panels provided the fastest and most inexpensive rain-screen cladding system. A result of the requirement to have the building be rentable floor space and/or residential, the character of the building - visible from the bridge between Greenpoint and Long Island City - made it necessary to consider the façade as more than a problem of inexpensive cladding. The fiber cement board system, as organized, was equal in price to a conventional (and standard for new residential buildings) EIFS cladding. The inexpensive cladding

allowed for the addition of the solar awnings to the south façade. These became a recognizable element for the building which was repeated at the building entry. (Fig.12,13)

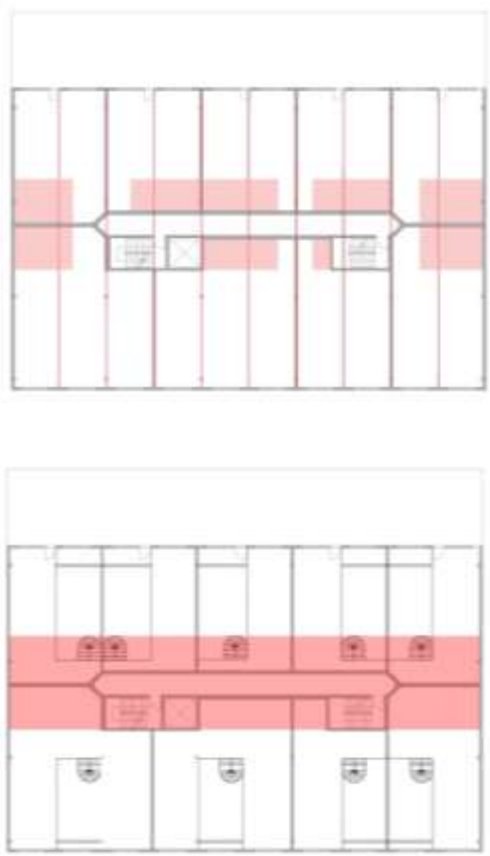

Figure 11: Simplex and Duplex Apartment subdivisions with wet areas.

CONCLUSIONS

The idea of designing a predictive building, rather than a reactive building, is critical to understanding how decisions are made by clients and the city. In the end, this is a simple, straightforward building. The larger intention was to build in the potential to react and respond to change without making such possibilities unaffordable in the long term. Simple devices – the efficient steel frame, the crude and oversized floor framing, and the sensitive façade organization – allow for easy adaptation while establishing building identity. These all become another way to give a simple building value. This building gains value not only because of its unique aesthetic qualities but because of the unrecognizable ones as well. (Fig.13)

Historically in New York City, the process has been for manufacturing buildings to be transformed into housing with difficulty or simply torn down and replaced; in this case the transformation will be relatively simple and efficient, with the built-in flexibility allowing the building to respond to both the varying markets and possible futures.

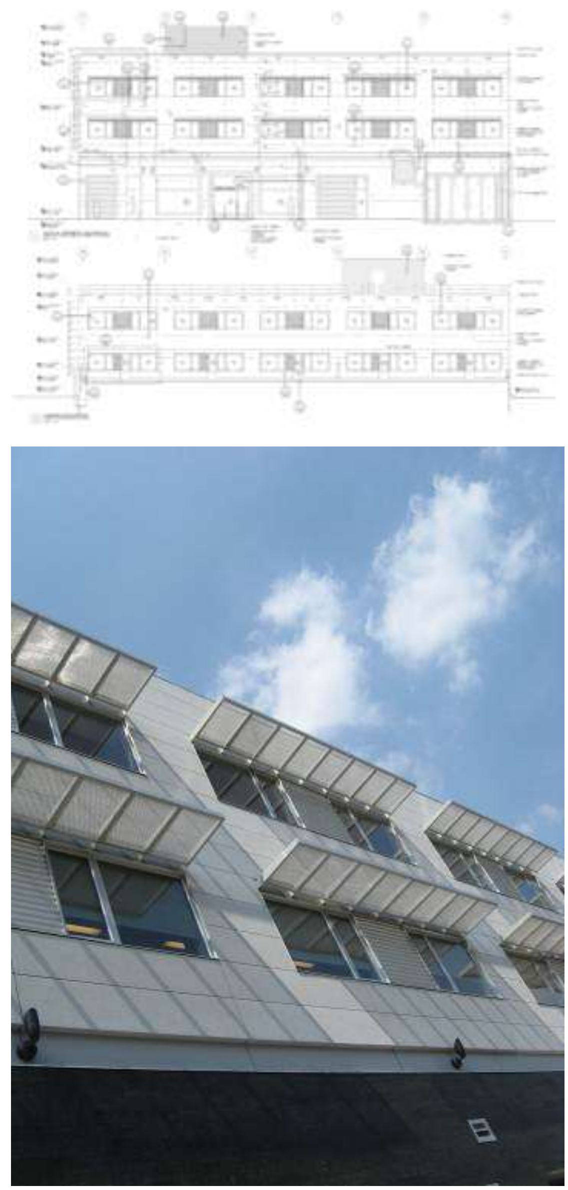

Figure 12: Elevations and Solar Awning

Figure 13: Photographs of completed building

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How Dwellings Expanded: Case Study on Dojunkai Wooden Multi-Family Houses in Shin-Yamashita

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ABSTRACT
This paper conducts a case study on Dojunkai housing complex in Shin-Yamashita, Japan, and clarifies how the dwellings expanded by residents' additions through years. Shin-Yamashita houses were built in 1924 on a manmade land in Yokohama bay area, which included 61 wooden two-story multi-family houses (280 units), composed of 18 six-family tenement houses (108 units) and 43 four-family semi-detached houses (172 units). The latter was a unique type for this project, which had 2 units sitting on the 1st floor and 2 units above them. All these were developed as social houses to recover from Kanto Earthquake, and were sold to the residents by lot after the World War II. The acquisition of home ownership led the residents to make additions in need of better living conditions.
This study, based on document examinations, analyzes spatial transformation of Shin-Yamashita houses after the sale of town.

KEYWORDS
Dojunkai, addition, territorial control, room layout, changeability and stability, homeownership

INTRODUCTION
What are Dojunkai wooden multi-family houses in Shin-Yamashita?

Dojunkai was a foundation to afford a series of social houses as to recover from Kanto Earthquake in 1923. As one of its projects, wooden multi-family houses were developed on a manmade land in Shin-Yamashita, Yokohama bay area in 1924. (Figure 1) In this project, 61 buildings (280 dwelling units) were constructed in total, which included 18 six-family tenement houses (108 units) facing main streets and 43 four-family semi-detached houses (172 units) behind them. The latter was a unique type for the project, which was composed of 2 lower units on the 1st floor and 2 upper units sitting above them and having entrance and toilet on the 1st floor. (Figure 2) Concerning site planning, buildings were placed back-to-back to surround common backyards. (Figure 3) All these were built on a land that Dojunkai leased from a private firm.

One of the most significant events for the neighborhood afterwards was sale of houses in 1951. Dojunkai properties were disposed of after the World War II, and the residents acquired each unit by purchase. However, they did not go to a consensus with the landowner over land purchase. Then, Shin-Yamashita houses came to be owner-occupied properties on a leased land (Morita et al., 2000, 2001).

The acquisition of home ownership led the residents to make additions in need of better living conditions (Matsuura et al., 2010). (Figure 4 and 5) No rules and regulations had been formulated for additions, and the residents enlarged original units in each manner, in each allotment of site. In case of four-family semi-detached houses where units adjoined vertically, case-by-case agreements were made between the lower and the upper units. Rebuilding have been the only to be prohibited by the landowner.
As a result of unregulated additions over time, the built environment in Shin-Yamashita had became over-crowded, and Yokohama city launched redevelopment project of the whole area in 1990.


Figure 1: Aerial view of Shin-Yamashita houses (1924)

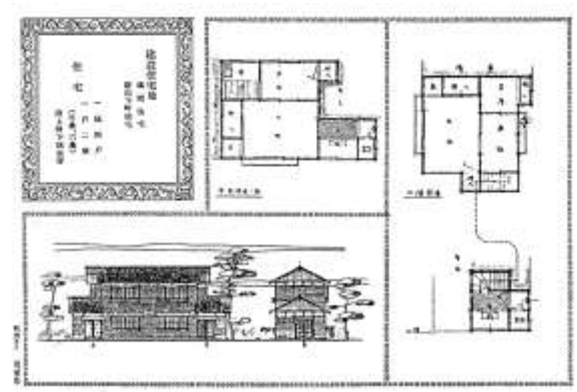
Figure 2: Four-family semidetached houses

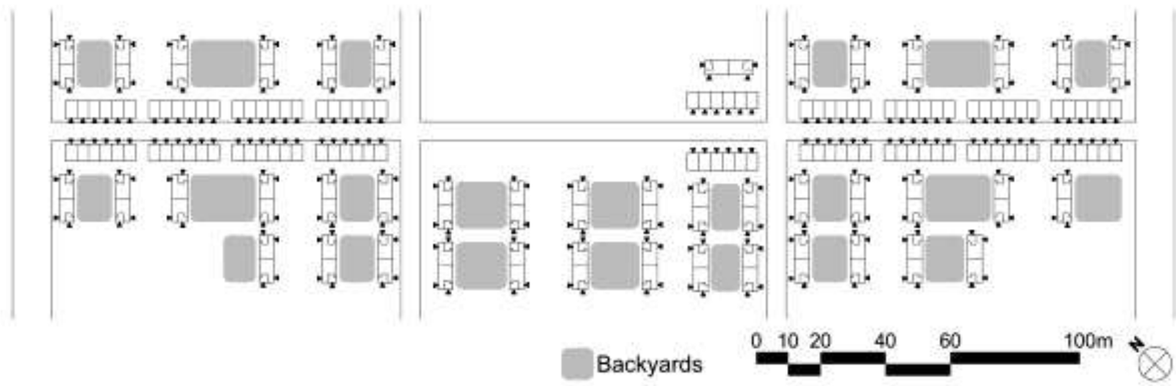

Figure 3: Original site plan

Figure 4: Six-family tenement houses facing the main street (1999)

Figure 5: Shin-Yamashita houses over-crowded with additions (1999)

Study purpose and methodology

This study aims to analyze spatial transformation of Shin-Yamashita houses after the sale of town. The study is based on document analyses of records showing each eventual floor plan which the City collected for the redevelopment. The questions are as follows:

1) How large the dwellings expanded in each building type?
2) How the dwellings enlarged territories between adjoining units?
3) How stable the original layouts were?
4) How homeownership affected dwelling expansion?

HOW DWELLINGS EXPANDED?

How large dwellings expanded?

Figure 6, 7 and 8 show eventual floor plans in 1990. There are no original units without additions, and the yards were mostly filled with building expansions. All additions were built in wooden structures, and most of them followed a conventional modular system on a grid of 910mm square as well as the original buildings.

Out of 80 four-family semi-detached units traced, 10 units were combined into 5, and 4 were rebuilt. Similarly, out of 32 six-family tenement units, combination was found in 6 units (combined into 3), and rebuilding was found in 1. (As previously mentioned, rebuilding was not allowed by the landowner.) Additionally, 6 freestanding units were newly built on vacant space.

Table 1 indicates the increase in floor area per unit by building type, which excludes combining, rebuilding and new units. The upper units of four-family semi-detached expanded 1.5 times as large as the original floor area in average. In case of the lower units of four-family semi-detached and six-family tenement, the extent of enlargement was almost twice as the original.

By room usage, the most increase was seen in 'living room and bedroom' in all types. The most double increase in 'toilet and bathroom' is supposed to be mainly due to bathroom additions that the original units did not have.

For four-family semi-detached houses, the upper units made additions both on the 1st and 2nd floor, whereas additions of the lower units were mostly limited on the 1st floor.

Table 1: Increase in floor area per unit by building type (m2)

		Four-family semi-detached								Six-family tenement (N=25)			
		Upper unit (N=33)				Lower unit (N=33)							
		Original		1990's		Original		1990's		Original		1990's	
Living room and bedroom	Total	15.7		23.2		15.7		29.2		21.5		33.2	
	1F 2F	0.0	15.7	3.1	20.1	15.7	0.0	26.6	2.6	11.6	9.9	13.0	20.2
Entrance, inner terrace, corridor and stairs	Total	6.6		8.6		3.3		7.6		5.8		9.5	
	1F 2F	5.0	1.7	6.5	2.2	3.3	0.0	7.2	0.4	4.1	1.7	7.1	2.4
Kitchen and dining	Total	3.9		5.5		3.3		7.0		1.7		8.2	
	1F 2F	0.0	3.9	0.2	5.4	3.3	0.0	6.7	0.3	1.7	0.0	7.9	0.3
Toilet and bathroom	Total	1.7		3.0		1.7		3.4		1.7		3.5	
	1F 2F	1.7	0.0	2.9	0.1	1.7	0.0	3.4	0.0	1.7	0.0	3.3	0.1
Closet and storage	Total	2.5		5.2		2.5		5.6		2.5		5.4	
	1F 2F	0.0	2.5	1.2	4.0	2.5	0.0	5.2	0.4	0.8	1.7	1.7	3.6
shop and work area	Total	0.0		0.0		0.0		0.7		0.0		4.0	
	1F 2F	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	4.0	0.0
Total		30.4		45.6		26.5		53.5		33.1		63.7	
1F	2F	6.6	23.8	13.9	31.7	26.5	0.0	49.8	3.7	19.0	13.3	37.0	26.7

Figure 6: Floor plans in 1990's (north-west part)

Figure 7: Floor plans in 1990's (middle part)

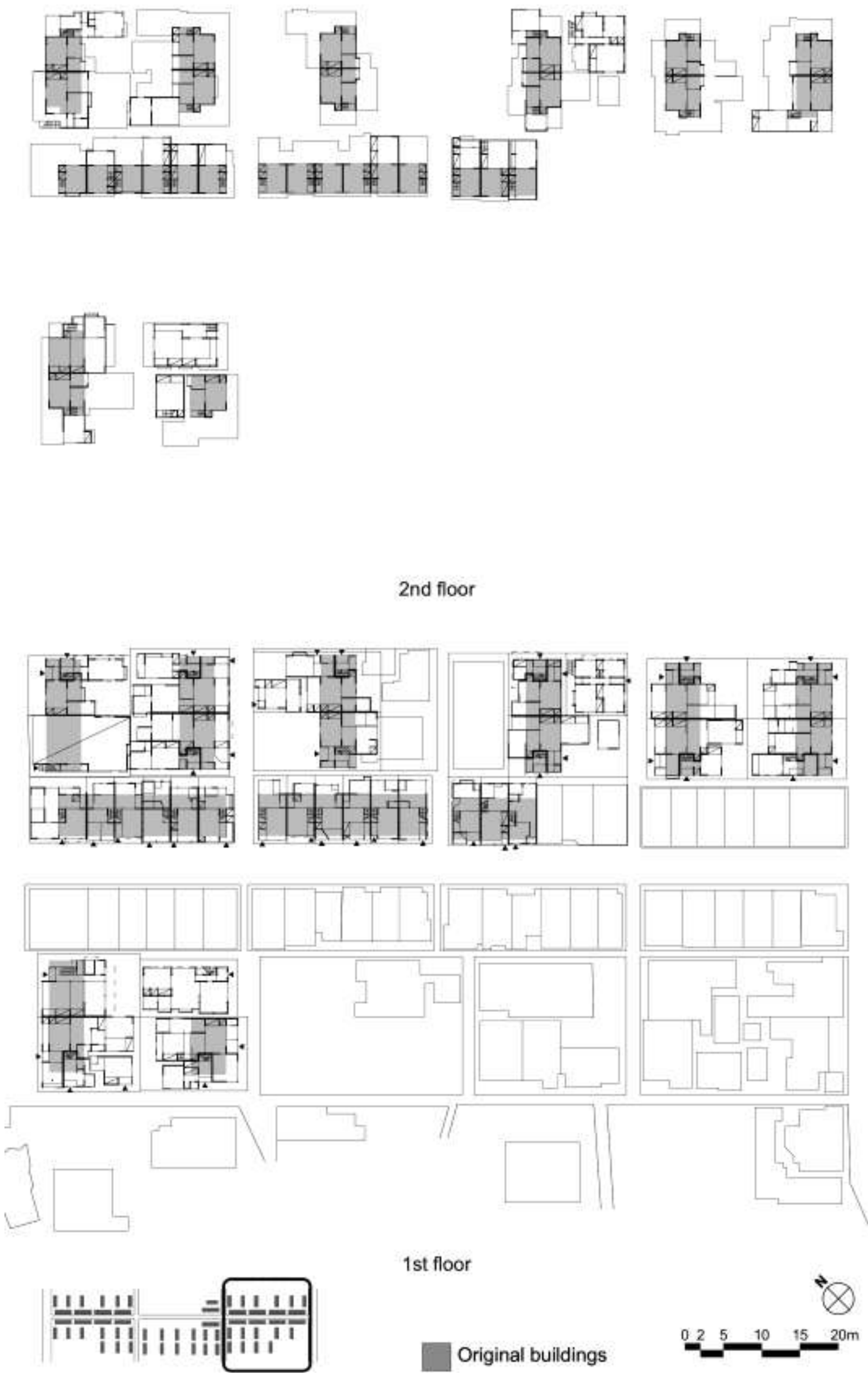

Figure 8: Floor plans 1990's (south-east part)

How dwellings enlarged territories?

Figure 9 shows additions by date in a part of the whole area. Additions began soon after the sale of units, and continued until the redevelopment. They vary in date, and adjoining additions with no gaps were not necessarily built at the same time. Party walls in additions between adjoining units are supposed to have been structurally independent because of such time lag of building additions.

Figure 10 shows a superimposition of additions in four-family semi-detached houses. It implies a tendency that the lower units expanded to front yards and inner side of backyards, and upper units made two-story additions in outer side of backyards. And, as seen in Table 1, additions both of the lower and upper units could be found on the 1st floor, whereas additions of the lower units were rarely seen on the 2nd floor, which might be due to a consideration so that such additions did not interrupt daylight and ventilation of the upper units.

Figure 11 indicates a superimposition of party walls in additions on the 1st floor, gaps between adjoining additions on the 1st floor, and additions upon lower units on the 2nd floor. Although Japanese civil law requires buildings to keep setback of 50cm from site boundaries, most additions in Shin-Yamashita stood with no gaps. A few gaps could be seen between additions of the lower and upper units on the 1st floor, where boundary lines were left to each negotiation of parties concerned.

Regarding vertical coordination, a few upper unit additions climbed onto lower ones, most of which were small overhangs with no loads to the lower units.

Figure 9: Additions by date

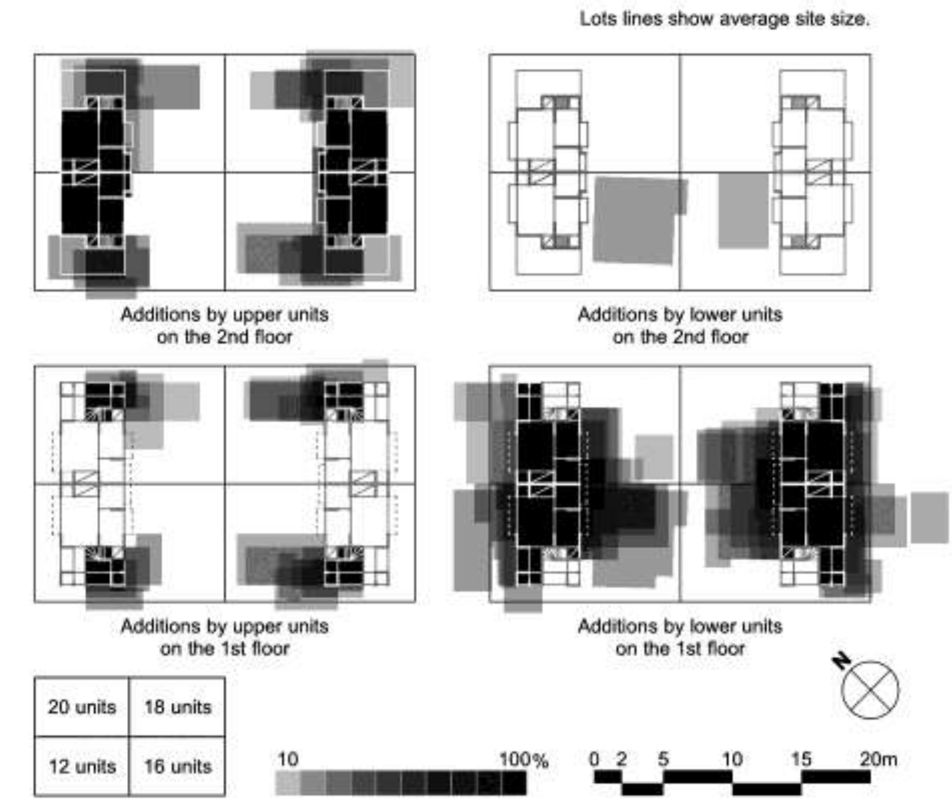

Figure 10: Superimposition of additions

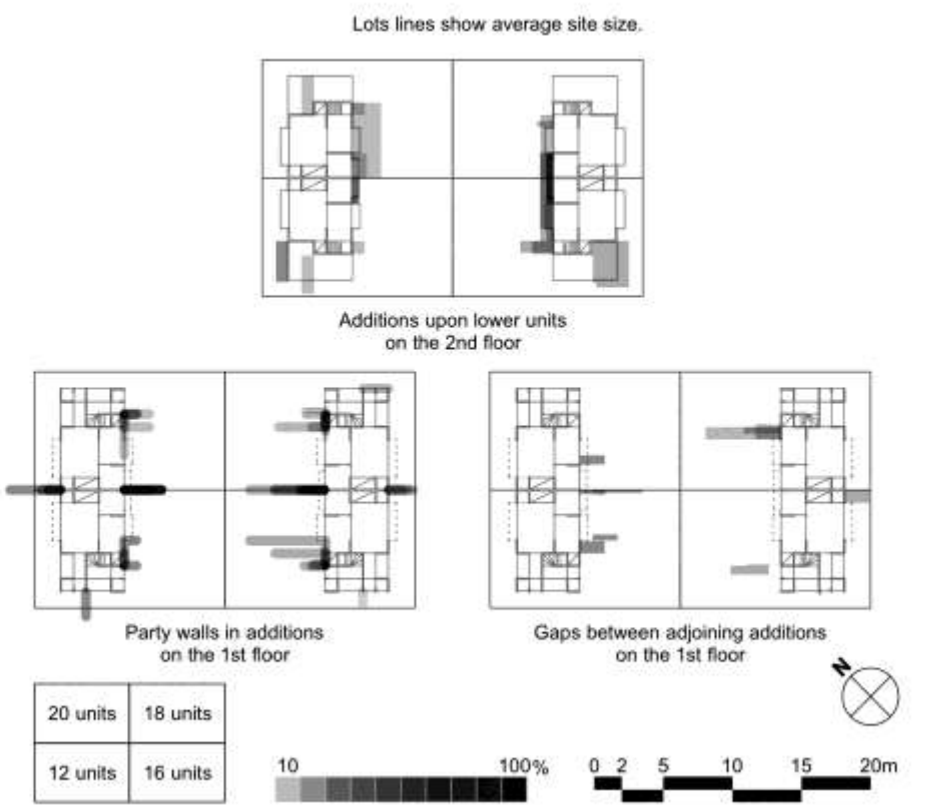

Figure 11: Superimposition of party walls in additions, gaps between adjoining additions and additions upon lower

How stable original room layouts were?

Figure 12 shows a superimposition of rooms of 'kitchen, toilet and bathroom' in the eventual plans in 1990's. Those facilities expanded while remaining the same positions as the original ones in most cases. Additionally, it can be pointed that such facilities tended to expand to the north, which might try not to prevent south sunlight to other main rooms. It is contrastive with the positions of additions as whole shown in Figure 10, which were little affected by the orientation.

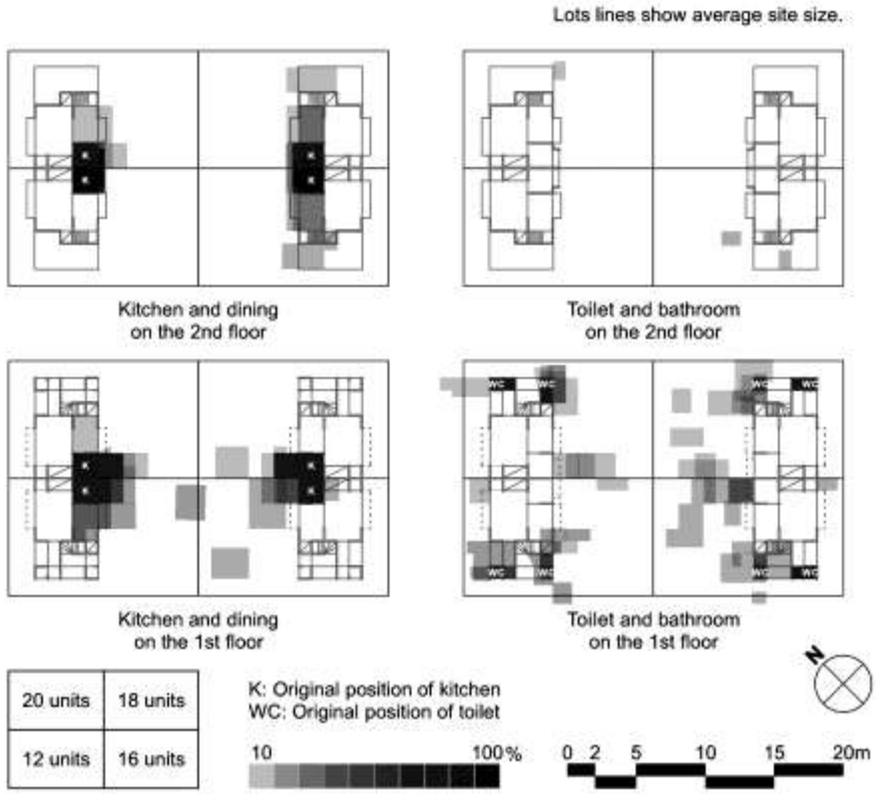

Figure 12: Superimposition of kitchen, dining, toilet and bathroom

How homeownership affected dwelling expansions?

Table 2 shows average floor area by homeownership of documented cases in 1990's. 16 units among 91 were rentals by owners, and they have less floor area than owner-occupied ones in average. This result is understandable because tenants have less rights and incentives to make additions than homeowners in general, although it is unclear how long they had been served as rentals. Additionally, it can be pointed out that rentals were mostly seen in the upper units of four-family semi-detached, which implies that homeowners favored to dwell on the 1st floor close to grounds. The less amounts of additions of the upper units of four-family semi-detached shown in Table 1 might also be explained by this reason.

Table 2: Average floor area by homeownership in 1990's

		Total	Six-family tenement	Four-family semi-detached			Freestanding	Rebuilding
				Upper unit	Lower unit	Combination		
Owner-occupied	Number of units	75	23	19	25	5	2	1
	Average area (m2)	56.9	57.8	51.7	53.2	93.0	27.7	106.0
Rental by owner	Number of units	16	2	8	2	1	3	0
	Average area (m2)	44.3	39.3	40.3	41.0	122.3	33.3	---
Total	Number of units	91	25	27	27	6	5	1
	Average area (m2)	54.8	56.3	48.6	52.3	97.9	31.0	106.0

CONCLUSION

The built environment of Dojunkai wooden multi-family houses in Shin-Yamashita changed dramatically by residents' additions after the sale of units. Such changes were formed in composition of the coordination of adjoining residents, the capacity of original buildings, the orientation and the type of homeownership. The findings are as followings:

1) The extents and positions of additions differed among 3 building types of units.
2) In case of four-family semi-detached units, vacant sites were divided into separate zones for additions on case-by-case negotiations between the upper and lower units, and little additions were found to gather vertically.
3) In those cases, the positions of additions as whole were little affected by the orientation, while rooms for utilities tended to be added to the North.
4) Rental units tended to expand less than owner-occupied units, and such units were mostly found in the upper units of four-family semi-detached houses.

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Co-Developing a Renovation Approach for Housing in Order to Achieve Energy Efficiency

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ABSTRACT
Complex energy related innovations in construction usually involve the contribution of multiple disciplines represented by different firms. Practice shows a change in the fragmented organizational structure of construction is required for these innovations to become mainstream. Even integration beyond the supply chain appears to be necessary in order to upscale energy related innovations from individual houses to renovation projects commissioned by housing cooperations. A scenario approach is being developed in order to bring more transparency in the decision making process for these clients. This approach is a co-development with organizations from both demand and supply side.
The initiation of this new approach was the result of new emerging insights from other institutes related to construction. The Dutch trade organization of service companies in construction, UnetoVNI, cooperates with the Dutch knowledge institute TNO in order to prepare their members to contribute in the realization of an energy efficient future of the built environment. After years of presentations to firms and many fruitful brainstorms on emerging business opportunities without the dreamt profound change in every day practice, UnetoVNI en TNO decided their approach had to change. Together with the innovation office of the Ministry of Economic Affairs (Syntens) they started a new organization (InstalNova) through which they directly support and coach firms in developing this new integrated approach.
As a result firms in twenty regions have formed cooperations to organize their supply chains (E.nu). Knowledge, tools, products and smart ways of working are aligned and re-developed in cooperation with these firms and their most important clients. As a result clients are able to plan and weigh intervention strategies for the life time of their property portfolio. Observations and conclusions from this E.nu initiative will be presented and discussed in this paper.

KEYWORDS
housing, renovation, energy efficiency, scenario approach

INTRODUCTION

Context

The building industry is one of three mayor energy consummating sectors in our global economy. Buildings are consuming about 40% of the total amount of energy (WBCSD 2004, 2005, 2007). It is also one of the four mayor CO2 emitting sectors, next to power generation, mobility and industry & manufacturing (WBCSD 2005). Important parties and organizations worldwide are underlining the urgency to prevent further increase of CO2 levels in our atmosphere, in order to prevent global warming (e.g. IPCC 2007, IEA 2008, UNFCCC 2002) and its dramatic consequences. Since the three main users of energy world wide are industry, mobility and the built environment, different authorities, institutes and organizations formulated ambitious goals to reduce the use of fossil energy in the built environment (e.g. WBCSD 2004, 2005, 2007, NSTC 2008). All kinds of ambitious goals were formulated at different levels, e.g. EU (20/20/2020), national, regional and local authorities. To fulfill these goals there is an acceleration needed in the process of bringing energy efficient innovations in construction in the phase of full implementation. The built environment contributes about 40% to the emissions of CO2, produced especially by operating the older buildings in the existing building stock (WBCSD 2004).

In the Netherlands, the largest potential in diminishing energy consumption in the built environment lays in residential buildings (Meer met Minder 2007), since it represents almost 60% of energy consumption in Dutch buildings. The organizations that represented the most important stakeholders in this process of conversion (contractors, project developers, municipalities etc.) signed treaties to underline the realization of the ambitions set for energy reduction and renewable energy generation (VROM 2008). The companies anticipating on energy efficiency in Dutch construction usually are large or medium sized companies. The smaller companies involved in these issues usually are advisors or architects. Some firms in construction already positioned themselves as leaders in this field. The larger part of the companies however had been largely ignoring these issues. For UnetoVNI, representing the electrical and plumbing contractors, this was reason to rethink their options to stimulate their members to proactively explore the opportunities related to these issues. This Dutch trade organization collaborates with the Dutch knowledge institute TNO in order to prepare their members to explore new opportunities trends are providing. Every few years an inventory is made of new emerging opportunities in the form of an Innovation Radar (Zwinkels 2007, UnetoVNI 2010). The realization of an energy efficient future of the built environment is one of the important opportunities. In an Innovation Radar a description is made of the most important opportunities and the main changes required from service companies interested. Innovation around energy efficiency in the built environment was positioned as the main focus area in 2007 by UnetoVNI with a dedicated vision document. Some of their medium and larger members already adopted this innovation area. But after years of presentations to firms and many fruitful brainstorms on emerging business opportunities, without the dreamt profound change in every day practice, UnetoVNI en TNO decided their approach had to change. Together with the innovation office of the Ministry of Economic Affairs (Syntens) they started a new organization (InstalNova) through which they directly support and coach firms in developing this new integrated approach. InstalNova can be characterized as a kind of skunk works (Bennis 1997), a group of people from the partnering organizations dedicated to a special project given a high degree of autonomy. The first initiative in InstalNova was dedicated towards energy reduction in the existing building stock, and was given the name E.nu.

The goals of E.nu

E.nu is an initiative aiming to develop and market new integral service concepts targeted at the energy renovation of different buildings in the Netherlands. In this initiative for small and medium sized companies (SME's) integrated supply chains are formed dedicated to a specific market segment. The composition of these regional supply chains varies. On average it is a collaboration between 4 to 5 firms, and it can for example consist of a builder, electrical contractor, plumbing contractor, insulation company, consultant for energy efficiency and /or architect etc. Most of these supply chains are focusing on the conversion of residential buildings, some others target the market of businesses, schools etc. This paper will focus on the E.nu regions focusing at residential buildings. At the moment there are about twenty E.nu regions throughout the Netherlands. Their clients may be housing cooperations, private house owners, united private house owners (VVE's) and investors.

The main target of E.nu is to smoothen the customer experience by integrating different energy related measures in combination with additional services to minimize nuisance during the process. This requires among other things: a tailored advise, transparent process including weighing of alternatives, eye for customer preconditions (information and additional services for example like moving furniture, offering of a temporary relocation) and minimizing length of the renovation activities including noise and dust during renovation and maintenance work. The companies collaborate on a local level, thereby creating one stop shopping. For firms and E.nu regions this is a means to create both business and employment. On top of that collaboration between the E.nu regions exists on national level. This means the work required on the development of concepts, service development, marketing, tool engineering, etc. can be divided and is supported by central activities. The aim is to create more additional value in an efficient manner for clients. One E.nu region can for example develop and test a new approach or organization concept and share their experiences so other E.nu regions can learn.

The purpose of this paper

Networks are known as an important factor in the introduction and diffusion of new technological solutions (Porter 1998). These networks can be national (Lundvall 1988, Nelson 1993, Freeman 1995), regional (Brenner 2003) or sectoral (Malerba 2004). Little is known yet on how to implement SME networks. Knowledge available is mainly directed at policy makers (e.g. Klein Woolthuis 2005) or at individual companies (e.g. Von Hippel 1986, Chesbrough 2006). Other relevant research is directed at specific elements in innovation processes, like dissemination (e.g. Rogers 1995), learning (e.g. Nonaka & Takeuchi 1995) and barriers (e.g. Kulatunga 2006). This paper is focusing on an SME network in its initial phase. It is based on my experience as the coordinator of the development work for the E.nu in the period March 2008 – July 2010. During this period the following important basic elements of the E.nu approach were developed: an integrated and client centered process, the concept development process, including the development arena and a first concept for terrace houses from 1966-1988. E.nu has now moved beyond the initial phase, a good opportunity to look back. The material on which the analysis is based derives from action research, joint E.nu meetings and one to one conversations with people from companies and InstalNova partners. In this paper the results consists of evaluation of the practice of up scaling energy related innovations in the E.nu network. In this paper first a theoretical framework for the analysis will be presented, followed by a quick overview of the developed E.nu approach, and then a section will be dedicated to evaluation. This paper will conclude with a summary and conclusions section.

INNOVATION SYSTEMS

Throughout the years a lot of effort has been put in the development of energy efficient technology, products, pilot projects, stimulation programs etc., unfortunately the implementation, especially in residential buildings, still lags behind (Beerepoot 2007). InstalNova is aiming with E.nu to stimulate implementation on a larger scale.

Up scaling

The process in which broad implementation of an innovation is achieved, is called up scaling (Bosch 2009). In this process the innovation evolves from a niche solution towards a mainstream solution. This means all parties have to become familiar with the benefits of the innovation and have to develop know how on its use and application. In general this leads towards a change of competences and habits of people involved, both on supply and demand side of the market. It also means that all infrastructure has to be put in place and all institutions have to be aligned for mainstream application.

The process of up scaling is known to require long periods of time, taking at least several decades (ibid.). This is especially true for more complex and rigorous innovations, since these types of innovation demand drastic change on several aspects. An integrated approach for energy renovation can be considered a complex innovation since projects require multiple measures, for example insulation in combination with improved air tightness, controlled ventilation, low temperature heating, heat pump, etc. Multiparty involvement on design and realization is necessary, as well as planning for a high energy reduction in one or several steps. The ambition can vary per project, but a 40% reduction of fossil energy consumption is not uncommon.

Innovation System Analysis

Innovation System Analysis (ISA) can help to identify the priorities (Suurs 2009). Seven system functions are identified crucial for an innovation system which will support up scaling (see table 1). Such a process is complex, unpredictable and not controllable. ISA is not claiming to be some sort of dash board, which can be used for steering the up scaling process. It is a tool to systemize reflection. One should keep in mind there are no silver bullets in complex innovation processes. During the initial phase of an initiative like E.nu there are so many issues that need to be addressed. ISA can help to prioritize. Were to focus attention and resources knowing you can't address them all at once. This makes it necessary to take a moment in the development team to analyze the field by using this tool from innovation management. An analysis can be made of what system functions are maybe not ideal, but currently working, and what elements need attention in order to upscale and achieve higher levels of implementation.

Table 1: System functions (Suurs 2009 p 68)

System function	Examples of activities and events
Entrepreneurial activities	Projects with a commercial aim, demonstrations, portfolio expansions
Knowledge development	Studies, laboratory trails, pilots, prototypes developed
Knowledge diffusion	Conferences, workshops, alliances between actors, joint ventures, setting up of platforms/ branche organizations
Guidance of the search	Expectations, promises, policy targets, standards, research outcomes
Market formation	Regulations supporting niche markets, generic tax exemptions, 'obligatory use'
Resource mobilization	Subsidies, investments, infrastructure developments
Support from advocacy coalitions	Lobbies, advice

In this paper the system functions of ISA are used as a framework to evaluate the activities within E.nu.

THE E.NU APPROACH

The approach of E.nu is developed in order to address multiple requirements from clients and to fit different building types. With this approach advice to clients can be tailored to their specific situation. This means the E.nu approach has a broader focus then improving energy performance of buildings alone (Oostra 2010). The approach was developed in combination with housing cooperations. These clients expressed the need for information at the initiation phase of projects in order to determine the ambition level of the renovation planned. In essence they would prefer to have a strategic partner with the ability to assist them in this process. With the work in the E.nu development process it was made explicit what this would mean for the interaction process between client and E.nu region and what kind of tools, concepts and solutions should become available to realize such an integrated approach.

Integrated and client centered process

One of the main ingredients of the E.nu approach is the interaction process with the client. To align client requirements with relevant information, advise and business offers a method is formulated based on the MCDM 23 (Multi Criteria Decision making Method) (Poel 2002). This method is used in several steps throughout the process in order to frame the most important project goals and how these are prioritized (step 1). This inventory is used as a base to combine suitable measurements and/or matching Energy Comfort Concepts (ECC's). Ideally more precise performance indicators are formulated which will make it easier to evaluate the alternative packages.

Figure 1: Representation of the E.nu approach.

E.nu toolbox

Combinations are made from measurements, tools, and solutions available in the E.nu toolbox. The E.nu toolbox builds on existing knowledge of energy measures and energy concepts (e.g. Toolkit bestaande bouw 2008). The E.nu toolbox does not only contain energy measurements, like additional insulation, HR++ glazing or a solar thermal collector. It also contains measurements to improve other issues like comfort, health, esthetics, functionality and livability.

Additionally measurements are added to prevent nuisance during the realization phase, since most interventions will take place in inhabited housing complexes and existing neighborhoods.

The MCDM method will be used to package measurements in order to match the requirements of the client (step 2). There will be pre-packaged measurements in the form of Energy Comfort Concepts for recurrent situations. Additional measurements can be added to match the specific situation of the client. Alternative packages can be tested against the different requirements, as indicated by the client. Two or three alternatives will be presented to the client (step 3). With the client the different packaged will be evaluated. The best choice will be made based on his situation and ambition (step 4).

The E.nu toolbox creates flexibility, while building up on existing knowledge by re-using successful Energy Comfort Concepts and using the information available in the supply chain on durability, maintenance, operational costs etc. For concept development both a process and an arena were formulated.

Scenarios

Scenarios are also an ingredient of the E.nu approach. Dependent on the available budget, organization, process and ambitions of the housing cooperation the objectives of energy reduction included in a renovation plan will differ. The housing cooperation itself first needs to take a strategic decision what the ambitions for the housing complex will be. In order to get an overview of current possibilities. This information is available at the supply side of the industry. Usually, however, contractors do not have a role in providing the required information.

In order to be able to choose from the options available different scenarios will have to be prepared. This can consist of an intervention in which the entire complex will be converted towards energy neutral, or a step-by-step approach in which energy neutrality can be achieved in the future. Not only will the different scenario's help in the decision making processes on what current ambitions should be, but it will also help in choosing measures that leave the option open to raise ambition levels in the future. This will do justice to the dynamic nature of our built environment. We know ambitions will change in the future, we can't predict how they will change. We need to anticipate and not ignore this fact. The ambition now can be to achieve a reduction of the energy consumption of 50% with the option to become energy neutral in 2030 and keep options open for realizing energy production on a later date. The scenarios will allow the alignment with activities from the maintenance department. A step-by-step approach will provide the framework in taking decisions what to do if the boiler from central heating system breaks down or the renter moves out and a medium size intervention for a single dwelling becomes possible. All decisions can be made from the overall ambition for the complex. The scenario approach will make it possible to align objectives from different parties dynamically (figure 2).

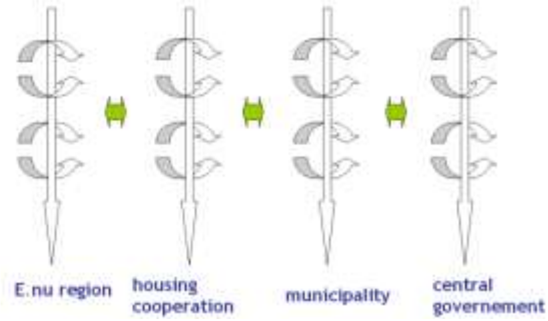

Figure 2: A scenario approach allows for dynamic coupling of objectives between parties.

Performance-based building

Another important ingredient of the E.nu approach is working with performance objectives. This part is still at its infancy, as in construction in general. But the first steps are made within the E.nu initiative in order to align for value based procurement. First step will be agreeing on how the quality level within E.nu will be set and how this level will be raised step-by-step. This can either be achieved by standardizing process, product or education (Mintzberg 1979). It can involve measurements ranging from quality requirements for new companies joining E.nu and training for employees to performance guarantees towards clients.

EVALUTION OF THE SYSTEM FUNCTIONS

The system functions of ISA are used as a starting point for the evaluation. An overview of some preliminary results.

Entrepreneurial activities

The formation of the regional E.nu teams was a process in itself. What companies should be partners? What companies should be allies, but not E.nu partners? This process takes time and no shorts cuts can be made. The process does not only require decision making on the distribution of work, investments and revenues in the E.nu region itself and committing to the rights and obligations of the E.nu national network. It asks a change of the participating organizations as well. Different capabilities of employees are asked, a new way of approaching clients, a new organization strategy etc. The implications appeared not easy to oversee for all companies. We saw E.nu regions crumble, and entire regions collapsing as a result. If all went well contracts were made to establish a specific E.nu region and to regulate the membership of the E.nu network.

A network of contacts has been made with local and provincial authorities, trade organizations, professional clients, their representatives, producers etc. Workshops, trade shows and lectures are being held regionally and nationally. There is publicity generated, although the visibility of E.nu still needs improvement. The first small assignments are being rewarded. There is actively being lobbied for larger scale demonstration projects.

Resource mobilization

At the start of InstalNova and E.nu in 2007 the economy was flourishing. InstalNova partners were able to raise budget to initiate the network before profits could be made. The first development projects were funded for the larger part with subsidies (e.g. money to stimulate SME's from the ministry of Economic Affairs) and investments from UnetoVNI. Companies in construction were confident and in the position to invest in new developments. Housing cooperations had financial resources in place for large scale renovations and they were able to arrange for additional budget by project development or by selling dwellings from their portfolio.

The financial crisis changed all that. Both new development and the selling of dwellings were no longer possible or profitable for housing cooperations. Research budgets and grants were reduced. Companies were facing difficult times. Competing construction companies normally not interested in renovation entered the market. Only private house owners received an incentive to invest with temporary VAT reductions for renovation.

Knowledge development

Knowledge development is actively addressed, although along the way new questions needing answers seem to be pilling up as well. Within the teams responsible for the development of concepts clients were involved. This not only resulted in learning on technical possibilities but also in developing new skills and capabilities, as well as mutual learning on context related issues. E.nu companies learned al lot about the needs, preconditions, possibilities and problems of their clients, but also visa versa. An arena for concept development was designed. Concept development is now ready for the next phase, up scaling parallel development trajectories in order to speed up the innovation process: designing concepts, tools and services for the client.

Knowledge diffusion

The organizational approach of E.nu can be seen as a catalyst for learning. The formation of supply chains in the different regions stimulates the learning process among partners. Additionally the meetings on national level made it possible to enhance learning between E.nu regions, since work and development tasks could be shared with other regions and made learning possible from the experiences of other regions. Both are important elements in knowledge diffusion. We discovered that one such a meeting is not enough. Knowledge available at different E.nu regions should be further disseminated throughout the network. The first plans are currently made for E.nu specific courses.

The process of supply chain learning is ready for a next level. A lot of knowledge is available at suppliers of solutions or producers of different products. In order to ameliorate the use of knowledge already available, ideas to involve these parties should be realized. This would also lay the basis for new product development and other innovations.

Learning is crucial, not only by the people within the E.nu regions, between E.nu regions and clients, but also people involved in InstalNova at UnetoVNI, Syntens and TNO. While learning can be seen as the essential activity within the development of such an initiative, it is however not the topic that is addressed in these wordings within regions, with clients or even within InstalNova. A specific analysis was made of the different issues related to learning (Van Sandick 2011).

Guidance of the search

With the one stop shopping model of E.nu the client is put central, which helps in focusing the development work. This means a real turn around for the sector. Therefore a new integrated approach had to be developed. The direct involvement of clients in the development process proved to be essential. The supply chains are learning, although old patterns can at times be hard to escape. Put a group of engineers in a room for concept development and within no time all attention will be focused on technical issues related to energy measures. This was however not the part were the most important unresolved issues were as perceived by the clients. Client involvement kept the engineers focused on the elements in development creating customer value. For example, housing cooperations indicated they were looking for ways to extend active involvement of renters and to create more choices for them in the process.

The assurance of a certain quality level within E.nu proved to be a returning issue on the management agenda. It was agreed upon as an important topic. A project proposal was submitted for external funding of this part of the development work. Unfortunately it was not granted. Most E.nu regions preferred so far to contribute in other forms to the E.nu network: concept development, marketing strategies, tool engineering etc. The development of a quality control structure within E.nu, therefore remains on the table.

Support from advocacy coalitions

Support from all sorts of institutes and organizations can be heard and read everywhere. The treaties for the reduction of CO2 emissions in the built environment were signed by all important parties. Several local and regional authorities indicated this initiative matched their aims both on the part of the conversion of existing buildings (energy efficiency / energy from sustainable sources) and the part of stimulating regional business and employment development.

MARKET FORMATION

Development of demand

Housing cooperations connect the issue of energy efficiency to their social objectives: keeping housing affordable for people with lower incomes. Sustainability usually is not a goal in itself. They have to deal with split incentive (investment for the housing cooperation, benefits for the renter) and the difficulties raising budget during times of economic stagnation. Management statements of housing cooperations often are in line with the E.nu approach; however the organizations still have strict divided departments for project (re-) development and maintenance.

For clients, especially private house owners and investors, it is not always evident why they should invest in energy efficiency. It can actually be seen as a learning process in which they first learn to understand why these investments are in their own interest and then, in a next phase, how to do so in a wise manner (what are options?, what comes first?). A lot of effort of the E.nu regions is involved in the first phase, educating clients on why investments in energy efficiency are in their interest. Financing energy measures is, at least in the Netherlands, not a top priority of households. Energy prices are still affordable and price increases do not worry most people. This means that investments in energy measures are not seen as a priority, even when renovating or remodeling. A new kitchen, oriel, dormer, bathroom make over, an international holiday trip, new television set or a financial reserve at the bank appear more appealing to most. The additional comfort, reduction of the energy bill, keeping overall housing costs affordable and future-proofing of the house as an investment are not evident to everyone.

Incentives

Although several temporary incentives were given by national, regional or local authorities private house owners were not easily seduced towards investments in energy efficiency. A more structural approach for policy on energy related innovations was developed (PeGO 2010, CDA duurzaamheidsberaad 2010), but not embraced by the current national government.

SUMMARY AND CONCLUSIONS

Looking at the results of E.nu structured according to the functions of the Innovation System Analysis the following can be concluded. Within the E.nu network efforts were made on all systems factors regarded in ISA. A considerable amount of time and energy has been invested in integrating supply chains and in building regional and national networks of contacts. This provides a firm foundation to build upon in the future.

Finding sufficient resources always is difficult for new initiatives, especially in a project-based sector as the construction industry. So this came not really as a surprise. Just after the start of the E.nu network the sector experienced a major set back as a result of the financial crisis. Business has not recovered yet, and it is predicted the amount of new buildings to be realized per year will never raise to the same level again. Still the E.nu network managed to grow against the tide with at the moment 18 E.nu regions with on average 4 to 5 participants (summer 2011). The first assignments are rewarded, which is a positive sign. However the resource base remains vulnerable.

A start has been made with the knowledge development work. The first results have been produced. It has become clearer what issues need to be addressed, what priorities should be made, with who and how to continue. In short, things are ready for a new line-up for the next round of development work.

A tremendous amount of dissemination work is done and remains to be done directed at potential clients, end-users and other stakeholders on why, what and the how of energy renovations. It would be interesting to look at initiatives abroad, like Austria and Belgium to see how they approach dissemination.

Market creation is what it is all about. The conversion of the current building stock is a new market that needs development. The dissemination activities, the development work etc. all are essential ingredients to produce a fit between supply and demand. This is therefore probably the area that is the most crucial. The question remains if it all comes together fast enough to make it a commercial success. This is however not only an interest for the entrepreneurs in E.nu. Since energy reduction is a matter of general interest, there seems to be a logical role for national government. Due to the current economical situation and the present national government however, certain national policy measures seem unrealistic in the short term, like creating financial carrots and/or sticks to provoke investments in energy efficiency or additional regulation or norms. Still there are regional and local authorities looking for ways to realize their targets on sustainability.

Starting an initiative like E.nu is both hectic and inspiring. Hectic due to the complexity and all the different aspects that demand for clear answers and solutions. Inspiring because combining the different aspects necessary unexpected problems and solutions come at bay, showing the commitment of the participants and the insights that grow from the interaction between firms and their clients. Innovations are known for taking their own course, and E.nu is no exception. There is still a long way from realizing all the envisioned promises and impact. The construction industry is still far from changing their capacity based way of working and contracting towards a performance and result based approach. In and around E.nu organizations, both on supply and demand side, are showing they are ready to take on this challenge and have started to change their way of working.

InstalNova provided with E.nu a new way of involving SME companies in exploring new business opportunities and to get them actively involved in innovation. This goal, set by the initiating partners of InstalNova, is met beyond doubt.

For the companies within E.nu only one criterion is important. To them E.nu will be a success if it will become a commercial success. At the moment it is too early to tell whether it will be.

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The Impact of 'Informal' Building Additions on Interior/Exterior Space in Hanoi's Old Apartment Blocks (KTT)

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ABSTRACT
Hanoi, the capital of Vietnam, has been examined as a place where the built environment is characterized by dynamic transformation. More than 1000 years of Chinese domination, almost 100 years of French colonization, and several decades of post-independence with support from the former Soviet Union, have created different layers to the built environment of the city. Over two decades of Doi Moi (economic reform) and opening up to global market have led to rapid transformation of the built environments, including 'informal' building addition that seems to bring another urban coating to Hanoi.

This paper presents one 'cut' through Hanoi's layered built environment. It looks at Hanoi's old Soviet-style apartment blocks - locally called khu tap the (KTT) representing one layer of external influences on the city's built form - to examine spatial changes, more particularly, the impact of 'informal' building addition on interior/exterior space. This includes firsthand observation and interpretation of everyday life and recent building additions made by local residents at an inner-city KTT. This examination will be integrated into a review of relevant space/place theory. Lessons from such review hopefully will be an addition to the theory, which also suggest some design strategies for architects and planners in their attempt to maintain the unique characteristics of Hanoi's architecture and more particularly the city's old and new apartments in the face of rapid urbanization.

KEYWORDS:
Hanoi's architecture, apartment block, building changes

HISTORY AND DEVELOPMENT OF HANOI'S KTTS

Several decades of support from the former Soviet-Union had an impact on Hanoi's built environment. While South Vietnam had American support, the North followed the socialist ideology of the Soviet-bloc. During and after Vietnam War, Hanoi received great economic and technological aid from the Soviet-Union. This also applied to the field of architecture and urban planning. Architects and urban planners from Russia were sent to Hanoi, while many Vietnamese were sent to universities in Soviet-bloc countries to study architecture and construction.

The influence of the Soviet socialist ideology on Hanoi's urban fabric was probably most recognizable in housing. After 1954, houses and land were strictly controlled by the government. Hanoi's government implemented subsidized public housing developments called khu tap the (KTT), which were modeled after the Soviet housing system called 'microrayon'(Bater, 1980). This scheme was implemented in Hanoi by Russian experts (Hung and Thong, 1995). Each KTT was a self-contained residential community that consisted of a number of four- or five-level apartment blocks with attached basic services, such as medical centers, schools and kindergartens. Each apartment block had standard units for different sized families with shared bathrooms and kitchens. They were often managed by a government company to provide homes for its employees and staff.

In early 2008, Hanoi's People Committee decided to demolish KTT Nguyen Cong Tru, one of the earliest KTTs in Hanoi, and build a new housing and commercial estate. In early 2011, two apartment blocks in KTT Nguyen Cong Tru have been pulled down as part of this redevelopment. Historically, KTT Nguyen Cong Tru, together with other KTTs, such as Giang Vo and Kim Lien, represent an important layer of Hanoi's architecture. The building of the KTTs began in 1954 and marked an historic change in Hanoi's planning and architecture, hence transforming its urban image regarding housing and building development. For many people in Hanoi, this model of housing recalls the memorable so-called 'government subsidized' period between the early 1960s and the late 1980s. It was a difficult time for the country, due to years of wars and a closed-door economic policy.

Even though Hanoi's KTT still remains as an architectural reminder of Vietnam's socialist links, they have changed significantly since Doi Moi started in the late 1980s. Most changes are the result of informal building additions and interior renovation. On one hand these informal building activities are criticized as illegal and unsafe. On the other hand the changes show that this Soviet-style architectural model seems to have been adapted to meet local lifestyles and routines, which reveals Hanoi's unique urban characteristics.

The term 'informal building addition' adapts its meaning from a broader term, 'informal settlement', which is defined in The Oxford Dictionary of Environment and Conservation as 'houses (for temporary or permanent use) which have been built on land without formal planning approval'. In this paper, 'informal building addition' is used to describe construction and building renovation and addition activities occurred in Hanoi, including those in the KTTs, without formal planning approval. Not just mere residential space, much of these informal building additions to Hanoi's KTT provide space for family-based shops, restaurants and workshops, which are vital to social, cultural and economic life of individual households as well as neighborhoods nearby.

Before 1990, under strict socialist housing regulations, private ownerships, private construction and building renovation activities were discouraged in Hanoi. These activities were controlled by the government. All changes to both interior and exterior spaces of a building required a number of separated construction permits, which normally took very long to issue. Since the 1990s, some of these requirements were dropped but all construction activities supposedly need certain types of official papers from the ward or higher levels of local government.

According to Mr. Vinh (2008), who has lived in KTT Nguyen Cong Tru since 1957, most construction activities, including building additions to this KTT, either with or without permits, violated the construction regulations. This phenomenon, which is also popular in most other KTTs, is due to critical shortage of housing with standard living space during and after the Vietnam War. It is also partly due to a lack understanding of local everyday need by policy-makers as manifested in current construction rules, which appeared not to respond well to local housing need and changes. To get more living spaces, local residents did not have any options other than violating the rules. The roles of local officials at the ward level who were supposed to enforce rules to control informal construction activities may be questionable. To record the significance of KTTs this paper will continue with observations of everyday life and a review of its history and present-day changes in KTT Nguyen Cong Tru. It will also examine several units at block B1, an apartment building in this KTT.

KTT NGUYEN CONG TRU

KTT Nguyen Cong Tru, located in Hai Ba Trung District south of Hanoi's Ancient Quarter, has an area of around 6 hectares. It contains 14 four-level apartment blocks, 4 two-level apartment blocks, a kindergarten, a primary school, and a food market. It was planned to provide homes for 4200 residents (Hoang, 2000), who were state employees from the countryside. Generally, employees who worked in the same state-owned company or factory stayed in the same apartment block.

The site of the KTT was originally village settlements (Uan, 1995). The French redeveloped the area and constructed Nguyen Cong Tru Street in 1895, and provided a cemetery for themselves on the land where the KTT is now located. They also built a catholic cemetery for the locals and a wine factory on the other side of the street. The area is surrounded by streets with shop-houses, which usually have narrow facades. In the late 1950s, the cemeteries were removed to construct the KTT, which fully occupied the area of the French cemetery. However, the French funeral chapel still remained and was later used as a community building for the residents living in the KTT until the present.

KTT Nguyen Cong Tru was first opened in 1963 (Long, 2006). Fourteen apartment buildings were arranged from north to south on three allotments divided by the main roads. Public buildings, such as a general store, a primary school and a kindergarten, were located on the eastern allotment. Most apartment blocks were built in the western and the central allotments. There was a spacious tree lined yard between pairs of buildings. The apartment blocks have rendered brick walls with a yellow finish and precast-concrete panel floors supported by brick walls. Like many other KTTs, the apartments in Nguyen Cong Tru had simple looking facades, with a monotonous pattern of windows and balconies, which symbolized a modern life-style in Hanoi at the time. In fact, it was really a dream-home for many people who had suffered during the wars.

Each apartment block has four levels and measures 60 metres long and 13 metres wide. Each block has two main entrances from the yard. Each leads to a staircase and a central corridor to apartments. On the ground level of each block there are also secondary exists at both ends. A typical floor plan of block B1, for instance, contains 20 flats, with shared kitchens, bathrooms and toilets. One amenity unit containing a kitchen, a bathroom and a toilet was shared by five apartments. This worked well until the 1980s, when an increase in the number of people living there made it very hard to utilize this community space efficiently. The inhabitants' desire to improve their living conditions put more pressure on the government to re-arrange the space inside the block. The shared kitchens, bathroom and toilet were divided into smaller rooms, providing space for a private kitchen, a bathroom and a toilet for each family. Basic expenses for this spatial re-arrangement, such as building the internal walls and fixing or replacing standard domestic equipment, were funded by the government. However, if the families wanted to use better equipment and more expensive building materials, they had to pay the difference.

'INFORMAL' CHANGES TO THE 'FORMAL' BUILDINGS

As described earlier, massive changes happened to the KTT after Doi Moi were due to an increase in local business and the number of residents. The housing survey conducted in 2007 by the Hanoi Housing Development Company No7, suggested that the population of KTT Nguyen Cong Tru had almost doubled compared to its initial population. At present there are 1292 households consisting of 7000 people living in 14 apartment blocks. This includes 346 families that make a living from home businesses on the ground-level apartments. Moreover, 320 families, consisting of 1350 persons, illegally have occupied the open spaces between the apartment blocks to build houses or open stalls selling different items (Quan, 2008).

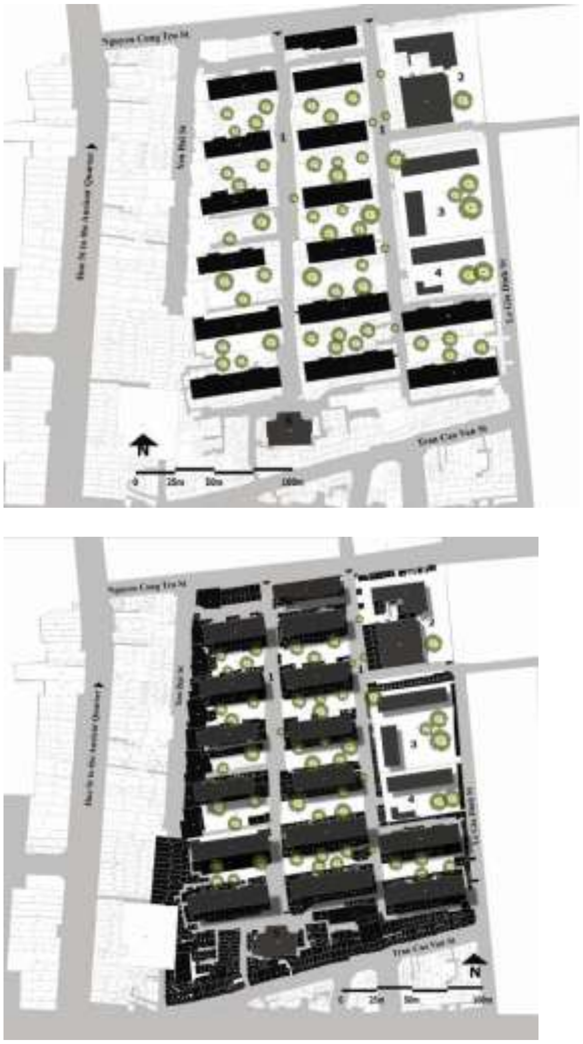

Figure 1: Top, Original planning of KTT Nguyen Cong Tru; Bottom, Plan showing additional structures at most apartment blocks and open space in the KTT. (Dinh Quoc Phuong, 2009)

Most apartments are over-populated and run down due to a lack of maintenance during the several decades of war and economic struggle. Since Doi Moi, and especially during the late 1990s, many families have extended and renovated their units to better suit the increases in their families, wealth and the general living standard in Hanoi. The renovations have led to significant changes in the interior layouts of the units as well as the overall appearance of the apartment blocks. The once monotonous buildings with dull façades now seem to be more lively looking structures, due to a large extent to the additions made to accommodate daily activities and business interactions. By adding extra rooms to the front and the back of their flats, the floor plans are much longer compared to the original ones.

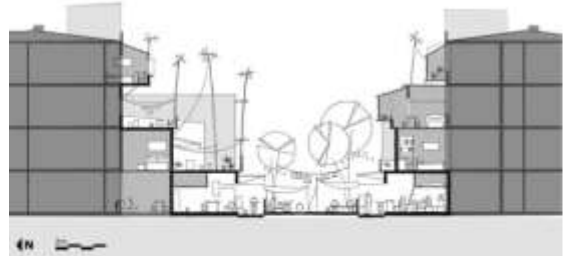

Figure 2: Section through the yard between Blocks B1 and B2 (Dinh Quoc Phuong, 2009)

For instance, the space between blocks B1 and B2 is characterized by these extended structures, locally known as chuong cop or tiger cages, because their steel frames look like cages for tigers. To get extra living space, many residents extended their balconies and turned them into rooms for domestic use, such as bedrooms. A chuong cop is often supported by steel beams on the main structure of the building. While chuong cops are the same width as the original units, their length varies depending on how much space their owners need. Most of them are between one and 1.5 meters long, but some are 2 meters or more. Through negotiations many residents, especially those on the second levels, have built their chuong cop on top of the extended shops on the ground level.

Most chuong cop were built by the owners themselves. They used recycled materials they had at hand to finish them. Therefore, the do-it-yourself chuong cop have a similar structure supported by steel-frames with light weight flat roofs, but they present different patterns of use, decoration and colors. The steel-frames, the main structure of chuong cop, often have a grid-pattern with different decoration motifs: some are simple grids, while others present circles or flowers. The most popular and advanced material used for the roofs and façades of chuong cop is aluminum sheets, usually painted in dark red or green. Some units use less expensive materials, such as plastic or fibro-cement panels or old blinds made of bamboo usually painted blue. Chuong cop that are used as bedrooms are usually covered by these sheets, and each often has a small opening for ventilation. Chuong cop that are used as mini-gardens are partly covered and show a variety of domestic activities, such as planting, drying clothes, exercising, and cooking with charcoal ovens.

Figure 3: 'Chuong cop', additional structures to the KTT. (Dinh Quoc Phuong, 2008)

The outdoor environment in KTT Nguyen Cong Tru is nourished by everyday life activities. Most retail businesses take place outside or at the front of the shop, which are opened to the streets and the yards. The lack of space inside the apartment units causes the residents to make the most use of public-open spaces for private-domestic and retail activities, such as cooking, eating and bathing. Moreover, units in each level of an apartment block like B1 shared a central corridor, which are often lined with kitchen facilities such as cookers and dust bins, since not all families have enough kitchen space. The corridors are also full of shoes and slippers because people have a habit of taking off their shoes before entering their units.

The ad hoc changes made to KTT Nguyen Cong Tru can also be seen in most other Soviet-style apartment areas in Hanoi. The massive and monotonous buildings were adapted to be architecturally and culturally closer to the existing urban grain and human scale of spaces found in Hanoi's Ancient Quarter, by extending the units with family-shops and commercial activities. The spatial and formal transformations of the KTT were also a result of the poor living standards and the lack of living space that are now unacceptable since Doi Moi. There is a critical need to improve the living conditions, particularly the interior spaces, of those residing in the KTTs.

'INFORMAL' CHANGES TO THE 'FORMAL' UNITS

This section will examine in detail units 304 and 309 on the third floor of Block B1, owned by Mrs. Viet and Mr. Long respectively. The owners of both units, who were government employees, migrated to live and work in Hanoi after the war. Focusing on the physical conditions, internal spaces and ownership exchange of these units will lead to a further understanding of the nature of the informal changes to Hanoi's KTTs.

Initially the units had similar layouts. However, in the late 1990s, unit 309 changed significantly, while unit 304 remained relatively unchanged. In 1996 Mr. Long lived in 304, and wanted to extend his flat, but he needed the cooperation or at least support of the owners of the two units underneath his, which shared the same footprint. The owners of these units, however, were not willing to corporate and support, but those underneath 309 were, so Mr. Long suggested to Mrs. Viet, who lived in 309, to swap apartments to help him carry out his plan. As a result, Mr. Long's family now resides at 309, while Mrs. Viet resides at 304.

Unit 304 is one of the few that remains almost the same as it was 40 years ago. This one-room unit provides accommodation for five family members: Mrs. Viet, her husband, her mother-in-law and her two sons. The main room serves as a living room and a bedroom for Mr. and Mrs. Viet. A small timber mezzanine was built above the bed to provide a 'hanging bedroom' for her sons, as well as a tiny storage space. The balcony was adapted as a bedroom for her disabled mother-in-law. It is also big enough for a small study table for the sons.

The family used to share an amenity block that contained kitchens, toilets and bathrooms with four other families, which was located opposite unit 304, over the central corridor of the apartment block. It was divided into four, with each used by one family. The facilities provided in Mrs. Viet's kitchen and toilet are almost original, consisting of an old squat toilet, a bathroom, a built-in water tank, and a built-in kitchen table. They are in a narrow and long room, which is not fully tiled and therefore is very wet and looks rather shabby. To prevent any further deterioration of the structure, Mrs. Viet uses plastic sheets and cement paint to cover the walls and ceiling.

Since the unit is very small, the family makes the most use of open spaces for extra storage. A small mezzanine located above the entrance door inside the main room is full of boxes, and there is also stuff on top of the wardrobe and in the corridor between the units. Mrs. Viet (2007) said that even though her sons will soon get married, she will not extend the unit because she has heard that the government plans to pull down KTT Nguyen Cong Tru to build a new one.

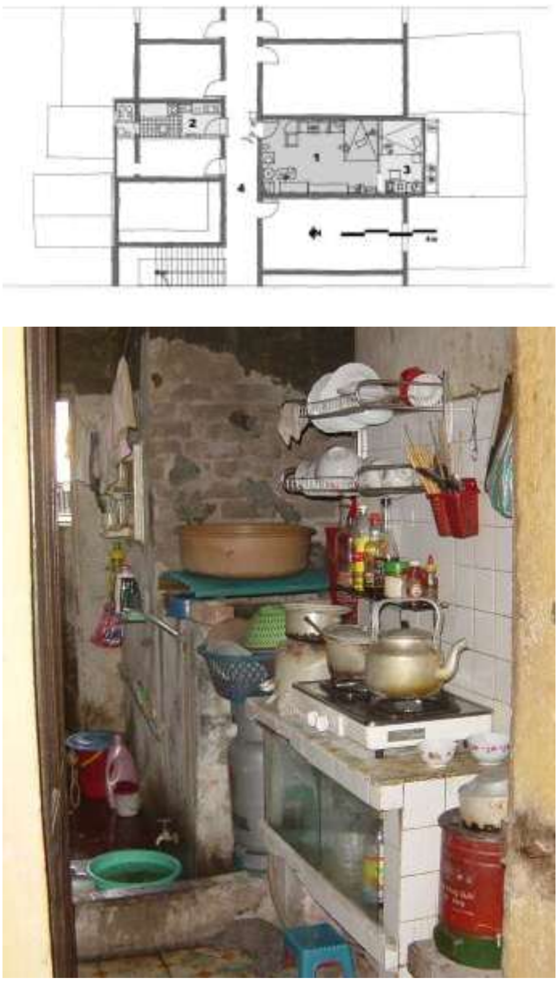

Figure 4: Top, floor-plan of Mrs. Viet's unit: (1) original room; (2) kitchen, bathroom and toilet; (3) balcony used as an extra bedroom; (4) shared corridor; Bottom, the kitchen of Mrs. Viet's unit (Dinh Quoc Phuong 2007)

Mrs. Viet and Mr. Long agreed to exchange units so that Mr. Long could renovate and enlarge his flat to accommodate his extended family. Originally, unit 309 had one room, 3.3 meters wide and 7.2 meters long, with a balcony and a shared kitchen, bathroom and toilet. In the late 1980s, as part of the KTT renovation project supported by government, the shared kitchen, bathroom and toilet of 309 were divided into smaller rooms, providing space for a private kitchen, a bathroom and a toilet for each family. Mr. Long's unit therefore had its own kitchen. Even though basic expenses for this renovation project was covered by the government, Mr. Long paid an extra 12 million Vietnam Dong for further renovations to his kitchen.

While the initial interior renovation was approved by the government, further changes to the interior and exterior, such as adding more rooms to the front and the back of units, were not. Most external changes like those in Mr. Long's unit, initiated and constructed by the residents, were classified by the government as informal and dangerous. However, they were critical to satisfactorily accommodate the need for daily life.

Similar to other units, the transformation of Mr. Long's unit followed the changes in his family's structure. When Mr. Long's son got married, the newly weds also stayed in the one-room unit, putting more pressure on the living space. Finding a solution that provided an extra room was the obvious response. But people could only add a small space by converting their balconies into rooms. Mr. Long found a better solution. He discussed the situation with the other two families underneath his unit, and since all three units shared the same footprint and were pressured for more living space, they agreed to work in collaboration to extend their units. The family on the ground floor built walls of an additional room that could bear the load of the additional structures on the two upper units, including Mr. Long's. Costs for laying the foundations were equally shared among the three families.

After building this addition, the area of Mr. Long's unit was almost doubled. The additional room for his children is approximately the same size as the original room. Therefore, the unit became much longer overall. The floor plan is 3.3 meters in width and 16 meters in length. Mr. Long (2007) said that his flat might be extended even further to the north in the near future. Since the neighboring family at unit 310 is not home very often, Mr. Long has tried to convince them to sell the unit so he can enlarge his unit by joining these two units. Another benefit of this purchase, said Mr. Long, is that he can further extent his unit by adding more rooms to unit 310. If this scheme is successful, then Mr. Long's combined unit will be up to 30 meters long.

Since the unit above Mr. Long's did not participate in the collaborative building renovation work, Mr. Long was able to have an open inner-courtyard between the rooms. The inner-courtyard has become an important part of the unit, which not only improves circulation and ventilation within the unit, but also provides an open space for domestic activities, such as cooking, drying clothes, planting, and resting. To prevent thieves entering through the opening, Mr. Long installed a steel security grill above the courtyard space. This also allows Mr. Long to make a good use of the light-well by keeping his doors and windows open more often to the courtyard.

The original room is now used as a sitting room and a bedroom for Mr. Long and his wife. It contains a set of sofas and a coffee table at the northwest corner of the room, and a big TV cabinet combined with a bookcase, a wardrobe and a fridge are located along the northern wall. Mr. and Mrs. Long's bed is located at the southwest corner of the room, which is near the window to the courtyard and there is a single mattress between the bed and the sofas, which is used by one of Mr. Long's relatives who comes from his home village to help the family with everyday housework.

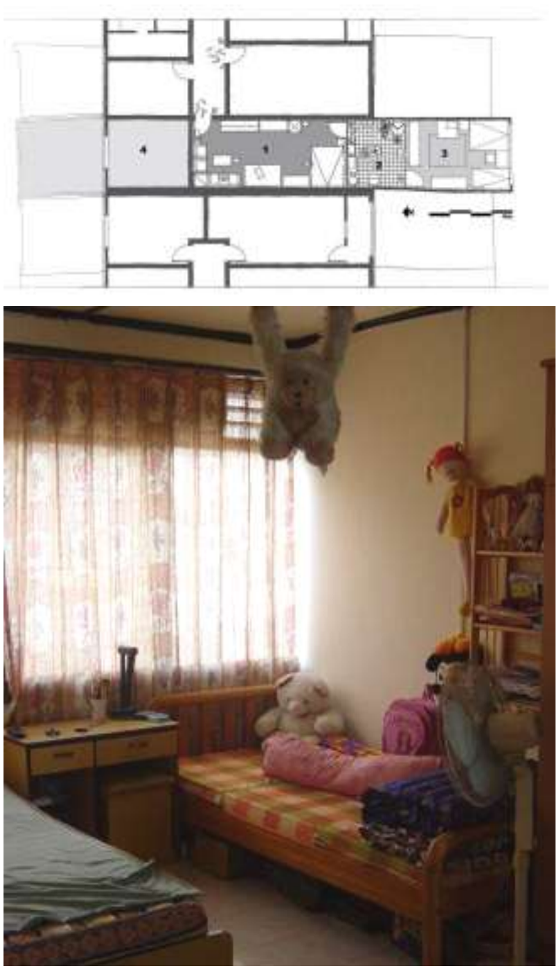

Figure 5: Top, Floor-plan of Mr. Long's unit: (1) original room; (2) added courtyard; (3) added room for the son's family; (4) neighbor unit; Bottom, Inside the extended room of Mr. Long's unit. (Dinh Quoc Phuong, 2007)

There are significant differences in terms of interior decoration between the original room and the new one, which perhaps reflect the generation gap between Mr. and Mrs. Long, who are in their early 70s, and their children and grandchildren. While the furniture in the original room is dark in color, the new room is much brighter and more colorful with yellow and beige walls, furniture and curtains. There are a double bed and a child-size bed in the room decorated with colorful quilts, pillows and children' toys, especially teddy bears, and a big home-theatre TV set. The room looks larger due to a large mirror hanging on the eastern wall. Below the mirror is a low table, where a microwave oven and some food containers are placed. Mr. Long's extended room is one example showing the interesting mixed-use of space because it accommodates different functions: a sleeping place for a couple and their kid, cooking, studying, play and entertainment.

As an important layer of Hanoi's architectural history and urban development, the Soviet-style apartment blocks like KTT Nguyen Cong Tru contribute to Hanoi's sense of place, which is not only characterized by the massive structures of the apartments, but also enhanced by the community life and everyday experiences inside and between them.

The extended structures illustrate local adaptations and reactions to this imported built form, as well as the changes brought by Doi Moi. Even though chuong cop are often criticized as being ugly and unsafe, they are unique in Hanoi, and with design guides and technical support, they could be an interesting and safe architectural element that brings a unique sense of place to the KTTs. Moreover, the additional structures to the apartments, such as shop-fronts, mezzanines, internal courtyards, mix-used rooms and the shops selling the same items reflects Hanoi's Ancient Quarter. The mezzanine built in Mrs. Viet's unit for extra living space is very similar to these old shop-houses in Hanoi's ancient streets. The courtyard added to Mr. Long's unit also resembles the multi-purpose nature of courtyards in the old shop-houses. It is crucial for designers to observe, record and comprehend the patterns of life within these structures that reflect tradition and culture, and hence the process of maintaining the sense of place.

The main intention of this paper is not to question the roles of local officials, who were supposed to act on behalf of the government to control the informal building activities. But it is worth noting some observation from field study in the KTT. Local officials appeared to be relatively flexible in dealing with the informal building activities. Given that getting permits from local officials to do interior renovation and to add extra rooms to the downgraded units was required by law, for the unit owners like Mr. Long, major obstacles to such activities, were getting agreements with neighbors who are happy to corporate or at least do not object the renovation plans. Mr. Long said that he did not really worry about getting building approval from local officials in the first place but agreements with his neighbors (Long, 2007). If the neighbors, who also supported the building additions, they would make a case to convince local officials that these building activities would not negatively affect their units. Local officials then would 'ignore' the case by not enforcing building regulations. If the neighbors were not happy they could object the plans and it is likely that local officials would have to terminate the building activities by enforcing that they are illegal. Even though most building additions like those done by Mr.

Long were illegal they were made possible essentially as a result of informal agreements between neighbors, which are keys to go about 'informal' approvals from local authorities.

DISCUSSION AND CONCLUSION

In KTT Nguyen Cong Tru and others KTTs, renovated interior spaces, chuong cop and shops extended to the ground floor units are informal building structures, which actually bring more human encounters to animate the monotonous-look buildings. They are, however, legally unrecognized and blamed as 'ugly structures' by local authorities and architects. Due to a lack of design and engineering guides these informal building structures may look dilapidated but they should deserve more positive judgments to the extent that they bring livability and character to the place because they were built to meet the residents' needs for basic and traditional living spaces, which also include the necessary re-emergence of the local pattern of family-shops and associated domestic and retail activities.

Study of changes to KTT Nguyen Cong Tru presents grounded experiences, which evoke ideas illustrating the theory of production of space by the French philosopher, Henri Lefebvre (2002). The significance of referring to Lefebvre is his dialectical interpretation of space as a contestation of two modes of spatial construction: the first is defined as conceived space, which, according to Lefebvre, is the space formally created by profession, such as architects, designers, urban planners or decision-makers and the second, perceived space, is manifested in normal economic activities, everyday life practices and daily reality of the inhabitants, which often does not follow the rules appreciated by the professions, the creators of more 'official' spaces, conceived spaces (Lefebvre 1997). Different professions often elucidated his theory differently and accordingly to their specializations. The intention of this section is to practically read the manifestation of Lefebvre's concepts for further understanding of Hanoi's built environment including informal building additions in KTT Nguyen Cong Tru.

The present condition of KTT Nguyen Cong Tru shows representative pictures of most other Soviet-style apartment areas, a constituent layer in the mixed architecture in Hanoi before Doi Moi. Post Doi Moi's market economy is responsible for increasing changes to local everyday life and physical transformation of the apartments. The spatial transformations of the KTT were a result of informal building activities representing the attempt to improve the poor living standard and lacks of living rooms according to the living 'benchmark' boosted up since Doi Moi. Living spaces inside the flats are self-adjusted and self-improved in accordance with their users' daily needs, and more importantly, substantial changes to the flats are only feasible through internal negotiations between their owners, which seem to be almost out of the control of the local authorities and professionals.

Construction and transformation of Hanoi's KTT, perhaps, are an architectural representation of Lefebvre's dialectical account on space. KTTs, which were derived from those designed in the Soviet-bloc countries, appear to represent conceived spaces in Hanoi. The buildings reflected the Vietnamese government's strategy and socialist idea to fulfill post-war demand for subsidized homes. Architectural changes, made by residents living in these KTTs, in accordance with changes to daily life seem to represent perceived space. This illustrates that Soviet-style conceived spaces have been appropriated by the practices of everyday life reality and changes in Hanoi. The conceived space of massive and monotonous KTTs were locally adjusted to be perceived space, which is architecturally, culturally and practically closer to the existing urban grain and spaces with human scale, such as those in Hanoi's Ancient Quarter, featured by shops and domestic and commercial activities of extended families.

The present-day changes in the KTT or else where in Hanoi represent the tension between conceived space, stands for profession's (local authorities and architects) viewpoint toward the changes (including informal building changes), and perceived space of the everyday life changes to the built form. This tension or different viewpoints recalls top-down and bottom-up experiences. Building upon de Certeau (1984)'s two modes of experiencing places as voyeurs and walkers, Ross King (1996) concerned about 'our' (interior designers, architects, and urban designers) preference in looking and being at cities. In his reflection on this tension the author concluded that both extremes of experiencing places are part of the human, and there is a need to take an in-between mode in order to reinstate what it is to be human and to design in response to the reinstatement. De Certeau's metaphor or top-down and bottom-up experiences, which, in my view, closely related to Lefebvre's definition of conceived/perceived space, seems to imply that designers and decision-makers should also observe everyday built form from bottom-up viewpoint to fully understand different experiences and concerns, which are occurred in reality.

The ultimate and practical implication for redevelopment projects is that local professionals, including interior designer, architects, urban planners and authority should be more open to different ways of reading built form, particularly those with more considerations for everyday life reality of the local residents. Observed Hanoi's perceived/conceived spaces manifested in the KTT, including changes to everyday activities and experiences, significantly contribute to Hanoi's characteristics. However to sustain this there is a need for 'human encounters' that put together different viewpoints to relatively close the gaps between the experiences of residents, the ideological vision of decision makers, the abstract pictures created by the architects and designers and, more specifically the void between building regulations and informal building activities lead by local residents.

Even though there is a need for a more intensive research on the role of local government officials in dealing with informal building activities, the brief discussion on this issue starts to illustrate local residents' attempt to fill the gap. Given that current building regulations are not open enough to well respond to everyday need of better interior/exterior spaces, local officials' loose control of the informal agreements and subsequent informal building additions, either pretended or not, metaphorically presents an 'open space', which appears to informally, albeit practically, help mediating the tension between the so-called conceived space and perceived space in Hanoi's KTTs. Despite post-war economic recovering, it might be unrealistic to get enough government funding and attention to totally deal with housing shortage and poor living standard in Hanoi's KTTs. The redevelopments like what has started in KTT Nguyen Cong Tru may take several decades or so to complete. This means that building renovation, initiated by the local residents, might be the immediate and practical solution to best deal with the on-going issues in Hanoi's KTTs.

Further judgment of KTTs need to be put into a broader research ground to have a clearer understanding of the nature of informal building changes to this housing typology. The issues discussed in this paper are bottom-up and interdisciplinary in nature. Traditionally, self-made and self-adjusted buildings have a long history in Vietnamese vernacular architecture. Culturally and economically, living and working in extended families with home-based retails are vital part of local economy in Hanoi. It is understandable that some aspects of this tradition have persisted in the KTTs. Socially and technologically, most local residents, who may not have enough knowledge on contemporary design and engineering, need assistant and guidance from professionals so that building renovation and addition will be safely done with reasonable look. Researchers, designers and policy-makers should consider these aspects in their attempts to (re)judge and regulate informal building additions in Hanoi or to come up with more effective open building projects elsewhere.

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From Modular Architecture to Adaptable Collective Housing: A design charrette bringing the open building knowledge to the "Solar Decathlon 2012 Europe"

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ABSTRACT
The design workshop is a central part of the academic module on "Industrialized housing" within the MSc in Industrialized and Prefab Architecture, at the Faculty of Architecture, CEU-Cardenal Herrera University in Valencia (Spain). The workshop constitutes an opportunity for students to get acquainted with several aspects of "4th dimension architecture" applied to housing, particularly on the articulation of levels and domains of control. This feature is made patent by changing the roles of students from designers to users during the workshop. This year, the main objective was to bring a "4th dimension" input to the CEU-UCH proposal for the Solar Decathlon Europe 2012. Students were asked to outline a design strategy that should allow turning the single family module of the competition into a prototype for collective, multi-storey, adaptable housing. The paper's aim is dual: on the one hand it illustrates the background, development and results of the workshops held during the Master. Particular attention was paid to the learning process and the broader influence it has on the students' view of collective housing. On the other hand, it will describe the impact of this approach on the current development of the SDE 2012 prototype.

KEYWORDS:
architectural education, Open Building, Solar Decathlon Europe, collective housing

INTRODUCTION

The paper describes two teaching experiences led by the authors at the School of Architecture, CEU-Cardenal Herrera University in Valencia (Spain).

On the one hand, it explains the experience of a short studio housing workshop held every year since 2010 as a part of the Master's module on Industrialized and Modular Housing.This module is set up on two main assumptions. First, that focusing on collective housing, instead of single family housing, makes a lot more sense within the Spanish (and European) context. Second, that the Open Building theory may help to structure in a stronger way the discourse on prefab and modular housing, especially when sustainable criteria is taken into account. The studio workshop is focused therefore on the design of a support building conceived within the framework of the Spanish socially accepted standards for housing, although not exclusively limited to it.

On the other hand, the paper describes the development of the university proposal for the Solar Decathlon Europe 2012 and the attempt to imbue it through this year studio workshop and further work within the SD 2012 team with some of the concepts developed along the Master's module.

THE SYLLABUS OF THE MODULE ON HOUSING AT THE MASTER ON INDUSTRIALIZED AND MODULAR ARCHITECTURE IN THE SPANISH FORMATIVE CONTEXT

The Spanish context

Teaching and practice of housing design in Spain does not usually put users' control and the 4th dimension of architecture in the centre of the debate. Very seldom, Open Building concepts have overtly been incorporated into the academic discourse in Spain, not to mention inside real projects. Since the early attempts in the '70s, when Fernando Ramón (Ramón, 1975), architect and professor at the School of Architecture in Madrid, introduced the Support theory in Spain, these concepts have not gained any broader diffusion among scholars and professionals. In the last decade, publications and competitions as result of the joined European research program Manubuild (or the Spanish one named INVISO), have introduced Open Building theory in relation to industrialized construction, but with reduced impact in schools and practices. "Flexibility" in housing has been a common concern for housing through academic research and, occasionally, in practice. Some exercises of "economy of space" have been enhanced by certain "economy of means" in public housing. However, very little room for such flexibility discourse was applied during the last real estate boom, partially also because of the constraints of the regulation system. As a result, users and customers deal now with a monotonous, inflexible and repetitive housing stock which is unprepared for changes over time.

The syllabus of the module and the diagram on industrialized collective housing

The syllabus of the module of industrialized housing provides the framework for developing a critical discourse on the layout inflexibility and construction standards of collective housing in Spain. It also advances a broader view on housing adaptability and on "housing as a process", integrating user's control. The program introduces a historical and geographical context of industrialized collective housing, and places N.J. Habraken's legacy at the center of the debate. It helps students identifying several qualities of the industrialized housing project throughout the

XX century. These are: economy, efficiency, adaptability, sustainability and customization. The case studies reviewed during the lectures and seminars are shown in a diagram and are evaluated in relation to the performance of these qualitative indicators.

The diagram on industrialized collective housing is a graphic resource allowing a dialectical approach to several subjects studied along the module. It is open to the students' seminars research, updated every year. By doing so, it enhances both their research and active participation during the class sessions, and helps to build up a wider knowledge about industrialized housing. The information in the diagram is organized according to qualitative criteria and provides a dual reading of data with reference to chronological and geographical coordinates. Since it is intended to become both a survey of industrialized mass housing and an academic tool, data is not limited to projects and buildings, but also to those relevant texts, agents and programs that contributed to the development of industrialization of the housing sector. The picture portrayed in this snapshot addresses both the achievements made in the field of architecture as well as the results of "non architectural fields", as described by Colin Davis in his book (Davis, 2005), which are indeed largely responsible for technological progress. The taxonomy for each entry in the diagram is defined by a graphical code. Different symbols classify the information according to the type of industrialization, i.e., closed and open systems; finally, a specific graphic code distinguishes the Open Building residential projects. Different colors classify entries according to geographical criteria and case styles introduce information about tenure. Once the entries are set on the diagram, the relationships among programs, texts and projects are drawn vertically.

The Workshop on Industrialized and Modular Housing.
The workshop takes up a central part of the module and is structured on a four-day full time design studio. First, students receive an introduction to the concept of levels that operate in the dynamic processes which affect our environment, both according to control and responsibility as well as in relation to the lifecycle of buildings. Second, they are given a brief detailing of the design requirements for a collective housing prototype of 30 housing units approximately, to be conceived according to the Open Building principles. The exercise is an opportunity for students to get acquainted with the 4th dimension in housing design and test the general approach on dwelling adaptability and users' control elaborated during the module seminars and lectures.

The structure of the workshop invites students to design from the permanent and collective scale to the changeable and personal one. In the first 6-hour stage, they are requested to conceive the "support level" focusing on the "collective layers", which include the access system, load bearing structure and main service systems. No specific units' layout is defined in this early phase, though they must size up several spatial arrangements in order to develop support systems. In the second 6-hour stage of the workshop, students swap their proposals so as to test others' supports capacity by developing single units. They change their role and act as potential users. At the third and final stage, students take back their designs with the range of layouts developed by others in order to optimize the performance of the support and to adjust the dwellings' layout according to the feedback received. In this final stage students are also invited to test their support designs with non architectural literates, for example, with friends or family members.

Several educational strategies are designed to strengthen the "levels approach" learning process:
The articulation of the design process in several stages according to levels' life-cycle criteria reverse the usual design process in housing, giving the adequate autonomy to the support level in relation to the layout level.

By swapping their support proposals, students exercise the levels of control and responsibility, and partially experience the role of designers and users at the same time.

Team work, quite unusual in architecture studio pedagogy in Spain, brings students closer to the professional practice, where multiple agents intervene and negotiate to produce a collective work.

Each stage ends up with a short presentation of the work undertaken. The students group acts as a collective forum in which, through debate, a critical knowledge about the concept of levels is constructed, allowing the introduction of the 4th dimension in collective housing design.

The 2011 workshop and the Solar Decathlon Europe (SDE) 2012 design charrette
This year, the Master workshop ran in parallel with the SDE 2012 proposal development and involved the same group of students. It is then worth to explore the synergy between both experiences and the way they inform mutually. Some preliminary information about the SDE competition and the UCH CEU team participation is needed.

SDE Competition
SDE is an international universities competition in the European context, originally held in US, to design, build and test a single family prototype, energetically eco-efficient and limited to 74 sq. meters. The "decathlon" term refers to the evaluation process by an external jury which, since the first European edition in 2010, tests the following ten features: architecture, engineering and construction, energy efficiency, electric power balance, comfort, functionality, communication and social consciousness, industrialization and market feasibility, innovation and sustainability. The main goal of the competition is the learning experience of

the students taking part in the development and construction of a 1:1 scale project. The brief of a single family unit should be understood in these terms. However, it is a serious limitation to a broader sustainability discourse on housing. The single family housing scale, a legacy of the North American edition, doesn't fit neither in the present European context, nor in the future urban development trends. Moreover, the SD evaluates the performance of an isolated object treated as a readymade machine. This view is unsuitable when housing is understood as a process in which users shape their habitat over time. Both a collective dimension as well as a time dimension could improve the competition's objectives.

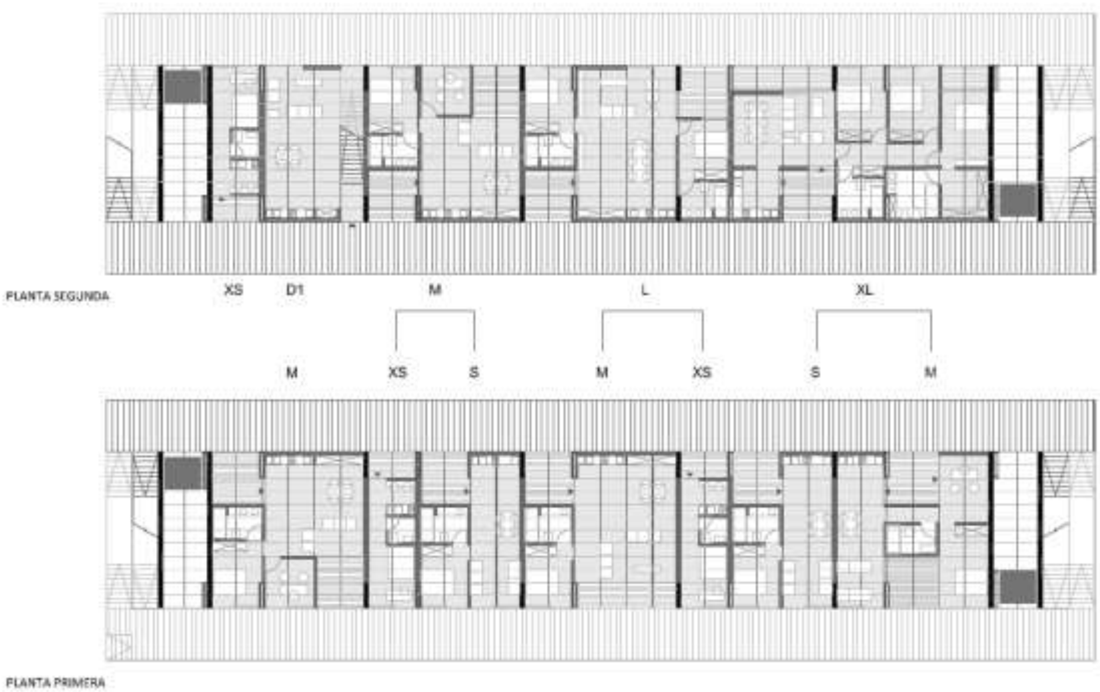

Figure 1: Support design by students M. Villar, B. Ferrer (2011)

The house designed and built for the Solar Decathlon Europe 2010 by the School of Architecture at the CEU-UCH University in Valencia was conceived on a strong modular concept that allows users to configure their own house according to changing spatial needs and financial resources. The proposal was in fact a system of configurations based on the combination of modules which originated S, M, L or XL units. There was a basic 3D full prefab module, 1,85 x 7,80 m long, at the core of the project which offered spatial diversity thanks to the different position of the small courtyard inside.

The system variations were both at the module level and in the composition of different modules at the whole housing unit level. Users, according on their space requirements, (for a family, as a second home, workplace, etc) may choose the number of modules of the house and their specific internal variation. The dimensional limit of the competition reduced the possible configurations of the built house to 6 modules. The modules' design and construction were the result of a detailed and thorough process that involved many faculty members together with a group of graduate students. The two main courtyards were used here both for the articulation of the interior space, segregating three basic areas of the dwelling, as well as for the efficient bioclimatic behavior. Living-dining room, kitchen, and bedroom-study are organized around them, making cross-ventilation and indirect natural light easier. Moreover, the contact of these courtyards with the façade helps defining the entry area and strengthening the spatial depth of the house. The SML House was the highest ranked of those presented by Spanish universities during Solar Decathlon Europe, received the most votes from the 190,000 people who visited the works of the 17 universities participating in the competition and won the Industrialization & Market Viability test.

The SDE 2012 proposal inherited the modular concept and the patio as a spatial and bioclimatic device of the previous SDE edition. Both strategies fit into the Spanish national housing regulations in terms of space and natural ventilation requirements while they allow for a wide variety of combinations. As a further guarantee of continuity, many students taking part in this year's Master edition were already involved in the SDE 2010 competition. At the time of starting the Master workshop, the basis of the design strategy for the house were already settled and they focused on the addition of several spatial modules in order to create customized units. The reduced space inside each module was initially designed for polyvalence: a fitted out envelope contains part of the furniture as well as the main necessary services, liberating space for users who may qualify it according to their needs.

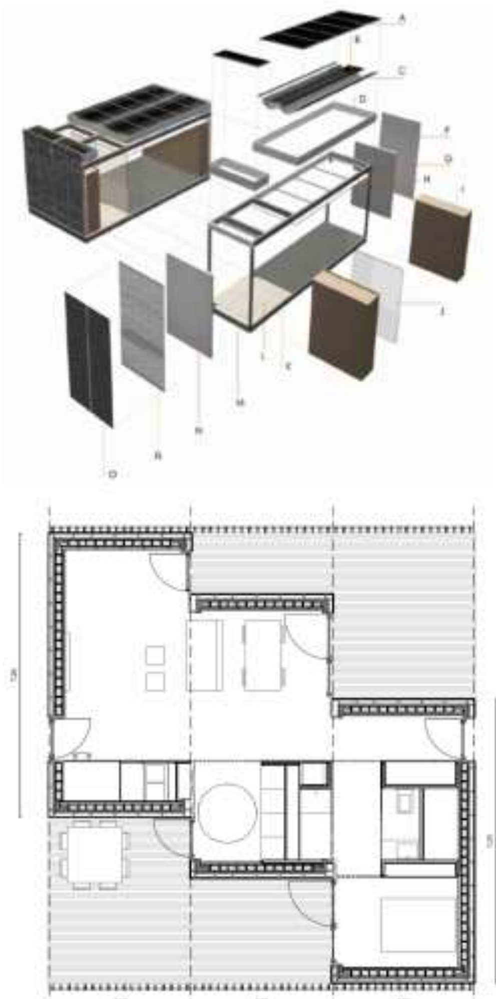

Figure 2: Axonometric of SDE 2010 module (top), and layout of current SDE 2012 proposal, sept 2011(bottom)

Figure 3: SMLsystem CEU-UCH, SDE 2012 proposal (sept 2011)

Interaction between Master module's Workshop and SDE 2012 proposal development

The brief of the Master's workshop held this year invited students to apply levels concept design in order to explore the collective aggregation prospects of the basic spatial modules that they were simultaneously designing for the SDE proposal. The SDE 2012 initial proposal did not differentiate levels clearly, due to the practical requirements of the competition. Building in a short time by inexperienced students slanted the initial design toward prefabricated 3D modules. Material and dimensional choices already taken in the SDE housing proposal were to bias strongly the supports design. However, the workshop tried to construct an alternative lecture starting again from the identification of levels. Students were asked to define an access system, a load bearing structure and the collective services layout according to capacity criteria, taking modular coordination for granted, components and wood construction as defined in the SDE proposal.

Students split into 4 groups: each of them explored design solutions capable to provide an optimal capacity to the support level in a synchronic and in a diachronic mode. Each group picked one of the two different access systems suggested, the corridor and the central access core. Students should design in other to allow diachronic change in terms of future units' split. It meant testing the capacity in terms of access from bigger to smaller units. Students also had to determine the location of the main service ducts, as well as the load bearing system around the access core and within the façade system, allowing the synchronic configuration of different SDE proposal layouts, named respectively XS, S, M, L, XL after their size. They also had to consider the accessibility of the collective services shafts by means of floor trenches, raised floor, double ceilings, etc.., in order to make interior layouts changes possible, attaining the position of kitchens and bathrooms.

Although the infill level development has been basically understood as a mean for testing support capacity, students had the opportunity for approaching the design of industrialized modules and components such as bathrooms, prefab panels for layout and cladding, lattice components, etc, which connects with the materials developed for the SDE 2012 proposal.

Time constrictions brought to restrict the analysis and development of urban level at the end of the exercise. As a kind of final test on the support proposals, the students were asked to reflect on the insertion of their prototype in a real urban context freely chosen. In some cases this process leads to a further detailing and adaptation of the façade system as a response to the surrounding environment, considering the significance that envelope portray to the public space.

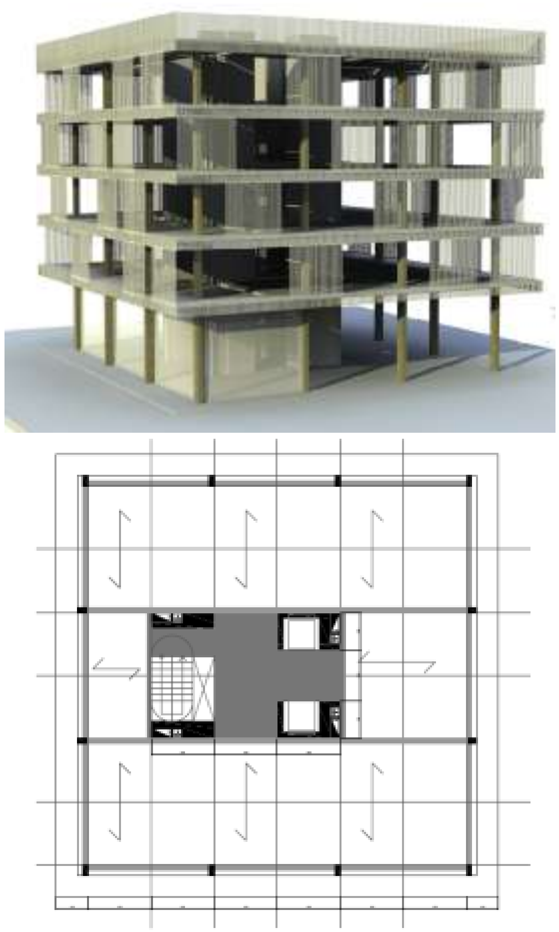

Figure 4: Support design by students L. Navarro, I. Soler (2011)

Figure 5: Dwelling layout proposal by students M. Villar, B. Ferrer (2011)

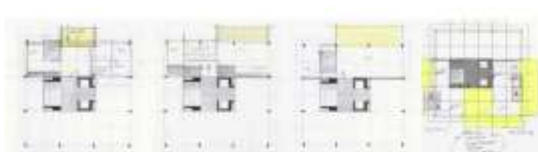

Figure 6: Support capacity test: layouts developed with non architectural literates by students L. Navarro, I. Soler (2011)

The current (September 2011) development of the proposal reinforces the input from the Open Building theory as introduced in the master module. The new SMLsystem house adopts now a concept of dimensional coordination and of compatible elements leaving behind the idea of 3D modular construction. A basic structural system made out of L wood columns (that combined can form X shape supports) and cross laminated wood slabs (CLT) made possible a great variety of layout combinations both horizontally and vertically. The main L supports grid is stiffened by vertical CLT panels making possible the superposition of up to 5 levels. However, for the 2012 final phase in Madrid, the house will be pre-assembled in three sub-modules 3,6 x 7,2 m in order to fit into the tight competition schedule. These elements reflect the main spatial modulation of the SMLsystem that combined with sliding wooden lattice allows widening the patio/terrace outside, stretching the modulation up to 10,80 m. Now a clearer distinction between levels is made. The support consists of the wood structural system, a ventilated larch wood cladding, and the vertical lattice system which combines wood and ceramics. In the multilevel and collective configuration a vertical core, that is subject to the same spatial modulation (3,60 x 3,60), is added to the support configuration. In the specific case of a lineal building a further access deck 3,60 m width extends the basic 10,80 m span of the housing units.

The infill is organized into two main levels. The first one is fixed during the customization process of the units. It consists of pre-fab "wet units boxes" that bring together all the necessary connections for the kitchen and the bathroom(s) and, in the specific case of the competition, an "services box" where most of the photovoltaic, electric, HVAC, home automation and plumbing elements have been joined up. The second one is a variable level and includes the furniture and the home appliances.

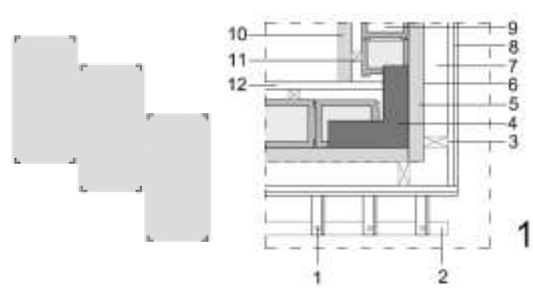

Figure 7: The structural L shape supports grid at floor level and a detailed horizontal section of the SMLsystem house (Sept 2011)

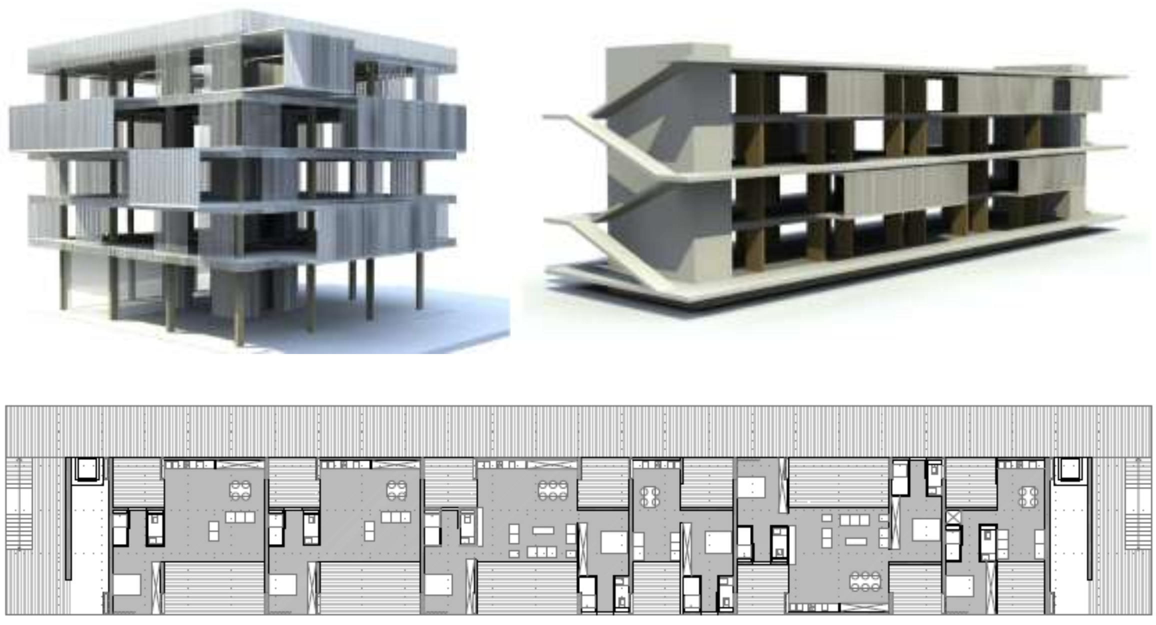

Figure 7: Lineal and tower supports preliminary design as resulting from the assembly of compatible elements of the SMLsystem, above. A possible layout of a lineal block that includes vertical cores and the access deck, below. (Sept 2011)

CONCLUSIONS

The Open Building approach to housing, by taking into account time, the 4th dimension, and the users' control in shaping their own domestic environment, when introduced to the studio learning format, helps students to question themselves about their previous skills and knowledge. The focus of the Master module exercise is not the product as much as the process and students are challenged to develop a more critical vision of urban habitat and of housing solutions.

In response to the module's evaluation questionnaire, students revealed their surprise in discovering not only a different way of conceiving collective housing, but also recognized the value of a more collaborative process in design. In this case, thanks to the team work and the swapping of proposals, they understand in a straight but effective way the necessary distinction between the more permanent parts and the less permanent ones in housing design. It questions the idea of dwellings as a finished product, due to the existence of discontinuity between building uses over time. Moreover, when requested to test their design proposals outside the classroom and with non professional subjects, the question of users' control and the surge of unexpected variety of lifestyles clearly emerge. This experience brings into the discussion the architect's role not only as a mediator between different parties involved in the design and construction of a building, but also as a mediator in the spatial negotiations about dwelling. Testing the "capacity" of others' design put under scrutiny not only the design's qualitative aspects in terms of space adaptability and technical systems feasibility, but it undermines as well the "average user" syndrome that too frequently underpins housing design.

The hybridization between de SDE 2012 proposal and the collective housing module resulted initially (March 2011) in a design charrette that made clear the intrinsic limitations of the SDE competition rules. However, it also challenged some of the assumptions on flexible design and space adaptability previously imbued in the ongoing proposal development. The contradiction stems out from the contrast between the need for delivering a fully equipped prototype and the application of the concept of users' control at infill level. Moreover, the collective dimension that is a preliminary condition for the module theory itself clashes with the SDE rules, since there is not enough room, literally and figuratively, for developing a proposal that tackles this issue without losing any chance of competing on equal terms with other teams.

Nevertheless the current development of the 2012 SDE CEU-UCH proposal has steered towards a better integration of the Open Building concepts as learned by students during the master module: a sharper definition of subsystems and compatible elements, a dimensional coordination and a renewed role given to users as developed in the market viability draft of the SMLsystem house. A significant progress has been made in tuning up Open Building criteria into the SDE proposal since first proposal drafts and it is now commonly understood by the student team that there is still room for improvement during the development of the proposal from now until the competition in September 2012.

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Ordering the Structure of Light Wood Framed Row Houses to Sustainably Accommodate Change: San Francisco's Sunset District as a Cautionary Tale

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ABSTRACT
As the last neighborhood developed in San Francisco, the center of the Sunset District stands today as one of the least altered built environments in that city. Through the detailed survey of 12 blocks, original construction documents and field research, this paper argues that the Sunset District tunnel houses have limited opportunities for change due primarily to their design and how they were constructed. By considering construction as the assembly of elements with varying degrees of permanence and using Open Building hierarchies, conventional construction techniques, such as light wood platform framing, can be used to structure the built environment to better accommodate change without the need for specialized systems or materials.

KEYWORDS:
ordered structure, row housing, light wood framing, San Francisco, Sunset District

INTRODUCTION

Light wood frame construction accounts for over 90% of all new buildings in North America (Thallon 2008), and this building method is still used for the bulk of new residential construction, both single-family and low-rise multifamily, in the United States. As the only commonly used building system consisting of a low carbon, low embodied energy, and renewable resource, light wood framing will continue to be an attractive alternative for housing construction in the foreseeable future. Consequently, the longevity of housing using conventional light wood framing and how it accommodates change must be examined.

While "Open Building" research into light wood framing in the United States to date has focused on single-family detached houses, the suburban sprawl associated with this building type has fallen increasingly out of favor over the past two decades as progressive planners, developers, and architects have promoted denser, more compact and connected models of development as more walkable, livable, and healthy (Larco 2009). As 18 percent of all CO_2 emissions in the United States were a result of gasoline consumption for personal vehicle use (U.S. Department of Energy 2009), reducing automobile use not only reduces congestion but also reduces one of the major sources of greenhouse gas emissions. Increasing the density of housing and associated development reduces the need for automobiles by creating the minimum levels of density needed to support a public transit network and allow residents to walk for shopping trips (Smart Growth Network, 2010). Urban form, specifically increasing both the density of housing to exceed 13 residents per acre and employment to exceed 75 employees per acre, is associated with a reduction in single occupancy vehicle travel (Frank and Pivo, 1995).

Light wood framed row houses offer a more sustainable and viable alternative to the current development of single-family detached houses. By removing the underutilized five-foot side "yards" between the typical contemporary detached houses, row houses can increase density to levels necessary to reduce single occupancy vehicle travel. Sharing or abutting walls with neighboring houses, row houses reduce the amount of energy required for heating and cooling. At the same time, row houses still provide many of the amenities American homeowners seek in a single family detached house. These include ownership of both the property and building, attached garages, backyards, adequate privacy, and multiple stories. In contrast to multilevel, multifamily housing, row housing offers a wider array of options for transformations as space is more readily available for extensions outside the original building envelop both horizontally and vertically.

This paper documents the transformations of conventional light wood framed row housing in San Francisco's Sunset District over 60 years at multiple scales. While not designed or built with longevity and future adaptations in mind, these row houses highlight the importance of using Open Building principles of support and in-fill to create a hierarchy that orders light wood framed systems. It is critical to examine not only how a single row house can be transformed but also how the subsequent interventions of individual homeowners impact adjacent properties and the neighborhood as a whole. As an increasing number of houses are being demolished and replaced, the Sunset District serves as a cautionary example for architects and developers of light wood framed row housing today.

OPEN BUILDING AND CONVENTIONAL CONSTRUCTION

The origins of the Open Building movement are most often associated with the publication of N. John Habraken's *Supports* in 1961 where the concept of "support structures" that are in filled to create housing is introduced. What is less commented on is that Habraken promoted the use of "modern production techniques" and "assembling prefabricated elements" for both support and infill systems (Habraken 1972). While there are many benefits to prefabricated construction systems, including reducing construction waste and onsite construction time, conventional light wood frame construction has dominated residential construction over the past 50 years. This is in spite of many attempts in the past decades to promote prefabrication, including HUD's Operation Breakthrough in the 1970s and Dwell magazine's Dwell Home competitions in the 2000s.

In built multifamily examples of support and infill or "base building" and "fit out", such as NEXT 21 in Osaka, Japan, there is a clear material difference between the concrete structure for the support and the aluminum panels, as well as other materials, for the infill (Kendal 1999). This reinforces the hierarchy of what is permanent and what can be transformed over time. In conventional light wood frame construction, no clear material hierarchy between support and infill exists as the same wall system is used for load bearing and non-load bearing walls. This does not mean that a hierarchy or support and infill system cannot exist in this type of construction. Ari Friedman (2002), in his book *The Adaptable House*, reinforced the notion that "limited adaptability is possible" in platform wood frame structures with the exception of interior walls where long-span, engineered floor systems are used. Consequently, Friedman focused primarily on strategies for interior transformations in his study of adaptability in wood framed housing.

In "The Control of Complexity," Habraken (1987) distinguished between two types of hierarchies. The first is the "part-whole hierarchy, a hierarchy of assembly" that breaks down the physical components of a building, such as studs make up walls and walls make up a house. The second is the "control hierarchy" or "dependency hierarchy" that designates levels of intervention in which infill is dependent on the support system and can be manipulated independently over time. The major distinction between the two is that the lower level, the infill, in a control hierarchy can be changed without altering the higher level, the support. A control hierarchy can have multiple levels that range in scale from the city to the placement of furniture and could be used to break down a given system, such as light wood framing, into multiple levels of control.

Based on the amount of time a given level might change, Stewart Brand (1994) developed a six-step hierarchy, based on the work of Frank Duffy, that disentangles building components with different rates of change and includes site, structure, skin, services, space plan and stuff. With founding partners Bensonwood Homes and the MIT House_n Research Consortium, the OPEN Prototype Initiative was responsible for the design and construction of two prototype houses that primarily use conventional building materials and adhere to Brand's hierarchy. Unlike conventional light wood framing, both prototypes used timber frames for load-bearing structural elements and then used prefabricated walls made from light wood framing in order to separate structure and skin. Services such as water and electricity that typically run inside walls and floors in conventional light wood construction were routed through raised floors and accessible chases in walls. While there are significant strengths to these strategies, there are is one major concern with Brand's model. Space planning occurs within the structure, skin and services, making transformations outside of the original envelope more difficult. As was the case with Friedman's Grow Home, change is primarily accommodated through interior renovations.

ORDERING STRUCTURE

While specialized open building construction systems for residential supports and infill may one day be as accessible and comparable in cost, conventional wood frame construction can be improved to support building longevity and better accommodate change. As noted earlier, light wood framing is the construction and structural system overwhelmingly used to build most housing in the United States. While arguably malleable, conventional light wood framing integrates many building systems (structure, insulation, plumbing, electrical) into one, which Open Building advocates argue is not able to accommodate change over a long period of time. Yet, a number of houses using light wood platform framing, including San Francisco's Victorian houses, have been transformed and adapted to new technologies for over 100 years. Light wood framing itself is not an impediment to change, but how it is deployed could be.

By considering construction as the assembly of elements with varying degrees of permanence, conventional construction techniques, such as light wood platform framing, can be used to structure the built environment to better accommodate incremental change. How a house is built influences how it can be changed. Seemingly simple decisions during construction, such as which direction to run joists in a given space, can assign some walls to be more permanent, either through structure or services, and less likely to be altered than other walls. The larger organization of permanent and less permanent elements, supports and infill, influences how a house can be transformed. Consequently, a hierarchy based on how a building can be changed is necessary.

Using light wood frame platform construction, an order of permanence can be developed and used to structure incremental change. In a two-story house, the foundation, vertical load-bearing walls and floor joists are the least likely to be changed and are considered primary assembly elements. The floor joists are considered primary because the direction they span determines which walls below are load-bearing. The second floor load-bearing walls and ceiling joists or trusses are dependent on the walls and floor joists below but can be altered without having to alter any primary assembly decisions. These elements are considered secondary. Finally, the tertiary elements refer to all non-load-bearing walls on either the first or second story as they can be altered without disruption to primary and secondary elements. In places with extreme lateral loading, such as seismic zones, walls not carrying vertical loads, tertiary in the order of permanence, may be needed to carry lateral loads. This does not mean they cannot be altered, but after any transformation, the capacity of the altered structure to resist lateral loading must be reassessed. Any lateral support removed must be compensated for with another transformation.

While not used in contemporary housing, light wood balloon framing has a different order of permanence and offers a useful comparison to how permanence is ordered in platform framing. The foundation and load-bearing walls are primary. In balloon framing, the stud walls run the entire height of the house, so the order of permanence is not tied to a vertical hierarchy. Secondary elements includes all floor and ceiling joists which could be raised, lowered or completely removed without altering the load-bearing walls. Finally, all non-load bearing walls, including single height interior partitions and the double height non-load bearing exterior walls, are all tertiary elements. While both balloon and platform framing have non-load bearing tertiary walls that can be treated as infill, each story of this wall in the platform framed house can be alter without disturbing the other. This is not the case with balloon framing as the lower and upper floor walls are a single structural element using continuous studs. Without ordering the permanence of each system, these subtle yet important differences could be missed in the design and construction of new housing.

It is not enough to offer legible opportunities to alter tertiary elements and, by doing so, accommodate incremental change. There must be a shared understanding of how additions and alterations could be realized. Structuring incremental change across lot lines ensures that each house can be transformed in the same way without sacrificing the quality of existing spaces, those of the house being altered or those of a neighboring house, or impeding any transformations a neighboring house might undergo.

CASE STUDIES IN SAN FRANCISCO

The geography and topography of the San Francisco peninsula influenced the density and type of housing constructed there. Steep hills and limited land encouraged the development of housing unlike that found in other large cities of the western United States, such as Los Angeles and Portland, Oregon. While not technically row housing, as party walls are not shared and some cases there are small side yard setbacks of about three feet, the Victorian houses and Sunset District tunnel houses in San Francisco offer contrasting examples of higher density single-family housing using light wood framing.

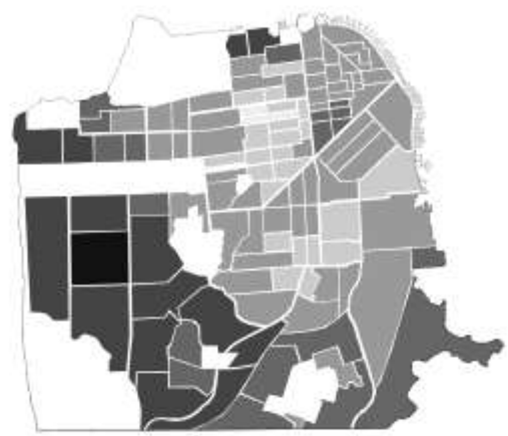

Figure 1: The average age of housing in San Francisco by neighborhood with light gray being the oldest, Victorian houses that remained after the 1906 earthquake, and black denoting the newest, the heart of the Sunset District.

Victorian Houses

In her book *Built for Change*, Anne Vernez Moudon (1986) focuses on the adaptability of the Victorian houses that have accommodated a significant amount of change without undergoing significant physical alterations. She credits this to the generous dimension, regular shapes, and the variety of possible connections between rooms as well as the organization and structure that permit every room access to daylight and ventilation. Furthermore, she appreciates “the malleable construction system of the wooden houses” as it has allowed the Victorian row houses to accommodate change through flexible alterations such as adding rooms to the rear or raising the entire house a full story for a garage. Renee Chow (2002) documented in detail plans how the Victorian houses currently accommodate a wide range of occupants and their lifestyles and in particular the role that access, claim, dimension and assemblage all play in accommodating change. In particular, the density of the Victorian houses has increased by easily converting each story into a separate flat due to the organization of the access and assembly.

The structural order for a San Francisco Victorian house is straightforward as it is balloon framed with the load baring walls running perpendicular to the street. The foundation and shared party walls are primary. The floor and ceiling joists are secondary, and all remaining non-load bearing walls are tertiary. Consequently, transformation to the front and rear of the Victorian houses are straightforward and relatively uncomplicated. It is obvious from Chow’s documentation of how these houses have changed over time, that the primary and secondary elements have remained constant while the tertiary elements have been significantly transformed on the interior to break up houses in multiple units and on the exterior to create storefronts and add new spaces in the rear.

Sunset District Tunnel Houses
As the last neighborhood developed in San Francisco, the center of the Sunset District stands today as one of the least altered built environments in the city. Produced in the late 1930s and early 1940s by a relatively limited number of developers using similar plans across numerous blocks, the single-family row houses served as "starter homes" offering suburban amenities, such as attached garages and back yards, with easy access to downtown. Despite 70 years of use and shifting demographics over that time period, relatively few of the houses show any sign of alteration. This suggests that either the houses as-built have fulfilled the changing requirements of San Francisco's population or, more likely, people move when the Sunset house can no longer meet their needs. It is clear that the design and assembly of these houses seriously impedes incremental change.

Despite the small range of floor plans, all of the houses in the Sunset District share some basic design attributes. The Sunset District consists of long narrow blocks, all platted 25-foot wide and 125-foot deep lots, and the houses are typically set back ten to fifteen feet from the sidewalk and span the entire width of the lot. As designed, all of the living space is on the upper floor, and due to this, each two-story house has an exterior stair to the entry. Collective spaces, such as the living and dining room, open onto the street while individual spaces, namely bedrooms, open onto the backyard with service spaces, like the kitchen and bathrooms, in between. Primarily used as a garage, the entire ground floor is labeled as a "basement" in the original plans and is accordingly unfinished with studs and floor joists exposed with only an eight foot height between the rough concrete slab and the bottom of the floor joists. The houses are typically more than two rooms deeps and require lightwells and skylights to ensure each room has adequate ventilation and daylight (Figure 2). As over three quarters of the row houses in a twelve-block study of the Sunset district are tunnel houses, named after the tunnel-like entry, this paper will focus on this typology.

The assembly of the tunnel house is complex and severely limits incremental change. The Sunset houses primarily use light wood platform framing, and consequently, the party walls are actually just two stud walls built on either side of the lot line and not a shared wall. This allows for one house to be transformed or altogether demolished without disturbing neighboring units. Most joists run between three load-bearing walls, one along each of the lot lines and the third dividing the width of the house into a 14-foot and 10-foot wide dimension. In the basement, a series of posts and beams are used for all interior supports, and the floor joists at the front and back of the house are turned parallel to the first set of load-bearing walls, in order to create three-foot cantilevers, which require both the front and rear façade to be load bearing as well.

These cantilevers are a result of the Federal Housing Authority (FHA) design guidelines for insuring mortgages that limited the size of the ground floor. In order to initially create slightly more living space, the ability to easily transform the front and back facades was compromised.

As the entire perimeter of the tunnel house is load bearing, extensions, alterations and additions to both the front and back are difficult. The location of the existing living spaces on the upper floor as well as the cantilevers further complicated any extensions or additions. Services and the walls that contain plumbing are perpendicular to the load-bearing walls, blocking any attempt to significantly transform the interior spaces. The height and design of the basement makes any alterations to this space difficult. Transforming any part of the ground floor into a habitable area would be limited to the space adjacent to the rear wall as it provides the only windows on this level. The post and beam system used on the ground floor also drops the ceiling another foot imposing a boundary on any attempt to renovate the basement. Furthermore, the proximity of the house to the sidewalk and lack of sectional change between the sidewalk and ground floor would make any transformation of the front part of the basement awkward.

Consequently, the order of permanence for the Sunset tunnel house is complex, despite being platform framed, and impedes incremental change. The primary elements include the foundation, ground floor load-bearing walls, which include all perimeter walls due to the cantilevered joists at the front and back of the house, and upper floor joists. Instead of load-bearing walls, the interior vertical supports are a post and beam system and are also considered primary. On the upper floor, the three parallel load-bearing walls, the rear façade, ceiling joists and service walls, which run perpendicular to the load-bearing walls, are all secondary. Only the interior non-load-bearing partitions are tertiary in the tunnel house, and there are very few of those (Figure 3). Consequently, a secondary or primary element must be altered in order to make an addition or extension. This is the primary argument for why the Sunset District has changed so little. Finishing the rear portion of the basement and enclosing the tunnel are the only easy transformations, as they do not require altering any existing part of the tunnel house. These moves simply add more tertiary elements.

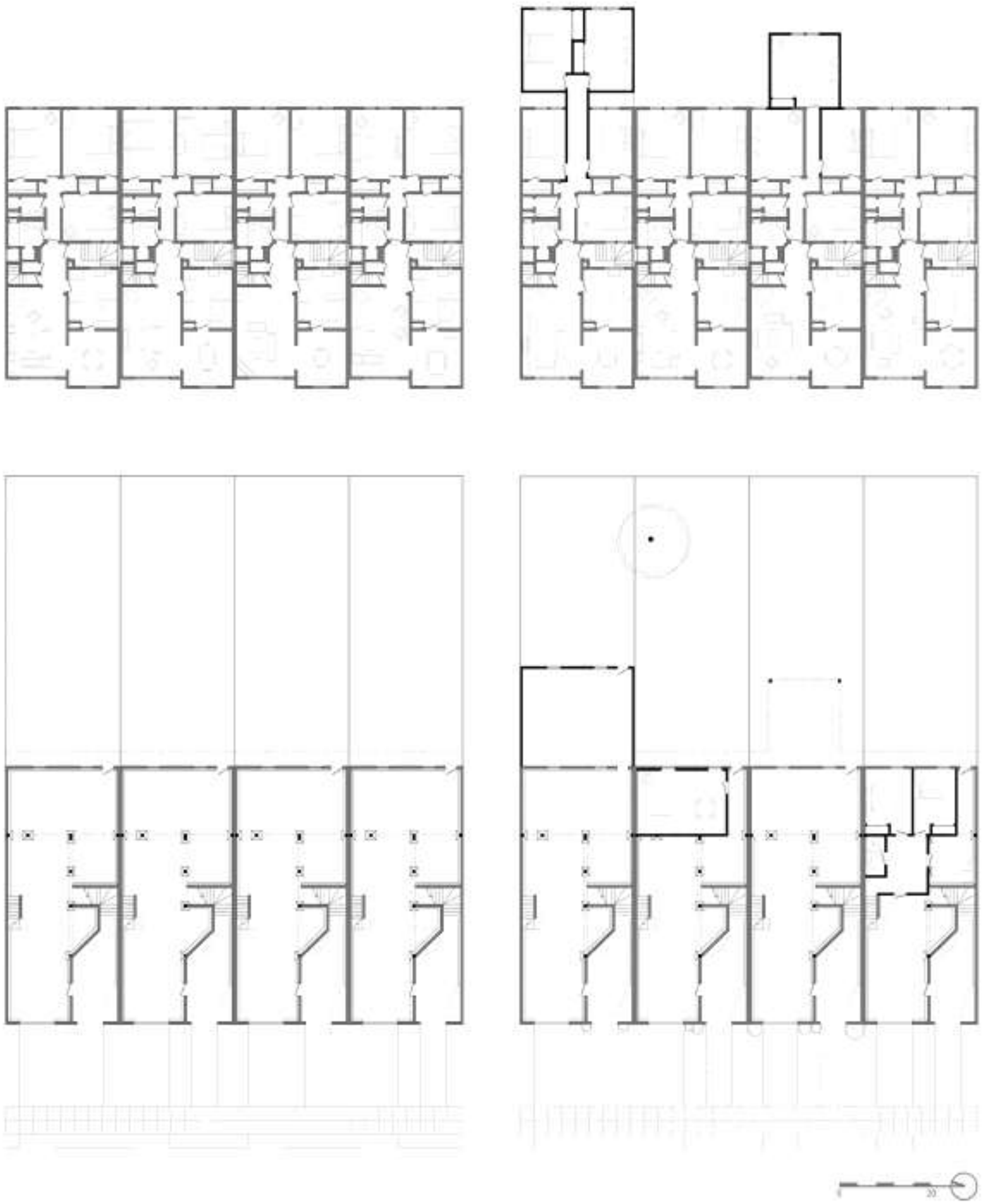

Figure 2: *Four Sunset District tunnel houses as built (left) and showing the limited range of transformations (right).*

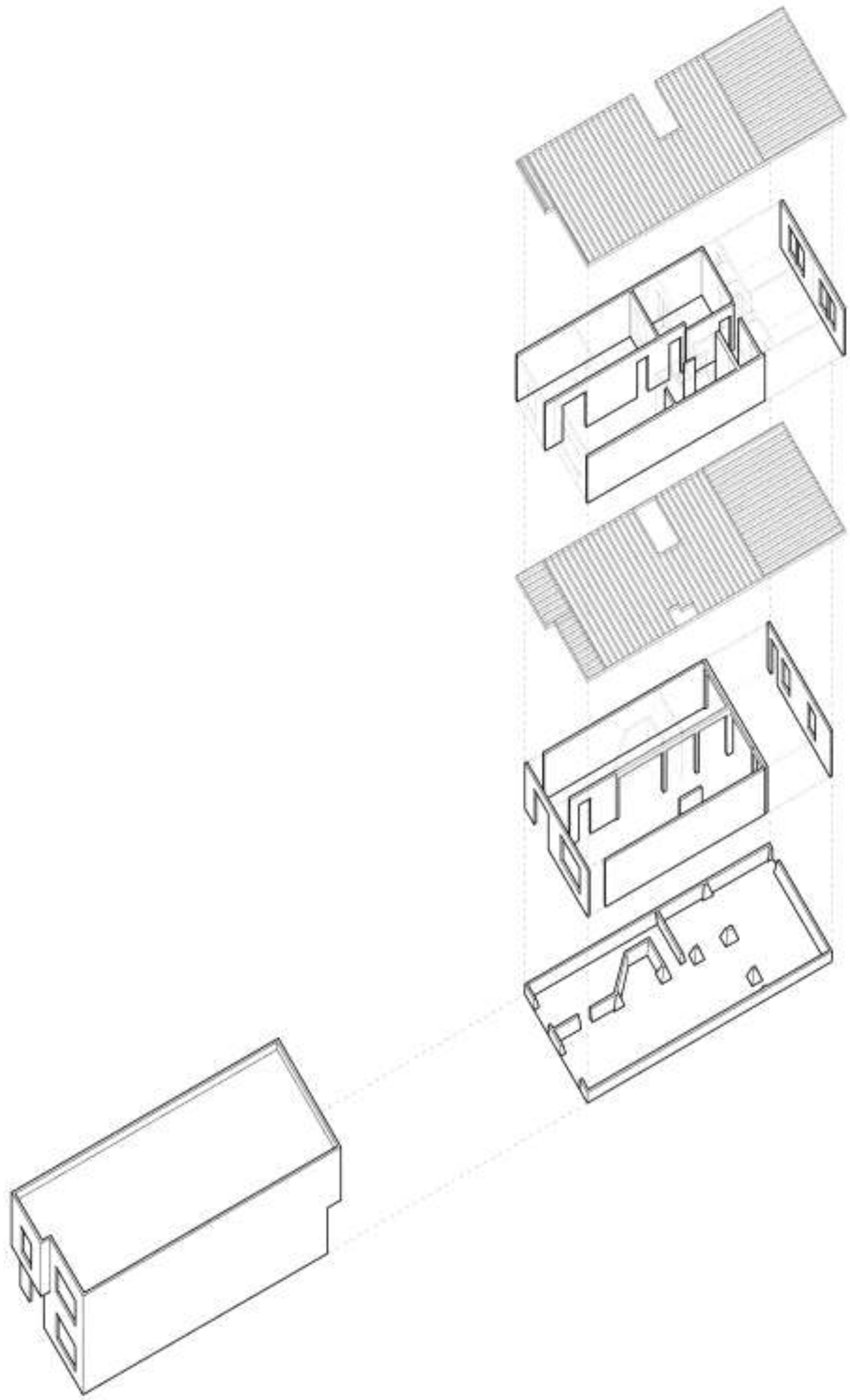

Figure 3: The structure of the Sunset District tunnel house ordered in terms of permanence. Primary and secondary elements (supports) are shown in black while the limited tertiary elements (infill) are shown in grey.

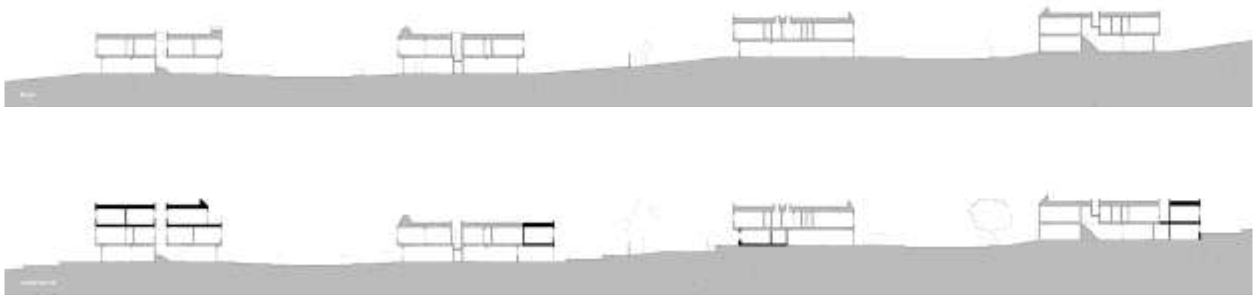

Figure 4: Sections through two blocks of the Sunset District Tunnel houses showing the houses as built (top) and renovated (bottom) with renovations highlighted in black.

Access is equally problematic for incremental change in the tunnel house. First and foremost, there is no way to access outdoor spaces directly from the living spaces. A narrow, unfinished back stair leads into the basement, so one must always pass through the ground floor to access one of the most treasured amenities in the Sunset, the back yard. While a handful of houses have added decks and stairs to the rear of the house, people must still pass through bedrooms, typically individual and private spaces. There is also no way to access the backyard from the street without passing through the house. The consequence of this restricted access is that the back yards in the Sunset District are grossly underutilized on just a day-to-day basis and to accommodate change. In a likely effort to minimize the amount of space used exclusive for circulation, the entry tunnel delivers inhabitants to the center of the house and the front door opens onto the narrow corridor linking the living and sleeping spaces.

As a result of all these limitations, only one-quarter of the houses in the 12-block survey of the Sunset District show any sign of incremental change. Furthermore, any alterations made are limited to finishing the basement or enclosing the tunnel on the ground floor, adding entire rooms to the rear of the house on the upper floor, or adding a third story. With each of these transformations, the quality of the original spaces is compromised, particularly in terms of daylighting and view. As there is no way to structure the incremental change that is actually taking place in the Sunset District, one individual can make it virtually impossible for his neighbor to construct a similar transformation as well as reduce the quality of his neighbor's spaces, for example, by blocking lightwells and skylights from receiving any direct sunlight with a third story or rear addition (Figures 4 and 5).

CONCLUSIONS

In the fifty years after the publication of Habraken's *Supports*, there has been slow but growing interest in Open Building principles. During this time older neighborhoods in San Francisco have accommodated a significant amount of change, including the transformation of the Victorian row houses and the adaptive reuse of warehouses in the South of Market. Though densities have increased and uses radically altered, these neighborhoods in San Francisco still have a strong sense of place. While this is the case for many urban areas built around or before the early twentieth century, most housing built over the past fifty years resembles the unalterable Sunset District tunnel houses more than the malleable Victorian houses. In fact, the tunnel house was a model for thousands of houses constructed after WWII in the new suburbs south of San Francisco. The result of several decades of districts like the Sunset is an increasingly placeless built environment with a transient population.

Both the Victorian and Sunset District tunnel houses used conventional light wood framing of their respective eras, but how the structure was deployed in each case is critical to accommodating significant and meaningful change in the future. More importantly, the initial construction of the tunnel houses did not allow for a shared understanding how additions or alterations could be realized. The resulting free-for-all negatively affects the existing spaces of the house altered and the larger fabric of the Sunset District. Instead of writing off conventional construction methods in favor of prefabrication that has yet to gain traction in the United States, ordering the permanence of light wood framing and structuring legible opportunities for transformations can accommodate incremental change in the vast majority of new construction today.

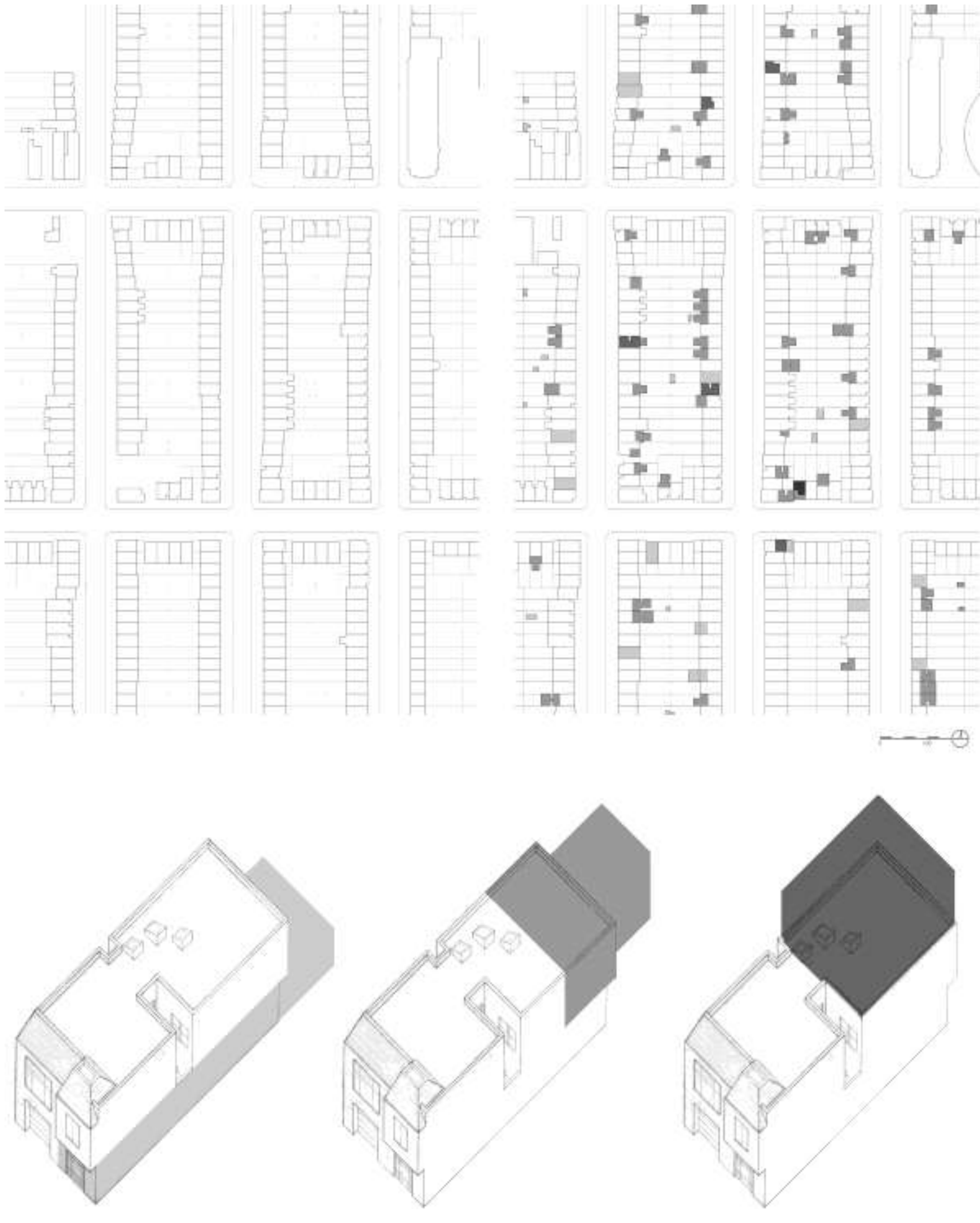

Figure 5: Several blocks of the Sunset District as built in 1940 (top left) and as renovated in 2010 (top right). Each shade of gray denotes the type and floor level of the alteration.

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How to Promote Sustainable Remodeling of Apartment Housing in Korea with an Environmental-Economic Approach

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ABSTRACT
Sustainable development has been the no.1 issue in architectural society since mid 20c. The top policy priority would be placed on attaining an economic stability and sustainability at the same time. Under these circumstances, a rapid growth has been shown in environment-friendly material market in Korea since sick house syndrome appeared. In spite of efforts to vitalize sustainable architectures, most of households don't implement environment-friendly interior remodeling. It is mostly resulted from both the ignorance and high price. To meet the need of users with diverse and accurate information about sustainable architectural materials and methods, it is required to figure out consumer's interests and their priority order related with interior remodeling including interior finishing materials and environment friendly performance such as energy saving, water saving, IAQ(indoor air quality), and non toxic chemical. This study surveys present papers with environmental-economic approaches which are mostly about; present statics and decision making procedures of interior remodeling patterns and prior interests in the relationship with the general characteristics of users and proper method to evaluate the benefit from using environment-friendly material and a method of construction for benefit-cost model and finally to encourage sustainable interior remodeling of apartment housing by individual consumers.

KEYWORDS:
apartment housing, interior remodeling, cost-benefit, environmental economics, MWTP, MWTA, decision making, AHP

INTRODUCTION

Sustainable development has been no.1 issue in various fields to reduce environmental loads worldwide since mid 20c. Though revised regulations and financial investment have seemed to attain goals in Korea, there still have lied complex and worsened environmental issues such as development without considering environment, urban air pollution and endocrine-disrupting chemicals, etc. Though revised regulations and financial investment have seemed to attain goals, there still have lied complex and worsened environmental issues such as development without considering environment, urban air pollution and endocrine-disrupting chemicals, etc. Due to the recent global economic down-turn and longer reconstruction terms, the market for remodeling of apartment buildings has been steadily expanded. Advantages of remodeling can be a diversity of factors including its shorter construction period or less construction waste and debris compared to new buildings, however, they can be comprised of two, 'environment-friendliness' in view of public matters and 'healthiness' or 'economic efficiency' that individuals pursue. Though the two values have been regarded incompatible, a recent emerging concept in business management 'Eco Efficiency' tries to lessen loads on environment and to maximize economic efficiency simultaneously.

> Eco Efficiency =
> Value of Product or Service / Environmental Effect (Eco Efficiency: WBCSD, 1994)

There is no question in the possibility to adopt 'Eco Efficiency' into construction business with assumptions and suppositions of integrating the two values. While consumers consider interior remodeling individually, environment-friendly remodeling can meet their key interests, provided the comparison of the benefits from using environment-friendly materials to other factors affecting pricing of housing and consumers' priority can be reflected on their decision making.

Objective

This study offers an economic approach to environmental issues by surveying individual potential consumers in their decisioin making in case of remodeling their own unit of apartment housing. Residents' recognition, experience and involvement in decision making, more importantly surveyees' understanding and acknowledgement of environment-friendly interior finishing materials have been analyzed with an environment-economic view, based on theoretical analysis on the solutions to various types and causes of environmental issues.

Consequently, it aims at providing a systematic yet complementarily designed decision making model of which indexes to help consumers determine the extent of environment-friendliness they put into their own remodeling by taking environmental efficiency into consideration during interior remodeling. The model is to support object decision making, ultimately anticipated to encourage environment-friendly remodeling by offering a chance to put in standardized consideration of environment-friendliness, functional and economic benefits of envirionment-friendly remodeling, all of which have been rather generally excluded in apartment building residents' decision making for individual remodeling.

The items they want to improve by remodeling and the reasons have been questioned and AHP (Analytic Hierarchy Process) was taken to obtain priorities of benefits of environment-friendly for understanding surveyees' recognition of environment-friendly efficiency. Apart from that, professionals have been requested to give priorities among the factors to form finishing materials, arranged into three, aesthetic benefits, functional benefits, and environment-friendly benefits. The priorities and weights of the factors have been assembled. Reflecting functional priorities and weights of each category, this revised decision making process model(Kim M., 2005) can be thus applied as an alternative assessment tool for selecting finish materials item by item

ISSUES AND VARIETY OF ALTERNATIVES IN DECISION MAKING FOR BUILDING RENOVATION

Building Renovation is defined as an act or process to increase the value of building and economic efficiency by improving structural, functional, aesthetic, environmental, energy efficiencies as a result, heightening residents' productivity, comfort and health. Improvement of buildings may have a wide range of alternatives and substitutes so it is desirable to make decisions by systemactic methods and to go through analysis in terms of economic feasibility.

With particularly higher interest in interior air quality, contemporary consumers demand environment-friendliness in decision making for remodeling, being aware of Sick House Syndrome. However, making decisions in remodeling indivisual apartment units relies on their own unprofessional judgement or small size professional advisories rather than consideration of overall environment-friendliness, resulting in focusing on interior air quality limitedly. In case of new buildings or a large-scale remodeling apartment complex, increasing are compulsory usage and adoption of environment-friendly methods and materials with incentives given. Nevertheless, individual interior remodeling on a rather personal level, adoption of environment-friendly methods or materials is still rare since there is no pratical institutional basis or liabilities for them. Moreover, consumers put more stress on harmlessness to human than approaches to consideration of environmental loads by LCA(Life Cycle Assesment) which do not receive much of attention. Even as for interior finish materials, taken into account is environmental effect during usage, while their high environmental loads of raw materials or of transporting process not being concerned.

Though individual consumers have interest in environment-friendliness, there remain a barrier, the availability of trustworthy information on which alternatives are superior to others in a matter of environment efficiency, in a stage of decision making. Hence, environment-friendly remodeling should be executed by decisions based on reliable information and data with regard to environmental loads and causes with a wide awareness not by personal tastes or interests.

Economic Approach of Environmental Issues

Efficient allocation of resources in market economy means no waste of them in usage. Pareto Optimality is one of main scales to measure the efficiency of distributing resources.

For the efficiency to occur, pre-requites should be fulfilled as following. All markets should be formed for all merchandise and services under sufficiently active competition. Market failure occurs when these markets do not function properly by certain causes. One of the causes is that the market prices do not cover the costs imposed on the society for the benefits or products that the whole society experiences(Kim S., 2003).

On account of unique characteristics of environmental materials, economists claim that above-mentioned market failure can be perceived as a typical cause of environmental issues, that is, pollutions, resource depletion, ecological damages, etc. The reason why environmental issues are refered as an occasional cause to bring a consequence, market failure, is that the prices formed in the market do not bear out the values of the environmental products. Therefore, it can be presumed that environmental failure can be basically accounted as one of the economical issues, i.e., market failure. Consumers are willing to, according to economists, pay for environmental improvement and wish to be made up for aggravated environment by being compensated monetarily. In other words, they have intention, in principle, to pay extra on condition that environment is to be rectified for betterment - MWTP, marginal willingness to pay – and that to demand further recompense in case of its deterioration - MWTA, marginal willingness to accept. MWTP or MWTA of the whole society can be attained by vertically totalizing the sum of individual ones, as environmental products or services are public properties. Yet, attention should be taken into account to the follwing:

Though consumers basically have MWTP for improved environment, their intention is subject to changes depending on what they pay for once specified. Consumers encounter challenges to confirm their MWTP, suggested it is difficult to ascertain improvement or what they pay for is not familiar.

Table 1.

Survey	
Survey period	2007. 8. ~ 2007. 9.
Respondents	Residents of apartment and detached housing in Daegu city and Kyungpook province, Korea
Total no. of respondents	225 (inclusive of 20 faulty respondents) ⇒ 205 respondents analyzed

INDIVIDUAL INTERIOR REMODELING OF APARTMENT HOUSING

Main reason of considering environment-friendly remodeling

The main reasons that consumers considered environment-friendly remodeling were firstly and dominantly 'Sick House Syndrome'(http://www.epa.gov/iaq/pubs/sbs.html) followed by 'Saving environment', 'Recommendation', 'Cost Saving'. It reflects consumers' higher interest in sick house syndrome as a primary factor to make them consider environment-friendliness practically in decision making for remodeling, Group 2 planning and practically implementing remodeling showed higher answer ratio than group 1 planning remodeling only without real execution, which can be deemed as the former group went through and experience sick house syndrome themselves.

Despite high interest in environment-friendly remodeling, the reasons consumers fail to adopt it to their remodeling practices are firstly 'Higher cost compared to general materials' followed by 'Doubt in environment-friendly function', 'Lack of information on environment-friendly materials and their functions'. In other words, not much of objective information on the material and functions has been standardized, hence, consumers seem to be unwilling to pay additional cost for uncertain cost-efficiency. Moreover, consumers perceive environment-friendly materials as costly and no practical information is specifically known to public even though interest increased through media or institutional campaign. Refering to the study result mentioned earlier, 'Though consumers basically have MWTP for improved environment, their intention is subject to changes depending on what they pay for once specified.', it explains why respondents having answered 'interested' in a view of sick house syndrome or saving environment do not take on environment-friendly remodeling. Considering 'Consumers encounter challenges to confirm their MWTP, suggested it is difficult to ascertain improvement or what they pay for is not familiar.', it is assumed that distrust in environment-friendly indication marks or tags and shortage in information and convincing promotion result in the reality that they do not take up final purchase in decision making in spite of high interest.

It seems to be imperative that the consumers be familiarized and exposed to consequences of their decisions to environment through nemerial data, illustrated reference or information, even if they start to have interest in environment-friendly materials and interior air quality with regard to 'harmless to human'while experiencing sick house syndrome.

Prioritized items in case of environment-friendly remodeling (multiple selection available with priority) The top priority was interior finishing material and kitchen furniture, interior flooring material came after that In second selection, interior flooring material took the first place, followed by interior wall material.

Consumers show concerns in interior air pollution resulted from wall paper and lignocellulosic material themselves and emission of hazardous substances from adhesives as for interior finishing materials for flooring, wall and kitchen furniture. As commented above, referring to the fact that consumers' perception of environment-friendly remodeling is limited to air quality represented by sick house syndrome, it is required that they be educated and informed of the procedure where their choices of environmental loads end up as in environmental consequences worldwide, which is rather difficult to presume and unrealistic to the consumers, as well as promoted by enomomic policies like a variety of incentives and restrictions, to convince them to take up additional costs derived from selecting environment-friendly and energy saving materials.

Majority of the respondents were considering remodeling, especially for functional improvement, taking kitchen furniture as priority. The reasons to stopping them from practicing were rather economic issues and inevitable inconvenience than environmental ones as sick house syndrome. Interestingly, more than 80% of respondents having answered they are planning on remodeling were positive when inquired interest in environment-friendly remodeling and their main concern is sick house syndrome(45%). Even so, they do not take environment-friendly remodeling firstly due to higher price secondly doubt in fuction. As for general remodeling, 40% of consumers answer 'economic issue' to stop them from remodeling their properties. When objective information is not generally available and trustworthy, it is natural that consumers do not accept the need to pay additional for uncertain efficiency, which gives a concrete 'Consumers encounter challenges to confirm their MWTP, suggested it is difficult to ascertain improvement or what they pay for is not familiar.'

In addition, in spite of their high interest in sick house syndrome, they do not give much of anxiety to public issues such as recycling of material, water saving, lessening waste, for they do not regard themselves directly involved in them as the cost imposed on them is rather low, hence they do not see necessity to set relevant policies or realize the issues properly.

User recognition of environment-friendly finish materials for interior renovation

This study took a survey to 143 apartment building residents to figure out priority of important functioins and compative weight for environment-friendly remodeling through AHP. Collected was 143 respondences and 115 only was analyzed due to 28 disqualified.

Figure 5. Floor plan and exterior image of one of sample apartment buildings

Respondents took interior air quality as top priority, and sound proofing, usage of environment-friendly material, energy saving and water saving came afterwards. Interior air quality seems to be the result of high concern in sick house syndrome. Unlike pre-assumption that they would be more sensitive with the matters they can expect direct and quantitative advantage or disadvantages such as energy saving and water saving, they put more weight on indoor spatial quality(/psychological comfort), i.e., interior air quality or sound proofing. Obviously, respondents have more concerns in health and quality of life rather than energy that can be converted to monetary benefits Also, they are not very sensitive with water saving which can be regarded as a main directly quantitative utility because it is generally not very high since water bill does not incluce social overhead cost. It requires that consumers should positively perceive long-term advantages of environment-friendliness by government-driven restriction or incentive applicatioin.

Table 2.

Energy saving	Water saving	Indoor air quality	Noise control	Environment-friendly material	Total	CI quotient
0.157	0.143	0.276	0.222	0.202	1.000	0.0357

DIFFERENCE IN PRIORITY ABOUT FUNCTIONAL HIERARCHY ACCORDING TO THE PROFESSION

AHP is a versatile tool to help decision making by 1:1 comparison of items to make it possible to evaluate not only quantitatively also qualititatively.The functions to be targeted for evaluation are classified hierarchically as Level 1 and 2 as table 3 below. In AHP, the difference between scores is significant and respondents were supposed to score 1 for non-significance and 9 for absolute importance on interval scales.

Table 3. Functions for evaluation classified hierarchically as Level 1 and 2

Level 1	Level 2
Aesthetic benefits	Material
	Color
	Form
Functional benefits	Durability
	Manageability (maintainence)
	Convenience in use
Environment-friendly benefits	Indoor spatial quality(/psychological comfort)
	Energy(/Water) saving
	Load on environment in LCA

According to the mentioned above, questions were arranged to relatively evaluate the importance of functions, with changes in items in each category. Considering the critical focus on finishing materials in decision making process, interior/flooring finish material, kitchen furniture, plumbing equipment, window and door were taken as 4 materials in question, that were answered highly interested to remodel in the previous survey(Kim H., 2008).

It was assumed that these four remodeling items, interior/flooring finish material, kitchen furniture, plumbing equipment, window and door, were connected to environmental functions – interior air quality/sound proofing, interior air quality, energy saving, water saving(water tap, toilet), respectively.

When the respondents give weight to each function, the results can be matrix-analyzed to create weights of each of them. Derived weight is to be an indicator of which items to consider with priority. In selection of finishing materials, multiple alternatives are to be assessed individually, and the score is multified by weight to attain final optimum alternatives(Kim H., 2008).

Results of the survey for the experts group

Survey was for professionals in architectural design firms, building contractors and post-graduate students. Collected was 83 respondences and 78 only was analyzed due to 5 disqualified.

To avoid inner contradiction of AHP caused by lack of consistency, architectural professionals were subjected. The comparison among benefits in Level 1, functional benefits (39%) took the highest place with environment-friendly benefits at 34.9% and aesthetic benefits at 25.8%.

One thing that deserves attention was that functional benefits(39~56%) ranked as highest in Level 1 regardless of items, followed by environment-friendly benefits(26~35%) and aesthetic benefits(16~26%).

It is not in line with consumers' first choice of plumbing function and asthetic benefits to the question what drives them into considering remodeling. It concludes that consumers' initiatives of remodeling in earlier steps are to improve plumbing functions and aesthetic benefits, but in the phase of selecting finishing materials and their adoption should embrace consideration of adequate functional benefits for each category to be remodeled.

Table 3

	Material	Color	Form	Durability	Management	Convenience	Indoor Spatial quality (/psychological comfort)	Energy	Load on environment
Interior /floor finish material	0.377	0.332	0.292	0.373	0.268	0.359	0.420	0.433	0.148
Kitchen furniture	0.063	0.065	0.107	0.098	0.113	0.291	0.105	0.098	0.061
Plumbing equipment	0.284	0.185	0.531	0.217	0.270	0.513	0.315	0.412	0.273
Windows & doors	0.056	0.038	0.061	0.191	0.131	0.238	0.079	0.142	0.062

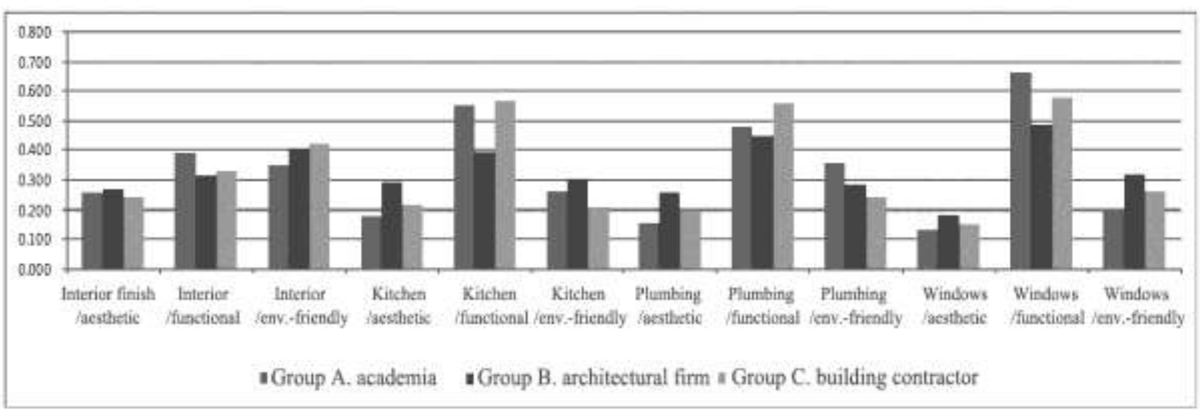

Figure 2

Weights were compared after putting the professionals in to three groups with regard to their profession(Fig.2), that are Group A. academia, B. architectural firm, C. building contractor.

It showed regardless of profession, functional benefits were overall highly acknowledged. While kitchen furniture, plumbing equipment, window and door simultaneously show high score in functional benefits except interior wall/flooring finish material, two professions (architectural firm: 0.408, building contractor: 0.424) took environment-friendly benefits as priority.

To sum up, as well as consumers, the relevant professionals are sufficiently aware of and consider environment-friendly benefits of interior wall/flooring finish materials, less aware of the importance or needs to choose environment-friendly materials for kitchen furniture, plubming equipment, widow and door, or perceive them less critically compared to functional benefits.

CONCLUSION

With an assumption that there exit different benefits to consider in categories of remodeling items, professionals were surveyed and their priorities were analyzed by AHP for decision making for interior remodeling finishing materials and their adoption with regard to environmental efficiency. Presumeably considering that consumers persue economically optimum alternatives in selecting finish materials and the economical alternatives are those with higher functionality compared to cost, priorities of benefits of remodeling were relatively compared that greatly influence the formation of prices. The benefits are given different weights by remodeling items and decision makers' identity.

This study reflected both of methods - to apply professionals' advisory results and to apply individual assessment of weights – in decision making process. Consumers can assess functional benefits of each category, apply weights of them, sum final scores and decide an optimum alternative after all.

As the process of attaining weights commensurate to the importance of functional benefits is combined into decision making process, in consumers' selecting items to remodel or their alternatives, it is deemed possible to lead or convince decision makers to reasonable and environment-friendly remodeling, The stage to derive weights by comparing importance of benefits gives a possible reflection of the functional benefits that decision makers see significant in selecting alternatives of categories after decision makers' finalizing ranges and items of remodeling.

Professionals' data analyzed by AHP can be useful for allocating alternatives weights by considering functional benefits of each remodeling category. As for remodeling of individual unit, each owner can come up with their own weights in case they want to aggressively reflect their taste using hierarchical diagram of functions provided in the study, however, referring to the results from the survey of functional benefits in each item of finishing materials to 83 architectural professionals were relatively consistent and compatible in the content, it is advisory that consumers refer to the professionals' weight on functional benefits offered by this study in their more reasonable decision making of each category of finishing materials.

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Transitioning Towards High-Quality Low-Impact Housing: +hytte, Designing for Change

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ABSTRACT
Solar Decathlon Europe is an international competition among universities aiming at making students and society aware of the possible advantages deriving from the integration of solar energy in architecture. Twenty solar houses will be built next year in Madrid, Spain in September 2012, where they will compete in ten different contests. +hytte is the NTNU contribution - Norwegian University of Science and Technology - to the Solar Decathlon Europe (SDE) competition. The prototype is developed inside the international interdisciplinary 2-year MSc programme in Sustainable Architecture. The participation to SDE represented both for researchers and for students at NTNU, a unique opportunity for developing an integrated design process with the support of private companies and public institutions. Because of the high level of uncertainty characterizing the entire design process, +hytte was conceived as a flexible construction system made of three different layers. The last of those layers is intended to give to an otherwise aseptic box spatial and sensitive value. In the +hytte project open building strategies have been reinvented and implemented into an environmentally responsive housing project.

KEYWORDS:
energy, housing, solar, integrated, adaptable.

INTRODUCTION.

The Solar Decathlon competition.
Solar Decathlon is an international competition among universities aiming at making students and society aware of the possible advantages deriving from the integration of solar energy in architecture. The competition site alternates every year between the USA and Europe, and will expand to China in 2013 (SDE, 2011). Twenty solar houses coming from four different continents will be built in September 2012 in Madrid and evaluated on ten different contests, amongst others energy balance, comfort and architectural quality. The participating housing projects will have to be market ready and take advantage of commercially available components and technologies. The development of each prototype should therefore be done in tight co-operation with the national building industry. Their construction should give evidence that energy-efficient solar houses can represent a concrete alternative to the ordinary housing market. SDE participation represents a unique opportunity for researchers and students at NTNU to develop an integrated design project of low-energy, high-quality housing, together with private companies and public institutions.

Project background
"Norway is a country of outstanding natural beauty, whose fjords and mountains are revered by its inhabitants". Cabins - or "hytte"- represent for many Norwegians "the necessary tool for conducting a life close to pristine nature, outside modernity" (T. Berker and H. J. Gansmo, 2010). A new tendency of transforming traditional cabins into proper second houses has led today to a steady rise of energy consumption and related CO2 emissions in this sector. This has shifted "the desire to live close to nature from a core tenet of Norwegian culture to an unsustainable threat to nature" (T. Berker and H. J. Gansmo, 2010). "Municipalities and investors are currently stressing the green potential of developing more coordinated and denser settlements in city centres, but a significant majority of the population still feel that they have to be restrictive" (Kaltenborn, B. P., 1998): for most of them the hytte should still represent an austere way of living alone inside nature.

A cabin independent from the energy grid and other infrastructure, thanks to the use of natural resources, would strengthen the desired feelings of distance from modern society and symbiosis with nature, while lowering the environmental impact of the second house sector. On the basis of this hypothesis we initiated together with our students at NTNU an integrated design process aiming at developing a prototype of an energy positive hytte able to be:

- Easily assembled and disassembled in order to solve transport issues from the university to Madrid and backwards, while enabling temporary use in remote sites as well as city centers.
- Energy positive thanks to the use of integrated photovoltaics for energy production and passive strategies for the reduction of the energy demand
- Market ready; reflecting existing desires of Norwegian society, adaptable to diverse customer groups in different phases of life
- Adaptable to the various inland and coastal climates of Norway.

Four different concepts were developed in the first semester of the MSc in Sustainable Architecture at NTNU (Finocchiaro L., Haase M., Wyckmans, A., *2011)* as an internal competition among multidisciplinary groups of students. In choosing the winner, priority was given not only to design excellence but also to the potential of the prototype for future development. The chosen project was conceived as a flexible system able to evolve together with the challenges arisen by a partly unpredictable design process. For this reason +hytte could be defined as an "open" construction system aiming at being:

– Flexible _ in order to satisfy different functional requirements
– Elastic _ able to increase its surface according to the users' needs and desires.
– Climate adaptable _ solving the contradiction of designing a Scandinavian house able to perform optimally in the completely different climatic context of Madrid, Spain.

Thanks to these qualities +hytte represents today a highly versatile module that can be used in many different scenarios. Open building strategies represented the opportunity for solving typical energy issues of the Norwegian building stock. +hytte can be used as a stand-alone module located in rough nature or it can be attached to existing isolated houses compensating their lack in energy efficiency (this typology represents the most energy demanding typology in Norway, Fig. 1) (Sartori, I., Wachenfeldt B. J., *2007).*

Figure 1: +hytte. Original proposal.

Architectural design narrative: the building as a system.

The use of an open construction system seemed to be the most obvious answer to an extremely complex design process. The evolution of the project from the original proposal to the current status can be synthesized in a sequence of diagrams (Fig.2). Reasons at the basis of the evolution are carefully explained in the following paragraphs, giving evidence of a meaningful design process towards low impact housing.

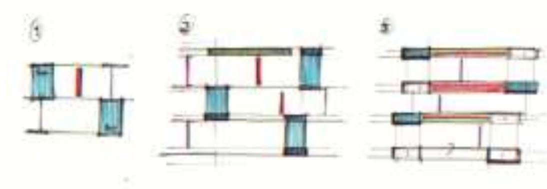

Figure 2: Evolution of +hytte: the building as a system.

The original concept.
Flexibility and elasticity.

In the original proposal the plan of +hytte was characterized by a high degree of indeterminacy. Services like kitchen, bathroom and technical core were concentrated in two compact boxes located in opposite corners of the plan. The big empty space between them could have been arranged in many different ways thanks to the movement of a second series of boxes containing different kinds of furnishings (beds, tables, etc). Floor and roof, represented the only timeless hard elements within the project. Their complexity aimed to satisfy most the functional requirements of the project. This would have permitted to leave the internal vertical partitions rather simple and movable (Fig. 3). If needed, the surface of the house could have been extended simply by attaching new modules in row.

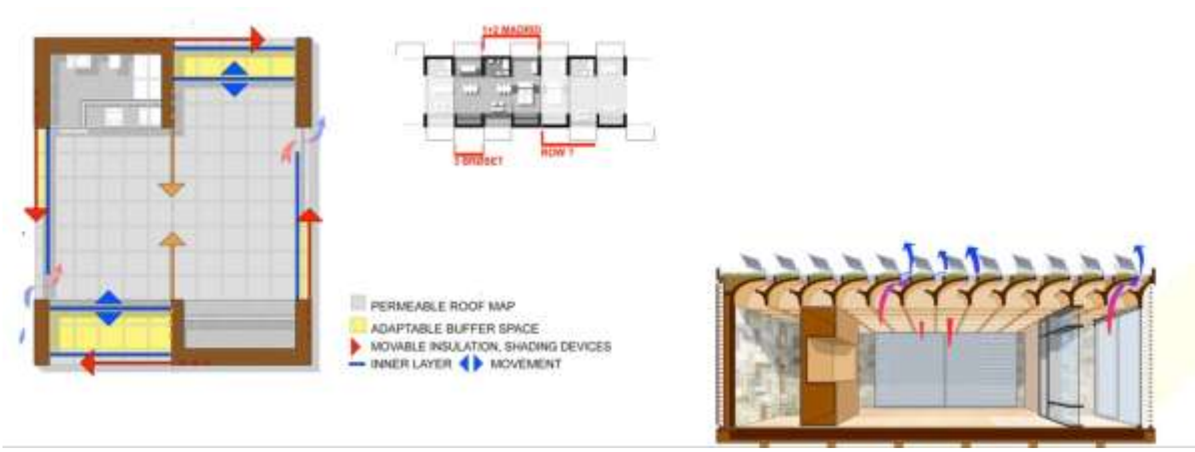

Figure 3: +hytte original proposal. Flexibility, elasticity and climate adaptability.

Climate adaptability.
Flexibility of the plan was also used as a tool for enhancing climate adaptability of the prototype, solving the contradiction of designing a Scandinavian house able to perform optimally in the completely different climatic context of Madrid, Spain. Three different layers of movable devices integrated in the envelope shaped an extremely flexible buffer space able to assume different configurations and behaviours according to different locations and seasons. On the basis of a system of sensors, located inside and outside the house, buffer spaces are able to expand or draw back themselves letting the interior space to breathe in symbiosis with the external environment. The roof, made of a grid of valves can also adapt its environmental behaviour to the movements of the plan, filtering and diffusing solar radiation and air.

Stage 2.
Flexibility and elasticity.
In the second stage of development the +hytte project evolved into a more credible construction system based on a clear hierarchization of its architectural components. Different expectations in durability was translated into different layers of the construction system. The indeterminacy that characterized the plan in the original concept was maintained only in the primary layer of the construction system. This still represents the hardware of the project made of boxes containing different kind of services. The soft parts of the project are organized in a second series of boxes. Characterized by a light construction those secondary boxes contain appliances and furnishing that can be freely arranged in the plan on the basis of the customer desires. This second layer is thus intended to make the universal module of the primary system a custom made house.

Elasticity.
The possibility of different modules in row is maintained in the second stage of development.

Climate adaptability.
Climate adaptability of the model is now expressed in the possibility of using different kinds of components for environmental control (insulation, shading devices, special glasses, etc). Modular panels of different nature should be located in a gap conceived for this purpose and running all along the modules (Fig. 4). This gap is organized in two lines: one for fixed panels and one for movable devices provided of rails. Consequently, in comparison with the original proposal, the plan is now characterized by a lower degree of indeterminacy (North and South facades are now different).

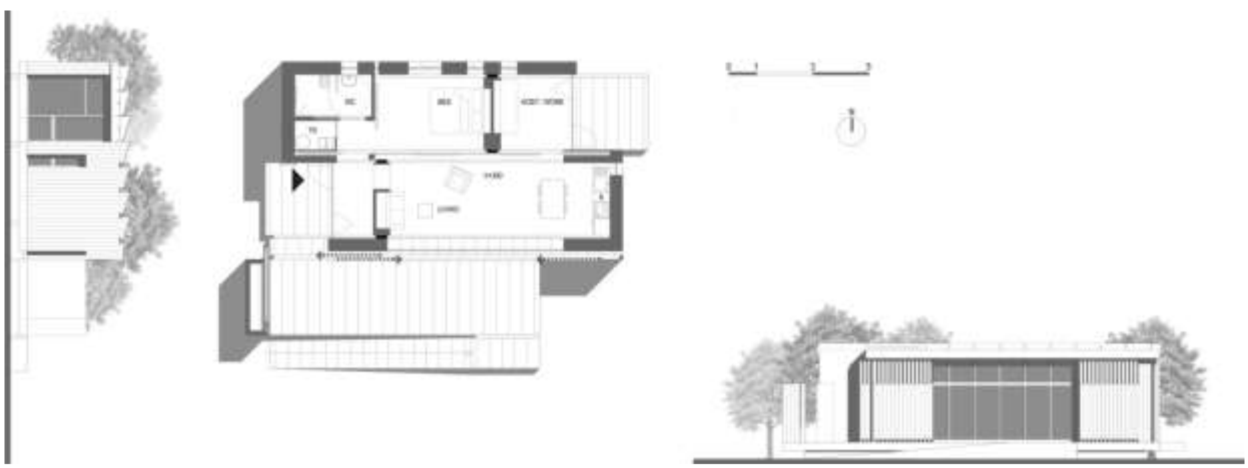

Figure 4: +hytte: second delivery. North and south façade are differentiated. Lower degree of mobility.

Stage 3.
Flexibility.
The third stage represents one of the most intense moments of evolution of the +hytte project. In this stage we focused on the need of minimizing the need for transport. We thus decided to reduce static, functional and environmental requirements of the house to long functional cells dimensioned on the internal measures of a container. The construction of these boxes has been again organized in two different layers. The primary layer aims at satisfying basic common requirements like the static balance and the location of primary technical equipment. In this primary stage of the construction there is no relation between form and function, between structural and spatial layout. The space included between the functional cells is still undetermined and empty but it is potentially able to host any sort of functional program. The secondary layer represents a collection of possible interventions that can be applied within the frame and include a wide range of components that can belong to different manufacturers. Modularity ensures in this case interchangeability of components. When the user defines the secondary layer on the basis of his personal requirements the

undetermined space in between the cells acquires a functional identity.

Elasticity.

Elasticity is now translated into a grid permitting to extend indefinitely the construction of the house in the three dimensions of space. The grid is not intended as a limitation to the growth of the building but as a framework that guarantees an order in its development. Each module can extend its surface along its length. Different modules can also be attached in row or vertically thanks to an overdimensioned structural frame. In shaping multi-residential housing +hytte requires however the support of an extra infrastructural system, for static and circulation purposes, to which grasp all the different modules.

Climate adaptability

Climate adaptability of the house is based on a homogeneous distribution of skylight and air inlet all along the length of the module permitting different degrees of illumination and permeability. Such characteristics can be adjusted according to different climatic contexts. Hierarchization of the constructions system will be also related to the house environmental requirements. Thermal mass and skylights will be included in the primary layer of the construction system. While climate specific components will be included in the secondary layer. Integration of advanced phase changing materials in the inner layer of the roof will be investigated in order to stabilize temperature fluctuations inside the house. Flexibility of the plan becomes the opportunity for collecting inside the perimeter of the building interstitial buffer spaces able to improve the environmental sensitivity of form.

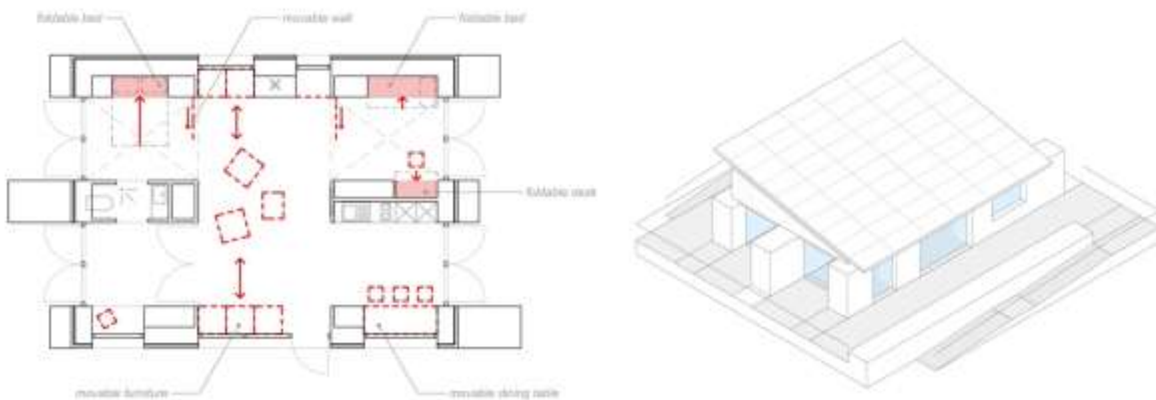

Figure 5: +hytte: third delivery. Boxes are reduced to the minimum into long functional cells in order to rationalize the transport process.

CONSTRUCTIVE AND TECHNICAL FLEXIBILITY. THREE SYSTEMS.

The house that will be brought to Madrid next year will represent a provisional configuration of an open building able to assume many different shapes. Its form can be read as the result of the logical layout of three independent but related systems that can be combined in a wide range of solutions. Such systems will be characterized by a high degree of industrialization and prefabrication and are: the functional cells, the roof and the space in-between. Their features are briefly described in the following paragraphs.

The functional cells

The functional cells represent to a certain extent the hard-core of the project. Their location and shape varied continuously during the design process. Their construction has been organized in two different layers. The primary layer is totally inelastic and characterized by a high degree of abstraction due to its universal nature. The second layer is instead customer-specific and made of interchangeable components dimensioned on the basis of the same modularity.

The primary layer is intended to satisfy all the basic requirements of the building like structural and technical primary needs. It is intended to survive any functional change and includes all the primary devices of the technical equipment totally integrated with the structural frame - a homogeneous distribution of ducts and electrical devices along the beam; vertical connection in correspondence of the pillars. In such a way ducts for ventilation, hydraulic and electric systems are potentially able to reach any point of the structure. Whatever technology is defined or adopted within the prototype can be attached anywhere and assessed for performance and cost effectiveness.

The secondary layer includes a series of customer-specific furnishing and is thus more subject to change. It intends to give the isotropic undetermined space of the primary layer an architectural meaning with spatial and sensitive values. This layer is based on a series on specific requirements related to the user and the context where the house is located. A wide range of components can be located in the width of the functional cells according to its position, internal or external (130 cm = 60+10+60, furnishing/envelope + partition + furnishing/envelope - Fig. 6). The most external layer will determine the façade of the house.

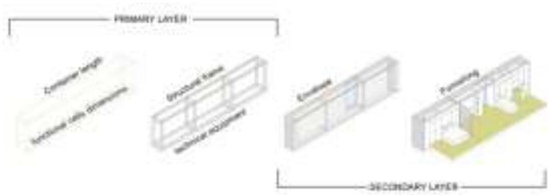

Figure 6: The functional cells: construction.

The roof .
Since the very early stage of development of the project the roof was conceived as a key component for environmental control of the building. In the original concept the roof was conceived as a homogenous distribution of skylights and valves for natural ventilation and lighting. The idea behind the concept was that of enhancing the flexibility of the plan creating an isotropic space in which any point of the structure was equally comfortable, thus able to host any sort of function. In such a way the plan could have been freely arranged in many different ways according to the customers desires. Coherently with the evolution of the project the roof aims now at providing a homogeneous distribution of lighting and air all along the linear modules (no more homogeneous distribution on two dimensions, but only one). Skylights and valves for permeability are homogeneously distributed along the linear system that characterizes the plan. In this way any transversal section of the module can be potentially able to integrate different passive strategies and provide environmental comfort under many different external conditions. Many different formal solutions are also possible thanks to a number of site-specific variables (the angle of the roof can be adjusted for example according to different climatic contexts and locations. This makes the roof a key component for landscaping).

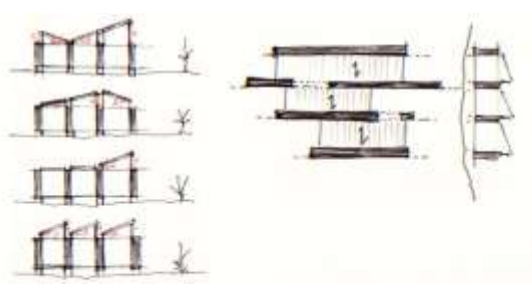

Figure 7: The roof: site-specific variables.
The space in between.

As already mentioned, there is actually no relation between spatial and functional layout of the house in the primary layer of its construction. The space included between the functional cells is still in this stage an isotropic empty space able to host any function. The secondary layer of the construction with all its furnishings overlaps to the universal space a functional program (Fig. 8). Follow two kinds of interventions: the placement of a secondary technical equipment distribution and a series of transversal partitions. Both these components are specific to the functional program and are thus the most subject to change. Technical equipment distribution aims at letting pipes and ducts – if required - reach any point of the structure. Inter partitions aim at regulating visual, thermal, acoustic comfort and air quality.

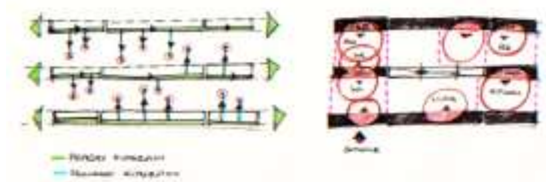

Figure 8: The space in between. Technical equipment distribution and functional program.

TOWARDS LOW IMPACT HOUSING

In the next months the students will work with the detailing of the different components constituting the system. In this final stage of the design there is still a wide margin of action for stressing the potential of the +hytte concept towards low impact housing. Particular attention will be paid to:

- The reduction of waste. Industrialization will focus on the production of light components able to reduce need for raw materials, the need for transport and minimize waste generation. The structural frame will be conceived for example as a combination of two-dimensional wooden trusses.
- Relate the hierarchization of the construction system to its materiality. High-embodied emissions will be justified only in the primary layer of the construction system for which we expect a much longer life span. On the other hand use of recycled or recyclable materials will be maximized in the secondary and third layer of the construction system. Deconstruction process of these two layers aims at being as rational as the production itself.

CONCLUSION

During the design process of the +hytte project, flexibility, elasticity and climate adaptability have assumed more and more importance in the +hytte concept, opening new possibilities but also giving rise to many problems. Our main focus has been that of enhancing the potential of open building strategies for the production of high-quality low-impact housing. Architectural design of open buildings becomes thus a meaningful process towards sustainability. The idea of the custom home has been reinvented and implemented into a more environmentally sensitive process. This was done avoiding to transform the '+hytte' project into an anodyne box with no spatial and sensory value. Since the very early stages of the design +hytte had to be inspiring, provide the right atmosphere for an extensive touch with nature. Technical solutions and spatial values had thus to coexist in a project handled by many different actors. Such complexity was solved through the definition of the different layers of the construction system. While the first layer has a purely structural and technical function, the secondary layer has to give a spatial and sensory value to the house. The roof, conceived on the basis of site-specific parameters, serves to provide an added value to the landscape with the location of contextualised site-specific boxes. The second layer is not intended, however, to hide the real nature of the house behind a masquerade for pleasing the eye of the customer. In +hytte universal and custom-made coexist and complement each other.

Figure 8: +hytte.

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Scalable and Customized Houses and Homes for the Promotion of Active Aging

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ABSTRACT

The overall goal of the project is the adaptation of the building and housing to allow people have a healthy aging (physically and emotionally) by staying in their homes as long as possible and adapting them to the different needs that will arise over time.

To achieve this objective the project establishes modifications of the architectural design of the houses, their constructive elements, the supporting technologies and the environment that surrounds it.

In the previous analysis and the development of the project it has been taken into account the structural characteristics of housing in the Basque country (Spain), accomplishing a division based on the different building typologies present in the area. Within this division (buildings in the old part of the cities, in the urban development and in rural areas) actions to be taken in the old part of the cities have been chosen for this article since these type of buildings are considered the most representatives ones. Furthermore, it is known that a higher percentage of seniors live in these type of zones.

The project has also taken into account that a more sustainable development means to avoid, whenever possible, the construction of new buildings (to avoid the considerable impact that new buildings have). Thus, the rehabilitation of existing buildings is proposed because it is more suitable for the characteristics of the buildings present in Spain and the Basque Country.

KEYWORDS:
aging, architecture, urbanism, rehabilitation, construction

INTRODUCTION

The Housgai project aims to give an initial response to the problems existing in Spain as regards homes of elderly people. Its main objective is to try through rehabilitation that elderly people can stay in their homes as long as possible by adapting the characteristics of the home spaces to the new needs. The solutions to be developed within the project are focused on three major groups: flexible and adaptable building systems, technologies for the home and new models of management and care of the elderly. This article will develop the first of these points, ie which systems have to be used to make a home more flexible and adaptable. For this reason it has been designed a flexible partitioning system that incorporates the different housing facilities and allows to vary the house spaces as needed by its occupants.

Within the article an initial analysis of demographic characteristics existing in the Basque Country will be done to identify areas where the presence of elder people is higher. After that, an analysis of the characteristics of existing homes in these areas will be carried out to verify the existing problems and the possible actions to be taken to solve them. In parallel, an analysis of the needs of elder people regarding housing will be developed, which will result in a series of design recommendations. Finally, the different buildings that are going to be rehabilitated within the project will be briefly presented and the flexible partitioning system and their different possibilities will be shown.

ANALYSIS AND SITUATION OF THE ELDERLY PEOPLE IN THE BASQUE COUNTRY

In order to tackle the study of the demographic reality of the Basque Country and in particular, to locate geographically the group formed by people of more than 65 years old, it has been proceeded to accomplish an analysis by Geographic Information System (GIS). This study has allowed connecting the urban and demographic situation of the Basque Country with their geographical location. With this system it was possible to locate the areas where the percentage of elder population is higher in order to propose an intervention prototype in one of them.

Below a map of the Basque Country is shown with the results of the study obtained by GIS:

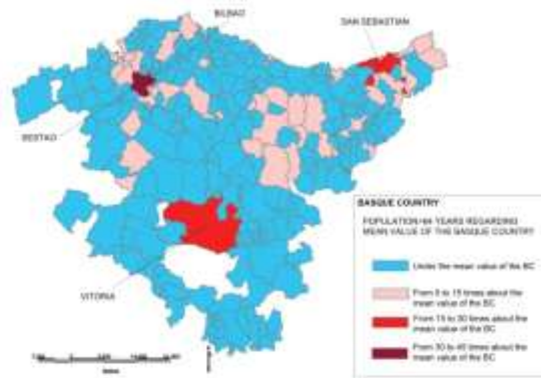

Figure 1- Population> 64 years with the local average of the Basque Country (Census 2010)
Sources: Cartografía por municipios. Instituto nacional de estadística, 2010. Padrón municipal de habitantes.

After analyzing figure 1 it was concluded that the elder group (>64 years) is mainly located in the most populated towns, especially in the capitals (San Sebastian, Bilbao and Vitoria). Furthermore it can be seen that Bilbao is over the other two capitals in the number of people over 64 years old.

From what was observed the following can be concluded:

- Those towns with the most rural character present the highest shares of elderly.
- Most of the towns that in the industrial boom had large urban and demographic growth (Eibar, Elgoibar, Barakaldo, Mondragón ...) now show negative growth rates and a high level of aging.
- The Basque Country capitals bring together most of the total older people. However, only Bilbao is in clear process of aging, followed by San Sebastian and Vitoria-Gasteiz. The Orographic characteristics combined with industrial and tourism development are factors to consider in the circumstances of each one
-
-

Photo 1 and 2: Facades of two buildings in the old part of San Sebastian

As a result of these conclusions it is proposed to "focus" in various towns of different characteristics and analyze them more in detail, from both a demographic and an urban point of view.

These municipalities are:

- Bilbao: as the capital with the most population of the Basque Country
- Donostia-San Sebastian: as a capital but with a more residential character than Bilbao
- Aramaio: as a town with a rural character
- Sestao : as a post-industrial city.

And specifically within the selected municipalities, it has been planned to carry out the pilot scale test in the town of Sestao because the Housgai Project has an agreement with the city council to amend a housing based on the conclusions reached in the project.

CHARACTERISTICS OF HOMES IN THE OLD TOWN OF CITIES OF THE BASQUE COUNTRY

An analysis of the characteristics of the houses in the old quarters of the cities in the Basque Country has been carried out. Below there is a summary of them:

The bathroom: the houses of the old part of the cities often have only one bathroom. Their dimensions are not minimal as they usually have a bathtub, toilet and sink, but most of them do not meet the appropriate size for the integration of an adapted bathroom. They have natural ventilation, normally to the interior courtyard.

The kitchen: The kitchen and dining room are often in the same room. For this reason, it is quite large and although they are not usually open to the outside, have natural ventilation that comes from an inner courtyard.

Rooms: The homes generally have 3 bedrooms, but sometimes some of them do not have windows or natural ventilation. The dimensions of the rooms are well below those required to have a large bed. They don't have enough space for an adapted room with sufficient space to allow rotation of a wheelchair.

Access zones and corridors: the entrance areas are very limited, sometimes there are no access zones as defined as the entrance to the house (it only appears the corridor to the stairs).

The living room: the living room is usually large enough to provide everything necessary and can be adapted to the dimensions that the use of a wheelchair requires. Typically they have ventilation and natural light, as they are open to the outside and they are the room with the largest dimensions of the house.

The façade: the ground floor is made of stone and the upper floors are made of brick or masonry, garnished and painted on the outside and with plaster inside.

Balconies: the balconies of the houses of the old part of the city are very narrow due to the proximity they have to the opposite buildings. They don't exceed one meter width and often have even smaller dimensions.

Structure: The structure of most of the houses in the old part of the towns of the Basque Country is made of wood. Generally it consists on beams perpendicular to the facade and then small beams perpendicular to the previous ones.

Dividing: Although not originally made of stone, legislation was changed due to fire propagation problems and now they are of masonry, usually sandstone.

Windows: Almost all the front windows and shutters are made of wood. The window frame is also made of wood and many of them are badly damaged. Moreover, in most cases there are not double glazed.
Floor: The floors are made of wood and the kitchen and bathrooms are tiled.

Photo 3 and 4: Detail of living room and the ceiling

Interior walls: although originally the partitions were made of wood, now almost all of them are built with bricks, plaster and a paper or paint finish.

Installations: The installation systems at the time of their construction and in subsequent decades were reduced and simple. The electricity did not come until the mid-eighties of the s. XIX, while the gas plant went into operation at the beginning of s. XX. Therefore, in these buildings there is only installation of water supply and drainage. Over time owners have been renovating their homes and have placed other installations like hot water, gas and heating. However, in many cases there is no gas and heating installation yet, and there are even some without hot water installation yet.

Moreover, it was not common the presence of a conduit for water pipes, so its installation was confusing and arbitrary, with a lack of a unitary approach.

The downspouts sewage usually went down through the courtyard walls, but the pipes of water for kitchen and bathrooms did not always followed a rational path, so they could climb alternately through the rear facade, the courtyard, the stairwell or inside homes.

Over time, new supplies and services will be placed, but without a general criteria for all the houses. So, new lines are integrated into each of the buildings without addressing issues of safety, traceability, or the possibility to make them registerable.

Based on this analysis it was revealed that the biggest problem in the homes of the old part of the cities in the Basque Country is the accessibility to the home itself and the distribution of spaces and facilities inside.

REQUIREMENTS OF DESIGN FOR HOUSING FOR THE ELDERLY

The analysis of the conditions of the elder group studied in the project has been based on data collection through surveys and field supervisors. With these data, it has been built a profile of frail elder people above 75 years old.

It was also taken into account the rules in the Basque Country, Spain and existing approaches at European level to define the characteristics to be met by housing for the elderly. Below there is a summary of features to fulfil by the different spaces and systems present in the home:

Access:

- Differentiate the inside and the outside of the house by using materials and finishes
- Use non-slip finishes around the entrance of the apartment
- Provide the access with an extra space to leave heavy objects

Characteristics of the rest areas

- The bedroom should be large enough to accommodate a bed (single or double) and a closet, with enough space to ensure accessibility to both elements
- Should be possible lateral transfers from a wheelchair to bed
- The acoustic insulation of the rest area shall be sufficient to ensure a peaceful rest
- Must be at least two electrical outlets per bed and a telephone and a TV socket. Should be placed a video intercom close to the nightstand
- It should be possible to turn on and turn off the room light directly from the bed position

- It must be considered the possibility of space at home for guests / potential caregivers

Characteristics of the toilet areas:

- Should be ensured easy access from other areas of the house to the bathroom for wheelchair users
- The bathroom must be large enough to allow full rotation of a wheelchair (minimum radius unobstructed 150 cm)
- It must be ensure that the longitudinal distance from the toilet bowl to the wall is adequate for easy up and sit down and use the handle easily (we recommend at least a distance of 40 cm)
- It must be installed a shower in the bathroom (the tubs should be avoided entirely.) The entrance to the shower must be placed at the ground level
- The shower should be large enough to allow the presence of an assistant
- Should be guaranteed a space of at least 60 cm on both sides of the sink to guarantee that an assistant can fit

Food preparation area:

- Equipping the home with a kitchen area or an integrated kitchen. Whenever possible, physically separated from other areas of the house
- Provide a kitchen large enough to contain a fridge with a freezer, a sink, a cooking surface with at least two rings and an oven
- Set the kitchen area for people with reduced mobility and strength
- A sufficiently large work area, easily accessible, organized in order to reduce lateral movement, with rounded corners, smooth coating (but not slippery), strong enough to support and use foldable electronic Systems
- Assure that the kitchen area free of obstacles is large enough to allow a wheelchair user to turn (minimum 150 cm)

Dining area:

- The dining room must have enough space for a table and chairs, and be next to the preparation area
- Should be considered the option of eating in bed

Construction characteristics:

- Housing should be flexible enough to meet the different and changing needs of its occupants
- Should be avoided the use of glass materials in the soil
- Where there are different floor levels between the rooms of the house it will be required to install ramps with a slope not exceeding 1:12 and preferably 1:20 or less
- The key areas of the house (bathroom, bedroom, kitchen) must be on the same floor
- Doors must be wide enough to allow easy passage of people with disabilities. The corridors must have a minimum width of 110 cm
- The rooms must be designed as square as possible rather than very narrow or curved (as they are easier to furnish)

HOUSING REHABILITATION

The last goal of the project is to make the rehabilitation of housing in cities and neighborhoods where it was detected the presence of a large number of elder people. The city selected as the most representative one is Sestao. This city has problems related to the aging of its population and there are many houses that pose big challenges to its inhabitants as they lack the special characteristics needed for elderly.

The Housgai Consortium has reached an agreement with the City of Sestao to apply the solutions achieved in the project in one of the houses owned by the council.

Information is being gathered on various buildings with problems (accessibility in doorways, lack of elevator and space problems inside home). Below there are some type floors of the buildings in the area:

Figure 2: Floor plans of two buildings in Sestao before the rehabilitation

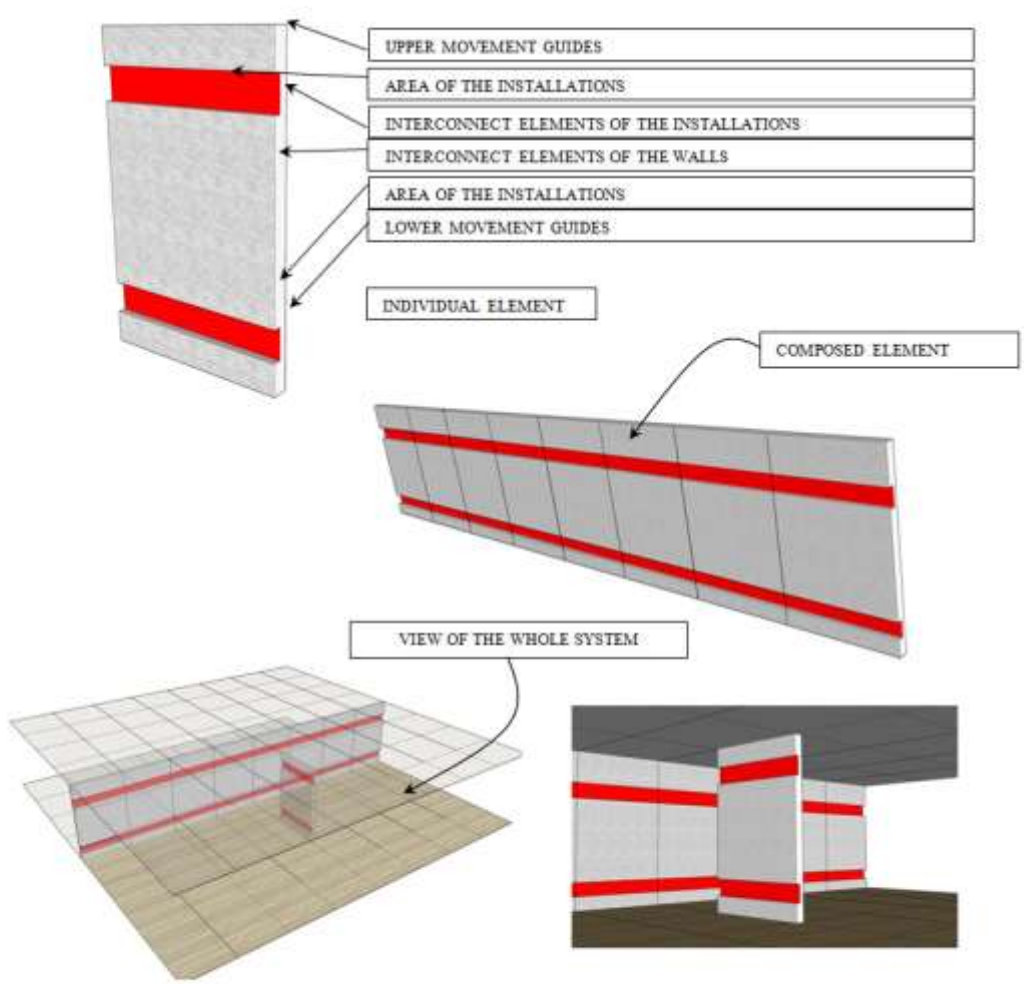

Figure 3: Description of the flexible wall system

In one of these homes the Consortium will proceed to implement solutions to improve flexibility of the spaces. Within the solutions to improve the flexibility of housing, it has been developed a flexible wall partition with the following characteristics:

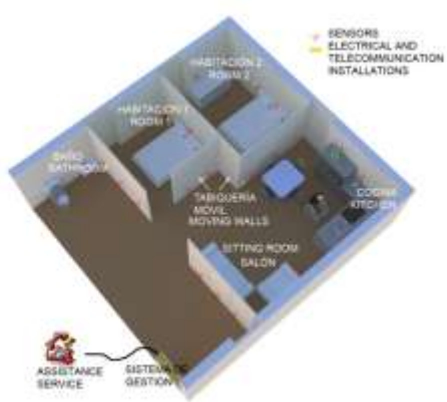

Figure 4: Home with two bedrooms + living room + bathroom + kitchen

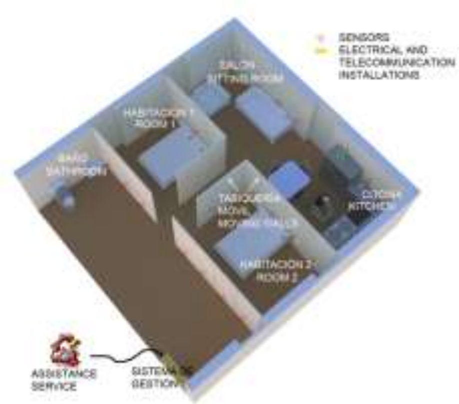

Figure 5: Home with two bedrooms + living room + bathroom + kitchen

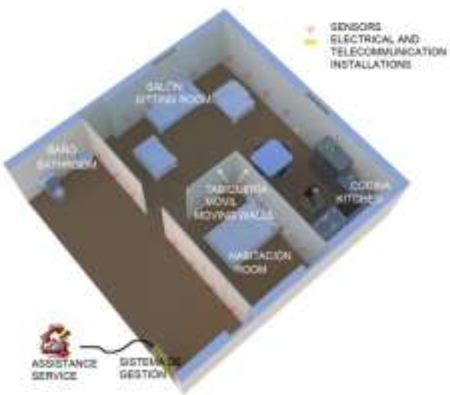

Figure 6: Home with one bedroom + living room + bathroom + kitchen

As can be seen in the drawings, the proposed system offers several possibilities. This is possible because the mobile partition system includes both the electrical and communications facilities of the home and the central heating. Wetland areas (kitchen and bathroom) are located in specific areas of the house to not produce variations in the existing facilities

To finish just say that the project is now in the conditioning phase of the housing provided by the city of Sestao to incorporate the flexible wall system. At the same time it is being done the study of the spatial possibilities offered by each house to define the right space for each one based on the needs of its occupants using the flexible wall system. It is expected to make by early 2012 on-site testing of the systems developed in the Project

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Application of Open building Principles in Ecological Renovation & Adaptation Design of Modern Historical Buildings in Nanjing, China

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ABSTRACT
Ecological renovation & adaption design is an important topic for modern historical buildings in Nanjing, China. Principles of Open Building proved to be new opportunities in ecological renovation & adaption design of these buildings. Zhongnongli project was taken as an example to show how principles of Open Building could help to make the sophisticated job of ecological renovation & adaption design of modern historical buildings efficient. Simulations of effect of renovation & adaption design were also given to show the improvement in building performance.

KEYWORDS
Open building Principles, Ecological Renovation & Adaptation Design, Modern Historical Buildings in Nanjing, China

INTRODUCTION OF NANJING AND THE PROJECT
Located in the Yangtze River Delta economic zone, Nanjing has always been one of China's most important cities. With urban population of over five million (2006), Nanjing is the second largest commercial center in the East China region, after Shanghai. It has been ranked fourth by Forbes magazine in its listing of "2008 Top 100 Business Cities in Mainland China", also being awarded the title of 2008 Habitat Scroll of Honor of China, Special Award of UN Habitat Scroll of Honor and National Civilized City.

Nanjing used to be the capital of the Republic of China before the Chinese Civil War in 1949, so it is famous for its modern historic buildings. Modern historic buildings in this paper refers to the buildings from 1840(Opium War) to 1949 (establishment of People's Republic of China). Development of Modern historic buildings in Nanjing, not only numerous in numbers and types, but also with great cultural and architectural value, is big issue for both Nanjing and China in the rapid development & renovation of Chinese cities. The Zhongnongli project in this paper is very typical in this circumstance.

Ecological Renovation & Adaptation: important topic for Modern Historical Buildings in Nanjing, China
Ecological Renovation & Adaptation is important issue for modern historic buildings because it could improve the performance of these buildings. This is important for not only the modern historic buildings themselves, but also the residents living in it.

Zhongnongli block lied in downtown Nanjing. Most of the buildings there were built in Republic of China era. Lacking of maintenance, the modern historic buildings in the block were in poor condition. Residents there were mainly low incomer and elders. In rapid renovation of current Chinese cities, poor building performance and living condition were always major reasons for these buildings and blocks being demolished. Ecological Renovation & Adaptation design was very important to improve the building performance as well as preserve cultural value of these buildings.

Current status of modern historical buildings: great value vs. poor condition
In our detailed field investigation and research on buildings in the Zhongnongli block in both the hottest summer and coldest winter, each with duration of 7days, we found that most of the old buildings, although with great cultural & Architectural value, were in poor condition. Lack of maintenance, without insulations, high energy consumption and poor interior environment were major problems for the buildings in Zhongnongli. In winter, when the exterior temperature was -2°C (Centigrade), the interior temperature was only 2°C (Centigrade)! Among the residents, 63% think it was intolerable cold in winter and 62% think intolerable hot in summer in their home. While the residents, the elders and the poor, couldn't offer either heating or air conditioner at home. So we can imagine how terrible the interior environment was.

Gap between construction & materials of old buildings and modern technologies
According to our research, the key reason for poor living condition in modern historical buildings was poor performance of the buildings. This was result of gap between construction & materials when they were built and current technologies as well as lack of maintenance. Most of the modern historic buildings were built without insulations and dampproof treatments. As time went by, the walls got very wet and serious mildewed. Almost half (48%) of the walls and furniture got serious mildewy in Summer and there is still almost 1/3 (31%) got serious mildewy in winter. (Figure 2) In this case, it was almost impossible to further improve performance of these buildings just by ordinary renovation (painting, façade renovation, etc). We need ecological renovation & adaptation to get real improvement of performance of these buildings.

Figure 1: Site plan and photos of Zhongnongli block

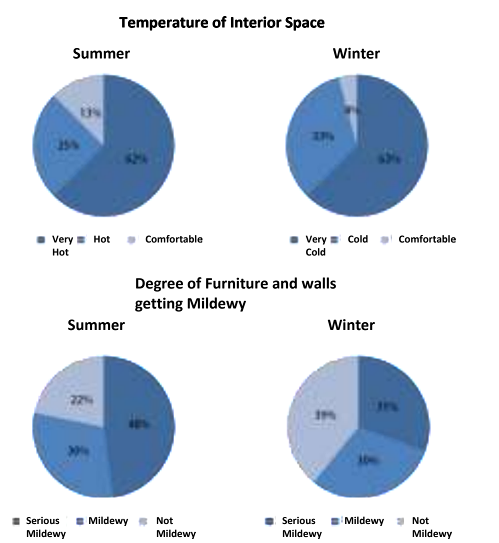

Figure 2:
Temperature and Mildewy of interior environment of buildings in Zhongnongli block in Nanjing, China

Open Building Principles: New Opportunities in Ecological Renovation & Adaptation Design

Ecological renovation & adaptation of modern historical buildings was quite sophisticate job. There were several characteristics of ecological renovation & adaptation design of these buildings that made it special, especially different for ecological design of new buildings.

- Envelope could not be changed easily due to the need of cultural & architectural value preservation of the buildings
- Possibilities of spatial change must be considered according to the existing space layout & envelope of the building from the very beginning of renovation design
- Ecological design methods and technologies easy for new buildings might not be suitable or quite difficult for old buildings.

In research, we found the basic principles of open building: levels of intervention and distributed control, showed to be new opportunities for furthering ecological renovation & adaptation design of modern historical buildings. With the division of buildings into “shell” and “infill”, ecological renovation & adaptation design of modern historical buildings could become very efficient. The very complicated and technical part: “shell” renovation & adaption could be controlled by designer (together with government /developer, etc). They dealt with most challenges of ecological renovation & adaption and providing utmost flexibility. While “infill” adaption design could be controlled by occupants (with help from designer). Yet, for preservation of modern historical buildings, occupants need to obey much more cultural & technological regulations from the very beginning of renovation design. This was a great different between ecological design of modern historical buildings and new buildings in the situation of “control”.

How Open Building Principles could help Ecological Renovation & Adaptation Design

Figure 3: Site plan of the Zhongnongli project

In Zhongnongli project (Figure 3), we made ecological renovation & adaptation design for the pink housings (converted into shops) and the yellow housings (still using as housing). Principles of open building were proved to be efficient way for ecological renovation & adaptation design in the following aspects:

Division of “Shell” and “infill” and ideas of levels of intervention made the sophisticate job of ecological renovation & adaptation design clear and easier.

In the zhongnongli project, “Shell” meant the common part, including envelope, structure system and overall layout, with intervention from municipality, developer and designer. “Infill” meant individual part, with intervention from occupants (with help from designers), mainly the layout of their individual space. By this division, tasks and roles of ecological renovation & adaptation design became very clear.

Ecological renovation & adaptation design included ecological renovation of shell and design of ecological cell: adaption design of overall layout & space, renovation of envelope: addition of insulations and shadings, change of windows, design of PV and roof, updating of structure system, and thermo-bump, etc. Shell was the key point in ecological renovation & adaptation design for the purpose of both cultural value preservation and building performance improvement. While infill, although individual, need to obey much more cultural & technological regulations of the buildings from the very beginning of renovation design.

Figure 4: Original façade (left) and façade after adding shades (right)

Ideas on distributed control of different levels and & different roles of different people insured both improvement of building performance and flexibility for occupants’ needs.

According to ideas of open building, shell is controlled by designer (together with government /developer/occupants), while infill is controlled by occupant. In the zhongnongli project, this principle proved to be an efficient way to make clear tasks and roles of various participants and make them work together.

The very technical part: ecological renovation of the shell was mainly controlled by designer to ensure cultural value preservation and building performance improvement. Occupant had much control in their individual part. This was especially true for the buildings that would still be used as housing after renovation. Residents could easily express their ideas and needs and took part in adaption design. While in the buildings that would be converted into shops, developer and designer had much control with consideration to market investigation since the occupants were not clear in design phase. Flexibility was especially focused in this circumstance for different needs of different occupants and different needs of occupants in different time. Further adaption design of the infill would be controlled by occupants when they moved in.

Figure 5 shows the ecological renovation & adaption design and simulation of effect of the changes in building performance after renovation of the shell we made in Zhongnongli project. This building would still be used as housing. First we made adaption design of overall layout & space (together with structure renovation), removing some partitions and, adding individual kitchens and toilets, adding of skylights, etc. We did this according to investigation and consultation with residents. From the difference in simulations of natural day lighting and vitalization before and after renovation, we can see the improvement in building performance. Second, we did ecological renovation & adaption of envelope, adding insulations and shadings, changing windows, designing PV and roof renovation, etc. Then, we designed the ecological cell with application of thermal pump for the whole block.

A SUMMING UP

All in all, due to aims of cultural preservation and building performance improvement, ecological renovation & adaption design of modern historical buildings was very sophisticate. Principles of open buildings: levels of intervention and distributed control showed us an efficient way to simply the design. In Zhongnongli project, by division of "Shell" and "Infill", designer controlled the "shell" to ensure the design could fulfill the need for cultural preservation and building performance improvement, as well as providing utmost flexibility for occupants (in housing renovation, also consulting with residents). While occupants could control their infill, residents starting from design phase and commercial occupants when they got the key. In this means, principles of open building proved to be new opportunities for efficient ecological renovation & adaption design for modern historical buildings in China.

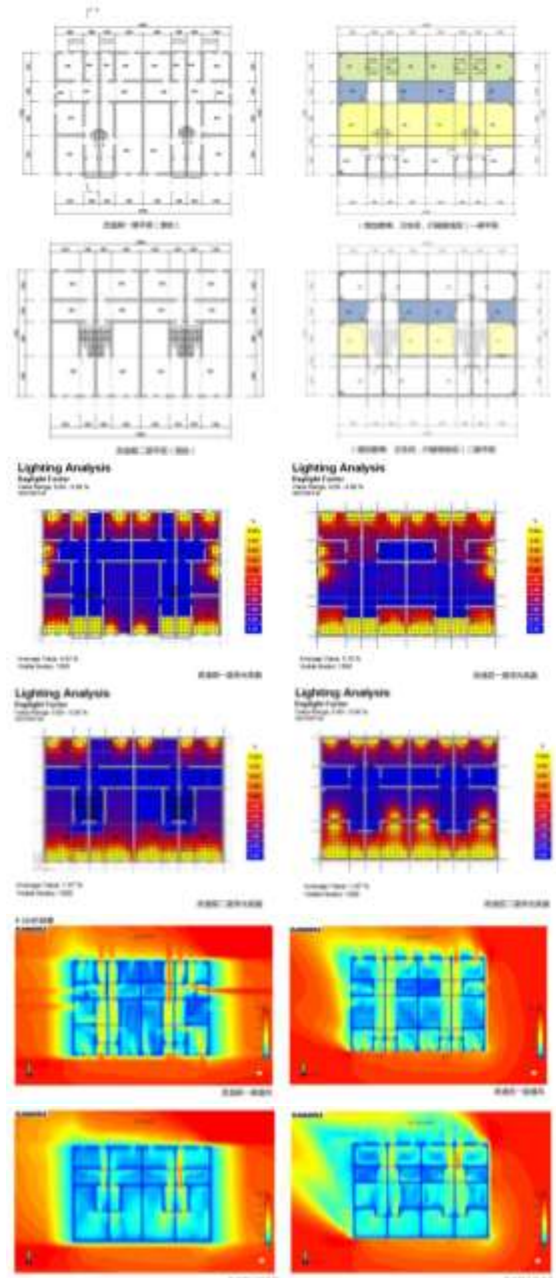

Figure 5:
Adaption design of overall layout and simulation of the improvement in building performance.
Top four: comparison of housing plans before and after renovation design
Left two: original plans
Right two: renovated plans
Middle four: comparison of lighting status before and after renovation design
Left two: original lighting status
Right two: renovated lighting status
Bottom four: comparison of natural ventilation status before and after renovation design
Left two: original natural ventilation status
Right two: renovated natural ventilation status
Note: in each group, top ones are for first floors and bottom one second floors

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Timeless Flexible Building:
Matching Demand and Supply in Flexible Housing

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ABSTRACT
The concepts of Open Building and Lean Construction suggest strategies for designing, building and operating the built environment. These concepts create value and take into account all present and future stakeholders who are in control during construction and use. It gives guidelines on how to manage a construction process to create a built environment that is sustainable. At the same time we can see that in practice the concept is less flexible than the value it hopes to create. The starting point of this research project was the assumption that there is a major mismatch between consumers' demands for flexibility on the one hand, and the flexibility that is actually supplied. This paper reports on this research project, which finally provides easily understandable guidelines to manage housing during the different stages of the life cycle.

A description of long-term value is provided, based on user interviews and case studies have been conducted in order to identify obstacles on the way to long-time flexibility. References are made to the Netherlands IFD (Industrial, Flexible, Demountable) Governmental initiative that ran from 1999 to 2006. Five experimental projects from this initiative are used as case studies in this research project.

This study builds on the assumption that a foolproof product will add to the adaptability of a building, thus extending its life cycle, preventing waste and contributing to the sustainability of the built environment. In the final analysis the conclusion is drawn that among other things, house manuals should be compulsory and that a house that is easy to understand and "read" would only require a short manual. Such a manual would guarantee a natural hand over of IFD responsibilities to the next generations.

KEYWORDS
Open Building, Lean Construction, user-participation, IFD, Continuous Customization

INTRODUCTION
Many people in the Netherlands are unable to live in the type of home they would like. The quality and quantity of housing stocks often fail to meet the ever-changing demands of users since too few suitable homes are available.0} As a result, first-time buyers in particular face difficulties finding a home. In addition, many people choose to remain in their existing home for too long until they are successful in finding a suitable home that matches their specific individual wishes. This is leading to a blockage in Dutch housing stocks (Boelhouwer, 2009). When it comes to their home, people's needs are also constantly changing. Market supply is failing to respond rapidly enough to changes in demand, leading to stagnation in the housing ladder. In the last decade, the housing market in the Netherlands has changed from being supply-led to demand-led. This means that users need no longer select from a specific and limited supply, but that the supply must more effectively meet the specific and individual demand of these users. Flexible construction is one way of providing a better response to individual demand. A flexible home is designed and built in such a way that it can be adapted to suit the changing requirements of its users. This is also referred to as consumer-focused building (Zijgers, 2008). First of all, an explanation will be provided of IDF construction,

INDUSTRIAL FLEXIBLE DEMOUNTABLE CONSTRUCTION
In the period 1999-2006, the Dutch Ministries of Housing, Spatial Planning and the Environment (VROM) and Economic Affairs (EZ) instituted an experimental programme: Industrial Flexible Demountable Construction (Industrieel Flexibel Demontabel or IFD in Dutch). Construction companies and developers were attracted to take part in the experiment by subsidies awarded for the development of innovative construction products and methods. The IFD programme was a response to a demand-led market. The residents were involved in the development of these homes from as early as the design phase. The homes cannot only be adapted to suit changing requirements during the design phase (process flexibility), but also in the user phase after construction (product flexibility). During the course of the IFD programme, a total of 91 projects were realised, including 34 residential construction projects (Sev, 2007).

Consumer-focused construction
In consumer-focused construction, the building's occupant plays a central role. The home is designed especially for them and built in accordance with their individual wishes (Cuperus, 2002). It is therefore very important to evaluate the results of the IFD programme. What is the ultimate experience of the occupants of these homes? Which flexibility elements are now being used in practice and which are not? The answers to these questions may prove very important for development companies if they wish to build flexible and adaptable homes in the future. In other words, which measures would companies be advised to invest in and which not?

Industrial construction

Industrial construction is a building method in which construction components are system-built in a uniform manner under controlled conditions. These components are then assembled on the building site to create larger components or complete buildings. Industrial construction often involves the manufacture of large series of components that are not intended for any specific project, but this is not a necessary precondition. Mass customisation enables these components to be assembled in a range of individual combinations and variations despite the fact that they are manufactured in large standardised series. Industrial construction is one way of improving the speed and manageability of construction and enhancing product quality (Thillart, 2002). Mass customisation involves the following: the consumer purchases a product or part of one that ultimately results in a customised solution but is actually made from standard components that are mass produced (Stienstra, 2004:16).

Flexible construction

Flexibility is a characteristic of a building or construction components that enables adaptations to be made in response to the changing demands and wishes of users (Gunst 2008). Flexibility can be divided into process flexibility and product flexibility. Process flexibility offers possibilities for adaptations during the design and construction process and provides extensive freedom of choice for the first generation of occupants in particular. Product flexibility makes it possible to make adaptations when the home is actually in use in order to meet the changing living requirements of the occupants (Geraedts, 2000).

Demountable construction

Demountable construction involves constructing buildings in such a way that the building components can be easily removed or relocated and removed at a later date. This aspect is extremely important in terms of enabling buildings to be modified or extended. For example, part of a facade can be literally dismantled, removed and then re-used after the building has been extended. This reuse also means that demountable construction helps to reduce environmental pollution caused by the construction process by preventing waste.

OPEN BUILDING AND LEAN CONSTRUCTION

Open Building and Lean Construction are complementary strategies that can work in synergy (Cuperus, 2001). In order to grasp their full potential, some elaboration may be helpful.

In 1961 John Habraken observed: 'We should not try to forecast what will happen, but try to make provision for what cannot be foreseen' (Habraken, 1999). He proposed a built environment layered along lines of control. The urban fabric comprises base building (support), and fit-out (infill). This understanding is intended to structure the way buildings are designed, constructed and operated. Open Building gives guidelines for structuring the product and to a lesser degree the construction process.

Lean Construction is the construction equivalent of Lean Production, which in turn is a westernized interpretation of the Japanese TPS, the Toyota Production System (Womack et. al., 1990). The lean mantra is: 'Create value, banish waste'. The construction industry's output is the built environment; it needs to create value for its end users, in the same way as Toyota serves its clients. But what is value and who is the value for? In this respect lean production differs from lean construction. This is an ongoing debate, which still has a long way to go. Banishing waste from the construction process is easier. Observing the Toyota process enabled seven types of waste to be identified (Ohno, 1988). Waiting and re-work are two of the most notorious wastes in the construction industry. One strategy to prevent re-work, in other words to do things right the first time, is by fool-proofing the process. For example: a USB connector is foolproof, it does not need any explanation on how to plug it in. A bank card with magnetic strip is not: it can be swiped in four different ways of which only one is correct; and the different swipe machines and a sticker with explaining texts and graphics only complicate things.

Lean Construction gives guidelines to structure the construction process and to a lesser degree the value of the built environment it is supposed to accommodate. A deeper understanding of Open Building in relation to Lean Construction is instrumental in undertaking the case studies that will be described next.

Problem statement and research questions

Seven years of IFD has left us with the unsatisfactory notion that its products have never been thoroughly evaluated. This is understandable, since it takes time to measure the effects. The longer the time lapse, the more valuable the data become. This chapter describes the need to evaluate in the light of consumer oriented building.

Problem, approach and objective

A superficial evaluation of IFD housing construction projects suggests that many home occupants are not living as they would wish and are actually unaware that their home can easily be adapted to suit their requirements. If this is indeed the case, there is an unnecessary mismatch between how people would like to live and their home. If IFD had been effectively evaluated, this problem would have been revealed and potential improvements could have been identified.

Five of the 34 IFD housing construction projects were investigated to explore the mismatch hypothesis. Data was collected by means of a document survey, project visits and interviews with the key stakeholders, in other words the residents and commissioning parties. Lean Construction and Open Building provided conceptual frameworks for questions and answers that can reveal solutions. For Lean: 'Does the home offer the optimum value that its occupant would like? If not, where is the waste and what is the remedy to prevent this?' For Open Building: 'Is the domain of the occupant clearly defined and delimited? If not, how can residents be made to understand the dividing line between the base building and those sections that can be modified?0}

RESEARCH METHOD

This study focuses on 34 housing projects realised in the period 1999 - 2006 as part of the experimental IFD programme in the Netherlands. In order to obtain a good impression of the actual use of the flexibility measures, only those housing projects completed at least five years before the start of the study (2010) were selected. Ultimately, five housing projects were singled out for further study: 1. De Kersentuin, 2. Multiple Choice, 3. Ecoflex, 4. La Fenetre, 5. Terbregse.nl.

By means of a literature and document review along with interviews with the project developers, the original initiatives to achieve flexibility were compared with the actual flexibility achieved after completion of the housing. Surveys were conducted among residents in the relevant projects in order to investigate the actual use of flexibility once the home was in use, the aim being to get answers to the following questions:

- Are the residents aware of the flexibility and adaptability of the homes?
- Were these actually utilised in the development phase?
- Are the homes already being occupied by a second generation of users and, if so, have they adapted the home to suit their specific living requirements?
- Did the occupants receive documentation to inform them of the possibilities for adaptation?
- Do the occupants wish to make adaptations to specific elements in their home that are not currently included in the possibilities?
- Which options for flexibility that were initiated and realised are being utilised the most?

FINDINGS

Analysis of the literature and documents revealed that, with the exception of the initiatives on the basis of which the residential construction projects were awarded experimental status (SEV, 2007), there has been no documentation of what happened to the projects concerned during the design, construction and user phase. The results of the survey are therefore an important source of the findings in this study.

De Kersentuin case

For the IFD project De Kersentuin, the brief was to realise a sustainable and ecological project with a great deal of freedom of choice, but it was not specifically focused on innovative or industrial construction methods. The project comprises a mixture of 94 apartments and terraced houses and was completed in 2003. The homes were built using a timber frame construction and are 6 m in width in order to provide sufficient flexibility and freedom in terms of layout. Almost all types can be extended. Only 10% of residents opted for a standard basic home, with the rest choosing individual detailing.

The occupants of De Kersentuin were given a lot of freedom to arrange the layout of their home to suit their personal requirements. But some changes were only possible during the development phase. After realization the houses behaved like traditional ones, without any special adaptability services. For instance there were three different possible positions for the staircase to choose. (see Figure 2).

The volume of the homes in De Kersentuin can also be modified after completion when the home is in use. This is made possible because additional strip foundation was installed for future extensions and the facades are partly demountable and can be re-used after the home has been extended. The interior of the homes can also be adapted by relocating the movable lightweight partition walls. The equipment and finishing can also be adapted for subsequent occupants. The survey revealed that the occupants were well aware of the developments and possibilities for adaptation in their home and most had actually made use of these (42%). This is because most occupants attended meetings of the De Kersentuin residents' association from the outset, which played an important role in the development of the project right from the start. The occupants had also adapted the layout and volume of their home after completion. Interestingly, as many as 60% of occupants questioned had not received a manual for their home after completion.

In one of the extensions completed later in order to increase the volume of the home, the existing facade was not re-used despite the initial built-in flexibility and the additional investment aimed at making the facade demountable. In order to make it possible to continue to live in the house during the modifications, the original demountable facade was not relocated and re-used after the modification. Only after completion of the rebuilding work was it removed (see Figure 3).

Figure 1: De Kersentuin case with 94 homes.

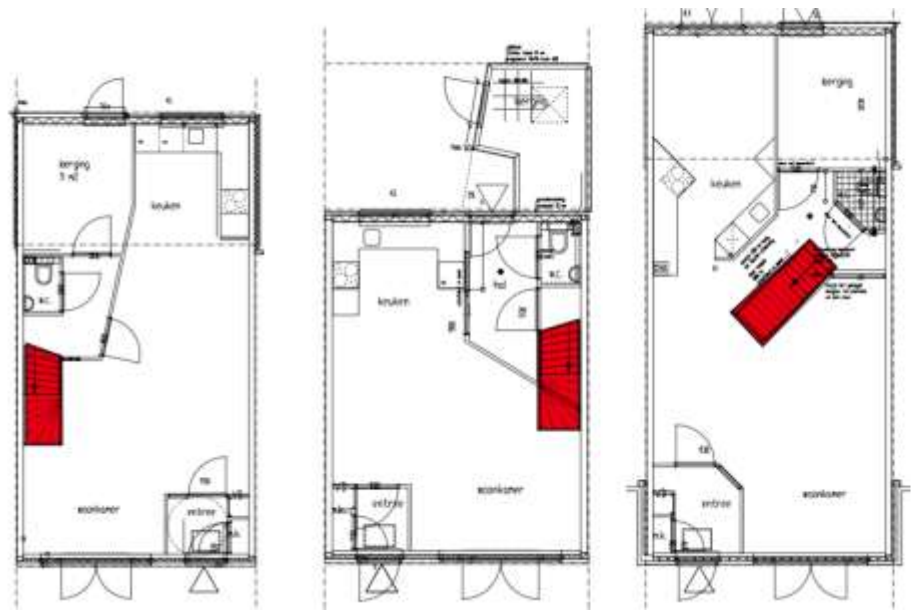

Figure 2: three possible positions for the staircase and kitchen in the floor plan (only in the development phase), and the possibilities for extension on the garden side by means of demountable facade components and additional strip foundation.

Figure 3: the volume extension realised in a home in De Kersentuin.

Conclusions for De Kersentuin case

This study reveals that flexibility primarily takes the form of greater freedom of choice for the first generation of occupants since they are directly involved in and have an influence on the design and realisation process. The long-term adaptability of the homes is currently limited by the fact that many are still occupied by the first generation of occupants. Several occupants have however made use of the possibilities to adapt the home while in use, including expanding the bedroom or the hallway. One of the problems identified relates to a lack of information. In particular, occupants who would like to change or adapt something after completion do not know whom to contact. For this reason, most occupants made modifications to their home on their own, largely applying traditional methods and therefore not taking full advantage of the flexible and demountable facilities invested in the home for this purpose.

Multiple Choice Case

The Multiple Choice project is a flexible construction concept comprising 18 detached homes with a steel frame construction. This project differs from all the other projects because the occupants did not have to choose between a range of different design variants, since the homes were developed and constructed on the basis of what are known as envelopes. An envelope is the maximum contour or built volume within which the house can be built. When the homes are in use, occupants are free to extend them up to the maximum limits of this envelope.

One of the key characteristics of the Multiple Choice project is its high level of industrialisation. The size of the home is variable within the set envelope. The width sizes vary from 4.80 m to 8.40 m, with increments of 1.20 m. The depth template varies from 2.70 m to 3.60 m, making the home extendable from 5.40 m by modules of 0.90 m. The customer does not have to choose between different extension modules, but chooses within the maximum construction size, gradually working down to smaller levels of scale.

The buyers received an interactive CD-ROM, which they could use to determine the budget, the position of the garage, the direction of the garden and spatial features such as additional rooms and loggias. They could then choose from variants that matched their chosen profile. Residents could choose from a total of 159 variants. Multiple choice questions were used to make an assessment of which homes most effectively matched the requirements of the residents. By making use of the Corus metal floor system, services and cabling were also adaptable after realization (see Figure 5).

Figure 4: Multiple Choice case with 18 detached homes.

Figure 5: the Corus metal floor system makes the adaptability of services and cabling possible after realization of the homes.

In order to enable future extensions to the homes while in use, additional driven foundation piles were included and the facade components were made demountable. The layout of the home can be easily modified as a result of the use of easily demountable partition walls. Electrical cabling in the demountable walls and floors can easily be adapted. The pipes in the upper floor are accessible to enable future adaptations. As a result, wet rooms on the first floor can also be modified when the home is in use.

Conclusions for Multiple Choice case

The residents of the Multiple Choice project have so far made little use of the flexibility options offered. This flexibility was primarily focused on the first occupants during the development process. For example, they were able to choose between different staircase positions. The first generation of occupants had no reason to modify their home after completion because it had already been designed in line with their individual wishes. One second-generation occupant did modify his home while in use by changing the location of the kitchen. Because of a lack of information in the form of a manual, he was not aware of the fact that he could use the demountable walls and floors to rearrange his services.

Ecoflex Case

The brief for the Ecoflex project was to develop a sustainable housing concept in which the 14 homes have flexible layout, can be extended and can be used for several purposes. A wide freedom of choice was achieved within a normal price category for terraced homes. The fact that the homes can be extended also makes them attractive to buyers. Ten buyers extended their homes immediately. It would appear that residents initially tend to opt for many additional cubic metres. The variants selected do not differ to a great extent in terms of layout, but primarily in terms of size.

This project is an example of partitionable base building. Residents had the choice of five different basic variants and a list of possible additions. The final result is that all 14 homes have a different layout and fittings. The homes can only be extended at the rear thanks to the additional 1.50 m of strip foundation and because the rear facade is made up of demountable and re-usable timber frame components and window frames. This also makes it possible to have different facade layouts. The only thing that cannot be modified is the core of the house. Residents are free to arrange the layout of the house around this core as they wish. The house can be extended by a total of around 50 m2 (see Figure 6). The home layout can be adapted for the second generation of users, with the exception of the staircase and the vertical pipes.

Conclusions for Ecoflex case

The survey revealed that none of the second-generation occupants took advantage of the options for flexibility. It also emerged that the occupants had no idea whom they should contact if they wished to modify their home. This is partly because no manual is available for residents providing information about possible modifications. The research also revealed a problem directly related to the industrial flooring system used and the fact that the homes used a partitionable base building system. In the detailing and finishing work, insufficient account was taken of possible noise nuisance relating to the desired flexibility of the demountable construction components. Many residents complained about contact noise: “when the children are playing upstairs, it sounds like a cupboard crashing to the ground”, said one resident.

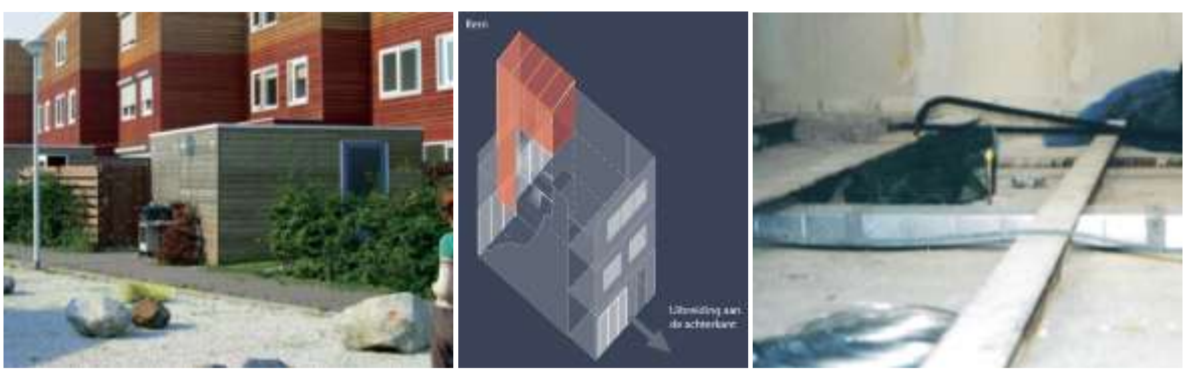

Figure 6: Ecoflex case with 14 detached homes and the possibilities for extension of the homes around the fixed core, and future cabling adaptability by the metal Infra+ floor.

La Fenêtre Case

La Fenêtre is the largest housing complex within the experimental IFD programme. It is one of the first residential buildings with a complete steel construction and also one of the largest projects to include industrial infrastructure and flooring. The aim was to achieve permanent adaptability.

The layout of the homes could be modified. In principle, future generations of residents also had the freedom to arrange the layout of the apartment as they wish. The interior walls are easy to remove. Thanks to the floor system used, the pipes were easily accessible and could be modified, enabling changes to be made to the wet rooms in the future. But, due to sound problems, an extra concrete finishing layer had to be added to the house dividing floors.

Conclusions for La Fenêtre case

The survey results revealed that no one had taken advantage of the flexibility options offered. This is because the landlord does not allow residents to make modifications to the homes, having opted for a fixed standard layout. In addition, it emerged that no one was aware of the fact that the homes have a flexible design and can be adapted to suit changing individual living requirements.

Terbregse.nl Case

The Terbregse.nl project, featuring 41 homes, is an example of collective private commissioning. The aim of the project was to offer a high level of freedom of choice for individual purchasers.

The focus was on a flexible construction process that enabled individual choices for future users. The homes are three storeys high and the layout can be freely determined. In addition to the opportunity to freely determine the number of rooms and change the position of the kitchen, toilet and bathroom, the homes can also be extended upwards and at the front and back (see Figure 9). This has been made possible by the use of additional strip foundation. The facade is demountable and the window frame can be re-used in an extension.

Figure 7: La Fenêtre case with 115 homes spread across 16 floors; the Infra+ metal floor system, with an extra concrete finishing layer against sound problems which prevented most of the future adaptability

Figure 8: Terbregse.nl case with 41 homes.

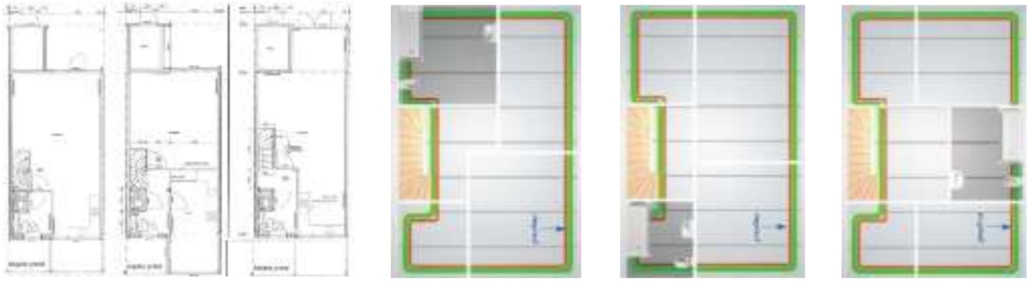

Figure 9: options for extensions, at the front and rear, with demountable and re-usable facade components (left); only in the development phase the choice for 3 different bathroom positions was possible (right)

Conclusions for Terbregse.nl case

The residents all took advantage of the flexibility options to arrange the layout of their home to suit their individual wishes, primarily during the initiative phase. As a result, most of them have so far had no need to make further adaptations. Three residents have subsequently taken advantage of the possibility to adapt their home, ranging from changes to the layout to the relocation of the kitchen. It emerged that none of them were aware of whom they should contact to arrange possible modifications.

CONCLUSIONS AND RECOMMENDATIONS

No wide-ranging IFD evaluation has been conducted to date. Studying five of the 34 IFD housing construction projects has revealed that the second-generation of residents have made little or no use of the options for flexibility, the F in IFD. In the current demand-led market, people moving house prefer to find a suitable home within the available budget and in the desired area that does not need modification. Seen from that perspective, the need for flexible homes would appear to be lower in a demand-led market than in a supply-led market. Some of the second-generation residents have made modifications to their home using traditional methods, being unaware of the integrated flexibility. According to lean terminology, this unawareness is a source of waste that can be avoided by making the home fool proof. This would require the flexibility of the home being obvious at a glance or announced in some other way, for example by means of a laminated manual that cannot be removed from the meter cabinet, or an app for a smart phone. The Open Building concept provides indications of which part of the home belongs to the infill level, the user's domain, and which belong to the base building or support level, the section that cannot be changed by the user. By making the boundaries of flexibility easily identifiable, owners can be encouraged to increase the value of homes by means of improvements, while preventing waste caused by the use of inappropriate techniques. These conclusions are based on the study of five IFD housing construction projects, all of which have what appears to be hidden flexibility. The next challenge will be to identify these hidden secrets in existing buildings, name them and make them visible or otherwise announce them. This will ensure that value is created with minimum effort and waste is prevented.

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The Situation of Apartment Renovation in Japan

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ABSTRACT
In Japan, there are almost 6 million apartment housing units, the oldest having been constructed 40 years ago. Originally, utilization of old apartment units by renovation is hoped-for housing cost reduction, realization of prosperous housing and circumstance and waste reduction. Japanese apartment buildings are basically suitable for renovation.

But until now in Japan, old and deteriorated apartment buildings are demolished and new buildings are constructed to replace them, or the buildings are left vacant.
For this situation, trial of renovation business for apartment stocks are being developed in Japan, this paper will introduce these trials.

Now in Japan, low fertility and the aging population are a reality. As of now we could endure housing markets overemphasizing newly built housing. But from now, we must address how to realize prosperous housing by utilization of used housing units. Renovation of apartment buildings is one of important measure for utilization of old stock, for this view-point, through positive research on business models, technology development and political buck-ups, it is necessary to trials for renovation business come to be spread wider area.

KEYWORDS
Renovation, Apartment Business Model, Long-life Quality used Housing

INTRODUCTION
After World War II, the construction of apartment housing units increased year after year in Japan, and recently 150 to 200 thousand units have been constructed each year. There are now almost 6 million apartment housing units, the oldest having been constructed 40 years ago. (Figure 1)

The oldest of this building stock have poor facilities and performance in comparison with newer units, but the oldest ones often have good locations in mature towns that new apartment building may not have. It is now clear that there is a potential demand for modernizing the oldest apartment units by improving performance and facilities together with interior finishes and equipment. This modernization of old units is called “renovation”.

Most Japanese apartment buildings are constructed by reinforced-concrete or concrete encased steel beams/columns, so that it is difficult to renovate their structural frames. On the other hand, the structural frames are designed with modular coordination, and the infill is made of easily worked materials such as wood, gypsum board, plywood, and so on. Originally, therefore, Japanese apartment buildings are suitable for renovation.

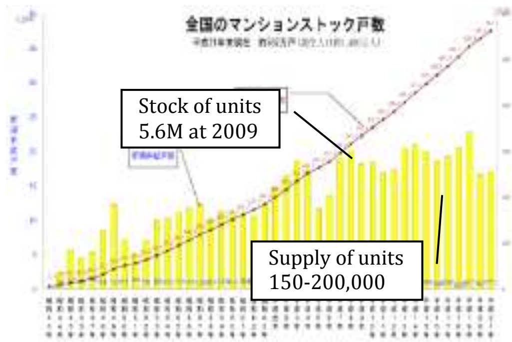

Figure 1 Stock & Flow of Apartment units*1

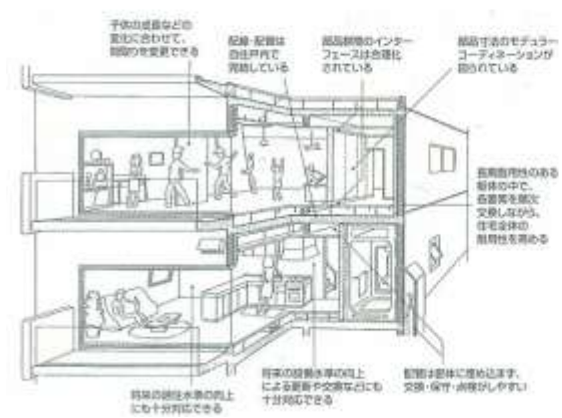

Figure 2 Century Housing System(CHS) Concept drawing*2
Actually, CHS is proposal, but some parts are involved in the actual projects. Infill is installed under modular coordination, dimensions between wall to wall are 300n.

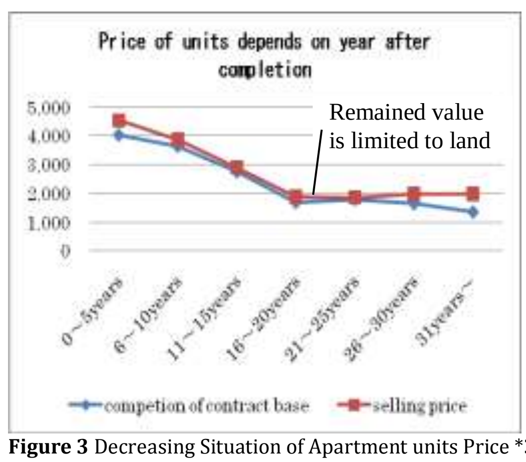

Figure 3 Decreasing Situation of Apartment units Price *3

But until recently fundamental renovations were strictly limited to a small volume. The reasons are as follows;

1.Apartment buildings lose value within more or less 20 to 30 years, so the owners cannot invest to improve their old apartment units. Above all, units constructed before 1981 are often inferior to those built after 1981 in seismic safety and thermal insulation.

Until recently end users were indifferent to performance of apartment units, but end users are becoming more informed.

2.There are few companies that have enough know-how and organization for renovation.

The Japanese housing sector has concentrated assets on new construction for a long time; therefore, developers or builders that struggle with renovation and have know-how for renovation were few.

3.It is difficult to renovate shared or separating parts of these buildings (between individual space and common spaces) like doors, windows, plumbing and so on, because of shared ownership and annexed legal documents.

The ownership and other documents do not assume the renovation of units.

As a result of this situation, one of two things happen to most of the older and deteriorated building stock - either

1. The stock has been demolished and new buildings constructed to replace them. This replacement often results in the loss of old building's atmosphere and environment. Or
2. If the owners cannot manage the replacement cost, the occupants are forced to endure inconvenient and uncomfortable lives, or the stock shall be left vacant. The situation results in further deterioration of the buildings.

Generally speaking, to maintain apartment buildings in good condition, owners associations have recently begun to implement maintenance work on common parts of building, such as installing waterproof overlay on the roof, repairing cracks in the exterior walls, applying overlay finishes on the walls, and cleaning pipes. But if the building has inadequate seismic safety or thermal insulation, it is very difficult to cover the costs of repairing these problems.

Table1 Japan –Major Amendment of National Building Code（NBD）and other laws

1980 Energy save Act(1st)
1981 NBD Bringing in New Seismic Design
1992 Energy Save Act(2nd)
1999 Energy Save Act(3rd)
2004 Sick building
2007 Energy Save Act(4th)
These major Amendments are targeting Level up of performance of building

Figure 4 Image of major repair of Apartment*4

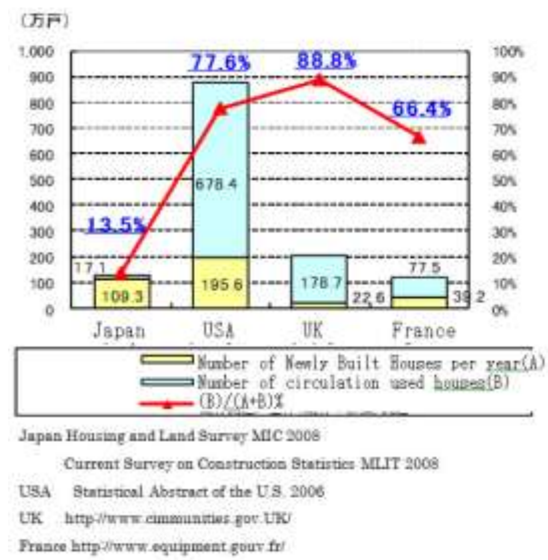

Figure 5 Comparison of Circulation of used housing units between Japan, USA, UK and France*5

On the other hand, in the individual units, the building owner is the one who manages all units, but the owner has not been forced to improve their units. Because circulation of used housing units is quite less in Japan than in the United States or Europe, there is no incentive for owners to invest in improving for their units.

The owner cannot take care about thermal insulation, sick building syndrome, high inefficiency of facilities, and barrier like difference of floor level and so on.

Until recently therefore only minimal repair and change of finishes are implemented, while complete renovation work is rare.

But recently the renovation market is being cultivated. It has started to supply units at lower price than newly built ones by renovation of old "good" units into comfortable and modern apartments, because some of the older buildings have good locations, environment, style and basic performance.

A NEW RENOVATION MOVEMENT

There are now three types of business models for apartment building

Type 1. Whole building renovation

These companies select and acquire shataku (that is rental apartment buildings owned by corporate enterprises as dormitories for their employees) based on the location and basic performance like seismic safety, size of units that are impossible or difficult to improve. Then the shataku is renovated into an apartment building with shared ownership (condominium or cooperative). In this case, the whole building including common space and common piping can be renovated. Users can choose their apartment from several types.

The key features in terms of production are reasonable scheduling of the various workers and the steps of renovation. Typical example of this type is ReBITA inc

Type 2. Unit renovation with ownership

The company acquires individual apartment units in the active market and renovates the units based on the location. Compared to Type 1, common space and piping are difficult to be renovated, but individual spaces are renovated reasonably and are often well designed.

The key features in terms of production are product planning of apartments based on consolidating individual and scattered demands for apartments, and reasonable renovation technology, material acquisition and shortening of period of renovation.

Typical example of this type is Intellex Co.LTD.

Type 3. Purchased and Order-made or customized unit renovation

In this case the company acts as consultant of acquisition and renovation of apartments for their clients. In this case, clients can get apartment units designed according to their preferences, within their budget.

The key features in terms of production are attentive/customized and performance-oriented renovation, hospitable organization in the company and objective inspection of renovation work of the apartment.

Typical example of this type is Life Design Co.LTD.

Detailed information of three renovation types is follows;

Type 1. Whole building renovation as introduced by REBITA, INC

Specifications

Location	Saitama pref.
Ownership	Shared ownership
Year after construction	18 years
Total number of units	35units
Size of units	79m2
Structure	Reinforced Concrete /4 stories
Height of story	2495mm

1) Feature of business model:

• Reasonable arrangement of the various workers and the steps of renovation.

• Decision of shataku acquisition under due diligence, ex. basic performance and situation of deterioration

2) Renovation work in common areas

Anti deterioration

• Measurement of neutralization depth and strength of concrete, rebar arrangement;

• Repair of skeleton, e.g.. Concrete cracks, honeycomb of concrete, absence and rust of rebar;

• Repair of protection on the exterior walls, waterproofing on the roof;

• Regarding seismic safety, the original building meets legal standards, no need for upgrading.

Improvement of facilities

• Heat source: from combination of gas and electricity to electricity only;

• Refreshment of all piping: e.g.. cleaning inside of drainage piping by high-pressure water, rust removal in water supply pipe; etc.

3) Renovation work of infill in individual units

• All finishing on the floor, walls and ceiling

• Preparation of several types of units,

e.g. Number of bedrooms or "style" of design, and so on, in order to provide choices for end users.

e.g.. Menu type supply: after selection of unit floor plan, end user can choose finishes, equipment and so on.

4) Features of implementation

• In this type basically all implementation consists of repetition of several steps in each unit. Therefore, it is important to arrange for various workers and steps in order to avoid inefficiency of workers and to pursue good work by upgrading skills through experience.

5) Features regarding maintenance

• History of building and each unit is prepared for utilization for maintenance work and next renovation, e.g. report of due diligence, drawing of improvement insurance for renovation work.

Issuance of certification. Such certifications are based on standards of renovation work created autonomously by the association of developers and renovation builders.

Figure 6 Modelhouse picture *6

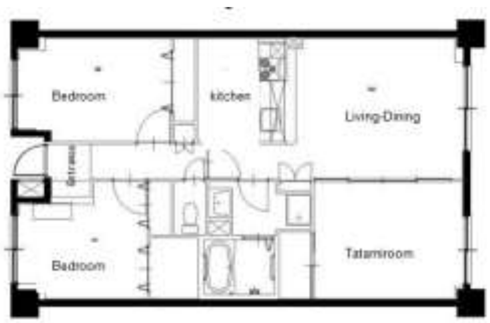

Figure 7 Before renovation

Figure 8 After renovation

Figure 9 Interior wall work and piping*7

Type 2. Unit renovation with ownership as introduced by INTELLEX

Specifications

Location	Tokyo
Ownership	Shared ownership
Year after construction	31 years
Size of unit	65 m2
Structure	Reinforced Concrete / 10stories

1) Features of business model

• Project planning of apartments based on consolidating individual and scattered demands for apartments in a given metropolitan area;

• Developer concentrates their resources within the Tokyo metropolitan area, so that they can assess / evaluate apartment units, and they can acquire units based on project planning in the area.

2) Renovation work in common part

• Common space and piping are difficult to renovate. But if honeycomb or heavy cracks in the concrete are found, the developer will inform unit owner's association, and the association shall repair the honeycomb or other defects.

3) Renovation work of Infill in individual units

• The developer prepares a catalog of equipment and finishes with a few grades and prices, and based on this catalog and project planning in the area, they design renovation.

• Thermal insulation over exterior wall, ceiling and floor, and attached inner windows that are installed easily for used houses

• Inspection and repair of piping

• Infill planning based on performance and features of common part.

4) Features of implementation

• Reasonable renovation technology such as prefabrication of interior walls and ceilings for shortening renovation work, and improving material acquisition and reducing salvage on site.

• Reasonable workers arrangement through adoption of common work among several implementation sites in the area, and utilization of small building firms.

5) Features of maintenance

• History of building of each unit is prepared for use in scheduling future maintenance work and next major renovation.

• Warranty of after-service such as periodic inspection, adjustment, repair of defects for customer satisfaction.

• Issuance of autonomous certification

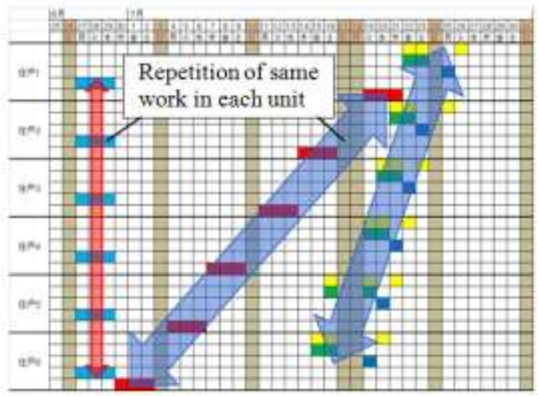

Figure 10 Image of Schedule arrangements

*Figure 11 finished renovation*8*

Figure 12 Before renovation

Figure 13 After renovation

Type 3. Purchased and Order-made or customized unit renovation LIFE DESIGN CO.

Specifications

Location	Kanagawa pref.
Ownership	Shared ownership
Year after construction	22years
Total number of units	10units
Size of unit	73ｍ２
Structure	Reinforced Concrete / 3rd floor of 3stories

1) Features of business model
• Attentive/customized and performance-oriented renovation, hospitable organization in the company and objective inspection of renovation work of the apartment;
• Selection of proper unit based on hearing end user's preferences, through the realtors' network.
• The company is not involved in sales contract of the unit to be renovated, but they attend preview of units to give advice in terms of feasibility of the project.

2) Renovation work in common part
Same as Type 2

3) Renovation work of Infill in individual units
• Fully customized based on end user preferences
• Proposed renovation plan is prepared before completion of unit sales contract
• Design with necessary detail according to stage of project by utilization of available history of unit, the result of inspection and measurements.

4) Features of implementation
• Facilitation with unit owner association
• Quality-oriented system with skillful workers for each part of work
• Progress report with photographs for end user during implementation
• Inspection during and at the completion of the renovation by third party firm for confirmation of the quality of the work.

5) Features of maintenance
• History of building and each unit is prepared for use in future maintenance work and to plan for the next renovation.
• Facilitation of maintenance work relationship cultivated through planning and implementation period.
• Issuance of autonomous certification

Figure 14 Wall and ceiling work by wooden base frame*9

Figure 15 Bathroom Unit*10

*Figure 16 Finished picture*11*

Figure 17 Before renovation

Figure 18 After renovation

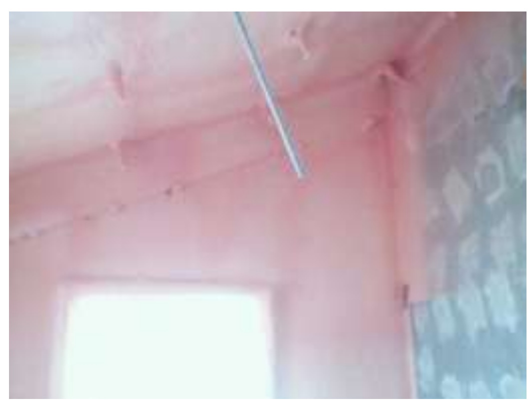

*Figure 19 Interior wall work (Thermal insulation) *12*

CONCLUSION

	Type 1. Whole building renovation	Type 2. Unit renovation with ownership	Type 3. Order-made or customized unit renovation
Feature of business model	Location, Basic performance clearance; in order to avoid high cost of seismic safety upgrades	Location, Basic performance clearance Pre-fabrication for short term implementation Unit acquisition through realtor's network	Establishment of a System for customer satisfaction
Renovation work in common areas	Improvement of thermal insulation and piping performance; Heat source change to electricity for further comfort	Almost impossible because of shared ownership Through implementation, if there are cracks etc found in concrete, the cracks shall be repaired	
Renovation work in individual units	Basically developer implements improvements based on the location; some units are prepared for menu plan or order made for end user	Basically developer improves by the product planning based on the location	From unit acquisition to renovation, the company supports end user and proposes design based on detailed interviews with the end user
Feature on implementation	Arrange for various workers and steps in order to avoid inefficiency of workers and to pursue good work by skills upgrading through experience	Efficient arrangement for small work tasks; Material acquisition utilizing a certain volume through year	Dealing with individual production based on special needs Quality control through inspection by third party
Feature on maintenance	Preparation of history of apartment building Insurance, Certification based on autonomous standard	Preparation of history of apartment unit Issuance of after-sales service guarantee Consideration for maintainability Certification based on on autonomous standard	
Spread ability	Depends on supply of good shataku, the process is not easy to quickly apply on a wide scale	Developers need to have economic strength to shoulder risk to purchase ownership.	Applicable mostly among 3 types. Depend on system for customer satisfaction

FUTURE ISSUES

For further growth of renovation in Japan, there are some issues as follows;

1.Spread to big cities other than Tokyo

As of now the movement of renovation is almost concentrated to Tokyo and surrounding metropolitan area and a few other areas. Because there is a varied and very large demand for units, big supply of units for renovation, number of players for renovation in this area. But from this starting point, even though renovation is spreading slowly in Osaka and other big cities, the movement is expected to spread to all big cities in Japan.

Cost of renovation must be limited for affordability in the cities other than Tokyo, because price of units there is low. Therefore software and technology for reasonable and attractive renovation are necessary. Then more entities will enter the renovation business and supply choices of renovation units for end-users.

2. Political backup is necessary.

In 2009, the "Act on the Promotion of Popularization of Long-life Quality Housing" came into effect in the newly built housing field. Following this movement Long-life Quality of used Housing is being studied by private consultants (such as Ichiura Housing & Planning Associates Co., Ltd) subsidized by Ministry of Land, Infrastructure Transport and Tourism (MLIT) under technical supervision of Building Research Institute, an Incorporated Administrative Agency, Japan.

The target of Long-life Quality of used Housing is not equal to renovation strictly, but the political backup will be a great help for spreading renovation in terms of technical development, finance, realty market cultivation, and so on.

Once this Long-life Quality of used Housing starts, renovation will be promoted because the volume of used housing is much more than newly built housing.

3. Technology development is necessary.

Through involvement of many entities such as general contractors and electrical product manufacturers, technology development shall be encouraged. Above all, general contractors have to shoulder the main stream of technology development of construction, and can be expected to bring dramatic new developments into the market.

Expected technologies for renovation are the following;

• Inspection

As of now inspection is not easy, e.g. the condition of the inside of exterior walls is vitally important but we cannot grasp these conditions without demolition of walls.

Technology of inspection for strength of concrete and arrangement of rebar near the surface of concrete without demolition are well-developed, but for rebar arranged deep in concrete, neutralization depth, and thermal insulation are impossible or very difficult to inspect without demolition.

• Promotion of concrete durability

In reinforced concrete buildings, it is important to inhibit neutralization of concrete in order to promote durability. In the older RC buildings, it is reported that an overlay coating on the exterior of the wall is effective to some extent. Additionally promotion of effect durability and quantification of performance are necessary.

•Rationalization of infill work

Though many used apartments are built under modular coordination, dimensions of concrete frame are not so accurate. Complete pre-fabrication of infill is therefore difficult, but the use of small prefabricated frames on the walls and ceilings is effective in minimizing on-site work, to lower noise and dust, to speed up installation, and to deal with decreased worker skills. Further development in terms of rationalization and thermal insulation is necessary.

•History accumulation and succession

Detailed information has to be recorded and accumulated such as how to fasten and disassemble infill to concrete walls and ceilings, not only in the specifications and drawings prepared for construction. The history has to be passed on to successive occupants of the units. This accumulation of the history of unit renovation work to the succession of users is very important for reasonable renovation and maintenance of units in the future.

LASTLY

Now in Japan, low fertility and the aging population are a reality. As of now we could endure housing markets overemphasizing newly built housing. But from now, we must address how to realize prosperous housing by utilization of used housing units.

For this view-point, positive research on business models, technology development, social systems for stock utilization are important.

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Photograph and drawings in this paper are posted under permission by companies below. I would like to express my gratitude to the companies.

ReBITA inc

Intellex Co.LTD

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Note

*1 Press release of MLIT (http://www.mlit.go.jp/common/000114581.pdf)

*2 Pamphlet Ministry of Construction What is Skelton and Infill Housing?

*3 Real Estate Information Network for East Japan REINS TOPIC

*4 Nihon Sougou Jyuu Seikatsu. Corp Major repair of Apartment Building : Guidebook for piping

*5 Paper for Inquiry commission for infrastructure/MLIT

*6 ReBITA inc

*7 Yasunao Uji

*8 Shinichi Chikazumi

*9 Shinichi Chikazumi

*10 Shinichi Chikazumi

*11 Life Design Co.LTD

*12 Life Design Co.LTD

A Computer-Based System for User Participation Towards Mass Customization of Housing

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ABSTRACT
The concept of implementing computer- based design systems towards mass customization of housing has been an interesting area of research throughout the last few decades as an outcome of emerging computation techniques in architecture. The development of digital design and manufacturing technologies has expanded the opportunity to visually articulate to the buyer a wider range of choices in terms of building typology, layout, exterior cladding and interior finishing for example. Various approaches have been proposed with the aim of efficiently engaging future homebuyers in the design of their homes. The ultimate goal of this paper is to systematically formalize a generic approach for developing design systems for mass customization of housing. The proposed framework is developed as a result of critically analyzing previous efforts, and studying relevant generative design systems.

KEYWORDS
Customized housing, Design system, Generative design

INTRODUCTION

Mass customization, as defined by Pine (1993), is the production of individually customized goods and services. It relates to the ability to provide customized products or services through flexible processes, in high volumes and at relatively low costs. The concept emerged in the late 1980s and may be viewed as a natural outcome of design and manufacturing techniques that have become increasingly flexible and optimized regarding quality and costs. In addition, mass customization, as an alternative, gives companies a competitive edge in a highly competitive and segmented market. Lately, almost every segment of the industrial production market of is moving into customization, as the process could be applied to a wide range of customer goods such as cars, furniture, personal computers and watches. As companies target customer satisfaction, they intend to adopt such production strategies, in order to remain competitive.

Regarding the building industry, mass customization is considered to be a suitable production paradigm as buildings are mostly unique and highly customized products. Individual components in buildings could be mass customized to allow for optimal variance in response to differing local conditions, such as uniquely shaped and sized structural components, variable window shapes and sizes. Housing, a vital sector in the building industry, witnessed the failure of mass production as a viable approach for producing dwellings throughout the Twentieth Century; this is in part due to the lack of a personalization options for the industry's clients. Mass-produced homes were usually monotonous, and poorly designed. Nowadays, however, homebuyers are becoming more demanding for change. The idea of one model fits all no longer satisfies clients' preferences and needs. Recent advancements in digital design and fabrication technologies have made the idea of mass customization possible in the housing industry; nevertheless, it has been relatively slow in adopting the new paradigm.

This paper proposes a generic framework for the design of design systems for mass customization of housing. It aims conceptualizing a methodology that can be pursued in order to develop the generative tool within a system that would capably engage future homebuyers in designing their homes at the level of spatial layout. In order achieve this goal; the paper is structured according to the following sequence. The first section is a survey of precedent efforts towards mass customization of housing. The second section explores the basic concept of mass customization and its various strategies. The third section explores the design of design systems, leading to structuring the framework for developing designs systems. The final section presents conclusions and topics for future research.

The paper is a part of an ongoing research that explores the application of computational techniques towards implementing a comprehensive, multi-performance design system that would lead to efficiently adopt mass customization in the housing industry. At this stage, the focus is on single family detached housing, and complexities accompanied with the process of devising spatial layout solutions. However, the methodology can be also applied to multi-family housing, but will require managing a larger amount of information.

PRECEDENTS

Larson, Mark A. Tapia, and J.P Duarte (2001), defined three main necessary elements for the mass customization of housing

- Preference engine: a framework to engage the customer in a dialogue to build profile.
- Design engine: a computational system that encodes data collected by preference engine, into an architectural design to be evaluated by the user. The system will then follow up with the generation of more solutions. It is important to study how these solutions may become affordable when linked to integrated,

component based, and Computer Numerical Control (CNC) fabrication techniques.
- Production system: a digitally controlled production system that can extract geometric and other information from the digital design model.

Duarte (2001) proposed a comprehensive model for mass customization based on implementation of a design system into an interactive computer program that would generate housing designs through a given language. The design system used description and shape grammars as a technical device for encoding design rules. The model was demonstrated through implementation developed for the Malagueira housing project by Alvaro Siza. Such system requires developing a grammar, then encoding it into a computer system, which is considered to be time consuming. See also Duarte (2005).

Later on, Juan et al. (2006) presented a hybrid model that employs Case Base Reasoning (CBR) and Genetic Algorithms (GA), in an attempt to bridge the gap between customers and builders in the communication stage, the paper. The system first uses CBR technology to retrieve satisfactory housing layouts based on customers' needs, and then GA is applied to search for satisfactory solutions for housing customization options by optimizing cost and housing conditions. The model demonstrates high potential in deploying information technology for user participation and customization in the housing industry.

Duarte (2008) proposed a model that includes a design system that encodes the rules for generating customized designs and a prefab building system that makes it possible to construct from such a design. A computer system was implemented to enable the easy exploration and visualization of solutions, and automatically generates the information required for production. Rules of both design and construction were systemized, and then encoded into the computer program, which operates in three stages. The proposed framework opens new opportunities as it remarkably established a link between the design system and the building system.

In an interesting direction, Beetz et al. (2010) proposed a method to allow homebuyers customize their homes, restricted by a set of constraints representing building regulations, architect, and user requirements. Constraints are presented as internal functions that take a building model as an input and return a Boolean value (true or false) indicating whether the constraints are violated or not.

The need for customization, along with development of digital design and production techniques stimulated remarkable interest in its application in realm of housing. However, there are still open opportunities regarding exploring design systems, which is the topic of this research. For other approaches to the mass customization of housing, see Saas (2007), Nogushi (2004, 2008).

THE CONCEPT OF MASS CUSTOMIZATION

Mass customization refers to a production strategy that aims providing customers with individualized products at near mass production efficiency. Although products are still being mass-produced, customers are increasingly demanding adaptation to their own requirements. Recently, most companies have to offer a range of choices, in order to remain competitive. The application of mass customization as a business strategy enables companies to gain an advantage over competitors by providing additional features and benefits.

The starting point towards mass customization would be mass-production of one- of-a-kind products. Mass production companies work on the basis of a fully developed model by making standard components to stock. These companies may decide to shift towards mass customization in response to market pressures and customer demand for a broader product portfolio. Companies adopt various strategies based on two main characteristics: the point of customer involvement in the design process and the type of modularity. Identifying the point of customer involvement and the modularity type are key elements in defining the configuration of processes and technologies that must be used to produce the mass customized product (Chandra, 2004). Processes in which customer involvement comes early in the production cycle result in more customized products. Accordingly, five strategies could be defined:

- Pure standardization: standard products
- Segmented standardization: product assembly using standard parts
- Customized standardization: assembly of standard products, with configuration according to customer demand
- Tailored customization: products where the customer can have materials or extra equipment of choice, but constrained by the basic design of the product.
- Pure customization: products specially designed for a specific customer (Da Silviera, 2001).

The lowest level of customization occurs if all stages of the value chain are standardized. On the other hand, firms achieve the highest degree of customization, pure customization, if customers are able to have a direct impact on the design process at early stages (Da Silviera, 2001). The other strategies are intermediate forms, which are situated between the extreme levels. Figure 1 illustrates the division of products into groups based on the point of customer involvement.

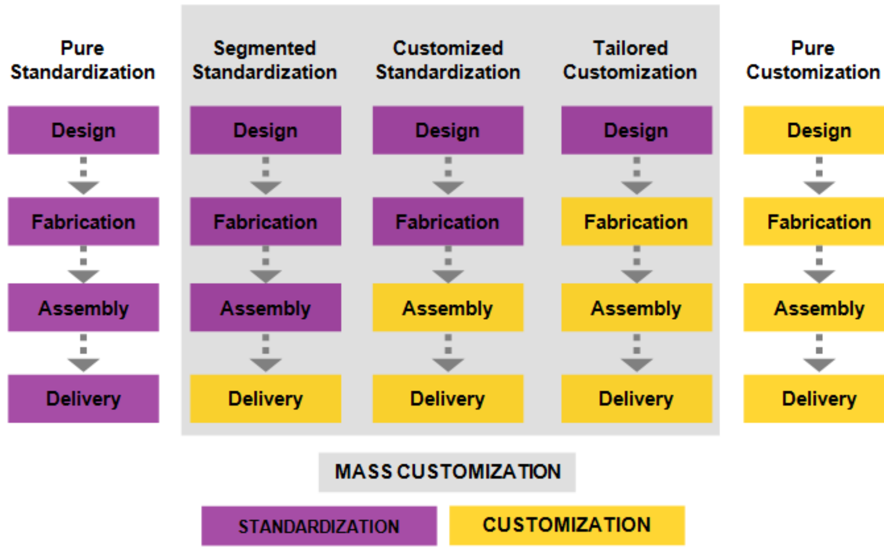

Figure 1: Mass customization strategies with regard to level of customer involvement (source: Tseng, 2003).

MASS CUSTOMIZATION OF HOUSING

The common application of customization within the housing industry is to provide homebuyers different alternatives regarding layout, finishing and systems. For example, the homebuyer will be offered to choose between housing layout A, B, or C, then kitchen layout A, B, or C, an optional extra garage or even extra story. This approach has been defined in research as "multiple choice housing", which takes the form of printed catalogues and, recently, developed into interactive electronic catalogues. Electronic catalogues; typically, take the form of internet websites, offer users the ability to navigate then modify the design on a computer. Such trend is considered to be exhaustive, as the architect is required to formerly design all possible alternatives. As a result, in some cases the amount of alternatives has to be kept limited to three to four options in order to avoid additional overhead cost. Moreover, offering many choices might be confusing to some homebuyers. Nevertheless, there are still chances that customers' desired design variation will not be offered, since alternatives are developed according to architect's view, not the customer's demand.

Implementing mass customization in the housing industry requires an intensive communication between the homebuyer and the designer, in order to gather homebuyer's needs and requirements, then realize it. Moreover, the concept of enabling users to make a wider range of design decisions intelligently requires providing them a search space with various design alternatives and a mechanism to search for desired solutions. This process of interaction can be attained through an interactive design interface that takes users systematically through a series of design diversions, images and diagrams, making them choose spaces, colors, and every design detail. The methodology described in this paper focuses on the embedded design system within interactive interface, that would allow customization at the early stages of the design stage of a dwelling unit.

Design of Design Systems

The use of computation techniques in the synthesis stage of design process with the aim of automatically generating solution has been an interesting trend ever since development of CAD systems in the late 1960s. Applications were centered towards space-allocation planning and circulation, which are considered as a decisive architectural problem. These applications employed accessible programming techniques of that time, focusing on fulfilling various design requirements. Accordingly, many efforts were directed towards formalizing the connection between human designers and computers; how to develop design systems that would effectively aid designers in the design process. Cross (1977) stated in his book "The Automated Architect" that the first thing to consider when designing a design system is to clearly define the objectives. Cross then proposed a detailed checklist as a reference for the design of design systems.

As an outcome of development of CAD systems on different levels, the scheme of user participation captured the interest of many researchers; using computers as a way to engage various participants to contribute to the design process. The result of such interest was the development of formal structure that allows participation of users from various domains in the computer aided process. Maver (1970) proposed a mechanism that would engage different members of the building process; clients, users, designers, and others affected by the building proposal, in an iterative process of evaluating design processes. Coleman (1973) proposed a CAD prototype that could enhance user participation in housing design through enabling users to arrange a number of graphic symbols within a given perimeter, on a computer screen. The symbols represent various spaces of a house; living room, dining, kitchen, etc, that could be arranged by potential occupants to suit personal requirements and needs. In such case, the role of the computer is to constrain the arrangements with respect to different factors such as building regulations, and then provide an evaluation of the outcome. The aim of this research was to establish a computing platform to assist non-experts in the design of their future homes, thus result a more socially evolved architecture.

The process of designing a design system requires primarily a clear definition of the design problem, thus definition of the overall system's objectives (Cross, 1977). Accordingly, the role of the computer has to be well interpreted as the process develops. as an outcome of studying previous efforts, it is believed that computer-based design systems can play a vital role towards mass customization of housing, providing a practical link between the architects, users, and builders.

A Design System for Mass Customization

The process of housing design can offers a great range of variations, but at the same time it is subjected to many regulations controlled by homebuyers' profile, needs and requirements, site and building guidelines, and contextual constrains. In that sense, it is infeasible to consider all these parameters through predesigned prototypes. The rational solution is to offer future homebuyers products that are tailored to their wishes by getting them involved in the design process.

The application of generative design tools towards customizing housing has been explored with the aim of bridging the gap between homebuyers, architects, and builders. In other words, because it is almost impossible that the architect will meet with all future homebuyers to design custom homes, then implementing a computer-based generative system can be considered as an appropriate solution. Such design system will be an outcome of collaboration between the architect, and builder, thus based on design and production rules. However, prior to designing a design system, it is crucial to determine the level of customer involvement in the customization process, which determines the customization strategy to be implemented, thus the nature of the design system. This will have a direct impact on the nature of the design system as it will describe whether the design system will be accessible by the user, or operated only by the architect. Finally, the level of automation of the system is also an issue to explore closely.

According to critically analyzing diverse approaches to implement mass customization in the housing industry, the following framework for the design of design system was derived and structured.

Define the design problem: the definition of the design problem is primarily based on:

- The nature of the problem: according to Mitchell (1974), a problem is specified by giving description of the required object.
- Problem statement, including various conditions that must be met, tools and operations that are available to be employed, and limits on resources.
- Goals to be achieved
- Appropriateness of the problem for being solved through computation methods.
- Integration scheme; the interface through which homebuyers/architect will be able to manipulate the proposed design of their homes.

A design system for customizing housing requires the input of homebuyers profile, socio-cultural background, building context, budget, and required spaces and activities, all to be accommodated into a set of precise spatial requirements that would structure a design brief for a specific case. At the same time, the system also depends on the ability of the building method to accommodate variations. This type of data has a direct impact on the problem definition.

Structure collected information: it is important to structure all the collected information hieratically in order to formalize a design brief that would help developing the design system. This concept of structuring information was proposed in Alexander's seminal book Notes on the Synthesis of Form, where a list of statements was written to be considered by the designer.

Define set of variables and parameters: variables, in addition to mathematical equations, are used to translate a design brief and represent it in terms of shapes and spatial relations, thus produce a solution that responds to users' desire. Variables would translate user profile into numeric data required for the design. It can include desired area, number of room in response to family structure, and choices related to layout perimeter. The number of variables and its influence in the design process has a direct impact on selection of generative tool.

Define set of constraints: the outcome of systematically structuring gathered data is a set of constraints that control the nature of the desired outcome of the design problem. Constraints help directing the search process towards the suitable candidates by providing checkpoints. Each constraint is a definite statement of characteristic that the solution has to comply. Constraints can be grouped into larger classes, each related to a precise feature of the project.

Set of constraints will usually include:

- Design rules
- Functional requirements
- Spatial proportions , adjacency, and orientation

- Building codes and regulations
- Environmental consideration
- Additional constraints may be added according to construction system. For example, if designing for a prefabricated housing system, then module sizes, transportation, dimensions, and connection regulations can be regarded as constraints.

Select appropriate generative model: the study of applicable computer-based generative design tools towards mass customization of housing has demonstrated promising possibilities. However, because it requires managing enormous amount of information, the issue of covering all aspect of the process has always been questionable. Precedent research demonstrated the application of the following generative tools:

- Shape Grammars: it is classified as rule-based formalism that facilitates the process of generating design through structuring, then applying a set of rules. However, implementing such system on the computer is time-consuming because it requires defining shapes and rules, then encoding them (Stiny, 1972).
- Evolutionary systems: considered as highly creative, and can be employed in through various phases of architectural design. Its performance could be enhanced when introducing constraints to the generation process. Formalizing an evolutionary generative system requires considerable computing expertise, in addition to determining feasible form generation and production methods. The discourse about how to encode forms and manipulate the resulting data is more philosophical in nature, compared to technical (Frazer, 1995).
- Parametric systems: can be classified as a specific case of algorithmic systems. They were developed to handle variations within various design and production environments. They are based on the notion of associativity, where object properties branch from relationships or inheritance. However, parameterization increases the complexity of both designer task and interface, as designers have to model the structure through which variation is controlled, in addition to the artifact being designed (McCormack, 2004).
- Constraint based systems: Design by constraints has gained notable interest lately due to its ability to direct the design process towards desired solutions, by being able to managing a large complicated set of relationships (Kalay, 2004).
- Hybrid systems: The real power of these systems lies behind the combination of two or more systems, depending on the nature of the problem, and its level of complexity. Various hybrids have been proposed, such as combining shape grammars with evolutionary algorithms, and parametrics with other rule-based systems. In other words, it involves combining the power of knowledge-based systems, with rule-based systems, or even the power of two rule-based systems.

Constructing a generative tool is considered as complex process, as it involves a discrete design within the design system. Each of the mentioned algorithms can be constructed in various methods based on the nature of the problem and the desired outcome.

Implementation: since computation involves processing information in mathematical terms, it is required to describe spaces and spatial relationships in terms of numerical values, and define it in a formal language which has the ability to bring the structures and meaning of the model into the desired object. There is various software platforms that enables encoding design knowledge and rules and produce high visualization. The selection of the platform relates to the nature of the link between design and production.

CONCLUSION

Research on mass customization of housing is directed towards three main areas: first, application of design systems to allow the generation of customized housing. Second, implementation of BIM technologies to efficiently link design and production. Finally, the role of digital fabrication techniques to handle complexities associated with the process of customization. This research focus primarily on design systems, and the use of computation techniques to enable mass customization of housing.

Mass customization of housing is considered as a remarkably complex process, as it requires orchestrating the relation between homebuyers, architect, and builder. The development of computational techniques in the form of generative models demonstrated great potential towards involving homebuyers in the process of customization. However, the process provokes many questions concerning its efficiency and applicability. Selecting, thus designing a generative system for mass customization of housing depends mainly on the business model. In other words, housing typology, design and production technology, and marketing strategy. This dictates the level of customer intervention in the design process.

This paper proposes a framework that can be pursued when designing a design system to customize housing at the level of layout design. The proposed framework is generic, and flexible for further developments. It raises various issues regarding the applicability of generative models to customize housing. First, the model by which clients would interact with the design system. Second, required type of data output to efficiently link design and production. Third, the appropriate process to customize the components of the house. Finally, the possibilities of implementing the described method for customizing multi-family housing.

Future work will be concerned validating the framework through two cases studies. The first will be within a prefabricated single family housing system, while the second will focus on multi-family housing. The reason behind selecting these two cases that prefabricated housing will offer the opportunity to explore customization of components, and link between design and production system. On the other hand, multi-family housing involves managing large amount of homebuyer's information which, in addition to building constraints, which is in some cases, difficult to handle. Once the framework is validated, it will open prospect opportunities to mass customize housing more efficiently

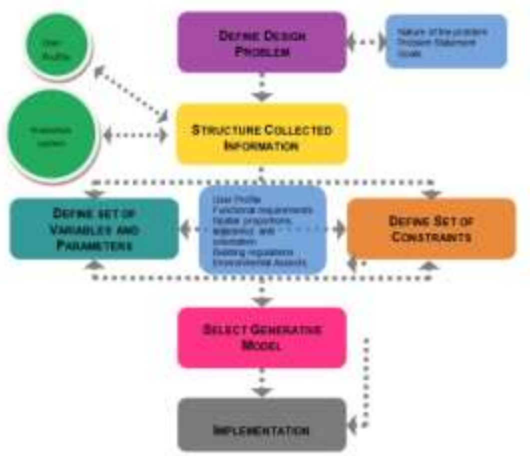

Figure 2: Graphical Presentation of the framework.

Recent developments of parametric and Building Information Modeling (BIM) software have opened new opportunities towards linking design and fabrication. Parametric modeling creates the mean by which architects, engineers, planners, builders and fabricators can communicate together in a fully integrated environment. BIM forms the basis for design, and contains all the information required for the development of fabrication, and assembly of the house. The outcome of such systems is more efficient structural and technical coordination, better management of parts schedules of procurement, an understandable approach to sequence of assembly, and greater control over fabrication, assembly, and building

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Strategic Asset Management: Relating to Open Building Concepts

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ABSTRACT
Healthcare services are provided in increasingly complex environments which are driven by multifaceted internal activities along with changing patterns of demands, rising costs and the management of the physical assets is vital for efficient delivery of these services along with improving quality and increasing productivity. Healthcare estates planning is supported by a Trusts' programme management and investment appraisal and planning. This paper explores current approaches and develops an approach to Strategic Asset Management using open building concepts that can be applied to healthcare projects to enable a flexible estates response to service redesign, technology innovation and changing business demands. This is achieved through collation and comparison of these approaches to identify existing gaps and inform how open thinking can transform business case procedures for estates planning and assist in the strategic evaluation of healthcare assets.*

Aim: To investigate healthcare estates planning approaches and assess various decision making criteria around Strategic Asset Management (SAM) in order to develop a SAM framework utilising open building principles.

Objectives:
Develop a state of the art through a review of literature on estates planning approaches in the UK.
Identify limitations and gaps with current approaches.
Define key terms (Strategic Asset Management).
Devise a framework supporting Strategic Asset Management that compliments open building principles and concepts.

** In UK the National Health Service (NHS) hospital physical asset planning is referred to as estates planning.*

KEYWORDS:
Strategic Asset Management, Open Building, Business Case, Estates Strategy, Healthcare

CONTEXT
The National Health Service (NHS) in England is facing a huge financial and capacity crisis. New thinking is needed to meet expanding demand while controlling rising costs, improving quality and raising productivity. Recently the government published The White Paper, 'Equity and excellence: Liberating the NHS', setting a long-term vision for the NHS, realising up to £20 billion of efficiency savings by 2014, which will be reinvested to support improvements in quality and outcomes (Department of Health, 2010). The government plans to reduce NHS management costs by more than 45% over the next four years, freeing up further resources for front-line care. In 2010 the Chancellor identified improvements to NHS estate utilisation as a key saving area in 2010/11-2012/13, potentially reducing in 2010/11 the need for new hospital space by up to £3bn and saving up to £100m per annum of estate costs (DH/NHS Finance Performance & Operations, 2009). The importance and possibility for these kinds of savings have been well articulated in grey literature; however, current estates teams are faced with challenging decisions raised by competing priorities and conflicting policy drivers. Several Department of Health (DH) and Community Health Partnership (CHP) organised initiatives and approaches (such as Commissioners Investment & Asset Management Strategy and Strategic Service Development Plan) have improved this situation, however, many Trusts are only now in the position to better understand the value of their estates. Only a few Trusts have a clear idea of how services are being delivered spatially and how buildings can be adapted for future change or marketed as valuable real estate. The underlying principles for all Strategic Asset Management (SAM) plans are to deliver 'optimum' and efficient estate providing good 'value'. Given the complex nature of healthcare, a one-stop solution may not address the challenges encountered. A framework is thus required to address the current gaps within estates planning approaches along with providing valuable guidance to planners. In the current economic environment, where capital allocations are under pressure, such an approach to SAM (which relates to open building concepts) will enable the healthcare sector to re-appraise asset ownerships along with determining sustainable approaches to asset acquisition, maintenance, refurbishment, reconfiguration or disposal.

HEALTHCARE ESTATE PLANNING APPROACHES

Healthcare Estates Planning within the NHS (UK)

The effective planning and maintenance of NHS assets is essential for the provision of safe, secure, high quality services capable of supporting current and future service needs. This should take place at a number of different levels - starting at a strategic level and cascading down to a more operational level. This can be achieved by the systematic management of all decision-making processes taken throughout the life of the physical asset. Using assets effectively can realise improved capital receipts and efficiency savings. Estate planning needs to address critical capacity gaps and establish appropriate demands for accessible service models. Within England, the estates planning process begins with the projection of the demand on the infrastructure (calculated on the basis of volume of patients and resources required). This demand is driven by factors such as: demographic projection; epidemiological changes; and advances in medical technology. Historical trends are projected based on these factors to determine the future national demands. This leads to projections of system level clinical activity, which is factored into different types such as inpatient, outpatient and A&E activities (Neufville et al., 2008). Within the NHS, many hospitals (NHS Trusts) have tended to calculate their anticipated volume of activity on the basis of the previous year's activity levels and waiting lists, complemented by estimates of the activity levels required to meet the 18-month waiting-time target (Ettelt et al., 2007). There is no central planning of hospital services at the national level per se. They traditionally negotiate anticipated volumes of activity with the Primary Care Trust (PCT), and these figures are then set out in a service-level agreement between the organisations. Demand is then be segmented into disease categories which is considered first at a national level and then broken down to: a regional level (Strategic Health Authority); a local level (Primary Care Trust); and finally a hospital (Neufville et al., 2008). This demand is then used to calculate the required hospital capacity. But given the current re-organisation and reform of NHS organisational structure as proposed in The White Paper, 'Equity and excellence: Liberating the NHS' (Department of Health, 2010) has meant the abolition of Strategic Health Authorities (SHAs) and PCTs. This entails giving responsibility for commissioning health care to GPs and their practice teams working in consortia; the creation of an independent NHS Commissioning Board to allocate resources and oversee GP consortia; the introduction of an outcomes framework for holding the NHS Commissioning Board accountable in place of targets and performance management and the creation of an economic regulator that will set prices, promote competition and ensure service continuity of essential services (Dixon and Ham, 2010). The lack of detail in The White Paper (Department of Health, 2010) makes it difficult to predict how these changes will play out in practice and the effects it will have on estates planning. The traditional measure for hospital capacity has always been inpatient beds which are derived from required target occupancy rates; but this is a complex issue as there are many hospital beds within 'length of stay' category (medium term, long term and short term), along with the type of specialities within each of the hospital departments. This is further compounded by the site specific characteristics such as patient management profiles, structural, political, geographical and organisational environments (Nguyen et al., 2005, Nguyen et al., 2007). Care models are then designed to determine how these services will be delivered through different healthcare providers (Green, 2004). Given the current changes within the NHS the Kings Fund (Dixon and Ham, 2010, Ham et al., 2011) suggest the implementation of a new model of care driven by clinicians working collaboratively to meet the needs of patients and to co-ordinate services with regional level leadership (provided by multi-professional clinically led groups or clinical cabinets working with the NHS Commissioning Board). Alternatives to the tariff are also needed for non-elective, long-term and complex care. These alternatives may include bundled payments, pooled or delegated budgets and capitated budgets. Any payment mechanism adopted needs to ensure that financial rewards are linked to the quality and outcomes of care (Ham et al., 2011).

Over the years, there have been several guidance documents related to capital investment and management of estates and facilities such as: the Capital Investment Manual (NHS Executive, 1994); NHS Estates Code (NHS Estates, 2003); Developing NHS estates strategy (NHS Estates, 2005); World Class Commissioning (Department of Health: Commissioning, 2007); and Transforming Community Services: enabling new patterns for provision (Transforming Community Services Team: Department of Health, 2009). These have tried to address the effect of changing organisational, commissioning and procurement impacts on estates. Tools such as SHAPE (Strategic Health Asset Planning and Evaluation) (Department of Health, 2008c), ADB (Activity DataBase) (Space for Health, 2011), PAM (Premises Assurance Model) (Flory, 2010) deal with various aspects of whole building life cycle from planning and designing of spaces within the building to operation, maintenance and disposal. Other tools such as: DQI, Backlog maintenance, ERIC (Estates Return Information Collection) (Department of Health, 2008b), PEAT (Patient Environment Action Teams) (NHS National Patient Safety Agency, 2011), AEDET (Achieving Excellence Design Evaluation Toolkit) (Department of Health, 2008a), BREEAM (Building Research Establishment's Environmental Assessment Method for Healthcare), NEAT (NHS Environmental Assessment Tool) (Department of Health, 2009) deal with the quality and performance of the estates and services. There are a number of approaches prescribed and adopted for effective estate planning within healthcare. The following approaches were selected as these were recommended by the Department of Health and are widely utilised for estates planning within England and deal with various aspects of asset management.

Commission Investment Asset Management Strategy (CIAMS) (2009)
CIAMS, developed by Community Health Partnership, is one of the recent approaches to estates strategy. It was built on existing practice and aimed to promote an alignment between a PCT's commissioning strategy and its plans for the future of primary and community care estate (Community Health Partnerships, 2009a). This was built on the approach set out to achieve the separation of the operational provider services from commissioning functions (Transforming Community Services Team: Department of Health, 2009). This guidance provided a high level approach for a comprehensive estates audit that aimed to enable commissioners to have a complete picture of the quality, use, location and cost of the estate from which primary and community health services could be provided. The process described in this toolkit takes commissioners through a series of questions about their estates (e.g. baseline information, suitability of the property and finance). The output from this process is the production of a strategic document (CIAMS Output Spreadsheet).

Strategic Service Development Plans (SSDP) (2009)
SSDP, also developed by Community Health Partnership, is defined as a document that 'brings together the service vision of local public sector organisations to describe a local economy service strategy to radically improve the health and well being of local communities. It should identify the new facilities needed to deliver that strategy and link health and social outcomes with infrastructure development' (Spence, 2010). A SSDP underpins a LIFT project and adopts a whole-system approach in relation to capacity planning for primary care, acute care and related services. It can also be used by PCTs and SHAs to match premises investment against service plans. CIAMS can be seen as the process that provides the foundation for the development of an SSDP through:

- understanding the current estate;
- analysing the gap between the existing estate and that required to accommodate projected future service provision; and
- bridging the gap through identification of infrastructure solutions (Community Health Partnerships, 2009b).
- It deals with wider determinates of the health economy and is suggested to be a 'live' document that has to be updated regularly or at least annually by the participants and reviewed by those required to approve capital investments (such as LIFT Co).

Developing an Estates Strategy (2005)
This guidance provides best practice advice on developing a robust estates strategy and also includes example strategies in the form of case studies. According to this manual the key components of an estates strategy are informed around three common strategic questions:

- Where are we now? To cover: current service profile (Up-to-date existing estate appraisal; property schedule and value; estate occupancy costs; physical condition; functional suitability; space utilisation; quality; mandatory fire safety/statutory compliance; environmental management; environmental impact assessment; patient perception surveys; risk-adjusted backlog; and a summary of priorities.)
- Where do you want to be? (A summary of the service strategy, environmental strategy, and estate performance criteria).
- How do we get there? (Implications of service strategy for the estate, preferred strategic option for estate change, implications of local authority development strategies, capital investment programme, a summary of disposal and proceeds of sale, site-based development control strategies, forecast effect of strategy on estate performance, forecast effect of environmental performance improvements, risk management strategy) (NHS Estates, 2005). Amongst the guidance evaluated this was the only one that provided best practice examples.

Health Building Note 00-08: Estatecode (2007)
This was designed for providing best practice guidance to NHS organisations on all aspects of managing their estates to inform decisions based on strategic investment procurement, acquisitions, disposal and leasing of land and property (sets out what is mandatory as opposed to discretionary guidance) along with including legal, financial, regulatory, statutory and administrative issues. This was intended to inform day-to-day management issues. It includes detail on town planning (statuary legislation, NHS involvement, application and appeals) along with management of land and property. It refers to a SSDP which should include: innovative methods of service delivery, including those that cut across established organisational boundaries; practical applications of current guidance and initiatives; local expertise (patient, clinical and strategic); contributions from available partners; along with details of anticipated and required workforce changes. It has detailed guidance with regards to asset management (e.g. legal considerations, procurement, acquisitions, leasing, disposal and capital charges).

Capital Investment Manual (CIM) (1994)

This is one of the key guidance documents that most PCTs, SHAs refer to during planning and evaluation of their capital schemes and is broadly organized around project organization, Private Finance Initiative (procurement route), business case guide, management of construction projects, Information Management and Technology (IM&T) guidance, commissioning of health care facility and post project evaluation (NHS Executive, 1994). It describes key roles and responsibilities that must be discharged and recommends structures for managing construction and IM&T projects and also recommends the use of PRINCE (Projects IN a Controlled Environment) methodology. It also provides details on appraisal of services along with linking service volumes to demands to provide appropriate facilities along with a gap analysis of capital asset base and affordability of the investment along with detailing out each step of the business case (BC) planning process from the options appraisal and formulating the outline BC through to Full BC. It also recognizes that Trusts may not have the capability and capacity to design and build facilities and to attempt this may be a risk; hence suggests engaging experts in construction project management, architects, quantity surveyors, design contractors, building contractors and equipment suppliers. This guidance also provides templates of documentation required (ranging from project certificates and business case forms through to financial status reports, tender and procurement reports along with quality and performance reports). This can be inferred as one of the 'core' guidance as all other guidance (evaluated in this paper) makes a direct or indirect reference to it. Along with the vast amount of detail provided in this guidance, what sets it apart from the others is the reference to IM&T procurement and implementation along with equipment procurement, identification of competencies and training requirements along with post project evaluation guidance. Table 1 summarizes the findings of the comparison of the various estates planning guidance.

STRATEGIC ASSET MANAGEMENT (WITHIN THE CONTEXT OF AN ESTATES STRATEGY)

One of the key findings from the above analysis was that many current processes of estates planning are based on a 'top down' approach that evaluate business cases or appraise infrastructure plans for prospective capital investment based on rigid master plans. Most of the guidance provide a comprehensive approach to planning and management of assets along with delivery of capital schemes, however many of these are based on national policy quality initiative and targets rather than on a robust evidence base. There is no clear understanding of how estates strategic planning and asset management sit within a wider whole systems plan. As a result, Trusts may find themselves ineffectively and inefficiently delivering some aspects, for example, accessibility and transport planning are critical, however there is little guidance or methods to perform these activities and stakeholder involvement process need to be better integrated with the decision making process. Strategic estates planning needs to demonstrate buildings that focus on quality, coordinated care, economic and environmental sustainability along with patient and staff safety. The key message is to build a system based response to manage all the policy drivers in place, along with managing collaboration and competition. Many trusts go through a prioritisation process for investments, driven out by: fragmented and minimal funding streams; changing policy; contentious business case development; and unaffordable minimum standards. There is little guidance on how priorities can be realistically made against national standards and best practice for flexibility and adaptability. Trusts' estates strategies may be improving efficiency and speed of provision but may not be enhancing design quality. As such, a SAM approach should supplement integrated business planning to anticipate change in the estate. There are new ways of organising hospitals (e.g. co-located models and integrated care centres) and new specialist care models and managed networks that all need to be better understood during up-front planning and strategy formulation. There is a need to develop SAM as a facilitating framework. Estates planning approaches are not comprehensive enough (they need to be more than just technical strategic estate planning solutions); the development rationale needs to move from a 'static' to a 'dynamic' approach leading to a more 'agile' infrastructure planning solution.

Table 1: Comparison of Estates Planning Approaches

	CIAMS*	SSDP*	Estate code	Estates Strategy	CIM
Tools	Multimap, survey tools and techniques, SHAPE, Six Facet Survey, good corporate citizen assessment, BREEAM For Health (B4H), AEDET, SMARTWaste (SWMP) *can be viewed as a tool in itself	Gap analysis, Joint Strategic Needs Analysis (JSNA), options appraisal, cost rent premises analysis *can be viewed as a tool in itself	SHAPE, AEDET option appraisal, financial appraisals, cost benefit analysis, sale methods (formal tender, informal tender, private treaty, late bids, public auctions), risk management, health and safety, transport planning, SSDP	statutory legislation, NEAT, mapping trends, income to asset ratio comparison, patient journey model, site density analysis, guidance for managing backlog and risk management model, quality assurance model for the patient journey	PRINCE, porters five forces, SWOT, cost benefit analysis, financial appraisal, option appraisal, brain storming, weighting and scoring of benefits by options, scenario planning, patient surveys, cost analysis, demand analysis, analyses of disaggregated population data (demographics), competitive analysis
Approach	Strategic (High Level)	Strategic (High Level)	Strategic, Tactical	Strategic	Strategic, Operational
Time Frame	3-5 years	5-10 years	10 years	5-10 years	3-5 years & 10 years
Provision of Best Practice Examples	No	No	No	Yes	No
Structural Decision Making	No	No	Yes	No	Yes
Stakeholder Engagement	Patient Surveys	Public Consultation	Public consultation	Stakeholder engagement (financial, general and business managers, clinicians SHA stakeholders)	GP and patient surveys, internal stakeholder consultation (clinicians, nurses, managers, department head and NHS staff), external stakeholder consultation
Potential Gaps	Focussed on front end planning and lacks operational detail on asset management. References are made to guidance for building functionality, suitability and functional condition, but none made for capacity planning and room utilization. No detail is provided on stakeholder or public and patient engagement, only reference is made to patient satisfaction survey for core suitability of the property or estate in term of quality of environment for patients; in order to reveal underlying consistent concerns that need to be considered in assessing the building's quality.	A high level strategic document and lacks detailed costing and financial reviews of the proposed infrastructure solutions. No detail on asset management and broader issues related to estates planning. It promulgates a whole system approach but does not provide the necessary tools and guidance required. Reference to dealing with workforce issues without providing much detail on labour market trends and recruitment and retention issues.	It recommends careful evaluation of space requirements (through utilisation of open- plan office and shared facilities) to secure significant space, energy and ultimately cost savings; but does not articulate other aspects of rationalisation such as sharing flexible spaces which are designed around room adjacencies and shared care pathways. It provides a detail account for the current premises (lifecycle costs of the assets) but does not take into account future scenarios.	A high level strategic document that only sets out the components of an estates strategy. It refers to the chief executives and estate and facilities directors as the key personnel responsible for generating an estates strategy, but does not detail their role or include other stakeholders. Although it refers to stakeholder engagement, it does not entail the key methods utilised for this.	Key roles for management structures defined are too rigid and have a top down approach; traditional roles of estate planners defined may be inadequate and may lead to a lack of project ownership. Organization of the management structure also suggests switching responsibilities between individuals at various points in the project, unless good team working and collaborative practices are established this may lead to a blame culture. This guidance needs to be updated and referred to PRINCE2 (OGC, 2011) . Guidance is lengthy and resource intensive; and risk in overspending

The terms Asset Management and Strategic Asset Management have been defined by various organisations (Knowledge Group Consulting, 2006, Audit Commission, 2009, Audit Scotland, 2008, BSI, 2008, Institute of Asset Management, 2009, Maheshwari, 2006, Woodhouse, 2001), for the purpose of this research, SAM is defined as 'systematic and coordinated activities and practices that are based on evidence based decision making supported by capacity planning to sustainably plan, manage, maintain and dispose estate through optimum whole life costs with robust risk management plans which deliver the organisation's objectives with effective stakeholder engagement at appropriate levels'. SAM is complemented by: systems knowledge (defining the problems); transformation knowledge (synergies for simulation scenarios); and objective knowledge (strategic planning defining roles and new areas).

The following figure sets out a framework for SAM which is driven by capacity planning at one end and also lists the key factors that should be considered for effective asset planning, maintenance, operation and disposal. This framework adopts a strategic systems thinking approach which considers ever evolving models of care and is complemented with a good estates planning strategy along with accounting for accessibility issues in order to provide capital investment solutions that provide value for money along with effective healthcare service provision. It should also be noted that estates planning, care model scoping and design and access (transport planning, accessibility and issues around co-location etc) (Mills, 2010b) are placed at the heart of SAM as these are seen as essential components for effective healthcare infrastructure planning (Mills et al., 2009, Mahadkar et al., 2010). SAM needs to tackle issues that the current healthcare landscape faces along with quantifying future levels of demand to provide accessible services within flexible premises.

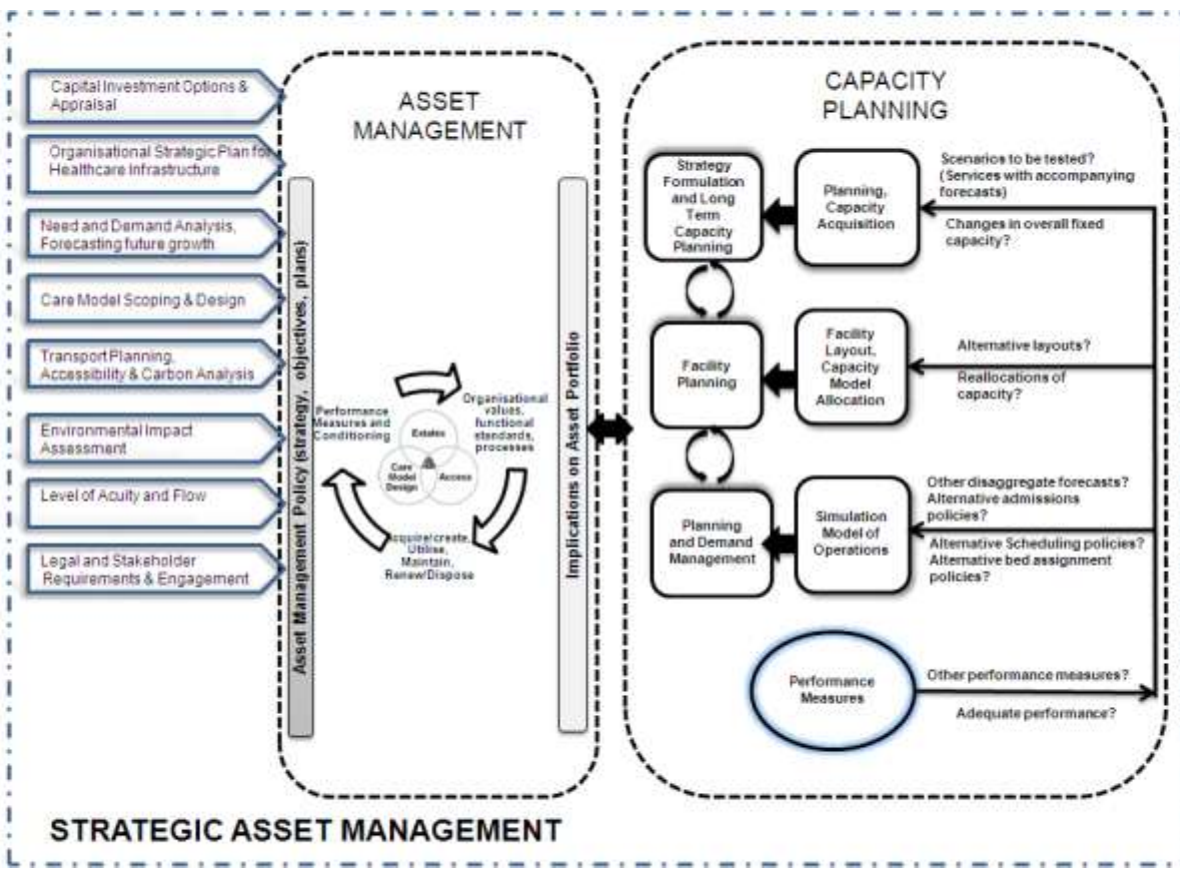

Figure 1: Framework for Strategic Asset Management; Adapted from (Butler et al., 1992)

OPEN BUILDING APPROACH TO STRATEGIC ASSET MANAGEMENT (SAM)

In open building, the building is seen as a potentially well organized combination of available systems and subsystems (Kendall, 2007a). Healthcare is complex and dynamic, and hospital buildings or assets or estates are complex facilities that are not built and operated as 'whole buildings'. It has long been recognised that hospitals are 'rigid' when subject to changes in demand (driven by demographics, epidemiological patterns), advances in technology and new medical equipment and political and organisational changes which effect the scale and scope of the hospital along with changes in funding of healthcare services (Neufville et al., 2008, Miller and Swensson, 2003, Olsson and Hansen, 2010, Tannis et al., 2005). Open building recognises and appreciates the fact that no party makes all decisions when a building is first constructed and through its lifespan, the building adjusts to new needs and technical requirements and decision making and construction has to be organised in such a way as to reduce excessive dependencies and 'entanglements' among all parties involved (Building Futures Institute, 2011). Kendall (1999) defined system entanglement as 'ad-hoc and disorderly layout of physical systems so that the change of one part disrupts (requires the movement, destruction or change of) many other parts. The greater the number of physical systems and their "entanglement", the greater the chance for conflict among the various parties controlling them. Conflict leads to legal disputes, reduced quality, increased rework, and unsatisfied users and building owners'. The 'entanglements' that are referred to by Kendall (1999) in open building are also seen within the healthcare estate planning process. Various stakeholders of the project (clinicians, patient, public, construction managers, builders, suppliers and others) have to organise new ways of working through estates planning, design and procurement methods in order to deliver healthcare while dealing with these 'entanglements'.

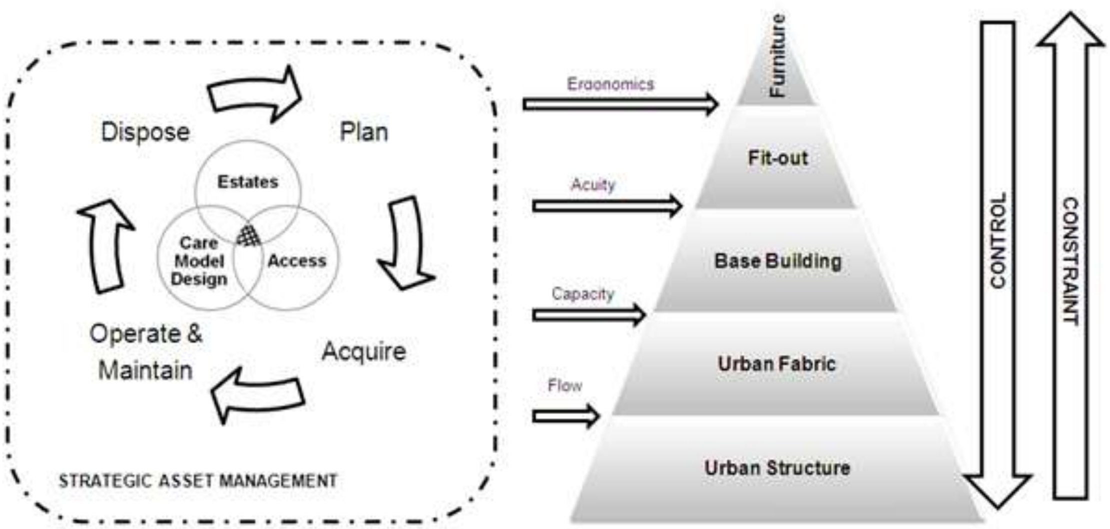

Figure 2: Relating SAM to 'Open Building' principles

The various levels of infrastructure planning used for the design, build and management of buildings has been organised into 'principles of levels' by (Kendall, 1999, Habraken N. J., 2000); these hierarchical levels structure interventions by various stakeholders who control work at each level. Habraken and Kendall (2007) first introduced the term 'infrastructure' into open building to describe that a base build infrastructure fits within a 'higher level infrastructure operating in the city' (p. 2), where open building has levels of intervention that serve or conflict with some greater 'three-dimensional urban design' (p. 4). For Habraken and Kendall (2007) this thinking contributes to longer life spans for the 'base build infrastructure' and is instrumental in achieving sustainability, through the uncoupling of the complexity and intricacy of fit-out demands with high performance envelops, a principle that they state is now recognised by the United States Green Building Council's LEED rating system. The merits of using open building principles and techniques have been seen in various projects all through the world (Kendall, 2007b, Kendall, 2003, Kendall, 2006) and given the complexity of healthcare infrastructure planning (presence of multiple design firms, contractors, suppliers, construction managers, planners and various other stakeholders that are involved through the life of a hospital), these 'levels' can be utilised in order to enable 'agile' planning and decision making.

Figure 2 depicts how the SAM framework can relate to open building concepts. The various 'levels' are arranged within a pyramid to depict the 'control' each level has over the other, the lower levels exert a higher control than the top and similarly the top layers are less 'constrained' than the bottom layers. Cuperus (2001) explains that each of these levels are separated yet co-ordinated and there is decision making and consultation between each level. They connect a decision making party or stakeholder to an object under construction or in transformation (Kendall, 2009). We have incorporated the different types of decisions between the levels, for example, 'ergonomic' decisions that look at adaptable workplaces with user adjustability that promotes safety will be included within the 'furniture and equipment' and 'fit-out' level. Similarly decisions based around 'acuity' (provision of appropriate level of care that matches variable patterns of acuity in a multitude of settings), 'capacity' (the utilisation and a measure of the maximum possible output of a process or system) and 'flow' (movement of people and logistics of other infrastructure assets along a process or around a system) are included between the other levels. Further explanation of these concepts can be found in (Mills et al., 2011).

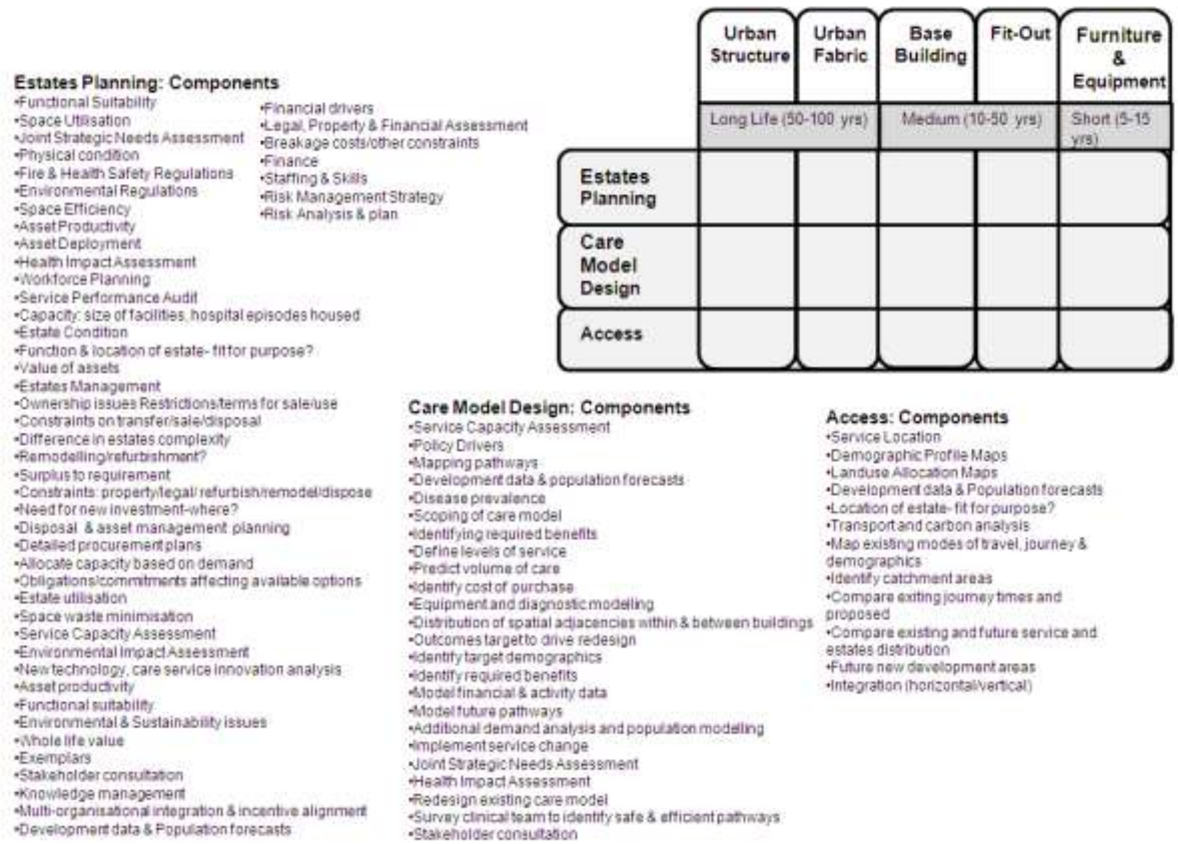

Figure 3: Tier Model for 'agile' decision making in Strategic Asset Management

Kendall (1999) developed a three tier model of control distribution in which he has divided 'fit-out' level into two categories for products and work and has further overlaid this onto a CSI (Construction Specification Institute) model. A similar approach has been proposed in this paper, where three key components of SAM (Estates Planning, Care Model Design and Access) are organized around the principle 'levels' of open building.

Figure 3 above depicts the various components in estates planning, care model design and access that need to be considered against each of the building 'levels' i.e. urban structure, urban fabric, base building, fit-out and furniture and equipment. Once each component is mapped, it will enable to see the interfaces between different levels and will help determine which activities can be carried out independently and the interplay between different levels. Consider the following example (Figure 4), in which a few components from Figure 3 (above) have been taken. It can be seen that 'estates condition' has a medium and short-term impact on 'base building', 'fit-out' and 'furniture and equipment' levels, this is considered during estates planning and the condition of the estate does not affect the lower building levels. On the other hand, 'mapping pathways' and 'service location' is considered on a wider neighbourhood and regional planning level. These have a longer life and changes to these will impact estates condition. To explain this further, consider the introduction of telecare for patients with long-term conditions, this will enable them to record vital patient information such as blood pressure and sugar levels, and those details can be sent directly to a nurse, GP or clinician to monitor remotely. This means that the 'service location' in this case is changed from a hopital or care home setting to a patient home along with a change in the care pathway i.e. 'mapping pathways'. This will have an impact on estates condition, as there may not be a need to have certain equipment and the patient beds/rooms within the 'base building' can be used for other treatments or providing other services. Similar tier model diagrams can be drawn for each of the components within estates planning, care model design and access. These will be case specific and should be considered for individual SAM plans. These will enable thinking of new environments along with the impact of commissioning and the implications on estates planning and the ability of the assets to flexibly respond to service re-design. Once these are established the next phase will entail establishing appropriate decision making networks between each of the levels after considering stakeholder consultation and engagement.

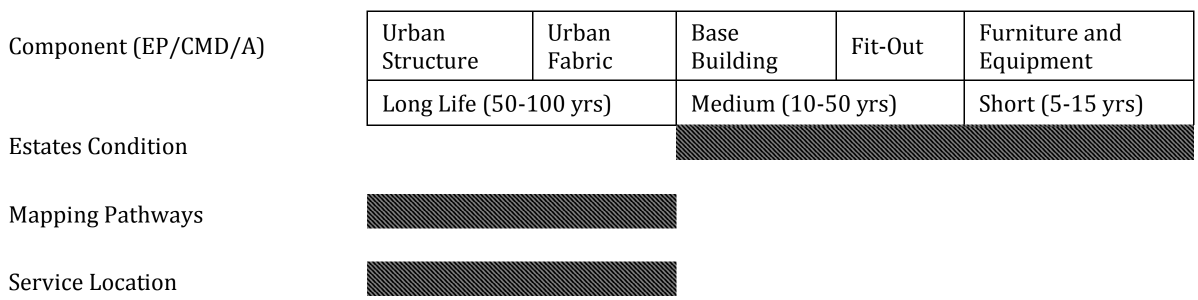

Figure 4: Application of the Tier Model Concept

CONCLUSION AND WAY FORWARD:

The authors were also involved in investigating the strategic estates planning approach with six Foundation Trusts within England (Milton Keynes, Southampton, Salford Royal, Taunton, St Thomas's and Guys and Brighton) and have also trialled an open scenario planning approach with them (Mills, 2010a, Mills et al., 2010). This approach was designed using strategic scenario planning concepts developed using open building and planning principles by Kendall (2007b) and Astley (2009) respectively. This enabled the research team to witness first-hand the the multi-intuitive and multi-stream approach adopted by the Foundation Trusts to execute their estates planning processes. The rigidity of estates planning approaches and techniques was observed at two levels: first, through a detailed document analysis of the guidance recommended by the DH; and second through active engagement with the estates planning teams within the Trusts. Open building concepts and principles provide a strong backbone to deal with the complexities presented during the healthcare infrastructure planning process. This paper has only just begun to explore the relationship between a flexible estates strategy and a contextual Strategic Asset Management plan that can support a Trust's capital investment and procurement appraisal and can be responsive to service, organisational and political changes. The tier model designed for SAM needs to be validated in order to test its suitability and will be developed in line with the open scenario planning approach that will enable planners to create a map of uncertainty and to build a broad visible understanding of the driving forces for change along with achieving strategic objectives of the organization. The next phase of this research will entail trailing this approach with estate planners, asset and facility managers and hospital designers.

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An Open Value-Based Perspective to Healthcare Building

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ABSTRACT
Aim: This paper aims to build a conceptual relationship between value and open building and scenario planning to aid the assesment of healthcare infrastructures over the short, medium and long term and against dynamically changing contexts.

Background: Faced with the current financial climate, organisations often find themselves debating the impact of short-term economic pressures, at the expense of planning the strategic long-term sustainability and value of their physical assets. Existing decision making and stakeholder consultation approaches are inadequate and as such an open and dynamic value-based approach to scenario planning is required that will capitalise on the benefits of standardisation, customisation and learning.

Methodology: This paper is supported by a critical and comparative review of health infrastructure, value management and open building literature to understand similarities and differences. It also reports on a workshop with academics and industry professionals and coins "open value" as a new direction for research.

Findings: This paper advances the emergent understanding of open building and planning by classifying workshop data into value and evidence based dimensions that can be used to assess value at two levels - open planning and open building.

Implications: Value is an important concept in open scenario planning and building. Furthermore, a new method of categorising open value as benefits, sacrifices and resources is trialed.

KEYWORDS:
Open, Planning, Building, Scenario, Value

BACKGROUND CONTEXT

In the present climate there is a propensity to focus on static short-term demands, rather than more dynamic long-term organisational value. This tendency is driven by uncertainty and is exacerbated in an industry such as healthcare, which is characterised by perpetual, and complex building types, many spatial configurations, continuous innovation and competing evidence on what delivers value. One consequence is that the effective life span of healthcare buildings are shortening and contributing to growing numbers of buildings being renovated or abandoned because of technical, social or economic obsolescence. Open building offers levels of malleability to accommodate inevitable changes at various building and site scales however, on some occasions these buildings and sites themselves can become victim to broader structural changes and developments to the landscapes around them that can result in building redundancy. These high investment and long lasting asset-based decisions should ultimately be made to optimise value (if indeed this is ever fully possible).

According to Engel and Browning (2006) systems provide value against stakeholder needs and expectations that emerge over time, degrade and change. The implication is that value-related decisions must be made about which assets to invest in and which to disinvest in. The healthcare infrastructure system is like a kaleidoscope and certainly complex (Mills et al., 2010b). It raises then the question how can adaptability be designed into the system so that it can provide maximum whole life value. What is certain is that a system's value is likely to diminish and depreciate over time as stakeholders' value judgements emerge (and their expectations and experience rise), technology changes, system's maintenance costs increase and components become obsolete. Upgrades come at a substantial cost and disruption, and are often critical since the cost of complete replacement is prohibitive.

Open value is proposed as a useful research direction to bring planners, designers and wider stakeholders together to agree a common reconciling infrastructure solution that goes beyond the functional and so can accord with the underlying values of the NHS. However, functional "ware hanger" and "shed" like construction is today seen, as the best most efficient and adaptable building solution. Rogers (2011) for example, cites comments made by todays UK ministers on the importance of building economic hospital "sheds around people and equipment".

THE CONCEPT OF VALUE

Value is according to Mills (2010) inherently complex with various people, product and process perspectives overlapping, interlocking and at odds. This makes adaptable and open buildings more challenging. There is a need for a new broader interpretation of value that includes an emergent and iterative process of stakeholder engagement and sensemaking, which goes beyond standard approaches and integrates unique stakeholder views into the asset planning and design process. Since its conception in 1945 (Miles, 1972), value managements application has often centred on understanding static, functional and cost effective product alternatives at a single point of time and within a single coherent stakeholder group. Open building, in contrast, looks for the dependency and interdependency between products and systems seperation between expert decision makers and in integrated teams. As larger and more complex products and systems were analysed, the emphasis in value management shifted to more strategic, whole system and upstream decisions, "Function Analysis System Technique" (FAST) evolved to accommodate this change (Bytheway, 1965), however time and undertainty were not centrally incorporated as core principles. Whole life value however, evolved to emphasis the importance of the time and cost uncertainty dimensions in evaluating long lasting built assets. Ellingham and Fawcett (2006) within the field of whole life costing presents a “fan of uncertainty” and “binominal tree” as a means of quantifying future favourable or unfavourable outcomes against numerous diverging events and options on a timeline, which is a useful principle in value-based decision making for open scenario planning and building. Other techniques such as lean have looked to re-engineer activities to maximise value using relatively quantitative measures to minimise waste, while useful these are by-and-large applied at a micro level (Mills et al., 2010a, Mills et al., 2011).

The overarching definition of value used in this paper follows research carried out by Thomson et al. (2003) and Mills et al. (2006), which follows an economic output input model however, is more socially determined by stakeholder trade-off, rather than objective mechanisms of transformation. Fundamentally it comes down to: “what you get” (outcomes in terms of Benefits and Sacrifices) for “what you give” (inputs in terms of resources). As such, this equation is used to characterise the nature of a stakeholders’ definition and evaluation of a proposition over time and between alternatives. The pseudo equation presented in Figure 1 provides a common unified definition and consensus view of the literature, where stakeholder perspectives (Sn) are sumed and aggregated to form a project view of value. However, it should be noted that it is not presented as the only one way of universally representing value, for example against a healthcare context we may talk of “health” and “harm” as top line outcomes, and “investments”, “disinvestments” and “risk contingency” as inputs.

$$\text{Value} = \sum \left(\frac{\text{Benefits (B) - Sacrifices (S)}}{\text{Resources (R)}} \right) + \left(\frac{\text{B-S}}{\text{R}} \right)^{Sn}$$

Figure 6. Value Equation Mills (2006) and Thomson (2006)

The engagement of wider stakeholders in the decision making process is gaining much greater importance to ensure that wider feelings of involvement, however open building has not been extended to incorporate a broader stakeholder viewpoint beyond the system seperation of teams. Within value management authors on the subject have described it as a multi-stakeholder approach, however in practice the breadth of those stakeholders consulted have often been only those stakeholders in support of the project; this is further described elsewhere (Mills et al., 2009). Today there is a clear recognition that there needs to be broader stakeholder consultation, however that this consultation also needs to be controlled to deliver value (to ensure that it does not lead to considerable design change and escalations in scope, specification and cost). There is a clear need for a hierarchy of project roles that range from those who are informed of the project outcomes, those who are consulted on design alternatives (scenarios and options) and asked to make compromises and trade-offs and those who decide and approve schemes based on stakeholder participation roles, structure and levels (Arnstein, 1969).

OPEN BUILDING INFRASTRUCTURE PLANNING

State-of-the-art debates in the field of open and adaptable building are focused on strategies for adapting to changing task, space, performance, function, size and location (Schmidt et al., 2009). Other definitions primarily centre around Brand (1995) and the exploration of physical and spatial building scales, rather than looking at the wider systems of business operations and a wider definition of what makes up value over a buildings whole life. Kendall (2002) was perhaps the first to relate broader performance (and its various measures and economic, technical and social purposes) to open building. However, he also limited value, using spatial constraints in open building levels (against a view of “territorial control” and “time”) as the rational spatial bounds of value. Kendall (2002, 2007) did however define the importance of a three tier design team system separation. This same principle applies to wider project stakeholders, however this has significant implications on project management control.

Brand (1995) describes a building adaptability model, where buildings are stratified into layers that function in a totality, but are most adjustable and adaptable to specific uses and technical changes when different layers can be changed independently or with few consequences for the other layers. For Brand (1995) the totality and interdependence between the systems and layers are critical to decision making to create a clear purpose in use. Kendall (2002) defines a level as “...a configuration of spaces and physical elements under the control of a party”. Kendall (2002) states that there are a number of situations that contribute to a buildings complexity, these include for example multi-tenant, design process responsibility change, operating and tenant change, real estate sale, differing fit-out performance expectations. While for Ellingham and Fawcett (2006) complexity is increase by whole life development, expansion, switch of use, reconfiguration, refurbishment and new technology options. All of which are critical in the definition and realisation of value. Kendall (2002) uses a hospital example to describe the importance of thinking about organisations and systems of buildings over time. Using the Inselspital Hospital, Bern, Switzerland Kendall (2002) noticed that the principle of optimising the constructed whole, at once as a "large lumpy and static object", and from the beginning around dependencies, lists of technical parts and performance was unachievable, generalising that the "whole" of such complex hospital buildings is organised and comes into existence over time and that artefacts are organised according to the "...distribution of control". Facing this "evolving rather than static" (p. 5) paradigm, the hospitals administration at Bern changed its strategy to "open" building, with specific and detailed "accommodation capacity" for a range of "programmatic scenarios" to "balance stability and change" and to organise on three primary system (100 year), secondary layout (20 year) and tertiary levels (changeable over 5-10 years) (p. 5). Such timescales and scenarios should be the basis of value based decision making. Kendall (2002) concludes that "it may be possible to account for performance in terms of whole buildings, [but] it may be more meaningful to attribute performance to distinct levels of control, of interest to distinct parties, whose performance expectations nevertheless are not in conflict" (p. 8). Jensø (2007) provides a study of Rikshospitalet and St. Olavs Hospital to show that hospital projects often change drastically, particularly as a result of decisions on investment, concept, size and shape of the building site. However, this work is still ongoing. The importance of these finding for this paper is that value is nested and emergent at various levels and that it can be organised and equated. That value at a wider site or system level, could be the sum of value from the lower dominated levels. However, this requires further definition as the social complexity of building may be more chaotic, dynamic and dependent on subjective judgments and relative stakeholder powers.

Outside of open building, perhaps one of the most applicable and advanced property and real estate approaches to layering hospital developments was published by the Netherlands Board for Healthcare Institutions (2007). This approach sees "acuity" being the most central value concept in organising assets. Where different building types are measured by their specificity, cost, flexibility and marketabiliy. Acuity, a measure of the level of health or possible harm, defines the severity of the condition and prioritises the patients' treatment (what team, what space and what urgency). As such, it is a critical overarching organising principle. Acuity has no bounds, it is organised around patients wherever they are. This layered approach divides the hospital into four buildings, referred to as the layers. These layers are the:

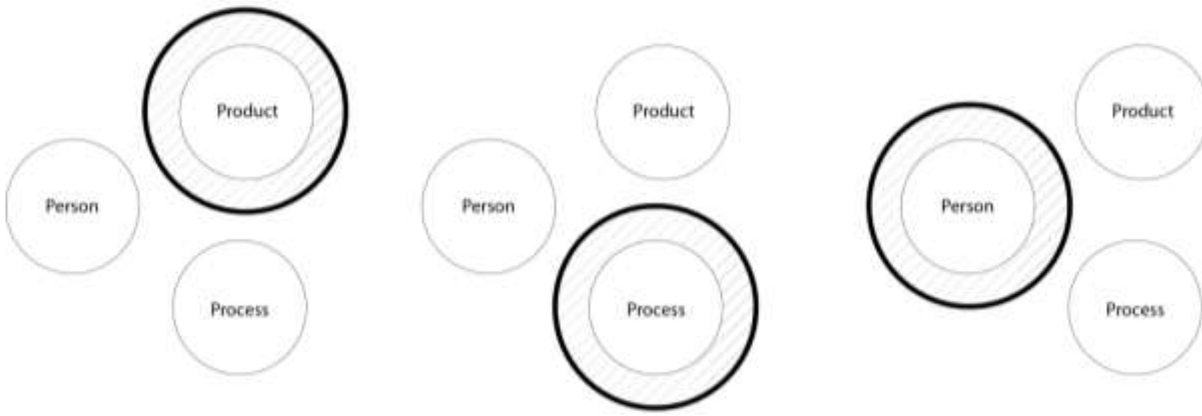
- Hot floor, the high-tech, complex capital intensive specialist functions.
- Hotel, all accommodation and inpatient functions.
- Office, these are the administration, management and simple diagnostics, examination and treatment functions.
- Industry accommodates all medical supporting and facilitating functions.

If acuity can be modelled and understood against open value levels, changes in patient acuity must determine spatial adjacency, flow and movement through the system. Technologies are the means of managing acuity, and for every change in technology modality value and disruption must be understood. Whether blood clotting drugs that stop stroke, organisation around helicopter access, ambulance based diagnostic technologies or remote tele-care systems; open planning and building must accommodate these changes if it is to deliver value. With organising around the concept of "acuity" and "changes in acuity", infrastructures will be more open and adaptable to change/refurbishment and so will deliver higher long term value.

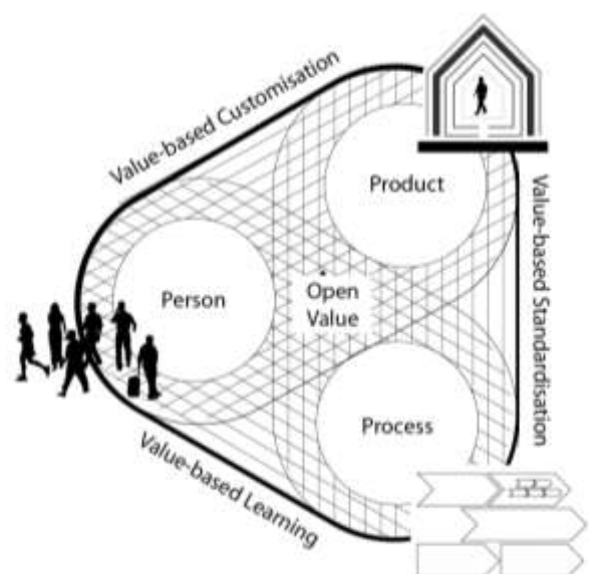
DEVELOPMENT OF A NEW VALUE-BASED OPEN APPROACH

Value, at its most fundamental, can be understood in terms of the interaction of people over time in the creation of service and built products. What is needed therefore, is an open framework of levels that supports an understanding of this interaction, so that uncontrolled and closed views of value interactions can be limited (Figure 2)

A concentration on the routine engineered product (whether it be the built product or service), rather than its interaction with people (and their values and behaviours) can predictably result in overly mechanistic, systematised and hard outcomes (Figure 2a). The creation of an overly controlled process using structured tools, which do not acknowledge stakeholder differences and product variations can lead to lost opportunity for learning and inflexibility (Figure 2b). While overly people driven "designing by committee" processes (centred around changing baseline expectations and experiences) and missing competencies within integrated teams can limit the experience and expectations encapsulated in the product (Figure 2c), a topic of discussion in Mills et al. (2009). Open building may enable interactions between stakeholders and the emergent product solution however, various levels of control must be put in place to facilitate value dialogues and clear interacting lines of decision making. What is necessary is an open interaction between stakeholders during the process of design that is managed according to open planning and building levels and robust people and process controls. This interaction of learning, customisation and standardisation is a process that asks people to be adaptors (to be involved in the processes of trading-off adaptable building qualities and coming to compromise). This interaction is defined in Figure 2d. Standardisation and design re-use in open building can have many benefits; however without project customisation and the maintenance of standards and standardisation systems, these can become quickly outdated and obsolete against changing environments and customer needs and expectations. What is needed therefore is an evaluation and learning system that provides some flexibility and openness during design delivery rather than prescriptive and standardised re-use alone. Designers must develop approaches that provide a rich and diverse multi-stakeholder and multi-criteria understanding that can be reconciled into a more creative "satisficing" as in Simon (1969) and open solution. It is clearly important to understand and learn to decrease customer sacrifice to lessen the gap between what each customer expects and what they judge they get. If organisations can find ways to reduce sacrifices, they will be able to create significant value for each customer. The introduction of value in planning and design will also stimulate value based learning, sacrifice reduction and sustained competitive advantage.



a) Closed product value b) Closed process value c) Closed person value



d) Open value
Figure 7. Open Interaction of Person, Process and Product

METHOD
This section describes the application of the Value Equation (Figure 1) in a workshop with 32 participants (14 practitioners and 18 academics). The participants were grouped into two sub-work-groups according to their expertise. The aim was to consider the dynamic nature of value (against the proposed benefit, sacrifice and resource definition) for open planning (defined as lean assets, lean logistics and lean access) and open building levels (described as lean space, lean flow and productive departments). To understand the trade-off between value criteria, and the similarities and differences between open planning value and open design value. These two sub-work-groups answered the following to investigate whether value can be universally measured using a common structuring equation: 1) benefits; 2) resources; and 3) sacrifices.

DATA AND FINDINGS
The columns in Table 1 and 2 contain a summary of the value-related issues expressed in the workshop. Open value in planning, in Table 1, was considered from a commissioner perspective.

Table 1: Open Planning (defined as lean assets, lean logistics and lean access)

Benefits	Sacrifices	Resources
Whole-system organisation	Opportunity cost (time, money, hassle)	Built Estate assets
Social enterprise and cooperation	Hospitals going bust and closing / Risk of market failure - Barriers to market entry and exit	Informal carers and family members
Patient access and time	Workforce issues (skills lost due to localisation) / Re-skilling and redundancy of particular clinical specialists / staff access	Cost of preventative mechanisms
Acceptability to the public	Loss of local service / fear of distance from protected services / rural in-access	Staff / Skills
Improved thru-put	Lost whole-system organisation power	IT / Data Information / Knowledge / Access to Evidence
Health outcomes (mortality)	Market power of GPs / Loss of control for GPs in consortia	Available Capital / Options
Convenience	Social care cuts	Space
Patient satisfaction through care closer to home	Carbon footprint and whole system organisation / sustainability	Equipment
Carbon footprint	Wasted opportunities for innovation and diffusion	Branded and Clearly Understood Service Models / User and Patient Knowledge
Self-management / personalised resources	Political leverage (Kidderminster)	Wellbeing and Social Cohesion / Team Stability / Culture / Creativity, Invention and Ideas
GP equity stake / shareholding in a consultant led service / commissioner control		Forecast-ability / dynamics and understanding of resource scenario
Equitable access and distribution		Self management / personalised resources
		Competitive market and choice "Any willing provider"

Open value in building design. Table 2 was considered from a user perspective.

Table 2: Open value in Building (described as lean space, lean flow and productive departments)

Benefits	Sacrifices	Resources
Single rooms	Floor space utilisation	Energy
Quality contact time	Flexibility	Time planning
Infection control	Aesthetics	Investment in cultural / behavioural change
Privacy and dignity	Too generic standardisation	Plan – Do – Check – Act
Flexible use of rooms – e.g. gender separation	Patient experience	Management and sustainability
Better sleep	Longer distance for staff	Budget
Reduced length of stay / Quicker recovery / Speedy treatment and response times	More land	Land
Space for family	Patient isolation	Stress and pain
Standardisation	Direct observation and communication	Visitors
Safety	Storage	Drugs
Lack of waiting between departments – user flow		Flows – Information, Waste, Food and water / goods / movement
Good communication / information		
Healing by natural daylight		

This activity showed that very few of the open planning value interactions were spatially constrained; rather, they were driven by market organisation, economics (scale and scope), investments, assets and real estate or location. Therefore, to understand the dynamic interaction of these value criteria, there is a need for a broader and open scenario planning approach. Very few of the criteria identified could be attributed to open building as it is presently defined. However, at an open spatial scale there were a number of interacting value criteria that related to open building and adaptability. These included: flexibility of rooms, standardisation, and gender separation. One concept, "flow" however was identified by both groups and as such may be an integrating concept. For open buidling, this is the movement between departments and spaces and the flow of resources (good, waste, food, etc) and the elimination of wasteful flows. For open planning, flow is more associated with access, transport and the distribution of clinical skills. Social capital, cultural change and human values were expressed at a building scale, while an understanding of clinical service, access and branding was identified at a planning level.

FUTURE RESEARCH – OPEN VALUE LEVELS
Value assessments should be made within the context of a process of decision making that responds to the underlying baseline case for change (standards, evidence and models) and potentiality of scenarios (uncertainties, horizons, opportunities). Value should be assessed at various levels of infrastructure scale, against the baseline case for change and possible open scenarios (Figure 3).

Value is nested, in that equating value at a higher systems level requires the summation of value from lower "dominated" levels. Figure 4 shows this. However, it is important to consider the limitations of this mechanistic argument, to recognise both ordered nested hierarchies and complex networks. Which have different types and uses such as: inclusion, control, level, tangled, sandwiched emergence and triadic (Anderson, 1972, Holland, 1998, Lane, 2006, Simon, 1962), and that not all of these are spatially constrained as in open building. Figure 4 shows the multi-disciplinary evidence and multi-level interaction at open building levels (were open planning may require input from all such disciplines to deal with future-orientated uncertainties). Researchers must come together from across disciplines: economics, health planning, architectural design, transport planning, public health, engineering, technology development, ICT, innovators and inventors, ergonomics, micro-biologists, nano technologists, clinicians and nurses, to develop new integrated approaches that can support healthcare infrastructure planning and design decision making and value delivery.

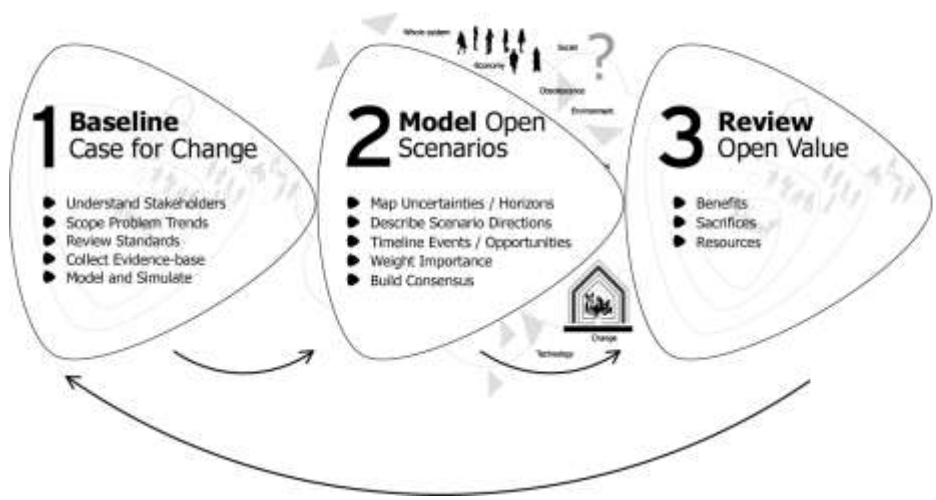


Figure 8. Open Value-based Scenario Planning Process

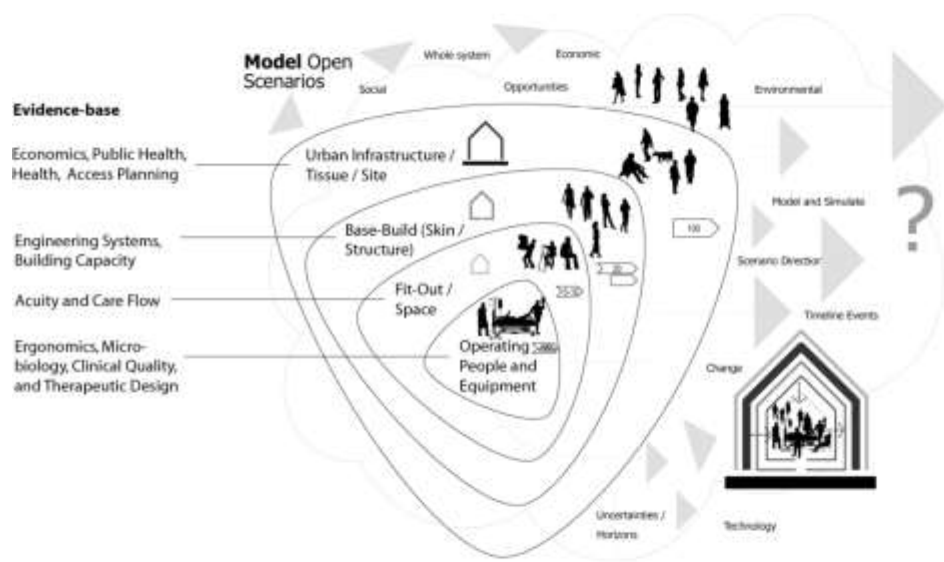


Figure 9. Open Value Interaction at Open Planning and Building Levels

$$\text{Infrastructure Open Value} = \sum \left(\frac{B\text{-}S}{R}\right)^{\text{Scenario Value}} + \left(\frac{B\text{-}S}{R}\right)^{\text{Base-Build Value}} + \left(\frac{B\text{-}S}{R}\right)^{\text{Fit-Out Value}} + \left(\frac{B\text{-}S}{R}\right)^{\text{Operating Value}}$$

Figure 10. Infrastructure Open Value Equation

What is needed is a more dynamic approach that recognises open levels. While crude, the equation in Figure 5 shows that value must be understood and calculated at each level of open scenario planning and building, and that tools must be developed to facilitate this nested assessment.

Value at open planning and building scales must also be understood over time against a baseline (existing project, experience or expectation) as shown in Figure 6, where benefits and sacrifices must be understood against various alternative scenarios and building level options (e.g. base-build, fit-out and operation).

However, value assessment (over time and against various scenario and option alternatives) cannot be categorised and constrained to levels alone. For example the influencial technical systems, which are organised at a basebuild level (like power cables) will interface with the infill level and must be organised according to the positioning of furniture, equipment, bodies and utensils. The most flexible and high value spaces are those that allow the greatest number of changes and flexibility, while also delivering everyday benefits and minimising sacrifices and resource use.

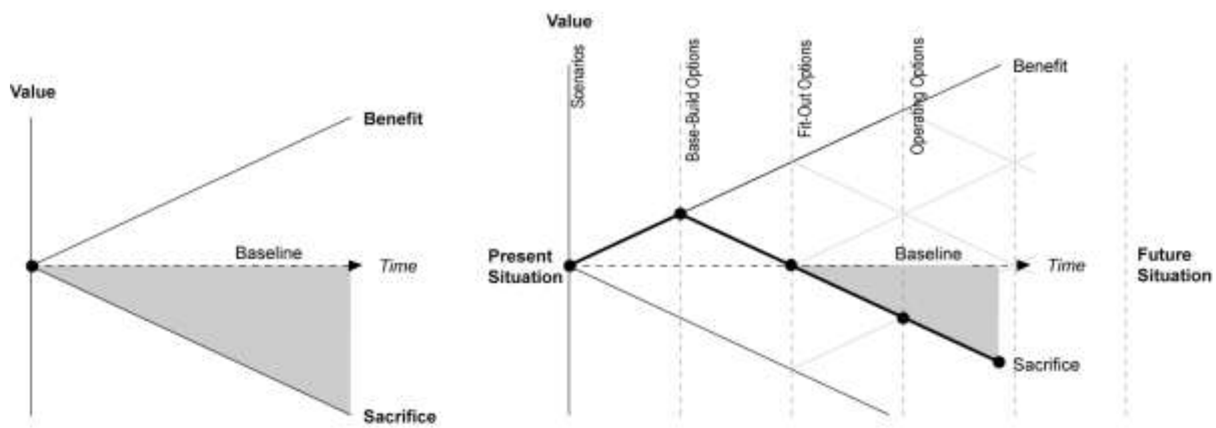


Figure 11. Fan of Uncertainty and Binominal Tree, adapted from Ellingham and Fawcett 2006

CONCLUSION

This paper has discussed the multi-organisational, multi-stakeholder and multi-disciplinary delivery of value in open healthcare construction. A clear definition is emerging that can be used to inform standardised (structured, evidence based, standards, guidance and tools) and customised (dynamic, stakeholder unique) views of value-based decision making and learning.

Workshop findings show that there are many different perspectives and categories of value that will sit across open levels. Some of these may include for example:

- Market Value (e.g. demand and choice)
- Economic Value (e.g. scale, scope and volume)
- Asset Value (e.g. real estate, equity, liability)
- Location Value (e.g. distribution, logistics, amenity and access)
- Flow Value (e.g. clinical process, acuity and capacity)
- Built Environment Value (e.g. evidence-based design)
- Open Building Value (e.g. adaptability and flexibility)
- Intangiable Value (e.g. wellbeing, social capital, sustainability, culture, brand)

This paper extend the need defined by Mills et al. (2010b) to evaluate emergent scenarios against value and the complexity of achieving whole system, scalable and dynamic buildings that can handle growing or shrinking capacity, increasing or decreasing demand, the adding or removing of resources without impacting the performance or value of that system (Mills et al., 2010b). As long as mechanisms can remain functionally equivalent then the whole system can be scalable and performance and value can be maintained and changed. However, hierarchies must forever adapt and change according to emergence, learning and innovation (Anderson, 1972, Holland, 1998, Lane, 2006, Simon, 1962).

UK healthcare infrastructure planners and designers must develop tools and systems that are among the most advanced in the world, as existing tools and approaches are outdated in their agile and open presentation of information for decision making. For example in the US, according to Habraken and Kendall (2007), open building thinking has contributed to longer life spans of “base build infrastructure” and is instrumental in achieving sustainability, through the uncoupling of the complexity and intricacy of fit-out demands with high performance envelopes, a principle that they state is now recognised by the United States Green Building Council’s LEED rating system. Many of the tools within the UK that were once the envy of the world such as National HBN standards, ADB, ERIC, SHAPE and AEDET/ASPECT must adapt to address a deeper conceptual understanding of open building.

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A Dimension to Sustainability: Life Cycle Assessment (LCA) Approach to Adapt Environmental Performance of a Medical Office Building

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ABSTRACT
As sustainability becomes a central figure in the design process in both architectural education and practice, research on office buildings' impact on the environment is gaining high momentum worldwide. Although many designers claim their buildings to be sustainable, unless a comprehensive Life Cycle Assessment (LCA) study is conducted, it is difficult to calculate and evaluate the total environmental burden a particular building has on its surrounding and global environment. This paper demonstrates how LCA is applied to choose more sustainable materials alternatives during the maintenance (retrofit) phase of the building with an estimated life cycle of 60 years. A "what if" scenario analysis is conducted to evaluate replacing some building materials with others that have less environmental impacts and contribute more towards healthier environment for a case study of a medical office building in Michigan. It shows also how this building could adapt and modified for more environmental friendly performance. The method used employs a quantitative approach in calculating these environmental impacts with the different replacement alternatives and show the reduction contingent with each one of them. Studying the whole life cycle of a building also shows to what extent each life cycle phase (manufacturing, construction, operation, maintenance, and end-of-life) contributes most to the total burdens, where some environmental decisions could be taken to reduce that burden in this specific phase. It aims also to provide a comprehensive assessment to which building component (structure, walls, floors, roofs) contribute the most to the total impacts to inform designers decisions of buildings materials that could be replaced through the "what if" scenario analysis to reduce the total impacts to the environment.

KEYWORDS:
Environmental research, Sustainability, Quantitative Methodology, Life Cycle Assessment, Environmental burden.

INTRODUCTION

Life Cycle Assessment LCA represents a quantitative tool for calculating the environmental burdens (impacts) of products at all stages in their life cycle from cradle to grave. Throughout the life cycle of a building, various natural resources are consumed, including energy resources, water, land, and several pollutants are released back to the global/regional environment. These environmental burdens result in global warming, acidification, air pollution, etc., which impose damage on human health, primarily natural resources and biodiversity. For example, in the United States, the construction and building sector has been estimated to be responsible for roughly 40% of the overall environmental burden (U.S.DOE 2002). The building sector, constitutes 30-40% of the society's total energy demand and approximately 44% of the total material use as well as roughly 1/3 of the total CO2 emission, has been identified as one of the main factors of greenhouse gas emissions (U.S.DOE 2002). There is no doubt that reducing the environmental burden of the construction industry is crucial to a sustainable world.

Most research on the environmental impacts of buildings examine the issues at a relatively broad level though extensive descriptions. For example, Finnveden and Palm (2002) stated that the use phase accounts for the majority of the environmental impacts of buildings. Klunder (2001) gave a description of environmental issues of dwellings, noting that assessments should focus primarily on components that involve large quantities of materials (e.g., foundation, floors, and walls), but there are also dangerous materials that should be avoided regardless of quantity (e.g., lead). Some of the building-related environmental studies present detailed quantitative data about the life cycle of a building (Scheuer et al., 2003). Trusty and Meil (2000) have assessed the environmental impacts of an office building, including the structural and envelope elements, which were compared against the annual operational energy. Junnila and Horvath (2003) took the same path to quantify the most significant impacts of a high-end office in Europe. However, this study narrows down to the systems and materials that release most emissions for the studied case in order to test better retrofitting or fit out alternatives as building adapts to its future.

Building assembly systems (structural, envelope, floors, and roofs) are rarely studied on individual or as combined systems in LCA studies. Thus, such information and data indicating the significant impacts by building systems would be of great use in design and management of the building life cycle maintenance. In this analysis, the study also acknowledges that the idea of an open building with ever changing capabilities would reduce environmental impacts significantly as time goes by and as technology changes. It also supports that the design process, especially for medical buildings, is never a finished process and the procurement and building adaptation should support this fact. Thus, LCA could be a beneficial tool in this ongoing process as the findings support these flexible changes of some of these systems with way less impacts.

APPROACH, METHOD, AND ASSUMPTIONS

A life-cycle assessment (LCA) framework is selected to analyze the environmental impacts of a new medical office building in Southeast Michigan. Sixty years of use was assumed to be the basic life cycle. LCA is the most appropriate framework for the identification, quantification, and evaluation of the inputs, outputs, and the potential environmental impacts of a product, process, or service throughout its life cycle, from cradle to grave i.e., from raw material acquisition through production and use to disposal [as defined in ISO 14040, 1997]. The LCA had three main phases; inventory analysis for quantifying emissions and wastes, impact assessment for evaluating the potential environmental impacts of the inventory of emissions and wastes, and interpretation for defining the most significant aspects.

LCA is defined as a systematic, holistic, objective process to evaluate the environmental burdens associated with a product or process. The process identifies and quantifies energy and material usage and environmental releases of the studied system, and evaluates the corresponding impacts on the environment. Identification and quantification of material and energy flows (inputs and outputs) of the case study office building were conducted during the design and construction of the building in 2008. The material and energy flows of the building's life cycle were primarily derived from the floor plans and specifications of the building.

Some emissions data related to different energy and material flows were collected mainly from the actual manufacturers in Michigan. The quality of the data used in the life-cycle inventory was evaluated with the help of a six-dimensional estimation framework recommended by (Lindfors et al. 1995). The quality target for the LCA was set to be at the level of ''good,'' which means reliability of most recent documented data from drawings, specs sheets, and contractor rep on-site. In life-cycle impact assessment, the magnitude and significance of the energy and material flows (inputs and outputs) were evaluated. The impact categories included were those identified by EPA (2006) as 'Commonly Used Life Cycle Impact Categories'. Among the 10 listed categories, the impact categories in this paper included:

- Primary Energy (Fossil Fuel) Consumption,
- Resources Use RU,
- Global Warming Potential GWP (Climate Change),
- Ozone Depletion Potential ODP,
- Acidification Potential AP,
- Eutrophication Potential EP,
- Human Health Respiratory Effect Potential, and
- Photochemical Ozone Creation Potential POCP or Summer Smog

The chosen impact categories are also on the short list of environmental themes that most environmental experts agree to be of high importance in all regions of the world and for all corporate functions (Schmidt and Sullivan, 2002). Furthermore, the used impact categories are consistent with the air and water emissions that the World Bank (1998) has recommended to be targeted in environmental assessments of industrial enterprises. The classification, or assigning of inventory data to impact categories, and the characterization, or modeling of inventory data within the impact categories (ISO 1997), were performed using the ATHENA 4.1 life-cycle calculation program (2010) which is used to model the building. The significance of different life-cycle aspects is evaluated by comparing the environmental impacts of different building elements in every impact category so that the significant environmental impact could be ranked in order of importance. In the life-cycle interpretation section, the results are also examined from the building assembly (foundation, walls, floors, etc.) so that the environmental impact of each system's life cycle can be quantified.

2.1 Case Study Building Description

Huron is a new office building in Southeast Michigan in the U.S. Its construction ended in 2008. The targeted use of the building is mainly medical offices. The building has 21,290 sq ft (1978 m2) of gross floor area, and a volume of 351,285 cu ft (9947 m3). The building consists of 1 main floor (16.5 ft high) with no basement. The structural frame is Hollow Structural Steel HSS columns and open web steel joist for roof support. Floors are light reinforced concrete of 1 floor. The exterior walls are brick veneer with steel studs backing. Interior walls are galvanized steel studs with gypsum board facing to receive paints or wall paper. Foundations are cast-in-place concrete. The annual energy consumption is calculated using equest 3.64 (2010). The estimated natural gas consumption (mainly for water heating) of the building is 34.42 Mbtu (1616 Btu/sq ft/year) and this is equivalent to 0.47 kWh/sq ft/year. The estimated electricity consumption is 183,870 kWh/year (8.6 kWh/sq ft/year). One important factor for Huron office building is that it is a LEED certified building and that might interpret its slightly lower use of electricity because it uses geothermal ground loops in heating and cooling.

In the study, the life cycle of the building was divided into 5 main phases; building materials manufacturing, construction processes, operation phase, maintenance, and demolition. Transportation of materials was included in each life-cycle phase. The building materials phase included all of the transportation to the wholesaler warehouse. The construction phase included the transportation from the warehouse to the site.

Building Elements and Materials Phase
The following building element categories were included in the study: foundation, structural frame (beams & columns), floors, external walls (envelope), roofs, and some internal elements e.g., doors, partition walls, suspended ceilings, and 2 stairs. The amount of each material used in the building was derived from the bill of quantities, architectural and engineering drawings, and the architect's specifications. Around 30 different building materials were identified and modeled.

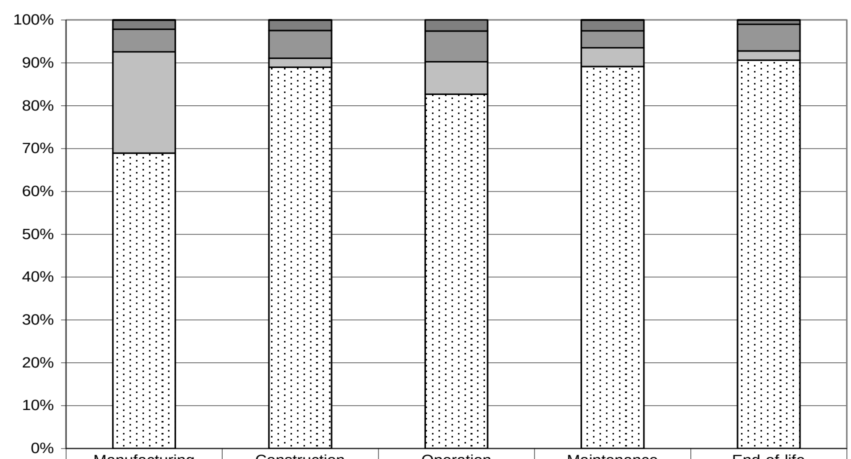
Building Construction Phase
The construction phase of the building included all materials and energy used in on-site activities. Data were modeled for the use of electricity, construction equipment, and transportation of building materials to the site (average 100 mi). Some of the data were collected from the contractor, and were further confirmed by interview with his representative on-site.

Building Operation Phase
The use of the building was divided into mainly heating service (by natural gas) and electrical consumption. For the purpose of energy simulation, the building was estimated to be used 55 hr/week for 60 years. Energy calculations were performed using eQuest, a DOE 2 energy simulation program for electricity use and HVAC heating and cooling loads. All building parameters (dimensions, orientation, walls, windows, etc) were modeled.

Maintenance and Retrofit Phase
The maintenance phase included all of the life-cycle elements needed during the 60 years of maintenance; use of building materials, construction activities, and waste management of discarded building materials. An estimated 75% of building materials was assumed to go to landfill, and 25% was assumed recovered for other purposes such as recycling.

Demolition Phase
The demolition phase included demolition activities on-site, transportation of discarded building materials (75% of the total) to a landfill (50 mi), and shipping of recovered building materials to recycling site (70 mi, on average). The entire building was assumed to be demolished.

RESULTS
Fig.1 shows the proportions of each life-cycle phase in every impact category with the associated numbers. Fuel consumption in MJ has a notable 80% or more in 4 life cycle phases with exception in material manufacturing phase in which it constitute 68% of the whole impact in that phase. This is consistent with most previous studies to show the significance of impacts due to fuel consumption. GWP seems to have a consistent ratio of 7% in all life phases. Resources use (kg) logically happens during manufacturing represents 25% of impact in that phase and another 5% in the maintenance when some of building materials are replaced to adapt to future and new regulations. Acidification potential comes next to GWP at almost 3% in each phase.



	Manufacturing	Construction	Operation	Maintenance	End-of-life
Smog Potential (kg NOx eq)	1,398.294	161.184	1,202.575	309.748	32.072
Ozone Depl Potn'l (kg CFC-11 eq)	0.001	0.000	0.000	0.000	0.000
Eutrophication Potential (kg N eq)	204.840	6.977	67.430	20.432	1.405
HH Respiratory Pot'l (kg PM2.5 eq)	1,196.921	8.077	14,501.971	556.762	1.814
Acidification Potn'l (moles of H+ eq)	175,154.608	7,016.363	2,592,450.170	52,601.491	1,578.329
Global Warming Potn'l (kg CO2 eq)	424,850.162	18,582.554	7,167,320.013	81,907.481	9,958.732
Resource Use kg	1,914,690.199	6,047.485	7,616,817.736	90,918.010	3,413.710
Primary Energy Consumption MJ	5,586,223.336	257,074.704	82,983,906.872	1,857,422.684	144,929.029

Fig. 1: Environmental Impacts by Life Cycle Stage

The study also found the summer smog impact of materials manufacturing and operation phases to be the largest contributor sharing the cause of smog formation at 40% and 50% respectively. This study along with very few others (Tekes 2000) touched the potential of this important impact category.

INTERPRETATION OF RESULTS

During materials manufacturing phase, the greatest contribution to overall impacts in the manufacturing phase comes from the extensive use of energy (68%) in the manufacturing possess of the construction materials (steel, concrete, aluminum, glass, etc) that are required for construction. The resource depletion in this phase also represents 22% due to all virgin materials that are used and processed from the nature. GWP and AP represent the rest of the impacts at this phase at 10% mainly due to the releases from fossil fuel use in that phase.

In construction phase, the use of construction equipment is the only life-cycle element with significant impacts (88%). That is due to the fuel and electricity used during the erection of the bldg. The other 10% attributed to GWP and AP with small fraction attributed to EP and Smog impacts.

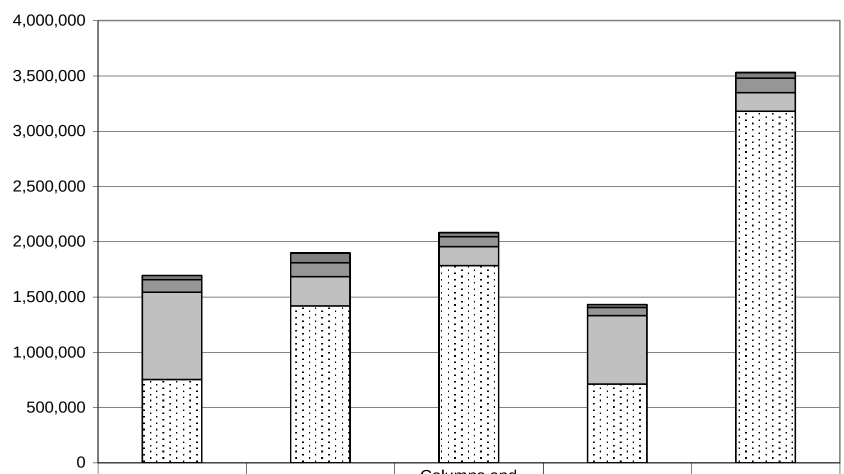
The operations phase dominates life cycle energy consumption. Numbers show the building operational demands over a 60 year life span, representing 83% (82×106 MJ) of the total life cycle energy. Almost 90% of life-cycle impacts in the use phase caused by electricity and natural gas used for heating in cold climate like Michigan.

The maintenance phase comes third to operation and manufacturing in terms of impacts. This is the adaptation and modification phase where several parts of the buildings are replaced or renovated to match future codes and needs. Ozone Depletion Potential ODP, albeit almost negligible in the study, most of its causes are concentrated in the manufacturing and maintenance due to the VOCs released by paint manufacturing and the re-painting processes (every 7-10 years).

The end-of-life phase does not have significant impacts in the overall life cycle, except for the Eutrophication category (2%) and Smog (4%). Transportation of the waste material to the landfill produces most of the impacts in this phase.

Life-Cycle Impacts by Building Assembly Systems

In practice the building design process typically proceeds by choosing building systems, not by chronological life-cycle phases. To interpret the results for the purposes of design management, an analysis of the result from the building assembly perspective is important. Hence, the life-cycle phases are divided into life-cycle elements, the elements belonging to different building assembly systems are grouped together, and the life-cycle impacts of each building system; foundations, walls, columns and beams, roofs, floors, are calculated. Fig. 2 shows that the environmental impacts of the office life cycle are divided into 5 building components systems. Three significant systems accounts for the highest environmental impacts of this building. These are roof, structure (columns/beams), and the wall systems respectively.



	Foundations	Walls	Columns and Beams	Floors	Roofs
Smog Potential (kg NOx eq)	332.056	485.228	110.018	240.167	733.829
Ozone Depl Potn'l (kg CFC-11 eq)	0.000	0.000	0.000	0.000	0.000
Eutrophication Potential (kg N eq)	16.878	32.018	111.730	27.103	46.038
HH Respiratory Effects Potn'l (kg PM2.5 eq)	269.108	916.360	186.794	172.429	218.883
Acidification Potential (moles of H+ eq)	37,498.127	87,191.762	36,181.156	25,769.766	49,709.980
Global Warming Potential (kg CO2 eq)	114,390.026	125,834.761	90,013.128	73,189.859	131,871.155
Resource Use kg	788,919.885	265,856.129	172,308.960	620,503.241	167,481.191
Primary Energy Consumption MJ	753,049.237	1,417,895.559	1,783,170.886	711,331.734	3,180,202.337

Fig. 2: Environmental Impacts by Building Assembly

These results were primarily due to the use of insulation with its notorious emissions during manufacturing (in roofs and walls) and the wide area walls system covers in the facades. The other material is steel (with its massive embodied and transportation energy) in columns and beams. The most dominant impact category in the whole assembly is the energy used by each material (its embodied + transportation energy). Resource use is the highest in foundations and floors systems. That's due to the massive concrete weight and wide area both systems occupy. GWP is slightly more in roof and walls (due to insulation emissions) than columns. AP is the highest impact in walls assembly due to some materials such as gypsum boards, fiberglass insulation, and vapor barriers which release SO2 and NOx during manufacturing that contribute to acid rains.

RETROFIT SENSITIVITY ANALYSIS

Sensitivity analysis is typically used to check either the significance of changing key parameters contributing to the overall LCA or key assumptions governing the methodology of the LCA itself. The what if scenario is used for sensitivity analysis according to Pesonen et al. (2000). Sensitivity scenarios are used to compare the replacement of materials that have high impacts within the building with more environmental friendly alternatives, and then quantify these changes in the environmental impacts at the end of the 60 years. From the previous results, the study found that materials such as: wall insulation, roof insulation and membrane have huge quantities and potential high impact in many categories. Therefore, walls and roofs materials are replaced with more environmentally friendly materials, then assess the total impacts again with the new alternatives to test how much reduction to the results achieved. The other systems (foundations, structure, floors) are not changed in this analysis because they are fixed systems once building is erected. The walls and roofs are also chosen because they represent the highest impacts share by building systems, besides structure (Fig. 2). This is consistent with ISO 14043 (1998) to "asses the sensitivity of data elements that influence the results most greatly".

Retrofits Assumptions and Scenarios

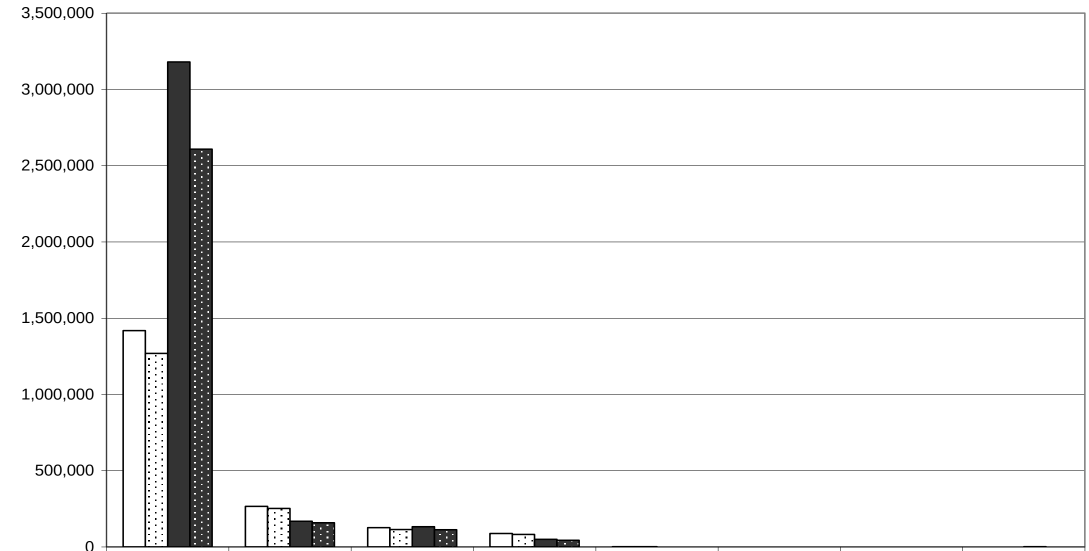
A list of changing variables included in the analysis is shown in table 1. The main assumptions for retrofitting are as follow: Walls are changed by replacing the fiberglass batt insulation with cellulose insulation at same thickness. Cellulose proved to be more environmental friendly and gives 10% improved R-value over similar fiberglass but with less environmental impact due to its recycling nature. Moreover, it is more durable and less vulnerable to moisture if enclosed with poly films. This seems quite reasonable assumption since the life expectancy of an ordinary wall insulation is around 30 years. Roofs change is suggested to take place 2 times during 60 years (every 30 years) by replacing the 4.75" thick poly-isocyanurate insulation and 60 mil black EPDM membrane with 5.25" thick expanded polystyrene insulation (to give the same R-value or better) and 60 mil white EPDM membrane. The materials that were chosen represent the most significant materials of these systems due to their high emissions during manufacturing.

Retrofit Sensitivity Results

Figure 3 shows results of all impact categories by building assembly systems. The two scenarios are the base-case calculations scenario and the retrofit scenario. Results show that sensitivity scenario has reduced values in all impact categories due to the change in the 3 systems shown in Table 1. These reductions range between 6% and 19% in the 8 different impact categories this study has investigated. The retrofit sensitivity also highlights the importance of insulation as sensitive material that has huge quantities within buildings. It significantly reduces the whole impacts if chosen carefully by architects.

Table 1: Sensitivity Analysis Variables

	Roof Insulation	Roof Membrane	Walls Insulation
Huron-base case	4.75" rigid poly-isocyanurate insulation w/ R-29	fully-adhered 60 mil black EPDM	6" fiberglass batt insulation w/ R-19
Huron - retrofit	5.25" rigid expanded polystyrene insulation w/ R-29	fully-adhered 60 mil white EPDM	6" cellulose insulation w/ R-19



	Primary Energy Consumption MJ	Resource Use kg	Global Warming Potential (kg CO2 eq)	Acidification Potential (moles of H+ eq)	HH Respiratory Effects Potential (kg PM2.5 eq)	Eutrophication Potential (kg N eq)	Ozone Depletion Potential (kg CFC-11 eq)	Smog Potential (kg NOx eq)
Walls	1,417,895.559	265,856.129	125,834.761	87,191.762	916.360	32.018	0.000	485.228
Walls-retrofit	1,269,083.034	251,813.332	113,929.445	82,137.109	874.516	28.151	0.000	460.201
Roofs	3,180,202.337	167,481.191	131,871.155	49,709.980	218.883	46.038	0.000	733.829
Roofs-retrofit	2,608,569.761	157,969.073	112,643.815	43,395.097	198.901	47.620	0.000	440.144

Fig. 3: Environmental Impacts Reduction Due to Retrofitting

CONCLUSION

The purpose of the study was to quantify and compare the potential environmental impact caused by a medical office building's life-cycle phases. The study also determined the life-cycle phases contributing most to the impact and defines the significant environmental impacts of the building. The study examined the building assembly components that most contribute to its life cycle impact. The study also found that roof and wall systems to have significant environmental impacts due to the use of insulation and membrane materials. Using more environmental friendly materials rendered a reduction of 6% -19% in different impact categories. Suggestions have shown the importance of LCA as tool to choose better alternatives during the maintenance (modification) phase of a medical office building. Some limitation on impacts included biodiversity, and indoor air quality are not assessed due to the lack of data. Some other elements like office furniture, computers, construction of infrastructure, were excluded to focus the attention on modeling the building itself as simply as possible.

The study also acknowledges the relationship between LCA and LEED rating system. LCA results demonstrated that a Huron medical building (LEED certified) has significant lower energy consumption for an office building. This is mainly due to using geo-thermal HVAC system during the operation phase in which most of the impacts would occur. One shortcoming though was the use of tighter envelope and thicker insulation without considering the negative impact of using such insulation alternative (polyisocyanurate). This resulted in that the roof system of the LEED building had the highest impact in most categories. The LCA method in this study opens the way for more testing of LEED certified buildings with high ratings e.g. gold or platinum using LCA impact analysis to verify their environmental performance. This helps to narrow down on the sensitive area of design and material choices (e.g. insulation) that LEED falls short by awarding points for overall energy savings without looking at the significant environmental impact of material alternatives that achieve this saving.

One of the main limitations of the study relates to the single-case study method used, because wider generalization based on a single case is not possible. However, the results of the study can be interpreted together with the results from previous studies. The findings of this study support previous arguments that operation energy is a major environmental issue in the life-cycle of an office building, and that some building materials e.g. insulation are also significant. This is typical for an office building in the U.S. For other countries, it is more difficult to generalize based on the results of this study. There are many regional conditions used in the calculations that could affect considerably the results outside the U.S. Building design, intensity of materials, construction methods, and intensity of energy use in the operation phase differ. Most importantly, there are differences in electricity generation and energy use (grid mix); e.g., a higher proportion of coal is burned in the United States, while Europe and Canada have a higher percentage of electricity from hydro (almost no emissions) and non-fossil fuels which will affect the final emissions especially the release of CO_2, SO_2, and NO_x to air. The study is also unique in modeling the building with the U.S. electricity grid which depends on coal as resource at 45% (DOE, EIA 2009).

Practical applications of the study's results could be directed to more environmentally conscious design and sustainable retrofit of medical offices. Companies, owners, facility managers, and designers could use the charts of the building systems and life cycle phases to help them focus their attention on environmentally sensitive areas of design and materials selection. LCA could help contribute significantly to the incremental improvement and adaptation of medical buildings.

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Flexibility and Environmental Sustainability in Hospital Facilities

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ABSTRACT
Environmental sustainability in healthcare facilities is a priority objective because of the high environmental impact, all over the life cycle of hospital buildings and especially during the service life. This paper aims to give a contribution to environmental sustainability assessment of hospital facilities focusing on infill in hospital facilities, with regards to their short service life and flexibility required over time for these components (the word infill is used according to OB theory). Research analyzes hospital complex system identifying and classifying the different areas that shape it, on the base of two criteria influencing the flexibility requirements: technological-systems complexity level and intensity of care. This study uses these two criteria to pick out, in every functional area, what is "base" and what is "infill", in order to optimize the flexibility during service life and limit the environmental impact following the short service life of the infill. As a matter of fact the higher the technologic complexity and intensity care are, the stronger will be the presence of infill with short service life and, consequently, the environmental impact due to their continuous replacement/modification. The study of the flexibility environmental impact is done through the LCA methodology applied to the surgery block case study.

KEYWORDS
healthcare, system complexity, infill, environmental impact, indoor comfort

INTRODUCTION
Hospitals are characterized by a very high impact, at both physical and environmental level. Their pressure on environment is due to:

- environmental aspects and impacts of medical activity (process domain);
- specific indoor environment required for medical activity (functional domain);
- impact of hospital building (technical domain).

Environmental sustainability in the process domain
In the process domain, most critical aspects during operation stage of hospitals are production of waste, both solid and liquid, emission in air of polluting substances, production of ionizing radiation.
Italia and other country's regulations focus special attention on health and safety of building users (staff, patient, visitors); laws and norms take into account the indoor air quality and indoor environmental quality. Instead, external control (aimed to environment protection) has been less important till '90, when European community promoted some "proactive" tools to stimulate organizations in the adoption of self-control systems for pollution prevention and environmental performance improvement. One of that tools is the EMAS Scheme, Environmental Management and Audit Scheme, initially addressed to industrial site and then extended to all organizations that want to improve their environmental performances. EMAS is a Label recognized to all organizations that adopt an Environmental Management System. Procedure for certification is based on the following six steps:

- Initial environmental analysis, to define the state of fact;
- Statement of an environmental policy, to define environmental objectives;
- Statement of an environmental program, with measures that allow fulfilment of defined objectives;
- Adoption and using of the defined environmental management scheme;
- Auditing activity, to evaluate the system;
- Environmental Declaration, with a short description of the system and its objectives.

Application of EMAS Scheme to hospital sector requires, analysis of functional areas and their healthcare process, to find specific issues and suitable measures allowing fulfilment of common sustainability objectives, such as reduction of waste production and their hazard degree.

Environmental sustainability in the functional domain
Indoor environmental quality and indoor air quality are responsible for an high energy consumption, therefore, for an high pressure on environment. High energy consumption depends on the need to maintain controlled levels of indoor comfort. These levels could change according to the kind of medical activity and healthcare process. Indoor environmental quality is defined by thermal-hygrometric, visual and acoustic microclimate; indoor air quality is defined by ventilation and emission from building materials.
As well known, indoor comfort has a directly effect on building users; therefore it influences psychological and physical human abilities.

In the case of hospitals, indoor comfort is strictly related to health and safety of staff and patients. Many researches have investigated the role of physical environment in the healing process. According to them health is a state of complete physical, psychological and social well being; not only the absence of illness! (WHO). For instance, Psychosocially Supportive Design, is aimed to stimulate a mental process attracting human attention, in order to reduce stress and promote positive emotion. Elements of physical environment, in a positive meaning, such as clean air, natural lighting, sound and music, nature, and other elements such as colours, art and space conformation, became salutogenic factors, capable of promoting, maintaining, sustaining positive outcomes in healing process.

On the same assumption is bases l'EBD (Evidence Based Design) that address design and operation of building to support positive health outcomes in hospital through a growing collection of solution informed by research and practical knowledge (Hamilton, 2003).

Other researches investigated these theories on high-risk functional areas such as intensive care unit or surgery block. In a hospital of Pennsylvania, 12 patient rooms of the surgery block have been monitored in the period from 1972 to 1981. Six of them looked into an open area with trees, and other ones looked at a brick wall. Monitoring activity demonstrated that severity of operation, patient's profile and staff rigor, were the same but the analgesic quantity and the duration of healing process were reduced of 30% for patient in rooms with pleasing view (Ulrich, 1984).

These researches demonstrate the opportunity to treat functional areas in a diversified way, more appropriated to the kind of healthcare process.

Environmental sustainability in the technical domain

In relation to technical domain, hospitals are characterized by an high consumption of energy during the whole life cycle. In Italy, energy consumption of hospitals is three times higher than residential sector's one (Fasano, 2009).

According to a study conducted about Italian hospitals, the expense for energy is only 2% on the total management expense. The percentage is relatively low, so facility managers are not stimulated to take improvement measures. But, if considered par rapport to the national budget, the expense is 2 billion of Euros. Economic advantages resultant from improvement of energy efficiency has to be considered as a growing of resources available for quality of hospital, from indoor comfort to new medical equipments, for users and community wellness.

Hospitals are characterized also by an high consumption of resources, due to flexibility. This is required to allow growing in dimension or internal layout modification; in fact, the scientific and technological progress requires adaptation both of medical process and healthcare facilities.

Therefore, "flexibility" requires special attention on infill service life and its environmental impact; design has to be consciousness that infill level is made of cluster of technical component with different service life. Service life depends not only on technical reasons but also on rapid changing condition within healthcare sector. If service life of infill is short, the number of replacement, repair, refurbishment, etc, will be more frequently during hospital life cycle.

As a matter of fact the higher flexibility level required is, several will be the number of infill replacement and modification.

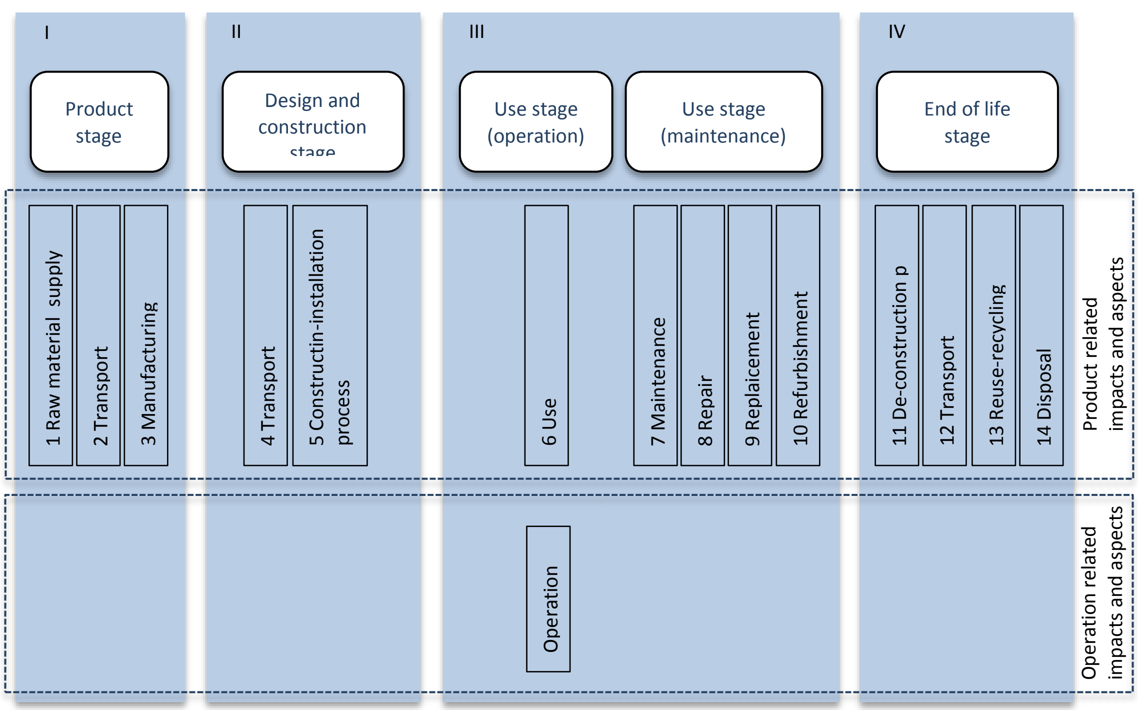

Figure 1: Building Life Cycle representation

Environmental sustainability of hospitals

After the previous description now is possible to give a definition of sustainable hospital:

> a system in which an environmentally engaged health care community is dedicated to the health of patients, workers, their communities and the global environment. A system where patients and staff interact in an healing environment that embraces safer building products, clean air, reduced toxins, safe working practices, energy and water efficiency, education and a commitment to public health demonstrated through waste volume and toxicity reduction (Hospital for healthy environment).

ENVIRONMETAL SUSTAINABILITY AND FLEXIBILITY IN HOSPITAL SYSTEMS.

Management and assessment tools should consider taking complexity of hospital systems. Complexity is something resulting from more parts, heterogeneous (Taylor, 2005). A complex system is characterized by numerous elements, different in quality (De Toni, Comello, 2005). This definition is appropriated to describe an hospital, characterized by a great heterogeneity. Hospitals, in fact, are resulting from more functional areas, each of which characterized by different technologic complexity and intensity of care.

In relation to environmental sustainability, is necessary to classify functional areas according to the kind of activity, and in function of technologic complexity and intensity of care: specific medical activity (high-care and high-care/high touch), activities such as hotel, office, industry activities.

Environmental impact, due to the operational activities, depends on the technologic complexity and intensity of care; at the same time the required flexibility level depends on the technologic complexity and intensity of care too. Therefore, flexibility level influences the environmental impact of hospitals in the whole life cycle. The proposed classification of the functional areas is in accordance with the one proposed by the Netherlands Board for Healthcare Institution (NBHI).

The open building theory as hypothesis of scenario for environmental impact assessment in operation stage.

Adopting the open building theory is possible to classify (in all functional areas) building components, furniture, fixture and fittings, according their estimated service life. The support subsystems have an estimated service life as long as the expected service life of healthcare facility; the infill subsystem have an estimated service life shorter than healthcare facility expected service life. For instance, if surgery department has an expected service life of 50 years, infill subsystems will be the ones characterized by a service life of 20 years, or less (such as, partitions, flooring, ceiling, etc.); support subsystems will be structure and plants (see table 2).

Table 1: Classification of functional areas in relationship to issue of environmental impact reduction during the life cycle.

Activity	Functional area
Specific Medical Activity	Reanimation, Emergency, Dialysis, Day surgery, Surgery, Partum Block, Radiotherapy, Radiology, Functional and endoscopic tests, Intensive care , Sub-intensive care
Activity like hotel	General Wards Cafeteria, Acceptance, Public services Storage, Dressing room, Cleaning service
Activity like office	Outpatients' department, Rehabilitation, Functional and endoscopic tests, Information service, Research and study service Medical and administrative office, Pharmacy, Technical services
Activity like industry	Histopathology and Anatomopathology (research), Transfusion center, Laboratories Blood bank, Sterilisation, Kitchen, Laundry

The estimated service life is defined as the service life that a building or an assembled system (part of works) would be expected to have in a set of specific in-use conditions, determined from reference service life data after taking into account any differences from the reference in use conditions [ISO/DIS 15686-1:2008].

Regard to infill subsystems, environmental impact assessment of operation stage has to include the impact due to maintenance, replacement and repair activities, and the impact due to production and installation of new components used in replacement and repair services. Environmental impact for replacement products shall include for:

- transportation;
- replacement process of replaced building component ;
- waste management for replaced products;
- end of life stage of the replaced building component.

In order to conduct an environmental life cycle assessment some hypotheses have to be done about flexibility of infill compared to flexibility of support. If the project is based on Open building strategy, the different scenarios will be identified in the logic of the project, oriented to design capacity of building to adapt itself to requirement change and in function of obsolescence level of its parts.

With improving of energy efficiency, and reduction of infill service life on the other hand, the impact due to replacement can became important.

So, is important controlling infill production impact and making hypotheses about future productive strategies. The most important impact indicators are: material and components embodied energy, and Global Warming Potential. These indicators can reach values comparable with ones related to energy management of hospital. It's important to reduce not only the impact due to replaced building components but also to replacement process; a project based on open building strategies should preview simplified and low impacting replacement process.

Environmental impact of flexibility: the case study of surgery block

Surgery block case study of San Giuseppe Hospital (Empoli, Italy) has been utilized as control environmental impact related to flexibility requirement. As well known, surgery block is characterized by an high level of technologic complexity and intensity of care, so by an high level of flexibility. Following, specificities of surgery block:

- in the process domain, medical waste production and emission of anaesthetic gas;
- in the functional domain, very clean area, and lower air temperature and humidity than in other functional areas;
- in the technical domain, specific building components and envelope such as ATU, anti X ray partition, etc, with the consequence of high resource consumption in the production phase.

Table 2: Synthesis of environmental requirements in technical domain. Gray colour indicates the infill subjected at rapidly modification/replacement. Environmental impact of this infill has been quantified through LCA tool

TECHNOGIC DOMAIN	Surgery block: systems and components environmental performance in the use stage			
	LIFE CYCLE ENVIRONMENTAL IMPACT	Support and Infill	Support	Structures
				External envelope
				Plants_main network
			Infill	Internal envelope (partitions, ceiling, flooring, doors, etc)
				ATU
				Plants_secondary network
				Terminal units
	Operational ENERGY EFFICIENCY	Building-system	Heating and cooling	
			Hot water	
			Lighting	
		Building automation and control	Medical equipments	
		Renewable source	Green Energy producted	
		Monitoring system	BMS Energy Meters	

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In the case study of surgery block the internal envelope is an infill subjected at rapidly modification/replacement, in particular: partition, ceiling, flooring and doors, of operating theatres and surgeons preparation rooms. It's not easy to preview expected service life of this infill, because it depends on scientific and technologic progress in medic field, not only on durability of components used. Is possible to assume a service life of 5-10 years for infill, with the hypothesis of 5 replacement; for the support a service life of 25-30 is reasonable. Assessment of environmental impact related to production stage can be conducted through current methodologies. The assessment is aimed to find low impacting components, to encourage manufactures, designers and managers to improvement of building's environmental performance.

Partition of operating theatre

Partitions of operating theatre have to guarantee a perfect air-proofness (higher pressure is requested). Partitions are usually prefabricated. Operating theatres of the case study have a pre-varnished stainless steel partition (total thickness 20 mm). Metal structure is made of horizontal guide in zinced steel, both on flooring and ceiling, horizontal intermediate guide in zinced plate, vertical guide in rectangular zinced tubular.

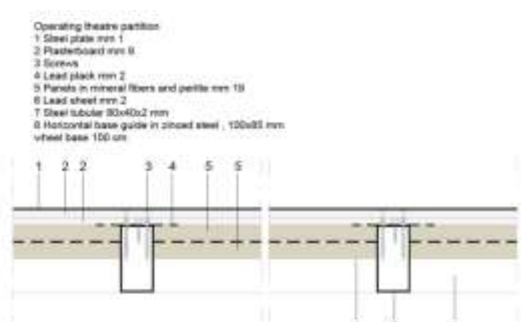

Figure 2: Partition of operating theatre (horizontal section).

Covering panels are composed of:

- stainless steel plate, thickness 1 mm ;
- internal rigidity elements in plasterboard, thickness 18 mm.
- Partitions have anti X ray protection made of a lead sheet (thickness 2 mm), located between two mineral fibres and perlite panels.

Other partitions

Other partitions are in plasterboard. Thickness and stratigraphy change according to delimitated functional unit. In particular, anti X ray protection is positioned for operating theatres and plaster room; high humidity-proofness plasterboard are utilised in surgeons preparation rooms.

Flooring

Flooring is in anti-static PVC (total thickness 2 cm)

Ceiling

Ceiling is composed by an air proofness pre-varnished zinced steel (600x600 mm panels).

Doors

Installed doors are in sandwich panels, their finishes are in stainless steel plate, pre-varnished by epoxy resins varnish.

Insulation is composed of high density and rigid poliurethanic mousse. Following, 4 type of doors: the door 1, 1.4X2.1 m, with anti X ray protection, used between operating theatre and clean corridor, between operating theatre and plaster room; the door 1a, 1.4X2.1 m (no anti X ray protection) used between the plaster room and the clean corridor; the door 2, 0.9X2.1 m, with anti X ray protection, used between operating theatre and dirty corridor, between operating theatre and surgeon preparation room; the door 3, 0.8X2.1 m (no anti X ray protection), used between surgeons preparation room and clean corridor, between plaster room and dirty corridor.

Methodology used for environmental impact assessment

Environmental impact of considered infill has been calculated according the Life Cycle methodology (LCA – Life Cycle Assessment), regulated by ISO 14040:2006. The LCA represent a scientific assessment methodology of energy and environmental loads, and potential impact associated to product/process/activity in the whole life cycle, from raw material supply to end of life (from Cradle to Grave).

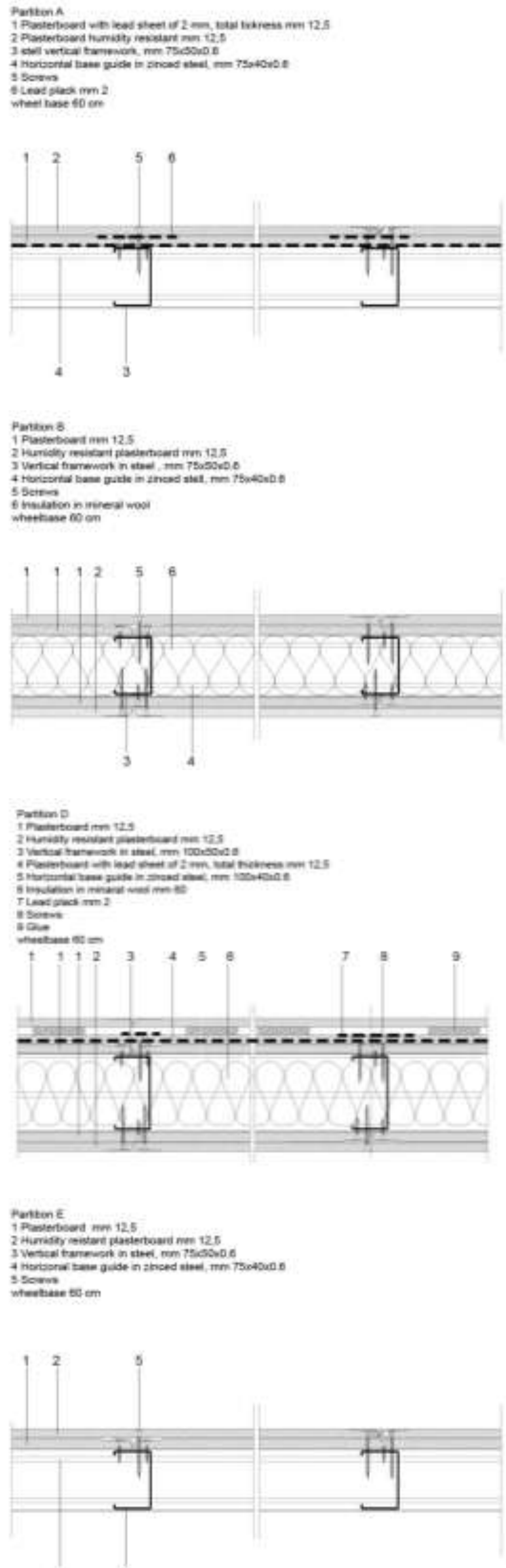

Figure 3: Example of other partitions in studied surgery block (horizontal section).

According to LCA methodology, an "input-output" analysis has been conducted in order to quantify resources allocated and emission production in the stage from cradle to gate, that means from raw material supply to the product production. Environmental profile has been calculated by Pre – SimaPro7.1.8 software. They are related to 1 sqm unit

Following, the data bank used: IDEMAT 2001, BUWAL 250, ETH-ESU and Ecoinvent. Impacts have been expressed through indicators used in environmental product declarations (EPD, regulated by ISO 14025) and proposed by CEN for environmental building evaluation: Photochemical Oxidation, Acidification, Eutrophication, Ozone Layer Depletion, Global Warming Potential, Non Renewable Fossil Energy. Following tables show results.

ENVIRONMENTAL IMPACT OF CEILING PRODUCTION STAGE		
Impact category	Unit	
ENVIRONMENTAL IMPACT OF 1 SMQ		
Acidification	kg SO2 eq	1.12E-01
Eutrophication	kg PO4 eq	6.40E-03
Global Warming Potential	kg CO2 eq	9.87E+00
Ozone Layer Depletion	Kg CFC-11 eq	3.03E-08
Photochemical Oxidation	kg C2H4	1.06E-02
Non Renewable, fossil	MJ eq	1.86E+02

ENVIRONMENTAL IMPACT OF OPERATING THEATRE PARTITION PRODUCTION STAGE		
Impact category	Unit	
ENVIRONMENTAL IMPACT OF 1 SMQ		
Acidification	kg SO2 eq	5.27E-01
Eutrophication	kg PO4 eq	2.92E-02
Global Warming Potential	kg CO2 eq	5.52E+01
Ozone Layer Depletion	Kg CFC-11 eq	1.19E-05
Photochemical Oxidation	kg C2H4	2.90E-02
Non Renewable, fossil	MJ eq	9.19E+02

ENVIRONMENTAL IMPACT OF FLOOR PRODUCTION STAGE		
Impact category	Unit	
ENVIRONMENTAL IMPACT OF 1 SMQ		
Acidification	kg SO2 eq	4.10E-02
Eutrophication	kg PO4 eq	3.61E-03
Global Warming Potential	kg CO2 eq	6.10E+00
Ozone Layer Depletion	Kg CFC-11 eq	0.00E+00
Photochemical Oxidation	kg C2H4	1.40E-03
Non Renewable, fossil	MJ eq	1.26E+02

ENVIRONMENTAL IMPACT OF PARTITION A,B,C,D PRODUCTION STAGE					
Impact cat.	Unit	PAR A	PAR B	PAR C	PAR D
ENVIRONMENTAL IMPACT OF 1 SMQ					
Acidification	kg SO2 eq	2.89E-01	1.11E-01	2.93E-01	3.62E-01
Eutrophication	kg PO4 eq	1.95E-02	1.48E-02	2.01E-02	2.92E-02
Global Warming Potential	kg CO2 eq	3.72E+01	2.61E+01	3.83E+01	5.36E+01
Ozone Layer Depletion	Kg CFC-11 eq	1.14E-05	2.36E-06	1.15E-05	1.28E-05
Photochemical Oxidation	kg C2H4	1.37E-02	6.78E-03	1.39E-02	1.76E-02
Non Renewable, fossil	MJ eq	6.13E+02	4.39E+02	6.31E+02	8.91E+02

ENVIRONMENTAL IMPACT OF PARTITION E,F,G,H PRODUCTION STAGE					
Impact category	Unit	PAR E	PAR F	PAR G	PAR H
ENVIRONMENTAL IMPACT OF 1 SMQ					
Acidification	kg SO2 eq	5.30-02	1.22E-01	3.66E-01	1.13E-01
Eutrophication	kg PO4 eq	6.65E-03	1.57E-02	2.97E-02	1.50E-02
Global Warming Potential	kg CO2 eq	1.20E+01	2.75E+01	5.47E+01	2.65E+01
Ozone Layer Depletion	Kg CFC-11 eq	1.06E-06	2.41E-06	1.30E-05	2.41E-06
Photochemical Oxidation	kg C2H4	3.98E-03	7.90E-03	1.78E-02	6.84E-03
Non Renewable, fossil	MJ eq	2.02E+02	4.64E+02	9.08E+02	4.45E+02

ENVIRONMENTAL IMPACT OF DOOR 1,1a,2,3 PRODUCTION STAGE					
Impact category	Unit	DOOR 1	DOOR 1a	DOOR 2	DOOR 3
ENVIRONMENTAL IMPACT OF WHOLE COMPONENT					
Acidification	kg SO2 eq	2.68E+00	1.61E+00	1.72E+00	9.30E+01
Eutrophication	kg PO4 eq	1.23E-01	6.36E-02	7.90E-02	3.66E-02
Global Warming Potential	kg CO2 eq	2.30E+02	1.13E+02	1.48E+02	6.52E+01
Ozone Layer Depletion	Kg CFC-11 eq	4.69E-05	3.14E-07	3.01E-05	1.81E-07
Photochemical Oxidation	kg C2H4	1.47E-01	1.03E-01	9.45E-01	5.95E-01
Non Renewable, fossil	MJ eq	3.89E+03	2.00E+03	2.50E+03	1.15E+03

According to results high environmental impact comes from anti X ray protection infill. According to GWP graphic (Global Warming Potential), partition of operating theatre (OP) is in absolute the more impacting infill, followed by partition G and D. Partition of operating theatre has been compared with a glass-steel office partition and a plasterboard common partition (see figure --), in order to do results more palpable.

The same result has been obtained for the whole surgery block. Major contribute to environmental impact is due to anti X ray partition. Besides, flooring and other partitions contribute is relatively low.

CONCLUSIONS

In conclusion, environmental sustainability evaluation tools have to be adapted to main hospital features:

strong relationship between building and activity/process and,

heterogeneity.

Integration of process, functional and technical domain in evaluation tools is needed for the environmental sustainability evaluation. This paper suggests the “crossing” of the actual state of the art that separate environmental design and management tools of hospital building (such as ecolabel for hospital buildings) from environmental management tools of hospital organizations (such as EMAS scheme).

In relation to technical domain, the weighting of impact reduction measures is significant, it should be based on infill quantity and its expected service life.

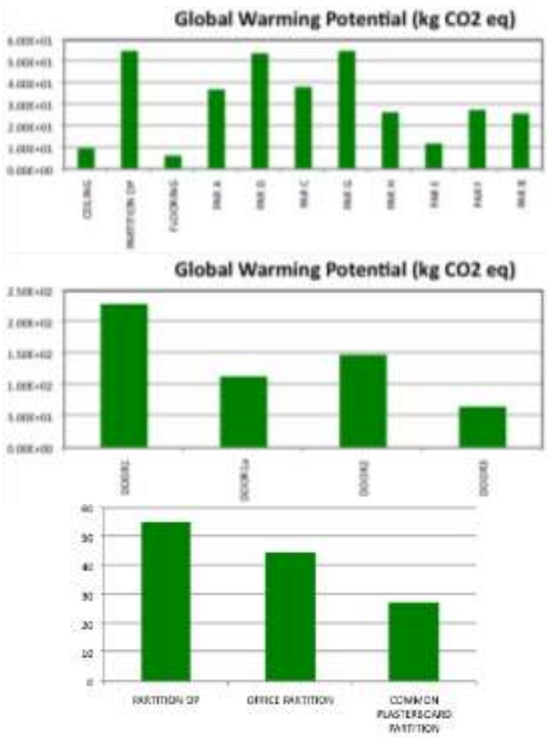

Figure 4: GWP of studied infill (top, bottom on the left) and comparison of operating theatre partitions with a glass-steel office partition and a plasterboard common partition (bottom on the right). Results are related to 1 sqm (regard to partitions, ceiling and flooring) and to a complete element (regard to doors).

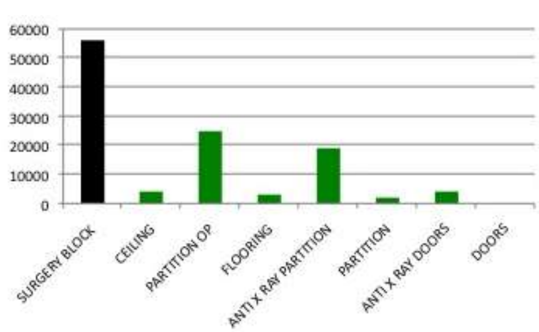

Figure 5: GWP related to the total quantity of studied infill in surgery block.

Table 3: Weighting hypothesis of environmental impact reduction measures in function of and quantity and expected service life. The dark indicates the major weight.

	Expected Service life (s, expressed in years)			
Quantity of component/Total quantity of components in the same category	Infill		Support	
	10 < s < 20	s < 10	s > 50	20 < s < 50
Low				
Medium				
High				

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Open Infrastructure Planning for Emergency and Urgent Care

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ABSTRACT
This paper stems from the development of research currently undertaken at the Bartlett, University College London and Loughborough University School of Civil and Building Engineering, Open Scenario Planning for Healthcare Infrastructure (OPHI). The study has investigated the concepts, tools and techniques that enable innovation and support the financial planning of built infrastructure. The aim is to improve decision-making for healthcare pathways across locations and settings through development of a framework for the rationalisation of existing property and buildings.

Evidence and analysis is drawn from case studies of Accident & Emergency/Trauma, Urgent Care and service re-organisation within six English Foundation Trust Hospitals, examining their strategic estates planning approach. The study sets out a process to determine scenarios of a shifting pattern of patient-centered requirements and clinical priorities by testing strategic options for clinical effectiveness rather than functional arrangements. The ideas and direction of the research were also supported by case studies from elsewhere in Europe. Most notably, at the Inselspital (Island Hospital) in Switzerland, the Canton of Bern has set out a 2025 to 2060 strategy for an 'Open Development Framework'. Organised through principles of Open Building this directs the future development of the hospital as a set of high-level objectives driven by clinical priorities incorporating planning and design innovation through the mapping of two divergent operational scenarios.

The paper sets out the findings of the study with the Trusts in England that respond to these emerging radical solutions and the appropriateness of their introduction within the context of UK service reorganisation for patient-centred, integrated care overcoming organisational commissioning boundaries. Findings suggest the emergence of new, clinically-led business units, supported by mobile multi-disciplinary teams on and off-site, for the planning of admission avoidance, referral patterns and long term care of chronic conditions.

This work is informing an outcome for a Strategic Scenario Planning Framework to enable decisions based on explicit values of stakeholders, together with the specific competencies required of these stakeholders. This framework aims to inform multi-factorial decision-making for patient care; clinical capacity, technology innovation, access to and utilisation of, the built infrastructure whilst developing the quality and efficiency of the Trusts' performance.

KEYWORDS
Open Scenario Planning, Open Building, Change-ready Hospital, Estate, Accident & Emergency/Trauma, Urgent Care

CONTEXT FOR THE STUDY

Background

Healthcare infrastructure planning, design and its project (and asset) management involve a complex interaction of factors that determine the distribution of its resources. In the planning process, these factors are interrelated and interdependent. The delivery of efficient and effective project proposals often relies on an iterative, multi-stakeholder decision-making process over variable time periods. Infrastructures must respond to fluctuating local demand, changing contexts, and innovative ways of doing things. Against this backdrop, buildings, technologies and workforce must enable rather than constrain development. What is more, the structure and influence of healthcare regulation, the power, distance and unequal relationships between stakeholders in any health care system and the volatility in healthcare commissioning, bring high levels of uncertainty to the planning and building design process (Mills *et al.*, 2009).

This study investigates a new approach to the planning, design and the project (and asset) management of healthcare buildings and infrastructure. This Open Planning approach marks a shift from traditional strategic asset management and master planning, towards a dynamic planning approach. It uses scenario-based organisational, programme and project discussions as systematic tools in making decisions about existing and future service transformations in healthcare, and the interaction of these service transformations within the built infrastructure through which they are delivered (Astley, 2009, Mills *et al.*, 2010). The principal aim of the study is to bring preparedness for uncertain futures to the forefront of health and social care system decision-makers' minds and to provide them with a common approach and language to enable a discussion of intangibles.

The study addresses current knowledge about this research problem in the following way:
At a general level

- the changing operating context for the UK NHS
- transformations in service delivery and the estates response
- the relevance of scenario planning and open scenario theory and methods
- tools and competencies to facilitate open scenario planning in practice

And at case study level

- A&E and the acute Trusts
- existing strategic estates planning procedures for A&E
- open building and planning concepts in the A&E context
- tools and models to support open scenario planning for A&E

PRACTICAL VIEWS OF STRATEGIC HEALTHCARE INFRASTRUCTURE PLANNING

Strategic planning techniques for large sites have evolved since the 1950s from Herbert A Simon's work on the theories of master planning; a plan as an outcome of complex decision-making processes. However, the architecture of master planning for healthcare sites has increasingly been seen as a starting point according to Astley (2009) and for clients an architectural prescription of complex processes. For Verderber and Fine (2000) and CABE (2011) the term *'master plan'* has more recently regained some of its original meaning, and can be seen as a comprehensive plan or description (both visual and written) of the potential of a place. This can describe a process by which healthcare organisations undertake analysis and prepare strategies to plan for major change in a defined physical area.

Recently, the risk of long term development programmes for such a large-scale approach to site planning, associated with private finance procurement, has been illustrated by the cancellation of hospital building projects through spiralling costs. New planning techniques need to support the strategic distribution of services across settings and enhance the relationship for an open, change-ready, estate strategy that is better aligned to the clients and their community partners commissioning and business processes. In current circumstances and in the future, demands will intensify for adaptable and agile planning and design responses to the driving forces underlying change in healthcare systems.

In their study of flexibility in hospital investment at Addenbrooke's Hospital, Cambridgeshire and the impact of PFI, Neufville *et al.* (2008) conclude that conventional forecasting does not provide planning and design with a sufficiently wide range of possible futures, opportunities and building flexibility, which results ultimately in the underperformance of the infrastructure. Furthermore, estates thinking and practice needs to deliver highly flexible hospital and other health care infrastructures that are suitably adapted in scale and scope as these demands evolve (Neufville *et al.*, 2008). Today, many advanced case studies are starting to apply 'master planning', where design recognises a number of possible futures for the hospital, inter-changeable developable 'blocks' and supported by future quantitative measures to inform infrastructure strategy. As Mills *et al.* (2011) argue, it confirms the importance of defining and assessing value during open planning and design. Mills advances the emergent understanding of open building and planning, looking again at the fundamental interaction between people, and the emergent processes and product in early stage scenario development and reflects on how value could retrospectively be measured.

Mahadkar *et al.* (2011) depict how a Strategic Asset Management (SAM) framework can relate to open building levels. The various 'levels' are arranged within a pyramid to depict the 'control' each level has over the other, the lower levels exert a higher control than the top and similarly the top layers are less 'constrained' than the bottom layers. Cuperus (2001) explains that each of these levels are separated yet co-ordinated and there is decision-making and consultation between each level. They connect a decision-making party or stakeholder to an object under construction or in transformation (Kendall, 2009). The SAM framework incorporates different types of decisions between the levels, for example, 'ergonomic' decisions that look at adaptable workplaces with user adjustability that promotes safety will be included within the 'furniture and equipment' and 'fit-out' level. This is a different organisation of information for estates strategy than currently provided. Large scale strategic planning is a multi -faceted process that requires experience and engagement directly in the field for an understanding of changing requirements within organisational thinking. It is dependent on policy makers, community needs and economic climate, as well as many other time-variant factors. This approach offers a more responsive 'open' decision-making approach to design and project management strategy.

THE RELEVANCE OF SCENARIO PLANNING

Scenario planning has its foundations in the 1940s within military and business sectors in the USA and, since the 1970s in France, to the work of Godet around strategic scenario planning for public policy and for firms and business sectors (Chermack *et al.*, 2001, Godet, 2001, Varum and Melo, 2010). Schoemaker (1995) describes scenario planning as a disciplined methodology for examining possible futures, over a range of issues, from which organizational decisions may be derived, considered and implemented. Despite the substantial experience of using scenario planning in business practice (for example, within Shell since the 1970s); in foresight exercises at government level (Foresight, DBIS, UK) or at the inter-governmental level (for example, The European Foresight Monitoring Network), there is little evidence of this thinking and practice in the healthcare sector. Neither does this form of investigation feature strongly in investigations within the field of construction and project management according to Goodier *et al.* (2009). However, a trace of scenario based thinking is emerging in healthcare infrastructure, although there are few published examples.

The most recent study using scenario techniques, and relevant to the current controversies around the future of the NHS, was conducted by the Centre for Innovation in Health Management at Leeds University (Ross *et al.*, 2010). This used scenario development at the strategic level of the whole NHS system. In addition some others understand the forces at work in changing the nature of radiology, and the uncertain impacts this would have on radiology as a technology, its practice in hospitals and on its professional workforce (Enzmann *et al.*, 2011). Scenario planning for healthcare, offers an approach that avoids linear projection, prediction or forecasts from which conventional master planning can then follow, but what is necessary is to understand scenarios on a number of levels of physical and spatial constraint (Astley 2009).

The open process is designed to stimulate decision makers to consider change that might otherwise be ignored. The actual practice of engaging with decision makers and other stakeholders allows narratives or stories to be derived and selected that have powers of explanation of potential that are greater than the accumulation of quantities of data (although quantification may be an essential part of the process). In a complex and changing sector such as healthcare, this approach provides an important tool in planning; however its relationship to infrastructure design has not been clearly made. This paper demonstrates the application of scenario planning alongside open design approach, and also demonstrates the application of a new combined *open* Scenario Planning approach that is responsive to future trends, identifies possibilities and begins to untie the levels of the building and infrastructure from the activities it contains. Its objective is to help clients and commissioners inform vertical and horizontal planning across the spectrum of care in order to deliver measurable future spatial efficiency.

SCENARIO PLANNING AGAINST CHANGING EMERGENCY AND URGENT CARE POLICY AND OPERATIONS

The operating context for Accident and Emergency ('A&E', as it is widely known in the UK), the case study area of this study, has to be considered within the current and expected changes within the hospital sector and within the NHS overall. The future of the NHS has received significant attention in the official reports in recent years (BMA, 2006, Darzi Report, 2008, Ham, 2009, Nicholson Report, 2009, Wanless Report, 2004). The movement towards an integrated model of acute, primary and social care has lead to a blurring of traditional scales and settings which may lead to opportunities for both collaboration and competition (Mills *et al.*, 2010). The prospect of continued churn in institutional arrangements proposed by the current government for the NHS in England underline the need for adaptability of healthcare infrastructure, including the hospitals which currently support A&E.

Studies within the last ten years have given priority to investigating ways in which the numbers of attendances at A&E departments can be reduced together with reductions in waiting times (British Association of Emergency Medicine, 2005, Cooke *et al.*, 2005, Dr Foster Intelligence, 2006). Extensive research conducted recently across the A&E departments in the NHS in England has analysed the trend for structural growth in A&E attendances and admissions to hospital (Nuffield Trust, 2010). These, according to the Nuffield Trust, are derived from a combination of increasing numbers of single cases (in specific non-elderly age groups); a lowering of the threshold of severity for admission to a hospital bed following A&E attendance; faster discharges from hospital as a result of improvements in clinical and medical care (resulting in greater bed availability); inadequate out-of-hospital care and poorly managed patient pathways within primary care and its relationship with A&E. Greater efficiency in hospital 'bed days' appears to operate as supply pull supporting a lowering of the threshold of severity for admissions from A&E.

Recent literature points to clear evidence to deflect demand towards minor injuries units, walk-in centres, integration with general practice, earlier discharge and care have all been attempted at various times and places within the NHS. However, detailed examination of actual experience and assessment of effectiveness and efficiency gains is patchy and only occasionally rigorous (Carson *et al.*, 2010, Cooke *et al.*, 2005, Fisher *et al.*, 2010). Clearly, there are many other organisational, behavioural and cultural factors at work, and planners and designers of A&E care pathways need to establish new forms of thinking and practice surrounding the relative functions of emergency medicine in both hospital and primary care settings such as dynamic and agile scenario planning approaches alongside robust evidence-based research.

A&E infrastructure is of a highly varying quality and departments have evolved over many hospital building programmes over the past forty years. Nearly all the functions of emergency medicine take place within hospital buildings, with some significant, but not widespread, use of related or separate sites and buildings to accommodate minor injuries units, walk-in centres and some larger GP practices. Given the current evidence about the structural nature of increasing demands on A& E units, and despite some successful initiatives to diversify the provision of emergency care, the existing sites and buildings of major hospitals will continue to provide most of the functions of accident and emergency medicine in the near future. What is needed therefore are new approaches like those recommended by CABE (2009) to adapt and reconfigure buildings, to be extended or reduced; to accommodate service change; to be responsive to new or changing functions in healthcare; and to be capable of integrating new technologies associated with climate change and sustainability.

RESEARCH DESIGN AND METHODOLOGY

Foundation Trust Hospitals (FTs) and design industry partners supported an investigation for a fresh approach to strategic site planning and design. Case study research was performed using an iterative grounded theory development and action design research approach. The strategic estates planning approach of six FTs within England (Milton Keynes, Southampton, Salford Royal, Taunton, St Thomas's and Guys and Brighton) were investigated and a new open scenario planning approach was trialled. This approach was designed using strategic scenario planning concepts developed using open building principles, which enabled the team to witness first-hand the multi-institutional and multi-stream approach adopted by the FTs to execute their estates planning processes.

A scenario and value-based research method was devised, with case study analysis underpinned by open building theory. These case studies were part of a wider action and iterative grounded theory approach that continue to inform two longitudinal trust studies. Workshops aimed to analyse the strategies and techniques used by these self selecting Trusts. However while this was largely a convenience sample, it can be said that they do represent a range of different organisational types (foundation, teaching and non-teaching full service), that showed different geographical distributions, variances in local health economy, market structures, dynamisms or ability to respond to change and in decision-making competencies. The rigidity of estates planning approaches and techniques was observed at two levels: first, through a detailed document analysis of the guidance recommended by the DH; and second, through active engagement with the estates planning teams within the Trusts.

What was clear from this level of expert engagement was that there was a need for a rapid scenario planning research approach as clinical Emergency Departments rarely have more than one or two hours for workshop activities. The workshops were structured around multi-disciplinary teams from the Hospital Trusts including: Strategic Planning & Estates teams, Clinicians and nursing teams, held over a morning or afternoon time-slot, located in the Emergency Department. Examples of operational changes and pilot schemes elsewhere, evidence-based measures conducted nationally and internationally, targeted literature review of current thinking were also used to enable rapid and focussed discussion of key issues around Emergency Department reconfiguration.

WORKSHOP FINDINGS

The A&E is nationally overwhelmed, with attendance increasing in most Trusts. This may be due to a number of causes which Trust workshops and interviews confirmed. Attendance rates for 2008-09 and 2009-10 reported by HES & QMAE (HESonline, 2011) indicate more than 60% of people attending A&E were discharged with no follow-up or referred to a GP, and of the first treatment recorded of those attending A&E, 50% were either just given advice or sent away *(Figures 1 & 2)*. These inappropriate attendances were one of the central themes in the workshops.

Exploratory methods for discussion and development of scenarios evolved using diagrams, which were presented to Trusts and industry partners to understand wider service and societal changes and their impact on A&E *(see Figure 3).*

Through the workshops two key delivery scenarios were examined and tested with Trusts: i) 'Exploded - or Upstream - triage' - triage and assessment being carried out in stages and settings outside the hospital, such as with Paramedics, GP Out-of-Hours & Urgent Care centres, etc. *(see Figure 4), and* ii) The 'Big front door' - a more all-encompassing view of A&E directing all emergent patients through one entrance/gateway allowing early assessment by senior staff, as well as bringing primary care services into the Acute setting *(see Figure 5).*

There is a great deal of discussion & debate about how best to 'filter' the flow of non-ambulance attendance at A&E. The need to restrict or limit access, allowing better ambulance access (fines are associated with time to arrival), or widen the 'front door' to enable faster assessment and turn-away rates. 'Frequent flyers' - a small minority of individuals who are in regular attendance and admission into A&E - account for a disproportionate cost to the service. An expanded ambulatory care system operated by some Acute Trusts, providing a more comprehensive acute medicine service, is also effectively keeping people away from the 'front door'. This study has shown that whilst many trusts have various approaches to planning A&E services, few have developed robust and open scenario planning approaches. Detailed here are some of the key principles of open infrastructure scenario planning as it is applied to emergency and urgent care.

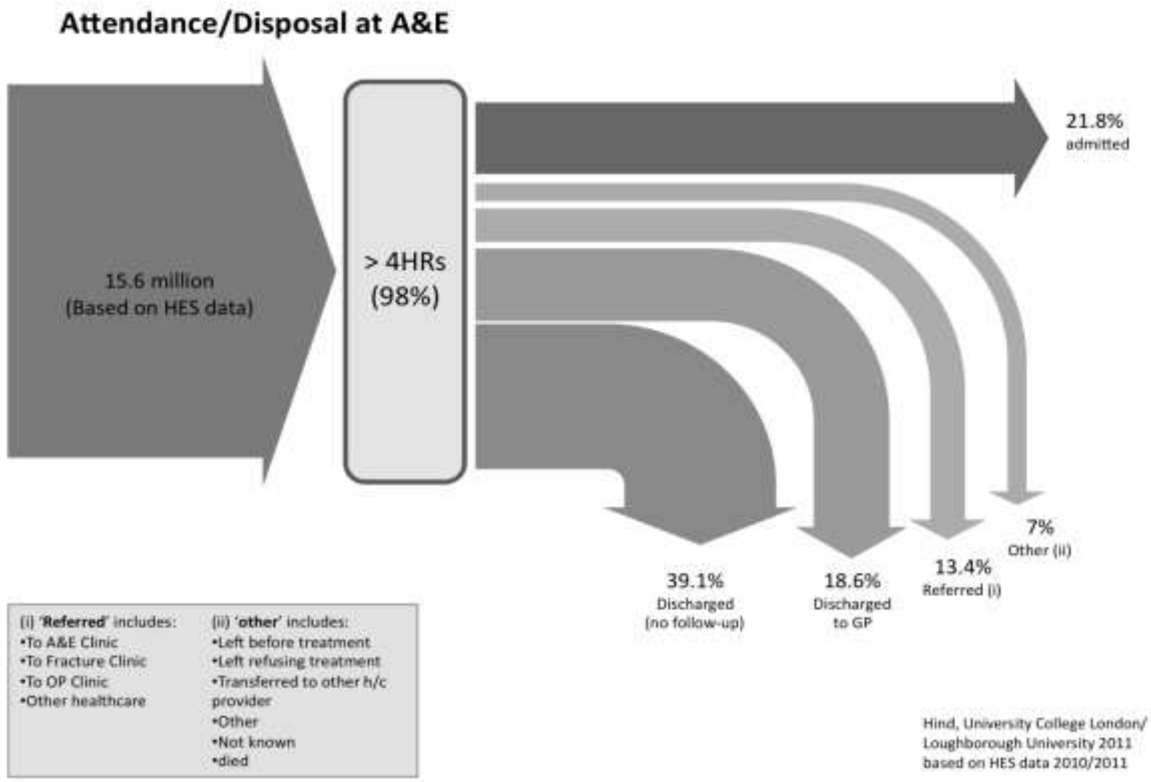

Figure 1 - Number of Attendances to NHS England A&E Departments 2010-2011 showing proportion of admitted patients, modelling HES 2010/2011 data (Hind UCL/Loughborough University 2011)

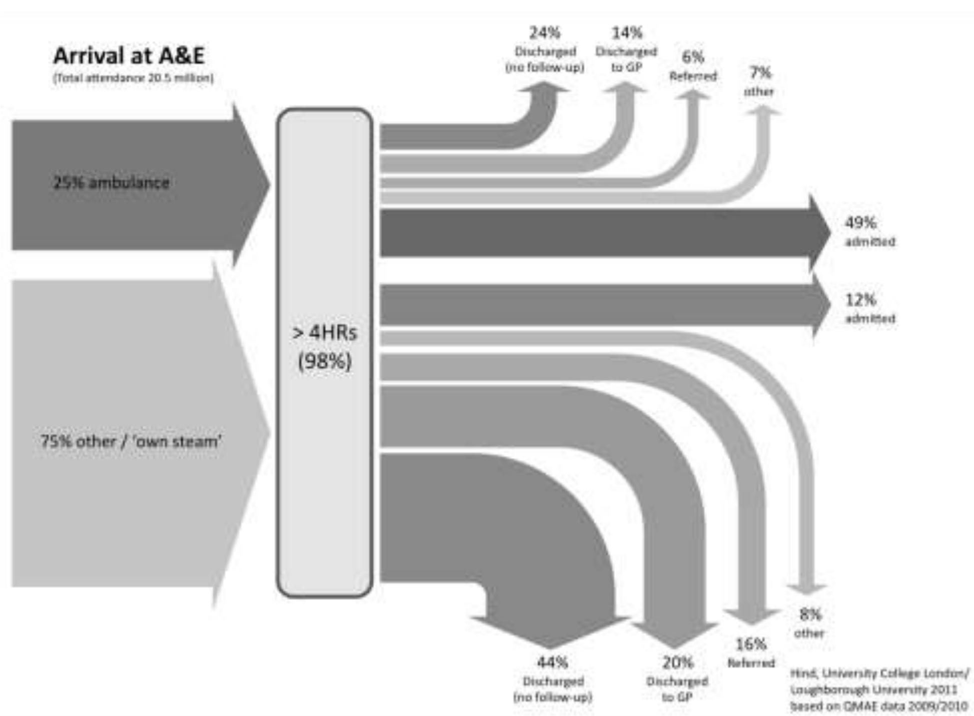

Figure 2 - Number of Attendances to NHS England A&E Departments 2009-2010 showing proportion of admitted patients and how they arrived at A&E (both groupings split into proportions of 100% for each method of arrival), modelling QMAE 2009/2010 data (Hind UCL//Loughborough University 2011)

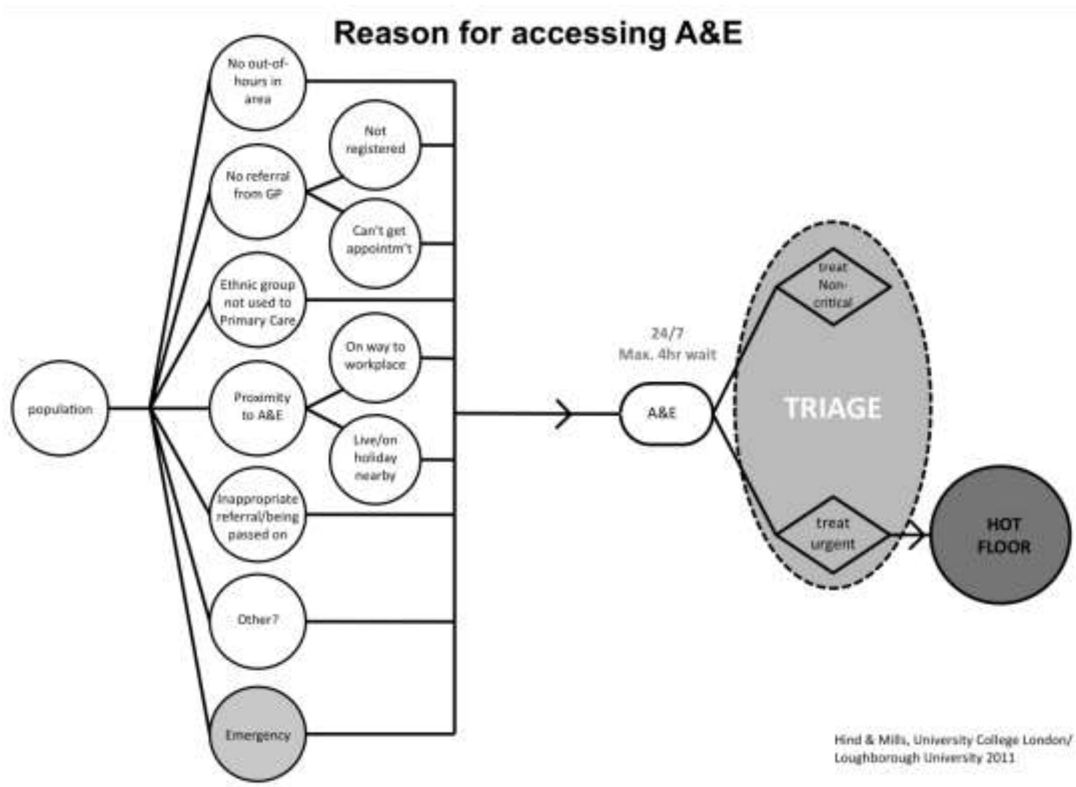

Figure 3 - dividing the population into reasons for attending A&E (Hind, Mills UCL//Loughborough University 2011)

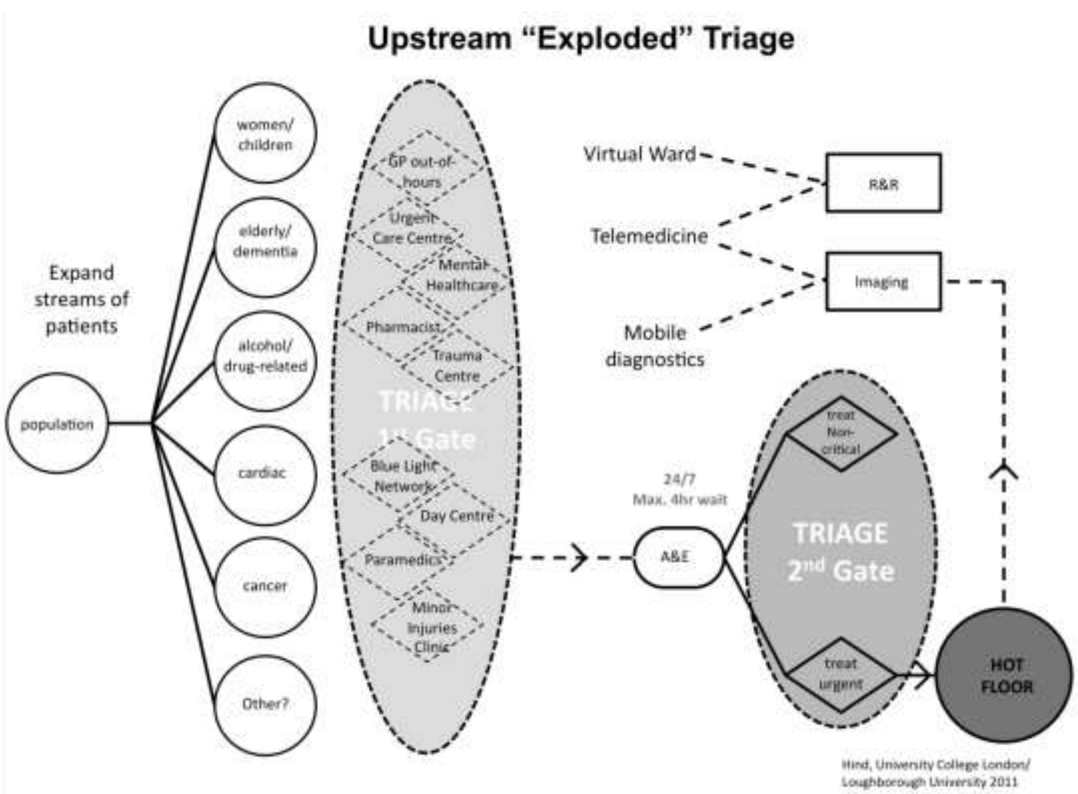

Figure 4 - dividing the population into patient pathways with potential for upstream '1st gate' triage outside of the hospital. (Hind, UCL//Loughborough University 2011)

PRINCIPLES OF OPEN EMERGENCY PLANNING

The workshops with Trusts provided the following key principles to developing Accident and Emergency departments that are able to cope with changing volumes.

- **Tidal Flow and Flux.** This concept describes the nature of change in the department by clinical staff. A&E is arranged to meet variable target needs - making sure the right people are in right place at the right time. It was considered by all Trusts as the 'front line', informing and impacting upon services behind. Furthermore, delivering services and managing people outside of hospital environment was important. Whilst there is a certain level of predictability in capacity planning the service, there was no absolutely clear model of care, in terms of space and service – *"it ebbs & flows".* It is essential, for workshop participants, not to have 'red lines' around areas, fixing activity to a specific area, as there are varying numbers of the more acute patients week by week. The design of an A&E department layout must therefore deal with any pathway that is chosen at any given time, responding to a number of changes over time.
- **Acuity Streaming.** Streaming into hot (acute - 48-72hr), warm (ambulatory 24hr) & cold (elective daycare/'minors') zones, placed patients into the correct *'temperature'* of activity with potential for team zone separation and variable specialist assessment. Some trusts had put in place a step-down *'discharge lounge'*, which would act as a 'holding area' for patients who are currently located in HDU/waiting. These patients would be seen and treated with 'clothes on' to in part encourage discharge, rather than admission overnight (see Figure 5).
- **Spatial Proximity and Flexing.** Another emerging strategy for change involved linking Resuscitation areas to cope with varying flow and flux. It was noted that Children's & Adults' departments could be separated from each other, but that the separation of Children's Resus' from Adults Resus' was not good practice. This then links the two departments as *flexing space*. *(Figure 6)*. Proximity of services meant efficiencies in operation (for example HDU beds help Resus as well as 'Majors' and nursing staff crossover).
- **Built-in Redundancy**. The creation of flexible space utilising non-specific rooms, are seen by Trusts as high priorities in order to accommodate change. Trusts also make use of 'soft space' such as administrative offices and storage areas, to allow for potential future expansion of clinical space. For one participant "*[We] need to build-in both redundancy and potential expansion".*
- **Co-location around Diagnostics**. Surgery, Medicine, Paediatrics, A&E are currently co-located around diagnostics, but the technological advances in mobile imaging may end this need. Some imaging is already carried out using mobile equipment within A&E departments. Layouts could be limited or at least constrained by the necessary proximity or availability of staff and equipment. Similarly, Trusts identified a need for close proximity between 1st gate & 2nd gate triage - cost effectiveness & access to appropriate treatment. *(Figure 4)*
- **Change-ready estate - Shell & Core/Fit-out Space.** There is a general understanding amongst trusts that "things will change". There is a clear need for 'change-ready' planning at both small and large scale, as well as compromise in reaching reconfiguration over the long, medium and short term. Experiences of ongoing change, and of new space planning around services that became rapidly redundant with changing needs, were recited by participants. One A&E department reported 13 separate changes in space in order to reach the current layout and were planning further reorganisation.

CONCLUSIONS

A&E clinicians were generally enthusiastic about the organisation of new change-ready concepts - both spatially and ideologically - recognising the expanding and contracting need for services on a daily or weekly basis. The need for change-ready spaces, with services & activities inhabiting areas as needed was discussed at length. Some estates teams understand and use existing open building principles (of shell & core), even in relatively old buildings, however many believe that there are opportunities to incorporate wider and less spatially constrained planning principles and to carry out short term space fit-out which may still suit existing business case frameworks.

All trusts interviewed faced the same or a similar dilemma that there is often not an opportunity for a new-build option on a green site, therefore from their perspective, open building is usually constrained and cannot always deliver an optimum value solution (only a best possible solution). Some trusts faced significant constraints as a result of existing previous master planned facility locations or service operations that restrict *'forward planning'*. Urgent and expedient expenditure of capital budgets due to short term national and regional funding cycles limit the potential (or opportunity) for longer term thinking and planning. Furthermore capital funding for enabling works and general infrastructural changes (such as for roads and mechanical services) were seen by some Boards as a none-necessary cost in favour of the purchase of equipment or care

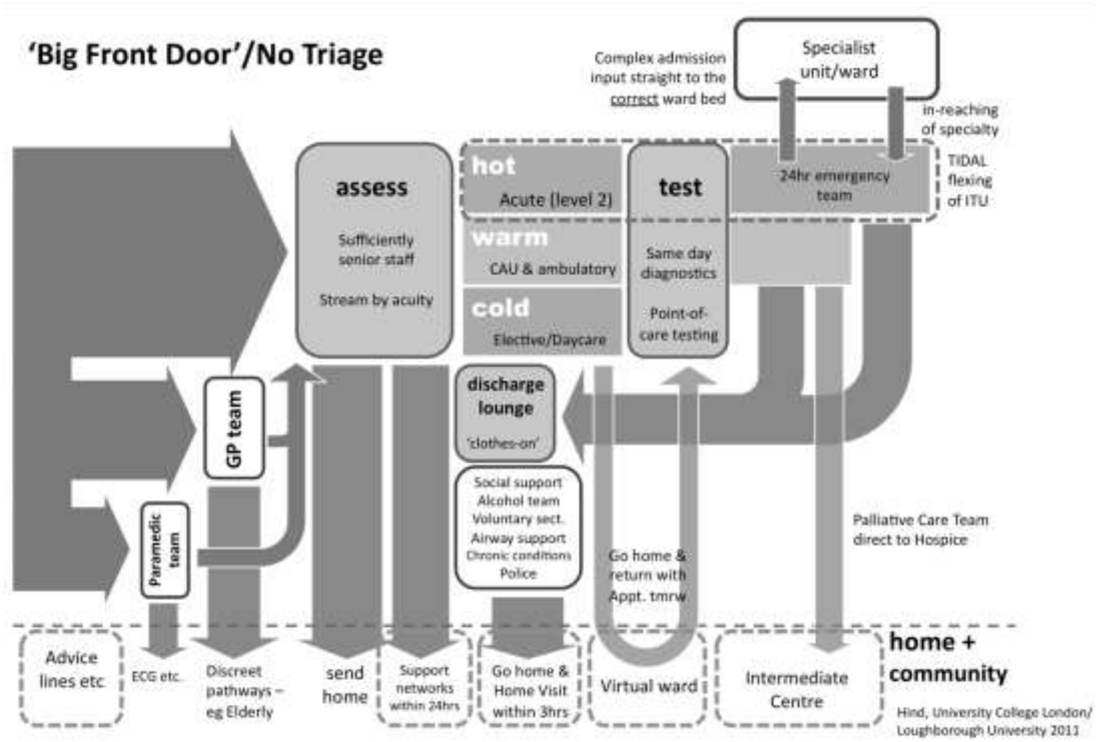

Figure 5 - streaming population through acuity, bringing forward some assessment and care delivery upstream, with in-reaching of community, social and specialist services (Hind UCL/Loughborough University 2011)

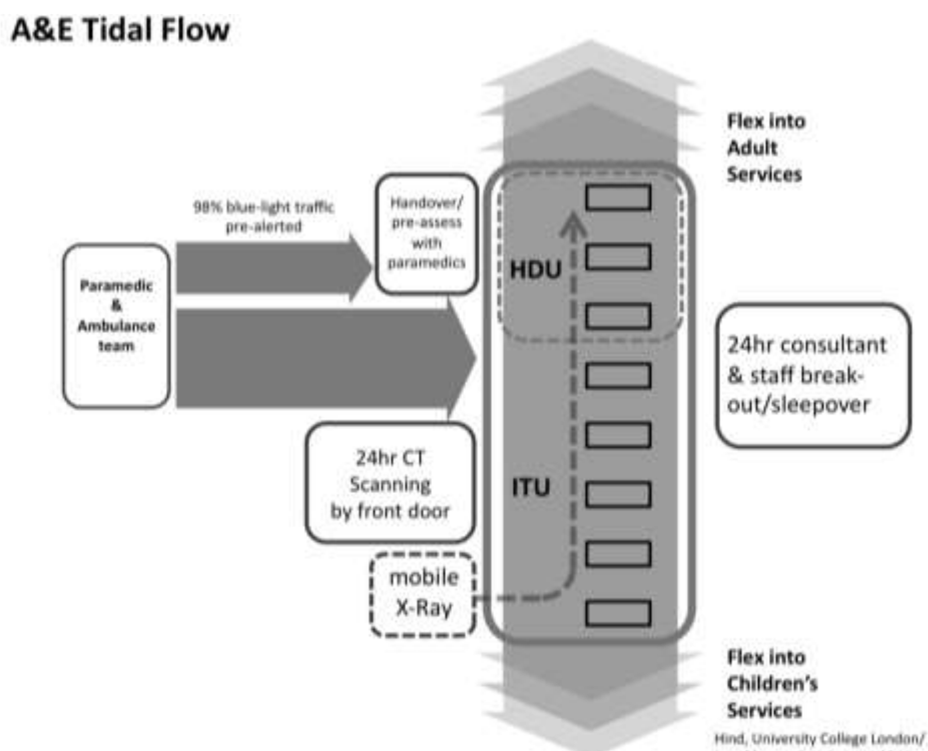

Figure 6 - Tidal areas and flux describe the nature of change in the department by clinical staff (Hind UCL/Loughborough University 2011)

innovation. This seems to indicate a need for more coordinated *open* funding mechanisms.

What is clear is that existing building stocks will play a significant future in Trust based open infrastructure planning scenarios and that limited funding will be able for radical redevelopment. A&E departments are starting to be seen as critical to future planning of services and inward investment which many have lacked, particularly in recent capital expenditure programmes. As a result of the funding downturn, capital developments in A&E over the next five years - and possibly up to thirty years - are likely to be within existing building envelopes.

Outside of internal project planning, learning and discussion of the built environment aspects of emergency medicine have been almost entirely absent from the strategic debates about the functioning and future of A&E departments. There are national guidelines and codes of practice to inform estates departments within hospital trusts, but most work within the established focus of known policy, specification and cost. This study has shown that there is some evidence of increasing attention to planning and design within strategic thinking about health care buildings. Within this debate the need for adaptable space accommodating the tidal nature, or 'ebb & flow' of normal Emergency Department procedure is considerable, along with wider scenario based consideration of changes in service, greater mobility of imaging equipment, and staffing levels.

FINDINGS

- Clinicians in Emergency Departments rarely have more than one or two hours available for workshop activity, so the need to focus quickly on issues and draw out scenarios was essential.
- Clinician teams were clearly focussed on short-term change (occurring in the 1-5 year period), and the obstacles to be overcome in the immediate future as well as innovations in the field. Developing longer-term (the 5-20 year timeframe) and wider service vision was made possible through the multi-disciplinary groups, enabling consideration of spatial and infrastructural limitations and opportunities using the scenario planning workshop method.
- Whilst there has been a steady upward trend in A&E activity over the past thirty years, and increasing burden and cost of A&E demand there are opportunities to improve approaches for an open infrastructure planning to minimise the disruption of changing demands and to maximise asset value.
- Literature and broader industry findings support the argument that Accident & Emergency Services cannot be considered in isolation as an island of special patients. It reflects weaknesses and strengths in other services and as such should be the focus for integration and the testing of innovative new approaches.
- The development of 'The Big Front Door' model, and its use for debate and discussion with clinical teams, demonstrated that whilst attendances are currently rising in A&E, there is a possibility of reconfiguring services around acuity. This study has shown many trusts vary in the approach employed to 'filter' the flow of non-ambulance attendance at A&E, the need to restrict or limit access, allowing better ambulance access, or widen the 'front door' to enable faster assessment and turn-away rates. The evidence still remains inconclusive, however this study starts to elucidate some of these approaches against a responsive, scenario-based *open* approach to infrastructure planning.
- This study has presented six key findings in scenario-planning for A&E, including: tidal flow (to accommodate the movement of key staff and patients); acuity streaming (the design around patient and treatment severity); spatial proximity and flexing (the arrangement of space according to staffing patterns and to cope with flux in demand); built-in redundancy (flexible, universal and non-specific rooms); co-location around diagnostics (supporting efficient operation and through-put) and change-ready estate (variability in shell and core/fit-out space to accommodate change).
- Open scenario planning can be a valuable form of analysis for decision-making at a number of levels. The Inselspital considers a high strategic level, where the thinking and techniques of scenario planning can be applied to whole sectors of an economy or at the strategic level of public policy. Through the application of Open Building principles for 'flexing' at the micro-level, to handle uncertain futures, or even at the inception of a project and in its development within an organisation, or part of an organisation. The application of flow can also be understood on a larger building scale and in the development of strategic and integrated business cases that create a buffer and resilience in capacity between organisations and buildings. Advancing networks such as "Trauma" are having significant impact at a clinical scale, but planning for built infrastructures must keep pace.

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Hospital Design: Evolution of Crododiles Rather Than the Dodo

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ABSTRACT
There is an inherent paradox in hospital architectural design in as much as a hospital is a purpose-built structure where form is determined by medical function and not necessarily its ability for flexibility and adaptation. If the building is too purpose-built this will affect future adaptation and result in a "Dodo" that will become extinct. The lifecycle will be shorter than a building which is purpose-built with enough flexibility to adapt and morph into a "crocodile", which is to say a tried and tested design that is stable and adapted over time to its environment relevant to its continued survival. This paper examines some of the design factors which embed or hinder adaptability in hospital design. Drawing on a portfolio of hospital projects in SA, the author discusses and compares current approaches to healthcare infrastructure. The structure of healthcare delivery is about to undergo a major overhaul with the introduction of a National Healthcare Insurance scheme. At this point, the author argues, it is appropriate to examine the implications of healthcare design strategies, design solely for present medical function or design for flexibility and adaptability. The question thus posed is: what approach to building design will ensure that future hospitals in South Africa are robust enough to withstand the test of time.

KEYWORDS:
Hospitals, design, flexibility, adaptable, South African.

DEFINITION
Since the rebirth of South Africa as a democratically free state in 1994, there has been the deepening distinctiveness of two healthcare service provision models. The first type – the public sector – exists in the custody of the various nine autonomous provincial departments of health and local government authorities. This is the platform to provide services for 65% of the population and does so with 40% of health care funding. The second type – in the private domain and with a relative investment of 46% of the expenditure provides services for the privately medically insured population which accounts for 35% of the population (McIntire et al:19). This imbalance in expenditure and benefit has prompted the re-engineering of the healthcare finance model and healthcare delivery systems. This effort will be heralded by the imminently planned introduction of a gradually phased National Health Insurance scheme which seeks to provide accessible and fair healthcare for all South Africans through a compulsory ring-fenced progressive tax base.
Each of these two healthcare service models has given rise to distinctive hospital architecture.

In both types there is an inherent paradox in design in as much as a hospital is a purpose-built structure where form is determined by medical function and not necessarily its ability for flexibility and adaptation. If the building is too purpose-built this will affect future adaptation and result in a "dodo" that will become extinct. The lifecycle will be shorter than a building which is purpose-built with enough flexibility to adapt and morph into a "crocodile", which is to say a tried and tested design that is stable and adapted over time to its environment relevant to its continued survival.
At this point, with the imminent introduction of a National Healthcare Insurance scheme, it is appropriate to examine the implications of healthcare design strategies and to speculate whether either type sufficiently balances the medical functional imperatives with design for flexibility and adaptability to survive or whether lessons drawn from both sectors may inform a new hybrid open building system. The question thus posed is: what approach to building design will ensure that future hospitals in South Africa are robust enough to withstand the test of time?
The dodo (Raphus cucullatus) was a flightless bird endemic to the Indian Ocean island of Mauritius. Related to pigeons and doves, it stood about a meter tall, weighed about 20 kilograms, lived on fruit, and nested on the ground. The dodo has been extinct since the mid-to-late 17th century. It is commonly used as the archetype of an extinct species because its extinction occurred during recorded human history and was directly attributable to human activity.

The dodo had a flawed design in that over time meant it didn't adapt to the threat in its environment and thence disappeared due to its inability to avoid its' predators i.e. humans

Figure 1. The dodo. (Source: Wikipedia)

A crocodile is any species belonging to the family Crocodylidae. Member species of the family Crocodylidae are large aquatic reptiles that live throughout the tropics in Africa, Asia, the Americas and Australia. Crocodiles tend to congregate in freshwater habitats like rivers, lakes, wetlands and sometimes in brackish water. They feed mostly on vertebrates like fish, reptiles, and mammals, sometimes on invertebrates like molluscs and crustaceans, depending on species. They are an ancient lineage, and are believed to have changed little since the time of the dinosaurs. They are believed to be 200 million years old whereas dinosaurs became extinct 65 million years ago; crocodiles survived great extinction events.

The crocodile has a tried and tested design that is quite stable and adapted over time to conditions in its environment relevant to its continued survival

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Figure 2. The crocodile. (Source: Wikipedia)

A building is the spirit of the age; theory and functional imperative frozen at a point in time. Out-of-date versus extinction is a product of design and adaptability over time.

In the experience of the author, some key factors that can demonstrably impact the adaptability of the organism (healthcare buildings) and that may result in extinction or adaptation over time include: contract period, changing disease profiles, information technology, equipment (beds, diagnostics), electrical supply and usage in healthcare environment, staffing skills and shortages, global trends versus local solutions, architectural style and building evolution over time. Each of these factors is examined in terms of how they apply to some current typical examples of each of the two identified hospital types in order to speculate which response may survive the "great extinction event" posed as the structure of healthcare delivery in South Africa undergoes its' major overhaul.

CONTRACT PERIOD – PROJECT TIMEFRAME

No matter how fast we construct buildings, the time it takes between planning and use means that the building is dated at the time it is handed over. This timeframe varies according to the nature and circumstances of the contract and construction. In the South African private healthcare context it currently averages 24 months. In public healthcare the time period varies between 36 and 60 months and frequently stalls indefinitely. Perception of the relevance of any particular building is partly determined by temporal proximity of idea and realisation. Fast-track contracts realise more quickly and in a real sense the parties involved may be inclined to feel that the building at completion is relevant to the ideas visualised at the planning stages. Conversely, post-project feedback studies show that protracted building contract times tend to leave healthcare architecture clients and consultants feeling that the trends in the medical field have supplanted their building and that they will need to change or update the facility to stay current with the trends in their field.

Private healthcare tends to a fast-track contract structure whereas public healthcare tends to protracted conception periods because of the checks and balances built into the process. In the private sector executive management makes investment decisions and tends to streamline this by consultation with preferred specialist professional teams and standardised design approaches. Private hospital groups maintain competitive advantage through capitalising on past experience and excellent intra-group communication to avoid repeating mistakes which improves efficiency and effectiveness of healthcare architecture. The public sector decision-making process has vacillated between local or provincial authority as the case may be and facility management. The first strategy is the enemy of equity (given the lack of norms and standards, regulations and guidance); the second the enemy of efficiency or sensitivity as it is removed from point of service. The extended contract periods which result lead to fatigue and also tends to entail breaks in continuity and institutional memory loss experienced in extended timeframes due to churn and high staff turnover. This fragmented experience of the building process – which is disproportionately more prevalent in the public sector – undermines user-client satisfaction. If user-client satisfaction is a goal (and given critical staff shortages this may be crucial to successful health service delivery) then, as South Africa prepares for National Health Insurance, it should consider streamlining contractual processes in order to improve stakeholder satisfaction.

CHANGING DISEASE PROFILES

Over time disease profiles change. In the 1500's the leading cause of death was infection, poor hygiene, poor diet and poverty. In the 1700's the leading cause of death was consumption (TB), ague and smallpox. In the 1900 the leading cause of death was the flu, TB and diarrhoea. In the 1960's the leading cause of death was heart disease, cancer and degenerative diseases. In the 2000's the leading cause of death is lower respiratory infections, heart disease, diarrhoea, HIV. Currently we have seen viral infection from various strains of influenza and closer to home the pandemic emergence of multi and extensively drug resistant TB.

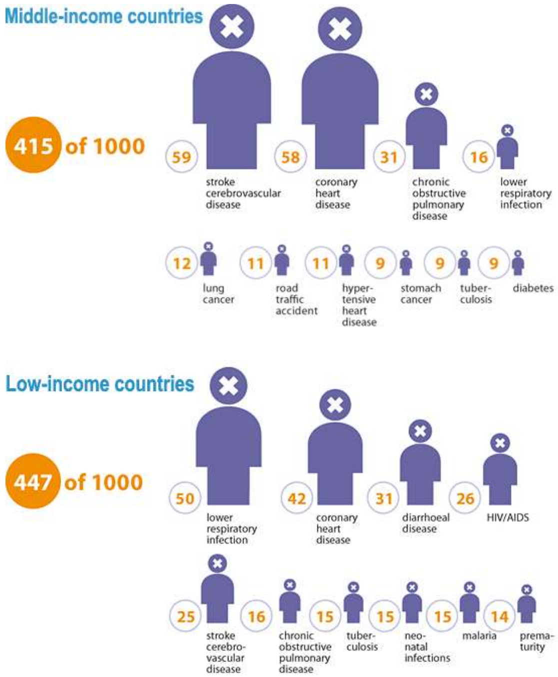

Figure 3 and 4. Disease profiles in different income groups. (WHO website)

Disease profiles are determined by region, the social norms and affluence of a society. Each of these diseases requires its own treatment regime and specific design factors that allow for effective treatment without infecting or endangering the staff that are treating the patients. Florence Nightingale was an accomplished statistician. Through careful recording of infection rates introduced the evidence-base to support cleanliness in hospitals and bed spacing to reduce cross infection. This has persisted as the basis for the modern hospital design.

Recently infection prevention and control has been recognised as one of six national priorities. Airborne infection measures to appropriately address the current specific risks of the South African epidemiological landscape can profoundly affect building architectural design and engineering. Infection prevention solutions vary from private to public sector according to their differing resource allocations and disease profiles. The threat of airborne infection is more profoundly experienced in the public sector because of the strong socioeconomic bias of TB and higher demand (characterised by overcrowding). This is also dealt with in the context of a resource constrained sector. Consequently in more basic levels of service public sector tends to favour technologically simpler natural ventilation solutions which require less preventative maintenance and hence consume less operational budget. By contrast the private sector has not felt the full brunt of the TB epidemic – a luxury which may not continue in the re-engineered service – and has frequently made use of mechanical ventilation systems which are designed mainly for indoor environmental control and patient comfort rather than for airborne pathogen mitigation

Figure 5. Ventilation criteria in TB wards. (Source CSIR)

Large openings that allow unobstructed air flow that diffuse pathogen droplet nuclei per volume, and larger allocated building volumes per capita reduce risk of airborne infection. Studies have demonstrated that some old hospitals with large windows and high ceilings could be better than the newer more efficient deep space planned and mechanically ventilated facilities (Escombe et al: 10).

But does this mean that the latter are doomed to extinction or can they prevail through adaption? As isolation rooms or wards for treating infectious diseases generally influence design, so too other specific diseases influence healthcare facility design. Thus the building's design and layout adapts to the people and their diseases at that point in time. At any given time, hospitals need to be responsive to their local communities. When community members are young, there is a need for paediatrics and maternity services. Over time, as the community ages, and if it is relatively stable (which is a prevalent pattern in South Africa as a growing, developing nation with emergent middle class) then the medical profile changes and the hospital needs to accommodate a different set of patient needs. In societies that have an aging population profile, the design input with regards medical care will be integrated into the residential unit at varying levels and has become a sub speciality all of its own with affluent people living longer. In South Africa life expectancy across the board has dropped disproportionately affecting socioeconomically disadvantaged. This is pertinent to both public and private healthcare as well as both developed and developing societies, the reasons and cost centres vary.

In South Africa there is talk of a triple burden of disease. The first is primary healthcare diseases, which are high mother and child mortality, TB and malaria. The second is chronic lifestyle diseases, heart conditions, diabetes and or strokes and other stress related illnesses. The third is the high trauma from motor vehicle accidents and crime. South Africa shows primary healthcare diseases the same as developing counties in conjunction with lifestyle diseases more associated with developed countries. High trauma levels characteristic of South Africa is an anomaly for both. Usually developing countries don't sustain motor vehicle accidents and crime because of a shortage of resources (other than conflict areas) and developed counties don't have this either due to a developed policing system and law enforcement. This means that designers are exposed to varying degrees of healthcare planning, competing needs, and a need to identify which is the most appropriate for an area and how it is likely to change over time.

Often the difference between obsolescence and flexibility is experience or a vision by the designers that prevent buildings being locked into singular function facilities that are unable to change and become inefficient in new roles.

INFORMATION TECHNOLOGY

Information technology has rapidly transformed hospital functionality and rapidly transforms itself. Information technology allows an interconnectedness that wasn't part of facilities previously, now designers have server rooms and control centres where a host of electronic data interfaces with the patients, staff and building management systems. This connectivity adds a layer of servicing, specialised spaces and support infrastructure. These systems make a paperless hospital technologically possible and potentially reduce patient file storage area but increasing other aspects like the electrical loading and backup systems to keep the electronic systems operational. The more ambitious of these systems envision a total integration into a singular operating and or management system, items like: security monitoring, access for staff, patient data and various levels of access, staff data and time management, reporting via diagnostics, x-ray and pathology, electronic load monitoring on electrical supply, building management systems that control the building environment, integrated stock control and remote ordering, statistical reporting on patient profiles and occupancies, pharmacy control via integrated networks that monitor patients. Private healthcare tends towards the high end information technology (with fully redundant electrical supply systems to address public electricity supply uncertainty). The public sector is incorporating hybrid systems as part of their transition.

EQUIPMENT

Along with information technology support equipment is changing as well. Beds are increasing in length and width to accommodate additional paraphernalia that make the bed more versatile for a variety of medical functions within a single facility, evolving electronic monitoring, and easier for staff to manage patient comfort. These impact the minimum spaces needed at the attending and non attending sides of the bed, as well as openings, lifts and the various corridors sizing in a facility. In regulations which apply only to the private sector, the norms and standards (R158) specify minimum open space requirements around beds based on conservative ergonomic needs analysis

Using an oversimplified graphical analysis method it can be demonstrated that a relatively minor evolution of equipment size (in this case beds) coupled with a design principle (application of R158) can substantially alter cost and area requirements. Applying the R158 norms to a two bed ward layout with a 1995 standard bed yields a minimum room sizing of 15.02m². Applying the same R158 norm to 2011 bed yields a minimum room size of 16.15m². This is a 6% increase on the room size. As a rule of thumb, in a 210 bed hospital with a foot print area of 19 250m² (a recently completed projects) would require an additional 1155m² and an estimated additional R 23.1 million initial capital investment just because the bed has increased marginally in size.

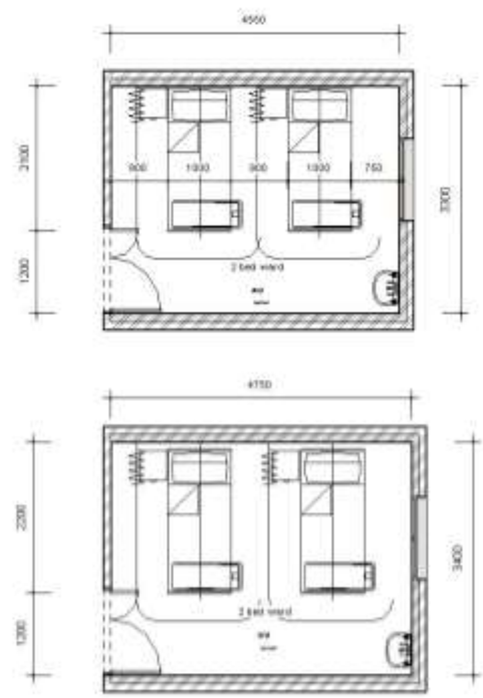

Figure 6. Graphic analysis of norms applied to a two bed medical ward. (Source: author)

MOOT Algemene Hospital – Pretoria was originally a dedicated stand alone paediatric hospital which was bought by a private hospital group. Their business plan was to convert portions of the facility into adult beds (the patient profile had changed) that had a better return on income. The challenge in the reconfiguration was that the wards where designed for children's hospital cots, which are substantially smaller than adult beds. The cots had the regulatory distances between each other but due to inconvenient positioning of concrete structural elements flexibility and adaptability of the facility to an efficient adult configuration were severely limited. Bed numbers had to be substantially reduced, generated pockets of inefficiencies all over and compromising the business model.

Subsequently our practice designs paediatric wards to accommodate standard hospital beds so that the ward can adapt in over time as the hospital's demographics change. The additional area in the case of paediatric use is always used by concerned parents. In the South African private sector, investment decisions are frequently imposed on the consultant team by the investing party on the basis of minimising initial capital investment as capital is scarce and expensive and the market is highly cost-sensitive and competitive. Provision of additional space even if it can be used for concerned parents (and even if this may provide a competitive advantage) is uncommon practice in the private sector and needs to be strongly motivated by the professional design team.

Jane Carthey notes that there are orders of magnitude for rates of change which vary by element more or less as follows: site 50-500 years, structure 30 – 50 years, skin 20 – 30 years, services 10 – 20 years, space plan 5 – 20 years and stuff 0 – 1 year (Carthey: 41). Discrepancies between rates of change of different elements are a challenge for healthcare facility designers in conventional design, construction and asset management practice.

Consequently building infrastructure which typically endures 30-50 years but which is designed to accommodate super-specialised equipment may be out of sync with space adaptation needs in the medium and long term. Items in diagnostics like x-ray machines and the support equipment is (generally) getting smaller, with lower hazardous radiation levels and may be accommodated in smaller spaces with more electronics. Items that lasted 10 years now turn over in six years, this impact on the spaces and their re-use. Large expensive pieces of equipment are reducing in price which means that they tend to become obsolete sooner (term of financing) and are more likely to be replaced sooner. The increase in monitors for patients means that there needs to be more or larger equipment stores built into a ward to accommodate the equipment when not in use or when charging the rechargeable batteries.

This has also lead to the addition of clinical stores and workshops where this specialised electronic equipment is serviced or repaired on site. More and more the inclusion of these items is to reduce staff workloads but also requires specialised training rooms where the staff is updated on the equipment, their use and problem solving or reporting. The specialised equipment also needs extra electrical loading and often extra mechanical ventilation to cool the electronics. Private and public healthcare are focusing on these items for the same reasons and regardless of the sector these will be determining factors in the design evolution.

ELECTRICAL USAGE AND SHORT SUPPLY

South Africa has a challenge in meeting current electricity demand, resulting in disruptions in supply and a sudden exponential increase in cost of electricity. These factors affect essential services like hospitals very acutely. On the one hand there is a shortage of supply as a resource issue and on the other hand we have an increase in demand brought about by the increasing adoption of increasingly sophisticated technologies. Often this increasing sophistication is driven by a need to use technology in response to staff shortages. A solution is the integrated building management systems that cut down on unnecessary electric usage and manages the power consumption via various management strategies. Heat pumps, solar heating and solar control are being systematically introduced to reduce loading in the private sector as a means of relieving burden of high electricity cost with the collateral benefit it being a more "green" and sustainable resource. Private and public healthcare are increasingly focusing on these items for the same reasons and regardless of the sector these will be relevant in the design evolution.

SKILLED STAFF SHORTAGES

Healthcare workers are in critically short supply in South Africa (McIntire: 5). Whilst this is a worldwide phenomenon, developed countries attract skills away from developing countries on an economic bias. Healthcare architecture that is not adapted to this constraint is doomed and there are several public facilities in existence which have been unable to operate. A strategy adopted predominantly in the public sector is to provide on-site staff accommodation to attract staff to facilities (mainly in rural areas) where services may be needed but where professional healthcare workers may not be available. Private sector has largely avoided these areas as they may present unfeasible business propositions due to suppressed socioeconomic demographics of these areas. In both sectors hospital designers are inclined to minimise travel distances for reduced staff complement and linking symbiotic functions through careful planning in order to maximise acuity. Enabling technologies such as electronic monitoring allows for less staff to deal with more patients but the reliance on electronic monitoring is financially feasible in private facilities and developed counties but not (yet) so in the public sector. The question may also be raised whether over-reliance on electronic patient monitoring – particularly when used in combination with single-bed ward configurations may alienate patients and undermine the healing environment.

GLOBAL TRENDS VERSUS LOCAL SOLUTIONS

In developed counties and in the private sector in South Africa the trend is towards a hotel like patient environment, with single occupancy bed rooms and more privacy. This leads to a higher staff requirement to service the one bed units or electronic monitoring; both are expensive options that are affordable only in private healthcare. In developing economies there is a predominance of two to six (or more) bed ward options. These require less staff to patient ratio and as a spin-off the patients become part of the nursing staff through their communal awareness. Locally we have a society that has a strong social basis so it could be argued that two to four bed ward configurations are more appropriate for South Africa. Concern for fellow patients means that patients are as likely to assist in the monitoring of patients as nursing staff; this reduces the load on staff and works within the social norms of South African society. Furthermore four to six bed ward configurations use less space per patient, reduce capital cost, reduce staff needs and improve circulation distances compared to their single and double bed counterparts. Global trends stack hospitals vertically because of the premium on land. Locally, in many contexts well-designed horizontally-spread hospitals with less reliance on mechanical circulation and servicing are a tried and tested typology. Only in dense urban environments are vertically stacked solutions prevalent. Architectural design solutions are sometimes copied from developed contexts without appropriate adaptation in order to create the impression of sophisticated healthcare delivery but this approach inevitably leads to extinction due to capacity and resource constraints leading to failure to afford and maintain these facilities.

ARCHITECTURAL STYLE

Private healthcare groups tend to minimise initial capital investment to minimise financial exposure and maximise profit. In order to sustain ongoing operation this sector relies on maintenance-intensive (tax-deductable) management of building stock and a rapid renovation cycle. There was an anecdotal rule of thumb that a facelift would be performed on a facility approximately every seven years and a refit every 14 years – reinventing a facility within a style matrix responsively for a fluid and style-orientated market.

Public healthcare architecture faces different constraints. Capital finance is accessible through the National Treasury and though bureaucratic and slow there is little institutional incentive (or until recently frame of reference) to economise to the extent apparent in the private sector. However facility maintenance regimes in the public sector have been almost universally exceptionally poor. In certain cases, hospital architects have responded through specifying very robust materials and fittings for new public facilities. These may then rejected by building users because of their user-unfriendliness (Stainless steel toilets, Western Cape). Alternatively the private sector architectural styling is copied but performs poorly in the absence of maintenance and refurbishment culture. The public sector is characterised by inconsistency in architectural allegiance and ambivalence of style.

BUILDING EVOLUTION

The most basic evolution is simply that a facility will grow incrementally and expand beyond the borders and boundaries of the original envelope. Careful planning will not always cover these eventualities but flexible design strategies can accommodate future extensions.

In 1994, A3 Architects undertook major additions and alterations to the Sunward Park hospital, Boksburg. Over the ensuing 17 years an additional four major phases were added to the facility as it outgrew its original shell, added beds, increased services and introduced support infrastructure.

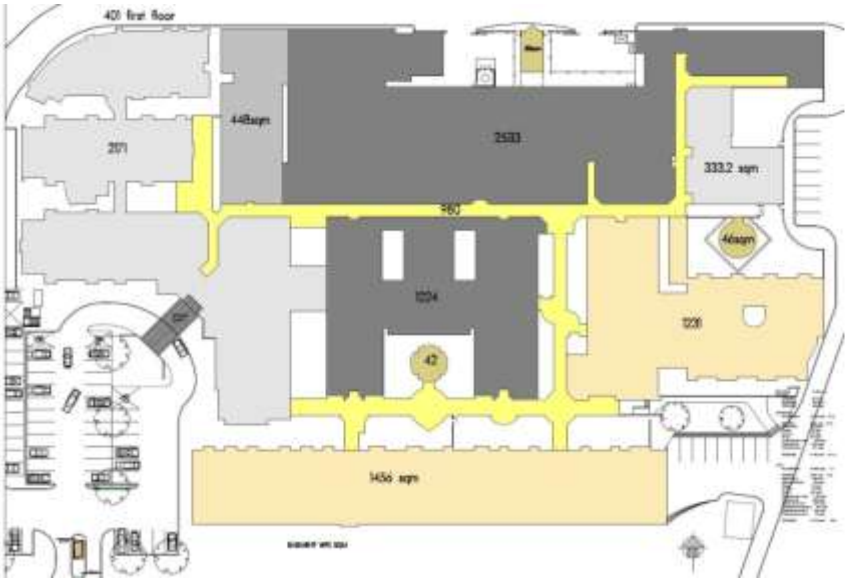

Figure 6. Adaptation over time at Sunward Park Hospital. (Source: author)

ADAPTABILITY, DISENTANGLEMENT AND LOCUS OF DECISIONS

Most hospitals historically are purpose-built, highly specialised structures which have by and large escaped the generic typologies of speculative investment (such as that experienced in office building and residential markets). A new generation of hospitals, such as INO Hospital in Bern, Switzerland, exploit open building, flexible construction solutions that aim to allow endless permutations and flexibility over the life cycle of the building.

Right now may be an opportune moment in history to entrench open building design strategies with the introduction of the National Health Insurance. When better to rethink architecture than when new policy, legislation and guidance are formulated? Hospital building infrastructure which can fluidly respond to the various pressures discussed above, such as variations in epidemiology and demography; equipment and information technology; skills, energy and resource availability; and architectural style; as well as emerging and unanticipated pressures may well have the necessary characteristics to ensure its continued relevance. Disruptions to ongoing healthcare service provision could be reduced by choosing open building technologies over conventional construction techniques when undertaking additions and alterations. Elements could be renewed at different rates according to their particular life spans or functional requirements if they are disentangled, which could potentially advantage financial management, and extend the useful service life of hospitals. If investment decisions in overall hospital building envelope were made at local or provincial authority level but detailed resolution and ongoing evolution could be the ambit of the facility, it could go some way to ensuring building relevance, stakeholder satisfaction (facility "own" the design process), improving equity (fair funding distribution located centrally), quicker contract period (less bureaucracy). However, several formidable barriers would need to be overcome in order to universalise this approach. Conventional professional design and specification practices, construction techniques and industry approach are likely to persist as the required widespread re-skilling or up-skilling would be expensive and time-consuming. Given this and the continuing need to provide healthcare infrastructure in the era of National Health Insurance, it looks like open building practices are more likely to succeed if introduced organically and incrementally as they gain traction over time rather than as a self-conscious imposed building philosophy. In this way open building strategies themselves may need to be crocodiles to avoid being dodos.

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Space Standardisation and Flexibility on Healthcare Refurbishment

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ABSTRACT
One of the most common features and aims of a flexible solution is to help all stakeholders throughout the lifecycle of a healthcare facility, own or take (full or part) responsibility of reducing, mitigating or abating the redundancy impacts throughout a building's lifecycle with the integration of flexibility and standardisation into healthcare refurbishment, this can be achieved effectively with task partitioning. This paper has acknowledged that there are barriers to task partitioning. Flexibility and standardisation strategies have been implemented globally across different sectors and industries. Refurbishment is usually undertaken to improve the current state or functionality of a building in order to extend its valuable life span. Flexible designs are intended to provide future proof solutions. This requires providing the ability to adapt to unforeseen future changes at a specific place and time. Standardisation can and should be used to improve efficiency and reduce errors, it has been implemented in many manufacturing processes such as the automobile industry, but the question is how will it impact buildings especially existing healthcare spaces?

This paper is aimed at identifying the impact of space standardisation and flexibility on healthcare refurbishment, with the view to identifying best practice and prescribing possible processes for integrating and optimising space standardisation and flexibility during the refurbishment of healthcare facilities.

KEYWORDS
flexibility; space; refurbishment; standardisation; healthcare facility.

HEALTHCARE BUILDINGS AND REFURBISHMENT: INTRODUCTION

Refurbishment can include redevelopment, renovation, reorganisation, extension, expanding, contracting or modification to suit current or future functions. This paper discusses refurbishment in the context of spaces within healthcare facilities as they house critical activities and are usually subjected to constantly and rapidly changing needs, for example the introduction of new technologies and the challenges created by an ageing and growing population. It is important to appreciate that refurbishment is different from a larger scale maintenance. Refurbishment often involves providing an ability to support new activities whereas maintenance is more about maintaining the status quo. The Joint Commission Resources Inc. (2006) stated that air quality, infection control, utility requirement or interruptions, noise, vibration and emergency procedures needs to be included with any risk assessment associated with the construction or refurbishment of healthcare facilities.

PROBLEM IDENTIFICATION

There is increased recognition that new and refurbished hospitals need to be flexible and adaptable, however, there is a large number of old hospitals in the UK which fail to meet current guidelines and standards. The state of many of the older properties can make it extremely difficult for staff to perform their tasks efficiently and effectively, thus affecting the quality of treatment and patient recovery. The Department of Health (DoH) figures shows that:

- In total, 17% of the NHS estate being used is deemed to be "not up to scratch".
- 33 hospitals have at least half of their estate below standard.
- There are more than 100 other sites - mainly community hospitals and mental health units - that have 50% or more of their estate not up to scratch.
- Part of the problem is that a large chunk of the NHS estate - nearly a fifth - dates back to before the NHS started in 1948.
- NHS estates classed as not suitable, mostly had design functionality problems.
- There are unpleasant spaces with poor space layout design, (lack of toilet, storage and suitable office spaces). "Mark Masters, the hospital's director of estates and facilities, said it means staffs are left to do their best in these circumstances" (BBC, 2010).

Although such reports need to be treated with caution due to the language being used such as "not up to scratch". What does "below standard" really mean? Were there justifiable and contextual reasons for deviation from the standards? Many standards and guidance documents are written mainly to support the design of new and refurbished facilities rather than as a tool to assess current facilities.

The need for healthcare refurbishment

The aim of refurbishment is to improve the current conditions of healthcare buildings. This can be based on the need to adapt to a rapidly changing environment, treatment, equipment, etc. With increasing concerns regarding the sustainability of existing facilities and facility whole life costs, researchers and healthcare planners are being encouraged to provide innovative means of improving these facilities. The refurbishment of healthcare buildings varies depending on the nature of the problem and the culture of responsible organisations such as NHS Trusts. Refurbishment is vital especially from a sustainability perspective; it frequently involves reconfiguring (recycling, modifying, extending, contracting and re-planning) existing spaces, meeting energy targets (carbon reduction), meeting users' needs to achieve desirable goals of healthcare facilities. Refurbishment can also be undertaken to save time and money, for example: higher fuel costs can mean that it is cheaper to refurbish a building (with double glazed windows and revolving doors) than to continue operating and maintaining it in its current state. Refurbishment is required to improve both internal and exterior elements and functions such as, indoor air quality and natural lighting. Sheth (2010a) has categorised the types of healthcare refurbishment into 3 drivers; user drivers, construction drivers and future drivers. This research has modified it as summarised in Table 1 to include space design, building structure, and facility management drivers.

Table 1: Categorisation of healthcare facility refurbishment key drivers.

Users	Space design	Building structure	Facility management	Future challenges
Infection control	Redundant spaces	Poor natural lighting	Operational cost	New treatment procedures
Improving patient privacy/dignity	Inadequate circulation	Ageing structure	Maintenance cost	New equipment
Improving quality to staff and patient	Lack of proper ventilation	Upgrading building facades	Energy consumption	Survey response
Increase in staff	Increasing communication between functional spaces	Damage to structures	Facility causing accidents	Demographic growth
User feedback	Creating natural distractions with green spaces	Structures with asbestos content	near miss (possible hazards in facility)	Competition
Introducing nursing stations closer to patients units	Improving distributed care, reduce walking	Upgrading windows (double glazing)	Change in leadership	Standardisation compliance
Patients using facility differently from how it is designed	Improving design to suit staff and elderly patients	Introducing more wash hand basins	Change in facility focus	Flexibility compliance

WHY FLEXIBILITY IN HEALTHCARE PROJECTS?

Flexibility is an alternative option, it supports buildings adapt to changes in healthcare, such as growing and ageing population, technological innovation in medical treatment and equipment. A building is able to perform effectively over the years, if it adapt to changes mentioned above. Experts' views on flexibility are listed below.

Ruwanpura et al, (2010) stated that "Hospitals are constantly under construction with ongoing renovation and expansion to accommodate new modalities, new protocol, and new technologies".

Gupta et al, (2007) stated that flexibility should be the cornerstone of the design as flexibility allows the facility to grow and expand in case of up gradation and also changes in internal functions.

Improving quality, safety and flexibility of healthcare facilities are one of the 5 Evidence Based Design (EBD) principles defined by Eileen Malone, 2007 (McCullough, 2009).

Miller, (2006) quotes Mortland stating that clinical laboratories are changing frequently; that most labs accommodate new equipment or technology frequently.

Pressler, (2006) states that a good hospital design should have an adequate amount of flexible.

McCullough, (2009) noted that future flexibility is important and essential for long term viability of healthcare institutions.

Pati and Harvey, (2010) stated that healthcare facilities more than occasionally need to be adjustable to adapt changes in operation, equipment and management.

Sheth et al, (2010) suggested that storage space, flexibility and adaptability help to make healthcare facility future proof. This could help save cost and improve quality.

Lam, (2008) was of the view that healthcare facilities have life span of 30-60 years, without design flexibility, they could be functional superseded. Flexibility has a place in healthcare centres as an influencing factor that allow hospitals to function properly over years, flexibility can be a functional declining inhibitor, that helps centres achieve their whole life cycle targets without compromising its efficiency.

LITERATURE REVIEW

Space flexibility and (changes and growth)

Lam, (2008) stated that flexibility is required due to changes or growth, which is inevitable, as hospitals are designed for a span 30-60 years and have a residual value at the end of their design life that makes refurbishment a viable and sustainable option. Also at some point in a building's life, standards and functions will change. Lam, (2008) listed flexibility drivers, this research categorised them into changes and advancement, and presented in Table 2.

Table 2: Flexibility drivers in healthcare.

Flexibility drivers	
Changes	Advancements
High density	Provision of better building performance
Special cases (epidemics)	Obsolescence and decline
Social and political issues	Advancement in medicine/equipment
Change in statutory requirements	Structural appearance

Over the years many healthcare facilities are becoming obsolescent while the life span has not reached its peak level. Due to variable demographics, cost and availability of technological hospital demands, operational and functional load requiring attention over the life span of facility, repudiating these factors in a given healthcare facility tends to reduce its life span, increase operational cost, causing early reconstruction, redevelopment and refurbishment. Adams, (2008:121) imagined that a flexible hospital could be designed today but used for an alternate operational and functional use in the future. Space for growth is one of the factors that initiates flexibility to take place in the future, Both growth and flexibility require space, but growth is considered as one of the major drivers for flexibility, it requires more space, while flexibility requires space to be organised and designed to adapt to different activities without compromising productivity or alternative to expand.

Space flexibility and forecast for uncertainties

To deal with uncertainty, the major problem is how do we forecast how healthcare facilities will operate and function in the next 10 years, 20 years or 30 years? And at what point in time will change or growth be necessary and to what extent? Another difficulty is for the healthcare facility to serve its exact purpose when the building is supposed to change in use or adapt to some specific changes. Predicting spaces that do not need to be used immediately but will be needed in the near future is another problem. When making flexible design decisions stakeholders involved should participate to achieve optimal results, as exact forecasts cannot be achieved. It is difficult to predict the future, but from past reference a clear projection can be drawn, at times healthcare facilities might need to be downsizing by offering these spaces to third parties for sub-letting. Neufville et al, (2008) reported that "it is impossible to predict future patient activity with a reasonable degree of accuracy". but Lam, (2008:43) suggested that the size of a big hospital depends on the number of beds, he also stated that in Hong Kong there is a standard of 5-6 beds per 1000 people population in a given area, this shows that the larger the population the higher number of bed required, with an estimated projection in population growth, an approximate amount of hospital beds in the near future can be specified.

Space standardisation and patient care

Designs attributed to Patient health and safety consider factors such as quality of working environment, healing environments (quality air flow, natural and artificial distractions, closeness to green environments, closeness of visitors) privacy, infection free healthcare environment. McCullough, (2009) noted that according to Eileen Malone, (2007) research was used to create healing environment using 5 Evidence Based Design (EBD) principles which included "design for maximum standardisation, future flexibility and growth". Apart from providing quality spaces that will give desirable comfort to patients, staff performance has an impact on patient care. Standardisation can help improve healthcare space to adapt to patient needs, by providing standardised procedures and guides. Standardisation can also reduce patient incidents such as falling down in the bath room, by providing handrails. A standardised space is designed so that patient can use healthcare facility with ease, it should take patient`s need and safety into consideration to improve patient care.

Space standardisation and staff performance

According to Reiling, (2007) Standardisation routine is important; it improve safety of both staff and patient. standardisation reduce the possibility of errors occurring during healthcare delivery, he also described the human brain to create patterns, which works subconsciously, standardisation helps these patterns work perfectly over time. Non standardisation leads to thinking consciously which "can lead to fatigue and human error in routine functions" also standardisation does not allow the ease to focus on imaginative problem solving. Standardisation routine or process can easily be analysed and evaluated for enhancement, hence simplification and standardisation helps ease human error. When human error is reduced in healthcare delivery, performance has been achieved. Joint Commission Resources, (2004a) states that "in the manufacturing industry, companies reduces error rates and increase productivity by standardising and simplifying" and also that "standardisation allows for the automation and predictability of many tasks so that they are unaffected by fatigue and interruptions, enabling staff to focus on clinical issues. Standardisation can help staff adapt to healthcare delivery by providing work flow delivery processes.

Impact of growth, uncertainties, patient care and staff performance on healthcare refurbishment

Literature shows that space flexibility can facilitate healthcare facility in adapting to growth and uncertainties, while space standardisation encourage and guides the ability to achieve patient care and staff performance. All these factors listed above make up the key drivers for refurbishment. Table 3 shows the relationship between space functions stated above and healthcare refurbishment. To achieve benefits of space standardisation and space flexibility they have to be implemented first. Swayne et al, (2006:413) stated that to carry out standardisation or flexibility it is vital to take into consideration the following.

- Financial resources available
- Skills
- Policies
- Human resources
- Management talent
- Facility and equipment
- Required information

Table.3: relationship between impacts of space functions and healthcare refurbishment drivers.

Space functions	Impact	Category of refurbishment driver
Space flexibility	Growth	Future challenges
Space flexibility	Uncertainties	Future challenges
Space standardisation	Staff performance	Users
Space standardisation	Patient care	Users

RESEARCH METHODOLOGY

Literature searched involved the use of both online and offline publications to gather information on flexibility and standardisation in healthcare facilities. More than 25 papers relating to space, flexibility, standardisation and healthcare were reviewed and analysed. Keywords such as healthcare staff, patient, flexible spaces, refurbishment, standardisation in healthcare were used to find relevant publication. Literature review helped in identifying healthcare drivers for space flexibility, space standardisation and refurbishment that was used to develop a framework relating all the three functions together, categorising them into three different phases, this can be found in figure 3 below.

Primary data collection

Questionnaire was distributed to a group of professionals that included architects, healthcare planners and project managers. Respondents came from different parts of the world comprising UK, Europe, North America, Africa, the Far East and the Middle East, Figures 1 and 2 shows demographics of the questionnaire respondents. Respondents were asked to indicate whether they agree or not with certain issues regarding space standardisation and space flexibility. Ranging from "strongly agreed", "agreed", "not sure", "disagree" and "strongly disagree", these were rated from 1-5 (strongly disagree-strongly agree) respectively. Questions were distributed via e-mail

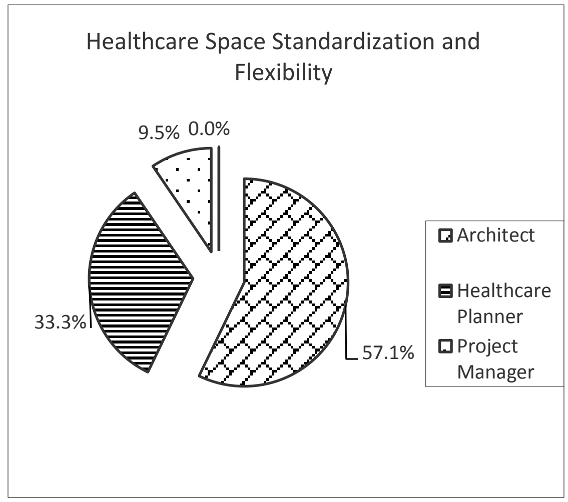

Figure.1: Professionals involved in questionnaire survey.

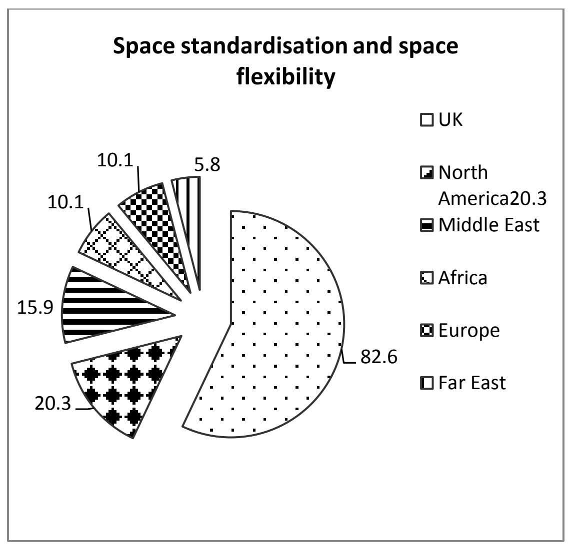

Figure 2: Location of professionals involved in questionnaire survey.

DISCUSSION ON FINDINGS

Due to the importance of both space flexibility and space standardisation on healthcare staff and patient, it is crucial they are applied during refurbishments. Sheth, (2010) categorised refurbishment into 4 levels which includes; 1) "Do nothing", 2) Interior works, 3) Exterior works, 4) Demolish. Flexibility and standardisation can take place at different phases of refurbishment, which includes minor, average and major refurbishment, putting limitation of refurbishment into consideration, such as budgets, constraints of existing structures and functions, certain flexibility concept can be applied at specific time and places to achieve specific type of flexibilities. Figure.3 proposes a possible relationship between refurbishment and both space functions identified in this research. Effective implementation of this strategic innovation can be facilitated by the concept of task partitioning. Von Hippel (1990) stated that "An innovation project of any magnitude is divided up ("partitioned") into a number of tasks and subtasks that may then be distributed among a number of individuals, and perhaps among a number of firms". He also stated that most problems can be resolved by decomposing them to tasks and reducing the cost involved with cross boundary problem solving. Tasks for both space functions at different refurbishment phases can be assigned to different individuals or firms. Task partitioning simplifies the whole process of integration in this paper by dividing and breaking down goals into targets that are easily achievable.

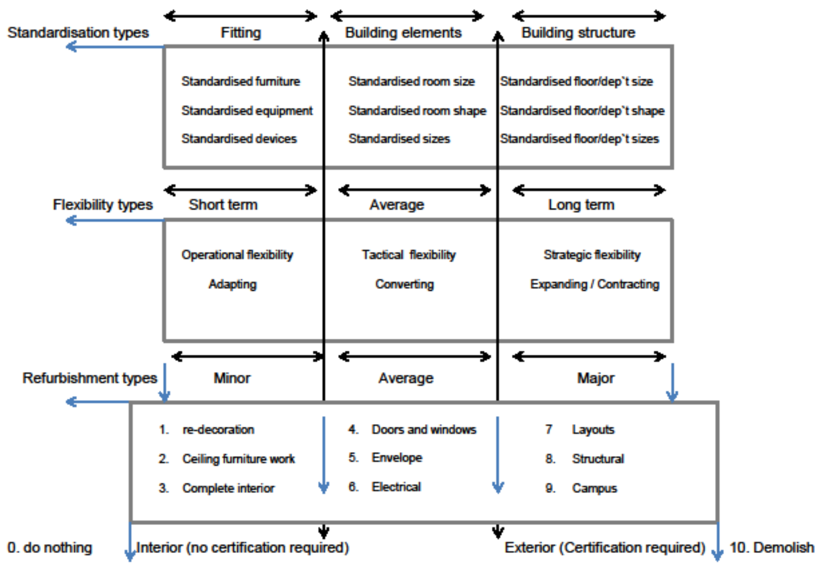

Figure 3: Proposed relationship between refurbishment and both space functions.

During the standardisation process, existing structures does affects the design brief, for instance a brief with a 100 percent single room target, might achieve 75 percent or 50 percent, this varies depending on the context, nature of existing structures and laid down standards involved in the type, location and need of projects, hence standards may vary, depending on their respective nature. Diversity in flexibility is expensive a time, as the more the space, the more the cost associated to flexible spaces. An innovative trend is to use spaces that expand and contracts back to their original size and shape after providing required services. Another major issue is how much flexibility is needed in a healthcare facility?

FINDINGS

Points to consider for space standardisation, space flexibility and refurbishment in healthcare facilities

It is vital to consider user participation in developing space standards for patient, visitors and other healthcare users. Facility users such as patients tend to use a facility different from how it is been designed to functions, there is a patient motive to always use a facility in a way they find ease and simplicity. Hence space standardisations should be simple, precise, concise and user friendly. Most respondents identified that clinical areas are more suited for space standardisation, it is still unclear if healthcare designers and planners can consider standardisation in an entire building, due to its rigidity, and the nature of existing structures.

The questionnaire used in this research showed Design brief to be the most important tool for achieving space flexibility, as other tools such as Health Building Notes, Activity DataBase gives information to choose from, while a Design Brief tells you exactly what is needed, but on the other hand it does not tell you how to achieve the brief aims, which is a major problem of depending entirely on the design brief. Questionnaire respondents also suggested healthcare designers to consider furniture flexibility and equipment flexibility while dealing with space flexibility, as space could change by converting, expanding, contract or adapting to changes when flexible process are taken place, this could affect furniture and equipment positioning and ease of use. Flexibility is considered to be expensive due to failure to link first building cost with building lifecycle cost in the initial stage of building design, construction and facility management phase.

During refurbishment, lack of flexibility affects the building process, while hospitals are still operational, it has been noticed by the questionnaire respondent that there is always lack of alternatives spaces to move entire patient and staff while current used spaces are under construction, refurbishment in this scenario can affects healthcare delivery processes.

QUESTIONNAIRE FINDINGS AND DECISION MAKING DURING REFURBISHMENT

The questionnaire findings can improve decision making during refurbishment, by specifying where best space standardisation and flexibility are more effective and efficient, Figure 3 shows relationship between types of (refurbishment and space functions used in this research), Figure 3 can also be used as a map, to decide where and when to introduce space standardisation and space flexibility best. These findings should be considered when refurbishment is taken place, as stated before, for a successful refurbishment, a facility has to be developed, improved, re-planned to solve major problems relating to sustainability, such as energy consumption, reducing facility management cost, improve users' needs, accommodating advancements in healthcare delivery and also natural ventilation and lighting.

Findings show that it is feasible to implement flexibility in the long term. Flexibility is linked with major refurbishments in Figure.1. Flexibility, in the opinion of the respondents should be introduced at long term basis in regards to room / ward / department / building / site levels, their responses showed that in three different cases, flexibility should be applied at long term basis. This gives an opportunity to in-cooperate it into building refurbishment. When making refurbishment decisions, it is effective to plan for long term flexibility during major refurbishments. Questionnaire results from three different questions was put together to compare and analyse the best time for flexibility impact in healthcare buildings, as this will help in decision making during refurbishments. Respondents were asked to indicate whether they agree or not that it is easy to implement cost effective space flexibility at three different places, identified as A-(building /site level), B-(specific area/room level) and C-(ward/department level) in healthcare design. At A, out of 70 respondents 48 answered and 22 skipped, at B, out of 70 respondents, 48 answered and 22 skipped. At C, out of 70 respondents, 48 answered and 22 skipped. Figure 4 shows the findings from A, B and C.

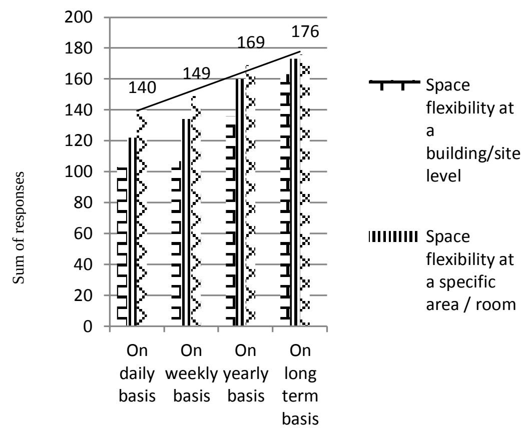

Figure 4: Questionnaire responses: Impact of space flexibility at three different places.

It is important to introduce space standardisation into refurbishment as staff efficiency and patient safety are one of the main key drivers initiating standardisation in healthcare. This was described and presented in Figure 5 below. Questionnaire respondents were asked to indicate whether they agree or not that the following are key drivers to achieving space standardisation. Out of 70 respondents, 56 answered this questions and 14 skipped. Space standardisation had a good impact on patient safety and staff efficiency according to the opinion of the respondents

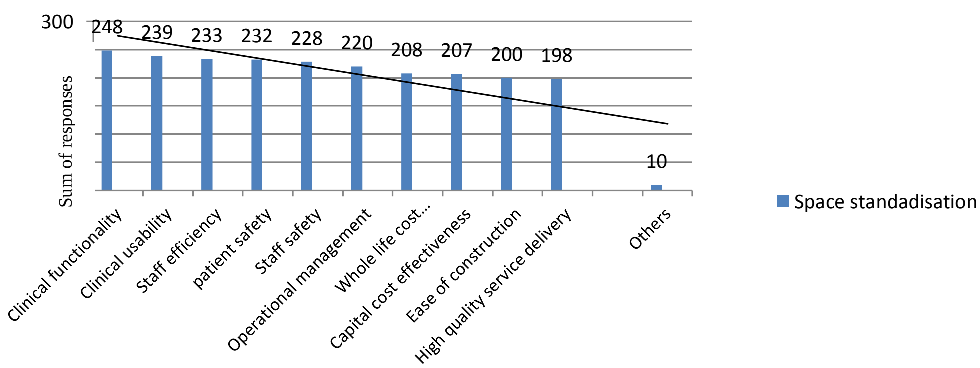

Figure.5: Questionnaire responses: Key drivers for space standardisation.

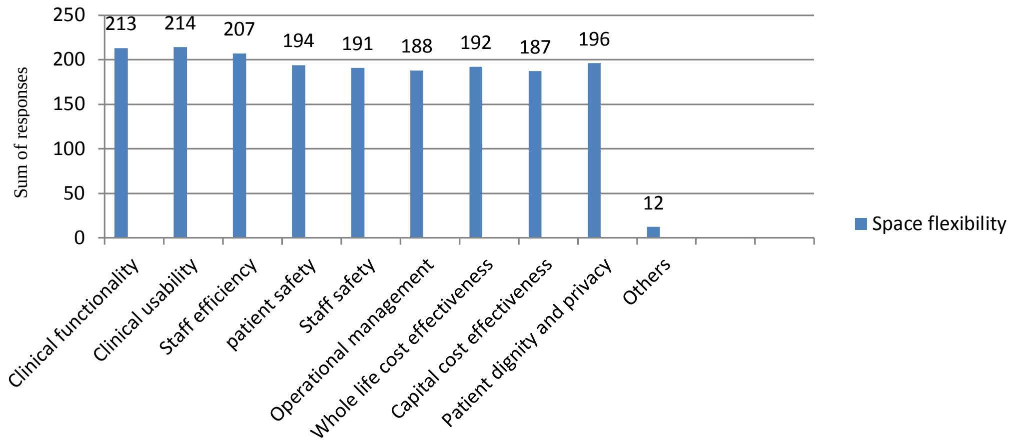

Figure 6: Questionnaire response: Key drivers for space flexibility.

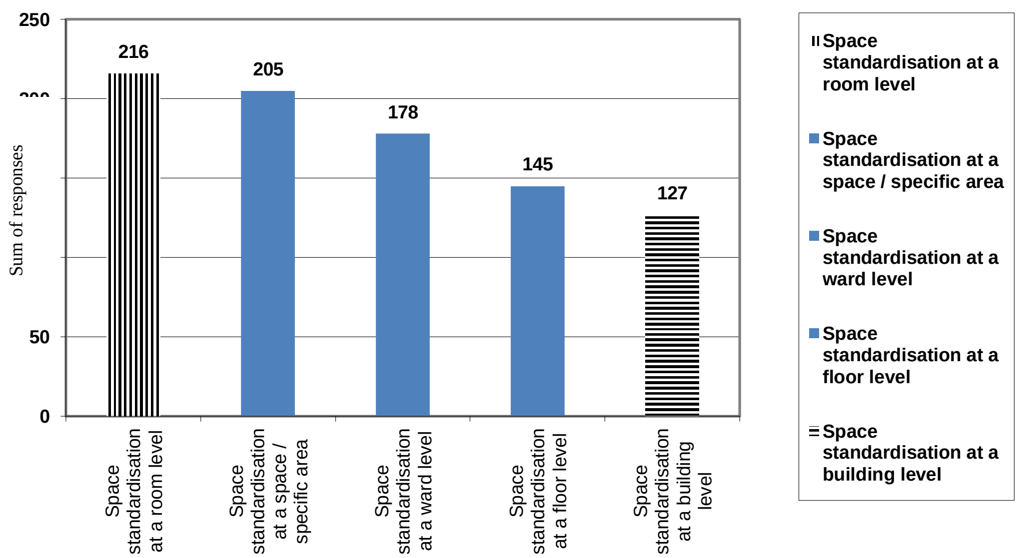

Figure 7: Questionnaire response: Best standard space/unit in healthcare buildings.

Figure 5 and Figure 6 shows key drivers for both space flexibility and space standardisation in healthcare facilities. Respondents were asked to please indicate whether they agree or not that the following are key drivers to achieving space flexibility? Out of 70 respondents 49 answered and 21 skipped. Clinical functionality and usability with staff efficiency were essentials in the design of healthcare spaces in the opinion of the respondents.

Figure 7 shows questionnaire response. Respondents were asked to choose the best type of standardised function. Out of 70 respondents 57 answered and 13 skipped. It was identified by the respondents that standardisation is easier to implement at room level. When refurbishment is taking place, rooms can be standardised to achieve optimum healthcare outcomes. Joint Commission Resources (2004) Environment of Care, (2004) stated that "standardisation of treatment areas, room layout, and medical equipment supplies provide flexibility to accommodate changing patient care needs"

CONCLUSION

Table 3 and 6 shows the relationship between refurbishment and (space standardisation and space flexibility) having similar key drivers, if both space functions are achieved, quality of refurbishment will be enhanced. Refurbishment as already stated is carried out to improve current situation of a building structure, accommodating changes and advancement in technology and method of healthcare treatment and delivery. Introducing questionnaire findings into healthcare refurbishment can help to achieve optimum results worthwhile. Questionnaire key findings were; 1) With regards to space standardisation, standardised rooms were noted to

Table4: Relationship between key drivers for refurbishment and ones for (space flexibility and space standardisation).

Refurbishment drivers category	Space flexibility drivers	Space standardisation drivers
Users	Staff safety Patient safety	Staff safety Patient safety
Space design	Patient dignity and privacy	-
Building structure	Whole life cost effectiveness	Whole life cost effectiveness Ease of construction
Facility management	Clinical usability Clinical functionality Operational management Capital cost effectiveness	Clinical usability Clinical functionality Operational management Capital cost effectiveness
Future challenges	Consistency of: Staff efficiency	High quality service delivery Staff efficiency

be the most effective standardised unit in a healthcare facility in the opinion of the questionnaire respondents, in Figure 3, standardisation can be better achieved in healthcare refurbishment, if "standardised rooms" are used at the level (average) of refurbishment, which focuses on building elements such as doors and windows, with the ability to allow conversions to take place. 2) With regards to space flexibility, applying flexibility at long term was suggested to be the most effective opportunity to achieve it in healthcare space / rooms / ward / department or any other specific unit in the opinion of questionnaire respondents, in Figure 3, flexibility can be better achieved in healthcare refurbishment, if "long term flexibility" is applied at the level (major) of refurbishment, were structural expansion and contraction is involved.

The implementation of space standardisation and space flexibility in healthcare refurbishment can be simplified by tasks partitioning, stakeholders involved in the design, construction, and facility management of healthcare facility should collaborate and divide this goal into simpler and achievable targets to facilitate integration. This research has identified a gap that further research can improve on.

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A Built Example of a Low-Cost Adaptable Building

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ABSTRACT
Öppen is a building system. Using experience from the retail, office and university research laboratory sectors, and from extensive involvement in forensic construction technology, Öppen has been designed as a lean and open-building system. The system delivers a high quality, adaptable building that can be constructed in about half the time and at about 20% lower cost than a traditional building. The first built project using the concept has now been in use for four years. The second and third will be completed by early 2012.

Öppen separates the construction into three parts: the skeleton, which is engineered to be quick and simple to build; the skin, designed to suit the context and the client's aesthetic wishes; and the interior fit-out and mechanical, electrical and plumbing services which have to suit the occupiers' needs.

It is within the skill set of a competent architect to design either a fully adaptable building or a very cheap building. Öppen benefits from hard won experience of what the market demands when balancing adaptability against cost. Öppen delivers sufficient savings to be of considerable interest to the funder, and sufficient improvements in adaptability to be of benefit to the users.

KEYWORDS
adaptable, lean, fast, system-build, Öppen.

INTRODUCTION and CONTEXT

If anything could be learnt from the UK's construction boom of the last decade, it is the folly of constructing expensive buildings that quickly become out of date: perhaps this largesse was possible as a result of a surplus of funding and consequently an inadequate need to economise.

The financial crisis, the change of UK government and the urgent need to reduce capital expenditure have led to a great impetus to reduce the cost of building projects, particularly where public money is being spent. In the private sector, where property values have dropped substantially, the challenges are just as severe: unless construction-related costs drop by at least an equal proportion, projects will not proceed.

In the UK, the 'James Review of Education Capital'1, has called for a rapid move to standardised school buildings that are both economical and adaptable. This is not new thinking: in response to the post-war school building boom, a consortium of local authorities developed CLASP, a system of building for schools. This was used extensively throughout the boom of the 50s, 60s and 70s, then dropped in favour of bespoke designs, leading ultimately to the excesses of the Building Schools for the Future programme from 2003 to 2010, before it was terminated by the current administration in 2011.

The transferability of this thinking is not lost on other sectors such as the National Health Service: like schools, health sector buildings are publicly funded and need to accommodate frequent change. In July 2011, UK Paymaster General, Francis Maude MP, announced the government's strategy to cut 20% off hospital building costs, achieved by building 'sheds around people and equipment that can be reconfigured very quickly as needs change'2.

In synopsis, for all publicly funded buildings, there is government pressure to reduce construction costs by a significant amount. In the private sector, the challenge is the same but for different reasons. Here the rents, prices and yields of commercial property have crashed. In order to keep the value to cost equation positive, construction costs have to be cut by at least as much as the reduction in value. In all sectors, there is considerable drive to reduce delivery time. This can be to diminish the time lag before receiving a return on investment, or reduce disruption on a busy estate.

RESPONSE

Introduction

Öppen is a building system intended to respond to the challenges of achieving greater economy and improved adaptability whilst maintaining a high quality product that is institutionally acceptable to UK property investors.

Architectural background

Architects have designed many buildings that include added sophistication to make them adaptable throughout their life – this almost always adds cost. For example, the recent brief for a university research building required any floor to be removable in case research projects needed to occupy a double height space. The architect and engineer's response was to design a frame that was strong enough to meet the client's brief. When found to be unaffordable, the client accepted that removing a floor was likely to be a rare requirement. On this basis it was determined that the extra cost of providing the necessary redundancy in the frame exceeded the cost of adapting the frame if and when a double height space was required. After six years in use, no such requirement has been forthcoming.

Architects have also designed very cheap buildings – this usually reduces long-term value and often reduces lifespan. For example, a major UK commercial developer close to Oxford, UK had demand for accommodation but found that using

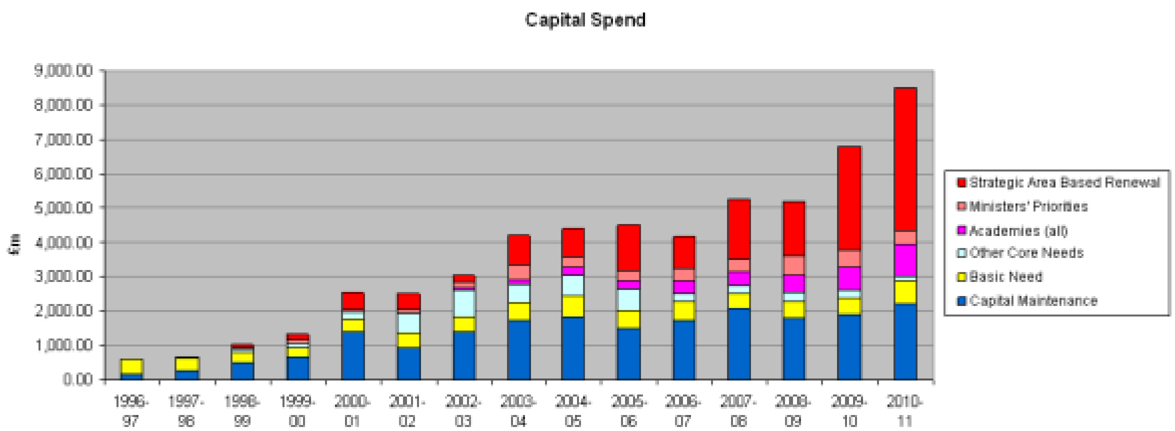

Figure 1: UK Government Education Department capital spend, from James Review

traditional construction methods and costs, the development appraisal did not stack up. The architect revised the design to make the buildings lightweight and sufficiently low cost to be viable. The accommodation was built and occupied. However, after a few years, the appearance of the buildings began to deteriorate resulting in high on-going maintenance costs.

Using experience gained on many commercial projects, Öppen has achieved both improved long-term adaptability and reduced cost, without sacrificing quality and durability.

Origin of Öppen

In 2006, following a study tour to inspect newly constructed university laboratories in California, Stubbs Rich were commissioned to design two research laboratories for a leading UK university. These laboratories were designed to be fully adaptable based on the knowledge that scientific research progresses continually, and that accommodating this rapid change needs to be facilitated within the design. The brief required an economical build cost and a laboratory design that would readily enable internal changes to take place as scientific research progresses. At the outset, it was anticipated the laboratories might be used for material science and engineering research.

The research laboratories, now in use, have proved to be as adaptable in use as was planned and house many activities that were not initially contemplated in 2006, including: a data centre; environmental and Cat. 2 wet and dry labs; hydrogen powered engine r&d; robot controlled vehicle r&d; clinical genetics r&d; and accommodation for 20 independent university spin-off businesses.

The university's business plan anticipated full occupancy might take three years – however, it was achieved within one year and the buildings have remained more or less fully occupied ever since, with only short void periods. Face-to-face research with the tenants has identified a high level of satisfaction with the building. The university's management team are equally satisfied and frequently promote the benefits of the project's economy and adaptability to other universities.

During the design and implementation of the fit-out works, many aspects of the shell (or support, the shell being the skeleton and skin) design were found to work well and to be every bit as adaptable as expected. However, ways to further improve other aspects of the design were identified and have been incorporated into the developed Öppen design. These design developments will be implemented in subsequent projects.

Following on from the completion of this initial university building, a research project was undertaken at the University of the West of England3. This research tried to identify what students and academics valued about the university buildings in which they studied and worked. Four buildings were chosen which had had very different construction budgets. When the responses were analysed, it was found that the quality of the teaching space and the facilities interested the users most, whereas the type of construction and external appearance had little impact. This suggested that it might be beneficial to rebalance the budget away from expenditure on the building shell and towards expenditure on the fixtures, fittings and equipment. This is a move away from those aspects which are of interest to property-focused people (clients, architects etc) and towards aspects of interest to users. This research pre-dated by two years the demands now being made by the UK government to cut the cost of school and health buildings and to focus investment on the fit-out and equipment 1,2.

EXPLANATION OF THE CONCEPT

In line with open-building thinking, Öppen separates the construction into three components:

1) the skeleton, which is engineered to be quick and simple to build. It is anticipated that the skeleton will never be changed. As part of the base-build works, the mechanical/electrical/

plumbing (MEP), in-coming services are connected to the building and terminated;
2) the skin, which has to suit the location and the client's aesthetic wishes. It is anticipated that the skin may occasionally be altered as the needs of occupier changes – extra windows and doors, the need for a refreshed corporate style; and
3) the interior fit-out and MEP services, both of which have to suit the occupier's needs. The fit-out and MEP services will inevitably change fairly frequently throughout the life of the building. Accommodating such changes is one of the system's strengths. As part of the design development of the system, straightforward ways of providing the services systems have been developed (heating, ventilation, cooling, plumbing, drainage, lighting, power, alarms, data). Ease of adaption has been achieved by providing a raised access floor, and by having a completely flat soffit. If required, sub-metering can be provided for sub-tenants.

Öppen's three components are differentiated by their life-expectancy: indefinite life (more than 50 years) for the skeleton; about 25 years for the skin; and 5-10 years or less for the fit-out and MEP services.

Throughout the design of Öppen, the two key questions have been: first, how much of the construction is in the base-build and how much is left for the fit-out; and second, what initial provision should be made to facilitate future flexibility? Experience has provided the answers, the response being the same to both questions: provide nothing additional to facilitate the future; reduce provision back to the point where all outcomes are equally achievable. This has a major benefit: it reduces cost as there is little redundant provision. We see this as zero-cost future-proofing.

Intentionally, the concept can only be applied to mid-range, mass-market buildings: up to four storeys and free-standing, where suitable dimensions are a depth of up to 15m (49ft) and a width made up of a multiple of 7.2m (23ft) bays. It is a building for 'everyday' uses – offices, universities, colleges, hospitals, schools. It may not be for owner-occupiers who want to stamp their personality on the design and want an iconic or quirky building, but is perfect in the new context of global frugality.

Figure 2: The skeleton, the skin and the fit-out

Designing using Öppen can be compared to choosing a mass-market new car. It is a body shell – highly engineered and fit-for-purpose, of no interest to the users but necessary; plus the external appearance – eye-catching and image building; and plus the interior – functional, enjoyable and tactile. To the car buyer it is the appearance and functionality that are of interest: perhaps it is only automotive engineers who are interested in the design of the body shell. The same is probably true of a building: only the architect, engineer and constructor are interested in how it was built, whereas all the users want to know is 'how does it look and what does it do for me?'

A further challenge was to determine the separation point between the three elements, and then how to design the skeleton such that it could readily accommodate an acceptable range of skins and fit-outs. There is an inevitable trade-off between flexibility and economy. Practical experience has aided determining where the balance point lies: providing either more or less flexibility would diminish the market's interest – the former as a result of the loss of price advantage, the latter as a result of an unacceptably repetitive appearance.

Finding the base-build to fit-out balance within the MEP design has also been a particular difficultly. Experience has shown that in the UK market, an economical heating system for this type of building will be either low pressure hot water with panel radiators and natural ventilation, or alternatively, heating/cooling and ventilation through a four-pipe fan coil unit. Öppen has been designed to accommodate either system but provides neither as part of the base-build. All that is provided is sufficient incoming power supply and a simple strategy for providing either installation as part of the occupier's fit-out. The approach to the design of the electrical installation is similar: a sufficient incoming power supply and a simple distribution strategy, in this case a raised access floor. The strategy for the plumbing is to co-locate all vertical services around a single riser. It is possible that by using a newly designed system, activities requiring water and waste connections could be located anywhere on the floor.

A derivative of Öppen has been developed for highly serviced laboratory buildings where it is necessary to provide an adaptable way to accommodate large diameter ductwork.

Features of the Öppen skeleton
The frame is constructed of hot-rolled steel in order to achieve a quick assembly on site. The frame design can support a building of up to four storeys.

The floors are pre-cast concrete planks. These are not necessarily the most economical way of constructing a floor but have the benefit of not requiring propping or a curing / drying period. Levelling is achieved with the use of a raised access floor as part of the fit-out.

The roof is of the same construction as the floors but is sloping to facilitate rainwater collection.

The exterior walls are constructed of flat panels ready to receive insulation and any style of rain screen cladding (from lightweight flat panels to terracotta tiles or brick) and to support the curtain wall glazing.

The foundations are designed to suit the site conditions. It is envisaged that with experience standardised foundation design might be possible.

The entire MEP installation, from the point at which the incoming services are terminated, is part of the fit-out. The skeleton build provides incoming service supplies and below ground drainage for rainwater and waste pipes. The rainwater collection is at the perimeter. Below ground waste pipes are in predetermined locations at the base of a vertical riser which is always co-located with the stairs and lift.

Benefits of Öppen
1) Predictable outcome – for the client, this concept converts procuring a building from a complex purchase (select an architect on the basis of their promise to design the desired building within the available time and budget) into the simple purchase of a pre-engineered product with an options list, having a predictable cost and construction time.

2) Reliable performance – most buildings are effectively prototypes with no product development (design one, build one). Öppen is repeatable (design one, build many) so reliability can be improved through learning.

3) Institutionally acceptable – in the UK, the majority of commercial buildings are owned by banks and funds as investors. This has led to the standardisation of specifications which are acceptable to investors. Öppen, while being innovative, fully meets the expectations of investors.

4) Durable – unlike many fast construction, low cost buildings, which are typically lightweight, projects designed using Öppen are intentionally robust and heavyweight, in order to withstand heavy use.

5) Adaptable – this has to be one of the most valuable attributes of any building, an ability to accept change without major structural alterations. A project based on Öppen is highly adaptable as a result of the lack of central columns, flat soffit and the raised access floor to all areas. Adaptations to the services installations being made wholly within that tenancy, rather than within the floor or ceiling of another space. The concrete roof slab means it is able to support roof-mounted plant.

6) Affordable – using Öppen produces buildings that cost approximately 20% less than a conventional building of the same quality. With experience, it is anticipated that further cost reductions will be achieved through reductions in time and waste.

7) Value for the users – through achieving economy in the expensive elements: the structure, roof, cladding and glazing, there can be more of the budget available to focus on the aspects from which the users gain most value: furniture, fittings and equipment.

8) Quick to build – the time on site for a building designed utilising Öppen is approximately 50% of that for a traditional building. This is of considerable advantage in reducing disruption, foreshortening the period between investment and benefit, and bringing the facility into use quickly. The components needed to build the skeleton are the same for all projects utilising Öppen, and with a rolling programme it would be possible to produce components ahead of demand, so that that they could be supplied on demand.

9) Sustainable – through achieving the desired result with less material, through improved insulation and air-tightness, and through exposed concrete soffits for summer-time free cooling. As this is a standardised skeleton design, the components could be dismantled and re-used, which is better for the environment than crude recycling.

10) A building system which offers a one-off, customised exterior and interior – a new building is a major investment for most organisations; the design of almost every building needs to satisfy the client's ego to some extent. Öppen allows the client to choose the external appearance and the internal finishes. It will not look like a cheap, repetitive, system-built structure.

11) Open system – Öppen could be used under licence by any designer trained to use the system. The fundamental aspect of Öppen is the design of the skeleton, the part that must work but no-one sees. As Öppen enables many external

appearances and internal layouts, and both speeds work and reduces risk for the designer, it should be of considerable interest across the industry. Any contractor with training could construct the system. The training is required so that designers and constructors alike understand how to work with the system to ensure that its full benefits are achieved.

12) Open source – Öppen uses materials that are widely available: hot-rolled steel, precast concrete, rain-screen cladding, glass. None are only available from a single source. All of the components are currently in use in the construction industry and are tried and tested. This ensures keen and competitive pricing.

Practical experience
Stubbs Rich, the architects who have designed Öppen, have used lessons learnt in several sectors from their own experience in practice. From the retail sector, they have learnt that substantial cost reductions can be achieved through innovative methods of design and procurement. From the research laboratory sector they have learnt that changes to the internal layout need to be made frequently and also that it is the adaption of MEP services that poses the greatest challenge. From the office sector they have learnt that good quality is important and that buildings need to be constructed quickly in order to meet immediate business needs. Therefore, the aim was for Öppen to deliver adaptable, low cost, high quality accommodation that could be built quickly.

The first commission applying this thinking has now successfully been in use since 2007 as two adaptable research laboratories for a UK university.

At the end of 2010, a commercial developer came forward with the need to build a new office building but with insufficient funding to do so within the traditional cost parameters. Having worked with Stubbs Rich successfully in the past, the client was willing to consider a new approach. The building now has an occupier and should be complete in early 2012.

Figure 3: Upper floor plan of the new office building using Öppen

The plan is 15m (49ft) deep and made up of eight 7.2m (23ft) wide bays. These standard Öppen bay dimensions (15m x 7.2m) suit most of the anticipated uses to which the system might be put. There is no central row of columns, this is to optimise the initial use and improve future adaptability. The creation of openings in the floor is expensive on any project (due to the need to introduce trimming steel or additional reinforcement), therefore the internal layout is designed around the co-location of stairs, lift and one vertical services riser. If subsequently additional vertical risers are needed, they can be constructed outside the footprint of the building to avoid having to perforate the concrete floor planks.

The height from finished floor to soffit is 3m (9ft 9in). This is driven by the tried and tested single-sided ventilation height to width ratio of 1 to 2.5. The raised access floor allows easy distribution of services. The exposed concrete soffit provides thermal mass for passive cooling.

The external appearance of this project is typical of that found on many UK business parks. This aesthetic suits the professional services firm who might occupy the building.

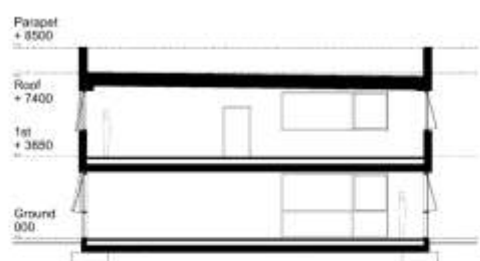

Figure 4: Cross-section through the new office building using Öppen

Figure 5: Image of the new office building using Öppen

Further examples of projects using Öppen
Since designing the new office building described above, the Öppen system has been applied to designing other buildings.

Figure 6: Image of a new single storey, timber-clad university library building.


Figure 7: Image of a new stone-clad prestige office building.


Figure 8: Image of a new brick-clad hospital administration building. Due to be occupied April 2012.

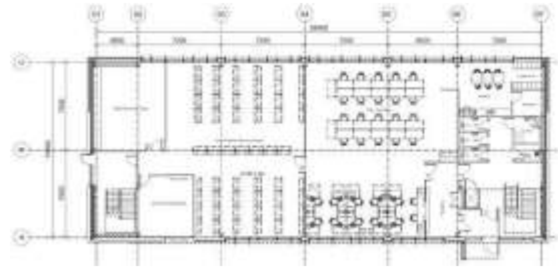
Figure 9:Ground floor plan of admin building

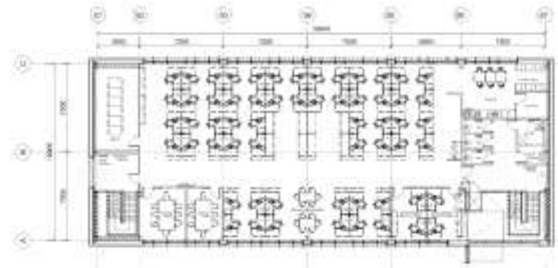
Figure 10: First floor plan of admin building

PROPOSITION
The design of Öppen brings together three strands of thinking:

- open-building – delivering future adaptability which is real future-proofing.
- lean design and construction – delivering economy and speed.
- demand for frugality – delivering a product that combines 'open' and 'lean' in a design that meets the 'more-for-less' or the 'better, quicker, cheaper' desire of the mass-market.

The commercial arrangements make Öppen scalable:

- a licensed design so that many people could use it, it is an open system.
- a design that uses widely available materials, it is open-source.
- it is of benefit to all architects as they would have less design work to do and so could concentrate on the external appearance and the internal layout, the aspects users and architects care about.

The timing of the development of Öppen is ideal:

- the tight supply of money in the economy means that new, more economical, ways of delivering buildings need to be found.
- the focus on the environment encourages thinking about reducing embodied energy and energy in use.
- the less frenetic pace in the UK construction industry during the recession allows people time to consider new ideas.

Experience of presenting Öppen has shown that not everyone understands:

- some deny the industry has a problem: that difficulties are the nature of the beast.
- some less experienced players assume their bad experiences are a function of their lack of experience: they are just going through a challenging and unpleasant learning curve.
- it is experienced consultants, clients and constructors who quickly acknowledge that the UK construction industry, from beginning to end, is often flawed and that this concept is a novel way to overcome some of the major systemic problems.

Why has this not happened before?

- perhaps because clients do not understand that the implication of writing a brief in very great detail is that when their needs inevitably change within a short period, the bespoke building may not readily meet their new requirements.
- perhaps because clients do not understand that the implication of writing into a brief the requirement to accommodate possible future scenarios is that the cost will increase.
- perhaps because architects enjoy responding to the challenge of a detailed brief and have not encouraged their clients to adopt an alternative strategy, which is to explain that change will happen in their organisation and the brief should simply demand adaptable space.
- perhaps because other economical system-buildings often appear to be cheap, repetitive and flimsy – and this is not the impression most people commissioning a new building want.
- perhaps because sophisticated adaptable designs have historically been too expensive because they enable too much choice.
- however in some construction sectors in the UK, standardisation has already happened. The design of large industrial warehouses is probably at a stage where they are already ‘open’ and ‘lean’. Also, in retail malls, the individual retail units are similarly already ‘open’ and ‘lean’.

The future:

- in other sectors, industrialisation has led to being able to deliver more for less. It has also resulted in choice being reduced to selecting from a wide, but not infinite, range of products. It seems likely that buildings designed using Öppen could initiate a separation between owner-occupiers who want to make a bold statement with a unique building, and others for whom their accommodation needs to be good enough but does not need to be flamboyant.
- a laboratory derivative has already been mentioned. Now that the nature of the problem has been understood and a strategic response developed, derivatives will be designed to reflect the specific needs of other sectors.
- through application of Öppen, continual incremental improvements will be made.

Wider application:

- Öppen responds to a set of problems that exist in the UK (high cost, slow delivery, one-off designs, blame and risk transfer, defects). It is believed that in other markets, some of the UK’s problems may have already been addressed.
- Öppen uses materials and forms of construction that are common and economical in the UK and may not be equally effective in other countries.
- the strategic thinking is completely transferrable.

Intellectual property:

- the design is copyright.
- aspects of the design are patent pending in the UK.
- licences to use the IP are available.

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Strategy of Old Community Regeneration in China

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ABSTRACT:
Community renovation in China has become an important part of urban construction, and also an effective way to solve the housing problem of low-income families. Based on the investigation of practical cases, this paper summarizes the strategies of old community regeneration under the specific condition of China from the following aspects: updating single residential buildings, optimizing open space, continuing urban context and applying energy-saving technology. Then this paper points out the practical significance of Chinese renovation approaches and the real problems faced in China. Finally, this paper suggests that policy-orientation and government support are the important guarantees for the success of sustainable regeneration.

KEYWORDS:
Strategy Community Regeneration China

INTRODUCTION

In the 1980s, China built a huge number of communities - about 150,320,000 square meters per year and nearly 10 times than that before 1979 - which made outstanding contributions to the improvement of urban landscape and living conditions of urban residents. Thirty years later, according to standards of today, these buildings has been far from satisfying the needs of contemporary life, in the aspects of living function, living environment and energy saving. There are many contradictions between material form, value orientation and living behavior. Therefore, many high-income residents moved to a new home, low-income residents and a larger proportion of older persons still lived in these old communities. "Model" communities before gradually degenerated into old buildings lack of management. How to properly deal with this phenomenon has become a common problem that the city must face.

STRATEGY FOR COMMUNITY REGENERATION

In the past, China generally took "big demolition and big reconstruction" approach for old communities and this approach caused many problems: firstly, not able to afford high price of new homes, most residents had to move to communities far away and new low-income communities were formed; secondly, original urban fabric have formed by years was erased instantly, which is not conducive to the continuity of urban morphology and culture; thirdly, in this process a large number of construction waste were produced and a large number of social resources were re-consumed. In contrast, many European countries have adopted a "cautious update" approach for old communities to avoid massive destruction brought about by the former. Today, China is actively exploring a variety of protective way to obtain communities regeneration.

Update of Single Residential Buildings

Everyday, update of single residential building can be seen everywhere in China, which shows the growth of urban. How to adapt old buildings to new requirements through their own improvement should be emphasized.

Figure 1 : The flat to sloping roof program benefits lots residents of old communities.

Renovation of Building and Facilities

Most housing roof of the 1980s is poor in preventing seepage. Under the permission of structure, the original flat roof are reconstructed to sloping roof - so-called "flat to sloping roof" program - which not only solves the problem of roof seepage, but also reach the purpose of heat insulation. Exterior surface of the wall are renovated not only to solve the weathering phenomena, but also improve residential quality and visual appearance. Because this kind of regeneration can be operated easily and have better effect, it open up the idea of old community regeneration in China.

The renovation of interior public space includes repairing or replacing corrupted handrail, increasing low handrails for children, increasing accessibility design, lighting design and ventilation design. In addition, without elevator most housing of the 1980s can not meet the requirements of current residential standard, therefore the addition of elevators has become one part of renovation. Because external conditions are complex, the renovation of aged pipeline facilities should be integrated with the actual situation fully. For example, UPVC pipes are used as drainage leaning on the outside of kitchen or bathroom wall, and tube wells are added on the landing, which not only facilitate equipment maintenance, but also do not occupy indoor space and get more space for residents. The renovation of pipeline facilities requires strong technicality and spends lot.

Figure 2: The renovation of bathroom for elderly households

Increasing Area and Optimizing Space

Most housing of the 1980s is small in size and single-type. The construction area of 70% units is less than 70 square meters. “Combine units” and extension are two ways to increase the floor area of one household. “Combine units” mean to combine adjacent units, which involves adjustment of property rights and resettlement of households, so it is very difficult now. Extension increases living space by sticking on the wall or the roof on condition that ensure sunshine standards. This renovation way is simple and easy which can improve housing requirements of all community households using less investment. To reduce the impact to the living of residents, prefabricated component and on-site assembly should be taken as far as possibly, which is also a good way to reduce the cost of renovation.

Small area and dysfunction are the core issue for kitchen and bathroom of old housing. The renovation try to adjust and optimize these function spaces. For kitchen space, smoke-free stoves are set to improve the cooking fume pollution; flues are placed outdoors to leave interior space. At the same time, in order to obtain larger and more completed space, the balcony area is changed to kitchen, original kitchen location is changed to dinning hall, and redundant walls are removed to form DK-type kitchen. For elderly households, besides the renovation way mentioned above shower chair, handrails and alarm are set in bathroom.

Practice Case 1 - Staff Apartments Renovation Project in Sichuan People's Hospital

Staff apartments of Sichuan People's Hospital were built in 1984. Because these apartments could not meet the requirements of residents with the change of living standard and lifestyle, the hospital decided to carry out renovation. The main renovation approaches were opening up the original kitchen, bathroom and the little hall to form a bigger space, which was used as living room, and adding new restaurant, kitchen and bathroom as extension. After the renovation, the construction area of each unit increased about 22 square meters.

Optimization and Integration of Open Space

Many old communities are lack of public open space and large-scale green space. Residents desire for more exercise yard and communication space. Therefore, with the existing environmental conditions, update the open space of old communities is necessary.

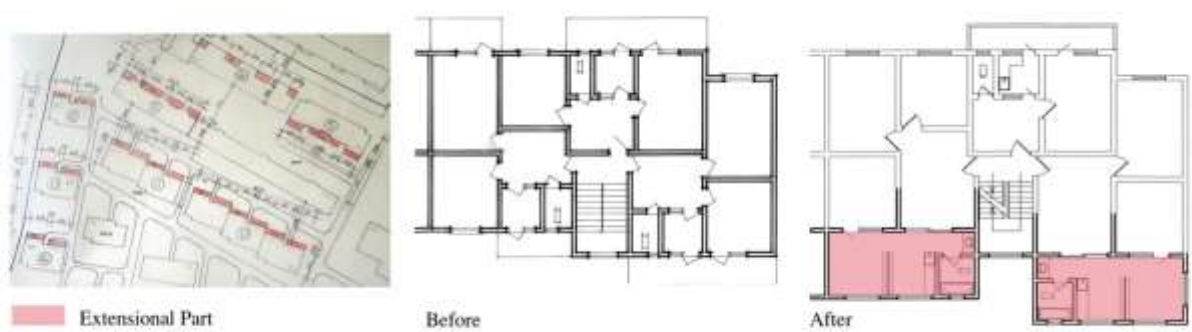

Figure 3 : The plan of staff apartment renovation in Sichuan Hospital

Improve Public Facilities and Public Space

Shortage of public facilities is very common in old communities. This situation is improved through the renovation of idle facilities, such as removing illegal structures to increase leisure facilities and public space, changing some original public buildings or ground units to commercial facilities. For example, in YuDao Street Community (Nanjing) one office building are transformed to a kindergarten; in ShenJuRen Lane Community (Nanjing) for its commercial location, the ground units along streets are transformed to many boutiques. For public green space, according to the principles of organic regeneration, original big trees are retained and some shrubs are added properly to form a multi-level green system. Maintenance of the form and personality of original space is the premise of organic regeneration. Trees, shrubs, green belt and green hills are used to define private and public space, and paving, hedges and water are used to define walking and rest space.

Most old communities are lack of parking spaces and vehicles on the road looking for parking cause traffic congestion. The basic principle of road improvement is to widen some road to mix-use of residents and vehicle. In order to ensure daily traffic in communities, the number of households divided by road should be about the same. In certain cases, some community roads are changed into city roads and groups divided by these roads become closed and self-managed. The original and additional public facilities are distributed along the road, which bring vitality to the new road and the communities, and well-developed transport facilities surrounded provide convenience for the residents.

Figure 4: The boutiques of ShenJuRen Lane Community after renovation

Promote Community Co-management

China does pay attention to public participation in community regeneration and encourage original residents and surrounding neighborhood residents to participate in the design and implement process of renovation. Therefore, the requirements of residents and neighborhood could be considered and studied fully which make the regeneration more stable.

When renovation completed, co-management of residents are encouraged in order to enhance the "hematopoietic" function of community itself, and finally it can realize fundamental regeneration. Respecting the wishes of residents, flexible management model are taken up to promote fine circulation of the old community management. For community with certain scale and relatively well facilities, a committee of owners is elected to hire a property company. For community without implement conditions, the committee of owners can organize the unemployed personnel responsible for cleaning or greening maintenance with paid to realize self-management and self-service.

Figure 5: The public facilities and space of SuoJinCun Community after renovation

Practice Case 2 - YuDao Street Community Renovation Project, Nanjing

YuDao Street Community locates in No. 526 ZhongShan East Road, west to Nanjing Wuchao Gate Heritage Park. There are 28 multi-level buildings constructed from the 1950s to the 1980s and 408 households. Before renovation, the residents suffered enough from seepage of walls and roofs. There were a large number of illegal buildings located in front of and behind buildings and a lot of roads were damaged badly.

The new "communities regeneration" plan demolished the illegal construction, ordered the route of traffic, refitted the damaged road, constructed bicycle shed and set aside temporary parking area. In addition, because most residents are low- income families which decide they will choose public transport for going out, so the additional ground parking spaces through partial update could meet the demand for residential parking. The land vacated by the demolished buildings has become a large central green space. There is square for chorus, dancing, Tai Chi, and other collective activities. There is also private space enclosed by plants or low walls. Meanwhile, take the advantages of Yudai River and Wuchao Park neighboring, the community shared external greens and water environment to arrange varied walkway, interesting landscape and pavilions.

Figure 6 : Road and temporary parking place of Yudao Street Community after renovation

ENERGY CONSERVATION AND UTILIZATION

Applying appropriate energy-saving technology to old building can improve its intrinsic quality. Popularizing less-polluting natural gas is one part of the renovation, while solar and other new energy also are experimented in the renovation.

Energy Efficient Materials and Passive Energy-saving Technology

In order to reduce the heat change coefficient and save heat energy, the renovation strategies of energy-saving materials and passive technical include: adding external insulation materials, replacing single-layer steel windows to energy-efficient windows, changing flat roof to sloping roof with heat insulation layer. Glass is used to enclose extended balcony for green sunny space, which absorb solar radiation in winter and block direct solar radiation in summer. Most staircases of old residential building are open with concrete lattice windows which is adverse to energy conservation. These concrete lattice windows are changed to plastic-steel windows and door sockets are added at the entrance of building. Meanwhile, pulling air facilities are installed on the top of staircases in order to pull wind vertically in hot summer and then take away heat for cooling.

Integrated Application of Solar Technology

The solution of roof seepage problem is integrated with the location of solar water-heater. In China, on the one hand, solar water-heater system provide hot water for residents, on the other it is a kind of auxiliary source to provide heat for low-temperature radiant floor heating system. Solar collectors are set on the sloping roof as building elements and move tanks to attic space below sloping roof. In the parts between the wall and window of building passive solar heating technology are used - perforated metal solar-wall. Solar collector panels absorb solar-radiation and heat the air in the cavity through the holes of collector plate. With the help of auxiliary fan, hot air rise along the cavity, then enter the building from pipes on the roof and finally reach each room to provide efficiency heating and fresh air.

Practice of Case 3 – SuoJinCun Community Renovation Project，Nanjing

In the renovation of SuoJinCun Community, the flat roofs of original multi-storey residential buildings are changed to sloping roofs and added heat-insulation layer and original single-layer steel windows are replaced by double vacuum energy-efficient windows. Meanwhile, solar corridor lights are installed in the public stairwells and electronic anti-theft doors and safe-monitoring system are installed at building entrance. Natural gas, as a fuel with low pollution is spread in all renovated community. The gas pipelines are installed from the first floor to the top floor. Because the use of natural gas involves funded issue of the residents, even for the residents without demand now, there is also reserved the interface. Taking the opportunity of road renovation, rain and sewage diversion projects are implemented. The detailed steps are firstly taking a full investigation of the drainage in this community, then water is accessed to pumping station and discharged into the moat to ensure its control function when the flood comes, secondly abolishing the existing septic pool, after the laying of new sewage pipes, sewage will enter wastewater treatment plant through municipal main channel.

Figure 7 ：The renovation of door for building entrance

Create a New Community Full of Vigor

When community regeneration is concerned and promoted generally, it is no longer limited to the renovation and improvement of physical structure, but more emphasized about the atmosphere creation. A harmonious neighborhood and fine spiritual home becomes its aim.

Merging Urban Fabric and Continuing Urban Space Context

City is a growing organism. In the community renovation, strategies are taken to merge urban fabric and space context as much as possible. Many communities of the 1980s play an important role in the urban spatial pattern. Although some have fallen and buildings have been worn, they still have huge and dogged vitality. This organic and vitality not only reflected in the external morphology of space, but also in the accumulation of centuries history, in an interrelated and intertwined form of socio-economic factors in all street district. In fact, in amenities living space of old city, 70% are offered by the old buildings of the 1980s and before. To protect these communities could help sustain the memories of urban development, continue urban context and enhance the heavy sense of urban history.

Maintenance and Reconstruction of Original Social Network

While a reasonable move-back rate is ensured, the renovation of physical environment to retain original social network is emphasized. One important point of renovation is to create individual and diversified space from original monotonous community, including that shared areas are formed to enhance ownership awareness and neighborhood communication, safe and outdoor-activities places are provided for children and younger and comfortable and health living spaces are provided for the aged. The entrance and roof of community are designed differently so as the residents will feel acceptance to the building and the community they belong to. It is worth to mention that the residents have deeper emotions to old communities than that in new ones. Sustainable community renovation in China respects lifestyle and emotional needs of residents and gives full play of people's initiative to create a comfortable and pleasant human environment, eventually maintain the original social network at utmost.

Practice of Case 3 – Xishiba 27 Community Renovation Project，Nanjing

Xishiba 27 Community is constructed in the 1980s. Its location is very sensitive, east to Pingjiang Road which belongs to Nanjing Confucius Temple Historic District, and adjacent to beautiful Egret Island Park. Therefore， in the renovation great attention are paid to the integration with urban fabric and the continuation of urban space context, ultimately improve the quality of community. The renovation approaches of public space include that entrance space and traffic space are improved and open space and new public space are added such as top space of gallery, front porch of balcony and roof, or combine with roof-setback and hanging gardens, so as to create communication and interaction opportunities and space for residents. For the renovation of building facades, classical elements are used in the garden wall and entrance doors to integrate architecture style of historic districts. The walls to Egret Island Park are opened to bring in natural landscape to community.

Figure 8：Renovation of building façade integrated architecture style of historic districts

THE ADVANTEGE OF CHINESE RENOVATION APPROACH

Contribute to Adapt the Renovation Demand of Present

The investigation of practical cases showed that the demand of most residents now living in old communities remained at a lower level. In the current economic conditions, the improvement of basic living function is the urgent problem need to solve and Chinese renovation approach is better to achieve this aim. It can gradually and continuously increase the living level and original function. It can keep those always in a state of improvement and avoid the conflict caused by leapfrog enhancement. Meanwhile, through this kind of renovation, the residential function of old communities has been continuously improved and the gap between old and new communities has been shortened effectively, which establish a good foundation for stable and gradual transition of renovation demand.

Contribute to Complete the Function of City

Strengthening and development of high cost business functions is one of the most fundamental reasons among a series of contradictions and conflicts of central city urban renewal. Just the overdevelopment of business functions in central city through “big demolition and big reconstruction” way causes the demand of residential renovation unsolvable. The objective of Chinese renovation approach is function improvement. It use a more gentle way and perfect urban functions, especially urban residential function, are achieved through gradual continuous improvement and updating. Therefore, it effectively avoided the adaptation period caused by jumped changes of urban functions and spatial. In terms of the function improvement in Chinese cities, this kind of renovation is more suitable for the present situation undoubtedly.

Contribute to Keep the Stability of Community

The purpose Chinese renovation approach is no longer confined to demolish old buildings and remove original residents, but more concern about the upgrade of existing buildings and living environment in small area. It takes a more tolerant attitude to old buildings, residents groups and community networks. For the majority of original residents, through organic renovation way, it not only improved their living conditions, but also retained their social network and the residents in central city. Through the renovation and improvement of the physical environment existing, management system and management methods, it can help community members to build awareness of community dependence, community belonging and community participation, it can provide residents with a better overall living environment. Therefore this kind of renovation way is often easier to get the support of residents.

Contribute to Relieve the Contradiction of Society

Compared to comprehensive renovation, which easily lead to social conflicts, the approach with function improvement purpose can more effectively avoid and alleviate social contradictions and conflicts. Firstly, this approach can continue the existing community structure, reduce the problem of the output of original inhabitants from the central city as much as possible and satisfy update requirements in the original region as far as possible. Secondly, because of its non-profit features, this kind of renovation approach is easy to release direct interest conflict between residents and government. Moreover, it can help to promote the image of the government through government' fund to residents' benefits.

CHINA'S REAL PREDICAMENT

At present, the community renovation in China is in a transition period, both similar to the developed countries: small-scale, detailed, high technology and high standard, while constrained by funds, time and technical support of developing countries.

Problem of Renovation Content

The problems of community renovation in China are that there is certain bias between renovation content and residents' real needs. Part content can not sufficiently reflect the focus of "basic living needs" improvement, part content limit practical requirements while pursuit of beautiful appearance and part content are relatively homogeneous and limit the diversity of needs. In addition, the depth and width of the renovation are bounded by some factors which involve the adjustment of property rights and resettlement of households to move out. Chinese current renovation approach is simple and easy to implement under the actual system, but not a long-term way.

Problem of Renovation Policy

Lack of technical specifications and renovation policies limit further expanding of renovation content, thus affect further reflecting of residents' will objectively. From the view of current administrative procedures of approval, it is the same with the new constructed buildings, both in design and in construction. Numerous procedures and long period hamper the promotion of community renovation. Therefore, the renovation policies of government can not be underestimated and preferential policies of financial and tax should be drawn up to realize the goal of regeneration. At the same time, special legislation should be introduced by the government to promote residents to participate in renovation and start-up fund is needed.

Problem of Property Ownership

Compared with other countries, the property ownership of old residential building in China is relatively complex and the residents generally do not have full property rights. Thus, it is considerable difficulty for investors to operate through market means. Only the government involves directly, the community renovation would be feasible. In addition, the target areas of community renovation are often the most complex city places of property relations, where one community may concentrate several property units, it is difficult for investors to predict risks and then lose their interests in such projects. Therefore, community renovation is not just the matter of residents, developers and architects, policy-orientation and government support is an important guarantee for the success of sustainable renovation.

Problem of Intensive Land Use

In the circumstances of limited land resources and increasing land price, high-rise housing has become a primary selection in many Chinese cities, which can both ensure the annual supply and reduce the consumption of urban land resource, Particularly those new communities which are in good location, influenced by the differential land rent and of commercial exploitation purpose, are mostly high-rise buildings. However, the communities of the 1980s are mostly multi-storey buildings and their FAR are about 1.5. Therefore, old communities have no obvious advantage in intensive use and value-addition of land. Under the current market economy, it is very important to find the balance point of commercial development and enable developers to become an effective help to community regeneration.

A PROCESS, A STATE and A GOAL

There are many old communities in China cities. The application of community renovation is very extensive. In future, a considerable long period, community renovation will show the characters of high-speed, high efficiency and low cost. However, in specific implementation process, there are still many problems to be solved, both in policies and regulations, public participation and cooperative mode. Communities of the 1980s vividly record and reflect the evolution of a city more than thirty years, and only new vitality inject in they could merge with the city fitly. For China, community regeneration is still a new issue. It is a process, a state, but also a goal.

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Appendix： Typical Renovation Cases in Nanjing （2010－2011）

Project Items	**ShenJuRen Lane Community, Nanjing**	**SuoJinCun Community, Nanjing**	**YuDao Street Community, Nanjing**	**Xishiba 27 Community, Nanjing**	**YingGeYuan Community, Nanjing**
Location	Near one commercial centre of Nanjing	In one big residential community of Nanjing	Near the main road of Nanjing	Near Nanjing Confucius Temple Historic District	In one big residential community of Nanjing
Housing Property	Private property right	Private property right & Public property right	Private property right & Public property right	Private property right	Private property right
Construction Year	1980's	1980's	1950's & 1980's	1980's	1980's
Construction Area	32，400 m2	18，500 m2	43，6 00 m2	13，700 m2	35，200 m2
Type of Building	5 three－storey，2 four－storey，7 five－storey，3 six－storey，1 seven－storey	9 six－storey	3 one－storey，3 two－storey，11 three－storey，7 four－storey，6 six－storey	1 one－storey，5 three－storey，6 four－storey，3 six－storey	2 six－storey，7 seven－storey
Number of Dwelling Units （Before）	399 households	250 households	408 households	78 households	542 households
Number of Dwelling Units （After）	Ditto	Ditto	Ditto	Ditto	Ditto
Fund of Regeneration	City government 70% District government 30%	City government 70% District government 30%	City government 70% District government 30%	City government 70% District government 30%	City government 70% District government 30%
Content of Regeneration	Building & Facilities	Building，Open space & Energy saving technology	Building，Open space & Energy saving technology	Building, Facilities & Energy saving technology	Building，Open space & Energy saving technology
Cost of Regeneration	$ 950，000	$ 1260，000	$ 460，000	$700，000	$ 1550，000
Duration of Regeneration	6 months	6 months	9 months	6 months	6 months
Evaluation & Management	Building renovation Community management	Building renovation, more open space Self－management	Building renovation，more open space & parking Community management	Building renovation, Energy saving renovation Property company management	Building renovation, Energy saving renovation Community management

An Open Design in an Environmentally Conscious City Plan – The Case Study of Parque de la Gavia

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ABSTRACT
The design of Parque de la Gavia, or Gavia Park, presents a revolutionary solution to the contemporary environmental issue of recycling resources and creating natural ecological environments. At the same time, the answer is nothing less than the conservation of the history of a particular region and a reproduction of its scenery. The device used to facilitate this plan, the Watertree, is a system coherent with nature that produces a dynamic condition of equilibrium in the park, resulting in the creation of a vibrant topos reinforced with a rich ecosystem.

While this open system involving a temporal axis allowing variation and change abandons the insistence on a completed "form," at the same time, the anticipated result is a powerful iconic production that will serve as a symbol of the ecological philosophy by which it was generated.

KEYWORDS:
The Gavia stream, Vallecas development, Watertrees, biodiversity, topos, self-generating park design, biotopes, yato

INTRODUCTION

The purpose of this paper is to introduce the plan of a new park being constructed in Madrid, Spain, for which biodiversity serves as the central design theme, and to discuss the planning concept of this project by considering the significance of the system of a sustainable park design which, with the recycling of city waste, changes and grows over time.

AN ENVIRONMENTALLY CONSCIOUS DESIGN PHILOSOPHY

Outline of the Plan

Gavia Park is a 39-hectare sustainable woodland park being planned for the peri-urban Vallecas region located southeast of the city of Madrid in Spain (Fig. 1). Designed in anticipation of the construction of approximately 26,000 housing units in an area adjacent to the old city of Madrid with an estimated population of 100,000 inhabitants, this park is expected to be central to the Vallecas development known as the Ensanche de Vallecas (Vallecas Extension), one of the five major urban development projects that are currently underway in Madrid.

In this area, the EMVS (Social Housing Enterprise of the Municipality of Madrid) has established the "Eco-Valle" program, an ecological strategy that aims to promote a pioneering sustainable city model by developing three distinct projects. One is the "Water Spiral" project, the landscaped and planted areas to be created in Gavia Park for water treatment, partially financed by the EU Cohesion Funds as an infrastructure project. The second is "Mediterranaen Verandaways," a bioclimatic conditioning of the main boulevard of the Vallecas Extension to introduce comfort to public spaces by appropriating place-making traditions of Mediterranean towns. The third is the "Sunrise" project, the development of social housing units, to encourage energy efficiency and improve interior environmental standards. These three public redevelopments have been in progress since 2003 and are still ongoing.

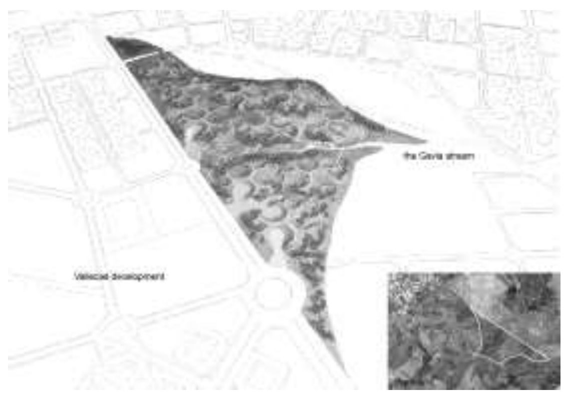

Figure 1: The site of Gavia Park. The town of Vallecas and the new urban plan (bottom right).

An Environmentally Conscious 21st Century Park Design

The design of Gavia Park commits itself directly and intimately to this city planning concept. Accordingly, we wanted to transmit a clear message of how the project will contribute to the global environment, or more specifically, how it deals with such issues as water use, ecology and energy, with which we are confronted on a global level. To that end, we incorporated the maintenance of the historical environment of the region and the creation of comfortable living standards into the design of the park.

Historically, park and garden designs have represented the order that idealizes the relationship between nature and culture, expressing the ideology of the times. We thus felt that for Gavia Park, the form—in other words, the order—of the garden of the twenty-first century, must be the creation of a vibrant topos reinforced with a rich ecosystem incorporating an ecologically sustainable system.

As a result, the following three design principles were considered important: 1) the construction of a simple system for creating diversity in both ecology and space; 2) the manifestation of a system that involves fractal coherence (3) the localization of various global environmental problems to establish roots in the Vallecas region.

THE QUESTION OF LOCALITY

A Multilayered Landscape and Gavia River

A dry, reddish-brown landscape extends across the bleak region of southwest Madrid. This landscape and the life of the local folk were deeply attractive to painters and poets of the Modern era such as Federico García Lorca, Rafael Alberti and Alberto Sánchez. They made manifestos and formed the first landscape school of painters before Spanish Civil War. Together, they gave birth to the modern approach to painting in Spain.

Through this gentle valley landscape and the old city of Vallecas flowed a stream called the Arroyo de Gavia, or the Gavia. Eventually flowing into the Manzanares River on which the city of Madrid developed, the Gavia was a symbol of this region and its landscape. The 39-hectare park site consists of gentle slopes which form a valley that defines the vestiges of the Gavia stream bed.

The flow of Gavia disappeared off the map in 2001. Faint vestiges, however, that remain after the flow of subsoil water that appears during the rainy season or in rainstorms are still in good condition, and a single willow tree remains at one point in the substrate within the park site. In the downstream area of the park site, there is a continuous grove preserving the traces of the former river bed.

In such a way, the series of hills and residual vestiges of Gavia stream form an environment characteristic to the region, and are natural assets that should be successively conserved as modern history. Although the current state of the topography of the land has been drastically transformed due to the disposal of waste soil from urban development, toward its renewal, it was considered vital to restore the essence of this topos.

Yet, the transferal of soil once deposited onsite to a location outside was considered unproductive and difficult. The solution thus involved the redistribution of the soil within the park, without any change to its total volume, adjusting only the amount needed to reproduce the essence of the former scenery. In determining the locations for soil redistribution, particular attention was paid to the substrate region of the former stream of Gavia. To reproduce the flow of the Gavia while applying a minimal artificial intervention, the natural method of using Arakida soil (alluvial clay soil with water-retentive and argilliferous features that composed the sediment of rice fields) was proposed.

While northwest of the city of Madrid, lush forests with bodies of water such as El Pardo and El Escorial extend over the land, the southwest region is extremely dry. Because the Gavia Park site is located in the dry zone, even if revitalization of the environment was possible, there was apprehension concerning the creation of a vast aquatic environment. However, this anxiety was eliminated through an elaborate regional survey.

The Manzanares (Rio Manzanares)—the river into which the Gavia enters—flows south and, as a tributary of the Jarama River, it eventually converges with the European waterway Tagus River (Rio Tajo). This point of confluence is in the town of Aranjuez. Prior to this point, there is a region called Tajuña, which possesses a characteristic fluvial terrace topography, and at the center of the base of the terrace, an expanse of a vast wetland was confirmed. Although the surrounding cliff terrain and earth is composed of dry clay-like soil where vegetation is typical of arid zones and spelt is grown, there was also a wetland area comparable to the size of the flow of the Gavia to be revived, verifying that the revitalization of Gavia was very possible (Fig. 2).

Moreover, the agricultural region of La Dehesa that lies along these rivers—or in other words, land permeated by underground water where cultivation of crops is possible—extends over this watershed, and thus, along with the presence of the fluvial system, a stable vegetation environment could also be confirmed.

Figure 2: Tajuña and Dehesa scenery. Indicating the favorability of a fluvial terrace and vast wetland along the watershed.

The Watertree System

The "Watertree System" is the system devised to generate the topography of the revitalized land for the Gavia Park. The system is comprised of two main components: "Ridge Watertrees" that are in the form of abstracted trees in plan, and "Valley Watertrees" that are in the form of abstracted trees in elevation (Fig. 3). The revived Gavia would then become the basis or "trunk" of the system of valley trees.

The intention of the Watertrees is to introduce a comprehensive system for creating the park topography based on the function of water purification and irrigation use. Therefore, rather than approaching the design by assuming uses and activities and making various zones, the geographical features and places generated result directly from the introduction of the water system to convert dry hills into green forest (Fig. 4).

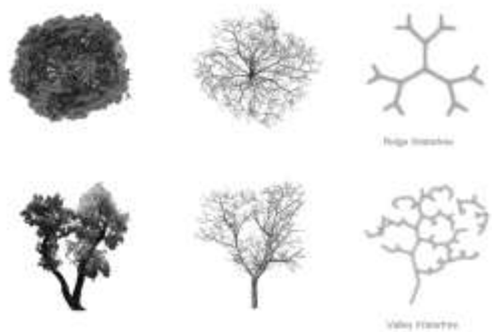

Figure 3: The symbolic nature of Watertrees

Figure 4: Land-forming system of the Watertrees

In Kamakura, an ancient capital of Japan located to the southeast of Tokyo, a fractal-like land form spreads out in the yato—one of the characteristic geographical features of the region consisting of folds in the low mountain ranges along which farmland and residential lots were developed (Fig. 5). An astonishing variety of terrain is formed by the subtle folds interspersed throughout the topography, and therefore a diversity of rich flora and fauna is maintained. Although the Watertree system is a product of research and development conducted expressly for Gavia Park, it is a natural system that generates diversity in a manner similar to these yato.

Figure 5: Kamakura "yato"

Generally, urban development result in the production of waste water that must be processed downstream at a treatment plant, but in Gavia Park, it is proposed that this water be re-used to create a waste-reducing "spiral" water cycle. This spiral will start with the daily delivery of 6500m3 of treated waste water measuring at level BOD5—a five-day biochemical oxygen demand, the measurement used to access the organic load on the treatment plant and/or the effectiveness of treatment—that will have received tertiary treatment, which is sent to the park from a filtration plant 10km away. In the park, this treated waste water will be further naturally purified to a level of BOD1 to BOD2, and will be irrigated throughout the park and valleys will form, revitalizing the Gavia that had once flowed throughout the site. This water system will be maintained by the interrelation of three kinds of natural water purification methods and resultant creation of a dynamic equilibrium. Those three are: "Ridge Watertrees" to be formed along the ridges of the site, "Valley Watertree" to be formed in the valleys, and finally, the eventual flow of the Gavia itself (Fig. 6).

Of the ten Ridge Watertree types, four are Type "A" Ridge Watertrees, which are set at the high points of the topography; these will be supplied with water that has been processed at the treatment plant to a tertiary level. The water will then be further "polished" within the Watertrees by natural purification methods involving stones and plants, and flow into the valleys and to the six Type "B" Ridge Watertrees (Fig. 7). Taking almost an entire day, this natural purification system will reduce the level of BOD through a purification process via contact with the porous bed, and aquatic plants such as water lilies and reeds for removal of nitrogen and phosphorus. Next, the process will move through the Valley Watertrees, where natural purification will take place primarily through aeration (to introduce oxygen), and finally enter a long period of precipitation and plant purification in the Gavia. A condition of equilibrium will be maintained by the diversity of the purification processes supported by ecology at various scales.

The Biotopes of Gavia Park

The topography generated by the Watertrees will create open green areas in some places and dense forests in others. It will also result in a continuous variety of plant features along the banks of the valley streams. Mutual interactions between the Watertrees will define new topos, and the park will thus be formed by the diverse conditions that produce many different types of spaces. Consequently, distinct biodiversity will be derived from these different environmental conditions.

The main structure of biodiversity will be established through a linearly connecting "corridor" comprised of a biotope of four disparate topographies: River and Wetland, Riparian Forest, Forest Valley and Paseo, and also through a biotope of six "patches" extending in a planar fashion: the Experimental Forest, the Mediterranean Arboretum, the Riparian Arboretum, Landscape Hill, Flowering Hill, and Park Land. In addition, although diminutive topos will be generated by the orientation of the valleys and slopes and the degree of contact with water, unique biotopes will be formed by their combination with various tree species (Fig. 8). After the basic direction and preliminary plan were determined, together with local landscape architects and biologists, these biotopes were reinvestigated in respect to the local climate, soil conditions, and vegetation, and practical optimization was implemented.

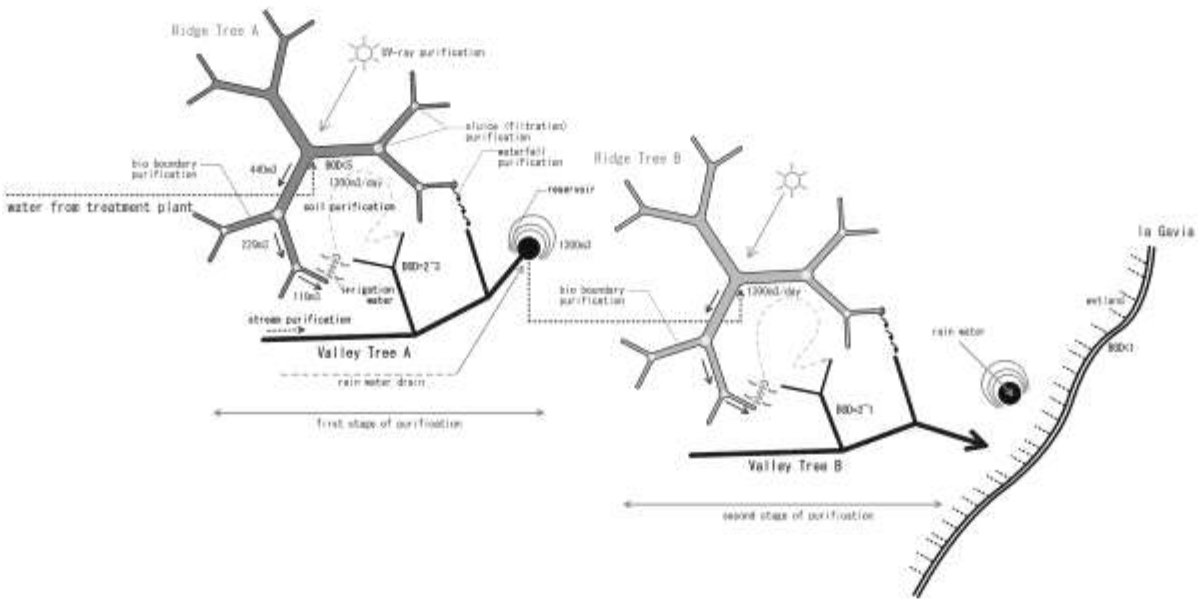

Figure 6: The Watertree natural waste water purification system

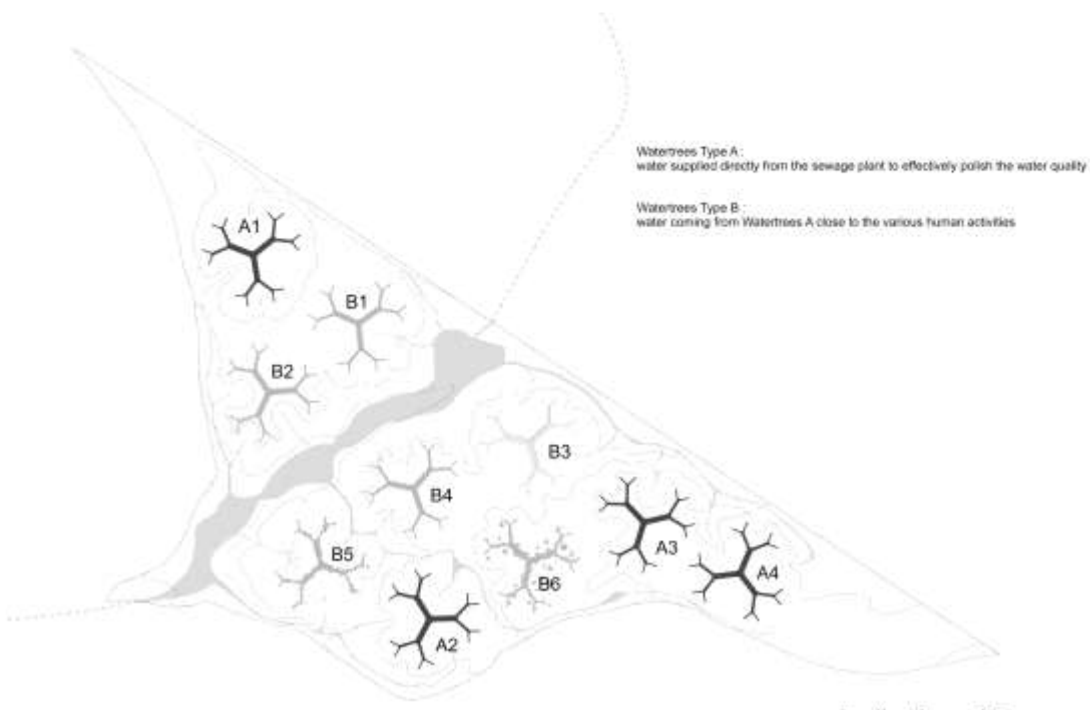

Figure 7: The Watertree System

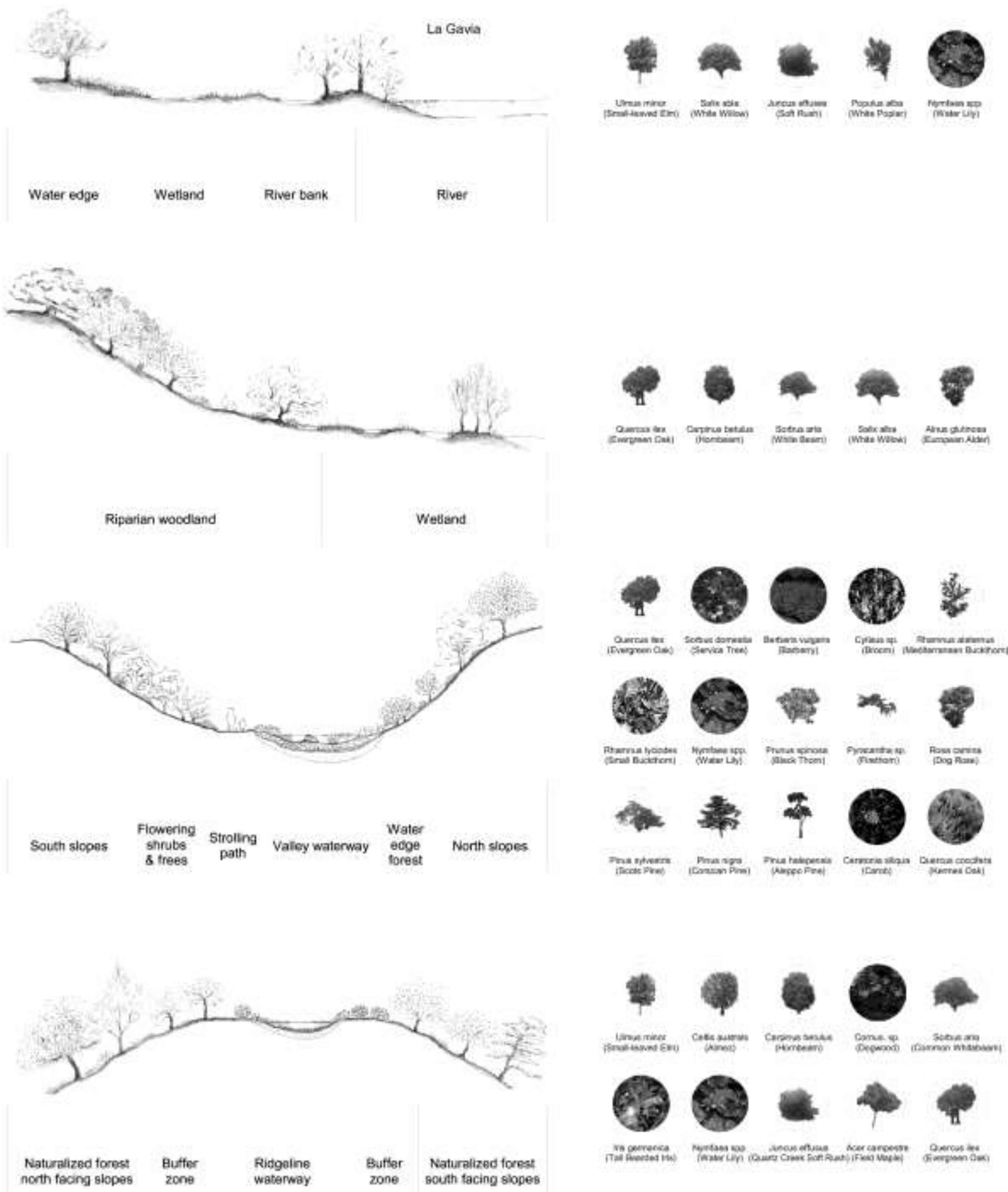

Figure 8: Relationship between land form and vegetation

Open Spaces

While modifying the environment surrounding each Watertree, the six Type "B" Ridge Watertrees will produce new spaces and attract human activity. For example, at one Watertree ("B1"), where the tree-shape is inlaid into a raised spherical surface, the active water flow over the sphere will create an alluring ambience (Fig. 9). At another Watertree ("B4"), the leaf-shaped topography created by its branches will generate a natural amphitheater facing the Gavia, and its mirror-like water surface reflecting the sky (Fig. 10). At other Watertrees, ripples extend outwards from various points, or horizontal flow lines of the water will contrast with the verticality of nearby trees—each of these six Type "B" Watertrees will have on its own character.

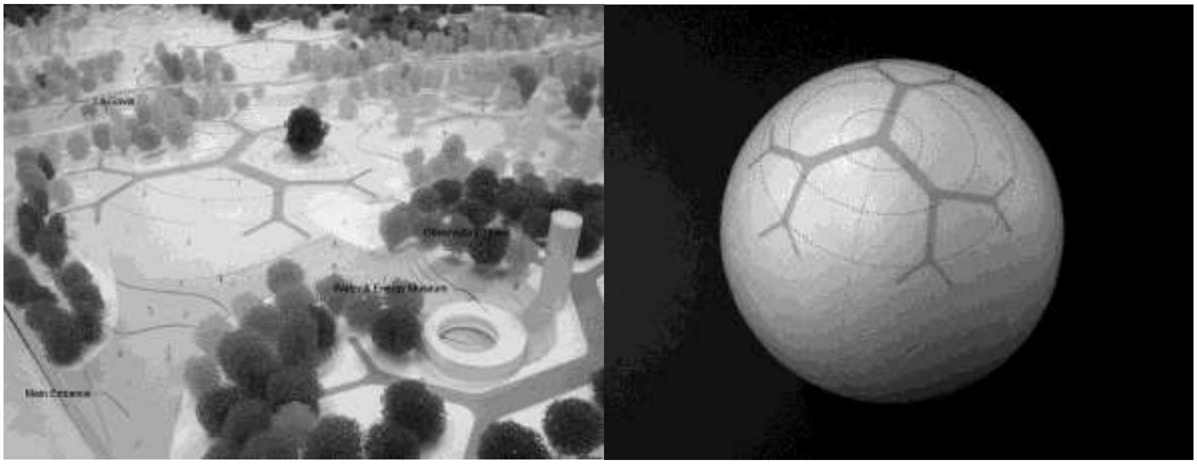

Figure 9: Type "B" Watertree ("B1"), (Model on left, conceptual image on right).

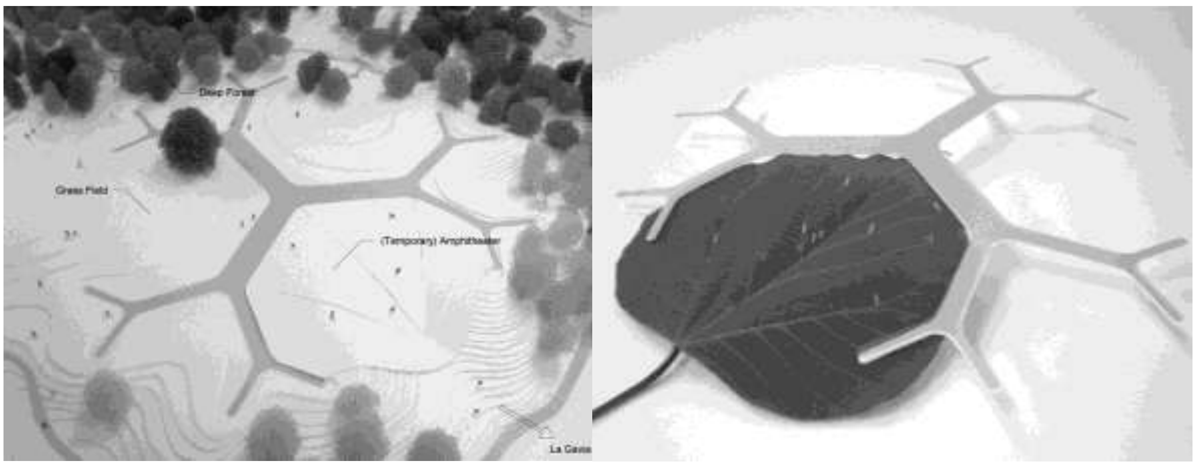

Figure 10: Type "B" Watertree ("B4"), (Model on left, conceptual image on right).

AN OPEN DESIGN

A System Involving Temporal Change and the Steady State

The landscape created in this park is, at the outset, given only the minimum definition by the Watertree system. However, based on these initial conditions of water, soil and space, and because of change and development over time, it is expected that the quality of the diverse places will evolve, creating a new qualities of space and gradually bringing the landscape to maturity. Rather than the construction of completed forms, the design for Gavia Park proposes that the park generate itself through the passage of time. The park design itself is the very process of the growth of its trees.

In Japan, the satoyama—border zones or areas between mountain foothills and arable flat land managed through local agricultural communities—are natural environments immediately accessible to people in their daily lives. They are naturally maintained through the routine activities of the community, and the people, in turn, benefit from the blessings of nature. Through this regular upkeep, the environment is constantly in a state of dynamic equilibrium sustaining its various aspects while retaining a certain state of regularity.

The premise of Gavia Park is to create an environmental park by circulating city waste. Towards that end, existing in multiple layers is an eternally evolving "spiral" composed of a fluid coherency of various materials. For example, as a result of the maintenance of park trees, rich soil is newly produced, or becomes a source of energy. Another instance is paving of the park with baked sludge that came from the natural purification of the waste water.

As part of the park planning, there are facilities for maintenance and those for the local citizens to nurture the park environment with their own hands, for example, a community orchard, a school farm, a rest house, a day-care center, an environmental museum, and plant nursery (Fig. 11). However, these need not be realized according to plan. Nor is it necessary for them to be built in their planned locations, and it is of no consequence if their programs change. The planning of these facilities was merely the provision of solutions that appeared best at the time of planning; yet, it is natural that issues be otherwise resolved in respect to the changes in the conditions of the neighboring community, or changes in the physical situation.

The design of this park enables this type of variation in planning. This is because it is not a plan conceived according to modern techniques with predetermined zones or functions. In fact, what is designed here is a system that accepts and allows change and modification itself. And as long as the equilibrium of the entire system is maintained, an internal transformation would, if anything, result in the deepening of diversity and multilayered nature of the system.

The Architect's Role and Social and Public Responsibility

For such a cross-disciplinary complex project, aspects of the master plan cannot be decided according to the will of a solitary individual. The scope of this design involves water purification, biotopes, plants, landscape, infrastructure, soil, energy, the historical climate, and architecture. Each specialist should gather and investigate the issues as a team, and then decisions must be made beyond their special areas of expertise. This is the role of the architect.

For that, the architect must not simply possess an interest in architectural design as mere form, but must have a strong will and the capability to scrutinize each event and dissect, reconstruct and intellectualize, with a sense of social and public responsibility. Meanwhile, flexible concepts, high expertise, as well as design ability are also required of the team specialists. If this level of strength in the design concept and team exists, it is possible to elicit the action to get people involved to create and nurture a park environment.

In closing, it is necessary to mention the iconographic symbol and unifying force of Gavia Park presented by the architect; it was important to provide the "shape" of Watertree as a singular icon to create an order of universal coherency with nature (Fig. 12). Although it need not be said, the architect's role is to present such "shapes," (not figures, iconography, or mere form). However, that role is based upon the premise of the possession of insight towards a vast and deep scope of issues, which are then unified and result in forms of multilayered expression.

The presentation of "shapes" is fact a critical issue, as the role of the architect is currently in the midst of deconstruction and fusion based on such keywords as "environment" and "participation." That is to say, there is a perceived shift in the architect's role to not create the "shapes" of a design, but to devise mechanisms or systems which do not have form. However, only after incorporating all those form-less elements, the architect should present one exceptional iconic "shape." This is the unifying force that will attract people to Gavia Park.

ACKNOWLEDGEMENTS
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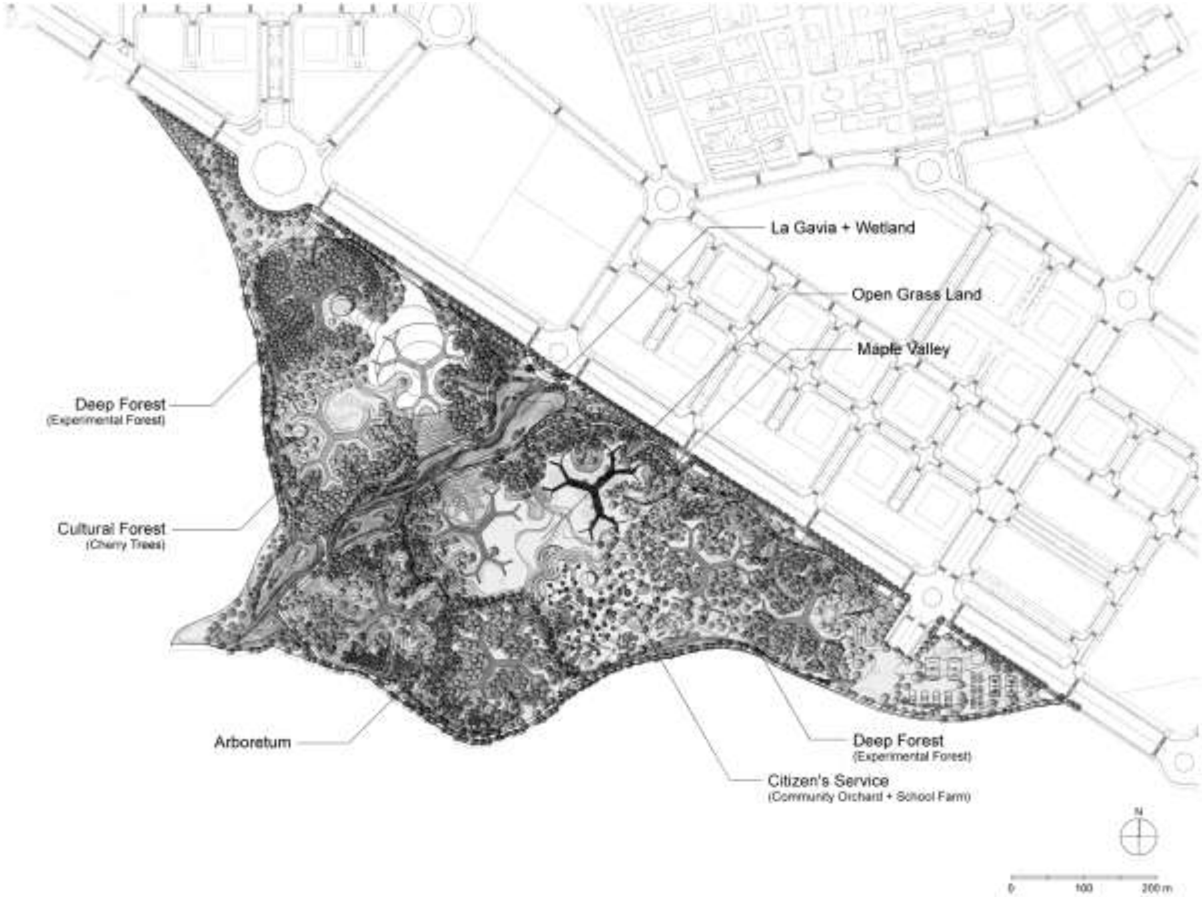

Figure 11: The Plan for Gavia Park and biodiversity

Figure 12: Model of Gavia Park

Adapting to a Culture of 'Transience' - Design Methodology for the 21st Centruy City

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ABSTRACT

Built environment is a continuously evolving dynamic entity. The role of designers is to mediate between stability and change. Design is thus an act of morphing built form and space to align people and their environment with change, yet retaining the vitality of fundamental human needs– dwelling, community and place. The transient nature of the built environment and indeed life is as crucial as the three physical dimensions of our perception.

This paper explores the above discussed theme in the context of today's 'network culture', where digital network technology has become a dominant cultural logic. Contemporary life increasingly dwells in the virtual information realm, apart from our familiar physical environs. Boundaries of time and space are shrinking, and fundamental notions of 'program' and 'typology' are being challenged. Consequently, built environment will be characterized by homogeneity and generic nature of spatial use and character.

Having said so, the 'atemporality' and 'location free' nature of activities and virtual interactions that have become possible, should only reinforce the need for the 'local' / 'specific' / 'physical'. This forms the premise to envision a new adaptable spatial system equipped to bring about an appropriate local-global / real-virtual relationship.

Keywords: network culture, physical, virtual, transience, generic, anti-type, parasitic, glocal.

INTRODUCTION

'Network Culture' signifies the development of a new societal condition spurred by the maturing of the internet and mobile telephony. Over the last decade, 'the network' has become a dominant cultural logic, and has restructured global economy. Owing to it's pervasiveness, the network's influence has crept into the major realms of urban life – economy, public sphere and culture [1]. Importantly, it has overlaid a new 'virtual information realm' over our physical urban environment. Architecture and Urban Design would have to increasingly take into account the play of digital information in space, apart from the traditional play of masses and light. The network's ubiquity is accentuated by the fact that it directly or indirectly affects urban life patterns of people from all walks. We are at the threshold of a new kind of transformation- that brought about by 'bits and bytes'.

Research methodology

The effort here is to understand the characteristics of 'transience' endemic to network culture. Subsequently, the research would attempt to trace the threshold at which network culture creates a paradigmatic shift in our notion of stability and change. This would entail that the organizational structure of the built environment that governs it's dynamics, will need to be revisited. It would bring to fore some critical concerns for space/place makers. Also, the exploration here dwells in a zone of contradictions – real vs virtual, local vs global. The study would then further attempt to find some latent opportunities, beneath these contradictions; which could become the basis to frame a design methodology for the 21st century city. Specifically, the paper elaborates on the 'generic city' theory as one of the implied transformations. In trying to counter this theory, the research tries to understand the fundamental human need for the 'local'/ 'specific'/ 'physical' as a possible latent opportunity.

TRANSIENCE – THE FOURTH DIMENSION

Let's see how preceding eras led to contemporary culture which is network driven and predicated on connection. While early 20th century modernist culture witnessed 'mechanization' for the first time; it's succeeding post-modern culture saw 'digitization', which was a process of abstraction or reducing complex wholes into more elementary units. In turning objects, machines, places and people into quantifiable, interchangeable data, digital culture was universalizing [2]. This laid the foundation for today's network culture and it's super global connectivity. Digitization made possible in the previous era, can now use the network to be sent or received anywhere anytime.

This phenomenon has accelerated the speed and volume of transactions that drive the world – be it financial, social networking or entertainment. This leads to the state of high transience.

To speak of network culture or network society is not to imply that networks are somehow new or unprecedented: postmodernity is also a culture of decentralized, global networks and what is modernity but the first regime of globalization and telecommunication? But our networks are different. They are lighter, more pervasive, colonizing everyday life. There's no way to separate out technology from mainstream culture anymore [1].

The following aspects would help understand some typical characteristics:

Dematerialization

In network culture, information is the key currency. By removing the physical aspect of commodities from their representations, digitization enables capital to circulate much more freely and rapidly. Today, networked connection replaces abstraction. Information is less the product of discrete processing units than the outcome of the networked relations between them, links between people, between machines, and between machines and people [1]. Increasingly, the immaterial production of information and its distribution through the network dominate the global economy.

The ensuing condition, as Manuel Castells suggests in The Rise of the Network Society, is the product of a series of changes: the change in capital in which transnational corporations turn to networks for flexibility and global management, production, and trade; the change in individual behavior, in which networks have become a prime tool for individuals seeking freedom and communication with others who share their interests, desires, and hopes; and the change in technology, in which people worldwide have rapidly adopted digital technology and new forms of telecommunication in everyday life [3].

Figure 1: A culture of transience.

Location-free and mobile

Network culture is a condition of 'connectedness' such that one could use the network to have interactions anywhere across the world. This operates through a network of scales from hand held devices like mobile phones to personal laptops to large displays in public spaces to whole urban regions and so on. What it also means is that an individual is no longer bound to any activity or function by virtue of it's physical location. People simultaneously inhabit virtual and physical realms to enable their high level of mobility. Activities and functions are no longer confined by 'place', rather it gets upgraded to becoming 'mobile place' whose physical construct could be used for various location – free interactions in the virtual realm.

Atemporality

If the last 50000 years of man's existence were divided into lifetimes of approximately 62 years each, there have been about 800 such lifetimes. Of these 800, fully 650 were spent in caves. Only in the last 70 lifetimes has it been possible to communicate effectively from one lifetime to another, as writing made it possible to do so. Only during the last 6 lifetimes did masses of men ever see a printed word. Only during the last 4 has man been able to measure time with any precision. Only in the last 2 has anyone anywhere used an electric motor. And

the overwhelming majority of all material goods we use in daily life have been developed within the present, the 800th lifetime. The 800th lifetime is the age of super industrialization and super-communication and super-technology. The 800th lifetime is where all boundaries of space and time have disintegrated [4].

Having obtained near-total instant access to information, our desire and ability to situate ourselves within any kind of broader historical structure have dissipated. The temporal compression caused by globalization and networking technologies, together with an accelerating capitalism, has intensified the ahistorical qualities of modernism and postmodernism, producing the atemporality endemic to network culture [1].

Threshold for a paradigmatic shift

There is an important aspect which has helped built environment deal with change; that of cyclicity. The concept of 'cycle' of course has varied manifestations – daily cycles, seasonal cycles, ritual/religious cycles, and so on. It lends a certain order, rhythm and pattern to the working of the built environment; and at the same time leaving the in-between zone of transience flexible to change.

This is where one begins to notice the threshold for a paradigmatic shift. Today, the long established principle of cyclicity gets challenged by our 24x7, globally connected, highly mobile lifestyle. It is not appropriate though, to suggest that the notion of 'cycle' will become obsolete. It only needs to be redefined and aligned with present day dynamics. This argument will be taken further in the following discussion.

GENERIC CITY

'Generic city' is a term coined by Rem Koolhaas to represent contemporary urban condition – that of global networks and homogeneity. Of particular interest to this paper is Koolhaas' remarks on how the notions of 'program' and 'typology' get challenged in network culture. Location-free and atemporal lifestyle means that Generic city would have to account for homogenization of activities – living, working, shopping, playing etc anywhere anytime.

> "It has to swallow more and more program to survive; soon we will be able to do anything anywhere. We will have conquered 'place'" [5]

"Traditionally, typology implies demarcation, the definition of a singular model that excludes other arrangements. Generic city represents a reverse typology of cumulative, approximative identity, less about kind than about quantity. But formless is still form, the formless is also a typology" [6].

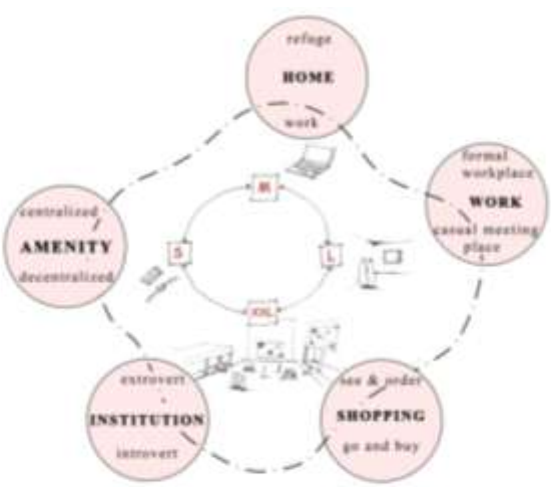

Figure 2: Homogenization of spatial use and character through a network of scales.

Repercussions on built form

The mechanism of 'cycle' is ingrained in the working and programming of basic urban components. Let's understand some possible spatial transformations:

Home- refuge as well as workplace:

Being connected to the network would increasingly make it possible to work from home. The challenge in designing the house typology would then be to retain the character of home as a 'refuge' while accommodating for an adaptable workplace [7].

Workplace- formal working as well as casual meeting place:

Working from home would not result in the disappearance of the workplace. The workplace would however begin to shed it's formal cubicle layout to accommodate a more casual meeting place to present and discuss work [7] .

Shop- going to buy as well as online orders:

Commerce would witness major dematerialization as a result of online transactions. Production, distribution and purchase would get decentralized. The activity of shopping would change from 'going to buy' to 'ordering after seeing a product'[8] .

Institution- location-bound introvert spaces as well as location-free extrovert space:

Traditional institution typology has been based on formal location-bound learning and spatial segregation of disciplines. Network enabled institutions will move towards location-flexible and interdisciplinary learning [9] .

Amenity- centralized establishments as well as decentralized access points:

Network connectivity would make it possible to create decentralized access points for civic amenities along with centralized establishments. For example: bank ATMs, telemedicine centers, e-governance centers [7] .

The above discussed situation shows a certain paradoxical ambivalence. The cycle in the built environment would need to deal with this paradox. The transformations as projected above show that; while on the one hand there is a tendancy to break away from the cycle of the local physical environs, there is a counter-tendancy to compensate for the broken cycle through global/remote virtual activities.

Let's see how this paradox affects the organizational structure of the built environment

CHALLENGES TO BUILT ENVIRONMENT'S ORGANIZATIONAL STRUCTURE

We need to relook at the idea of the 20th century city, to come up with an appropriate scenario for the 21st century city [fig. 3]. The 20th century city was automobile oriented, based on the model of core and periphery. It is increasingly becoming obsolete and is being replaced by the 21st century model based on network of globally connected techno poles (high-tech enclaves). The emergent model is thus, that of a network which allows for geographical dispersion yet reinforces certain strategic nodes.

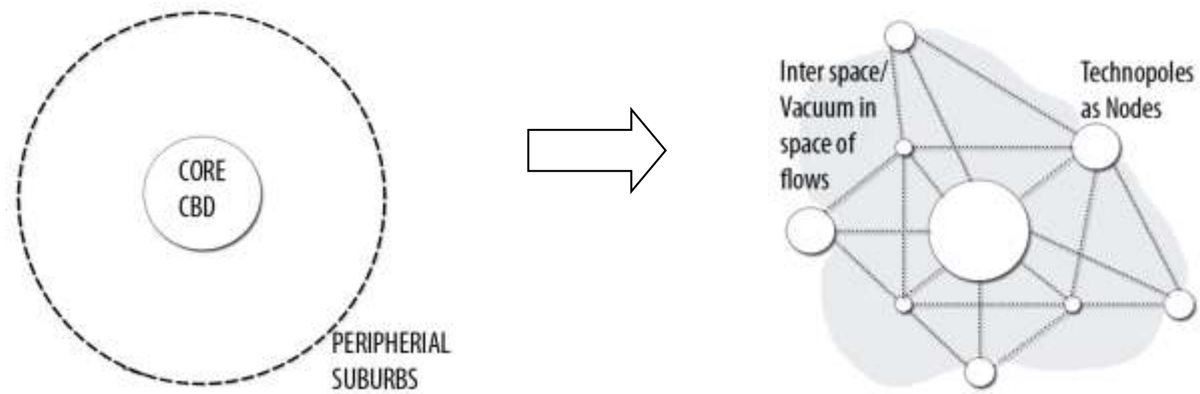

Figure 3: Switching to the 21st century metropolis.

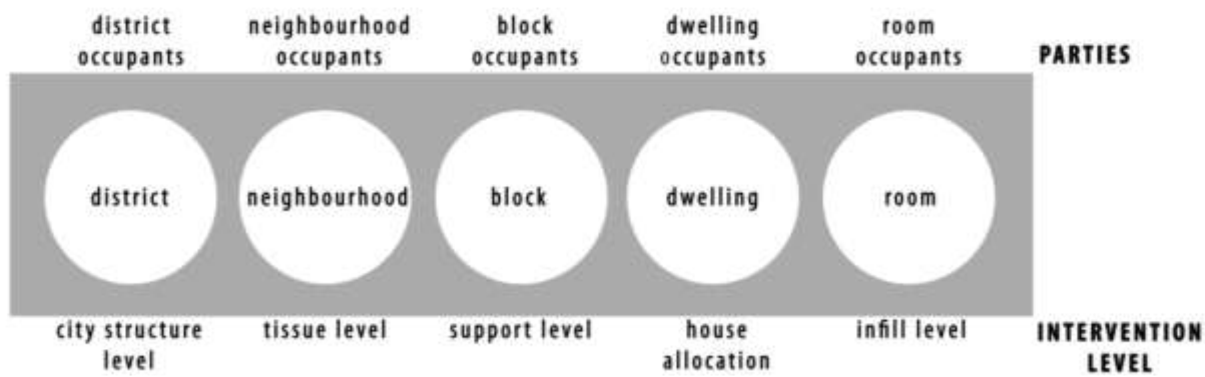

Figure 4: Built environment's organizational structure.

A good way to decode the organizational structure of a city's built environment is by understanding the distinct levels of intervention. The diagram in fig. 4 signifies that there are various actors (users, designers, decision makers) who shape the built environment at different levels. It is continuously in the process of change and transformation, such that all the actors involved in the process are part of an overall sense of order [10].

This kind of an understanding of the city gets challenged:

Emergence of the 'anti-type'
The earlier explanation of the transformation in fundamental urban components shows that the boundaries of time and space have been crushed and folded leading to the creation of the 'antitype', that category of user-systems and spatial-systems that do not fall under any typology. The challenge to the established systems of the built environment is that there is a new mix of relations emerging between space types in a particular level of intervention and across levels. One critical concern is thus to help the built environment adapt to this change.

Spatial Junk
Failure to adapt to the transformations brought about by culture of transience will lead to accumulation of spatial junk. Hence, the need for a spatial system that helps in sustainable use of space in the wake of generic homogenization of program and typology.

Arriving at an appropriate 'Global – Local' relationship
Traditionally, decision makers and stakeholders in a built environment have been within the confines of the political and economic confines of a context. This notion gets challenged in today's globalizing scenario where the world's economic geography is transforming based on virtual information technology based transactions. Cities are operating as nodes in the global network and are being inserted with high technology enclaves. A mechanism would have to be devised where these inserts could be rooted better to the local organizational structure.

NEED FOR THE PHYSICAL / LOCAL / SPECIFIC
By now, it is clear that the multitude of transformations brought about by network culture is operated by a global network of interactions in the virtual information realm. This presents us with the question as to what really is the role of the 'physical' then.

A careful observation of our daily lives reveals that a majority of our network interactions are meant to facilitate our actual physical activities, meetings, necessities. If anything, virtual interactions only augment the importance of the physical. For instance, the instant availability of free downloadable music hasn't meant the death of the music industry. It has only added to the demand for live concerts. The easy availability of movies online has only enhanced the value attached to multiplexes. One can also notice the increasing value attached to studio apartments, service hotels, and convention & meeting centers. After all, the more network transactions there are, the greater the value attached to face-to-face meetings.

This phenomenon is termed by William.J.Mitchell in his book, "E-topia 'Urban life, Jim – But not as we know it'", as the 'Economy of Presence'. In conducting our daily transactions, we will increasingly find ourselves constantly considering the benefits of the different grades of presence that are now available to us, and weighing these against the costs. Physical presence does consume money [7]. It would be possible to complete a large portion of day-to-day tasks online. While this means that one can save costs for physical presence, it also means that an added premium will be associated with certain physical activities and spaces which cannot be compensated by the virtual realm. This could assume two scenarios:

Firstly, certain exclusive places and activities would gain added importance – exotic restaurants, resorts and places of natural beauty like hills, beaches etc. The mobility offered by the network could help some select groups to flee their locational confines and cluster around places of special and exclusive attraction. Also, the flow of information on the network would accentuate the craving for some particular public events like concerts, live shows, sports events, large religious ceremonies, cultural displays etc.

Secondly, as remote long distance activities are facilitated by the network, the immediate local physical surrounds of a person would become additionally important. He / she would like to have as many diverse physical activities of immediate necessity, in the immediate vicinity as possible; be it work, shopping, play, amenities etc.

Opportunity

Thus, the physical and virtual realms work together rather than in isolation. The latter scenario projected above shows that, due to the location free and mobile nature of contemporary life, one's immediate physical surrounds get additionally charged. This means that, what one gets to do in the walkable vicinity around would become important. The paper argues that the 'physical-virtual' paradox in network culture is in itself be a blessing in disguise if one chooses to capitalize on the latter scenario. It could be an opportunity to create a walkable, mixed use humane habitat working in cognizance with the 'network'.

POSSIBLE DESIGN METHODOLOGY

The search for an appropriate design methodology in the scenario being examined, delves in a tricky zone of struggle between the physical and the virtual. The argument thus far leads to the standpoint that the virtual realm while significantly bringing down barriers for flow of bits and bytes, accentuates the need for the physical.

It would be appropriate to draw an analogy of physical and virtual realms with two organisms sharing a parasitic relationship – one feeding of the other. However, the role of the parasite switches as per the situation. As has been inferred in the previous section, the scale of walkable vicinity should be used as a design principle. Then, this parasitic relationship assumes greater charge because of the need for walkable proximity.

A 'Parasitic' system

This system involves a fixed spatial framework over which an overlay of parasitic growth is allowed which is determined by the forces of change. For instance, a transformable layer of transient local activities could be allowed to grow over a fixed layer of static global inserts. Here, local and global could exchange roles of the parasite depending on the situation. The traditional role of built environment has been one of reassuring us that things are under control, i.e. stable and static. The rate of change in today's network culture is obstructed by the inertness of existing spatial systems [11]. Hence, this parasitic urbanism helps in this adaptation by reuse as well as addition to the existing static systems.

Flexibility as a sustainable adaptation to change.

Flexibility is defined as the inherent property of a system of components to be able to modify itself to the forces of various internal and external stimuli, which directly or indirectly affect the system. Flexibility is a property of a system, preserving its basic recognizable qualities in response to change. Thus, flexibility means that some components of a system are transformable or dynamic while others are constant or static.

The intent behind the new spatial system implied above is to be complete at any stage, in order to allow for growth and change. Yet, it is functionally and therefore visually open ended. This indeterminate form thus offers clues for the interpretation of future users.

In the absence of this mechanism to adapt to a condition of high transience, there would be residual spaces. Thus spatial junk forms when a system is not planned for future growth or transformation and not left open ended as a design solution. And as a solution to spatial junk, the permanent space is simply broken down, altered, rebuilt or renovated. The result: uncontrolled waste of space and resources. Thus, the need for a flexible spatial system that allows for sustainable adaptation to transience.

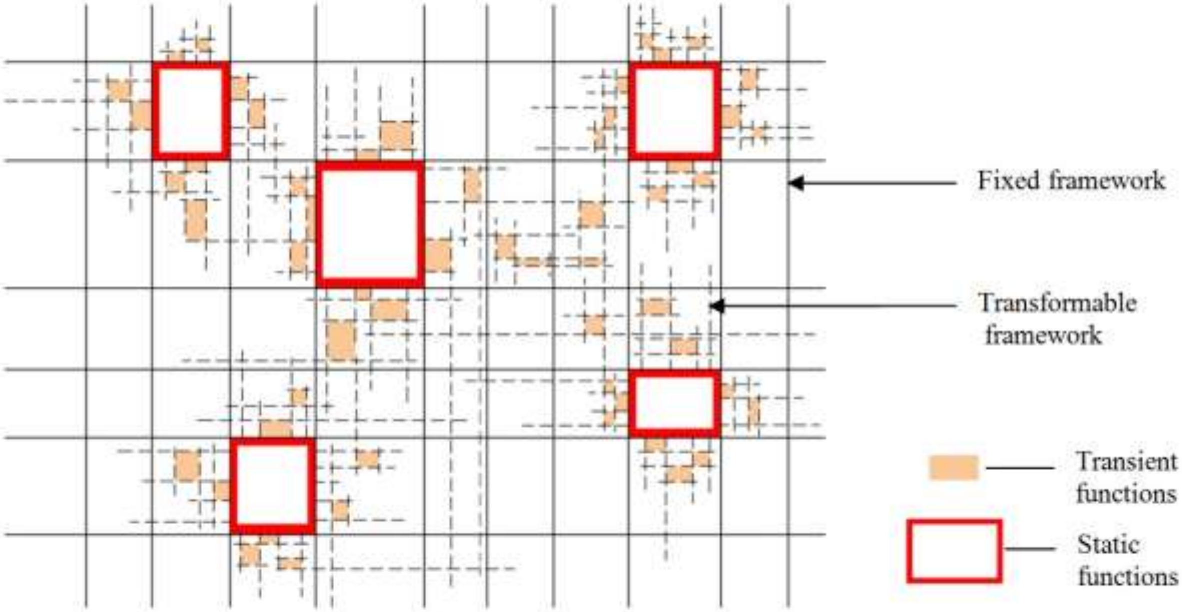

Figure 5: Parasitic spatial system – fixed framework overlaid with transformable framework.

One could now elaborate on some tangible facets that this concept implies.

Vertical landuse:
The envisioned mechanism entails that traditional landuse zoning becomes redundant. It would be replaced by vertical landuse planning, where a mix of functions would be created vertically, thus adapting to the advent of the anti-type and reusing existing spatial volumes. This would also mean that existing static functions could be inserted with compatible transient function at appropriate vertical levels. Thus, space between buildings would get activated apart from internal spaces.

Walkability as a structuring order:
With the redundancy of landuse zoning, there would be a diverse range of activities within walkable distance from a point. This is also influenced by the fact that an individual's activities in the city become location free, and mobility in the city is by choice rather than by necessity. Thus it would be preferable to be based at a particular location and having immediate necessities – work, shopping, recreation etc at a walkable distance, while long distance activities are accessed online.

Global + Local = Glocal:
The envisioned parasitic system allows for an interface between 'global' and 'local' in contemporary network where global could add value to local and vice versa. Thus comes about the idea of a 'glocal' public realm where global and local interact with each other. The design should allow for spill over from the global and local components at points, and at others allow for their particular territorial definition.

Hybrid interface between virtual and physical realms as architectural expression:
What could be the appropriate architectural expression for a network culture which resides as much in the world's material construct as in it's abstract dematerialization? Architecture like all other products – cars, appliances, commodities; has to be streamlined with the paradigm of networked intelligence. There are two aspects to this. Firstly, this is an opportunity to equip buildings with smart systems for better management and utilization of systems & resources. Secondly, one needs to explore the horizons of creating spatial experiences by means of network technology – interactive surfaces, facades; human gesture cognition etc.

CONCLUSION
Imagining 'future' has always fascinated designers. Quite often, utopian visions turn out be a bit too far from eventual manifestation. For example, futurists of mid - twentieth century predicted human inhabitation of 'extra terrestrial space' by the turn of the millennium, which quite clearly hasn't happened.

To round off the exploration in this paper, it would be useful to reflect on an approach which could lead us to a plausible vision for our future cities. The paper realizes that 'change'; on one hand, it is driven by people's evolving needs, their frame of mind and lifestyle. On the other hand, technology is a major catalyst of change. As demonstrated earlier, 'transience' has become the prime determinant for these two factors in today's network culture.

Taking stock of the findings in this paper, one can notice an underlying 'paradox' in this culture of transience. The human mind of the 21st century will dwell in an uncomfortable zone of conflict between global vs local, virtual vs real, solitude vs social network, home vs work and so on. Design has to increasingly deal with this.

An important lesson to be learnt is that, this paradox cannot and should not be resolved. What is critical though is to align people's frame of mind to change while morphing the built environment. So, the paradoxical tendencies of network culture are something that should be taken up as design parameters and expressed, rather than being concealed or eliminated. This approach could bring about an interesting set of urban relationships and interfaces.

Re-thinking mobility (dispersal vs centralization)

As people become equipped with virtual hyper mobility, there would be centralization of home / base location and immediate walkable environs. This helps in cutting down 'travel by necessity', thus contributing to energy savings and dematerialization.

Re-cycling of space (type vs program)

As has been suggested in this paper; with collapse of boundaries of space and time, it becomes essential to equip spaces with flexibility to accommodate several different programs and activities of life. This entails recycling the use of space, thus reducing spatial junk. This philosophy could also extend to recycling of building materials and resources.

Socio cultural re-connection (global identity vs local familiarity)

In a globalizing network of interactions, the mind is constantly caught up in a struggle to clarify one's association with identity, culture, language, religion, nationality etc.

In tandem with the above mentioned possibilities, one could imagine virtual reality as an augmentation of local familiarity. One could use the information realm to reconnect to local way of life and enhance one's face-to-face social interactions.

We could thus begin to take upon the paradoxes of the 'network culture of transience' to contribute to a networked sustainable future.

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Analysis of Long Term Occupancy Records of Public Housing in Japan

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ABSTRACT:
The objective of this research is to acquire a basic knowledge of architectural planning, in order to realize the changeability and long-term occupancy sought after for dwellings, from the survey and analysis of actual occupancy records and conditions of apartment buildings over a long period of time. One of the subjects of this survey was households that were long-term occupants of public rental and owned housing estates that were constructed in the 1960s. Analyses were made of how the occupants lived in the dwellings and records of infill improvements, along with changes in the family structures.

The author shows an example of changes in the layout of public housing over 40 years in Japan and examines how the residents have changed the infill according to the changes in their lifestyles. The author believes the study of long term occupancy records will give a useful knowledge to design longer life housing. Families mature and change continuously, and demand adaptability so they can make flexible use of dwellings in which they can live for long periods of time.

This research also examines how the apartment units of a public housing estate, most of which were equipped with movable partitions and movable storage units, have been transformed by the residents since they were built more than 20 years ago. The purpose of this research is to verify whether residents have adopted the design concepts to suit their individual needs and how they have adapted their living environments to changes in their lifestyles over time. Residents' family structures have changed since the first ones started to live in the apartment house in 1982. Therefore, they have needed to remodel rooms, change the position of partitions, the specifications of equipment, and so on. The author studied the movable partitioning system that had been used by residents as it was planned originally. This paper reports on the results of the studies, especially on the changes in room arrangement (layout changes).

KEYWORDS:
public rental housing, long-term occupancy records, POE, adaptability, customization, infill improvement

STUDY ON LONG-TERM OCCUPANCY RECORDS OF PUBLIC RENTAL HOUSING

Research purposes

The objective of this research is to acquire a basic knowledge of architectural planning, in order to realize the changeability and long-term occupancy sought after for dwellings, from the survey and analysis of actual occupancy records and conditions of apartment buildings over a long period of time. The subjects of the survey were households that were long-term occupants of public rental housing estates Fujimidai located in the western suburb of Tokyo and constructed in the 1960s. The author examined almost 100 households in out of more than 2000 households in the estate. Analyses were made of how the occupants lived in the dwellings and records of infill improvements, along with changes in the family structures. In some apartment buildings that were surveyed, an additional living area had been built onto the balcony side, and as a result of having more living space, young couples with children had moved in (Figure 1, Figure 5). On the other hand, most of the apartment buildings that had not had any additions have been occupied by the elderly households. With households that wanted to continue living in the same place for a long term, despite rental housing restrictions, cases could be seen where infill improvements had been actively carried out on the inside in order to improve the habitability.

Analyses of Occupancy Records of a Building with an Addition

One of the households surveyed was a long-term occupant household which had occupied their home in 1977 and had lived in their home for 31 years at the time of the survey (Figure 3). The family composition at the time of occupancy in 1977 was a four-person household, M32, F30, f5 and m3 Note 1. In 1997, the eldest daughter, and in 2002, the eldest son moved out to marry. At the present time, the household is a two-person household, M63 and F61.

Major Adaptive room modifications were performed four times during the 31 year period. The first was carried out in 1983 to provide private room for the daughter who was maturing (Room C in Figure 2). Adaptive room modification, this time accompanied by infill improvement, was done for the second time in 1987 when the building was enlarged. Room E became the parents' (M42, F40) bedroom, room A which had been their bedroom until that time became a combined den and private room for the eldest son (m13), and room B which had been used as a living room was changed to the eldest daughter's (f15) private room. The use of room C was changed by removing part of an interior wall between it and the kitchen so that it and the kitchen could be used as a single room.

Later, when the children became independent in 1997 and 2002, adaptive room modification was done for the third and fourth times. A characteristic of this household is that as each child became independent, rooms were adaptively modified in stages.

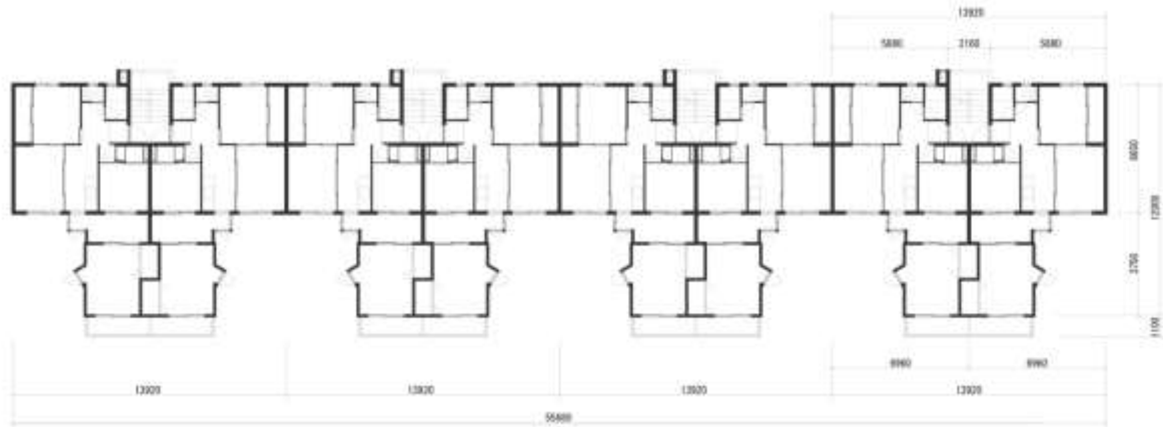

Figure 1: Floor Plan of the Housing Estate Fujimidai which was Surveyed

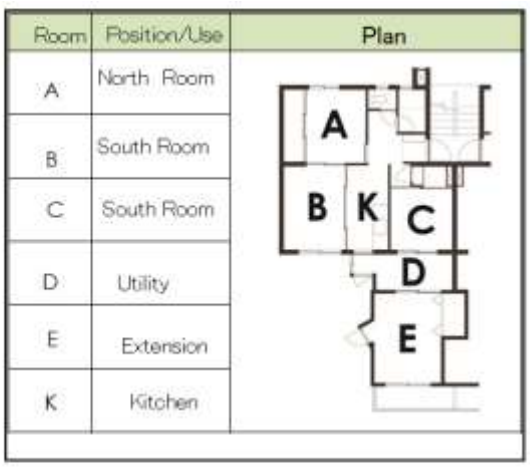

Figure 2: Legend of Room Codes

Figure 3: Example of Occupancy Records of Household in Building with an Addition Note 1

Figure 4: Example of Occupancy Records of Household in Building Without an Addition Note 1

Analyses of Occupancy Records of a Building without an Addition

One of the households surveyed was a long-term occupying household which first occupied the building in 1966, one year after completion of the residential estate, so they had occupied their home continuously for 42 years at the time of the survey (Figure 4). The family composition at the time of occupancy was a three-person household, M24, F21, F'- (grandmother). Their first daughter and first son were born in 1968 and 1971 respectively, and their second son was born in 1973. The household composition in 1973 when their second son was born was a five-person household, M31, F28, F'-, f5, m2, and m0, and six people was the largest number of members in the occupancy records of this household.

In 1983, the grandmother moved to a separate home in response to the maturation of the children, changing this household to a five-person household, M41, F38, f15, m12, and m10. The eldest son became independent in 1993. In 1995, the eldest daughter left home, changing it to a three-person household, M66, F63, and m35.

They performed major adaptive room modification five times during the 42 years. The first time was in 1968 when their first child was born: the parents and the grandmother switched bedrooms. The second and third times, adaptive room modification was done to provide private rooms for the children who were maturing. When the grandmother moved out in 1983, adaptive room modification was done a fourth time, then in 1995, it was done again when the eldest daughter moved out.

Infill improvements done twice during the 42 years were both paid for by the household. When the grandmother moved out in 1983, sliding doors were removed from between rooms A and B, and between room B and the kitchen and replaced with accordion curtains. And a closet in room A was converted into a western style clothes closet.

Conclusions of this chapter

The occupancy records of each dwelling shows a number of innovative measures which householders take over a period of many years so they can enjoy the limited space in their dwellings more effectively and more comfortably. Families mature and change continuously, and demand adaptability so they can make flexible use of dwellings in which they can live for long periods of time. The author believes that this survey of long-term occupancy records will provide basic knowledge needed to create methods of architectural planning to achieve long-term occupancy.

A POST-OCCUPANCY EVALUATION OF LAYOUT CHANGES MADE TO KEP ADAPTABLE HOUSING

Research purposes

The author investigated the “Tsurumaki -3” housing estate of Tama New Town, a suburb of Tokyo (Figure 6). It was the first undertaking of the KEP (Kodan Experimental-housing Project) which the Japanese Housing Corporation started in 1973 in order to research and develop flexibility and adaptability for housing. Since the 1970's, multifamily housing in Japan has been focusing on quality more than quantity. The most important object of this research is to investigate how residents have adopted the design concepts to suit their individual needs and how they have adapted their living environments to changes in their lifestyles over time by remodeling rooms and changing the position of partitions, especially that of KEP movable partitioning system (Table 2). In the Tsurumaki -3 estate, there are 192 units in four-storey flats and 29 units in two-storey terrace houses to own. This paper reports on the survey of the four-storey flats that was implemented in 2005.

Research methods

First, we developed a questionnaire survey for the residents. We took pictures of the interior layouts of units when we were allowed to do so. We asked the residents if they had altered the room arrangement by changing the position of the KEP movable partitioning system or by using a conventional partitioning system. Similar investigations were performed in 1982 (just after the completion of the estate) and in 1995*1,*2. We analyzed the transformation of the room layout of each unit through 23 years by comparing the results of the studies made in 1982, 1995 and 2005.

Results of the survey

The response rate of the questionnaire (the number of respondents / the number of housing units in the estate) was 51.1%. There are three main types of plans for units in the estate: A, B and C (Table 2). Type A can be subdivided into types A1 - A3, Type B into types B1 - B5 and Type C into types C1 - C4, for a total of 12 types of units. Type C units are not equipped with the KEP movable partitioning system. We did not study Type B3 because it has not been studied previously. Table 2 shows the plan and the location of the movable partitioning system in each type of unit.

Residents’ interest in permanent occupancy was changing during the 23-year survey period. In 2005, 26.2% of the residents were in their fifties and 17.2% were in their sixties. In more than 40% of all households there was at least one child over 18 and 34% of households had no children.

Figure 7, 8 and Table 1, 3 show the attributes of the residents (age structure) and changes in their views of permanent occupancy. Figures 7 and 8 indicate that the distribution shape has shifted to the right by ageing. In 2005, 26.2% of all residents were in their fifties and 17.2% in their sixties. As for family structure, about 40% of all households had at least one child over 18 years old and about 34% of households were childless couples at least 40 years old. The aging of the residents and the maturity of each family were the result of young couples in their twenties and thirties moving in at the time of the completion of the apartments and continuing to live there for more than 20 years afterwards. Eldest child ages rise toward the right of the graphs. Residents of Type C units tended to reside longer than residents of type A or B units which had been equipped with the KEP movable partitioning system.

Residents have been aging and families maturing in the estate. As they have aged, their interest in permanent occupancy has increased. Table 3 indicates that the interest in permanent occupancy has increased and 63% of residents were thinking of living permanently in their units in 2005. Table 1 shows the changes in concepts of permanent occupancy of the residents who have lived there continuously since 1982. Similar to Table 3, interest in permanent occupancy has risen. The residents seem to have become more willing to live in their units as long as possible as they aged.

Changes in the room arrangement

Rates of room arrangement changes

Both the KEP movable partitioning system and a conventional remodeling system were used to make changes in the room arrangement. Residents of 29.5% (26/88 Note2) of apartment units have made some changes to their room layout. Residents of 38.8% (14 /36) of Type A units and 47% (9 /19) of Type B units have made at least some room layout changes. On the other hand, only 9% (3/33) of residents of Type C units (which do not have the movable partitioning system of the A and B units), have made room layout changes. In most cases, the room layout has been changed in order to make the living room or private room larger and it has been residents whose children have left home who have made the layout changes. By 2005, the children of many households in the estate had already moved out. The KEP system, which allows a living room or a private room to be enlarged by moving the partitioning wall and/or partitioning storage walls separating two rooms, has been adapted well to the changing needs of residents.

An example of the room arrangement changes in a Type A unit

Figure 9 shows the changes in the layout of a Type A (A3) unit that have been made since 1982. The diagram illustrates the use of a room, location of movable partitioning wall, family member attributes (M: man, F: woman, m: boy, f: girl) and their ages (number shows age). In 1982, this family had pre-school children. In the ensuing years, the children entered school, finished school and left home. In 1995, the mother started to give piano lessons at home and moved the partitioning storage walls to connect the living room with the adjoining private room to make a large single room. This example shows how the KEP system has allowed residents to tailor their living spaces to meet their individual needs.

2.4.3 An example of the room arrangement changes in a Type B unit

Figure 10 shows an example of the layout changes in a Type B (B4) unit. This family has also been living in this unit since 1982. In 1982, their children were of school age, but finished school and left home afterwards. When the children left home, this family moved the partitioning storage walls and connected the living room with the private room to make it larger.

Figure 5: Housing Estate Fujimidai

Figure 6: Tsurumaki -3 Estate

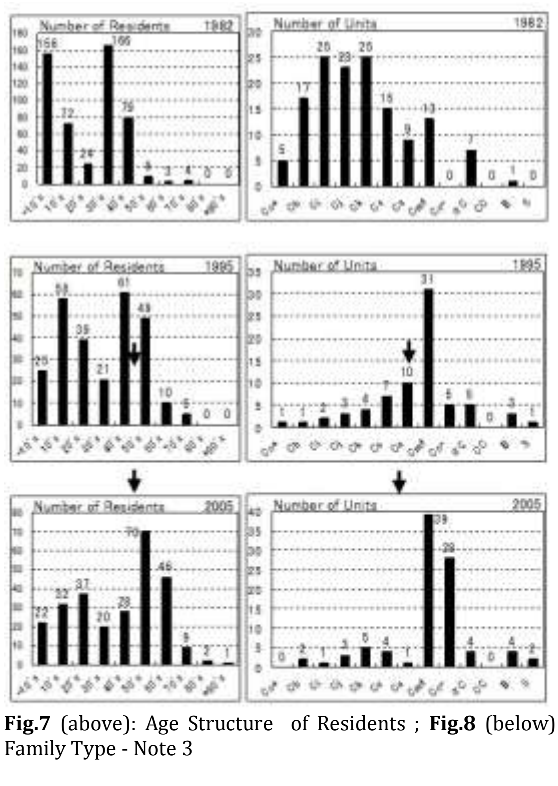

Fig.7 (above): Age Structure of Residents ; **Fig.8** (below) Family Type - Note 3

Table 1: Changes in interest in permanent occupancy (Families who have lived in a unit since 1982)

Unit Type	1982	1995	2005	Unit Type	1982	1995	2005
A1−1	permanent	undecided	undecided	B4−2	undecided	permanent	permanent
A2−1	permanent	permanent	permanent	B5−1	permanent	no data	permanent
A2−2	undecided	undecided	permanent	B5−2	permanent	permanent	permanent
A2−3	undecided	undecided	undecided	C1−1	temporary	no data	undecided
A2−4	undecided	undecided	permanent	C1−2	permanent	no data	permanent
A2−5	undecided	undecided	undecided	C1−3	undecided	no data	undecided
A2−6	permanent	permanent	permanent	C1−4	undecided	no data	permanent
A2−7	undecided	permanent	undecided	C1−5	permanent	no data	permanent
A3−1	undecided	undecided	permanent	C1−6	undecided	no data	permanent
A3−2	undecided	undecided	permanent	C1−7	undecided	no data	permanent
A3−3	permanent	undecided	permanent	C2−1	undecided	no data	undecided
A3−4	undecided	permanent	permanent	C2−2	permanent	no data	permanent
A3−5	permanent	permanent	permanent	C3−1	permanent	no data	undecided
B2−1	permanent	permanent	permanent	C3−2	undecided	no data	undecided
B2−2	temporary	undecided	undecided	C4−1	permanent	no data	permanent
B4−1	permanent	permanent	permanent				

Table 2: The plan of each type and the location of the movable partitioning system
①: KEP movable partitioning system; ②: KEP movable storage system; NA: Not available

Type A1	Type A2	Type A3	Type B1
			
Multi purpose room-Kitchen, Multi purpose room-Private room	Living room-Private room	Multi purpose room-Kitchen, Living room-Private room	Private room-Storage
Type B2	Type B3	Type B4	Type B5
	Not studied		
Private room-Storage		Private room-Private room, Living room-Private room	Private room-Private room
Type C1	Type C2	Type C3	Type C4
			
NA	NA	NA	NA

Table 3: Interest in Permanent Occupancy (% of all answers)

	Permanent occupancy	Temporary occupancy	Undecided	No answer	Number of answers
1982	37	13	50	0	135
1995	48	9	41	1	88
2005	63	5	30	2	93

Analysis of the room arrangement changes

Room layout changes to make a living room larger

The residents can make their living rooms larger by changing the position or removing the movable partitioning walls and/or the movable partitioning storage walls. 10 families made their living rooms larger by using the KEP system, while two families used a conventional method. Nine of these 12 families, including eight of the 10 families who used the KEP system, started to live in this estate in the 1980's. Many families have made their living room larger, especially after their children left home and they got an extra room in their unit.

The 1995 survey included examples of families who had changed the layout of their unit when they came to live in this estate. At the time, children of those families were still young, mostly preschoolers. These families connected their living rooms with the adjoining private room in order to make a large single room.

Layout changes to make private rooms larger

As the case with their living rooms, residents can make their private rooms larger by moving the partitioning wall and/or partitioning storage walls. Residents of eight of 11 units who changed a private room layout used the KEP partitioning system. Many of the residents who made their private rooms larger had moved to the estate some years after its completion in 1982. Although the 1995 survey noted that many families enlarged the private rooms in order to tailor the room arrangement for their way of living at the time they came in, not to fit it to changing needs in the future, the 2005 survey found that many of the residents changed the room arrangements to give enough space for their children who entered school or to use children's rooms for other purposes after the children left home.

Layout changes to increase the number of rooms

In this paper, we used the expression "layout changes to increase the number of rooms" to refer to the re-installment of KEP movable partitioning walls and/or partitioning storage walls which had at one time been removed. We found two examples of them in the 2005 survey. When they moved into their unit, one family re-installed the partitioning walls which had been dismantled by the previous residents. The other family dismantled the partitioning walls and partitioning storage walls once and reinstalled them as their children grew older.

The survey in 1995 showed that the number of children's rooms had increased as the children grew, resulting in an increase in the total number of rooms in an average unit. Many of the families who changed the room arrangements had children whose ages were late teens.

Conclusions of this chapter

We studied the post occupancy changes in housing units which had a KEP movable partitioning system. As children grew, and when they left home, many families used the KEP partitioning system to adjust the room arrangements to fit the changes in their lifestyles. The KEP system appears to have worked the way it was planned to more than twenty years ago. Some of the residents told us that some of the mechanical parts of the movable partitioning system had become rusted and did not work well enough for them to move and/or reinstall by themselves. There were also residents who thought the sound insulation performance of the movable partitions was not good enough because of the joints between the partitions. They did not think it would be worthwhile to sacrifice the sound insulation performance of the partitions for the sake of movable partitions that would likely be used only once in 10 years. The residents' experiences and comments suggest important topics for us to research further.

CONCLUSIONS

The lengthening of the life of a house is believed to be useful to reduce the consumption of natural resources and the economical burden of housing expenses for families. This is the inevitable approach for future housing in Japan. The research and development to increase the adaptability for housing is not new at all but there has not been enough research to examine the results of the experimental projects afterwards. The author has been trying to compare the occupancy records of experimental projects such as Tsurumaki-3 in Tama New Town and ordinary public housing such as Fujimidai to analyze the differences between them. The author observed the facts that even in rental housing without any movable partitioning building system, households tend to modify their infill to meet changes in family structures and lifestyles. This adaptability is the most important factor to enable households to live in their housing for a longer time.

As the number of people in households has been decreasing and most of the housing in large cities in Japan is occupied by only one or two people, the necessity for adaptability may be different from what it used to be. Nowadays, much housing in Japan requires remodeling to meet the needs of young, small families as well as those of senior families without children. The author believes that it is important to study how households change their living environments in order to find proper design methods and infill technologies which will continuously enable the needs of each family to be met in the future.

Figure 9: An example of the room arrangement changes in a Type A unit. The dashed lines indicate the position for the movable partitioning system (The symbols M, F, f in the figure show the rooms where the residents slept.)

Figure 10: An example of the room arrangement changes in a Type B unit. The dashed lines indicate the position for the movable partitioning system (The symbols M, F, f in the figure show the rooms where the residents slept.)

NOTES

＊1 : M: man, F: woman, m: boy, f: girl. Number shows the age.

The symbols M, F, m, f in the figure show the rooms where the residents slept.

＊2 : The number of effective answers

＊3: Family types are classified by the age of the eldest child of a family.

Co+: Couple only (the wife is under 40 years of age) Cb: Parents with child/children (Eldest child is 0-2 years old)

Ci: Parents with child/children (Eldest child is 3-5 years old) Cj: Parents with child/children (Eldest child is 6-8 years old)

Ck: Parents with child/children (Eldest child is 9-11 years old) Cs: Parents with child/children (Eldest child is 12-14 years old)

Ca: Parents with child/children (Eldest child is 15-17 years old)

Cmf: Parents with child/children (Eldest child is over 18 years old) Co-: Couple only (The wife is over 40 years old)

αC: Family with grandparent(s)
CC: Two-couple family

B: Single-parent family S: Single-person family
βC: Family with grandsons/granddaughters

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What Can Make Effective Use of Vacant Buildings Happen in the Market? New Context of Japanese House Building Industry

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ABSTRACT
"We need to overcome the lack of space and infrastructure." Urban construction in the 20th century had been basically motivated by this need. It had enabled almost automatic financing on land as well as plenty of public investment. However we can expect such investment in urban built environment no more in this century, when urban structures have been fully built. So the key question today is "How can investment in urban built environment be sustainable in this century?" "We have space and infrastructures but want to make them something better." This new want will not result in old-fashioned public investment nor automatic financing on land. Instead we will need the new way how to strategically organize users' creativity on their own environment as well as such users' want itself for sustaining investment in urban regeneration. This paper clarifies new business models to organize users' creativity on the use of many vacant buildings in Japan, such as infill renovation, building quality appraisal based on support/infill separation, matching service on web sites and specific conversion etc..

KEYWORDS:
users' creativity, vacant buildings, full-dress renovation, conversion, second-hand market

INTRODUCTION

The house-building market in Japan has been extraordinary from the viewpoint of the size. Fig.1 clearly shows that Japan has kept annually over nine new housing units construction per one thousand inhabitants for about forty years since 1967. UK market has never experienced similar size market since 1950. Although USA, France and Germany have experienced similar size ones, those are only a few years experiences. Compared with those, forty years continuity can be said extraordinary. Such phenomena in Japan as the appearance of huge prefabricated house manufacturers, the diversity of construction methods etc. should be understood based on this extraordinarily long lasting huge new house-building market.

However in these years Japanese market has become rather ordinary from the viewpoint of the size. In 2007 the number fell down under nine housing units per one thousand inhabitants and it became about six housing units in 2009 and 2010. This number equals to that in 1962 when the full-dress rapid economic growth started. It means that Japanese house-building industry faces an ordinary size market after an interval of half a century. They are now looking for their new business field. One expected field is foreign market and another is renovation of existing and buildings. This paper deals with the latter one.

While new building market will probably shrink, people's demand for effective use of existing buildings will enlarge. Many people in the industry come to think so. There are two major reasons relating to the today's condition of existing housing units in Japan.

Firstly, Japan has about 57.6 million housing units which exceeds the number of households, 49.9 million, by about 14% (Fig.2). Consequently vacancy rates has increased to over 13% in 2008. It can be said that Japan has quantatively enough housing units.

Secondly, lookig at the quality of those existing housing units, more than two thirds of them were built after 1981 when Japanese building regulations concerning seismic engineering were largely upgraded. And the average floor area of one newly-built housing unit in 1981 is larger than today. So it cannot be said that the quality of existing housing units in Japan is poor enough to demolish and rebuild.

Based on such an actual conditon of the market, there can be found new business models to organize users' creativity on the use of existing buildings including many vacant ones in Japan. This paper clarifies the newly appearing business models, such as infill renovation, building quality appraisal based on support/infill separation, matching service on web sites and specific conversion etc.., focusing on the way how to connect surplus space with users.

NEW CONNECTION 1– CHANGES OF SECOND-HAND MARKET

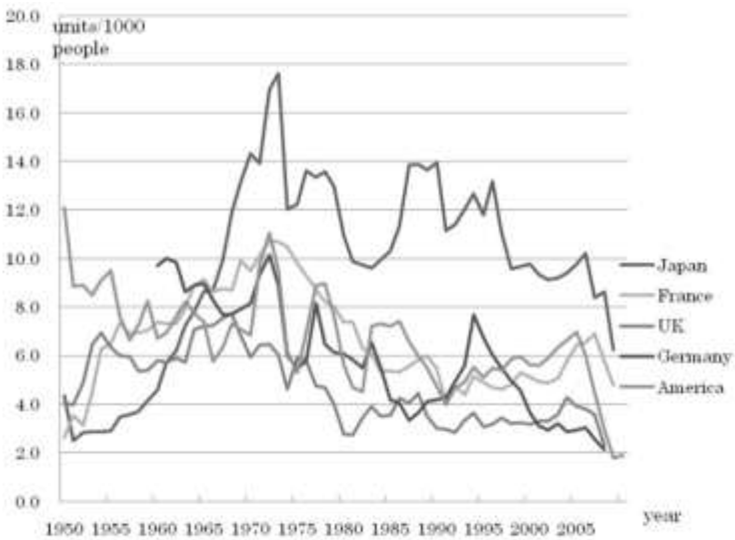
Appraisal and Trade of Existing Single-Family Houses

Several house-building firms started to stimulate second-hand market which has been much smaller in Japan than US or UK so far in order to find collateral demand for renovation. "2004 White Paper on Land, Infrastructure and Transportation in Japan" by Ministry of Land, Infrastructure and Transportation (http://www.mlit.go.jp/english/white-paper/mlit04.html) showed the percentage of second-hand home sales to total home sales in Japan-11.8%, USA-76.6%, UK-89.0% and France-70.7%.

As for single-family houses, appraisal has been majorly done on land because they believe its value will continue eternally while the life of a house on it is short. Generally speaking, a 15 years old house can be estimated as zero value in Japan. As its result, those who can manage to own a vacant but not so old house will not easily sell it.

To change this situation, ten large house-building firms -Asahi Kasei, S by L, Sumitomo Forest, Sekisui Chemical, Sekisui House, Daiwa House, Toyota Home, Pana Home, Misawa Home and Mitsui Home- established "High Quality Houses Promotion Consultations (Yuryo Stock Jutaku Suishin Kyougikai" (http://sumstock.jp/ available only in Japanese) and started to apply a new appraisal system. Their new appraisal system is different from conventional systems in Japan majorly from four viewpoints. Firstly, divide between support -they call it "skeleton"- and infill in the building appraisal. Secondly, appraisal by building experts. Thirdly, addition of long-term periodic inspection contract. Fourthly, price indication for a building separated from land. This appraisal system can be implemented in such a special condition that each firm only appraises its former products because they can easily know all the details of houses. On the contrary it is difficult and costs much for them to know all the details of other firms' buildings.

Based on this new appraisal system, some firms started a new business. Taking an example of Sekisui House "Everloop" (http://www.sekisuihouse.co.jp/company/data/current/document-768-datafile.pdf), Sekisui House buys back former products on land from former customers based on the appraisal and then renovates and sells them to new customers.



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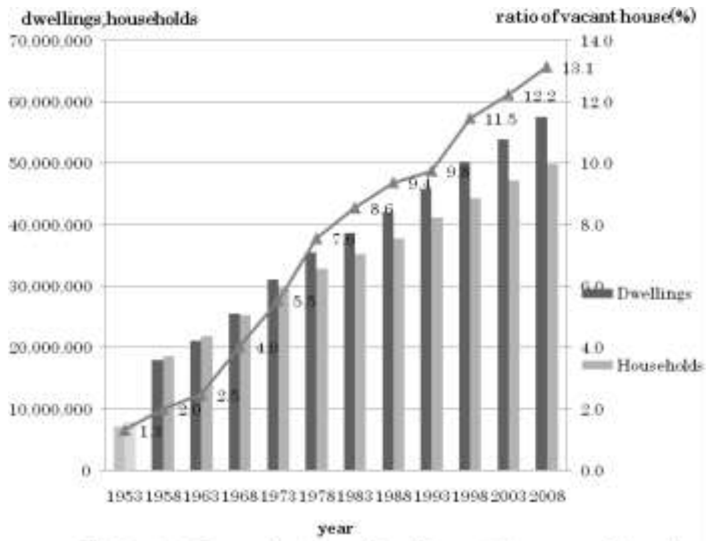
housing starts: "pocket housing statistics", Japan Housing Finance Agency, 2008, 2011
population : Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat
(http://esa.un.org/unpd/wpp/unpp/panel_indicators.htm),the 2010 revision

Figure 1: The Annual Number of Newly-Built Housing Units per 1000 Inhabitants



sources:The Statistics Bureau,Housing and Land Survey,1953 survey only in urban areas

Figure 2: The Transformation of the Number of Households, Housing Units and Vacancy Rate in Japan

Appraisal and Trade of Existing Condominiums

Similar movements of value addition can be found in the second-hand market of condominiums. Typical example is the activity of "Renovated Home Promotion Consultations ("Renovation Jutaku Suishin Kyougikai)" (http://www.renovation.or.jp/ available only in Japanese) established in May, 2009. It is composed of more than three hundred real estate firms (August 3, 2011). They made and apply their own standard of inspection, construction, reporting, record of condominium and warranty. Based on this common standard they are to relieve customers of second-hand and renovation market from uneasiness about invisible quality of existing condominiums.

Relating to such stimulation on second-hand market, lots of firms started to merchandise full-dress renovation called as "skeleton reform (Japanese English)" etc. especially for rather old condominiums built before 1990. Some of them are doing in a fixed price manner with their own standard specifications which can simplify their design and construction process and enable them to buy building components and materials in larger quantity, namely at lower price. Also some of them develop and apply prefabricated infill systems to upgrade some kinds of building performance and rationalize construction process (Intellex Co. http://www.intellex.co.jp/english/ as an example).

In most cases, such renovation is done after a new customer bought an existing condominium. But in some cases real estate firms buy housings unit or buildings and renovate them to sell.

NEW CONNECTION 2 – USERS' INITIATIVE

Two Kinds of Users' Initiative

Users' creativity can sometimes realize effective use of surplus space without any expert support from real estate firms or house-building firms. In such cases, users who understand area context and have expected activities in the area in their minds find potential surplus space to use. Those users can be organizations as well as individuals.

Even in newly-building oriented country, Japan, the organization initiative type could have been seen since the last century such as nursing home organizations' use of vacant dormitories for employees of large firms.

Individual Initiative

Although there is not statistical data on conversion by individual users' initiative, there can be many. But such conversion as to change or revitalize the area is still exceptional. Of them the most successful one is the activity of Real Tokyo Estate which established an unique "matching service" web site in 2003 (http://www.realtokyoestate.co.jp/ available only in Japanese). Its founder, Arch. Masataka Baba, selected Nihonbashi area which was an old commercial center of Tokyo as his working place and found a very tiny two story high vacant building. After negotiation with the building owner he borrowed and renovated it. Through this process he noticed that there were many vacant buildings built in 1960s and 1970s in this area. At the beginning he wrote in his personal blog how charming such ordinary '60s and '70s buildings in the area were. Soon it happened that many readers appeared and some of them asked him to instruct how to borrow surplus space and live in the area. Afterwards he and his friends from real estate business established a new type real estate firm specially for those who would like to live at converted vacant buildings in central area of Tokyo. There are many converted buildings in the area now.

Nowadays similar phenomena can be found not only in big cities but also small rural villages. Echizenhama village in Niigata Prefecture is a typical example. Mr. Yasuhiro Hoshina, who used to be a young architect and is now a dyer, was puzzled at the lack of space for dying in his apartment in Niigata City a few years ago. Then he remembered beautiful but vacant thatched roof folk houses at Echizenhama where he did research works during his undergraduate period. He visited the village at about 20 minutes distance by a car from Niigata City and looked for a good vacant folk house to live and work. Although the village people had no experience to rent a folk house to persons from outside, he toughly negotiated to succeed in borrowing a big folk house at a very low rent. Consequently his move stimulated his friends living in Niigata City as well as the village people to see more than ten vacant houses welcoming people from outside.

Both examples showed the possibility of individual initiative in the effective use of surplus space to organize users' creativity and find new market.

NEW CONNECTION 3 – EXPERT MEDIUMS TO ENCOURAGE NEW USERS

Consultancy for Building Owners

It has recently been remarkable that experts stimulate potential users' demand with renovation design or new use arrangement. Those experts mostly work as consultancy for building owners.

As for renovation design, it has gradually become a non-special field of architects and builders even in Japan. One of the pioneers in this field is Arch. Shigeru Aoki (http://www.aokou.jp/ available only in Japanese). He started to specialize in renovation design in 1990s and has called his works as "Refine Architecture (Japanese English)". Many building owners have recently ordered for consultancy of profitable use of their own obsolete buildings to him. Indeed the sites of his renovation works were limited in Kyushu Island at the beginning but nowadays his works can been seen all over Japan.

As for new use arrangement, new type of consultancy business has clearly appeared in these years. One typical example is consultancy for building owners, who have vacant houses or apartment buildings, which instructs them how to renovate such obsolete buildings to be a new type of apartment houses called as "Share House". In case of Hitsuji Incubation Square Inc., which was founded in 2007 and are managing the most popular web-site of shared houses named as "Hitsuji Real Estate"(http://www.hituji.jp/ available only in Japanese), this firm is instructing building owners how to renovate and manage such kind of apartment houses and introduce the renovated shared houses to expected users on its own web-site if the renovation follows its own requirements from sharing houses. Consequently such new consultancy business can actually connect surplus space with new users.

Provisional Building Managemment

It is also remarkable that some experts sublease vacant buildings for rather short contract term from building owners who want to find provisional use of their properties. Those experts mostly work as consultancy for building owners. Those experts renovate and manage those buildings for new demand on their own risks.

Fig.3 shows renovation of former Urban Renaissance Agency (UR) apartment houses. UR is a public housing agency which was founded as "Japan Housing Corporation" by the government in 1955 and owns about 700 thousand rental apartment all over Japan. Its original role was to solve housing shortage problems in big cities but there are not such problems any more. Therefore it stopped new supply of apartment houses and is now engaged in the management of existing apartments. Usually the management is its own task but in this new case UR decided to sublease four vacant fifty years old apartment buildings to those who had new ideas of use and the ability to realize them.

This challenge is called as "UR Building Renaissance Project" (http://www.ur-net.go.jp/east/pdf/ur2011e_0608_tamamusubi_01.pdf). The major reason of such subleasing is that UR had not decided to demolish them yet and wanted to provisionally use them. UR called proposals of new use and management of those buildings for 15 to 20 years subleasing term. Three proposals were selected and realized. One selected agency subleased two buildings to renovate them to shared apartment houses for younger generation and manage them. Another one renovated one building to apartment houses with vegetable gardens majorly for retired couples. The last one renovated another building to apartment houses with day care facilities and sevice for elderly people. Each of them will continue their own business. In short those three agencies invested for renovation to connect surplus space with new users.

Fig.4 shows another challenging sublease project called as "3331 Arts Chiyoda" (http://www.3331.jp/ available only in Japanese). There are now lots of vacant school buildings all over Japan bacause of rapid decrease of pupils and students. This converted building was a typical example. Chiyoda-ku Ward has been the owner of this former school building in the central area of Tokyo so far. After seeking new use of this vacant building for several years, Chiyoda-ku Ward finally decided to sublease it for five years based on prposal competition. The selected proposal was to renovate the thirty years old school building and revitalize it as a center of contemporary artists' activities in Tokyo. Its responsible agency found the possibility of the location next to a small park and opened the former school building to the park by making a big openning to the park as well as removal of long and tall fences inbetween. As its result, Chiyoda-ku Ward and the agency succeeded in not only connecting surplus space in a building with new users but also welcoming many new young people to this formerly deserted area.

One of common features in both cases are the fact that the agencies which subleased and renovated vacant buildings are composed of several kinds of experts including architects. Another is that the agencies showed the possibility of attracting and welcoming new users to make vacant public buildings the core of new area management.

Figure 3: UR Building Renaissance

Figure 4: 3331 Arts Chiyoda (Entrance Hall)
(Source:http://www.3331.jp/)

CONCLUSION

Based on the cases of individual initiative mentioned above, it can be said that two kinds of action is essential to make users' creativity work, namely to find utility value of surplus space and to arrange surplus space for new use. Fig.5 puts the above-mentioned support by experts in order accordingly.

As action A -to find utility value of surplus space- includes users' finding guided by others, the support by experts can be regarded as such guidance. Concerning "retailing of building components for DIY" in Fig.5, more and more examples of what is called "self-renovation" have appeared even in Japan where DIY is not so popular.

As the support for users' action A and B will be widely evolved, effective use of surplus space can be more promoted. For that, the existence of such experts as to read area's context as well as building's identity and new type of users' demand can be said important. Such experts need knowledge and experiences on real estate, management and buildings. For finding such experts, it is the easiest to make a team composed of all necessary kinds of specialists. But on the other hand education system of new kind of experts will be a new target of professional association and schools following the change of the market condition.

ACTION TO MAKE CREATIVITY ON USE WORK	SUPPORT BY EXPERTS (ACTUAL CASES)
A. TO FIND UTILITY VALUE OF SURPLUS SPACE	・APPRAISAL OF EXISTING BUILDINGS ("High Quality Houses Promotion Consultations" etc.) ・EVOLUTION OF "MATCHING SERVICE" ("Real Tokyo Estate" etc.)
B. TO ARRANGE SURPLUS SPACE FOR NEW USE	・MERCHANDIZING OF FULL-DRESS RENOVATION ("Renovated Home Promotion Consultations" etc.) ・RETAILING OF BUILDING COMPONENTS FOR DIY
C. A＋B	・PLANNING AND DESIGN FOR RENOVATION (Sigeru Aoki's works etc.) ・PLANNING AND PUBLICITY OF TARGETED CONVERSION ("Hitsuji Real Estate" etc.) ・PLANNING AND MANAGEMENT OF PROVISONAL USE OF EXISTING BUILDINGS ("UR Building Renaissance Project", "3331 Arts Chiyoda" etc.)

Figure 5: Action and Support to Make Creativity on Use Work

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Comparison of Residential Plumbing Solutions for Open Building Approaches with Chinese Conventional Approach

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ABSTRACT
China has a long history of mass housing construction. This history resulted inevitably in monotonous building forms and spaces and many problems including difficulties of constant renovation. Now China is undergoing a process of industrialization of products and processes in the building supply channels. One aim is to increase choice for inhabitants and future variability of residential building. As open building has widely shared principles in many areas throughout the world, its theory and practical strategies are valuable for Chinese future development of residential building, either in newly built or adaptive reuse of residential building. In this paper, as part of the research of Open Building, its methods and technical subsystems, plumbing systems in multi-unit housing are discussed. The paper compares Chinese conventional approaches with several possible plumbing solutions used in Europe and Japan. These are classified according to the installation position of plumbing pipes. These plumbing solutions are illustrated and analyzed from different points of view, including space utilization, layout variability and future variability, etc to objectively summarize the advantages and disadvantages of different plumbing solutions and applicability in Chinese multi-unit residential buildings.

KEYWORDS: Residential Open Building, Chinese conventional multi-unit residential buildings, Infill Systems, Plumbing solution

INTRODUCTION

Multi-unit housing is the main residential type in China. The result is that households have to share some parts of the buildings they occupy. Sometimes conflicts between neighbors are caused by territorial interference, e.g. noise, leaking of drainage pipes, etc. On the other hand, the parts in the building that have a long-life cycle such as concrete floors, facades and demising walls (unit separation walls) are entangled with the parts that have a relatively short-life cycle, such as electric wiring and plumbing. For example, penetrations of the floor slab for drainage pipes are common but problematic as we have known for many years, and pipes for water supply are buried in the floors and walls making any change, identification of problems and repair work difficult or impossible (Figure 1).

Actually, China has been attempting open residential building since the 1970's. However the approach towards Open Building was hard. Now China is undergoing a process of industrialization of products and processes in the building supply channels. One aim is to increase choice for inhabitants and future variability of residential building. Open building principles and methods may be useful in this development phase. In the meantime, the obsolescence of existing residential buildings only about 30 years old is very common in China. One of the reasons is the difficulty of adaptive reuse or upgrading for the existing buildings. For these existing residential buildings constructed conventionally in China, Open Building concepts can also be used to bring the older building stock "up to new standards".

The term Open Building can be understood in a variety of interrelated ways. It sees a building as a composition of a large number of sub-systems subject to change, at varying cycles, by the action of many agents over its lifetime. To enable buildings to last while recognizing that buildings are never finished, open building proposes a clear separation between base building (the long lasting and common part of a building) and infill or fit-out (the part of the building related to each individual occupancy – and sometimes under the direct control of the occupant). Compared to conventional residential buildings in China, Open Building concepts emphasize the disentanglement of base building and fit-out, rather than their integration and simultaneous design and construction (Figure2). All sub-systems of Open Building are also disentangled with each other to minimize interfaces and interdependencies among them, while they are still closely related and coordinated.

In recent research and practice of open residential building, plumbing system is always a core technical issue in regard to independent design of each tenant space, particularly the independent placement of bathrooms and kitchens. As a result, only drainage and domestic water plumbing systems in multi-unit housing are discussed in this paper. Further research will compare conventional practices and open building practices, including other sub-systems and their interrelations.

PLUMBING SOLUTIONS FOR RESIDENTIAL OPEN BUILDING

According to the general principle of Open Building, the following pipe routing strategies are classified by position of water supply and drainage piping between the fixture (part of the fit-out) and the vertical drainage pipe (part of the base building) (Figure 3):

Water supply and gray water drainage pipes are placed in grooves of Matrix Tiles, laid on the base building floor and under the finished floor. Matrix Tiles were developed and first used in the Netherland in 1989 as part of the Matura Infill System. Matrix Tiles have grooves to fix water supply and 0-slope gray water drainage pipes (Figure. 4, 5). Black water drain pipes connecting a rear-outlet toilet must be positioned behind walls but above the base building floor, unless a macerating toilet is used, in which case waste is pumped in small diameter pipes without regard to slope.

Figure 1: Entanglement in Chinese residential building

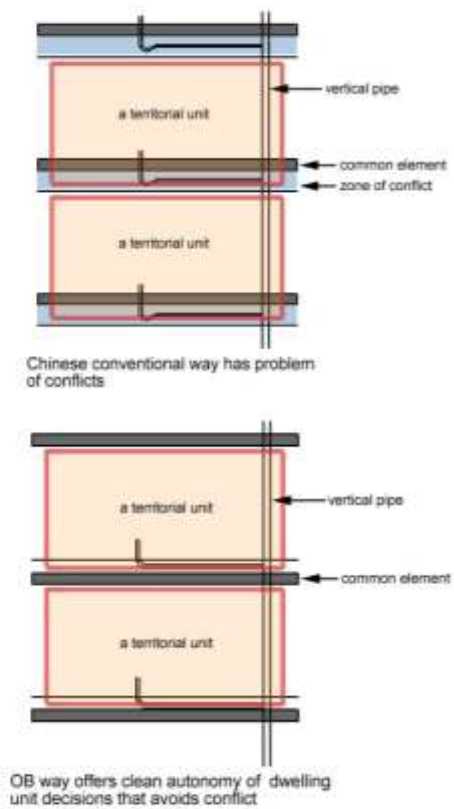

Figure 2: Comparison of Chinese conventional way and OB way

Water supply and drainage pipes are placed under hollow raised floors. Raised floors are very common in many Japanese residential projects as early as the 1970s (Figure 6, 7), while in Europe it was always problematic and never widely accepted. Underneath the raised floor, water supply and drainage pipes are located sometimes with floor heating system and other mechanical systems, and remain accessible by lifting sections of the floor. It always costs some additional story height, for example, in Hoya II Infill system of Japan the total height for the raised access floor is 1’4’’ (40cm).

Pipes for water supply and drainage are placed in floor trenches. Principally in Japan, floor trenches are formed into base buildings in some projects when a slab and beam structure is used – the beams are on top of the slab in this case. The use of “trenches” in specific areas of a floor plate constrains the location of the bathrooms and kitchens. In the NEXT21 project, floor trenches with the height of about 2’(60cm) were designed as 3-dimensional streets (equivalent to common aisles) to accommodate base building water supply and drainage pipes and gas pipes, allowing large-scale rearrangement of water-related facilities (Figure 8). In that project, the “street trench” was combined with the more standard raised floor in the dwelling spaces. Other variations of the “trench” idea have been used, for example, FlexCasco in the Netherlands. In that concrete system, the floor trenches can be cut on-site in a non-structural top layer of the concrete slab, according to different floor layouts.

Water supply and drainage pipes are placed between double walls. Some trials had been done with pipes placed inside partition walls - in the opening of metal studs with gypsum board on both sides (Figure 9). It turned out that the organization of pipes, especially horizontal drainage pipes with slope running through openings in studs was very complicated in the limited thickness of partition walls. It is simpler to place the pipes between double walls that provide more space for easy installation and do not require coordinated openings in studs,. The distance between two rows of stud partition walls (or between a partition and a demising wall) is usually 4’’ (10cm) or more and the total thickness of the double wall is 12’’ (30cm) or more (Figure 10, 11). This dimension depends on the size of ducts for air conditioning and ventilation that share space with water pipes, drainage pipes and wiring between double walls. One difficulty in this approach is that the organization of these utility conduits can be complex and become disorganized.

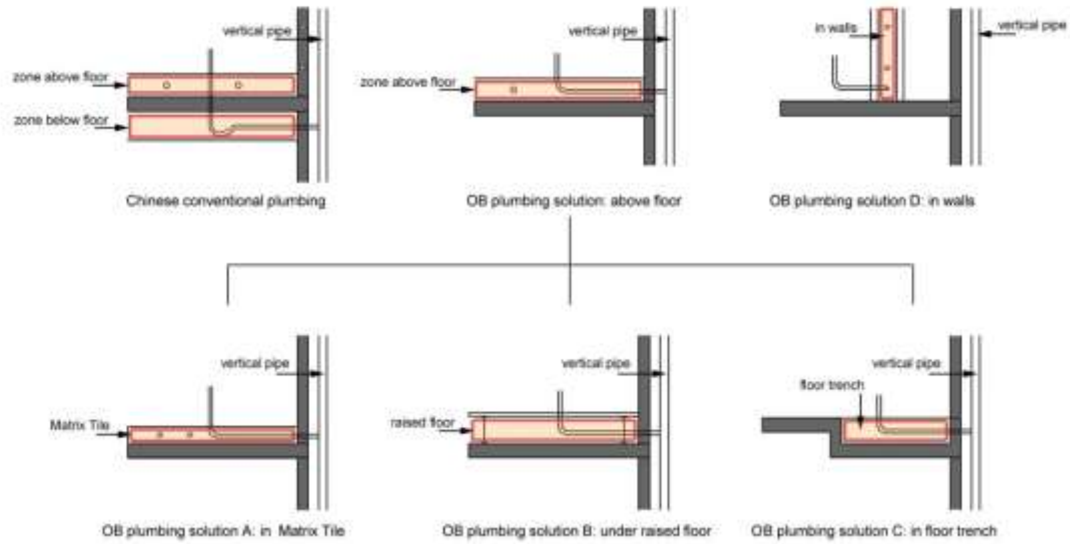

Figure 3: Chinese conventional plumbing and OB plumbing solutions



Figure 4: Original version of the Matrix Tiles with drain lines on the bottom (invisible) with domestic water and heating pipe-lines on top (visible) (left); **Figure 5:** New Matrix Tiles with drain and water supply piping in grooves on the top (right)

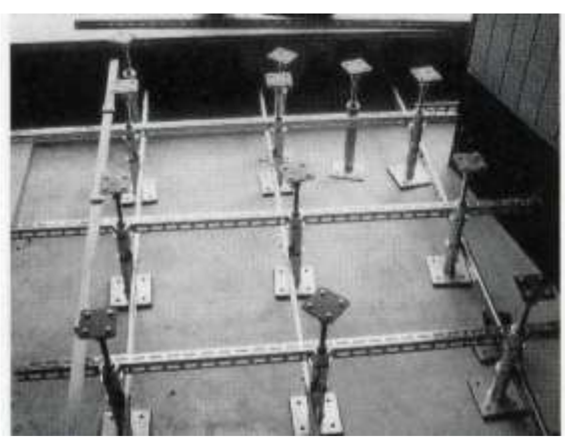
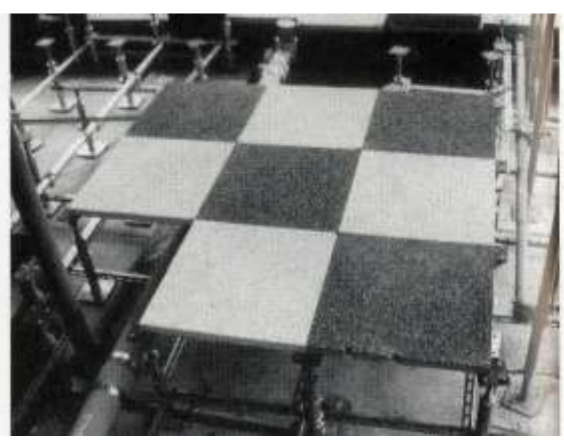
Figure 6, 7: raised floor

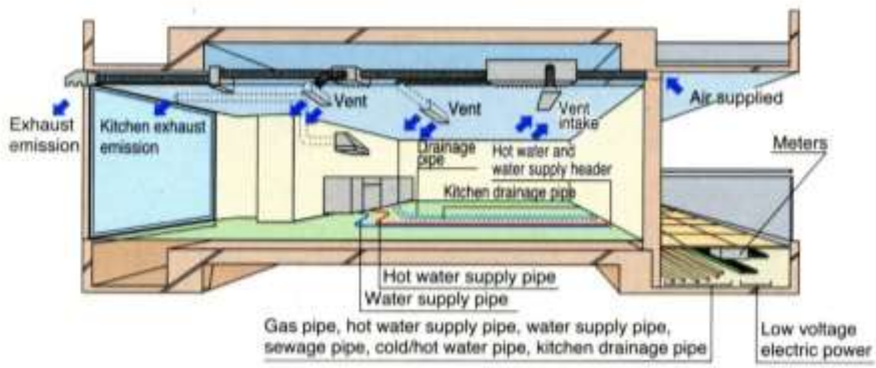

Figure 8: Floor trench in NEXT21 project

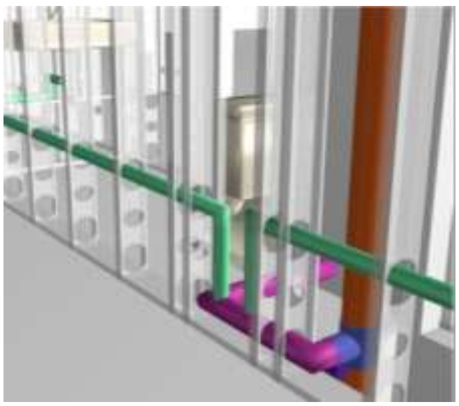

Figure 9: Pipes in partition wall (left); Figure 10, 11: Pipes between double walls (middle and right)

Table 1 Comparison of four kinds of Plumbing Systems with Chinese conventional approach

		Chinese conventional Plumbing	OB Plumbing solution A	OB Plumbing solution B	OB Plumbing solution C	OB Plumbing solution D
Position	Supply pipes	in the floors and walls	in Matrix Tiles	in hollow raised floor	in floor trench or raised floor	between double walls
	Grey drainage pipes	in the ceiling of lower floor	in Matrix Tiles		In floor trench with floor covering	
	Black drainage pipes		in or between walls			
Slope (Min)	Grey drainage pipes	0.02	0	0.02	0.02	0.02
	Black drainage pipes	0.01	0.01	0.01	0.01	0.01
Space needed		least 1'~2'(30~.60cm)height in the ceiling of bathroom and kitchen	less 4'' (10cm)height on the floor in whole dwelling	most 1'4'' (40cm)or more height for the raised floor	less 1'4''(40cm) or more height for the floor trench	less 8'' (20cm)extra thick for the double wall
Layout variability		lowest	high	highest	high	high

COMPARISON OF DIFFERENT KINDS OF PLUMBING SOLUTIONS WITH CHINESE CONVENTIONAL APPROACH

As already noted, floor penetrations are very common for drainage pipes in the Chinese conventional residential approach. In fact, this problem is evident in other countries as well and is not limited to China. The problem has been recognized for some years, so recently in China, partly recessed concrete floors in bathroom areas, or raised floors used in the entire dwelling space began to be carried out in some projects. These concepts were mostly imported from Japan, e.g. CSI (Chinese Skeleton/Infill). In this paper additional technical solutions for plumbing are introduced and compared, aiming to identify possible and proper solutions for Chinese dwellings in different circumstances.

In table 1, the comparison focuses on the space needed for technical solutions and layout variations, which are significantly determined by the position and slope of the pipes. Obviously from table 1, Chinese conventional plumbing offers the lowest layout variability (especially considering the position of bathrooms and kitchens) and lowest first cost. OB plumbing solutions A, C, D have high layout variability and consume relatively little space, and OB plumbing solution B has the highest layout variability and needs most space. It's a kind of balance or trade-off, but there is much more to discuss specifically with regard to Chinese dwelling.

Space needed

In China, space (story height and building footprint) is always the highest priority because of the economic necessity of high-density housing and also the cost of construction. Following is the analysis of space needed for different OB plumbing solutions compared to the Chinese conventional approach.

Generally, the height between top of floors is 9'4''~10' (2.8-3.0m) for Chinese housing. For multistory residential building (in China, it specifically refers to 4-6 story buildings), any increase of the floor height will correspondingly enlarge the distance between two adjacent parallel buildings to assure enough sunlight for first floor dwelling units, according to the local code (and not considering recreation space or parking spaces). In a 6-story apartment building in Tianjin for example, suppose OB plumbing solution A is applied. The increased height of 4" (0.1m) for each floor and 24" (0.6m) in total will need 40" (1m) more distance between two adjacent parallel buildings which is not so significant. Suppose OB plumbing solution B is applied. In that case, the increased height of 16" (0.4m) for each floor and 96" (2.4m) in total will need 160" (4m) more distance between two adjacent parallel buildings which will significantly decrease the density of the whole residential area and efficiency utilization of the land. In the case of OB plumbing solution C, because floor trenches are limited to certain areas which basically don't affect the general floor height except the height of the position that floor trenches locate will decrease to 96'~96'8'' (2.4-2.6m) and usually these area will be accessory occupancy like bathroom, kitchen and storeroom, etc. In some projects such as NEXT21, floor trenches in certain public areas and raised floor in the whole dwelling are used together to provide piping space and in consequence require more vertical space (Figure 8). For high-rise residential buildings (18 stories for example), most of them are not constrained by the sunlight angle and the issue of the building density and efficiency utilization of land doesn't exist.

In OB plumbing solution D, double walls are used to accommodate piping. Their thickness range from 12'' to 16" (0.3-0.4m) consuming horizontal space. Although double walls are not necessary for demising walls and all partitions, this solution can still occupy approximately 0.5~1% floor area which means the utilization area rate would be decreased.

Layout variability

As one of the essential aims of Open Building is the construction of buildings without first determining floor plans, these four OB plumbing solutions enable the placement of bathrooms and kitchens relatively freely compared to the conventional Chinese approach. Among these, OB plumbing solution B has the highest capacity by using the raised floor (depending of course on the height of the space available under the raised floor); OB plumbing solution A is less able to support floor plan variations because the outlet of toilet is 4''(0.1m) (or the Caroma WC as the standard at 7") higher than the floor which decreases the distance from vertical stack; OB plumbing solution D offers less variability because of the limited height of the outlets of toilet and bathtub; while OB plumbing solution C is also more constraining because the position of the bathroom and kitchen is constrained in some extent by the location of floor trenches.

Future variability

All of these solutions, including the OB plumbing solution B offering the most variability, are not so easy to be altered or upgraded as we desire although they made obvious progress in the past decades improving the variability to meet future conditions of use. The key problem is that after all OB plumbing systems are finished there would inevitably need a top layer on the floor and walls. Tiles are used as a surface material in bathrooms and kitchens for waterproofing which are installed on site. That means the surface is not easily removable or changeable in spite of the fact that inside plumbing parts are always ready to be altered or upgraded. On the other hand, repositioning drain pipes suggests that the layout of the kitchen or bathroom is to be changed, so the finish floor would be changed in any case, in which case the removal of the floor tiles or other waterproof flooring is not an issue. In some OB projects of Japan, access floors are used for easy repair, maintenance and remodeling in dry area, in the meanwhile, in wet area like bathrooms and kitchen, unit bathrooms, floor and wall panels with access are used to improve the future variability.

Possibility for reuse or upgrading of existing buildings

For the situation of reuse or upgrading of existing residential building, application of fit-out systems is sometimes constrained by existing building design. For example, floor height cannot be changed. Therefore, among the four OB plumbing solutions, solution A is the superior solution in renovation projects because the Matrix Tiles occupies little floor height with maximum variety and just needs to be added to the existing floor and does not interfere with any other parts of the building. While solution B requires more vertical space and will probably make the floor height unacceptable low; solution C is completely impossible because floor trench is part of base building and can not be achieved in existing buildings; and solution D will decrease the utilization area because of the double wall.

Regulations and codes constraints

Among four OB plumbing solutions discussed in this paper, only solution A using 0-slope drainage pipes makes sense, but it conflicts with current Chinese codes for design of building water supply and drainage. Even though the 0-slope drainage system has been tested in Netherland, Germany and Japan, it still takes time to obtain approvals by the authoritative organizations in China.

CONCLUSIONS

This paper doesn't attempt to reach any conclusion that shows which OB plumbing solution is better than others. It also doesn't mean to suggest that China should learn more from Japan than Europe, just because they are both Asian countries that share some common culture. The comparison in this paper demonstrates the advantages and disadvantages of different OB plumbing solutions and provides objective evidence for OB implementation in China. The results of this research are as follows:

•Compared to Chinese conventional plumbing, all OB Plumbing solutions disentangle the base building and fit-out which greatly enlarges the decision flexibility and variability of floor plan layouts, reduces the cost for future alternation, but in the meanwhile require more space, and some increase in initial construction cost. (However, added first cost of materials may be offset by increased speed and quality control, reduction of management and coordination problems.)

•The variability of the spatial layout, or the distance from the fixtures to the vertical stack, in other words, is decided by the slope of drainage pipes and the vertical space they require. In Europe and US where unit variety and diversity are a high priority, Matrix Tiles with 0-slope drainage pipes were used as a first choice to increase floor plan variety, in both new construction and adaptation of older buildings to housing. But drainage pipes for toilets still need slope (unless macerating / pumped toilets are used) and the height from outlets of rear discharge toilets to concrete floor limits the distance to vertical stack (depending on the outlet height). In Japan and China, if raised floors have enough height from concrete floor to accommodate pipes, they have better capacity than other solutions, but to achieve the desired residential "feeling", they are quite expensive. For most multistory residential buildings, the increased height influences the density of the whole residential area to some extent, as demonstrated in section 3.1 above.

•OB plumbing solution A with Matrix Tiles provides more possibility for the reuse and upgrading of existing residential building compared to other solutions.

•Each project is different from others in some respect, and no one solution is perfect for all applications. Some of the strategies can be combined and advanced to reach appropriate solutions for Chinese housing and other solutions may well be found in the future.

ACKNOWLEGEMENT

Matrix Tile and 0-slope drainage used in this paper and showed with images are owned by INFILL SYSTEMS B.V. of Delft, The Netherlands.

SOURCES OF PHOTOGRAPHS AND DRAWINGS

Fig1: http://www.tj.focus.cn.

Fig 2, 3: Huang, Q.

Fig4: Tarpio, J. Tiuri, U., Infill Systems for Residential Open Building, Comparison and Status Report of Developments in Four Countries, Helsinki University of Technology, Department of Architecture, 2001, P17.

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Fig 8: Osaka Gas Co., Ltd., Osaka Gas Experimental Housing NEXT21, P4.

Fig 9: Li, J., Design Constraints for Capacity Analysis of Residential Floor Areas, A thesis for the Masters of Architecture, Ball State University, 2004, P41.

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Customization with User Friendly Housing Technology

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ABSTRACT
Since the idea of "support-infill" was proposed in the 1960s, meeting dwellers' requirements for various living styles has been one of the purposes of achieving flexibility in residential buildings. In particular, the objective is to customize or personalize dwellings. However, constant invention of new construction systems driven by technological interests or technical separation of the "support" and "infill" systems may not necessarily achieve the goal of customization. Motivating users to control their environment and their various individual relations with dwellings is considered to be one of the tasks in Open Building theory.

The current paper first presents a brief history as well as the contemporary situation of housing technology with respect to customization in residential construction. Subsequently, customization activities are classified into several levels. For each level, certain cases in Europe, China, or Japan are enumerated, and the patterns, technology, and components implemented are analyzed. The lessons derived from the cases are further analyzed through the involvement and interaction with inhabitants, clients, and managers. Careful organization and integration of user-friendly infill components are suggested to be the key to achieving a balance between central control and personal freedom, and between efficiency and high quality. Finally, the knowledge on user-friendly technology developed is borrowed from other industries is addressed to improve infill systems for housing construction.

KEYWORDS:
Customization, housing, construction technology, user-friendly

INTRODUCTION
In the early 20th century, mass production manufacturing was used in many fields. High efficiency naturally made this ideal method for housing, especially when accommodation became the most serious social issue. The concept of "standardization in housing" was suggested to combat the great demand for post-war housing(Habraken, 1972, p. 1). In the following decades, several neighborhoods were built around the Netherlands, accompanied by an intense debate on housing industrialization and standardization. This resulted in increased focus on the flexibility of residential buildings to avoid rigidity and unity.

After WWII, a "fully industrialized house" with a "general panel integrated system" was proposed by Walter Gropius. A limited number of standardized elements were designed and produced. Through the combination of these elements, an unlimited number of different dwellings would then be erected swiftly and easily(Habraken, 1998, p. 268). This thought originated from the success of mass-production industries, such as the automobile industry. However, this method was not feasible for residential construction. The foremost distinction of dwellings is that "building dwellings is par excellence a civilized activity which is an important expression of human civilization first and foremost rooted in everyday actions of ordinary people going about their business.(1972, p. 11)" The diversity and un-certainty of dwellings can not be achieved via assembling standardized components easily, which were neglected totally by Gropius' statement(1962, pp. 12-13), as well as the effect of final users on the dwellings. Habraken directly indicates that Gropius' system will result in the centralization of technical control, which cannot realize diversity(Habraken, 1998, p. 269).

Given these concepts, how can the adaptation of housing to various users' real needs be implemented? Turner(1976) states that despite being officially certified experts, architects and planners should be confronted with a rapidly rising consciousness of their incompetence to decide on what is best for others(p. 11). He suggests that certain decisions must be left to those at the lower or lowest levels, which, being unpredictable or requiring additional controls, tend to slow the process and demand more administration(pp. 39-41), which is similar to Habraken's "control levels" coincidentally. The solution to similar phenomena in other fields is called "customization" or "mass-customization". To date, technological solutions have received a great deal of attention, whereas a limited number of studies have focused on the relationship between users and residential products. The current paper attempts to analyze the issue from the aspect of user participation and suggests possible improvements in future developments.

CUSTOMIZATION IN RESIDENTIAL OPEN BUILDING
Customization is generally defined as the process in which an individual or a group appropriates a product or practice of another culture and makes it their own("Customization," 2011). Although the idea of customization arose from the popularity of machines, it is not new in architectural history.

Almost all ancient buildings were constructed in a customized manner, and architects and their clients collaborated from the very beginning because the latter had to control the total budget for construction and related work.

Mass customization is defined as “developing, producing, marketing and delivering affordable goods, and services with enough variety and customization that nearly everyone finds exactly what they want.(Pine, 1993)” In another words, “mass customization aims at producing goods and service catering to individual customers’ needs with near mass production efficiency.(Piller & Tseng, 2010, p. 1)” The primary characteristics of mass customization can be simply understood from the word “mass” as efficiency, reliability, and low cost, and from “customization” as flexibility, individuality, and variety. In fact, “customization” as discussed in the residential Open Building refers to “mass customization,” which caters to the mass population based on the production of industrial manufacturing.

In retrospect to the development of flexible houses in the past half-century, the earliest tendency was to replace fixed partition walls with a movable sliding wall, hanging screen, or foldable furniture (Fig.1) which was inspired by traditional structures, such as Japanese wooden buildings. Another possible origin is the Schroeder House in 1924, which is considered the very representative of modernist and constructivist architecture. This pattern of housing design again appeared in the late 1980s, with the invention of new technologies that offered architects the diversity of flexible partitions.

Between WWII and the 1980s, another kind of tendency could be observed, wherein certain partition walls inside dwellings or between two residences could be torn down or openings on the partition walls could be closed and reopened easily(Fig.2). Both kinds of design possessed the same original intention that un-fixed partition walls and openings could be adjusted based on the final residents’ uncertain requirements. However, these were evidently an attempt to set up a house or a lifestyle for residents because the possibilities for variation could be controlled. Similar to a cabinet with shelves, when the shelves were replaced by drawers, the essence was not altered at all. Moreover, the latter kind of design possibly involved other space units, such as a public space and the residence units next to it, which may trigger a more complicated property issue. Under this circumstance, the flexibility of residences became more difficult to realize, more so with customization. These two kinds of design and their so-called “potential flexibility” are actually merely representative of the arrogance of architects.

For a long period, architects and designers balanced “flexibility” with the “immediate potential for movement and change.(Schneider & Till, 2007, p. 84)” Schneider states that flexibility should be viewed not only physically but socially because, definitively, the host is the occupant(p. 6). Habraken emphasizes the conflict occurring in mass housing after WWII is “a conflict between the method which from the professional point of views appears best and the instinctive reaction against on the part of the user,” and the solution is not technology, but “the return of consultation and involvement on the part of the users,(1972, pp. 2-3)” which is confirmed by several cases wherein the involvement of residents goes beyond moving walls, and represents a process of social interaction, communication, and constant reiteration among public, planner, designer, developer, and the occupant (Schneider & Till, 2007, p. 89).

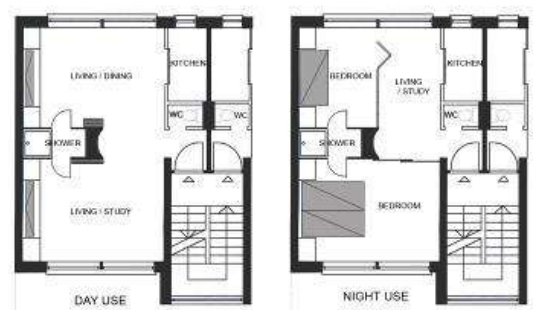

Figure 1: House with moveable walls and foldable furniture (Schneider & Till, 2007, p. 63)

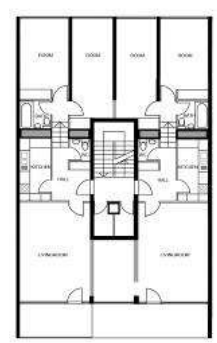

Figure 2: House openings on the walls (Schneider & Till, 2007, p. 84)

Since the mid-1960s, residents’ participation appeared in certain projects resulting from the democratic activities during the 1960s and 1970s. The first incidence was in 1966 when residents used the provided partition boards to design the layout of their own house independently. In the following decades, allowing prospective residents to take part in design and construction became one of the hot topics, and several pilot projects were conducted under the direction of SAR in Europe with various patterns of participation, such as independent design and construction, design consultation, and menu selection. Meanwhile, certain infill systems or technologies were invented, the most sophisticated of which is perhaps Matura Infill System, while in the US, the “customized home” emerged as a luxury with very limited production, super-high quality, and unique design based on single family. A similar business strategy can be easily found in Europe and China at present. In Japan, combined with the country's highly developed residential industry, customization service became a characteristic of residential marketing strategy in private houses. The project NEXT 21 Complex House built in 1994 by the Osaka Gas Company implemented the Open Building theory in its entirety, including customization and resident's participation.

Compared with products in other industries, the characteristics of construction – such as the product size, dimensional dialogues with users, and relationship with the site – make its mass customization different from that of others. Schneider and Till(2007) classify three types of customization methods that can be provided to users:

- Providing choice: giving future residents options for their future homes;
- Changeable design: adapting designs prior to occupation, giving residents and house providers the freedom to change the housing mix; and
- Post-completion: empowering the users to make adjustments on their terms.(p. 47)

Based on an early study on residents' participation in flexible houses conducted by Jia(1995), other methods of customization may be used, namely, user's self-design and consultative design(pp. 206-229). The levels of customization can be determined based on these types:

- Active customization: user's self-design;
- Semi-active customization: providing choice on design or construction;
- Passive customization: changeable design, post-completion; and
- Indirect customization: consultative design.

Active customization

Active customization is a process by which prospective residents can design their own houses by themselves with or without limitation. By providing opportunities for active customization, the completed projects truly meet the residents' needs. Meanwhile, users can gain a great sense of accomplishment and responsibility from the projects, motivating their passion and ambition in the future in such a way that, as Bell (1973) states, "people have the influence to control their life. (p. 157; Customization," 2011)"

One very famous SAR pilot project is the Papendrecht project in the Netherlands, which was built in 1977(Fig.3). After completion of the support and arrangement of the dwelling units, each household individually met with their architects for their houses' infill portion on several occasions, progressing from rough sketches to final drawings. Design content included the interior partition walls, doors, staircase, bathroom, kitchen, and other finishes(Kendall & Teicher, 2000, pp. 83-87; Schneider & Till, 2007, p. 91). The project applied the concept of "control levels" wherein the architects finished the part which they were in charge, whereas the residents decided on what they wanted. The entire construction was divided into two parts, the support with opening slabs and the individual fix-out part. Papendrecht left the vertical mechanical chases for piping and wiring, which freed the locations of bathroom and kitchen. Although the individual infill portions were installed using the conventional Dutch interior construction, this project is one of the earliest ones demonstrating residents' effect on multi-family housing. However, the low level of efficiency was inevitable. The appointed architects had to spend a great deal of time assisting users because grasping the design technique within a short time was difficult for the residents. This limitation might not be a big issue for small projects, but an extremely large amount of work was necessary for large-scale projects.

Figure 3: Papendrecht project in Molenvlit(Kendall & Teicher, 2000, pp. 83-87; Schneider & Till, 2007, p. 91)

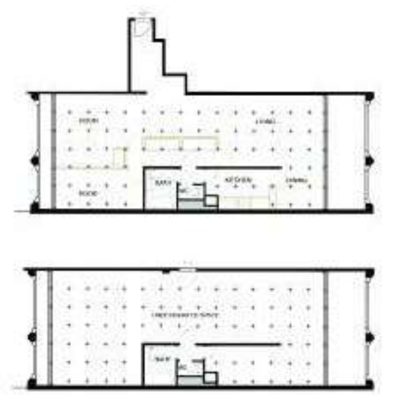

Figure 4: Les Anticonformes in France(Schneider & Till, 2007, p. 86)

Low efficiency, consumption of a great deal of time and energy, and coordination are the reasons why active customization cannot be accepted or realized by normal residential projects, primarily resulting from the lack of design technique on the part of the residents. Reducing the requirement for professional skills becomes one of the most natural solutions. In fact, it was suggested in the Les Anticonformes project in France (Fig.4), which was built in 1975. For this project, aside from the load-bearing structure, fixed interior bathrooms and toilets, an open floor plan with a 90 cm grid and a system of partition walls were offered to the occupants with the statement, “you place the walls where you want. (Schneider & Till, 2007, p. 86)” Finally, this transformed the special design technique into a more understandable diagram and consequently mitigated the need for professional assistance.

Semi-active customization

Providing choice is another solution for low efficiency in user design. Here, architects or developers propose several options on design or components prior to onsite construction. Prospective residents formulate their own decisions following a certain procedure without any effect on the other parts of the project. In the Oakridge Village project in England in 2006 (Fig.5), future tenants and architects were connected through the Internet, through which the tenants conveniently acquired an intuitive understanding of each option on the layout and external appearance of their flats. The load-bearing structure was a steel frame, and certain changes were allowed in the process of construction. However, upon completion, all the flats appeared unchangeable(Schneider & Till, 2007, p. 128).

Figure 5: Oakridge Village project in England(Schneider & Till, 2007, p. 128)

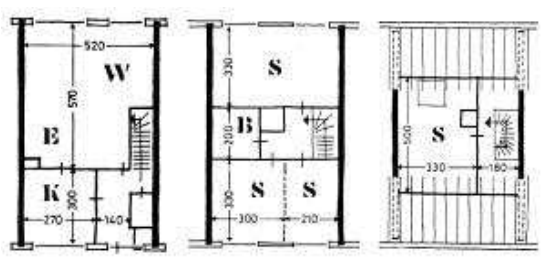

Figure 6: Sterrenburg III in the Netherlands (Kendall & Teicher, 2000, p. 82)

Another example is Sterrenburg III in the Netherlands in 1977(Fig.6). In this project, 10 alternative unit layouts were proposed with the price determined by the particular assembly kit fixed in the unit. The distinction is that further development of the families was considered that the layouts could be adapted correspondingly. The interior partition walls were fixed by wooden framing, framing connectors, and surface panels, all of which were easily removable. Furthermore, all the electrical raceways ran along the walls so that the house would not require rewiring upon modification of partition walls(Kendall & Teicher, 2000, pp. 80-82).

Providing choice, although significantly increasing the efficiency of active customization, essentially places customization under the control of architects or developers, which may not reflect the tenants’ real needs. When faced with options, tenants choose the one closest to their needs, which obviously remains slightly different from their real needs. A space for adjustment that the tenants themselves can utilize is needed. Therefore, flexibility should be considered as an auxiliary to providing choice. Sterrenburg III provided a comparatively more flexible environment for its tenants. Future tenants can adjust the internal space by themselves because of the changeable partition walls and independent wiring.

Passive customization

Passive customization is the process wherein residents are not involved in the process of design or construction. However, they can change certain interior portions after their occupancy without any effect on the structure. Compared with the former levels, this level’s customization can adapt to the situation more rapidly because it allows residents to perform most of the work by themselves.

There are two kinds of passive customization, and the first is providing changeable components. Take the Estate Tsurumaki project in Japan built in 1983 (Fig.7) as an example. A series of four-story buildings were offered with fixed unit plans. After move-in, residents can change the layouts using movable partitions and storage units. Changes that the users made after occupancy were as diverse as their various lifestyles(Kendall & Teicher, 2000, pp. 96-99). The achievement of this passive customization depends on the materials and related techniques. Gypsum board is one of the materials used in the early projects because of its light weight and effective installation. However, gypsum board has its own disadvantages: easy water damage and the need for a supporting frame, both of which restrict its use. More recently, the combination of gypsum board with mineral wool core has been developed that offers the capability of insulation and self-support. This evolution frees the partition walls from the restriction of posts and further decreases the procedures for construction.

Figure 7: Estate Tsurumaki project in Japan(Kendall & Teicher, 2000, pp. 96-99)

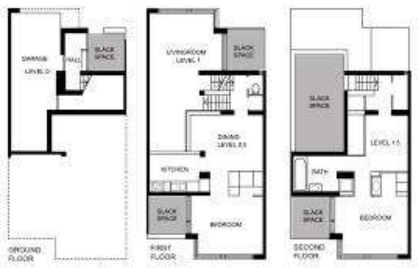

Figure 8: Sterrenburg III in the Netherlands (Schneider & Till, 2007, p. 82)

Another type of passive customization leaves the "undefined space" in the preliminary construction, which can be fixed by future residents. Diagoon Houses in the Netherlands in 1971(Fig.8) are an example. The houses were built with the concept of "incomplete building," including a structural skeleton and two fixed cores consisting of a staircase, toilet, kitchen, and bathroom. The residents moved in, decided the function of each room by themselves, and even enlarged the house by appropriating the "slack opening space"(Schneider & Till, 2007, p. 82). Both of these aspects offered the residents a level of flexibility. However, these aspects brought a great challenge to the architects, as they must determine the method for constructing such a "slack space" not only to satisfy the prospective residents' needs but to ensure that the project's complex appearance would be unaffected as well.

Indirect customization

Indirect customization is a process that residents are not involved in the process of design or construction, however, they express their opinion to architects or developers through various means, such as surveys and discussion seminars. The project is completed by the architects and developers, who decide on how apply the information gathered from the residents. In Gespleten Hendrik Nood in Amsterdam 1996, two consultation stages were conducted. First, prospective residents discussed the complex as a whole to reach an agreement on factors such as number of units, common space, and standard unit layout. Subsequently, details of individual units were closely consulted among the residents, architects, and contractors, finally resulting in 28 different floor plans(Kendall & Teicher, 2000, pp. 136-139). During this process, residents did not need to know any special technique but simply expressed what they preferred. In fact, indirect customization is a communication program, which in certain cases, was completed by socialists who had more experience in asking right questions and guiding residents toward the right way of thinking about their future life.

In general, the advantages and limitations of the four levels of customization are summarized.

	Advantages	Shortcomings
Active customization	Real participation, truly reflecting residents' needs	More time and energy consumption on organization, low efficiency
Semi-active customization	Comparatively high efficiency	Limitation of choice with the control of architects and developers
Passive customization	Quick reaction, future adaptability	Passiveness, possible waste and impacts on the whole project
Indirect customization	High integrity of professionals	No real participation, difficult to reflect every resident's needs

USER FRIENDLY HOUSING TECHNOLOGY

The term "user-friendly" is usually considered as a synonym for usable, which is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use"(Wiki, 2011). In other words, this term refers to how easily the users can utilize the products and is not a functional requirement. Scientist Jakob Nielsen(1994) and Ben Shneiderman(1980) emphasize the characteristics of being user-friendly should involve:

- Learnability: How easy is it for users to learn the program?
- Efficiency: Once users have learned the design, how quickly can they perform tasks?
- Memorability: How easily can proficiency be rebuilt after a period of not using it?
- Errors: How many errors do users make, and how easily can they deal with the errors?
- Satisfaction: How pleasant is it to use the design? ("Usability," 2011)

Let us take the Auto CAD design software and IKEA furniture design system as examples. As a professional skill, every architect spends at least two weeks to learn basic CAD. Users must have sufficient knowledge of how to convert three-dimensional buildings into two-dimensional drawings using simple symbols. For example, two thick lines represent a piece of wall, and an arc with a line stands for a door. A normal person without any professional background cannot easily understand the drawing nor draw a plan without assistance. One of the biggest furniture companies in the world, IKEA introduced a design system that clients can use directly through its Web site. This system is based on the models of real products. Clients do not need to draw every line, but merely choose the furniture, determine its style, size, color, and additional hardware; drag the products onto the provided background one by one; and arrange the positions. Daily articles are used as references to explain the issues of size and scale. The products can be partially modified as well by clicking on a particular component. Meanwhile, the total price is shown at the top right column.

In the following table, the five characteristics of the term "user-friendly" are employed to compare Auto CAD with the IKEA design system based on their own target users.

	Auto CAD for professionals	IKEA design system for average users
Learnability	Requires at least two weeks to learn how to use it basically	Requires only five minutes to watch the instruction video
Efficiency	Requires a period of time to practice	Requires very little amount of time to practice.
Memorability	Requires a review of the commands	Do not need to remember
Errors	Issues command errors; occasionally requires professional assistance to recover errors	Issues command errors, though ensures very low possibility of errors
Satisfaction	Unknown	Provides plenty of information on products in terms of style, color, price, size, and so on

When introduced in the field of construction, the concept of "user-friendliness" for construction technology can be summarized as follows, with the target users being the final residents, other than the architects and construction workers:

- Learnable instruction: How simply and clearly are the principles and usage explained?
- Operability: How easily can the residents operate or install the product?
- Compatibility: How easily can the products be combined with the other components?
- Development possibility: How easily can the residents reuse or reinstall the product?
- Satisfaction: How pleasant is it to use the product?

Evaluating a single product's user-friendliness is difficult, so a comparison can be used to analyze which product is more user-friendly. The development of the Matura Infill System manifests a trend toward user-friendliness. Superficially, the Matura Infill Systems 1 and 2 are similar to the "general panel's integrated system" proposed by Gropius previously mentioned. Both systems combine industrialized products to create a diverse set of houses. However, when these two systems are further analyzed, the differences can be clearly observed. Gropius' system is based on professional and architect's social position, wherein all limited-design products are works of art that cannot be achieved by average people. By contrast, Matura System merely provides a method for integrating products in the average construction market. Although the final construction should be implemented by trained workers because of quality standards, Matura systems attempt to present the entire concept to users and demonstrate how the entire system works correctly. Compared with Matura systems, Gropius' system is a closed one that cannot accommodate other components and future possibilities.

Since 1990 when Matura System 1(Fig.9) was invented, the products of the system have been improved into System 2(Fig.10). The major developments are as follows:

- Separation of partition walls and Matura matrix tiles;
- Introduction of cable stud; and
- The 45-degree grid added to the matrix tile.

These developments mainly focus on the aspects of operability and compatibility. In System 1, all the partition walls have to follow the 10/20 cm band grid on the matrix tiles. The separation of these two portions breaks this interdependent relationship so that more choices appear for the partition walls. Except for paralleling to the external façade, the walls can be angled toward the façade or even be slightly curved; these can be removed without any effect on the matrix tiles or on their cover board. Instead of the sockets only being located around the partition walls as part of the baseboard in System 1, the cable stud provides flexible locations for sockets on partition walls. Moreover, the 45-degree grid added to the matrix tiles allows for the horizontal distribution of various ducts, enabling these to turn a corner without supplementary cutting on the tiles. Consequently, these developments partially simplified installation on site. A brief comparison of Gropius's general panel integrated system with the Matura Infill Systems is shown in the following table:

	General panel's integrated system	Matura Infill System 1	Matura Infill System 2
Learnable instruction	Not learnable for residents	Provides exhibition room and instruction books	Provides exhibition room and instruction books
Operability	Cannot be operated by residents	Can be operated by residents with the assistance of professionals	Can be operated by residents with the assistance of professionals
Compatibility	Includes the designed products only	Easily compatible with average products	More easily compatible with average products
Development possibility	Offers very little possibility	Offers minimal possibility	Offers more possibilities
Satisfaction	Unknown	With more possibility	With more possibility

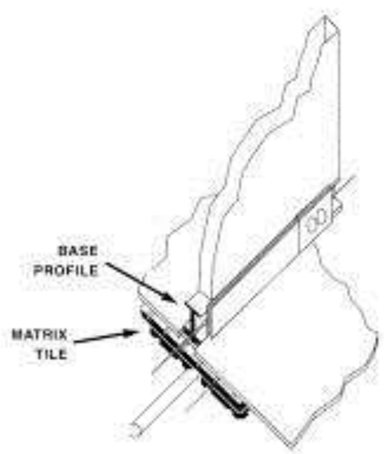

Figure 9: Matura Infill System 1(Kendall & Teicher, 2000, p. 196)

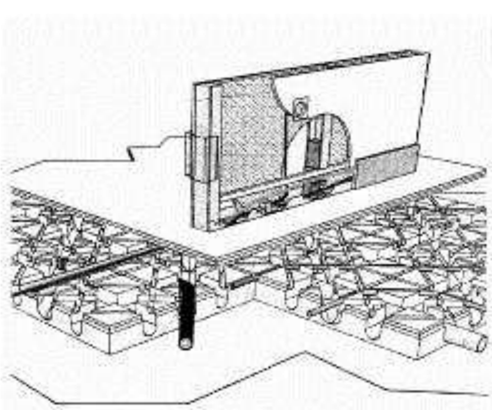

Figure 10: Matura Infill System 2(Kendall, 2010)

CONCLUSION AND DISCUSSION

Allowing residents to take charge of their own dwellings as the one purpose of Open Building is a way to achieve long-term adaptability in the field of residential construction. This is entirely different from setting movable walls in dwellings. Residents participating in and having complete or partial responsibility for a house is a process of customization, which eventually allows individualization and diversity. Depending on the degree of residents' participation, four levels of customization can be observed in practice. All levels have their own advantages and limitations, which require us to change the standpoint to review the development of Open Building. Nevertheless, user-friendly technologies reveal a possible tendency for the development. The comparison between Matura Infill Systems 1 and 2 shows that small adjustments on the products will improve performance significantly by providing users with greater convenience in on-site installation and future changes.

However, several issues need to be further studied. Based on the research on mass customization, an interesting finding contrary to the traditional belief is presented by Piller(2010): customers often do not know exactly what they want (p. 3). This phenomenon is likewise evident in residential construction and relative markets, which triggers a discussion on how the users can be guided to recognize their real needs and whether or not space should be left for trials or future adjustment. Another question arises from providing choices. Whether or not the options are suitable for prospective residents is difficult to justify. Generally, the options are provided based on the architects' idea of the possibility for variation. This finding presents a new challenge to architects and developers on how they should set up options to reflect the needs of prospective users. Finally, long-term service after residents' occupancy is always excluded in residential construction. A limited number of studies have mentioned this issue. However, just as Piroozfar and Larsen(2010) emphasize, the idea of customization in the building industry should be extended from merely the stage of design and production to the period of serving because of the relatively long lifecycle and closed relation with the users(p. 874).

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Slab-Stick Structure System for More Building Customization

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ABSTRACT
The Industry and construction systems by the aplicated concept of Open-Building in the World has grown rapidly for nearly half a century since its birth in the 60s. Many countries in the world which have been seriously concerned in aplicating and developing the concept of Open-building, have gained advantages from it. At present day, new challenges faced for Open-building is in it's flexible ability in terms of changes in building functions as well as changes in finishing materials and space organization that had been handled before hand. The problem which oftenly faced in building function transformation, is demands for changes in Structural and ME systems. Thus the innovations of a structural system that responds to it, are needed. This paper would try to introduce a simple design model of structure system, called 'Slab Stick Structure System'. It mainly consist of ice cream sticks-shaped Slabs made from pre-fabricated reinforced concrete materials, which will allow more customization and flexibility in terms variation of changes, such as space organization, pattern and extent of housing units, and also the function of the building itself. And also, a sample design of collective housing that implementing our introduced model structure system, will be added.

KEYWORDS:
Slab-stick, Customization, Prefabrication, Concrete, Open-Building

INTRODUCTION
Open-building concept had introduced us to a new choice for living in a dwelling. It allows occupant to determine their own dwelling unit's fixtures based on their needs, taste, and financial condition.

New challenge that would be raised in the concept of Open building nowadays is how to gain more variations from what users have already gained, as far as changing in building function. Problem which occurred during function changing of a building, is the building's needs of MEP system which is should be adjusted from the old building function to the new one. It means that new ideas of open-plan concept should be explored in order to answer or solve the challenge and the problem.

This paper offered a concept of structural systems. It is called Slabstick Structure System, which can accomodate the demands for more variation, differentiations and changes.

Problem
The main issues that this paper discussed is how to create a building structural system that can support differentiantion and changes. The variation that will happen should be more than Open-building concept has already offered.

SLAB STICK STRUCTURE SYSTEM

Reinforced Concrete and Fabrication Slab
Since the beginning of 20th century, high-raised building has began to flourishing in large cities, especially in America and Europe. This condition followed by development of new materials and structures technology, which leads to the skeletal system made of steel and reinforced concrete. These materials have been successfully answered the challenge of strength, durability, and endurance in the context of building floor height and age. They were remain kept in use until today.

Especially on reinforced concrete materials, in these years, so many industries engaged in prefabrication of them are can be found all around the world. A lots of Factories produce concrete column, Beam, pile, slab, etc. Construction workers just have to wait these products arrived on site, and then they can start working. By using the prefabricated concrete material, construction works becoming faster, clean, effective, and efficient.

Slab-Stick Structure System
Slab-stick structure system is a building structural system in the form of reinforced concrete which was specially designed, and manufactured by prefabrication method. It made up from stacked sticks of slabs. This system purpose is to create an open plan design at multistory building.

This system consists of parts, which are column, beam, and slab, that similar to skeletal structure system. Each parts of this Structure system are detachable. The parts shapes reminds us to the wooden ice cream stick/bars, which usually used by elementary school students to create a handicraft model of house.

Figure 1 : Pictures of building or house miniature made from Ice cream Sticks.

Figure 2 below shows some parts which will be used in slabstick structure systems. There are column, beam, and slab, and also special parts as additional support for the whole configuration. The yellow bar of individual MEP shaft system represents space for vertical MEP shaft.

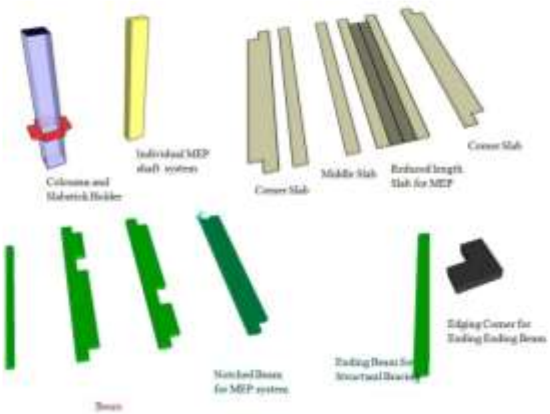

Figure 2 : Parts of Slab Stick Structure System.

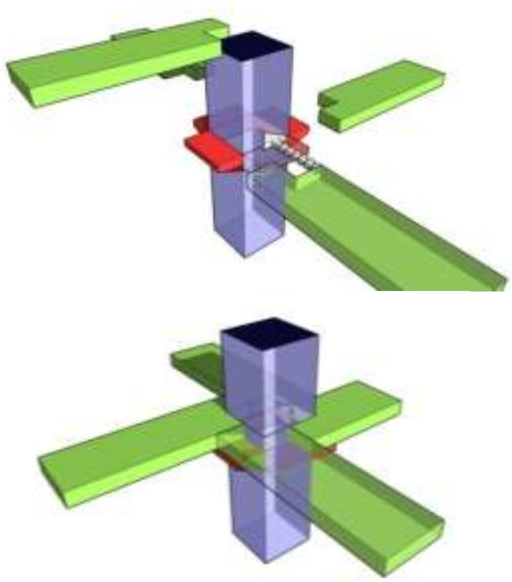

Figure 3 : Joining Process of Slab Stick Structure System Parts.

The first picture from Figure 3 above, shows the merging process of beams and columns. The red colored parts are footing devices which used for beam holder. They were casted all together with the column when manufacturing process. The second picture of Figure 3 shows prefectly merged beams and column.

The first picture of Figure 4, shown the configuration of two columns and beams which are ready to be installed with slab bars, while the next one shown the process of slab bar's placement on the configuration. A nearly complete configuration that occurred according to the explanation before is shown in Figure 6 below. It also equipped with some additional parts, such as bracing, and individual MEP shaft..

The main benefits of this structure system is that this design accommodates differentiation and changes. The open plan design which created by this system can generate lots variation of infill. Unit/spaces which separated by floor are can also be joined. So, with this system, rentable units/spaces can be joined both vertically and horizontally, instead of only horizontally one that Open plan had already offered. These features will generate more variation of unit/space modules.

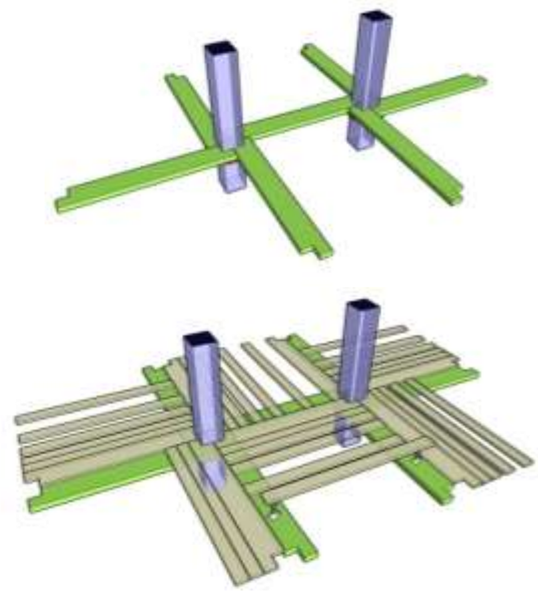

Figure 4 : Joining Process of Slab Stick Structure System Parts.

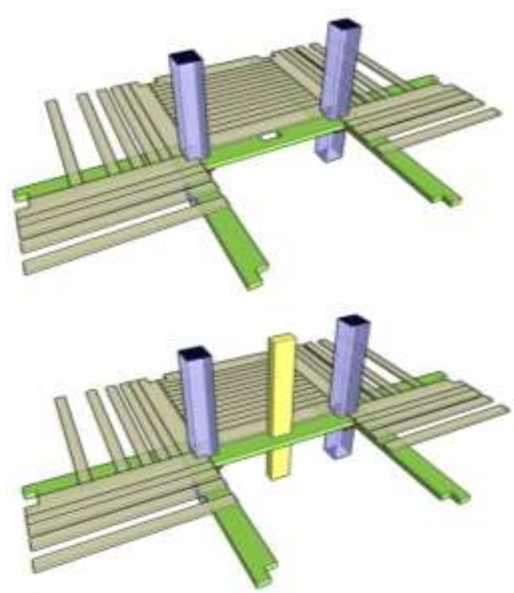

Figure 5 : Joining Process of MEP shaft system onto Slab Stick Structure System Parts.

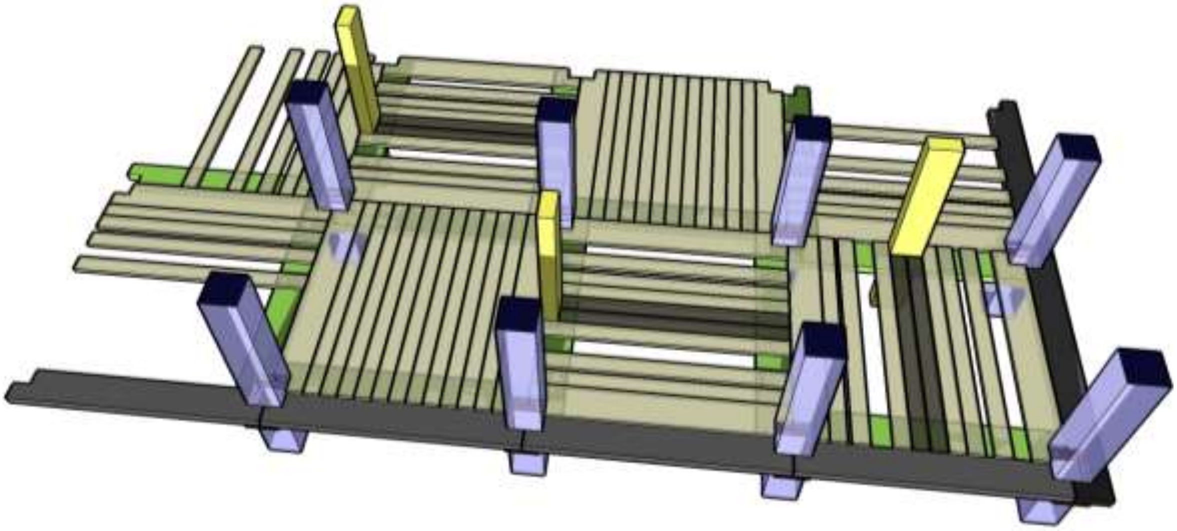

Figure 6 : *A Configuration of Slab Stick Structure System.*

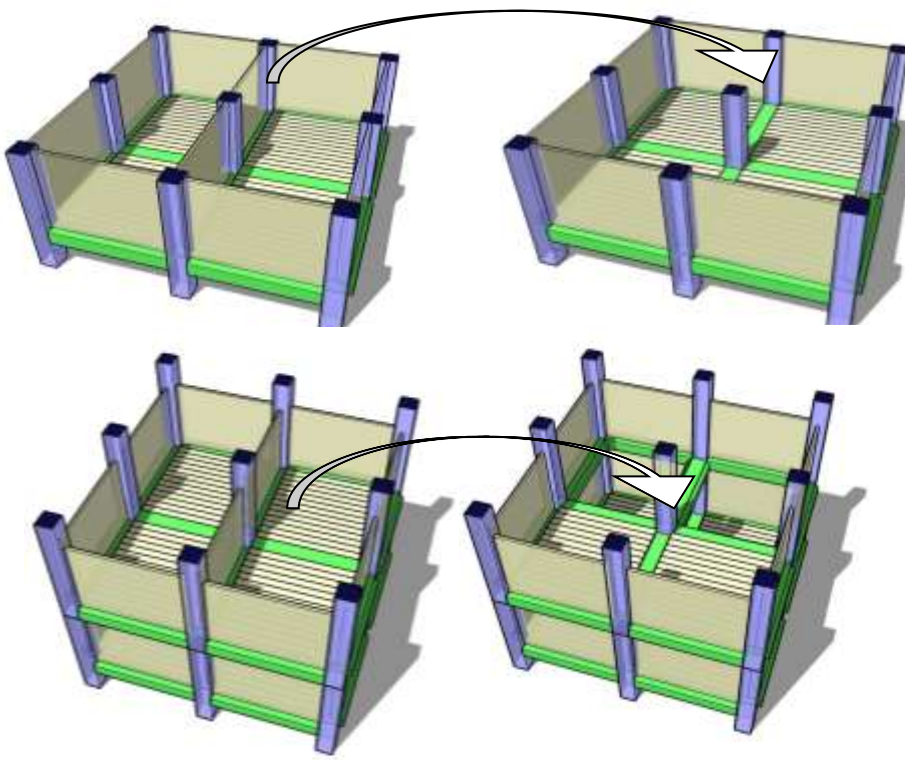

Figure 7 : *A Configuration of Slab Stick Structure System.*

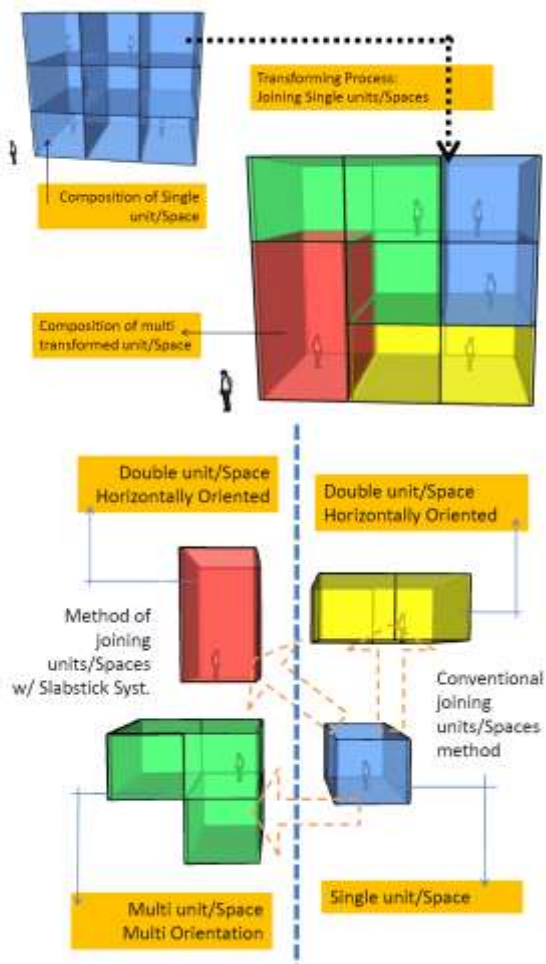

Figure 8 : Units/Spaces variation that could happen by using Slabstick Structure System

Slab-stick Structure System also has flexible feature on vertical MEP shaft placement. This feature made Slabstick Structure System is applicable for many building function such as residential, education, office, shopping centres, and health care wards. Altogether with the detachable feature, then we can say that this system can realized function changing of building. Figure 10 below shows plumbing fixtures inside vertical MEP shaft.

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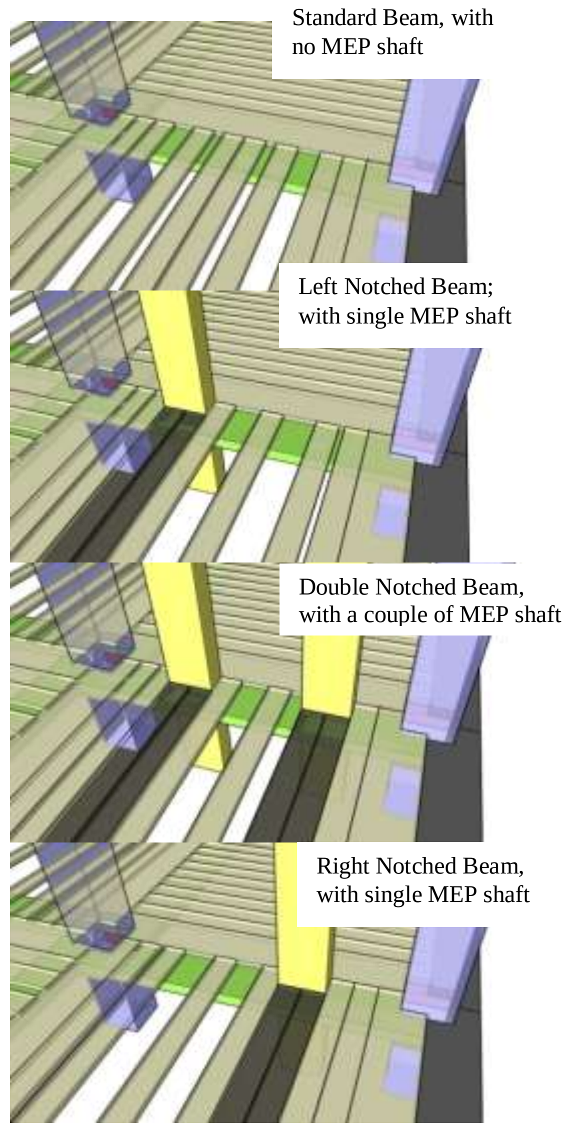

Figure 9 : Flexibility in vertical MEP placement with different kind of beams

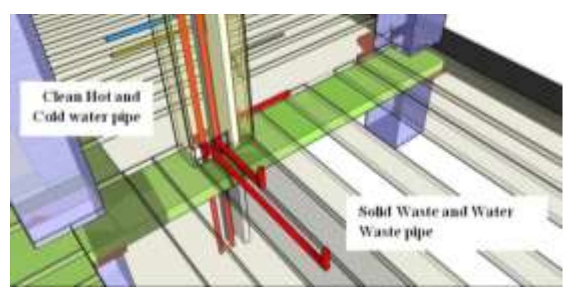

Figure 10 : Plumbing Fixtures inside MEP shaft system

BUILDING DESIGN SAMPLE WITH SLABSTICK STRUCTURE

15 Floors Apartemen Building

The building plan form of apartment buildings is a square. it combines our flexible-Slabstick Structure System for rentable space or units section and fixed-conventional reinforced concrete system as vertical circulation utility.

Distribution of rentable units/spaces inside apartment are decided by the developer. It depends on circulation pattern of each floor which is also decided by them. Figure 8 below shows two variations of a different floor plan which formed from the same floor plan design, but had different kind of circulation pattern

The 1st to 2nd floor of the building are used for developer or management offices, commercial use, and lobby. 3rd to 15th floor, are used for dwelling units. The vertical circulation utilities are located outside of the square-shaped section of rentable spaces/units.

Unit Variations : Plan and Facade

In this apartement, occupants are being given the opportunity to develop their own units as desired. They can propose and decide what rooms are should be applied inside and also how large the room is. Not only inside, but they also have to determine what will happen on the outside. Occupants have to design their own unit façade, based on rules and regulation that stated by developers. The rules are mainly about material usage and finishing method for the façade. This rules and regulations are made in order to maintain impression of continuity and avoid disorganization for the whole building design. Figure 13 to 15 below shows some variation in apartment's units/Space. These variations can be generated by apartment's flexibility in room organizing and façade forming for each rentable units/spaces.

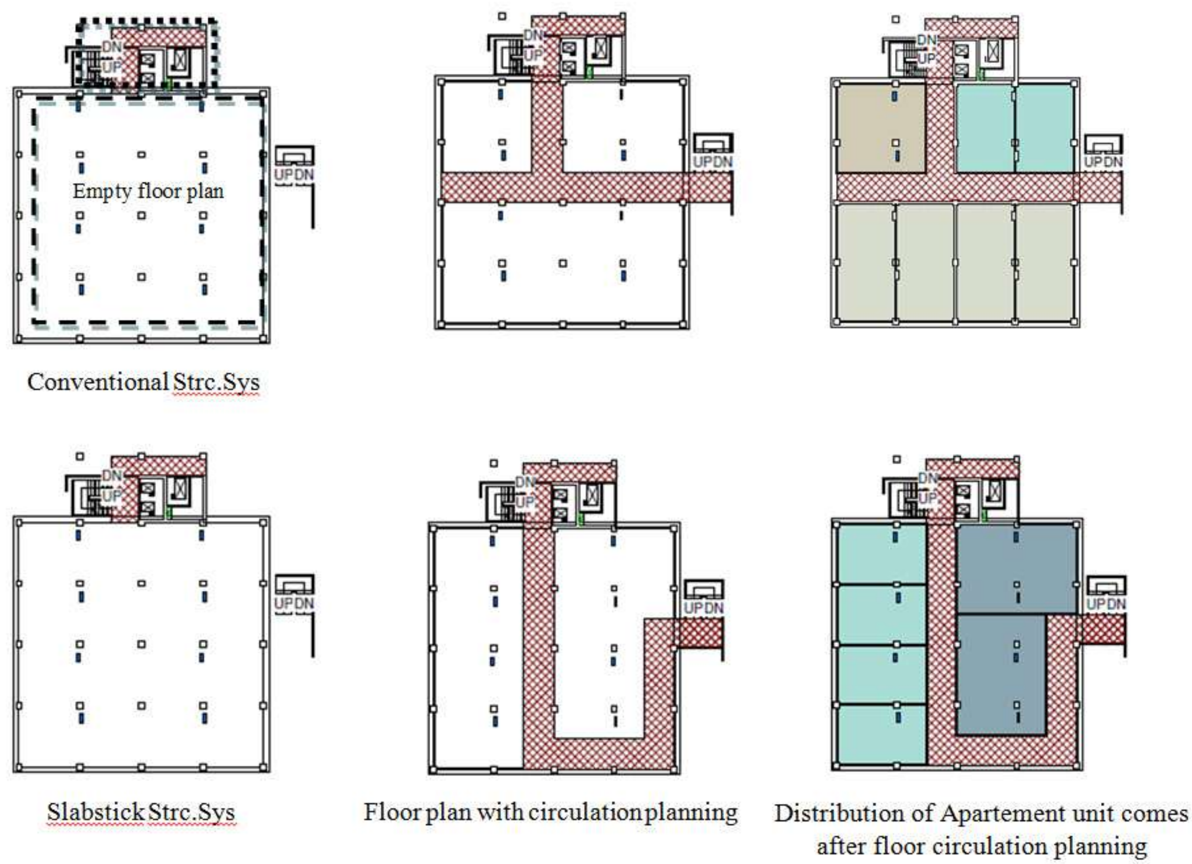

Figure 11 : *The process of rentable unit/space distribution at same floor plan design*

***Figure 12 :** Apartement Design Sample using Open-building concept and Slab-Stick Structure System*

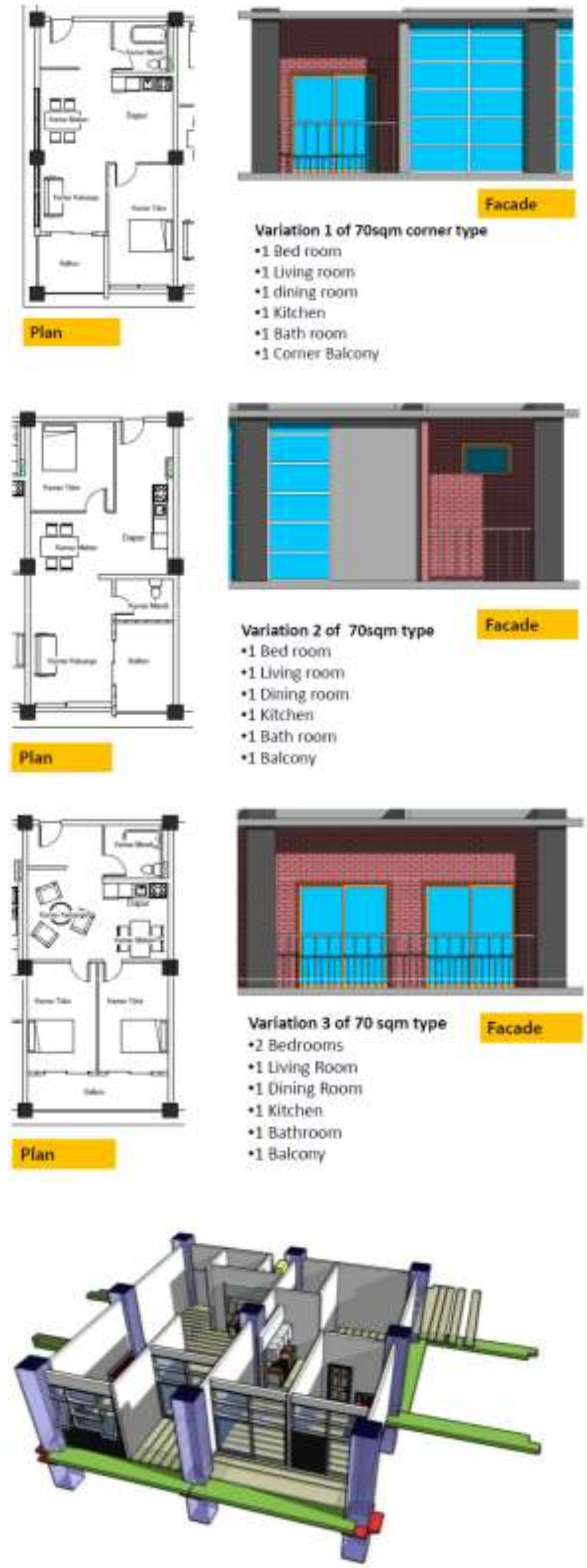

***Figure 13 :** Some variations of single unit in Apartemen design Sample*

Figure 14 : Closer look at Apartement Facade variation

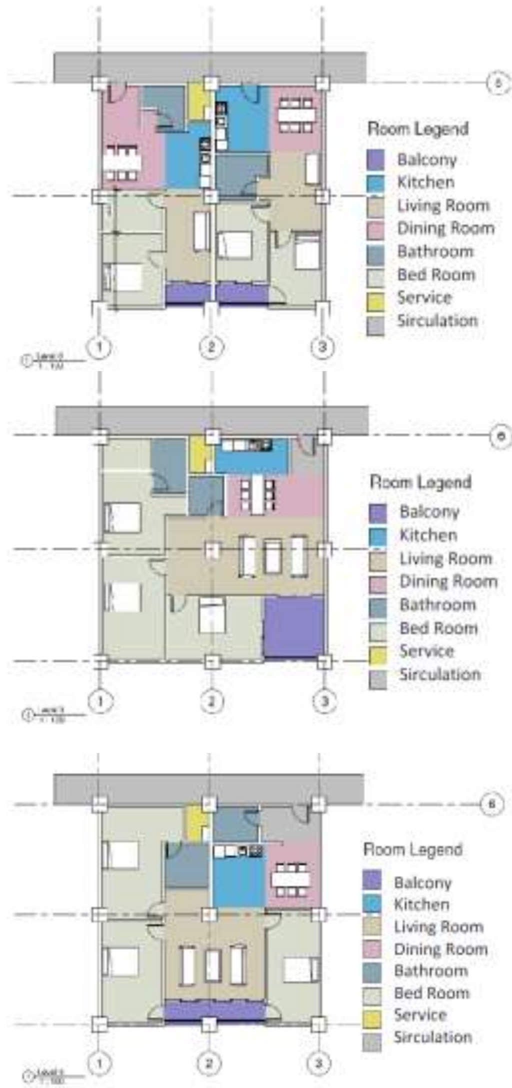

Figure 15 : Some variation of room arrangement on single units and double units.

CONCLUSION

The main feature of Slab-stick structure system is on its ability to accommodate differentiation and changes which are desired by the occupants. It will create a lot variation of rented space or unit shape. This system allows units/spaces joining horizontally and vertically. Slab-stick Structure system is flexible in vertical MEP shaft planning. This feature will facilitate building function changing. By using this Slab-stick Structure System we can gain more variations than those which already offered from Open-building.

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Transformable Building Façade: An Interface Between Community and User's Control

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ABSTRACT
External façades are among the most expensive components in building construction. They provide social identities and environmental comfort for accommodation. They are intermediate locations where collective and individual needs combine. Technological trends and the demands of increasingly efficient building maintenance have made the external façade lighter, more transparent, and more flexible.

This paper first reviews the latest research in theory and implementation of the façade designed for user participation and change. It concurs with previous findings that the single-layered façade may encounter constraints—technical difficulties and building regulations—for users to implement them. After a review of the new developments in double-glazed façades in office buildings, this paper points out a technical solution, not in terms of energy saving and environmental comfort, but also for redefined territory boundaries between the user inside and the public outside. It suggests a double façade as a hypothetical solution to reach a social agreement. To examine the feasibility, the paper introduces a few low-cost housing projects designed by Baumschlager & Eberle, an Austrian-based design firm famed for their sustainable building designs over the last decade. The paper argues that the double façade should be operable—easily controlled by the user—and is an approach that simultaneously maximizes both environmental and social performance.

KEYWORDS:
Facade, Transformation, Participation

INTRODUCTION
Building façades are one of the most complicated issues in building construction and management. Traditionally, architectural design treated them as an outlook, which may reflect the design styles of the time and interests of the clients or designers, beyond the basic functional needs, such as natural lighting and ventilation. Because of the recent development of technology, especially those related to glass and curtain wall construction and sustainability issues that require energy saving, more research effort are emerging.

The built environment is a major consumer of energy across the domestic, industrial, and service sectors. The construction and operation of buildings are responsible for approximately one-third of the energy use and one-half of the electricity use in most industrialized countries. A large share of the energy use is associated with protection from the external climate and operation of systems necessary to provide occupants with a comfortable indoor environment. These studies, however, were more technical and isolated to people and internal spaces. Because natural light is seen as a key driver to people's well-being both in the workplace and at home, a maximum glazing naturally became the solution. (Y. Kaluarachchi 2005, 89-95)

Research on the interrelationship between the façade and indoor space, except the physical quality, is still very limited. Karni (2001 p.113) conducted a hypothetical study on the interrelation between openings in facades and possible locations of adjacent partitions. Research conducted by the author regarding public housing in Hong Kong in 1999 also intended to find the optimal size and location openings on the façade that would allow more variability in the location of the partition. (Jia 2003) In the revised Harmony schemes, the most widely constructed housing prototype in Hong Kong, window facades of the living room and bedroom are lined up by repositioning the bathroom inwards (Figure 1). This change creates more possibilities for the user; the non-load bearing wall between the living room and the bedroom can be relocated or even removed. Users, therefore, can choose the layout of their space according to their needs.


(a)


(b)

Figure 1 Typical unit plans of Harmony block with (a) existing and (b) proposal for line-up façade to provide more possible locations of the partition

There have been comprehensive studies in the history of Open Building movement, ranging from addressing basic relationships between people and built form, including façade and industrial technology. The following paper first introduces the concepts of Open Building with a brief review of a few implementations of demountable façades. It highlights the façade as a territory of interactions between various "powers" working on different space levels as the major contributions of the Open Building theory. It will also discuss a few problems experienced with these projects, revealed by some studies. It address that there are still gaps between the theory and the actual behavior of the technology. Then the paper will introduce the latest research and development in double-façade concepts and implementation. The newest technology regarding climate control is effective, while the potential for user participation provided by the technology is not fully understood. The final part of the paper will review a few design works conducted by Baumschlager & Eberle that indicate a tendency towards integration of potential for user participation and energy saving within the double façade as a multiple-instrument facility by new but modest technology. Finally, within the context of Hong Kong, the paper introduces a conceptual solution to the dilemma of private and public interests with double facades:

- An outer façade clearly marking the public domain and reflecting collective public interests, while having elements operable by private interests;
- An internal façade responding to private interests; and
- The two also function as an adjustable buffer zone for environmental control that also saves energy.

FAÇADE AS A MARGIN OF TERRITORY POWER

As early as the 1960s, N.J Habraken considered two lines of development for mass housing. On the one hand, the occupant had to be reintroduced as an actor in the building process in order to restore the natural relation between the user and the dwelling (Jia 2001): "Dwelling is after all doing something; it is the sum of human actions within a certain framework, within the protective environment created by man…" (Habraken, 1972: P18 a) As he continued in the book, "Supports: An Alternative to Mass Housing", the dwelling is indissolubly connected with the building; the building and the dwelling together comprise the notion of man housing himself: "Dwelling is building". (Habraken, 1972: P18 b) On the other hand, in the contemporary world, technical solutions had to evolve to give households the opportunity for full control over his/her environment. A building production process, both rational and industrially based, should develop in such a way that the occupant can choose and directly show interest to the producers.

In this new industry, a building should be treated as an industry product working in separate systems. There are several subsystems, including the facade, working independently from the structural system. These subsystems consist of products completely subject to the choice of the individual consumer. They are made according to the variety of wishes of the individual occupants and can be used in new construction as well as in renovation. (Van Randen, 1992: P. 82) To make the building production as efficient as possible, these products should be standardized and systematic: "Within each group (of infill elements) an infinite variety of combinations is possible". (Habraken, 1985: P63) (Figure 2-3)

Figure 2 Façade and its demountable components in a situation of row houses in Holland (Source: Iformatiseren van de Bouwknoop. 1995 February.)

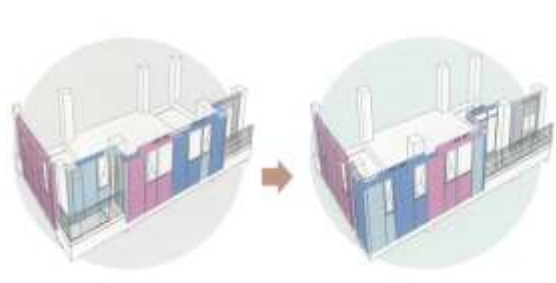

Figure 3 Façade of a unit in NEXT21, Osaka, composed by standardized and sophisticated components, was changed effectively after user occupation with coordination of a modular system. (Source: catalog 实验集合住宅NEXT21. Pg. 15)

For Habraken and Open Building, the issues related to façades are not only technical but social. It should be understood as margins of two territories controlled by different powers. A territory means a space, or an arrangement of spaces, that is under control of one power (Habraken, 1983: P29). And by using "power", Habraken gives people in any built environment, or any person or group of persons, the ability to change the physical reality of the territory (Habraken, 1983: P15)

Façade as margins are a timeless and universal phenomenon found everywhere. However, a detailed illustration from Kobets-Singh (2001 p.135) on the case of a settlement in Nepal provide a better picture of how it actually works: "Specific qualities of the façade that can allow 'growth' as any form of transformation, including addition, reduction or simply relocation of the elements, and therefore can make facades into living configurations". Walls function in this example as a specific part of a territory, located adjacent to the boundary, which displays characteristics of both neighboring territories.

Territories function in a hierarchical structure, marked and divided by the facade. The façade identifies the transition from one territory to another. One of them is on a higher level in the hierarchy, which is more public in general understanding, and the other is on a lower level of the hierarchy, which is more private. Firstly, walls are examples of boundaries, with fascinating richness of meaning. They separate and protect, while representing the character and values of the power controlling the wall. In the cases investigated by Kobets-Singh Relations between territorial boundaries and margins can be narrowed down to three basic ways:

- A Margin located within territory T2, but regulated by T1 territory;
- A Margin located in territory T1, but controlled by T2;
- A Margin straddling territorial boundary. (p.141)

Territory powers exercise their influence to the territory by changing the elements. Façade as marginal spaces also consisted of elements in two groups: elements of the façade and elements identifying boundaries. Usually building regulations established by "higher" powers are the way of influencing distribution of these elements. (p.139)

Although he pointed out that the problems identified as preventive for the development of living facades are commonly not "technical", he believes that better design with better understanding of the territory power in relation to the façade elements can achieve a "living facade".

However, another case of a designed "living façade" seems to suggest a dead end, as reviewed by Peng Liu (2001 p.174). The Student Dormitory of Medical Faculty, designed by Lusien Kroll in Belgium (1968-1972), is featured by the façade, built with standard industrial products designed to be changeable. Based on the SAR Tartan grid, façade elements with limited standard sizes are arranged in an apparently random way. (Kroll,) The connections among façade elements and those between them and the main structure are clearly separable, enabling them to be independently changed. However, more than 20 years after this project was built, there is almost no change accomplished on the façade of this building. The author seems to accuse the students, who live there temporarily, to have reduced their interest in any change. And she insisted that changing façade elements, no matter how technically easy, is a large scale technical action. And she also accuses the building regulation: "Of the two territories along the two sides of a façade, one is on a higher hierarchical level. The rules of higher-level powers influence changing the façade". However, if we look at the original intention, the consequence is not surprising: "First, he wanted to reject the monolithic and bureaucratic uniformity of typical university architecture". Still, there is a need from the designer to demonstrate an outlook of the building through the designed façade to the public.

In a later renovation project designed by the same architect, the interior function and appearance seems the major concern of a random façade, rather than demountability: "The intention of the architect in regard to the façade is not to make it changeable but to make it complex and fit for individual needs…"

In conclusion, similar to Kobets-Singh, the author fails in providing a solution to the conflicts between the users' interests and the public's interests, presented by building regulation: "Regulation is an often-accepted "invasion" of territory by another power". However, "Conventions are informal regulations. Regulations and conventions are influenced by local cultures". "Changing facades is forbidden in some areas because the quality of the modified facades is low and the low quality not only destroys the appearance of the building but also results in safety problems such as leaking water and falling parts".

However, she indicates the direction of living façades: moving the façade towards the interior. "If change of façade will result in a change of territory, it will be very difficult to be realized in the real world, especially when there are strict rules defining territories and boundaries or interfaces. It is much easier to alter a façade when it is inside a territory".

DOUBLE FAÇADE BEYOND THE NEEDS OF ENERGY SAVING

According to the theory of N.J Habraken and Open Building, there are at least two territories and two territorial powers in hierarchy on two sides of a façade. This naturally leads to thinking of double façades as a strategic solution to the problem of "invasions" from either side: an outer façade representing the interests of the higher territory power and an inner façade for the exercise of lower territory power(s). The simple fact that most Open Building implementation did not involve much in regards to double façades may justify that more effort needs to be put into experiments in this area. More encouraging findings are available from building engineering, with strong interests toward the climatic control effects of the double glazing façade in office buildings.

Single-glazed windows result in high winter-month heat loads, whereas modern double- or triple-glazed units could result in summer overheating without additional solar protection or ventilation. (Kaluarachchi 2005, 89-95) Persons working in buildings considered the possibility to control the conditions of their own post (lighting, temperature, and air conditioning) to be of very high importance. The owners of the buildings preferred objectives like long service life, technical and functional advantages, and additional value of a good and developing place to work while keeping in mind environmental conditions: "The owners thought the investments to double façade were worthwhile and considered it as the only solution for glass buildings in northern circumstances". (O. Tenhunen 2001, 141-148) It is already possible to classify five types of double glazing façade according the major functions:

- "The rain coat" gives a long service life and clear benefits in service costs. The inner façade may be made of any material.
- "The northern light" makes it possible to reflect daylight and control circumstances individually.
- "Environmental consciousness" produces electricity for local use and sells the rest to the common networks.
- "Cool buffer" zone protects against weather and works as a room for pause and temporary stay-active forum in institutes.
- "Green circle" creates its own specific microclimate. It changes carbon dioxide into oxygen by assimilation. It creates a new kind of city park.

The first type is directly related to our question about territories. The rest are more concerned with environment and energy resolution. This is because much of the energy exchange with the environment takes place at the building envelope interface, primarily the façade and roof. For example, heat losses owing to the glazing of domestic buildings are thought to account for as much as 6% of the UK's energy consumption. Electrical lighting accounts for approximately 5% of overall UK energy consumption, but in many commercial buildings, this can be as high as 60%. In addition, air-conditioning systems, which are used on many buildings, are often oversized, and it is believed that plant capacity in UK buildings exceeds peak loads by approximately 30%. (Y. Kaluarachchi 2005, 89-95) And even a new low U-value façade is not a simple solution, because a high degree of air tightness could result in reduced air exchange leading to overheating, stale air, and poor comfort.

The development of the double façade solutions that can respond to the needs of the occupants of both new and refurbished buildings is, therefore, a key area for development. The façade of a building can account for between 15 and 40% of the total building budget. And it has been shown that, when designed carefully, innovative systems do not represent additional initial building costs, running costs are lower, and energy costs can be reduced by approximately 30% compared with conventional solutions. (Y. Kaluarachchi 2005, 89-95) Figure 3 shows a new office building that stands in the center of Berlin that is primarily an advanced solution for energy saving and environmental comforts. But apparently the outlook provides a landmark identity for the building. And one of the interesting strategies to enhance such effect was from the users, who frequently open or close the orange solar protective devise between the double façade.

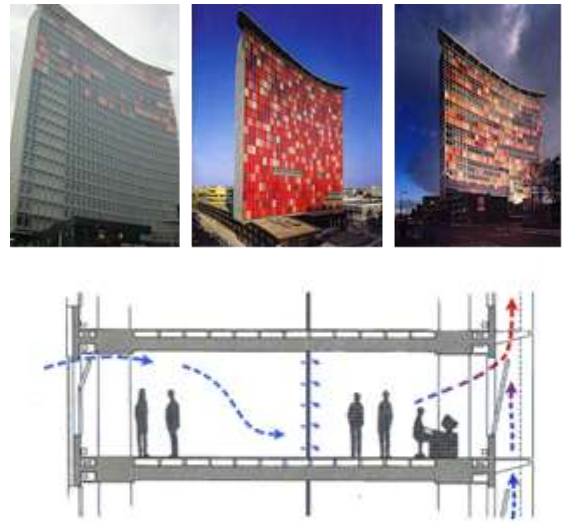

Figure 4 GWS Office Block in Berlin (2000) designed by Sauerbruch Hutton Architects (a) Constantly changing of façade (b) environmental concept with ventilation by double façade (Picture resource: http://www.hku.hk/mech/sbe/case_study/case/ger/GSW_Berlin/GSW-Index.htm)

DOUBLE FAÇADES FOR HOUSING: A LESSON BEYOND TECHNICAL SOLUTIONS

The double glazing façade normally found in office buildings maybe too costly for residential buildings. The limited control of users also found almost unacceptable. Double façades for housing requires a different approach in which the basic climatic control principles are also different.

Baumschlager & Eberle, based in Vorarlberg, Austria, started by designing small, reasonably-priced, detached houses and slowly developed a typology for mass housing developments with compact, flat–roofed buildings with which they distinguished themselves. Today, they are involved in the construction of many, large, multi-storied buildings, including, hospitals, office blocks and industrial buildings, schools, community centres, and shopping centres in European and China. Their architectural characteristics can be summarized as having a "strict economy with respect to material and artistic/architectonic means and a keen sense of cultural and social responsibility…. Their tectonic achievement deserves the highest recognition on a world-wide scale". (Frampton, P. 19)

Firmly rooted in practice, Baumschlager & Eberle have demonstrated a particular skill in which flexibility, sustainable building, a high level of craftsmanship, and the beauty of the architecture are expertly integrated together in a reasonably-priced, simple compact building. (Jia 2005) A compact form uses less material, less energy and is cost-effective. Basically, there are two very simple structures in the plan of the typical housing they designed. In the middle of building, there is a stairwell surrounded by closets and ancillary rooms. On the outer fringe, there is a surrounding wall, which serves as a structural feature as well as an enclosure. There are no divisions of rooms between these two structures. To omit or to add a room, all one has to do is to remove or insert a partition wall. (Figure 6)

These architects see the façade of a building as being of particular importance, since it is the structure, which provides the key to saving energy, the complicated inter-relationship between the exterior and the interior, the private and the public, as well as being responsible for creating the crucial syntactical enrichment of the public outdoor space. It is expensive to build, with high embodied energy, which is technically complicated and difficult to maintain. Therefore, it is treated as part of the support, which according to Habraken, is designed by the architects according to the collective decision made by the community. It is not an area where individual or private needs dominate. However, they also see that it is important and crucial for the users to be able to operate and be in control of part of the façade (i.e., to adjust the lighting, ventilation, shading, and views). Consequentially the outlook of the building changes according to the actions and the wishes of the buildings' occupants. In this sense, the façade accommodates the most flexible elements of the building and changes constantly. (Figure 5, 6) A variety of technologies and materials have been applied, which have resulted in intensifying this flexibility: "A housing problem is about establishing the border between individuals and community. It is about establishing the levels of community in spatial terms". (Dietmar Eberle: Lecture at HKU on the 24th October, 2003)

Figure 5 Sebastianstrasse Residential Project featured by a set of white and sliding glass panels as the outer façade.

Figure 6 Housing "Living in Lohbach", Hötting-West, Austria, 1998

Figure 5 featured a white, glass building configuration that presents a different façade according to the weather conditions, the hour of the day, and the day of the week. It is often closed, although it is also opened from time to time, according to the user's mood in each individual apartment. In front lies a mass-produced sliding mechanism. Glass panels that feature silk screens create the following effect: A person outside cannot look inside, but a person on the inside can see the goings on outside. This leads to a second effect: it is possible to adjust what can be seen from the outside; layering the panels over one another results in a visually almost impenetrable glass wall. The theme was individual living and that includes allowing everyone to choose how many windows they want to have, where they want them to be, and how much distance they require from their environment. And the geometry of the outer façade is an exciting addition to the surroundings. (Modified from project introduction by Lisbeth Waechter-Böhm)

Figure 6 illustrates the plan, a changing outlook of the building, and the technical section of the double façade. All openings in the internal facade are French windows from floor to ceiling, providing access to the very narrow terraces/balconies that run around the buildings. As a result, each apartment disposes of generous outdoor marginal spaces, which are accessible from every living space and room. Private activities and belongings are displayed, however, and partially covered by the outer façade. On the outer façade, shutters made of copper and parapets of glass, both mounted in front of the terraces/balconies, serve as a protection from sun and weather and provide different and changeable privacy.

Baumschlager & Eberle double façades show the following differences in terms of double glazing façades in office buildings:

- The users have a wider range of control in the operation of the façade, from completely open to entirely closed. At times, this operation may affect the effectiveness of energy performance of the building.
- Space between the two façades becomes the margin that the residents can use more intensively.
- Outer façade functions more for privacy protection, lighting, shadow, and vista adjustment, than single environmental protection.
- The outer façades are constructed with solid or translucent materials. This is understandable, because they are effective in protecting the building from heat better than any kinds of glass.

Their projects show clear differences in user-participatory design. They basically do not allow any construction by the users. They provided the maximum possibility for the user to operate the façade, including changing the position of the window at anytime. While at the same time, the façade maintains its high quality in architectural, construction, and environmental quality. High costs of construction and sophistications in technology associated with the façade may be the additional arguments to put façade under the architect's control. And it is certainly easy to cope with general building regulation. However, they believe this facade is also derived from the division of roles among territory powers. For them, both the outer façade and the internal façade represent the physical qualities of the buildings for the collective identity of all the residents and their relationship to the larger community through outdoor space created by the facade. There is no need for individuals to invade the collective territory: "These issues related to the facade can be discussed publicly. But it cannot be decided on an individual level". (Eberle interviewed by the author in October 2003)

CONCLUSION: OPERABLE AND DOUBLE FAÇADE AS AN INSTRUMENT TO BALANCE PUBLIC AND PRIVATE INTERESTS

Building façades are a very complicated issue. They are related to the internal layout of the floor plan, the environmental performance of the building, the cost and technology provided, and the relationship between the territories between inside and outside, and through this, the relationship between private and public. And finally, it is still the major component of the building's form that largely impacts the larger environment, if not limited visually.

However, there is already a matured theory dealing with the built environment through understanding territory hierarchy and territory powers. Façade is a location of two territories in different levels. It is preferred as a marginal space where the element of boundary and elements for the performance of territory powers are clarified. However, performance of the lower powers, even provided with demountable but standardized façade elements for the users to chose, may still conflict with power from upper levels presented by building regulations, quality control, and demands for collective identity. This thinking leads to the double façade hypotheses, with the outer façade representing the upper territory power and the inner façade representing the lower territory power. A review of the latest developments in terms of double glazed façades in office buildings and double façades in residential buildings does not give a clear-cut answer, although their technology experience shows much more potential. The most interesting examples are found in the projects designed by Baumschlager & Eberle, which provide maximum control for the residents, even in terms of changing the location of openings on the wall instantly. There is a marginal space between the outer façade and internal façade that the user can use as an extension of private domain. However, it does not involve any construction activity from the users, and therefore, is compatible with the building regulations. Each building provides a strong architectural identity to the building and a high-tech quality appreciated by the collective users. There is still a lack of systematic post occupancy evaluation on these buildings. Experience on increased influence and constructions on the internal façades from the users and the technical possibility to support such influence are still pending on future study.

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Cultural and Technological Factors in the Individualization of Multi-Dwelling-Unit Building Façades

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ABSTRACT
Everyone is different from the neighbour and from him/herself through space and time. The Infill fit-outs are more and more capable of generating adaptable interior layouts, but the options are very limited as far as the façade is concerned. Logically, the façade should follow; not only responding to what goes on inside but also reflecting, or hiding, the very personality of the occupants. Easy and usual with suburban housing, that task is more problematic and actually very rare in the case of multi-dwelling-unit buildings. Various levels of individualisation can be adopted: differentiation by the architect, selection by the occupant form a "menu" offered by the architect, appropriation or additions by the occupant, variable or demountable façade components and movable façade panels. Of course, the freedom of expressing one's individuality stops when in conflict with the neighbourhood: some directives should be agreed upon, some cultural values need to be shared and an appropriate technology is required.

KEYWORDS
Individualisation, multi-dwelling-unit housing, cultural values, adaptability, intervention of the occupant, interchangeable components, industrialised systems.

INDIVIDUALISATION OF THE MULTI-DWELLING-UNIT BUILDING FAÇADES

Basically, architecture is aiming at improving the life of the occupants. As each occupant is different from the neighbour and from him/herself through space and time, architecture should normally follow. So far, within the Open Building approach, the individuality of the occupants of a dwelling unit is addressed when a Support Structure is established and when the appropriate Infill fit-outs are available, thereby providing for an adaptable layout. Logically, individualisation should also be reflected outside, on the façade. That is often the case in a single detached or attached housing environment: the houses are usually different from one another and the occupants do intervene on the façades as the years go by, depending on the local culture.

But individualisation of the façade is actually very rare in multi-dwelling-unit buildings. The possibility is very limited in multi-tenant buildings as the occupants are usually restricted by the very wording of their lease and/or reluctant to invest in a place they don't own. The possibility is more relevant in a condominium or cooperative situation. Of course, the freedom of expressing one's individuality stops when in conflict with the neighbourhood. Therefore, the cultural values and differences need to be welcomed or at least accepted whereas the technology applied should not interfere with the adjacent units.

ARTIFICIAL ANIMATION OF THE FAÇADES

The search for individualisation in multi-dwelling-unit building facades should not be confused with the efforts by some architect to "diversify" the facades just for the sake of breaking away from a repetitive module, without any reference to the occupants behind those facades. Various "tricks" are currently used in contemporary buildings: "zigzags", random distribution of "special" features, "spinning" of a repetitive pattern, etc. These "tricks" are actually worst than a repetitive module as they give an artificial impression of diversity and actually deprive the occupants of a genuine expression of their personality.

Figure 1: "Zigzag" and "spinning" façades of a housing project in Montreal

LEVELS OF INDIVIDUALISATION

The author has identified five basic levels of individualisation in contemporary housing façades, going from partial interventions to fully demountable and movable façade panels:

- Differentiation by the architect;
- Selection by the occupant form a "menu" offered by the architect;
- Appropriation or additions by the occupant;
- Variable or demountable façade components;
- Movable façade panels.

DIFFERENTIATION BY THE ARCHITECT

Aware of the importance of avoiding the "chicken cage" image and of distinguishing units from one another in a multi-dwelling-unit building, many architects have deliberately opted for some form of differentiation right at the construction stage. That option is especially justified when the architect does not know ahead of time the future occupants of those units.

The most well known examples of differentiation by the architect are the Corbusier's "Unités d'habitation" in Marseille, Nantes-Rezé, Briey-en-Forêt, Firminy and Berlin-Charlottenburg. The inner walls of each dwelling unit's loggia are painted with a different semaphore like set of colors. In addition, various types and articulations of the awnings complete the individualisation sought by the architect.

Figure 2: Façade of the Marseille "Unité d'habitation" by Le Corbusier

SELECTION BY THE OCCUPANT FROM A MENU

When the architect can meet the occupant during the design process, a "menu" can be offered within a certain technology and without increasing the cost compared to merely repeating the same or a limited set of variations. Then, the options can be closer to the interior planning, to the taste of the occupants and to the degree of visual intimacy desired. But the possibility to modify the selection later on is technologically doubtful.

The Molenvliet project in the Netherlands was designed along the Open Building approach. Variations in window/panel/door/colours were in fact decided by the first occupants from a menu provided by the architect, Frans van der Werf. Of course, the colours can be easily modified through time by the same or by new occupants, but as the technology was not providing for easy dismantling, the window/panel/door placement is more or less bound to remain the same.

Figure 3: Façade of the Molenvliet horizontal multi-tenant Open Housing project

The "Institut de l'environnement" building in Paris is another example of selection by the occupant at the design stage. By introducing different spacers between the top and bottom, Jean Prouvé was able to economically generate five sandwich panel options out of the same mould: a large vertical window panel, a square window panel, a square window panel accompanied by a small horizontal bottom window, a small horizontal top window and a completely opaque panel. Then, it was up to the administration of the building to select the appropriate panels according to the functions of the rooms behind.

APPROPRIATION OR ADDITIONS BY THE OCCUPANT

Even within a very strict modular grid, the presence of different occupant can be felt either through their appropriation of the glazed areas, such as in the Mies van der Rohe buildings, or by operating shutters like in so many European cities.

In some cultures, the addition of personalized features is normal and allowed, as it is the case with numerous buildings everywhere in the world, notably with the old housing blocks in Hong Kong. However, the results can be considered quite "noisy" and even unacceptable in the context of some other cultures.

Figure 4: Five panel options produced by Jean Prouvé out of the same mould

Figure 5: A Mies van der Rohe multi-tenant building in Montreal and street scene in Bilbao

Figure 6: Old housing block in Hong Kong

VARIABLE OR DEMOUNTABLE FAÇADE COMPONENTS

To introduce the 4th dimension, time, in the individualization of the multi-tenant façade, an appropriate technology has to be implemented. Otherwise any change would imply the destruction of the previous arrangement, an operation that would be both costly and contrary to the sustainability agenda.

NEXT21 in Osaka, designed according to the Open Building approach under the leadership of Professor Yositika Utida, is so far the most adaptable multi-tenant residential building in the world. The façade does affirm the interior planning as well as the very personality of the occupants. For instance, by looking at the façade, one can easily read that some occupants are extroverted whereas some are not.

Figure 7: NEXT21 experimental adaptable multi-tenant residential building in Osaka

The façade of NEXT21 adopts a demountable technology, using vertical metal profiles to support the glazing modules and to attach exterior multicolour stainless steel laths in front of an insulated wall composition. The exposed structural concrete beam is acting as a neutral horizontal boundary between the various options selected.

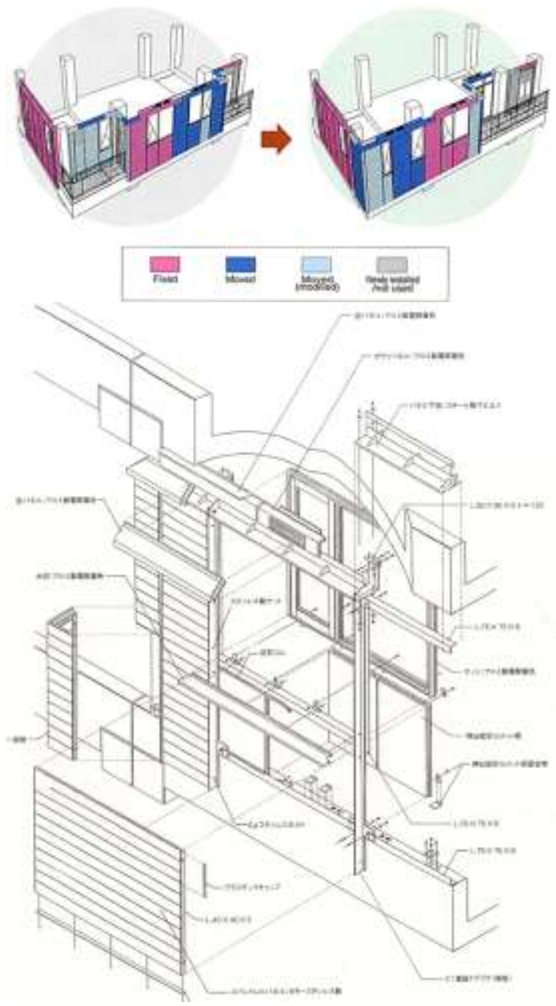

Figure 8: Components of the NEXT21 façade and examples of variations through time

MOVABLE FAÇADE PANELS

The most explicit and complete way to achieve full adaptability of the façade through space and time is to introduce a sub-system of fully movable panels. These panels should be easily and rapidly dismantled and relocated or replaced according to the needs of the occupant. Most likely, the work will not be done by the occupant but by some technical crew using off the shelf components. Afterwards, these components could be further personalized by painting or some other input.

Because they have to be autonomous, movable panels are completely different than the usual curtain walls which are usually installed in a progressive manner: when two windows share the same structural mullion, removing one disturbs the others; when two prefabricated curtain wall panels are installed through dowel connections, removing one disturbs the others.

The detailing of the movable panels aims at getting them easy-to-install from the inside without disturbing the adjacent units. Two methods are available:

Introducing a framework of "neutral" mullions and/or lintels connected to the structure and designed to easily accept independent panels.

Connecting independent prefabricated panels directly to the structure, with open joints overlapping horizontally and accommodating a gasket vertically.

Jean Prouvé has investigated and developed movable façade panels for many residential and institutional buildings. The curtain wall he produced for the Berlin Free University building, designed by Candilis / Josic / Woods, is a clear statement in that direction. Large horizontal metal lintels serve as "neutral" boundaries between floors and support various options of glazing and opaque panels.

Figure 9: Movable façade panels at the Berlin Free University

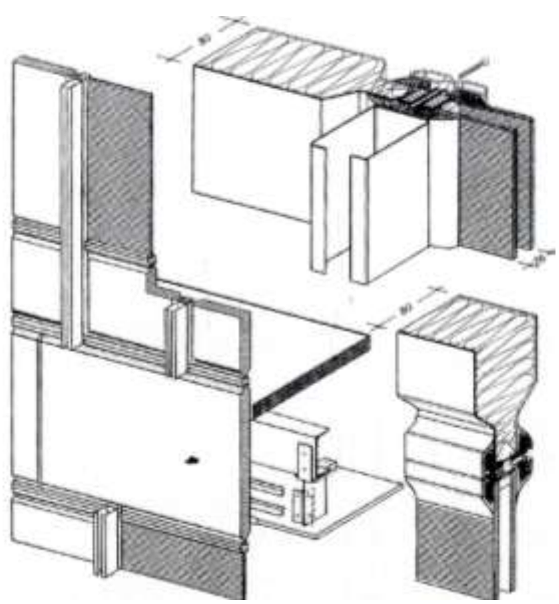

Figure 10: Details of the movable façade panels at the Berlin Free University

The horizontal connection is done through a neoprene gasket easy to open in a single operation. The vertical connection is facilitated by an exterior metallic support bolted to an interior profile through the same type of neoprene gasket. That support does allow for the changes to be made from the inside as well as permits the introduction of horizontal subdivisions between the lintels. Obviously, those details should be adapted to the new processes as well as updated in terms of thermal performances.

When connected directly to the structure, open joint lintels or full storey panels become autonomous and can then be dismantled, relocated or replaced without disturbing the adjacent ones. Full storey panels would normally need to be partly opaque in order to hide the floor frontage as the fireproofing required. For these reasons, the lintel method is usually preferred.

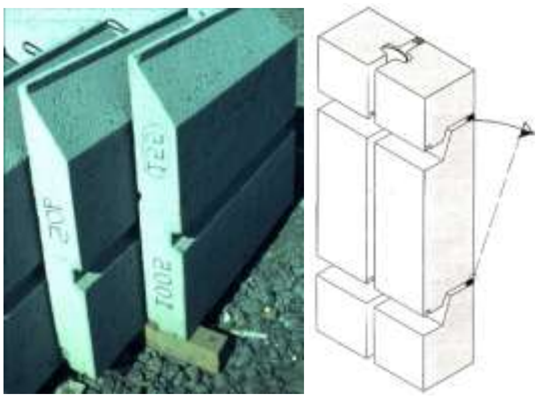

Figure 11: Details of precast concrete lintels / panels with open joints

The proposal for an Olympic Village in Montreal designed by the author, entitled "Cité-Jardin 76", was also introducing autonomous movable panels, using narrow lintels and mullions to act as "neutral" boundaries between adjacent units.

FULL INDIVIDUALISATION OF THE FAÇADE THROUGH SPACE & TIME

Facilitated by "neutral" mullions / lintels or connected independently to the structure, the movable façade panels are capable of generating a dynamic and ever changing expression of the inner life of the dwelling units. When the interfaces between manufacturers are regulated, the possibility of integrating various types coming from various manufacturers can generate even more individualisation. Although some may consider it as "cacophony", such a "democratic" venue would actually be more humane than the standardised "chicken-cage" façades encouraged by the some socialist regimes or the fuzzy tricks architects are sometimes using to artificially animate the façades. It is really a matter of cultural values.

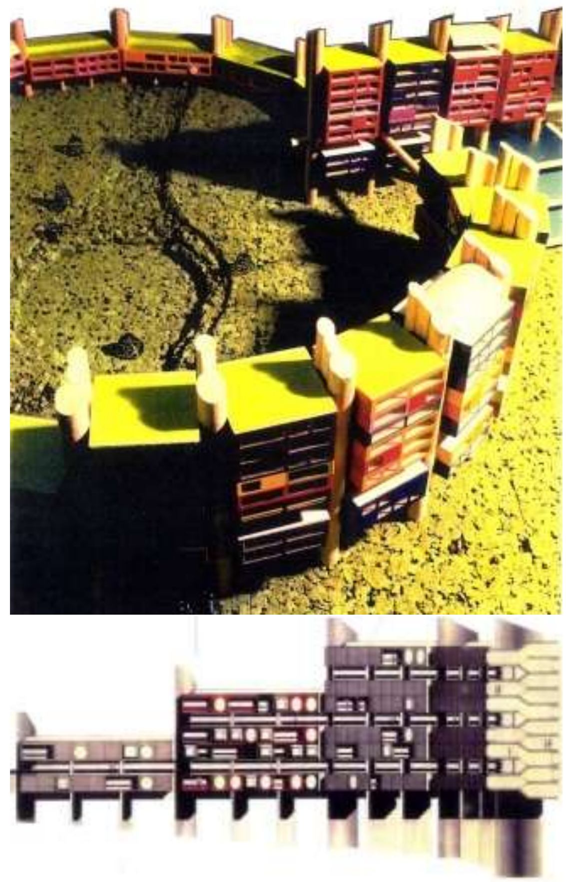

Figure 12: Individualised façade panels proposed in the "Cité-Jardin 76" project

Figure 13: Open framework narrow grid integrating various compatible façade panels

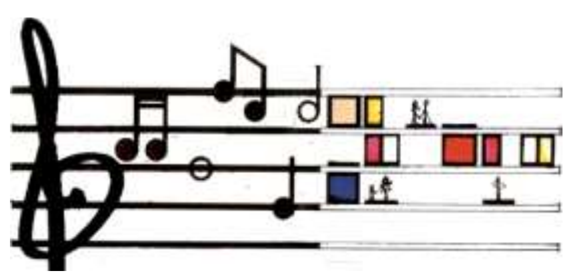

Figure 14: Analogy between music and the open framework grid

CONCLUSION

The façade is more than the building envelope, just like clothing is more than a comfortable interface between the body end the environment. Just like clothing, the façade should be responsive to the individuality and the personality of the "occupant" through space and time, whatever the level of appropriation available.

Obviously, movable façade panel sub-systems are the most responsive answers to external individualisation as long as:

- the cultural and aesthetics parameters are agreed upon collectively;
- a variety of glazed and opaque surfaces is offered;
- each dwelling unit façade respects the boundaries with its neighbours;
- the installation is done in a clean and timely fashion;
- interfacing rules are clearly spell out both to simplify the process and to allow for an open sub-system;
- thermal insulation, soundproofing and fireproofing high performance criteria are maintained.

Then the "neutral" mullions / lintels or structural grids can be to an individualised façade what the stave is to music: not only coordinating the positioning of different panels but also generating ever changing urban scenery reflecting the very personality and evolution of the occupants. A new dynamic architectural and cultural language is then available.

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Figure 7: Photo by the author
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Figure 9: Free University Berlin
Figure 10:Jean Prouvé: Complete Works
Figure 11:Photo by the author and diagrams from Components and connections
Figure 12:Model and drawing by the author
Figure 13:Photos by the author
Figure 14:Drawing by the author

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Determination of the Technical Direction on "High-Quality Housing Product Habitable in the Long Term" and the Architectural Answer

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ABSTRACT
Using the Yashi Alloy Apartment as an example, we describe how the design and research group selected, developed, optimized, and used several technological items for residential construction. We also discuss the manner by which habitable high-quality housing products are produced in the long term. Finally, we discuss how the achievement in housing research can be applied in actual construction.

KEYWORDS:
residential construction, high-quality housing products

THE TREND TO MAKE HIGH-QUALITY HOUSING PRODUCT HABITABLE IN A LONG TERM AS THE GOAL

Analysis of the issues of recent housing development from the viewpoint point of use

Recently, housing buildings have faced quality problems. Thus, improving housing quality is the main direction of residential construction. A broad definition of quality does not only concern construction problems, such as structural safety, water and power supply leakage, and wall surface integrity, but also the adaptability of housing function and the high quality of the residential environment. Daily housing issues concerning housing quality can be seen in newspapers, network information, and forums. From construction completion up to when residents move in, the function of housing buildings is both fixed and changing. Several problems affect housing quality in varying degrees.

First, the types of dwelling units and space functions have different use requirements. Thus, residents are not necessarily satisfied with the residential spaces provided by real estate businesses. Breaking down the walls is often the first thing people do after receiving new dwelling unit. The original space partition and inner wall arrangement are only checked and accepted when the project is complete. Thus, a deeper consideration of details is needed during the design stage. After determining the standard area of each unit and the type of unit organization of a residential building, circumspect consideration of how the space in a unit skeleton map is partitioned, how every square meter or every cubic meter is used, and how space is effectively arranged and varied must be performed. Often, a space pattern cannot meet the demands of housing functions because of the stylized design and limited design cycle.

Second, ensuring the final substantial form of housing requires a comprehensive construction method. Controlling several physical quantities, such as sound, light, and heat, among others, is necessary to realize a fine physical environment for a residential building. Moreover, choosing the appropriate construction technology and the necessary building materials and components is an important condition. A concrete construction team must perform excellent and advanced building processes using a precise quality-control system. However, modern construction teams still repeat many wet operations and perform less technical functions. In general, the technical level of building workers is not sufficiently high. Many of the workers from the countryside take up tools to perform brickwork as soon as they put down their sickles, which causes many quality problems. Workers have different skill proficiencies, which can generate uncontrolled factors and large errors to manual operation and easily cause quality problems on residential construction. Therefore, research and development of a proper construction system and setting up an effective training system based on industrialized construction are necessary. Through these, the drawbacks of quality defects and the ill performances of housing products can be solved. Housing industrialization can be then realized by popularizing the perfect and complete sets of housing components with the premise of housing standardized production and adaption of integrated construction technology.

The third problem is the lack of integrated and concerted consideration on the age of housing function for housing and its necessary building materials and components. In China, the standard life of housing is designed to be 50 years, considering structural safety. However, along with social development, the lifestyles of people have changed significantly; thus, accordingly, the original housing patterns must also change and adjust, and the life of components and parts vary. For example, a compulsory standard in the current national "Construction Engineering Quality Control Regulation" provides that the life of the anti-leak function on roofs, toilets, rooms, and exterior walls be five years, and the life of electric wires, pipes of water supply and sewerage, device installations, and decorations be two years. These housing components and parts must be replaced in different periods after their quality lives. Currently, most of the installation of housing components and parts and the setting of devices in China are integrated with the main part of the building. Thus, when the housing building is renewed, some parts of the building that do not need to be changed are damaged, resulting in huge consumption on substance and energy and producing a big amount of building waste.

Technical goals are set up from the perspective of the life cycle of housing

The problems mentioned above prove that housing quality is related to its life cycle. The life cycle includes two aspects. First, the life of all housing functional components and materials should accord with the life of the housing building, and the building should significantly reduce in quality because of the aging of several components. In this way, the goal of making the housing building provide a favorable basic physical environment in the long term can be realized. Second, the housing building should suit the changes in family life. To adapt to the changes in lives of its residents, the housing building should dynamically adjust its function while maintaining its high quality.

When the residential construction is analyzed from the viewpoint of the life of building components, a more important additional achievement is obtained: saving energy and saving material, which refers back to the technical goal. In the case that all the functional components of a housing building can be replaced freely during their life cycle, other components should not be affected or destroyed. Therefore, materials and resources should be used and managed effectively and intensively. Such actions must be active and sustainable for the housing itself and for social consumption.

For the housing system based on the conception of "high-quality housing product habitable in the long term," an integrated selection of construction measure and building materials and components are considered in the design stage, including the life of all components and the convenience and independence of the replacement of these components after their life cycles. The quality and performance of the housing building in its whole life cycle is the starting point of a design concept. Considerations on the integration of production, adaptability of residential spaces, and the long-lasting nature of the building in use during the process of building design and construction will ensure residential quality, increase the comprehensive value in the whole life cycle of the housing building, and realize a sustainable residential environment that is better on saving resources and reducing consumption.

The goals mentioned above can be realized via technical selection and optimization.

THE CHARACTERISTICS OF TECHNOLOGY INTEGRATION OF HOUSING IN CURRENT CHINA

A proper technology is necessary for improving the housing quality needs development. The optimization of design and construction technology of housing is correlated with the industrialization process. A housing building of the technically integrated type maximizes advanced and proper construction technology using the housing industrialization method. Housing industrialization is an approach that improves housing quality. Industrialized housing provides an objective condition and a platform for technical research, development, and innovation. The characteristics of industrialized housing include all the systems, such as structure, partition, envelope structure, water and power supplies, and devices, which are to be integrated in a factory. All factors related to housing performance are to be researched, developed, and integrated in component systems. Therefore, the core content of industrialization has been advancing, and all problems concerning housing quality, energy efficiency, environmental protection, green and low-carbon elements, and production efficiency can be solved.

Modern integrated technology for improving housing quality is divided into two steps. In the first stage, the work is focused on the main structure starting from the prefabricated concrete (PC) structure system or light steel structural system, which has led to the emergence of a large number of prefabricated component enterprises. In the other stage, the work is focused on interior decoration, SI system, and related technology once the main structure has been completed. Attention is paid to the industrialized prefabrication and integration on inner components. The main structure and inner components are separated in the SI system to achieve the required variability and replace ability of housing. These elements will permeate the whole life cycle of the building and the conception of "high-quality housing product habitable in the long term," which is an important expression in housing industrialization.

Prominent social issues and solutions in every period have been revealed in the development of the Chinese housing construction technology. Currently, technology integration remains an important approach for housing development in large-scale construction and accelerated process of urbanization in China. Technically integrated housing has three characteristics. First, buildings have a long-lasting nature suitable for saving energy, saving land, and protecting the environment, and which prolongs housing life. Second, the adaptable, flexible, and changeable system of housing ensures the good residential performance of the building. Third, the integrated production and construction method improve the comprehensive benefits of housing.

THE RESEARCH AND DEVELOPMENT OF TECHNICAL INTEGRATION, IN WHICH SI CONSTRUCTION SYSTEM WAS ADOPTED AS THE CORE, ARE USED IN THE PROJECT YASHI ALLOY APARTMENT IN BEIJING

Understanding and localization of the SI construction system

Many problems on the housing construction in China can be solved fundamentally using the SI construction system.

The SI housing construction system can separate the skeleton ("S") and the infill ("I") of the housing. "S" is the support part with a durable and public nature, including the main structure, common pipes, wires, and devices, which are forbidden to be altered by the residents. In contrast, "I," such as pipes and wires, partition, integrated kitchen, and inner decoration, among others, inside the dwelling unit can be flexibly changed according to the needs of the residents.

Such housing provides durability on the structure, flexibility on the residential spaces, and the characteristics of the "I" part can be renewed because of the separation of the "S" and "I." Such housing also has some advantages, including low energy consumption, high quality, and long life cycle.

After understanding the characteristics of the SI system, the following points of the SI system have been found to be suitable for the Chinese housing development.

The SI system is applicable to housing buildings with small and medium units (unit area is no more than 90 m2): Currently, in the development of the Chinese real estate industry, small and medium housing units are mainstream products based on either the housing policy or market needs. Along with a number of funds the government has put into the construction of affordable housing, construction demand will continue to increase. Nevertheless, compatibility and versatility are necessary for a residential space because the spaces of small and medium housing units are more limited. The construction conditions are easier with a large width of space for small and medium housing units. The adopted SI system may be flexible in changing the pattern of the unit to adapt to future changes.

The SI system is applicable to construct whole life cycle housing: The change and renewal of infill cannot affect the support because of their separation, thereby ensuring the durability of the support. Moreover, the flexibility and changeability of the infill will effectively adapt to the needs of a family in different periods. Its renewal may prolong the life of housing, and thereby upgrade the nature of sustainable living of housing and realize the long life and metabolism of housing.

The SI system is suitable to technology application with high integration: The SI system has realized the separation of the support and infill; thus, it provides a wide platform for the application of a number of advanced technologies, such as sewerage on the same storey and dried floor heating, among others.

The SI system favors a conservation-oriented society: The SI system is an advanced construction system that can effectively improve housing quality and prolong the life of housing. Thus, it decreases the ratio of repeated construction of housing. Moreover, it can reduce reducing construction waste and resource consumption during housing construction and use.

The SI system promotes the development of housing industrialization: The SI system can precisely control design sizes, which is very important for popularizing the design standardization and module.

The SI system favors the division of public and private property rights, thereby providing the technical support on relevant legislation on maintenance, reconstruction, and demolition.

Some difficulties in the implementation of the SI system in current China

1. Cost: Superior decoration is necessary in the SI structural system; thus, the cost for the separation techniques of pipes and structure must be increased. Both require more funds for the SI system.
2. The popularization of key components is not sufficient: Manufacturers of key components are lacking and some components have to depend on importation because of the limitation of the market during the initial stage. Thus, the popularization and application of a new construction technology is limited.
3. The SI system is short of a uniform modulus standard platform; thus, the application and integration of industrialized components is further limited, and the interchangeability of components will be lacking later on.
4. Errors in structural construction will adversely affect the whole SI system.

Localized implementation of the SI construction system on the Yashi Alloy Apartment

Project Yashi Alloy Apartment, as the first demonstration project of technical integrated housing that introduces and integrates the SI system, has realized the application of high-integration components from the structure to the superior decoration and the complete dried construction in superior decoration (Figure 1).

Figure 1: Illustration of SI system on Yashi Alloy Apartment, Resource: CNERCHS

The achievement of the Yashi Alloy Apartment in Beijing has conquered the contradiction between the SI system and existing Chinese situation. Moreover, it has realized the separation of the structure and inner decoration, including more than ten core items and the integration technology, such as the partition integrated system, internal heat preservation, and energy-efficient integration of envelope structure, dried floor heating and saving energy integration, integrated kitchen and bathroom systems, new-air ventilation integration, elevated floor system and sound insulation integration, and comprehensive space design and integration. Housing performance and residential quality have been markedly upgraded.

Technical integrated system of the Yashi Alloy Apartment

Project Yashi Alloy Apartment is located at the end of Yongding Road, outside West Fourth Circle Road in Haidian District, Beijing. The west of Yongding Road has an adult commercial atmosphere, and to the north is the main road of the city, Tiancun Road, which will be connected with the West Fourth and Fifth Circle Roads. Most areas around the project are residential. Big trees line the western side. The project site is 2.2 ha and has a total building area of 77,800 m2. The plot ratio is 2.20. The project is composed of two public facility buildings and eight 6–9 storey residential buildings with 486 families (Figure 2).

Project Yashi Alloy Apartment in Beijing provides an integrated solution for the technical integrated type of housing. It aims to solve the problems of Chinese housing, such as short life cycle, large consumption of energy, serious common faults on construction, and huge waste of repeated decoration when housing is received.

Moreover, it aims to solve another aspect of the problem on the lack of adaptability on residential style and lifestyle that affect the sustainable development of Chinese housing.

Figure 2: General model of Yashi Alloy Apartment in Beijing, Resource: CNERCHS

Interior space construction of small and medium housing units with changeability and high efficiency

The construction of Project Yashi Alloy Apartment in Beijing is based on the conception of “high-quality housing product habitable in the long term” and meets the demand of adaptability of space environment during the life cycle of the residents. In this project, the designers designed the housing to be durable and adaptable to the daily life and future changes. Thus, housing can provide residents with living accommodations for the long term, and resident can gain such residential spaces with good value for money. Housing has prolonged the life cycle of residential functions, upgraded the value of social assets, reduced resource consumption, and fully utilized renewable resources.

Changeability is a basic need of the conception “high-quality housing product habitable in the long term.”

In China, the life cycle of a family is approximately 50 years. During the initial period (5 years or so), a young couple may consider having two rooms to meet their basic residential demands. During the mature period of the family (15 years or so), along with the birth and growth of the children, the interior space can be partitioned into three rooms to meet their growing demands for space. During the recession period of the family (20 years or so), when the children have grown up and left, the basic residential demands may go back to the mode of family members living together with two or three rooms. In the old age stage after retirement, special demands for residences exist.

Aiming at the functional needs in different periods, Yashi Alloy Apartment provides space flexibility to adapt to all periods and meet residential needs during the complete family life cycle.

First, the apartment exterior and partition walls between two units bear structural walls, and the other interior space partitions depend on a partition wall system that is very easy to remove and change. Thus, simply through redecoration, the interior partition can be changed entirely, along with the changes in the number of residents, family structure, and life habits.

Second, when innovation are applied later on, because device wires and pipes are separated from the structure and the property is clearly marked, users do not need to worry about chiseling and cutting into the building or about the quality and life of pipes and wires buried and laid in walls, floor slabs, or intertwined with those of their neighbors (Figure 3).

Figure 3: Plans of dwelling units with multiple function. Resource: CNERCHS

Reasonable function division realizes high efficiency of housing

Considering the demands of maturity of residential function, high efficiency of building area, and space for medium-income families starting from meeting the needs of residential function of core families, the housing product Yashi Alloy Apartment realizes optimization and the intensions of function.

1. Based on the moving and tracking of residents, depository spaces are reasonably arranged. Corresponding spaces are set up in the entrance hall, toilet, bedroom, living room, kitchen, bathroom, and so on. Reasonable, convenient, and easy depositions make rooms well regulated, upgrade the use efficiency of spaces, and meet the basic needs of the residents.
2. An independent entrance hall provides a linking space from the outside to the inside. By necessity, an entrance space is arranged close to the house door of all housing units regardless of their size to strengthen the privacy of the unit. This space will prevent the inner rooms are from being by others when the door is open. Moreover, the space can block cold wind in the winter and prevent dust from entering the inner rooms.
3. The bathroom, washroom, and toilet are arranged as a whole, but are separated into three independent spaces; thus, three persons can simultaneously use them comfortably and conveniently, upgrading their efficiency. Moreover, the separation of dry and wet spaces may effectively prevent users from slipping; the dry space can prevent the breeding of bacteria caused by wetness. The arrangement of the three spaces in a unit design must accord with the action habits and use flow of the users. Normally, the washroom is located in the middle of the integrated bathroom and the toilet. Moreover, a door can link the washroom and bathroom, which would be favorable for changing clothes before and after taking a shower.
4. DK-type kitchen system adopts open spaces for dining and cooking, making the kitchen, dining room, and even the living room connected as a whole. This system has changed original concept of both spaces, created an interactive space, and optimized visional feeling, making it favorable to the joyous intercourse of family members in the living room and kitchen. The open space design enlarges a small space, especially for small and medium units, which is visually pleasing and favorable for the use for family members according to their habits and use flow.

Figure 4: Multi-function space inside the unit. Resource: Yashi Property Group

5. Reasonable arrangement of multi-function space: The so-called multi-function space is a soft space arrangement wherein adjoining rooms can be adjusted and combined into a new room patterned to meet the needs of the changes in the family structure and space transformation. Such rearrangement would be easy to realize because of the light and easily constructed partitions made of light steel keel and gypsum board, as well as the simple pipe layout. The construction of a multi-function space for small and medium units aims to meet the needs of the changes in the unit types during the whole life cycle of the family. For a young couple, a multi-function space could be embodied on the additional space of a bedroom, which is the study. Along with the changes in family members, for a three-person family, it could be changed into an additional room of the main bedroom: the baby room. When the child grows up, the baby room can be turned back to fu a study or a wide bedroom by removing the sliding door (Figure 4).

Integration of key components that will upgrade the function and adaptability of the building

Inner space system

The inner space system of Yashi Alloy Apartment is composed of a partition and a ceiling made of light steel keel, and an elevated floor, which are the best choices for constructing infill part in the SI system.

Heat preservation system

The project adopts an internal heat preservation system using polyurethane foam to solve the problem of heat preservation, which has existed for a long time.

1. The internal heat preservation technology (Figure 5) is the most suitable heat preservation system for the SI system. For the SI system, a space allowance (called a "sandwich space") must be reserved for pipes and wires; thus, an attached partition must be installed inside the outer walls. Heat-preservation material must be placed in the sandwich space to save space and upgrade the use efficiency. The outer envelope layer of the wall should not look too thick, even when an attached partition is added. The measure is highly efficient, similar to "killing two birds with one stone."
2. Evident technical superiority
   a. Internal heat preservation has high efficiency and can save more energy because it could reduce energy consumption of structural walls and decrease the "cold bridge" phenomenon on the seams that occurs with other methods of heat insulation.
   b. Internal heat preservation is more suitable for an independent heating system. The advantages include the fast-rising temperature and the "comfortable touch" feeling of the wall surface.
   c. The internal heat preservation system is water resistant, which may prevent rainwater leakage from the outer wall to the internal, especially in the case of using polyurethane foam.
   d. The internal heat preservation system has good isolation performance against water vapor. Solid polyurethane foam may reduce the penetration of water vapor from the room into the wall, which favors the durability of the structural walls because they have low water absorbance and permeation.
   e. Polyurethane foam material, including solid polyurethane foam, can be adhered the wall, making it difficult to break off; thus, it is more durable than other methods.
   f. Fire performance of solid polyurethane foam is better than conventional materials, such as polystyrene board in organic materials.
   g. Solid polyurethane foam has good environmental protection performance because it has no smell and is non-toxic.
   h. The internal heat preservation system is a good choice for a dry wall; it not only keeps the style of dry wall of blocks, it also puts a barrier for the block wall to prevent water leakage.
   i. Energy conduction between two neighboring units is inevitable if neighbors do not live in the units synchronously or if the temperature selections of heating are different during winter. The internal heat preservation system can reduce heat conduction between two units.

Kitchen and bathroom systems

Integration of the kitchen and bathroom has brought a huge change to the construction of the rooms related to water and sewerage and its quality insurance.

Currently, an integrated kitchen (Figure 6) has a high degree of industrialization and good market popularization. Through the coordination of modulus and standardized selection of types of cabinet, basin, and electric appliances, an integrated kitchen product may meet human demands with a reasonable operation process, high efficiency, and convenient maintenance and replacement.

An integrated bathroom produced in a factory not only supports the SI system, but also perfectly realizes the separation of the three spaces. After installing the integrate bathroom on site and achieving the examination of water leakage, future leakage problems that occur very often in traditional toilet decoration, upgrade construction accuracy, and ensure standard construction technology can be prevented. An integrated bathroom has the functions of a shower and a bathtub. In particular, the installation of an integrated bathroom on site is very simple. On average, a worker can complete the installation of an integrated bathroom in a day, and the speed and quality is much better than that of traditional installations. Moreover, a bathroom manhole is set up and a heater with exhaust function is installed, providing a comfortable and perfect bathroom.

Figure 5: Inner heat preservation system. Resource: CNERCHS

Figure 6: Integrated bathroom system
Resource: Yashi Property Group

Depository system

Integrated depository furniture (Figure 7, 8) is a key component in achieving maximum depository space. For small and medium units, the ratio of store space is the standard for measuring the use efficiency of the housing and life quality. The Alloy Apartment provides 10% of the building area as an effective depository space.

The depository system provides maximum depository space and all depository furniture are in standardized process because the partitions inside are made of light steel keel system with high accuracy and flexibility.

Depository spaces are classified according to the function; thus, storage can be categorized, and can be "easily taken and easily put."

Figure 7, 8: Depository system Resource: Yashi Property Group

CONCLUSION

Chinese housing development should begin from the research of the needs on use terminal and strengthen the connection of industrialized production and the aim of housing quality. Housing construction must be developed towards the direction of industrialized production to improve housing performance through integration technology and production of industrialized housing, and strengthen residential building, technology and component, and authorization systems. Moreover, housing construction must pass policies for saving energy, environmental protection, and complete decoration of housing, as well as for technical research and development. Residential conception on the universal life cycle of green housing should be popularized to realize sustainable and effective utilization of resources, minimize environmental effects, and actively promote residential construction with the conception of universal life cycle of high habitable quality housing products in the long term. Research and development of the key technology on the production of housing components and integration should be unfolded through technical innovation and application of technical integration to advance housing industrialization. Using the Yashi Alloy Apartment, Chinese housing of the technical integration type, the conception and construction method has been found to be suitable for the situation in China. Moreover, it will play a better role on driving the research and development of housing key technology.

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Research and Application of the Structural System of New Blocks in the Open Housing System

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ABSTRACT
The current study introduces a new reinforced fair-faced concrete block masonry for the application background, product development, and development of the design technology and construction method. Moreover, the advantages and characteristics of such blocks when applied on an open housing system are discussed. The project is expected to play the role of demonstration and popularization for the development of this type of building.

KEYWORDS:
concrete block masonry, open housing system

ANALYSIS OF BUILDING BACKGROUND FOR THE SELECTION OF THE STRUCTURE SYSTEM

The Yashi Alloy Apartment in Beijing gained the adaptability of a residential functional space because of the selection of open building system, thereby putting forward a challenge on the selection of the structural system. During the design stage, the working group made sure that the structural selection aimed at realizing the character of wide space on the SI system. The manner by which to express the building facade was another factor considered. Architects and structural engineers began from the traditional architectural word "brick" to search for an appropriate structural strategy. An old brick building is "a natural unity of function and form" wherein the bricks are used to build space as a structural element while creating an architectural image (Figures 1–3).



Figure 1: Building in Northern Europe; **Figure 2**: Pagoda in Yunyan Temple; **Figure 3**: Details of a brick building (L to R)

In recent years, relevant documents of codes in China have recommended the replacement of bricks with different kinds of blocks as structural materials because bricks use up a number of land resources. A block is a building material made of concrete, sand, stone, and water via a process of mixing, molding, and conservation that has been used as an industrialized product for a hundred years abroad. In China, blocks are mass-produced and have wide applications. Blocks look like bricks but have certain differences. Blocks are bigger in size and have more variety with good quality, and are better than bricks in terms of mechanical performance; saving energy, land, and materials; and environmental protection. Attention has been given to blocks, along with the intensive use of energy and other resources.

The size of a block is bigger than a brick; however, a worker with high speed can complete the work on block laying. The characteristics of a block are as follows. First, blocks have hollows where steel bars can easily be placed; thus, the method of reserved structural column outside the blocks is unnecessary. Second, the combination of a concrete product and a cement mortar can reach a high density. Finally, a block wall can achieve the effect of a durable dry wall that other types of materials cannot.

Similar to bricks, blocks are consistent on the expression of building appearance and structural function, and the building appearance is shown in the form of structural components instead of simple decoration materials. Thus, the structural image of a block building can last for a long time, similar to a brick building. Moreover, blocks can create many modern buildings with variety because they have hollows with high intensity and variety, which bricks cannot achieve.

Finally, the work group selected blocks as main structural materials after comprehensive consideration (Figure 4). The blocks are expected to provide a "time mark" on the building, which will present its time characteristic in cases where the color of the facade does not face with age.

DEVELOPMENT OF BLOCK PRODUCT

Product Positioning

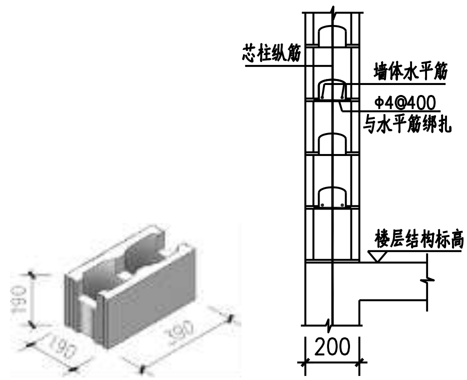
After determining the structural system, some factors were considered. For example, the appearance should remain unchanged for long periods. Moreover, it should be easy to maintain and suitable for the interior layout of wide spaces. The structural system of dry reinforced concrete blocks can meet these demands. Concrete blocks supplemented by thick floor slabs can realize the effect of a dry wall facade, ensure no bearing structures inside the dwelling unit, and reduce noises between floors. After a stringent selection process by the owner and architect, 90 mm high blocks with a light, the color coffee was chosen (Figure 5), which will not only form an elegant and simple architectural style, but also a modern and open one (Figure 4).

Development of Block Types

In China, the reinforced concrete block structure is a mature structural type.

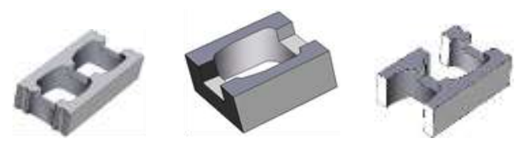
Figure 4: The appearance of the Ally Apartment constructed using blocks

Figure 5: wall constructed using 90 mm high blocks



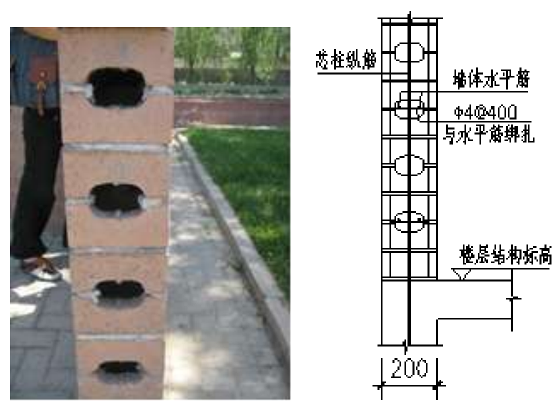
(a) (b)

Figure 6: A 190 mm high block and the details of the reinforced wall



(a) (b) (c)

Figure 7: Product series of 90 mm high block



(a) (b)

Figure 8: Terminal side of 90 mm high blocks

The types reinforced concrete blocks adopted the 190 mm high with 60 mm deep grooves that may be used for constructing furred walls. The adoption of 90 mm high reinforced concrete block system in the current project is the first of its kind in China. Thus, the design group cooperated with a manufacturer to develop new blocks. After further developing the design, more than 20 block types were designed in detail, and were awarded national patent rights.

Development of Design Technology

Examination of basic mechanical performance indicators

Design indicators of actual design criterion were mainly for 190 mm high common blocks. No data on actual criteria and relevant research documents on the design indicators and mechanical performance of

90 mm high blocks exist. Thus, the design group, in association with the laboratories of some universities, brainstormed regarding the blocks, and some reliable data were obtained for the project design. Parts of the data are shown in Tables 1 and 2.

Table 1: Parts of the testing results on the pressure resistance of 90 mm high blocks

Numbers of Tested Block	Crazin g Load	Ultimate Load		Intensity of Pressure Resistance	Formula Calculate d Value in Criterion	Elastic Modulus			Poisson Ratio	
		Value of Actual Measure	Average Value			Value of Actual Measure	Average Value	Effective Average Value	Value of Actual Measure	Effective Average Value
1Y90-10-7.5-1	94	658							/	/
1Y90-10-7.5-2	382	588	582	7.85	6.11				/	/
1Y90-10-7.5-3	320	500							/	/
2Y90-10-7.5-1	478	760				6408			0.22	
2Y90-10-7.5-2	320	664	748.7	10.1	5.79	7105	7373	7373	0.11	0.16
2Y90-10-7.5-3	382	822				8605			1.05	

Table 2: Parts of the Testing Results on the Shear Resistance of 90 mm High

Number of Tested Block	Crazing Load /KN	Ultimate Load /KN	Crazing Load/ Ultimate Load	Shear Iintensity /Mpa	Average Value of Shear Resistance Intensity	Formula Calculated Value in Criterion /Mpa	Mortar Intensity /Mpa	Damaged Form
1J-10-7.5-1	25	32.85	0.76	0.222				Single crack by shear damaged of upper block
1J-10-7.5-2	32.7	32.7	1.00	0.221				Double cracks by shear damaged
1J-10-7.5-3	29.81	29.81	1.00	0.201				Single crack by shear damaged of upper block
1J-10-7.5-4	32.2	39.25	0.82	0.265	0.213	0.205	8.82	Craked on upper block Firstly, then shear damaged of both
1J-10-7.5-5	22.91	22.91	1.00	0.155				Single crack by shear damaged of upper block
1J-10-7.5-6	28.4	31.7	0.90	0.214				Single crack by shear damaged of upper block

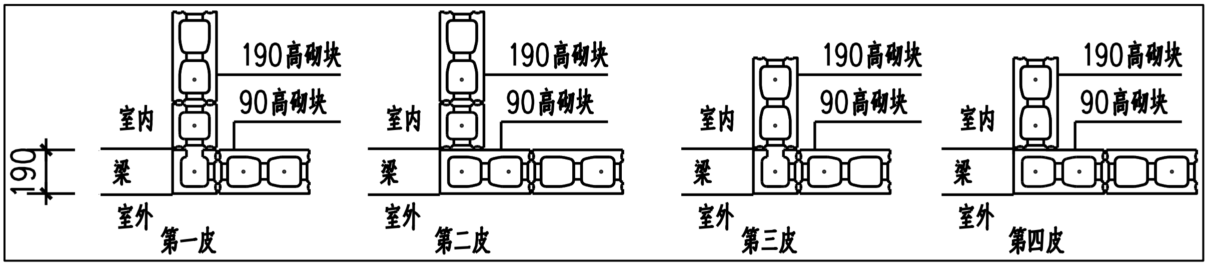
Structure Design

The dry reinforced concrete block structure engineering not only follows the structure system of a common block, but also improves upon it.

Dry concrete blocks of 90 mm×190 mm×390 mm with 60 mm deep grooves were used on the exterior wall. The blocks were laid groove to groove. For interior wall, the block type of 190 mm×190 mm×390 mm with 60 mm deep grooves were laid groove to back. The construction design of the structure is important to make sure that it is “safe and reliable, and the dry wall of the facade should be easy to construct and easy to maintain.” The design has three principles: (1) the entirety of the structural walls will be grouted with concrete; (2) vertical bars will be arranged on a single line, whereas the horizantal bars will be arranged on double lines; and (3) detailed block laying design must be performed on key joints to instruct the construction, including the wall corner (Figure 9), connection of the exterior and interior walls (Figure 10), hidden colum joint (Figure 11), and joint of the circle beam (Figure 12).

Development of Construction Method

During the process of construction, building design accorded with the construction enterprise, and the owner was involved in the research of the construction method for dry wall made of reinforced concrete blocks. Moreover, a building construction flow (Figure 13) was created to ensure the quality of the structural construction.



(a) (b) (c) (d)

Figure 9: Corner of the wall with balcony

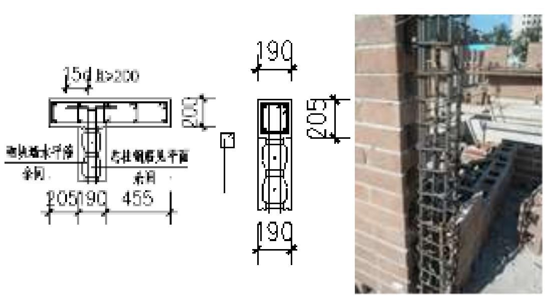
CONCLUSION

Block buildings in China have been developed for more than 50 years; however, block buildings have not been widely used and have not gained a uniform understanding. The research and development of a dry reinforced concrete block-building product and its construction technology on project Yashi Alloy Apartment in Beijing displayed the superiority and characteristics of a block building in the integrated project of a high and new technology. Moreover, it played a decisive role on the realization of wide spaces in housing and the creation of a particular building appearance and style of block building.

REFERENCE

Lou, N., Zhang, L., etc. Design and Saving Energy Technology of Block Building. China Building Industry Publishing Company, Beijing, 2011.

Figure 10: Joint connection of the exterior and interior walls



(a) (b) (c)

Figure 11: Hidden column joint

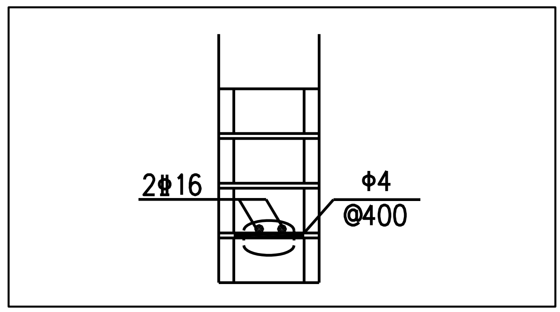


Figure 12: Hidden lintel on exterior wall

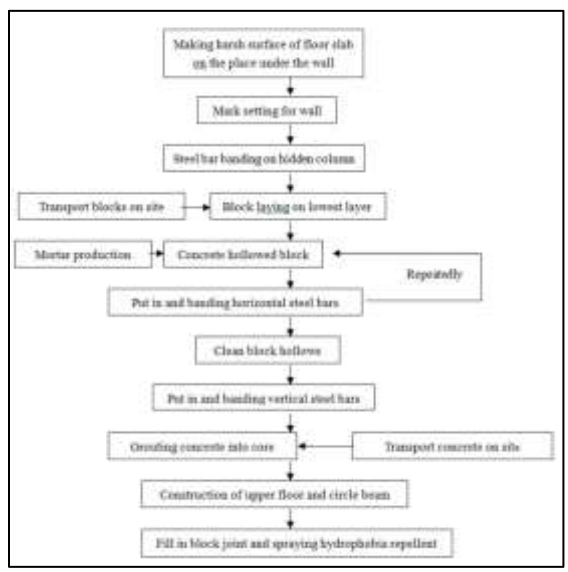


Figure 13: Flow of construction technology

Integrated Residential Construction Managemetn and Quality Control: Residential Construction Cases of Open Building Theory

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ABSTRACT:
The Yashi Alloy Apartment, a residential development project that uses open building ideas, integrates many commonly used residential space layouts and technologies to improve residential quality. It is very different from the residential construction process widely used in China, not only in project construction, but also in system design, resource integration, and project management. Based on the research and practice of the construction process in project Yashi Alloy Apartment, the current article proposes new residential development construction samples suitable for China's situation. Moreover, a concrete construction strategy for implementing open building ideas is also provided.

KEYWORDS:
open building, residential construction process, China, concrete construction

CONSTRUCTION GOAL
Yashi Alloy Apartment is different from traditional buildings in terms of construction ideas and goals because it uses the SI residential system. The differences run through the whole process, from the beginning of programming to the end of construction. During the start of project planning, the construction group set the following construction ideas and goals:

1). Integrate advanced and applicable architectural technologies, and improve residential use performance;
2). Build a completely decorated building, optimize plane and space designs, and improve space comfort and practicability;
3). The characteristics of the facade should be easy to maintain, have good texture, good durability, and so on;
4). Separate the structure and the pipe, reduce the indoor bearing structure, and enhance the transformation of indoor space; and
5). Use heat-insulation and energy systems that are mature, durable, and efficient to realize the economic, environmental protection, and energy conservation goals.

ESTABLISH A SYSTEMIC AND REASONABLE TECHNOLOGY SYSTEM THAT MATCHES THE GOAL
The construction team studied many domestic and foreign advanced technologies to realize the construction goal, and established the technology system combined with the characteristics of this project to direct the following project implementations. The key points in the technology system are outlined as follows:

1. Introduction and application of the SI construction technology: Unlike in the traditional way wherein the pipeline is embedded in a structural wall, as a technology that separates the bearing structure and equipment pipeline (Figure 1), the SI construction technology makes the pipeline and the equipment fundamentally independent of structural bodies, and facilitates the pipeline equipment lay out, quality control, maintenance, and future space transformation. Moreover, it can also reduce the effects of the maintenance of aged pipelines and future reconstruction on the structure.

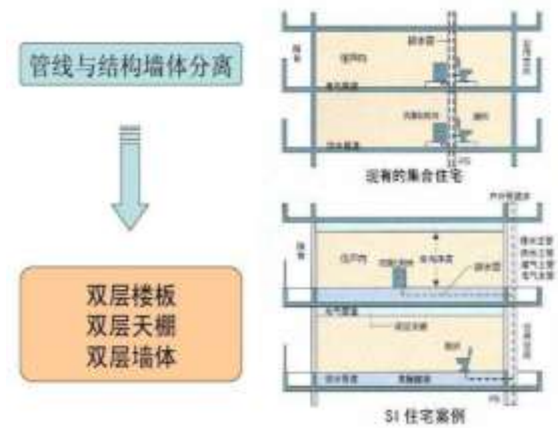

Figure 1: Diagram of construction technique

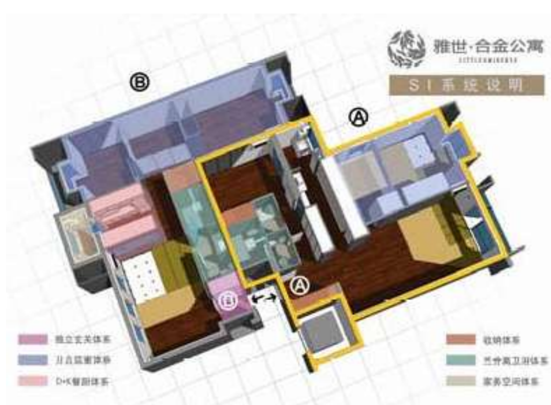

Figure 2: Plane design system

2. Reinforced small fair-faced concrete block bearing system: In this project, the type of structure should meet the requirements of a durable facade, easy maintenance, a large bay, and so on, which the reinforced small fair-faced concrete block fulfills. This bearing system, in combination with a thickened slab, not only realizes a fair-faced facade and ensures that no bearing structures exist in the room, but also reduces noise between floors.
3. Exterior wall internal insulation system: The internal insulation system not only achieves the heat-insulation effect, but also ensures the fair-faced facade. The epispastics polyurethane chosen in this project is waterproof, leak-proof, and moisture-proof. The calculation of energy saving was made before construction, and the reflexed insulation treatment is set at the top and bottom of the floors lab to avoid the occurrence of thermal bridge during the heat-insulation process. This project performed heat-insulation treatment between rooms to realize a better energy-saving effect, as well as improve the performance of sound insulation.
4. Open plane design system: (See DETERMINATION OF THE TECHNICAL DIRECTION ON “HIGH-QUALITY HOUSING PRODUCT HABITABLE IN THELONG TERM” AND THE ARCHITECTURAL ANSWER)
5. Efficient space utilization system: A compact apartment in an urban center should be paid more attention to in order to improve indoor spatial utilization. In this project, residents are provided with many usable spaces, especially storage spaces, by integrating design and decoration (Figure 2). The average proportion of storage space in the inside area was calculated to reach10%.Thisproportion is very high, even in Japan. Moreover, spaces, such as attics and outdoor patios, are used completely to provide the most convenience for residents.
6. Appropriate, effective, and humanized residential equipment system:

   This project use shousehold air-replacement equipment, indoor wall-type gas heater equipment (to provide hot water for heat and life), high-standard shockproof doorframe, dry ground-heating boards, split-type air conditioner, water separator for cold and hot water(adjustable water pressure balance), direct drainage equipment of gas, and so onto enable residents live comfortably and achieve the goals of energy conservation and environmental protection. Moreover, considering the layout of electromechanical terminals, this project also applied an innovative elevated floor system to meet the requirements of sound insulation and injury prevention.
7. Dry construction technology system: This project adopted the dry construction technology, which mainly included on-the-spot assembly of integrated bathroom, integrated furniture, and so on; the outside processing and on-the-spot fixing of light steel keel plasterboard, ceramic tile, wood floor, and so on; and the installation of ceramic tiles to ensure the construction quality of full decoration and energy conservation, environmental protection, and saving during the construction process (Figure 3).

HIGH-QUALITY, HIGH-EFFICIENCY, AND SYSTEMATIC RESOURCE INTEGRATION

Project construction is a systematic engineering process that needs the close cooperation of all project resources to achieve the fixed goal. This project made great efforts in terms of assessment and selection to form a high-quality, highly efficient resource team.

1. Design resources integration: Architecture, decoration, furniture, landscape, logo, and other professional designs were the key units that helped the project achieve the technology system and construction idea. They provided important technological bases for the future implementation of the project.
2. Component resources integration: This project adopted huge amounts of advanced domestic and foreign components, of which the combining and matching are very important problems. Thus, unlike the general residential construction process, at the beginning of the architecture design, the construction team performed many experiments, communicated constantly, compared hundreds of component companies, and fixed the cooperative component companies to provide precise technical data for the construction design in a later project. This integration of resources is also the key to ensuring that future projects will be conducted successfully.
3. Construction enterprise resources integration: Construction enterprises of civil, mechanical, and electrical engineering; fine decoration; and landscape are main organizations in the construction process. Their understanding on the construction target, implementation of technology system, and component resources is very important in the whole project; thus, the integration of these resources is the most time-consuming process.
4. Management and supervision resources integration: After fixing the resources above, managerial and supervisory resources should be integrated. This project chose quality supervision, cost consultation and management, drawing review, air-quality monitoring, and other professional organizations to cooperate with the project construction team in supervising the whole construction process.

MANAGEMENT AND SUPERVISION OF THE CONSTRUCTION PROCESS

During the construction process, the demands for management on this innovative building are higher than that of a traditional building. The demands are mainly embodied in the following respects: conflict of system update and traditional construction habit; the management difficulty caused by frequent crossing of multiple stage brought by technology integration; the elevation space control accuracy requirement caused by the separation of the pipeline and wall in the SI system is very high; and the plane space accuracy requirement caused by technology integration is high. The construction process in this project was managed and supervised in the following ways.

Quality management

Quality control target

The quality control target was set at the start of the project: more than 95 points, and the project set a full mark standard. The quality control target served as the guide throughout the whole process, and was the criterion of the project quality management.

Establish the principles of model first

The establishment of the model first has two purposes. First, some technological problems that may appear at the site can be solved at the prototype room stage, which can avoid a multitude of problems that can arise later. Second, the project management target became clearer and easier to compare and contrast because of the model was established first. For example, the construction team performed a number of model tests and comparisons on dry ground heating and elevated floors (Figures4, 5), examined the adaptability of this project, before making their choices. For the fair-faced concrete block wall, the construction team built a sample wall (Figure 6) that played an important guiding role, water treatment measures, and the choice of facade component. For the integration of all kinds of indoor components, the construction team built a sample room (Figure 7) to complete the processes and fulfill standards of technology implementation.

(a) Integrated bathroom

(b) Light steel keel plasterboard internal partition wall

(c) Integrated kitchen and finished result

Figure 3: Pictures of part components

Figure 4: Construction sample of dry ground heating floor

Figure 5: Construction sample of elevated floor


Figure 6: Construction sample of fair-faced concrete block


Figure 7: Construction process of sample room

Associate the quality control with economic incentives
In the engineering construction contract, reward and punishment measures in quality management were set to economically encourage and fully mobilize the subjective initiative of every department. Thus, the measures can focus the wisdom of everyone and provide service for the quality target of the project.

Utilize practical quality management
In practical management, specific quality control methods were used to realize the quality control during the construction process. For example, the project adopted the quality appraisal and the mechanism of rewards and punishments during different stages, thereby enabling each department to improve its quality requirement standards. Thus, a good quality management effect was achieved in coordination with the financial incentives in Article 3.

Enforce the quality management measures
From the start of the project, quality management was executed very strictly, and even the measures of making rectification and reconstruction was performed. These measures made each department obey the established quality management measures.

Progress monitoring
Adoption of a hardcover general contract mode
This project enabled the hardcover general contract mode, which was proven to be very good, during the stage of fine decoration. First, the hardcover general contract mode made the construction site management easier. Then, it gave the fine decoration department a larger right to manage the subcontract department, which created the better communication between the indoor hardcover and indoor hardcover subcontractor departments for solving problems. Their subjective initiatives were also encouraged because of the more responsibility given to the fine decoration department.

Careful planning and management of progress
During the fine decoration stage, various processes in the SI system, different cross-constructions, and various departments (the number of indoor departments reached 20) were involved; thus, the planning and management of the progress are particularly important. The construction team first controlled large schedule key nodes, the hardcover department then detailed the general progress based on the key nodes. Next, the subcontract department filled their single progress according to the general progress. Finally, everyone confirmed the final version and obeyed it.

Insist on the principles of model first
For new structures, components, and many other aspects, the principles of "model first" is often adopted to realize the adjustment of new technology, work out actual efficiency of every field and every process, and adjust progress in time to ensure the completion of big nodes.

The real-time monitoring during the construction process
During the construction process, the site administrator should first monitor the field performance of works in real-time, then compare it with the progress, find the cause of delay and the solution next, and, finally, realize the real-time controlling of on-site progress.

Safety and civilization construction management
Set target–build confidence
Calculate the additional costs and the benefits caused by the target in advance, and then obtain reasonable economic security measures after setting the target.
Adopt the prompting mechanism of mutual comparison

Similar to the comparison of the quality management, the on-site safety and civilization construction inspection and comparison were conducted on time. They made each department find its own shortcomings, and learn the merits of others to learn from one another and improve one another.

Establishment of awareness of finished product protection

The protection of the finished product is a very important during the site construction stage, especially during the fine decoration construction stage, which is difficult to solve. Its effect is directly linked to cost. The project encouraged workers to work safely and civilly, as adopted in the forms of economic or formal text announcements, to set a good example, and to execute contrast examination individually. Finally, it enabled everyone to form a new understanding of product protection, and psychologically made every department know that product protection is very important, which obtained a good effect.

Moreover, the construction team used the method of process transferring management, which is the transferring of the finished product to the next working procedure and hardcover overall contractors after the completion of this working procedure, signed the process transferring receipt. The team also clarified the responsibility of finished product protection to avoid the responsibility buck-passing after the damage of the finished product. These measures ensured protection of the finished product and the final effect of the product (Figure 8, 9).

Figure 8: Civilized construction in field

Figure 9: Elevator enclosure protection

Mechanism of the field technical problem solving and design drawings management

Design of the coop-building unit

Before the initiation of the fine decoration construction, all coop-building units create a detailed design for their own project content. Then, the construction team conducts a design coordination meeting, provides a platform for each joining unit to clarify drawing interfaces and deepen each node, and achieves the seamless connection of drawings of each cooperated-building unit. The course above has two effects. First, it greatly reduces the cases where the drawing interfaces are not uniform. Second, it makes each coop-building unit have a more in-depth understanding. Thus, the difficulty of future construction is greatly reduced.

Establishment and effective operation of mechanism on field technical problem solving

First, for all changes in the fine decoration construction drawings, the cooperated-building unit, which determines the changes, distributes the changed drawings. The construction team then sends these drawings to relevant units after confirmation, increasing the seriousness of the changes, and enhances the traceability. Second, the principal conducts regular technology meetings, holds occasional special technical meetings, and generates timely solutions for each problem that arises.

Application of the key technology and fine component that ensures the implementation of the project

1. Masonry technology for fair-faced concrete block fundamentally guarantees the construction quality. Based on the analysis of engineering quality monitoring data, the errors in the structure are controlled within half a centimeter, which meets high standards.
2. Traditional engineering decoration quality depended too much on construction personnel quality, which makes quality uniformity very difficult to achieve. Components, such as resin landside, salient corner protecting of wallpaper, and skirting board of wooden floor, were successfully used in this project, thereby realizing the purpose of constraining the project quality with these components and achieved very a good result.
3. Many holes were created for pipelines and equipment in this project. After multiple research and experiments, this project adopted the technique of integrating pipelines and reserving holes to reduce the influence of the holes on the safety of the structure and pollution of facade, which has been proven to be very successful in practice.

4. Many temporary protection materials, such as corner guards in the fair-faced concrete-block-laying process, temporary protection of the decorated wallpaper, tectorial membrane of wooden floor and doors, and safety wooden cover in pipeline construction process, were used in the construction process to achieve the established purpose of finished product protection (Figures10–15)

LAST WORDS

The Yashi Alloy Apartment has created a brave innovation on the building system design and building implementation process. In the case of absorption of many advanced technologies, the Yashi Alloy Apartment has realized the localized use of new technologies and ideas, and has become a successful case of the open building in China. This requires the construction unit and cooperation with the design unit and construction organization to explore a new construction management process that matches the achievement of centenary residence.

Figure 10: Finished product protection of pipeline

Figure 11: Laying protective covering on the floor

Figure 12: Protective bar of wallpaper in exposed corner

Figure 13: Finished product protection of wooden floor

Figure 14: Reserved pipeline holes sample that is connected with the outside wall

Figure 15: Relationship of indoor structures and the pipeline

Sustainable Homes:
Adaptation of Informal Settlements to Environmental Change

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ABSTRACT
A kampung is an informal urban settlement in which the people themselves have built the houses. The earliest kampung in the city of Surabaya were built about 700 years ago. As time has gone by, various changes have taken place in the city. Following the city plan, the primary settlement and housing area became the central business district. How the residents of the kampung have adapted to the changing environment of the city, the implementation methods used to keep their homes, and the pattern of responsibility and control in the kampung are all subjects of this discussion.

The methods used in the research included an exploratory survey of the kampung settlement and houses using structured questionnaires, as well as mapping of the settlement.

The results indicated that the open building method applied at the settlement level allow the houses to function as homes for the residents and adapt to the changing environment of the city.

KEYWORDS
sustainability, *kampung*, informal settlement, environment, dimension

INTRODUCTION
Surabaya is the second big city of Indonesia. The human settlements development shows that formal houses developed by the Government and private sectors housed about 40% of the city population, while the informal houses developed by the inhabitants can housed about 60% of the city population (Surabaya in Figures, 2008). The kampungs cover about 7% of the city area and the kampung residents are primarily from the lower income group and have limited resources to improve their houses and neighbourhood (Building and Social Housing Foundation, 1993).

The kampung in the heart of the city which have been developed about 700 years are still existed (Surabaya City Government, 2010). With the fast growing development of the city the kampung's density is increased and some kampungs become crowded. The area of the kampungs are surrounded by business activities which developed at the city and district levels. How the kampung's residents have adapted to the changing environment of the city is discussed in this paper. The discussions include the adaptations done by the residents at the settlement and the neighbourhood levels, and at the house level to keep their homes sustainable. The methods use to keep the houses and neighbourhood adapt to the changing environment, and the pattern of responsibility and control in the kampung are important dimensions beside the settlement's environment planning, the space arrangement of the neighbourhood and the house design dimensions.

INNER CITY KAMPUNG DEVELOPMENT
The inner city kampung was dominated by housing, covering about 67% of the land area and most of the houses were informal. Commercial area accounted for some 18%, infrastructure 11%, empty land 3% and public facilities 1%, with no open spaces and no industrial area. The major occupation of residents were in trading and services sectors, government services, industries and handcrafing and health sectors (Setijanti, 2006).

At the planning level of the inner city area, the housing area of the kampung would be inside a ring of trading and services areas and public facilities. The plan envisages improvements of some specific renewals of housing in the area, since some houses were categorised as disorderly and very dense. Transportation at the ring of trading areas was to be improved in order to reduce congestion and more evenly distribute the transportation and movement. Public facilities such as education, health, worship and government services were not further developed since they are in good order (Setijanti, 2006).

THE KAMPUNG PHYSICAL CONDITIONS AT THE DISTRICT LEVEL, SETTLEMENT LEVEL, NEIGHBOURHOOD LEVEL AND HOUSE LEVEL

District Level
The inner city kampung situated in the business district of Surabaya. The main road from South to North of the city pass the district area and the kampung. As residential area the kampung is surrounded by the hectic transportation (Figure 1). The road alignments and some modifications on it, do not affect the kampung settlement, since the kampung is bordered by big buildings at the main road sides. Hence the city development at the district level does not disturb the kampung in terms of physical conditions and accessibility, even though at peak hours the noise level is increased.

Settlement Level
At the settlement level some changing were happened as the results of economic activities and the increase of the population. Small shops and small cafes (*warung*) were constructed in the settlement

(Siregar, 2011). The gate at every settlement was erected to give sign for particular kampung area. A settlement office was also available. The construction of many hotels, offices and shopping malls at the main road sides, created demands for cheaper foods from the hotel's and shopping mall's staffs, particularly during lunch time and dinner. The small shops and cafes in the kampung can fulfil the demands. Sometimes a kindergarten was set up in the settlement level to provide preschool for children under 5 years. Health centre was built to give health service to the kampung residents. Some prayer houses were also built in the settlements, based on the resident's needs.

For security reasons, house guards were constructed in the settlement level. This house guard was built based on the need of the kampung and required small space or spot. Hence, the additional buildings built at the settlement level were small shops including barber shop, dress making, beauty salon; small cafes; guard house; kindergarten; health centre; settlement office; and prayer house.

Figure 1: The Kampungs in the Inner City Business District

Neighbourhood Level

At the neighbourhood level many house extensions were happened as the result of the population increase. The central business district with fast commercial development attract many people to work in the inner city and these people needed cheap accommodations. The cheapest accommodation is available in the kampung, therefore the kampung resident's increased in line with the increase of economic activities in the inner city. The negative impact of the vast growing residents in the kampung, was the less infrastructure and services available for the residents. Accordingly the infrastructure should be improved to keep the kampung in healthy conditions (Siregar, 2011).

House Level

At the house level, some houses changed their functions from households to home industries or boarding houses. Such functions were to create economic activities or to provide side incomes to the houses's residents. With the increase of resident in the houses the basic services of the houses, such as clean water, toilet and bathing rooms, became inadequate, particularly in the boarding houses. Figure 2 shows the settlement, the neighbourhood and the house levels.

Figure 2: The kampung settlement level, the neighbourhood level and the house level

THE KAMPUNG PHYSICAL ADAPTATIONS TO THE CHANGING ENVIRONMENT

The kampung, which has been developed more than 700 years, can still exist with sustainable physical environment, despite the vast development of the city areas surrounding the kampung. How the kampung residents can adapt to the changing environment are discussed here.

Physical Adaptation at the District Level

The development of the inner city as central business district was not directly affect the kampung settlement physical conditions, since the kampung was separated from the main road by the big buildings. Hence, no new buildings or new access roads in the kampung required to be constructed to adjust to the new physical development at the main road sides. However, the indirect effect was the increase of residents in the kampung, which created changes in the settlement level, neighbourhood level and house level.

Physical Adaptation at the Settlement Level

The economic activity growth in the kampung required the construction of small shops and cafes. The construction was done filling the available land in the kampung or in front of the houses. Some small shops or small cafes were constructed at the house gardens, when space was still available. Kindergarten, kampung office, and health centre were built filling the vacant land or used houses which were sold by the residents. Other implementation method used to provide prayer houses such as mosques, weas construction of those on the limited available land or used old houses, which design were changed into mosque design. In this case the adaptations at the settlement level were on the space arrangement and design dimension.

The guard house usually about 2 m^2 was built close to the gate of the kampung. This guard house was constructed attached to a house or the kampung-street. If land was not available the guard house was sometime built above the gate. The house guard was considered important for the kampung's safety, particularly at night. Here the control dimension is applied, together with the design dimension in the part of the guard house.

The adaptations at the settlement level show that houses in the kampung can be used for new functions, such as kindergarten, kampung office, health centre or mosque. Such adaptation at the settlement level can provide sustainable physical environment to the residents, through generations (see figure 3).

Figure 3: Physical Adaptation at the Settelement Level

Physical Adaptation at the Neighbourhood Level

One neighbourhood usually consists of about 200 households. The residents were mix of low income to middle income groups. To cater the need of new residents in the neighbourhood sometimes an additional small house was constructed when land was still available. Another implementation method used was a big house devided in to two houses and rented to different occupants. Other posibility was the combination of two houses into one bigger house. These changes were affected by the resident's needs or preferences and by the increase of population. Some houses were also function as boarding houses to provide cheap accommodation for the people who work at the vicinities of the kampung (Figure 4). On the other hand the house's owner could get some money from the workers who rented the house. In this neighborhood level the adaptation was based on space arrangement and design dimensions. Such conditions were happened through generations and this showed that at the neighbourhood level adaptation to the new needs and the changing physical environment were not a problem.

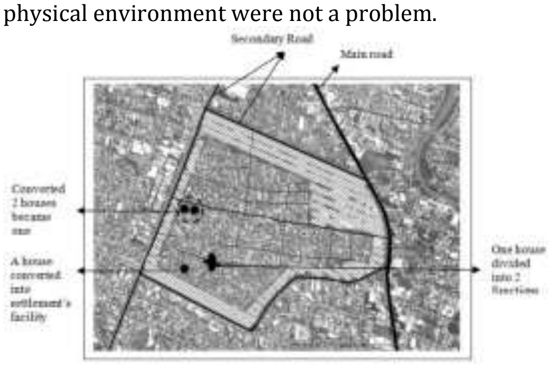

Figure 4: Physical Adaptation at the Neighbourhood Level

Physical Adaptation at the House Level

At the house level, physical changes occurred inside the houses, which were converted into boarding house, mosque, kindergarten, home industry, health centre or kampung office. The implementation methods to keep the houses usable for new activities were as follows:

- For boarding houses: the residents used partitions to provide smaller rooms, which were rented to other person or family. The front terrace was extended to provide more space for sitting. The kitchen was kept wide enough for cooking facilities. Some of the kitchen-roof was opened to construct small verandah for drying space.
- For mosque: the house was converted into a mosque by removing the interior walls to obtain a wider space. The front terrace was extended up to the street, which used to be closed during the Friday prayer time. Several valves of the tab water were set-up at the terrace for washing before praying.
- The kindergarten: usually no special changes required for the kindergarten. The children could use any room in the house. Usually the biggest room is for the class.
- For home industry: space required for home industry was varied, depended on the type of industry. For food and cookies, the interior of the house remained but the front terrace was used for selling. For other purposes, such as barber shop, beauty saloon, tailor, usually the house interior was not changed. Only the front façade was modified using wider glass windows. The intention was that the business could be seen from outside the houses to attract people to come.
- For health centre: the house could provide adequate rooms for a health centre, there was no particular change required within the house. The house terrace, in front or side of the house could be extended and sheltered with wider eaves for people waiting.
- For kampung-office: the house itself could provide enough spaces for a kampung office. Modification of the front façade might be required to put the sign of the office.

The physical adaptation at the house level was easy, since the function change of the houses in the kampung was not complicated. The house itself, usually consisted of one big living room with two bedrooms, a kitchen and a toilet at the back, was easily adjust to the new function. The house terrace could be modified, following the new function of the house. At the house level, adaptation was particularly at the design dimension.

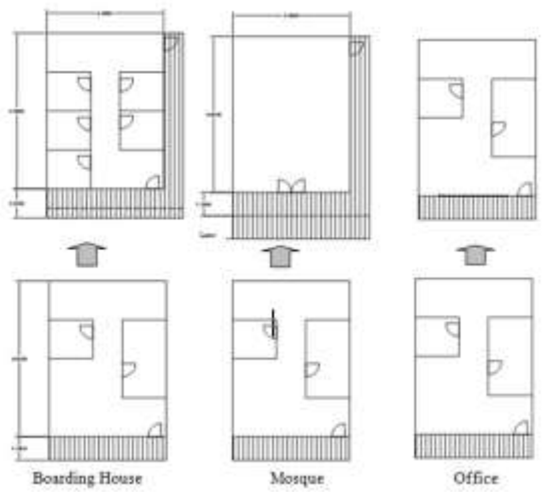

Figure 5: Physical Adaptation at the House Level

PATTERN OF RESPONSIBILITY AND CONTROL IN THE KAMPUNG

The safety in the kampung, as informal settlement, generally depends on every resident. Usually the residents in every lane could identify other persons who were not residents of the block. Overall in the kampung, the pattern of responsibility is as follows.

Responsibility and Control at the Settlement Level

At the settlement level the responsibility to control and to manage the settlement was done by a resident who was elected as the kampung's head by the residents and the government, and works at the kampung office. He/she was assisted by some staffs responsible for the management of the kampung. The kampung consist of about five neighborhoods, each neighborhood is headed by a neighborhood's head.

Responsibility and Control at the Neighborhood Level

Each neighborhood has its own responsibility and control of the neighborhood. For this reason the kampung has several guard-houses, located at the gates of every neighborhood. A neighborhood's head was elected by the kampung residents, responsible for the management and control of the neighborhood. However, safety control was done by the residents, who guard the neighborhood at night time. Each resident was given a turn about once a month to guard the neighborhood.

Responsibility and Control at the Block/Houses Level

At the block level the responsibility and control was done by the residents. Each household's head should be responsible for the safety of his own house. In one block of houses usually there was one resident elected as the block's head or the neighborhood's head assistance. The neighborhood's head assistance should report to the neighborhood's head if something in the block was not in order. Every neighborhood's head could has his own system of safety. For instance, one who passed the lane should get down from the motorcycle. On the other hand the residents of the houses could help watch strangers from their own houses. Since the lane was usually narrow, about 3 m wide, and the houses were dense, watching the lane from inside the houses was easy.

Responsibility and control at the settlement, neighborhood and house levels proved to be effective for the inner city kampung. Differ from formal housing which is usually controlled and managed by formal appointed persons, informal settlement such as the kampung is more effectively controlled by the residents. The residents, with agreement, can set-up special regulation for their own blocks (house level) to keep their blocks safe (for instance: no motor cycle driving on the lane). With agreement, they can also set-up a playing area. Such management and control at every house/block level can help keeping the kampung sustainable for living, with limited resources and land. It is clear that control dimension is important, beside environment planning, space arrangement and house design dimensions.

CONCLUSION

The kampung, as informal settlement in the inner city of Surabaya can adapt to the environment change of the city through generations. The adaptation was done at the settlement, neighborhood and house levels. At the district level, no adaptation was required since the kampung was separated from the business area by big buildings. Hence changing at the district planning, did not affect the kampung physical conditions.

Physical adaptation at the settlement level was based on the space arrangement dimension and design dimension, where small buildings were built to fill in the vacant spaces and many houses converted to other functions, such as small shops, cafes, kindergarten, kampung office, health centre and prayer house. The construction of the guard house at the gate of each kampung was important for safety reason. With the increasing population and activities in the inner city surrounding the kampung, the control dimension was applied to keep the kampung safe.

At the neighborhood level, the physical adaptation was also based on the space arrangement of the neighborhood, and the design dimension. To have sustainable homes and to create some incomes, the residents changed the house into other functions, for example, as boarding house. One house could be separated into two functions or two houses could become one bigger house, depended on the resident's need.

Physical adaptation at the house level basically was done inside the house, such as the used of added partition walls to create more rooms in the boarding house, extended the house terraces to create more spaces, or opened the roof to provide a verandah for drying place. Such adaptations were based on design dimension.

The fourth dimension, i.e. pattern of responsibility and control of the kampung was very important to keep the kampung as sustainable homes, despite the limited resources of the residents and the limited land. The control in the kampung, which was mainly done by the residents, could keep the kampung in order and sustainable for living through generations.

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Informal Settlements and the Human Dimension Challenged in Coastal Areas, Indonesia

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ABSTRACT
As one of the largest Island nation with 13,700 islands in total, Indonesia has the benefit of long coastal area with beautiful beaches and vast area of water and natural resources. Most of the areas were inhabited by fishermen. But there is contradiction to this phenomenon. Giving the enormous sources a coastal area has, the lives of most fishermen are substandard. This paper will give an overview of human, housing and infrastructure condition of the fishermen in ten sample areas in Indonesia and propose the way for improvement of the housing condition through human capital aspects.

The research is descriptive study by field survey. The strategies of development are taking into considerations the strategic settlement approach that promotes potentials of each area, and support the functions of maritime affairs and fisheries. Education among others is important aspects of human dimension, which can be supported from the development of housing and settlement.

KEYWORDS
housing, coastal areas, human dimension.

INTRODUCTION

The urgency of public housing and informal settlement development is clearly stated in Indonesian Constitution 1945 and several other international agreements. No one denies the universal need for homes anymore than the importance of keeping in good health (Turner, 1972). The main idea is that all people are entitled to live in decent housing, with good support system. But virtually all third world governments have failed to ensure that rapid urban growth has been accompanied by investments in services, especially in the poorer areas (Hardoy et. al, 1990). The government, as the policy maker must pay attention to the interests of housing and residential development to meet the basic needs of shelter for their citizen. Housing development in Indonesia must consider the characteristics of social, economic and environmental aspects. Indonesia is the country that has thousands of islands, and two-thirds of its territory is water. Such conditions do not exist in other developed and developing countries in the world. Thus the issue of strategic development of Indonesia is quite different from any other countries in the world. Indonesia's development model is not simply to reflect on other countries, including housing and settlement development. It is essential to focus the monitoring of housing development on the housing in the area of fishing / coastal areas, as they believed to be strategic settlements in this context. The study will identify the economic and social conditions of local residents, the physical feasibility of construction, and basic infrastructure in the settlements. Conditions that have been identified are evaluated to find the potentials and challenges in the areas. It is aimed to give recomendations to programs or policy in developing the housing and settlement within the coastal areas. Another strategic problem outside of the main strategic issues of wholeness, the Unitary Republic of Indonesia - *Negara Kesatuan Republik Indonesia (NKRI)-,* the problem of threats to the environment and preservation of wealth and resources that originated in the sea and border areas should be the center of interests.

RATIONAL PERSPECTIVE

Housing and settlement development in Indonesia

Entering the second decade of the 21st century, there was widespread awareness of the global community that has a housing problem principle difference between developed countries with developing countries that are in the stage of economic development and social life. For Indonesia, the phenomenon of specificity that is not owned by developing countries or other developed certainly need more attention. There are several characteristics that exist and apply only in Indonesia. The first characteristic is the establishment of the traditional house into evidence of the ability of citizens to build homes to meet the housing needs of families will even encountered the concept of development is able to present a symphony with nature and environment. The second feature is more than 85% of existing homes (in the larger village) is the result of self-help housing development by the citizens without any assistance from outside, neither from the government nor financial institutions like banks. The third characteristic associated with the configuration of the Indonesian population scattered across Indonesia with different natural conditions, plateaus, coastal areas, even in the island city.

The main objective to be achieved in national development is the increasingly strong economic and social potential, as well as unity of the nation and state. Maintain and guarantee the unity of the nation and the state is not an easy job and is still far from expected results for a country that has high number of islands and have a distance from east to west over a distance away from London to Moscow.

The explanation above is not the reason why Indonesia needs more time to become strong and stable country. But it must be recognized that in order to make NKRI strong and stable in a broad sense that strategies are needed not just out of frame bussiness as usual, in order to achieve them within a reasonable time and substance.

Settlements in coastal area

Settlements in coastal areas often related to the fishermen villages. Based on the regulation of Public Housing Ministry number 15/M/2006, residential area for fishermen - hereinafter referred to fishermen village- is a special area to support the functions of maritime affairs and fisheries. Infrastructure and fishing area are the completeness of the physical basis of fishing areas that allow the region to function and develop various activities relating to marine and fishery functions properly to maintain and develop the economic, social, and cultural life and livelihood of fishermen. Indonesia is the fourth country with the longest beach in the world and the world's largest archipelagic nation .That make fishermen villages are found along the coast in Indonesia and settled mostly Indonesian living closely linked to the sea, either fishing or which organizes the relations between island. This makes the settlement of fishermen holds a very strategic and vital position on the boundary, as they are in the best position to watch out completelely all the content in the sea as well as sea travel that connects the two continents (Asia - Australia) and two of the deep (Pacific and Indian) oceans. In the other hand, most settlements built along the narrow coastlines have to face with the ever-greater level difference between high and low tide, extreme weather (rain and wind), risk of natural disaster, etc (Silas, 2010).

METHODOLOGY

Research strategy

Research approach in the study is descriptive, which describes and measures as precisely as possible one or more characteristic and their relation in defined groups, which in this case is fishermen living in coastal areas of Indonesia. Research design is by survey, in natural settings.

Survey Area

The study was done in 10 provinces in Indonesia, located in 4 different big islands. In each province, there are two or three locations of the fishermen villages, based on the condition of the provinces. The provinces are:

- North Sumatra: Medan, Langkat, and Deli Serdang
- Riau: Pekanbaru, Bengkalis, and Siak
- Bangka Belitung Islands: Belitung and East Belitung
- Banten: Serang, Pandeglang, and Cilegon
- Central Java: Semarang, Jepara, and Kendal
- East Java: Surabaya, Gresik, and Lamongan
- West Kalimantan: Pontianak, Kubu Raya, and Sanggau
- East Kalimantan: Balikpapan, Samarinda, and East Kutai
- North Sulawesi: Manado, Bitung, and Southeast Minahasa
- South Sulawesi: Makassar, Maros, and Takalar

The distribution of the survey area is shown by star sign in figure 1.

Figure 1: Distribution of the survey area

IDENTIFICATION OF SURVEY RESULTS

In this survey, fishermen villages are illustrated through three general conditions, namely the condition of residents, feasibility of housing construction, and environmental/ infrastructure conditions. Depictions of these conditions then valued in ordinal data : good, moderate, and bad. Criteria of the three aspects and categories are as shown in table 1.

The monitoring survey is intended to provide a snapshot / portrait of stretegic housing conditions in Indonesia. The survey was conducted with respondents who are very limited, requiring a more in-depth survey to get more details. The assessment was done by using scoring method based on conditions respectively. Scope of the survey is carried out at the neighborhood level, with the RT (neighborhood head) as the respondent.

Condition of the residents

The characteristics of residents in the settlement of fishermen in the survey area is shown in figure 2. Good condition was identified in the aspects of resident’s origin. While the condition with good tendency is in the number of family members. The level of education and income are identical (bad). Residents in the fishermen area have low awareness of the importance of education. This condition automatically affects the type of jobs, dominated by fisherman and laborer.

Table 1: Category of general conditions

Category	Good	Moderate	Bad
1. Condition of Residents			
City of origin	From within city	From within province	From outer province
Family size	1-4 person	More than 4 person, single family	More than 4 person, multiple family
Education	Diploma/ Bachelor	Junior/Senior high school	Elementary school
Occupation	Permanent work	Permanent but susceptible	Non permanent and susceptible
Earnings/Wage	More than twice of regional minimum wage	Regional minimum wage to twice of minimum wage	Below the regional minimum wage
2. Housing Condition			
Wall	Permanent material, good condition	Semi permanent material, moderate condition	Non permanent material
Floor	Permanent material, good condition	Semi permanent material, moderate condition	Non permanent material
Roof	Permanent material, good condition	Semi permanent material, moderate condition	Non permanent material
Housing Tenure	ownership	rent	Not both
Size of House	More than 72 m2	36 to 72 m2	Less than 36 m2
Size of Lot	More than 120 m2	70 to 120 m2	Less than 70 m2
3. Facilities and Infrastructures			
Water supply	Piped from local water company	Deep well	River / lake
Sanitation	Lavatory with septic tank	Lavatory without septictank	No lavatory
Waste management	Trash bin available, managed	Trash can available, dispersed	Not managed
Drainage	Available, good condition	Available, poor condition	Not available
Access road	Permanent material, good condition	Semi permanent material, moderate condition	Non permanent material
Electricity	Available from local electricity company	Available, but from another source	Not available

In case of cash income, fishermen have a very fluctuative amount. For instance, in a good season, they can earn up to USD 1,200 in one big catch. But often also they went home with nothing. The lack of saving culture by fishermen in some areas made it more difficult in maintaining an economically sound and sustainable living. Most activities relating to the after process for the fish are done by the women in their housing area (figure 3), such as drying the fish to make salty fish, fixing the fishing net, selling the fish, etc. This activities require a special configuration in the layout of the house. It also requires an open space to support the activities.

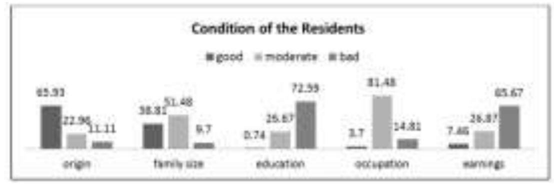

Figure 2: Condition of the residents


Figure 3: The ladies are drying the fish outside the house.

Housing condition

In general, housing conditions of the fishermen is good because of the major use of permanent material for wall, floor, and roof. Results from the survey of the housing condition is given in figure 4, while the typology of the housing in figure 5. For some areas in the South Sulawesi, the condition fisherman's house is still substandard. Housing tenure of fishermen are mostly owned houses, but land used mostly do not have a clear status. For a house built on water, the land tenure is not settled. While in some other regions, they occupied leased land. The problem is generally arouse when deciding the land lot to a house which was built on water, as it is difficult to define the boundary, as it is related to tides.

Figure 4: Housing Condition


Figure 5: Typology of fishermen housing in Indonesia

Facilities and infrastructure

Facilities for education, health, and the market has been available both on and within the settlements. Clean water supply in the region is quite good, some fisherman still use the water wells especially for bathing and cleaning purpose. Sanitary conditions in general is quite good, although in some areas identified in poor condition because the habit of not using the latrines.

Figure 6: Pathways in one of the Fishermen village

Adverse conditions identified in waste management and drainage, where people do not have a habit of throwing garbage properly. Households threw waste directly into the sea is a common phenomenon. The access road condition is generally sufficient (figure 6), with majority of paved road and maintained condition. For fishing areas located above water, the footbridges are made of wood, although they are in good condition, there is the possible danger in case of fire because it will easily be the medium of spreading fire. This should be a concern in an effort to prevent fire hazard. Electrical service has been used by most families in the area of fishermen, but for some public areas, usually they have difficulties in providing the electricity. Most of their boats are located in the public areas. If there is no proper light, then there is more likely the boat are stolen because the surveillance is minimum.

CHALLENGES IN HUMAN DIMENSION OF COASTAL SETTLEMENTS

Policy implementation for fishermen settlement

Based on the Regulation of Minister for Housing of the Republic of Indonesia (Permenpera) Number 15/Permen/M/2006, residential area of the fishermen are part of the strategic areas aimed at supporting the activities of maritime affairs and fisheries. The criterias are -among others- fishing area, situated on the coast or islands in the vicinity of the sea that has the potential of marine and fisheries or have a fishing port or fisheries development plan which requires support for housing. Based on Permenpera Number 15/Permen/M/2006, the development of the fishermen village is prioritized on the area that met the below condition:

- Substandard environmental conditions or slums;
- Pollute the surrounding waters;
- Having a low accessibility or isolated (eg, located at the border and remote small islands);
- The people are poor;
- Prone to catastrophic fires;
- Prone to wave/tide exposure, including abrasion, tsunamis and wind;
- Have a fishing port development plan, and the fishing industry.

Fishermen's settlements is unique in a way that their development is identical, in contrast to other public housing development. The identical development is mostly because they all share a common characteristic, as shown by the result survey. It is then very important to have a design guidelines and proper policy in terms of the human , housing, and development aspects of the fishermen.

Condition of residents

The quality of education of residents in the area fishermen are still low. Approximately 73% of family heads only graduated from primary / primary school graduate is not related to the condition of education of people living in settlements of fishermen educational standards that must be met in accordance with national provisions (9 years) In the policies that govern the development of special area fishermen have not included the charge amount and type of facilities provided by the formal school.

Fishermen are able to build housing in its ability of financial self-supporting although the performance is still minimum. Regulation of Permenpera Number 15/Permen/M/2006 mentioned that in order to plan the development of fishing areas, it is necessary to consider aspects of the pattern of housing and financial scheme. Details and models of the financing scheme has not been mentioned in the regulation.

Most of the residents, or approximately 65.7% of families, have incomes that are below the minimum wage set by each region with the majority of livelihood as a fisherman. The ministry regulation mandates that residential facilities provided assistance not only supplement to the basic needs of shelter alone but also facilities that could increase the productivity and income.

Housing condition

There are about 58.2% - 69.4% house in the fishing area which is generally quite good although many use wood that is resistant to sea water. The Government has issued guidelines and instructions in building good house construction, that ae applicable in the fishermen village. Adequate policies, including standards needs of materials used in their implementation, although sometimes these standards collided with local traditions, such as local wood materials commonly used, that according to the the government standard, timber is a non-permanent building materials that are easily damaged.

Most of the citizens of the fishermen area have obtained title to their homes. However, for the house that stood on the water, there is no guarantee of certainty policies governing residential lots of fishermen. Based on regulation Number 14/Permen/M/2006 mentioned that as a guarantee of legal certainty to the community, to every field of housing land in special areas to be given Certificates of Land Rights according to the legislation in force. Implementation has not been in accordance with the policies and the cargo that is not accommodated in policies such as residential development on the water.

Facility and infrastructure

Most of the fishermen community in the region consider the condition of infrastructure such as roads are classified as good, but related to the primary network is still required special attention. Based on Permenpera Number 15/Permen/M/2006, network of primary, secondary and tertiary are aspects that must be completed in the development of fishing regions. Network development of primary, secondary and tertiary which can increase the connectivity between regions has not been identified in the survey area in accordance with existing policy.

Infrastructure such as pier fishing area, educational facilities, health and other public facilities contained in the settlement and the object of the survey, most are already available, but still in a state inadequate. Based Permenpera Number 15/Permen/M/2006, residential area devoted to supporting the activities of fishermen and marine fisheries functions one of which need to be equipped with infrastructure such as a pier, boat mooring, boat dock. Fishing area of infrastructure development is in good condition. With this infrastructure development (in accordance with permenpera 15/2006), the development of the fishing industry can be encouraged and larger-scale production can be realized.

In general, utilities are good. Safe drinking water is accessed by 38.1% of the residents. For electric utilities, the condition is good enough that there are 92.5% who already enjoy direct electrical connection, although problem of the frequency of outages are still occurring. Based on the regulation, special residential development should be complemented with tools which include clean water, electricity, telephone and gas connections.

From the aspect of sanitation, there are still about 27.4% of fishing communities that dispose the household waste into the sea. This is the continuation of old habits when the number of fishermen are still few and regarded the sea can bear the disposed waste. Based on the regulation, development priority of housing areas is if the housing pollute the surrounding waters. In determining the location, it is also necessary that appropriate environmental criteria for not damaging the marine biota is implemented in accordance with existing policy. Sanctions for marine pollution or destruction of marine life need to be included in the fishing settlements development policy in line with national agreements in an effort to preserve the marine environment.

Human: a strategic and potential dimension

Land and sea borders has always been a target of some unscrupulous neighboring countries with various forms of violations that continue to increase, such as coastal and marine resource theft, smuggling of various materials and illegal activity. Cases of arrested foreign fishermen who steal fish proved that on the one hand the potential of fisheries in the exclusive economic zone boundaries of high value, but on the other hand there are weakness in the monitoring of the vast area. Relying only to the authority is impossible that such a broad area can be monitored effectively with frequent evidence of the capture of foreign vessels. The question is how things like this can be resolved quickly and who is most appropriate given the task of supervision. Then, who is assisting the authorities and citizens on the duty of supervision?

Answering questions on the above description, the fishermen are in almost all coastline of the archipelago, that have a strategic role to utilize and maintain local potentials. The characteristic of fishermen needs a special treatment from the government in ensuring the development of the settlement. The fishermen are one of the the oldest profession. The amount is also widely spread from the eastern coast of Indonesia to the most western. Traditional situation and lifestyle has become a trap that led to their stagnant life. Even worse is the limited accessibility to the fishing area made the support given to the fishermen is also very minimal, compared with other social groups such as farmers, merchant, and businessmen. And as described above, the role of fishermen as beneficiaries of marine resources are becoming more important. If the fishermen can simultaneously be a watchdog of the sea, then two-thirds of the total area in the form of sea NKRI will be more secure, whether from theft, vandalism or violations. Providing appropriate education as well as better access to the economic aspects of the residents in fishermen village is necessary, based on the survey. Education level relates with the economic condition of the fishermen. It can improve the life quality of the residents, so that they can do their task in the sea monitoring more optimal.

Fishermen village: informal and strategic settlements

Fishing settlements in Indonesia developed incrementally. Re-structuring process of fishermen dwelling does not necessarily relocating the settlement. Because of its permanent nature, the fishermen need to prepare almost nothing. Solving the problem of housing and settlement is an appropriate starting point to achieve the successfull human development.

Up until this period, the development and construction of housing and settlements is general and applied in nearly all forms of society. Local governments did not pay much attention to the demands of residents in specific areas, such as coastal areas. Development concept and housing settlements for fishermen should be done in full, complete and gradual scheme. Residential aspect is integrated with economic, social and environment. Different approach must be applied in fishing areas close to urban areas and those living on the island far from urban areas. From the point of NKRI wholeness, fishermen located far from urban areas need special attention. The principle of residential development pattern recommended for fishermen are:

- Facilitating the human resource development, focused on school facilities, formal and informal school that contains the substance of general education and special about the marine/fisheries in addition to training related to entrepreneurship of marine products, and more. The substance of education can adapt to the culture and needs of local economic potential;
- The pattern of funding support for fishermen to access the property and a decent home improvement can be provided through a simple scheme, such as microfinance cooperatives, pawnshops involvement, and others. Improving physical quality of housing is done through a self-help approach to housing improvement and building layout planning participatory supervised by experts led by local residents. Knowledge of safety standards of disaster is very important factor to be included in design considerations, building materials, and others.
- In addition to proper housing construction, there are three things to note, given the high density phenomena in fishing settlements, which are counteract the danger of fire by building a fire corridor, developed a pattern of sanitation facility that is suitable for home on the water or near shore, and safety standards to cope with natural disasters (storm tsunami, earthquake, etc).
- The status of land ownership rights that need to be resolved to give certainty to the plots inhabited. For housing that is above the water, it is necessary to determine the type of certification;
- Maintenance of basic infrastructure facilities (safe water piping network, adequate electrical network, a network of good roads, health facilities, places of worship, commercial, open space, 3R integrated waste management, and other)by the local community.
- Help support the provision of facilities and infrastructure and supporting activities such as fishing pier, boat / boats, equipment for sea, collecting market and sales of fish, fishing cooperatives, and others that can be done by central and local governments. If necessary the things that binds such a ban dumping into the sea, preserving the marine biota, the use of fishing equipment and other environmentally friendly substances listed in the policy development fishing/coastal area.

CONCLUSION

Housing and settlements in coastal areas especially for fishermen that is incrementally developed needs special attention because of their natural and residents characteristic. Recommendations mentioned must be expressed by the local government technical agencies as housing and settlement authority in their respective regions. The area of fishing settlements that has a substandard quality should be a priority area of central government in an effort to facilitate the appropriate specialized residential programs.

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Indigenous Sustainable Development Carried Out by the Low-Income People in Urban Areas

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ABSTRACT
Almost all big cities in developing countries have low-income people who live in low-income settlement. It is predicted that by the year 2020 three quarters of the world's urban dwellers will live in the cities and towns of developing world. The poor people live mostly around the city centre and occupy vacant areas within the city. It is obvious that the low-income people in Urban areas have to deal with minimal infrastructure facilities in their settlements. They have to live with bad access to the main road, bad environmental quality, lack of playgrounds for the children, etc. This situation forces them to be creative in using the physical facilities.

According to human right declaration 1948 all human beings in the world including the poor people have the right to live better like any other well-off persons. Even though the government regards them as illegal, they demonstrate great ingenuity in developing their residential neighborhoods especially in organizing the open spaces and construction of housing. There are many positive aspects that can be found in low-income settlements, if the settlements are observed carefully without having negative prejudice before. Those positive aspects are creative process of the inhabitants for struggling in their settlements.

Since the relationship among the inhabitants is quite close, public spaces are very important for them, because they use them as a place of communication. Besides the creativity in building their house mostly with used materials make their housing types unique. As an open building approach the way the poor people develop their housing areas can be formulated as strategic approaches for developing methods of design and building construction as well as improving the built environment in which the low-income people live. This paper will describe some field studies in low-income settlements developed in several big cities in Indonesia.

KEYWORDS:
Indigenous, sustainable, low-income, urban areas, open building

INTRODUCTION

Compared to indstrial countries population dencities in cities of developing countries were three times higher than in the industrial countries. If average densities continue to decline at the annual rate of 1.7%—as they have during the past decade—the built-up area of developing-country cities will increase from 200,000 km2 in 2000 to more than 600,000 km2 by 2030, while their population doubles.(Angel, 2005) Urban problems of cities in developing countries are the most challenging issues on its development agenda. Cities are developing in fundamental ways and once shape has taken hold, they cannot be easily changed.

Hundreds of millions of urban poor in the developing and transitional world have few options but to live in squalid, unsafe environments where they face multiple threats to their health and security. Slums and squatter settlements lack the most basic infrastructure and services. Their populations are marginalized and largely disenfranchised. They are exposed to disease, crime and vulnerable to natural disasters.(Nikken Sekkel Ltd, 2000) Mostly the people living in low-income settlements are very poor and many people say that the poor in such settlements make the degradation of the city. This state makes the poor people become marginalized by the urban community life. In these circumstances the work of architecture created by the poor in low-income settlements are often spontaneously known as a marginalized architecture.

Hardoy in his book titled "squatter settlement" wrote that the poor demonstrate their great ingenuity in developing their housing areas and in organizing the housing construction although the government appraises them as illegal. Compared to the legal standard required by the government, their way, planning, designing and building materials that they use is often much more suited to their local needs, income, and also their local climate. (Hardoy and Satterthwaite, 1989) Observing housing Facility in low-income settlements inhabited by low-income people in urban areas within Indonesian big cities, it is understandable that the housing facilities available in the settlements are very limited. They cannot build their housing areas well, because they have very low incomes and usually they work per day just for their daily survive. In other words, the low-income people are totally unable to save their money for their future lifes.

With all of the limitation existing infrastructure facilities the low-income people must be creative and very clever to anticipate the activities carried out in the settlement. Therefore, the form of spatial and community activities in low-income settlements are very specific and it is quite different compared to the formal settlements within the city. Seeing the creativities in living with limited facilities, an open building approach can be implemented in order to improve the built environment within the low-income settlements. This built environment is the product of an ongoing, never ending, design process in which environment transforms part by part.

There are case studies found in several big cities in Indonesia that will be explained in this paper. In addition, housing development strategies done by low-income communities around the city center will be described including the methodology of total participatory approach that advocates the housing development from and for low-income people who live in urban areas.(Tebbal, 2001) Through the approach above the inhabitants in low-income settlements may make design decisions as well. In principle, low-icome people in low-income settlements will be able to develop their housing areas in a sustainable way, if they are given a chance and also accompanied at the whole planning process.

LOW-INCOME HOUSING IN INDONESIAN BIG CITIES

Low-income settlements are available almost in all big cities in Indonesia. Understanding the activities of the poor in architectural space within the low-income settlements is very useful for arranging a development strategy based on the character of the inhabitants. By paying attention to the low income people living in low-income settlements, it can be understood that they are hard workers, who are persevering in looking for their basic necessities of life for their family. Besides, the character of their houses is also different compared to the formal houses developed by private investors. (Bawole, 2010)

In terms of population density, in 2004 the number of residents in the municipality of Yogyakarta was 511 744 people. In general the highest population density was located around the city center like in district Mergangsan, Danurejan, Gondokusuman, Wirobrajan, etc. Whereas the lowest density level was in Distrit Umbulharjo. With an area of 805.3 hectares, the population number in District Umbulharjo was 71,400 people. In other words the population density of district Umbulharjo was 88.66 persons per hectare. [see Graphic 1] With a view landuse map of Yogyakarta municipality, can be understood that the sub Umbulharjo still many lands that are exploited by society for agriculture. (Bawole, 2007)

Although the people come from different regions, they are able to live together in harmony. It can be observed when one family needs help, many other families will extend their hand to give their help. The relationship among the people living in the low-income settlement is very close. It is not limited by the difference of ethnic group, religion and race. Therefore the potency can be used as a tool for improving the environment quality of their housing areas, because it is not so difficult to stimulate the poor in low-income settlement to work together (gotong royong) in order to make their housing areas healthy and environmental friendly. The characteristic of low-income housing areas will be explained below:

The pattern of Settlement

In the low-income housing areas the location of the settlement cannot be seen directly from the main street, because it is behind a formal housing and shopping areas. The pattern of the settlement is linear following the flow of the river. The building density is very high and the position of one house to the others is quite close. There are certain pathways often passed through by the inhabitants. The other small pathway like alleys or alternative small ways called “mouse path” can connect to main pathways or even to the main roads. [See Figure 1]

All houses faced the kampong street and the back of the houses were facing the River. With this situation the inhabitants could easily threw away their garbage directly to the river. Therefore the environmental qualities of the riverbanks, in which the settlement exists, were very bad. There was so much garbage under the back of the houses. Some small open spaces developed spontaneously can be seen within the settlement and the inhabitants use the open spaces very intensively.

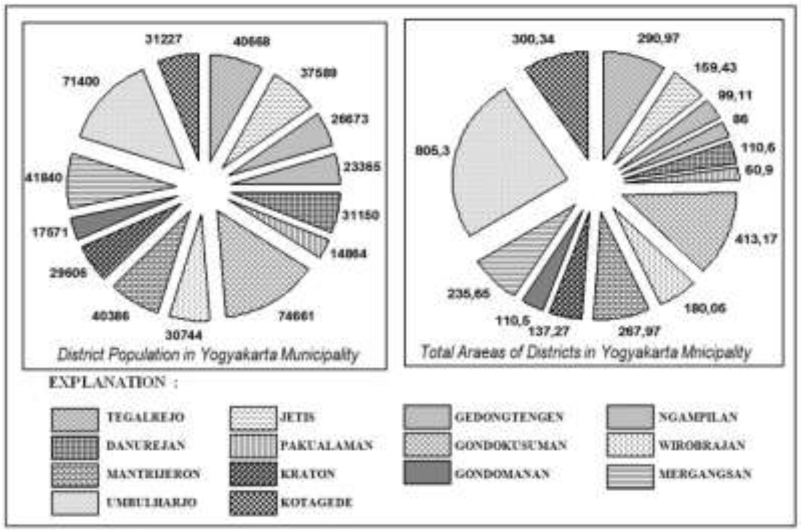
Building Architecture

Houses in the low-income settlement along Wonokromo Riverbanks have different characteristics, even though in general they can be distinguished as permanent, semi permanent and non permanent buildings. The architectural typology of the houses in the low-income settlement is relatively simple with a quadrangle ground plan and the building orientation is towards the kampong’s pathway or to public open spaces. There are usually two entrances to the house; the main entrance from the front of the house and a side entrance at the back of the house.

The roof form is dominated by the simple form of “kampong” and “panggang pe” roofs. The other forms, like Limasan, Tajuk and Joglo, have been found only on a few houses. [See Figure 2] Generally a house with a complex form of roof is owned by the upper low income people or the middle class. The walls of the house have been made from very simple material, like carton, plastic and bamboo, up to bricks with good finishing. The floor is made from boards or from bamboo, cement, tiles, ceramic or maybe just from soil without finishing.

Open Space and Circulation

In the case of low-income settlement along Wonokromo riverbanks, there are not so many informal open spaces, because the houses were developed in linear pattern directly following the kampong street. Small informal open spaces are located between the houses. Since the open spaces are few, the inhabitants use the kampong street as an open space for carrying out their daily activities. Based on the field observation, the open space in the settlement is very important for the social life of the people. Observing the socio-culture of the people living in the low-income settlement, all of the members of society like the children, youth, women and men, always have social interaction there. Especially for children, the public open space has a special meaning for them to play and express their creativity. [see figure 3. explaining spontaneous public spaces] Besides, the open spaces are very necessary for the settlement with dense built-up areas, because they function as a place for air circulation.



Graphic 1. The Percentages of Job Types and Monthly Income of the Inhabitants living along Code Riverbank - Yogyakarta

Figure 1: Low-income settlement along the Deli Riverbank in the City of Medan

Figure 2: Roof Types of Low-income Houses in Yogyakarta and Surabaya

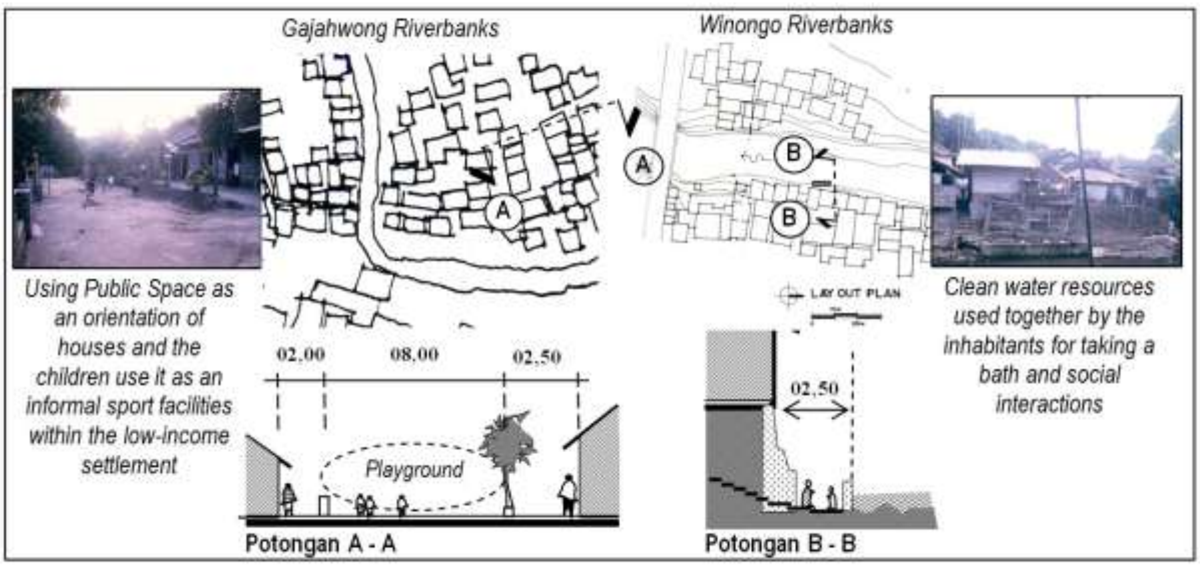


Figure 3: Public Open Spaces which are Active Utilized by the Local Residents for Communicating Among the inhabitants

Even though the open spaces are few, they use the spaces very effective and intensive. From the field observation, it has been found that there are some circumstances which stimulate the activity of the inhabitants in open spaces or on the kampong's pathway. One of them is the availability of open space used as an orientation of the houses. By facing an open space, communication and social interaction among the families living in the houses can be involved. Generally an open space will be used effectively by the inhabitants: children, young people and adults. They use the open space within the settlements with time sharing or by turns. The other activity stimulation is the available technical infrastructure facilities in the space, like a public water tap, public well and also social infrastructure facilities like a guarding house, food stall, small mosque, etc. Those facilities can stimulate the people to carry on social interaction and communication.

Infrastructure Facilities in Low-income settlements

Even though the infrastructure facilities are very poor, many families have electricity. Only the poorest families do not use electricity. They use oil lamps as an illumination. Since many families have electricity, electronic commodities like radio, tape recorder, television, etc. are mostly available. As street illuminations usually the family whose house is facing the street will provide electricity. [See Figure 4]

Vacant land in the Brantas Riverbank on the Backyard of Houses which is Frequently Flooded is Used by the Children as an Informal Playing Lot available in the Settlement

Brantas Riverbank in Village Jodipan- Malang City which is very dense with houses developed spontaneously by the inhabitants and the Paths inside the settlements are also developed spontaneously

Figure 4: Density of Residential Buildings in Village Jodipan and also Vacant Land Available on the Brantas Riverbank

The other infrastructure facilities available are public taps, public toilet and drainage. Almost all families in low-income settlements have no private clean water facility. If they need drink water, they have to buy it in PDAM (Clean water facility provided by local government). For washing and bathing they use public well available within the settlement. Those infrastructure facilities can stimulate the social interactions among the inhabitants especially if there is a small open space nearby. (Balanyá, 2005)

GREAT INGENUITY IN DEALING WITH MINIMUM HOUSING FACILITIES

As it was stated by Hardoy that the poor people demonstrate great ingenuity in developing their residential neighborhoods and in organizing the open spaces and construction of housing, even if the government regards them as illegal. Indigenous architecture is a term used to categorize methods of construction which use locally available resources and traditions to address local needs. It tends to evolve over time to reflect the environmental, cultural and historical context in which it exists. This happens also in low-income settlement especially if the settlements have developed in several decades. Even though the low-income people do not have any architectural edcation background, they learn how to address their local needs with using local material available. Therefore their ways, plans, designs and building materials are often far better suited to local needs, incomes, climatic conditions and resources than the official, legal standards demanded by governments.

In the case of low-income settlement “Kampong Aur” developed along the Deli Riverbanks the inhabitants build their houses indigenously without planning and helping from the architects. They always develop their houses including the surrounding environment in order to overcome the problems they face. The ingenuity to handle the problem creates specific characters of indigenous architecture. Since the houses have been developed along the riverbanks and the land is so limited for building their houses, they build their house on the pile construction and used the second hand building materials founded or bought nearby.

As an indigenous architecture in urban areas the physical environment within the low-income settlements has specific characteristics because people develop their houses and the surrounding environment without any plan and the developments are adjusted to their demand and capabilities. The relationship between the way the people develop their housing areas and limited facilities available creates specific characteristics. Hence there are many interesting places created by the inhabitants spontaneously. The creativities of the inhabitants can be seen in using the second hand materials, creating the architectural elements, developing building construction, doing their daily activities in informal public spaces, etc.

OPEN BUILDING APPROACH

Listening to the community may provide ways to improve the understanding about the socio-culture of the people and give bright ideas how to develop their settlement. Indigenous people demonstrate great ingenuity in developing their residential neighborhoods and in organizing the open spaces and construction of housing. Therefore their ways, plans, designs and building materials are often far better suited to local needs, incomes, climatic conditions and resources than the official, legal standards demanded by governments. To develop low-income settlement it is much better to involve the inhabitants in the development process.

Open Building is an approach to the design of buildings that is recognized internationally to represent a new wave in architecture, but a new wave with roots in the way ordinary built environment grows, regenerates and achieves wholeness.(Kendall, 2011) Concerning the sustainable development with minimizing the hazardous situation in low-income settlements, the planning program should involve the inhabitants from the beginning. Total participatory must be carried on in order to compile the idée and thinking of the inhabitants about how to develop their housing areas and to minimize the hazardous conditions.(Wilcox, 1994)

As an Open Building approach the strategy to develop low-income settlements is called “Advocacy Development Planning for and with the Poor” In this strategy all institutions interested in helping the poor people together with local inhabitants should discuss and establish teams for doing the research, making a development plans and also implementing them. This is an idea that more generally, designing is a process with multiple participants and also including different kinds of professionals. The team established will be divided into two groups: team for Field Research and People Participatory. These teams will prepare everything regarding the preparation of the research, the whole research, workshop with the poor people, development plans for the low-income settlements and implementation of the plan.

Building Construction Created by the Inhabitants in Low-income settlements along Deli Riverbank-Medan

Guarding Post Designed from Bamboo as a place of social interaction

Using small public open space in low-income settlement as a playing lot for the children

Creativity in planting vegetations along the small street in low-income Settlement

Figure 5: Great Ingenuity Created by the Low-income People in Low-income settlements

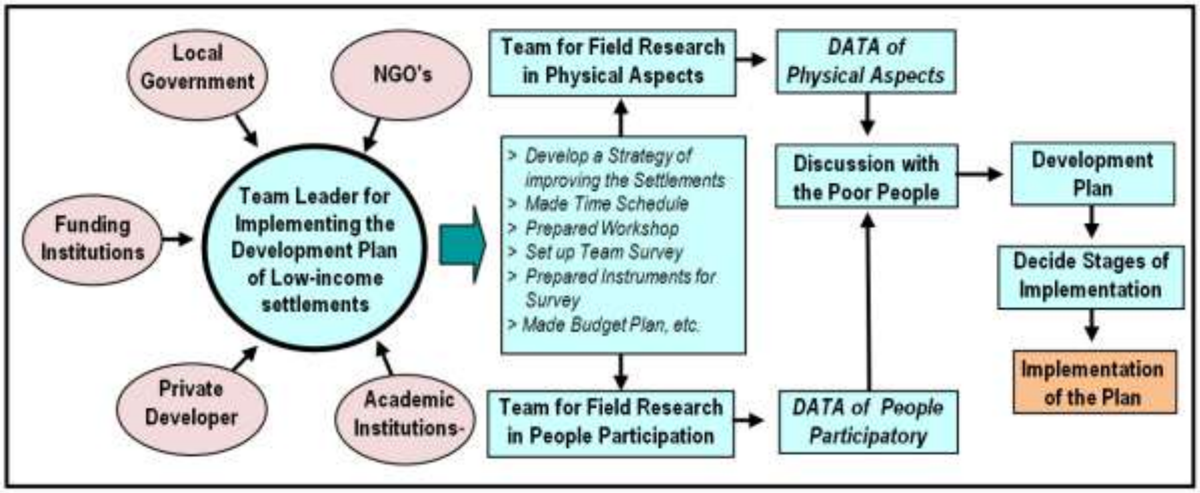


Figure 6: Process of Open Building Approach through "Advocacy Development Planning for and with the Poor" in Low-income settlements

The field research team will observe the physical aspects of low-income settlements especially the open spaces in which the inhabitants carry on their daily activities. Through the observation of the physical aspects, it can be understood how the people carry on their activities in available open spaces intensively. Whereas the research about people participatory will be done in order to find out how the poor people thinking about good environment around and safety life in their housing areas, if they have a chance to improve their living qualities. The research activities in the low-income settlement can be seen as ideas that inhabitants may make design decisions as well as the other stakeholders as professionals.

The dangerous condition within the settlements like the slope of the riverbank, the distance between houses and the river, building construction, etc. should be taken into account carefully. Besides there are also special form of pathways, alleys and also other types of open space developed spontaneously. The information above will be compiled and analyzed vigilantly cautiously, because it will be transformed into basic strategy for making sustainable development program in low-income settlements with minimizing the dangerous conditions of the settlement.

According to the experiences, if the poor people think about having enough money, they will have also an ideal housing area for their daily life. Usually the data got from the participatory research are ideal ideas and thinking that have a contradiction with the real situation of low-income settlements. Those data will be record carefully because in serial workshops they will be cross checked with the real situation gotten from the research of physical aspects. The further process is to carry out the serial workshops for making an urban upgrading plan. Through the whole process of planning it can be seen that the idea that built environment is the product of an ongoing, never ending design process, in which environment transforms part by part.

CONCLUSION

For millions of urban poor and slum dwellers, formal recognition of their rights and permanence in the city is often the catalyst for social inclusion, as well as the improvement of shelter conditions. After discussing the low-income settlements in Indonesian big cities and the development strategies with using the Open Building approach, the conclusions will be explained in the last part of this paper.

Decent housing and living conditions are the most basic needs of each individual. Gaining secure access to adequate accommodation is often a pre-request for exercising many of the fundamental rights which form the foundation of all decent societies, and should be enjoyed by everyone. These include the right of access to education, the right to work, the right to social protection, the right to healthcare, the right to personal privacy and to family life, as well as the right of access to basic services such as water and electricity.

Implementing the Open Building approach in improving the low-income settlements through the strategy of "Advocacy Development Planning for and with the Poor" can help the poor people to live in environmental friendly housing areas. If the poor are given a chance to develop their houses and surrounding areas, they will show their great capability to improve their settlements, because they know exactly what they need and they know also their capabilities regarding their financial and building knowledge.

From all the discussions above conclusions will be formulated in several statements. Besides, creative urban forms and Architecture developed by low-income people in low-income settlements will be taken into account as settlement potencies that can be improved. Those statements are:

- The opinion which thinks that an low-income settlement is the garbage of the city should be changed the other way around; it should see that the low-income settlement is a special housing area that has to be developed specifically.
- A development program by demolishing the low-income settlements cannot solve the poverty problems of inhabitants. On the one side such development program solves only a part of the city, but on the other side the program stimulates new low-income settlement in other parts of the city.
- Open Building Approach with the strategy of "Advocacy Development Planning for and with the Poor"can give a guarantee that the involvement of the community is able to carry out the development plan for low-income settlement.
- The whole stakeholders should have a good hearth in order to help the poor in low-income settlement. Their involvement can help to implement the Open Building Approach.
- The Creativity in handling the problems can be used as a basic strategy for improving the environmentl quality
- Transforming the spatial experiences of the poor into a sustainable development strategy can be carried out well, if the inhabitants are involved in the whole process of planning.
- The improvement of individual house qualities follows the development of public open spaces and infrastructure facilities which are developed earlier.
- Social infrastructure facilities are needed by the inhabitants for carrying on their social interactions.

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Community Self-Mapping in the Neighborhood Upgrading as Strategy for Sustainable Poor Settlements Development

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ABSTRACT
Alleviation of Poverty has been a great issue challenging the third world countries. Indonesia, as stated in the MDGs, has been targeted to reduce the poverty line by 7.5% in 2015. In rural areas, where there is a limited access to the decision making, the poor have been neglected from development. Moreover, the community organization tends to have no opportunities for social inclusion; empowerment and security. Community Self-Mapping has been a sustainable tool for including the poor in the development of settlements and make them participate through enable programs for neighborhood upgrading. Therefore this instrument is a tool for generating transformation of attitude and encourages self community management and entrepreneurship in the planning process. The research aims to identify the community capacity to conduct community mapping within the Neighborhood Upgrading Program, called PLPBK-ND. This research used Participatory Action research (PAR), where the researcher is involved in the process as a planning assistant expert. The implementation of PLPBK-ND has shown that this can be identified as planning in the fourth dimension characterized by a people-centered planning process, creation of good community governance, community participation, sustainable development and poverty alleviation.

KEYWORDS:
neighborhood upgrading; poverty; human settlement; community mapping

INTRODUCTION
Architecture and planning in the fourth dimension have been shifted the paradigm from modernist planning to environment, to community, to cultural diversity and to human spirit (leonies, 1998). There have been critical lenses on the pillars of modernist planning, which has attributes of rationality, comprehensiveness, scientific objectivity, the project of state-directed future, and the notion of public interest. There is a need for demolishing these pillars of modernist planning wisdom by the new concepts of social justice, citizenship, community and multiple publics (leonies, 1998 p 5). There are also strong social forces, which tend to shift the focus on minority issues, such as gender, difable and racial with the politics of multicultural citizenship.

Therefore planning for diversity and equity in multicultural cities and societies is needed. The Planning itself also changed. Planning is no longer exclusively concerned with comprehensive, integrated and coordinated action (multi-sectoral and multifunctional plans), but more with negotiated, political and focused planning. With this shift planning is made less document oriented but more people centered.

Due to this shifting planning paradigm, the role of a planner in the era of global change has been changed from a planning expert to a manager of global change. The mission is now to introduce methods and techniques of negotiation and mediation, collaboration and consensus building.

Neighborhood, Community Empowerment and Sustainability
According to Suttles (1972) and Gans (1991) in Peterman (2000), neighborhood is a recognizable community in a location with some geographical abstraction. This is also called community of limited liability. Jacobs stated that the neighborhood is linking together the people by interest, association and purpose. The neighborhood has also been considered as a self-governed mundane organ. Therefore the success of neighborhood depends on its ability to undertake self-governance through the community organization in addressing common problems and the ability to integrate the local planning into decision making policy on the city level.

Poor neighborhood communities lack often the ability to break out from poverty because the community organization institutions are not generating access social inclusion, empowerment and security (World Bank, 2002). Empowerment of a poor settlement's community is a basic component for planning and developing of their area. Social inclusion is very important in the development plan, where people share knowledge, interest and aspiration related to what is happening in their environment. The community organization institution plays an important role in empowerment of informal settlements, related to their capacity in organizing themselves in planning and development. Therefore community empowerment is basically the empowerment of community organization in the neighborhood. Sustainability has to be seen as continuing development for the next generation, which means enduring development of the physical environment; the economic; as well as the development of social institutions.

Indonesian Era of Planning in the Fourth Dimension

Indonesia has been facing the era of decentralization since 1999 through the regulation no 22/1999 and UU no 32/2004 regarding local governance and regulation no 29/ 1999 and UU no 33/2004 regarding fiscal sharing between central government and the local government. This regulation has been followed by revitalization in planning and government from top-down and technocratic planning to bottom-up and participatory planning. In 2005 the government of Indonesia was developing the National Program of Community Empowerment (PNPM : Program Nasional Pemberdayaan Masyarakat), coordinated by the Coordination Ministry of People Welfare, which becomes an umbrella program for other ministries to support.

Community-based Human Settlement's Planning – Neighborhood Development

(PLPBK-ND Program)

Community-based human settlement's Planning – Neighborhood development (PLPBK-ND= Perencanaan Lingkungan Permukiman berbasis Komunitas) is a Indonesian government program, which introduces comprehensive community development as well as human settlements development for achieving sustainable social life and health, productivity, identity and harmony .The program has been initiated by the Ministry of Public Work through the National Program of Community Empowerment (PNPM) and an advanced urban poverty alleviation program (P2KP advanced), supported by the World Bank. Focus of PLPBK –ND program is to strengthen and to empower social capital through development of universal value and local knowledge; to strengthen community services and to initiate community entrepreneurship, which encourages creativity and innovation in creating resources for human settlements development. Outputs of this programs are development of participatory human settlements planning documents called RPLP (Community-based Human Settlements Macro Plan) and RTPLP (Community-based Human Settlements Micro Plan, community institutions development and implementation).

The stage of the program of PLPBK –ND are shown in Figure 1:

This program has been implemented in almost 150 villages in the Central Java Region of Indonesia. One of these villages is Menuran Village.

Development Committee of PLPBK ND as Organs of Participation

Development Committee of PLPBK –ND is an ad-hoc organization, which was initiated to govern and to organize the program, also to synergize all the stakeholders for supporting the program. This organization includes the Main Participatory Planning Team (TIPP), which was elected from the local people for the purpose of community empowerment based on the changing behavior and attitude, strengthening the community management and developing community entrepreneurship.

The actors / institutions of PLPBK-ND are as follows (see figure 2):

The Main Participatory Planning Team (TIPP:Tim Inti Perencanaan Participatif) is an ad hoc committee, which consists of the local government, village government (desa), and the community empowerment bureau – Development Unit (BKM/UP-UP: Badan Keswadayaan Masyarakat –Unit Pembangunan - and interest group, supported by the Participatory Planning Assistant (TAPP = Tenaga Ahli Pendamping Perencanaan). During the implementation of the program, TIPP gets help from working Groups (POKJA) and Volunteers.

Technical consultation will be given by the technical team, which consists of a working unit of the local government, an interest group, the private sector, and a business party.

As technical assistant, the city coordinator and assistant coordinator (Korkot and Askot) give assistance to the technical team by the local government.

The Facilitator of PLPBK assists TIPP, POKJA and the volunteers.

Community Self-mapping in PLPBK-ND Program

Community self-mapping is one part of the phase in the PLPBK-ND. This is defined as a process of community participation in identifying the problems and potencies of the neighborhood and shaping their own futures as a basic for Participatory Planning. Community self-mapping is usually conducted through the instruments of self-drawn maps; tables, figures, and other instruments in a community-based development. The outputs of these instruments represent physical environment problems and potencies, social institution problems and potencies, as well as economic problems and potencies.

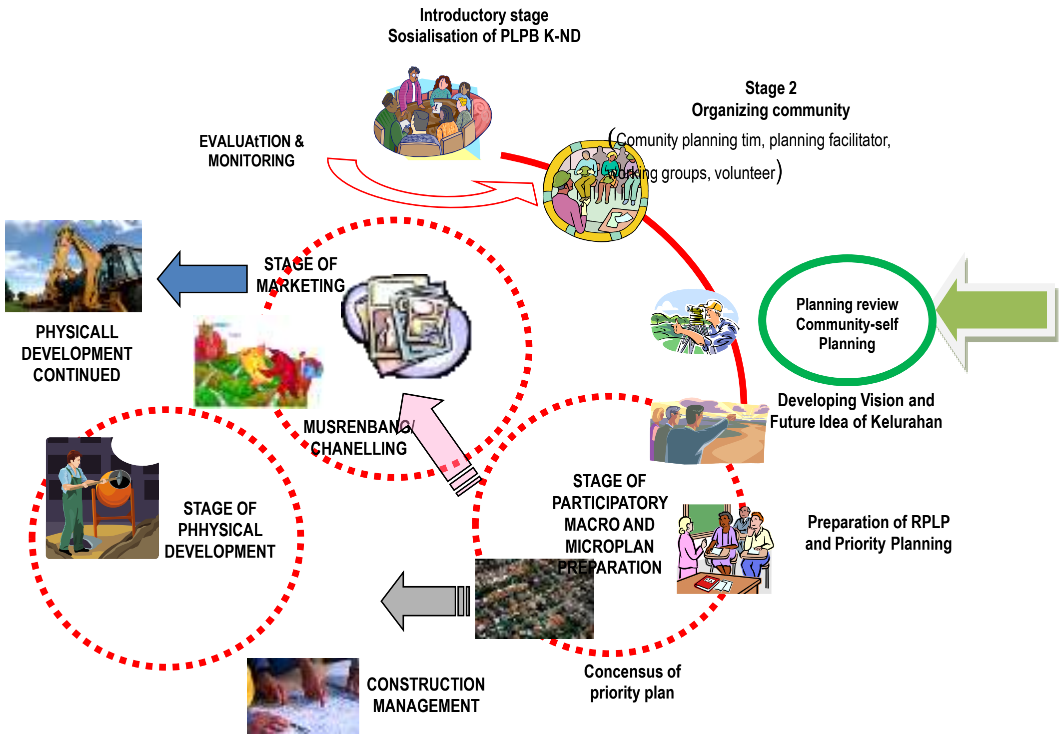

Figure 1: Circles of Planning in the PLP-BK –ND
Sources: Department of Public Work, Guidelines of PLPBK ND, 2010

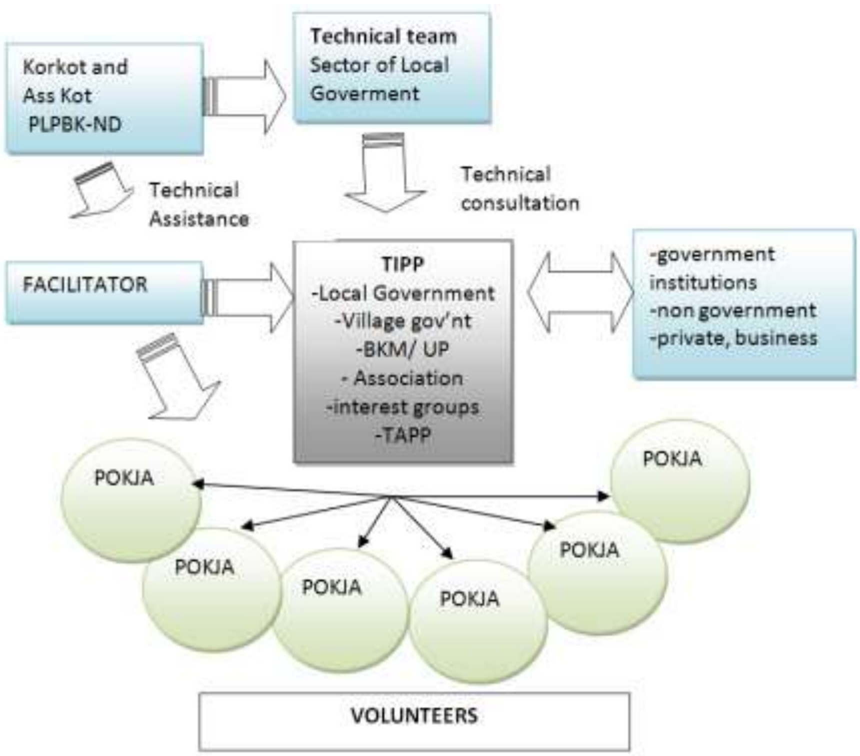

Figure 2: Development Committee of PLPBK- ND
Sources: Department of Public Work, Guideline of PLPBK ND, 2010

Stages of Community-self Mapping in the PLPBK –ND are as follows
(Ministry of Public Works. 2010. Guidelines of PLPBK –ND)

Stage 1. Preparation
Preparation stage is the first step in the Community-self Mapping. In this step teams of planning are organized, which consist of the Main Participatory Planning Team (TIPP) and the facilitator of PLPBK-ND for developing and determining aspects to be mapped according to the strategic issues of the area, such as aspects of infrastructure, water supply, economic and social issues. The Pokja (working team) will be in charge for each of the aspects.

Stage 2. Preparation of Basic Maps
Basic thematic Maps will be used for indicating different aspects of development. Furthermore other instruments such as an identification matrix of data for each aspect are also prepared from each POKJA.

Stage 3. Process of Community Consensus Building
This process is facilitated by TIPP and TAPP by conducting community meetings (rembug warga) to check the results of the community mapping for several aspects of development. This forum should present 40% woman, poor people and vulnerable people.

Stage 4. Preparation of Document of Community Self-Mapping
TAPP and TIPP prepare a document consisting of maps and matrices of development aspects, which have been agreed by the community.

THE CASE STUDY : PLPBK-ND PROGRAM IN MENURAN VILLAGE, CENTRAL JAVA INDONESIA
Menuran Village is located in the Baki District in Sukoharjo regency, Central Java Indonesia. It consists of 4 dusun/ kabayanan and 9 Community Units (RW: Rukun Warga) and 29 neighborhood Units (RT: Rukun Tetangga) situated about 10 km south of Sukoharjo regency. The study area covers 234 ha and is bounded by Bentakan village in the east, Jati and Geneng village in the west, Jetis village in the south and Baki pandeyan village in the north. The village is a poor rural village with a poverty rate of approximately 31.88 % (2009) and 34.36% (2010). In the area lived 1711 people in 2009 and 1844 people in 2010 (NPNP reguler, 2009 and 2010). General characteristics of the area are:

Domination of agricultural land use in about 50% of the study area (116 ha), which consists of 80 ha of wet paddy field, 30 ha of corn field, and 3 ha of fertile fruit field. Around 30% of the people work in the agricultural sector.

The Industrial sector in the area consists mostly of home industry, which produces bricks, nata de coco, furniture, guitar and kulinaire goods. In RW II and RW III 70 % of the people are working in the brick sector.

Other income generating activities are farming and working as a government officer.

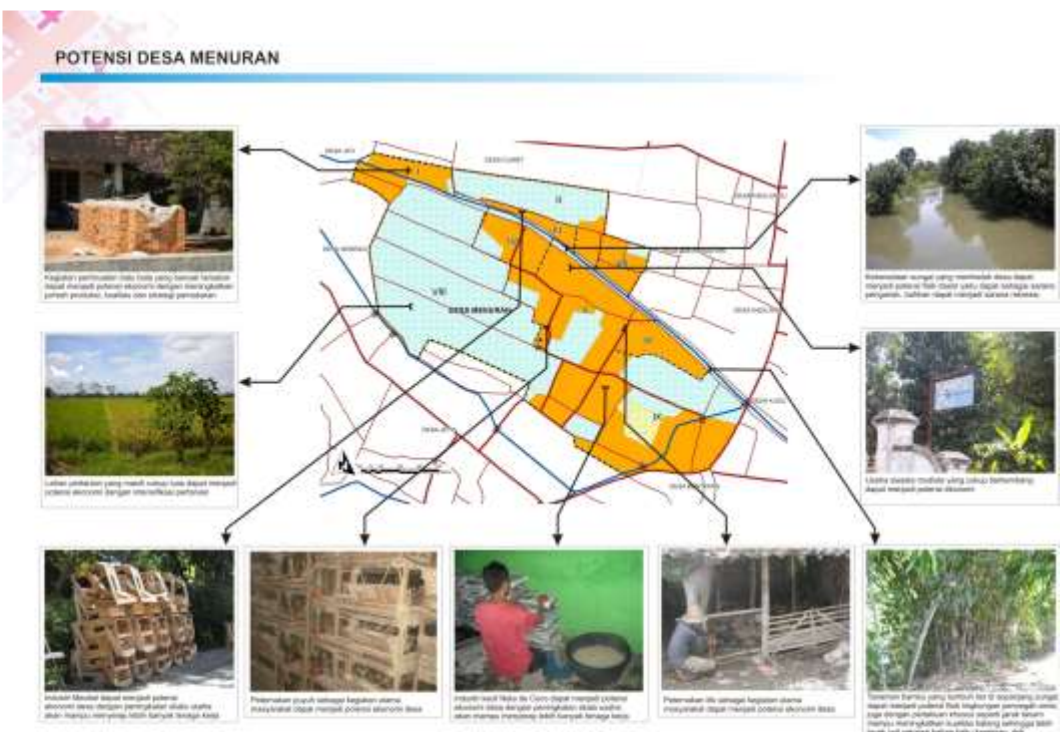

Figure 3: Map of Potencies and Problems of Manuran Village
Sources: Astuti, W. Materi of Presentation of TAPP, 2010

RESEARCH METHODOLOGY

The research was done by Participatory Action Research, where the researcher is placed as an actor involved in the process of development with the targeted community as a Planning Assistance Expert (TAPP). All the process was done in about 1 year from the 1th. of April 2010 until April 2011.

RESULTS AND DISCUSSION

Implementation Process of Community-self Mapping on PLPBK ND in Menuran Village

Community mapping is one of the implementation of Model of Community Empowerment for Slums communities as an effort for sustainable poverty alleviation (Astuti, W and Hardiana, A, 2009, 2010). This model has also been implemented in several village in Surakarta as well as in the areas of implementation of Poverty Alleviation Program in Indonesia. Several stages are as follows:

Stage 1. Preparation:

Training of Several Development Aspects of Planning and Process of Community-self mapping

The first step in conducting Community self-mapping (PS: Pemetaan Swadaya) is the coaching of PS, which was conducted in 20th July 2010 in the Village Office of Menuran. The audience counted around 100 people which consisted of the coaching members for PS and the members of TIPP (planning team), POKJA (working group), BKM (Community Empowerment Board), the leaders of RT and RW, facilitators of BLPBK ND and the TAPP (Planning Assistance Expert). Coaching PS was assisted and trained by the TAPP.

Objectives:

Objectives of the coaching are, first to give capacity building for TIPP and POKJA in conducting PS as a part and input for the community development plan, second to give direction and guidance for the process of community self mapping (PS) to TIPP and POKJA as the motor for conducting community self-mapping together with the volunteers, and third the distribution of work and work scheduling for each of the POKJAs.

Instrument:

Several mapped aspects are: Spatial aspects, infrastructure, housing and human settlements, economic aspects, socio-cultural aspects and institutions. Every aspect was conducted by each POKJA. Therefore the instruments which have been prepared were basic maps for each of the aspects and matrices with information of potencies and problems for each aspect.

Stage 2. Community self-mapping according to the several Aspects of Development conducted by POKJA

Community self-mapping by using the instruments of basic maps and matrices of potencies and problems was done on 31 of July until 20 of August 2010. Each POKJA has been assisted by the TAPP (planning assistant expert) and team members. The process was conducted by the transect method, where POKJA together with TAPP was tracing the surrounding village for all of the perceived potencies and problems, which is the area facing on a sectoral basis such as infrastructure, spatial, housing and human settlements and industrial aspects. Later all this information is put in several basic maps according to the thematic aspect. Some information, which could not be drawn in maps, such as public services, socio-cultural aspects and institutional aspects were put in the specified matrices.

Figure 4: Process of Training of Several Development Aspects of Planning
and the Process of Community-self mapping
Photo author: Astuti, W. 2010

Objectives:

The objectives of this stage are, first to identify and understand the potencies and problems of the area related to specified aspects; second to find and develop consensus for alternative solutions of the problems and challenges.

Instruments and methods used:

Instruments used in this process were basic maps and matrices of potencies and problems. The method uses was the transect method.

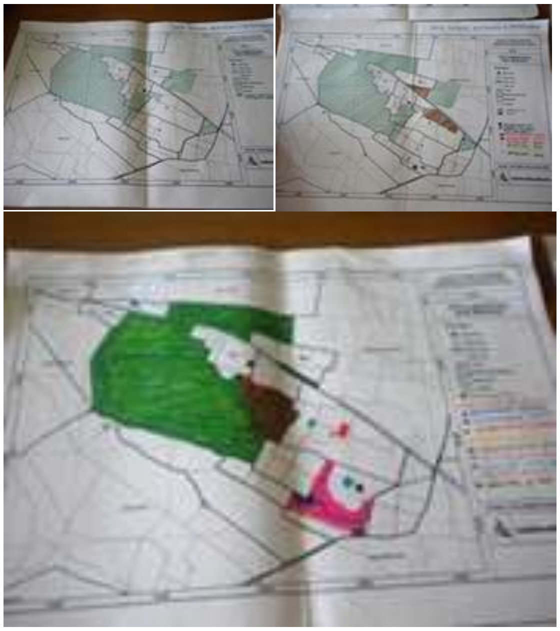

Figure 5: Results of community-self mapping of several aspects of development. Photo author: Astuti, W, 2010

Stage 3. Community self-mapping on administrative basis and process of consensus building

After all information needed in the settlements development planning have been obtained, the next step was to conduct identification of potencies and problems on the RW level (administrative basis). This process was also purposed for checking and fulfilling the information of several aspects from the previous data obtained from POKJA in the village level. Community self-mapping in the RW level was conducted in 9 RW in Menuran village. Each of the RWs invited stakeholders to be involved in this process by participatory planning. Average participants of the process in each of the RWs varied between 10 to about 45 persons, which consisted of the leaders of the RTs; woman organizations (PKK), youth organizations (Karang Taruna), community leaders, and vulnerable people. The process was assisted by TAPP.

Instruments and methods:

Instrument used in the process was plane paper, with the technique of Village sketches.

Stage 4. Document Preparation

After all the process was finished, the next step was to make a compilation of the data, to digitize of the spatial information and data by a GIS program and to synthesize the potencies and problems. This results of compilation of problems and potencies would become input for developing RPLP in the next level (see figure 1. cycles of planning in PLPBK-ND)

Figure 6: Process of Using Village Sketch method in the RW Level. Photo author: Astuti, W, 2010

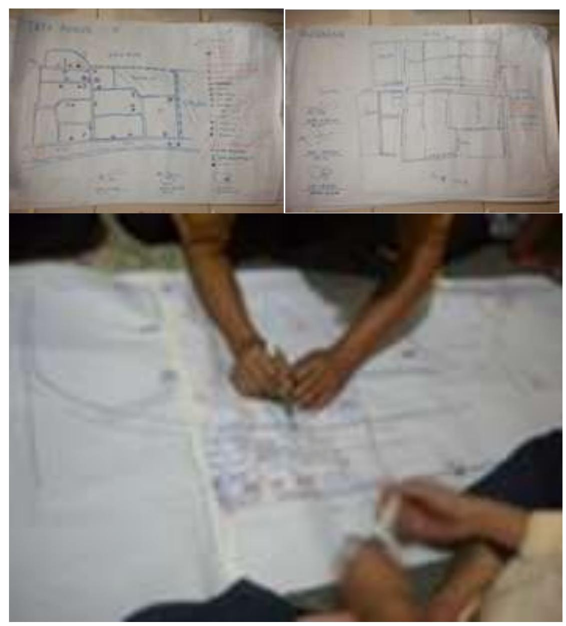

Figure 7: Results of Identification of Potencies and Problems using Village Sketch method in the RW Level. Photo author: Astuti, W, 2010

Related Issue of Planning in the fourth dimension in the Implementation of PLPBK in Menuran Village

People-centered planning

Implementation of PLPBK-ND in Menuran Village is a portrait of community-based neighborhood development planning. This places the people into the center of development and subject of development. The main objective of the Program is basically to develop the community in the context of harmony, health, productive, identity and sustainable human settlement development. Development of community is firstly dedicated to the development of a community attitude toward a clean and healthy neighborhood development planning, secondly aimed at a development of community entrepreneurship, which is creative and innovative in neighborhood planning, development and management, and thirdly committed to a development of good local community management through a strong Community Empowerment Bureau (BKM) with the Development Unit (UP), which is able to fulfill their own neighborhood demand leading to an independent community and wealthier neighborhood.

Good community governance

Through the strengthened Community Empowerment Bureau (BKM), the neighborhood becomes a community organization, which sustains and continues the neighborhood development planning in this area supported by the development units. With good attitude, good administrative work, transparency, this become a good community governance.

Community participation

As a subject of development, community organizes themselves for neighborhood planning, which enables many people to be involved and to participate in the process of development from the first planning process during the implementation till the monitoring and evaluation. This process is run by the main participatory planning team (TIPP:Tim Inti Perencanaan Partisipatif) as an ad hoc committee, which consists of the local government, village government (desa), the community empowerment bureau – the development unit (BKM/UP-UP: Badan Keswadayaan Masyarakat) – and interest groups. In implementation of the program, TIPP is helped by working groups (POKJA) and volunteers.

Sustainable Development

Development of community institutions is the key for sustainable development, because improving the community capacity will sustain the neighborhood development planning in the area. The outcome of empowered community institutions will be enablement for having synergy and generating networks with other specified parties, such as working units of the local government on the regency level as well as on the national level, private, business, etc. for continuing the development of the area.

MDGs and Poverty Alleviation

By this process of community-based development the community is empowered and helped on its way to become an independent community, which is able to see the opportunities and challenges for escaping poverty based on their own potencies and problems. This means that the Community-self mapping is one of the instruments for understanding the community's potencies and problems for developing the area and eradicating poverty. In this way the Millennium Development Goals are strongly supported.

CONCLUSION

Architecture and planning in the fourth dimension have been shifted the paradigm from modernist planning to environment, to community, to cultural diversity and to human spirit. This requires planners for adapting and facilitating the global change. Human settlement policy has to be linked with poverty alleviation, which is not only directed for healthy and physical environment development, but also has to be more directed to community development, improving good community attitudes, good community entrepreneurship and good community management in a healthy, productive and sustainable neighborhood development. Therefore some instruments are required for intervention in the community to enhance the community capacity in planning and development. One of the instruments is Community-self mapping, which enables people to involve in the neighborhood planning, by understanding potencies and problems of their neighborhood that can be used as an input for planning.

Implementation of PLPBK-ND has shown that this neighborhood development can be identified as planning in the fourth dimension with the character of people-centered planning, creation of good community governance, generating community participation, sustainable development and poverty alleviation.

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Application of an Open Building System to the Location, Settlement, and Floating Houses of Lake Tempe

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ABSTRACT
The coastal communities of Lake Tempe move their settlement from land to water using a system of floating houses. This is done in order for the community to meet their economic needs as fishermen and farmers. The tidal characteristics of LakeTempe cause the location of the floating settlement locations to often move from one area on the water to another. This displacement results in changes to the layout of the settlement. In addition, the floating houses fungtion as both residences and places of economic activity, necessitating a layout with flexible uses of space. The purpose of this study was to examine the application of the open building system within the specific locations on Lake Tempe, at the settlement level, and on the individual houses. The research method was qualitative and employed and ethno-architectural approach. The results showed that the settlement moved from land to the water because the open system allows anyone who wants to make a living on the lake to do so. The layout of the floating settlement moves and changes on the water, adjusting to seasonal variations in the climate and to allow the continual catching of fish. Application of the open building system has created a layout that is flexible allowing for the performance of both economic and inhabitation activities in the floating houses.

KEYWORDS:
Economic activities, open building systems, floating settlements, Sulawesi; Indonesia

INTRODUCTION

Bugis community, located in the area around Lake Tempe in South Sulawesi, generally earns their living as farmers. In addition, they also rely on fishing in the lake, which has become a major source of income. This is in line with the ideaproposed by Hamid (2007), who said that the main livelihoods for the people of South Sulawesi as Pallaonruma (farmers), Pakkaja (fishermen) and Passompe (traders, travelers, or other occupations of immigrants to the local area). However, given the changes in the local climate, the prolonged dry season resulted in farming being in sufficient to supports many families' economic needs. This has caused the economic life of the local community to depend entirely on the water. As a result, since the 1970's, the people have not only lived on the mainland, but also have settled on the water with a system of floating houses. Local wisdom is employed in deciding the location of a house within open-living system : one that is adaptable to the change in climate and strongly supportive of the community's water-based economic.

Moving from land to water for economic reasons, has had an impact on settlement patterns and the spatial and forms of the houses. Which have also been influenced by climatic conditions, natural environmental conditions, and community knowledge (Naing, 2011). This is in line with the idea put forward by Habraken (1978), who noted, three aspects are used as benchmarks for changes in the form of a settlement: (1) the spatial system: organization of space, along with the orientation and pattern of spatial relationships, (2) the physical system: construction and use of materials; (3) stylistic system: the creation of forms, including the facade, doors, and windows, along with other elements both inside and outside the building.

This research began with the observation that the change in the settlement's location from land to the water due to economic necessity, means that the community was originally settled in one place on the mainland, then moved on to the water. The creativity of the community is seen in the open building system that is employed in the and, movement of the settlement system on the water, and how it improves the economic life of society. The primary research question was: "how does the open building system manifest itself in the location, settlement and housing levels and what are the economic justifications for its application?".

The purpose of this study was to examine the concept of the open building system and how it is employed in the location, settlement, and housing levels, and for what economic purposes. The benefits of this research are expected to contribute to knowledge about the concept of architecture, mainly the kind that is settled in the water and helps provide economic value. In addition, it will contribute to knowledge regarding the concept of an open building system employed in floating houses.

APPLICATION OF THE OPEN BUILDING SYSTEM IN SETTLEMENT LOCATION

The floating settlement of Lake Tempe has been in existence for decades. Unlike other houses built on the water in Indonesia, these settlements can be moved in accordance with the conditions of the water as it rises (floods) and recedes. Local wisdom is applied in the arrangement of space in Lake Tempe, where an open system was introduced to anyone who wanted to live there. It is also open regarding the specific placement of each house on the lake, except in fish breeding and sacred areas.

The application of this open location system is linked to the local wisdom that has been agreed upon, either written or unwritten. Each fisherman is entitled to earn a living, and lives in Lake Tempe, in compliance with the applicable provisions and customs that have been passed down through generations. Customary provisions include rules regarding the movements of the settlement, fishing and distribution systems, and utilization of space above the water zone. This aims to protect aquatic ecosystems in terms of sustainability and ensure that environmental compatibility will be maintained, so that the social life, culture, and economy of the based community can continues.

The floating houses located in this region currently amount to 115 dwellings, the residents of 85 of which came from the village of Salotengnga, while residents of the additional 30 are from the village on the mainland, Salopokko. However, because the location of these two villages is close together, all of the residents houses are located together in one area of the lake. In-depth interviews also revealed that, when the water level of the lake rises, the group is moved to the edge of the lake, close to the mainland. This is to make it easier to sell the catch inland. Meanwhile, during the dry season, this settlement will continue to move and/shift into areas where there is standing water, usually in the middle of the lake.

Figure 1.The condition of the floating settlements in Lake Tempe.(Source: Secondary Data, 2009)

The location of the settlement can be spread across the surface of the lake, except in palawang areas during certain months. This corresponds to a system of astronomical knowledge of the society. This knowledge is associated with the awareness of natural indicators of climatic conditions and how these changes their ability to catch fish and the securely live in their floating houses. For example, from June until January, they can live outside the cappeang, palawang and bungka areas, but must keep a certain distance from the sacred area on the lake. The settlement should be kept away from the sacred area because, according to residents, there is a sacred area around posso tana (steppeds soil), which is more shallower than elsewhere; in case of strong winds, the floating houses above this area can be easily moved.

The results of in-depth interviews and participant observation indicated that living on the water with a movable of floating houses is undertaken primarily for economic reasons. This system makes it easier to fish and enable the residents to be close to their workplaces on the lake. Living as close as possible to the mainland also facilitates easier movement for back and forth from the lake to the mainland (Naing, 2011).

The Processes of Moving the Settlement on the Water Using an Open Systems

Generally, dwellings the water in Indonesia have properties indicating that they are permanently settled, but the floating settlement of Lake Tempe moves along the surface of the water, according to the conditions of the tide. According to Potter (2002), the use of shelter and settled lifestyle, even though it is both on the land and water, is not "primitive" lifestyle. Some nomadic tribes on mainland Indonesia as well as other countries around in an effort to adjust to the environment; because of this, their settlements often consist of simple buildings made from ingredients easily available in the vicinity. This means that people who choose to live on the water do so, not only because economic factors, but also on the basis of how changes in the climate affect the physical environment of their settlements. The condition of the floating settlements on Lake Tempe can be seen in Figure 2.

Communities living on the water have, the option of being able to continue their economic life. Rapoport (1977) proposed that the selection on an appropriate environment, is always a factor in the process of planning, design, and migration. Humans are unique in that they have the opportunity to choose environment suitable to their needs, choices, life style and the image that was inside him. So that people can live comfortably to meet their needs.

During the dry season, the water in the areas of the lakethat were flooded begins to decrease. All edges of the lake will turn into the mainland. The areas where fishing is still possible come smaller, even though the fishermen still need to be able to catch fish in order to meet the needs of their families. The fisherman will thus catch fish in the middle of the lake, the area that is still flooded, farther from the mainland. Under such will, over time, be come unable to be move anymore. So, before this happens, the fishermen begin to work together to move the settlement to the area that still has standing water. There is no other choice but to continue to shift into the middle of the lake, looking for water levels that allow the house to still to float and the resident to catch fish.

Information about the environmental conditions and water levels during the dry season through the flooding of the lake and surrounding land, can be seen in Figure 3.

Floating settlement location when the water is reduced / low tide during the dry season at Lake Tempe is as follows (Figure 4):

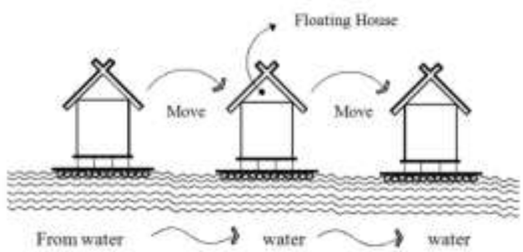

Figure 2. Movement of the settlement from different places on the water using an open location system. (Source: Secondary Data, 2009)

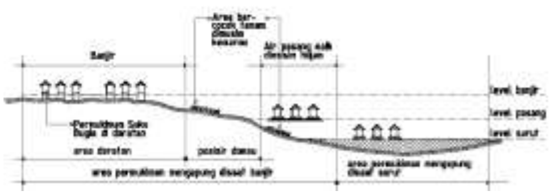

Figure 3. Water levels when dry season and flooding in the Lake Tempe and the surrounding land. Source: Results Survay, 2009.

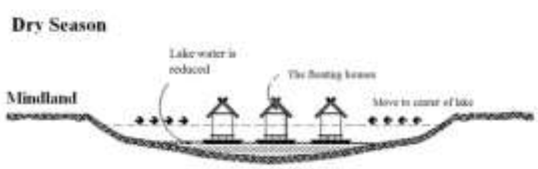

Figure 4. Location of the floating houses at low tide and movement of the houses to the centre of the lake (Source, Observations, 2009).

During the rainy season, which begins in early November, the reverse take place. The entire surface of the lake will be filled with water, thus making the fishing area wider, encompassing both the outskirts and centre of the lake. Water sometimes overflows on to the mainland, and the fishermen tend to approach the mainland by moving (pulling) the settlement to an area on the outskirts of the lake. The location of settlements at the time of high tide water (flooding) on Lake Tempe is described as follows (Figure 5)

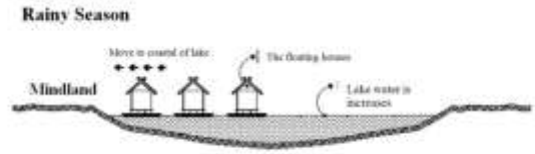

Figure 5. How the houses move during the rainy season:the settlement tends to approach the mainland (Source, Observations, 2009)

Open building and the Application of Astronomy in Selection of Location

Living with an open systems of movement over the water is supported by traditional knowledge in the community; that is, knowledge of astronomy traditional wisdom. This knowledge is used in the reading of natural phenomena that arise, so that the community can adjust to catch fish and perform other activities of living on the water. Through the knowledge of traditional astronomy, fishing communities can read the signs of nature and then prepare for fishing, as well as prepare the settlement to move or stay in a certain location on the water. In addition, traditional knowledge is also useful for preparing security and defense elements of the house against extreme conditions such as winds, storms and floods.

The decision to stay settled in one location or transfer to other areas on the surface of water, depends on the season. During the rainy season, the lake begins to rise because the uplands send flood waters into Lake Tempe. This condition causes the floating settlement to begin to shift to the coastal area of the lake near the mainland. Upon entering the dry season, when the lake water begins to decrease, the settlement prepares to move and find a place that allows the sertructures still float.

It can be concluded that the application of the open living system to the settlement locations on Lake Tempe is very supportive of the economic improvement of society. This system is based on local wisdom and traditional knowledge astronomy, and is an adaptive response to seasonal shifts in the climate. Adimiharja (1999) notes that local wisdom is reflected in systems of knowledge and local technologies in societies from various regions that still maintain traditional values.

APPLICATION OF THE OPEN BUILDING SYSTEM AT THE SETTLEMENT LEVEL

The Orientation And Wind Direction

Another dimension to the floating settlement in Lake Tempe, in addition to the application of local wisdom in choosing residential locations on the water, is the application of living systems that are open and flexible. The floating houses are moored on a pole that allows the home to easily rotate on an axis, thus not being rigid but following the wind direction of the wind. Wind direction influences the orientation system of the floating settlement, so it is better if the settlement arrangements are flexible. The Bugis Wajo people of Lake Tempe reside in moving settlements that are oriented to the wind in four directions. The northern cardinal directions is called manorang; the southern direction is called maniang; the eastern, alau and the westerm direction is called orai (Naing, 2011).

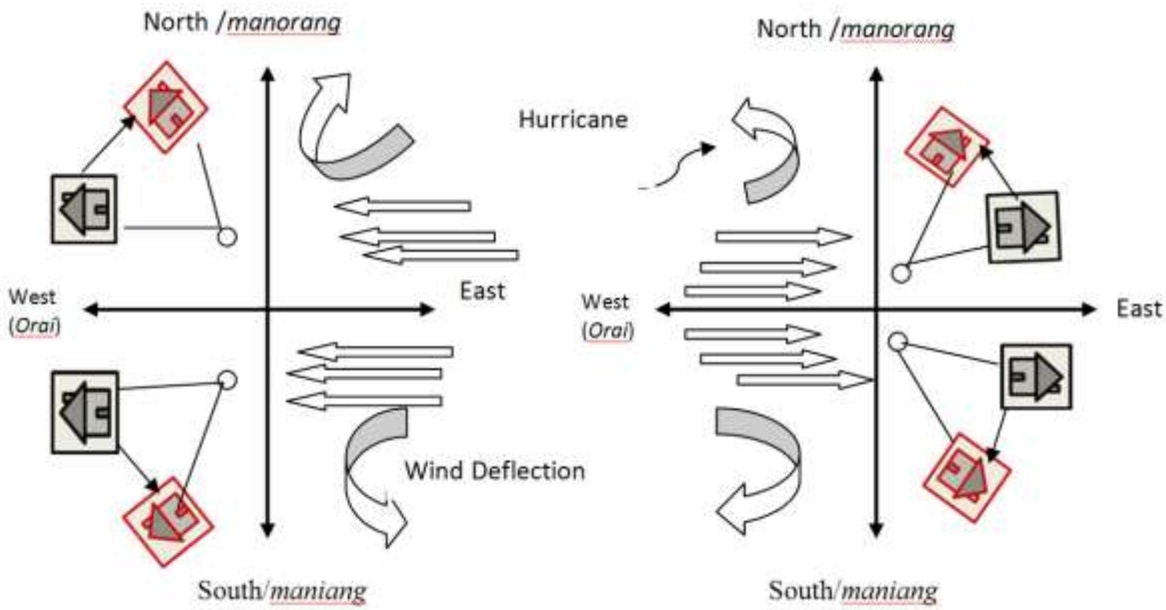

Figure 6 (left):Orientation of the house during western wind season. (Source: Results of Observation, 2009) ; Figure 7 (right): Orientation of the house during Eastern season.(Source: Results of Observation, 2009)

Placement of the floating houses does not form a specific pattern based on the specific orientation; rather, the orientation of the house is always opposite of the direction of the wind. If the wind comes from the east, the house faces the west. Conversely, if the wind comes from the west, then the house faces east. The house is tethered to a pole that is attached to the bottom of the lake. Allowing the home to continually rotate in accordance with the wind direction. Each pole is as high a five meters, and is tied with a rope five to ten meters long; thus, when the floating houses rotate accordance with the wind, the houses do not intersect one another. These conditions cause the orientation of the houses to change all day long, according to the prevailing wind direction of the season at that time (Figures 6 and 7). An arbitrary orientation allows the home to receive maximum air and light, thereby creating a comfortable place to inhabit.

The Central Pole

The open building concept used in the settlement is supported by the existence of the pole, in which a pole tethers each individual house and also, centers it in horizontal arrangement, allowing for the house to be more flexible in its settings. The pole that fastens the home can be defined as the 'central' place of rotation the floating house on water. The floating houses can rotate up to 360 degrees around the mooring mast placed at the front of the house. The existence of a single pole shaft allows the houses, to change their direction and orientation at any time, depending on wind conditions; this allows economic activities performed in the floating houses to be accomplished more efficiently. For example, drying fish in the houses is faster because of the influence of wind and sunlight, saving time and providing an economic improvement to the community.

In addition, the pole makes the house more flexible in terms of its movement with the wind, always following the rhythm of the wind and not working against the wind. This affects the durability of structures and materials of the houses and provides economy savings. However, various other factors such as currents, waves and wind deflection can cause the direction of the houses to change spontaneously (Figure 8).

The use of a single pole at the center (axis) also allows the house to turn as is floats, affecting the layout of the houses within the settlement. The layout of floating settlements is governed by the distance between the location of housing units, so as not to cause interference while spinning on the pole moorings. The minimum safe distance between the mooring masts is two times the length of the house, this allows the houses to never intersect, even in windy conditions. So, the distance between one house and another is considerable.

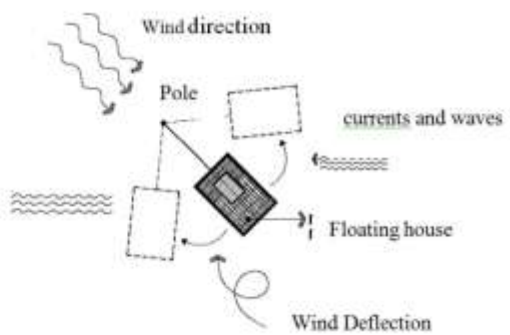

Figure 8. Rotation of a floating House on the pole
(Source: Observation results, 2009)

Application of Astronomy in the Open Building System of the Settlement

The open building system applied in the settlement is also related to the knowledge of astronomy possessed by the fishing communities, including knowledge of the changing seasons necessary, in order to still be living on the water. Knowledge of the seasons, affect the safety dan security of the community, both in terms of the safety of living on the water and economic of knowing when are the appropriate times to catch fish. The community has knowledge of the location, position and meaning of the constellation (Bugis langguage: wittoing) in space. The appearance of the constellations in the night sky can be used a guide for fishing and in the pereparation settlements to move.

For example, the Eppange star cluster is used as a sign of the coming rainy season. The Eppange star is always seen lit up at night, and through its location and position, the community came to know it specifically as the Eppange star. If the location of the star notes that the rainy season is to begin arriving, the floating houses will start to gradually shift away from the center of the lake, due to the rising of lake water. Another, the Walue star which translates into the 'widow-yet married, star' is also known by the international terminology, Alpha and Beta Centauri (α and β). For the fishing communities, the emergence of Walue star is a sign that the rainy season is over and the climate is shifting into the dry season. The season of the eastern wind coincides with the presence of the Walue star. When Walue is rising, the settlements remaining around the periphery of the lake gradually move toward the centre as the water recedes.

OPEN BUILDING SYSTEM IN HOUSING LEVELS

If the observed relationship between cultural influences on the physical form of homes is true, then the Bugis community that inhabits the floating houses have a culture that likes to spend time with family members, including during periods of rest, when they gather to eat, or in jointly conducting economic activities. These activities are integrated by the creation of open space without any massive screening, allowing the houses to require minimal furniture and providing an open layout. The goal is for the house to become a gathering place and centre of activities for the whole family.

The Multifunctional Layout

The open building concept as it is applied to the floating houses can be observed in its inherent simplicity, which allows the function of each space to be changed as needed, providing flexibility to the occupant in adjusting to different activities within the existing spaces. Such conditions help the fishing community to overcome the inherent limitations on space that come with living on the water. This is consistent with the concept of the open building theory proposed by Kendall, et al. (1999), which describes a new approach to building occupancy comprised of a novel approach to design, financing, construction, and long-term management of the structure. It is noted that the open building concept is employed to simplify the structure of the building, reduce conflict, and provide choices to the individual in adapting their homes to the environment (Kendall, et al., 1999).

Application of the open concept in the arrangement of space in the floating houses, can also be observed in the arrangement of the floor plan in a long rectangular-shape and simple, causing the floating houses to be used for various activities. Including both inhabitation and economic activities. An illustration of this concept provided in Figures 9 and 10. The arrangement of the open space is a cultural manifestation of fishing communities who still want to actualize themselves in various activities both in habitation and economic in nature despite the limited space above the water. To do so require a flexibility of space that can only achieved with a building concept that is open and multi-functional. As such, it is seen the spaces still human inhabit are places of self-actualization.

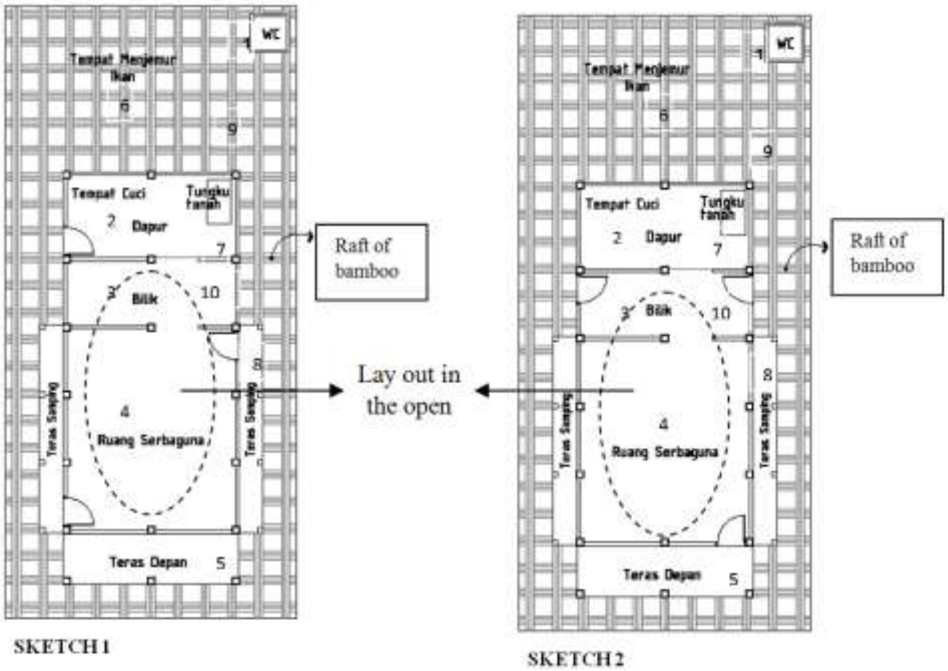

Figure 9.(left) application of the concept of the open building concept to the spatial structure of the floating houses. Informant 1 (Source: Survey Results, 2009); **Figure 10.** (right) application of the concept of the open building concept to the spatial structure of the floating houses. Informant2 (Source: Survey Results, 2009)

Image Description:

1. Bathroom/toilet
2. Washroom; place to clean and preserve fish
3. Room / bedroom with no door
4. Multifunction room (e.r.,living room, family room)
5. Front terrace
6. Place to hang fish over the back of the raft
7. Traditional kitchen.
8. Side terrace
9. Raft made of bamboo
10. Working space; a place to store dried fish.

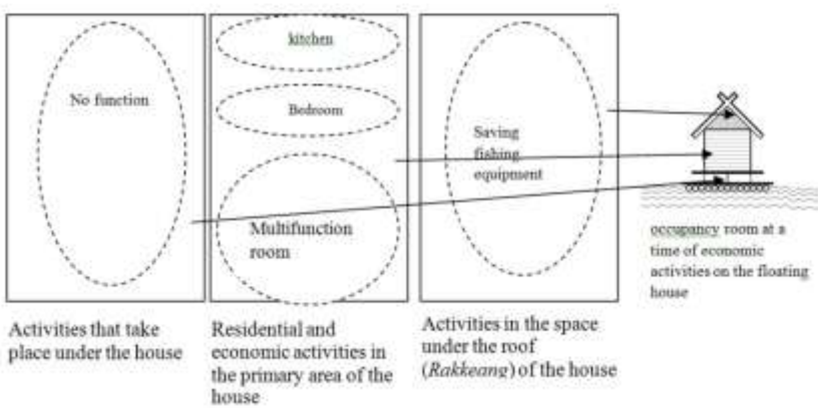

Figure 11. Distribution of Inhabitation and economic activities of the floating houses. (Source: Results Survey, 2009)

The application of local wisdom to the arrangement of space within the floating houses is done to overcome the inherent limitations posed by living on the water, and to contribute to the realization of socio-cultural and economic life of a human society based on climatic conditions and the natural environment. The inherent goal concept is to produce physical artifacts that match the characteristics of social culture on the water.

In addition, the houses are built without large devisions, allowing them to be used for various other functions, namely as meeting places, as rental houses for foreign and domestic tourists, as places to fish from the lake, and as places for the Lake Tempe festival, wich held on August , 23 of each year.

The space zones and arrangement of space horizontally and vertically within the floating houses show the embodiment of a social and economic system that is integrated into a single unit inside the house, and manifested into a multifunctional space division based on usages at different times. The flexibility in function and arrangement makes residing in the floating houses comfortable and accommodates all the activities of occupants, including both inhabitation and economic activities (Figure 11).

The arrangement in this flexible way shows a unique configuration that can accommodate all the activities of society on the water, allowing the community to continue to realize a social and cultural life that is as natural and normal as the communities inhabiting the mainland.

In terms of residential functions, the floating houses have a combined room, break room, dining room, and service room. As for the economic functions, the floating houses can be used as rental housing for foreign and domestic tourists, as places for producing dried fish, and as simple stalls selling a variety of goods needs for daily living and transportation.

Application of Astronomy to Individual Houses

The open building concept of the floating houses is an effective way of managing a house on the water, allowing for greater effectiveness in the use of space. The knowledge of astronomy contained by fishing communities is used to determine the seasons and natural phenomena so as to anticipate how activities can be carried out in the floating houses. The activities performed will differ according to climatic conditions. For example during the western wind season, the natural phenomena includes continuous rains and high winds, causing more activities to be done in the floating houses themselves, both residential activities economic activities such as the production of dried fish. Meanwhile, during the the eastern season droughts are naturally occurring which are, sometimes accompanied by high winds and the lake water begins to recede. These conditions activities to be done both inside the floating houses and on rafts.

From the study of the application of the open building concept to individual houses it can be concluded that this concept creates flexible and functional space. Such application is supported by the astronomical knowledge of the fishing community. The result is an effective utilization of the house and the raft for residential and economic activities, thus improving the quality of life of the fishing community in the floating settlement.

CONCLUSION

The implementation of the open building system in terms of settlement location on Lake Tempe allows everyone to come and settle in all areas of the lake except in areas of fish breeding, and sacred areas. This open system is economically beneficial because people can perform activities with which to earn a living while residing on the water.

Lake Tempe's natural conditions and seasional variations in the climate have caused the community to create an open building system that allows for a more flexible settlement arrangement in terms of the direction of the wind. By using a single pole to fasten each house, the houses can rotate based on the direction of the wind, thus improving the durability of the structure and, creating economic savings.

In addition, flexibility in movement provided by the rotation, creates a system that allows for maximum air and light to enter the houses, thus speeding up the process of drying fish. This equates to an economic improvement. The use of the open building concept in individual houses, makes the layout more flexible and functional. Additionally, the fourth dimension in this study is the knowledge of astronomy. The advantage of the application of this dimension to the architecture and settlement of Lake Tempe is that it can be used a symbol or sign in shaping the character of the houses and settlement. Another function is in reading natural signs in order to anticipate potential disasters on the water. Astronomical knowledge serves to provide for the security and the safety of the floating houses on Lake Tempe. In sum, the application of the open building concept of to the location, settlement and individual houses levels, and astronomy provides increased economic viability and improved quality of life for the fishing community of the floating settlement.

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Sustainable Incremental Support (S.I.S.)

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ABSTRACT

It is well known that Mexico is going through difficult times. It is imperative that most of the population´s standards of living should be improved in the near future. However, the viable options of doing so are not clear enough. It goes without saying that there is a strong need to face this reality and to accept the challenges attached to it. One of these challenges is the self-produced housing issue.

The information and ideas presented in this essay, are part of a research carried out at TAVI (Taller de vivienda: Housing workshop) in the Universidad Autónoma Metropolitana located in Mexico City. This research began in September 2007 and has continued up to now. It must be said that an advance of the work was presented in the XV Open Building conference held in Holland, November 2009.

This new analysis enhances the previous report since it deals with the theoretical and methodological approaches as well as with the architectural design proposal. The paper describes briefly the process of knowing, understanding and developing architectural options to improve the quality of life on self-production housing in Mexico City.

The first part deals with the background at a worldwide level as it happened in the XX century. The second part defines the self-production housing problem in Mexico City. In the third part, we briefly describe our conceptual and methodological approach whereas in the fourth part, we present the San Luis Tlaxialtemalco (Xochimilco) case study. At the end we present some reflections and final comments.

KEYWORDS:

Self-produced housing, incremental housing, supports, design methods

INTRODUCTION

This paper is about the process of self-production housing as it happens in most third world countries. The main focus is on the idea of improving the architectural design of this kind of dwellings. The assumption is that, instead of just developing mass-housing projects to substitute the informal settlements, there is a strong need of first, accepting the existence of informal settlements, secondly, understanding them and finally, developing proposals to improve them.

In the first part, there is a background which tells us about the last century main processes of building housing which can still be found in both developed and underdeveloped countries. In the second part, we present the problem of the self-production of housing as it occurs in Mexico. In the third part, there is a brief description of the theories and methods supporting our approach to the self-production of housing. The fourth part, San Luis Tlaxialtemalco (Xochimilco) is presented as a case study, partially showing our way to tackle the architectural design process, as we think it could be done.

At the end, as final comments, we do a reflection on our work and the attempt to focus it on making architectural design proposals which should preserve the participatory design main ideas of working together with the inhabitants in order to improve the quality of their dwellings and habitat.

BACKGROUND

The concept of housing has been continuously changing since the Industrial Revolution. Due to the fact that there have also occurred many radical changes in society as well as in urbanization processes all over the world, there is in the cities a big demand for places to live in.

Last century brought us a legacy of knowledge which unfortunately turned out to be either wrong or incomplete. It could be said that during the first half of the XX Century, technology and economy were the main issues on urban and housing development. The environmental impact of these approaches was not a main factor to be considered and it was, most of the times, sacrificed to the benefit of the economic and technological aspects. After the Second World War, the need to rebuild many cities in Europe for example, brought back some previously developed ideas such as the Athens Document and hence, thousands of dwellings were built based on the ideas of functionalism and international architecture.

Years later and according to the new standards of living of European population (England, Germany, France, Italy, Belgium, Netherlands, etc.), those new cities and housing developments were either limited or not entirely satisfactory. To some extent, this gave birth to the participatory design methods developed in those countries during the Sixties. This was the case of the Support and Methodology developed in S.A.R. (Stichting Architecten Research) under the direction and ideas of John Habraken in Holland. The majority of the changes took place in the countries up north or in the developed ones.

On the other hand, the south countries and under developed ones, were going through strong changes in their urban and natural environment transformations. This was the case of Mexico which since the middle of the century had begun to undergo important changes. As far as the growth of main cities is concerned, Mexico City, Guadalajara and Monterrey became a serious problem. Nowadays Mexico City with its more than twenty million inhabitants including the metropolitan area, is one of the biggest cities in the world. The fact remains that conditions such as the economic income or the educational level of the population, are completely different from those of the first world population. It is due to these differences that the growth of cities like Mexico City has mainly taken place through informal settlements on the periphery of the city. It must be said that 63% of Mexican citizens live in informal settlements and it was only until June 2006, that a new national law on housing recognized the self-production of housing as a legal action. Since then, there has been an intense work in order to generate a self- production housing system. Issues like financial support, legislation, technology, education, social organization, etc. have had to be taken into account.

THE PROBLEM

As it has been said before, 63% of the population in Mexico have self-produced their dwellings. They have had to do it due to the fact that they are outside of the housing market. I must stress that they do not receive any supports at all, not even from the housing public programs. Fortunately, thanks to the new law approval (June 2006), this has gradually been changing at a national level.

In self-produced housing is possible to classify the housing stock into two groups. On the one hand, the informal settlements, as they are known internationally. These are mainly located in the city borders of many cities in the third world. On the other hand, the vernacular architecture which has been the traditional way of building housing all over the world. In Mexico we have both ways of self-production of housing and of course, as soon as the old towns begin to be absorbed by the urban sprawl, new ways of self-production of housing are generated.

Before trying to make any kind of interventions in the informal settlements in Mexico City, one should bear in mind all the special characteristics these settlements have:

– ·This type of dwellings grows incrementally through long periods of time (15 to 30 years) because of the lack of economical resources

– ·There is a trend to begin the housing process with a nuclear family (one domestic unit) on the plot. Then, through time, this family changes into an extended family (two or more domestic units) on the same plot.

– ·It is stage by stage that these inhabitants have to build their houses; they begin with one room which is used as a multifunctional one where all the domestic activities take place. Needless to say, as soon as a new room is added, the functions begin to be separated.

– ·The lack of resources has a very strong impact on the quality of the dwelling unit. For instance, it is extremely common that the inhabitants should have to buy an illegal plot which not only will be located on the border of the city but will invariably, have no urban services

– As far as the vernacular or traditional dwelling is concerned, most of them are built in the rural side, small villages or towns. This kind of dwelling has a clear characteristic type of morphological, functional and built patterns which in turn and little by little, get defined through generations. The dwellings are mostly adapted to the natural and cultural environments. Their building materials are mostly located in the surroundings of the region and their building techniques are known and applied by most of the inhabitants of those places.
– By looking at those approaches, it is possible to say that popular or low income dwellings, have been self-produced, through time, by their inhabitants and so, these processes are the main way of housing production in most of the third world countries.

THE CONCEPTUAL APPROACH

This essay is based on the three theoretical approaches: the sustainable one, the social production of housing and the support theory and methodology.

The sustainable approach used on this paper is based on two complementary views of sustainability. The Aurora Slotnik Espinosa and the De Kruijf and Van Viuren approaches. These authors focus on the need of understanding and accepting the relevance of cultural and social aspects of the trilogy of sustainability. These aspects are the environmental, the economical and the social domains. The authors claim that sustainability has to be measured, mainly, through qualitative indicators.

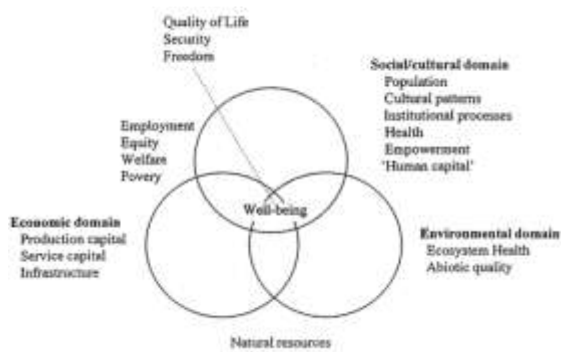

Figure 1: The interactive environmental, social/cultural and economic domains and several important elements in each of these domains. (De Kruijf and Van Vuuren, 1996).

Aurora Slotnik Espinoza says that the indicators recommended by United Nations are not enough to have a complete vision of the level of sustainable development of a country, region or community. She also suggests the De Kruijf and Van Vuuren model gives a relevant role to the social-cultural domain as related to the economic and environmental ones. On their approach, De Krujif and Van Vuuren say that "although sustainable development seems to be a concept that everybody supports, the interpretation of this complex notion strongly differs from person to person and is strongly related to one´s world view". Furthermore, in their essays both authors take the IUCN´S definition which claims sustainable development to be "improving the quality of human life while living within the caring capacity of supporting ecosystems" (IUCN 1991). Based on these ideas, the social and cultural aspects of a community´s way of life are determinant in order to understand their habitat and particularly their daily behavior in their dwellings.

The second theoretical approach in this essay, is related to the concept of social production of housing as developed by the Habitat International Coalition (HIC). Their approach has been shared by social organizations, non-governmental agencies on housing and human settlements in more than eighty countries all over the world. Basically, HIC consider housing as a process instead of as a product. According to them, the housing processes are different depending on who gets control of the production process of housing. On the other hand, if we really want to improve the quality of life and the quality of the habitat in most of the third world countries, it is essential to understand and accept the existence and needs of self-produced dwelling.

The third approach is the Support theory and Methodology. This approach was developed in Holland in the mid-sixties and is, in our view, a basic approach for improving flexibility, adaptability and incremental growth characteristics to new housing projects. In this participatory design method there are two groups: institutions and individuals. Although there is a clear division between these two kinds of participants, both groups individuals and institutions either social, public or private, play a main role in the housing production. This role changes according to the way of housing production. It is a fact that the individual who participates in the mass housing process, for example, just appears at the end of it, as a consumer of a standardized product which is repeated thousands of times. On the other hand, the concepts of support and detachable units, allow us to work into a new field where the roles of institutions and individuals can be adapted according to conditioning factors. These factors can be socio-cultural, economic and environmental. The self-production housing process for example, has the individuals as the main and perhaps the only actors in the process of producing their own dwellings. In this case, as it is known, the lack of economic resources and technical advisory, generates the kind of housing denominated as informal housing. To improve the process of housing production in these situations, it is possible to find the required equilibrium between institutions and individuals by using Supports theory.

METHODOLOGY

Based on the already mentioned approach, we can tackle and improve the informal settlements housing processes in three basic steps.

First, it is necessary to know and understand from a sustainable view, the main contextual requirements of the place and its inhabitants. This means that before any action is taken, it is essential to know all the socio-cultural, economic and environmental domains.

Second, once the contextual requirements are defined, it is essential to carry out a thorough investigation of the particular characteristics of the self-production of housing in the place as it has been done without any external help. At this stage, two complementary approaches are used: the social and the architectural ones. The first one uses the ethnographic and research action methods. The architectural uses the housing workshop method (TAVI method) developed in Universidad Autonoma Metropolitana and applied in Mexico City during the last thirty years.

Third, once understood and described the particularities of the self-help way of housing production in a specific place, then it is easier to find the where, when and how it is possible to make specific external or institutional interventions in order to improve those places.

SAN LUIS TLALXIALTEMALCO (SLT)

SLT is a small colonial town (1605) located on the border of the old lake of Xochimilco in the south of Mexico City. Nowadays SLT, along with some other towns, have become a lineal settlement which begins in Xochimilco and ends in Tlahuac towns (map1). This lineal settlement is bounded at north by dried lands, channels and chinampas which once were part of the Xochimilco lake. In the south border there are hills occupied by informal settlements and forests.

Map 1: Location of San Luis Tlaxialtemalco (SLT) in Xochimilco-Tlahuac, lineal city.

The historical background of this settlement tells us of a culture which has the water of the lake as the center of its socio-cultural and economic development. Since early times, more than 1000 years ago, this culture developed a particular way of agricultural production based on small, artificial, rectangular islands called chinampas. This way of agricultural production remained as the base of their socio-cultural and economic development from Prehispanic times until the beginning of the XX century, when Porfirio Díaz, President of Mexico at the time, ordered that a big water pump was built. The idea was to bring the water of the main water spring located in SLT to Mexico City and at the same time, promote the development of the place as a center of tourism. Both actions have had a strong impact on Xochimilco towns; the chinampas way of agriculture has been severely reduced, due to the fact that the main water spring has been dried. On the other hand, the tourist trade has become the main economic resource in the place.

However, the lack of water seems to be dangerous not just for the Xochimilco inhabitants, but for Mexico City as well. This is because Xochimilco is part of the natural reserve area of the place. Apart from that, it must be said that since the eighties, there has been a negative impact on the natural environment because of the fast growing urban sprawl that has extended into both sides of the lineal settlement.

At a regional level, there seems to be a need to restore the natural water flow by reforesting the hills. This way, the old lake can be partially recovered and the chinampas way of agriculture production can benefit from it. Needless to say, it is essential that the urban sprawl should be controlled through the increment of the buildings density in the lineal city, instead of allowing it to expand into the lake and hills. Based on that, we can go to the next step to understand and describe the self-production of housing in the place; SLT has a mixture of traditional or vernacular housing as well as informal settlements. As most of the population located on the informal housing comes from the old town, the low income housing of the traditional town has been the focus of this study.

As it was said before, TAVI has developed a method to analyze and describe the socio- cultural and spatial patterns of dwellings in a place. This method has been successfully applied in many places including SLT since it deals with a socio-cultural approach along with the architectural approach. Both approaches are applied, first, through a diachronic analysis (see plates 1 and 2) where we identify the relationship between dwelling and building through time. On the other hand, we have the second analysis, the synchronic one in which it is possible to describe the daily use of a dwelling´s spaces. This way we can describe the dwelling unit´s patterns of use of open and built spaces. After carrying out the TAVI analysis of a group of dwellings located in the traditional part of SLT, and once having defined the main patterns of dwelling and building on the place, then it was possible to develop a new model of housing growth by using SAR methodology.

STAGE 1 (1950). Don José remembers when he was a child: “The house was just a big room built with adobe walls and a cane and grass double pitched roof. In the yard, there was a washing place which still exists up to now”. There were eight people living there: his grandparents, his uncle, his parents and his two brothers.

STAGE 2 (1967). At that time, four people were living in the place: Don José, his grandparents and one of his brothers. Don José was 23 years old and he worked as a policeman. He decided to build a new room for his grandparents. This room would have brick walls and a concrete roof. His parents, one of his brothers and his uncle, were now living somewhere else.

STAGE 3 (1970). By this time, Don José had a wife and a one year old baby. Because of that, he changed the adobe room for two new rooms made with brick walls and concrete roofs. His grandparents were still living in the room which he had sent to be built before. The kitchen, the washing place as well as the yard, were still shared places by both nuclear families.

STAGE 4 (2002). Now Don José has five sons who are between 25 and 30 years old. However, just two of them live there. His grandparents and his uncle have already died.

STAGE 5 (2009). At that time, the house was inhabited by Don José, his wife and two of their daughters who had both come back with two children each.

The presented example (plate 3), was developed by four students. Each one worked with real data collected from different families located in SLT. After analyzing the data, the students defined a support model and carried out an exercise in which each domestic group (extended family) used from the beginning of their housing process, a basic set of sectors as defined in SAR. All this, in order to develop their dwellings. Finally, the render (plate 4) shows us a façade of a part of a support where four different extended families could live and grow as they usually do. The attempt of this render, is to use façade elements as they are traditionally used in the place. However, it is possible to systematize those elements in order to have different options of architectural design.

Some achievements can be possible thanks to the use of a support model according to the local patterns of dwelling and building. As an example we can mention the fact that it makes it possible to increase the housing density in the place, understanding and using the local dwelling patterns. It makes it possible to begin with a minimal base-building which can grow stage by stage, as it happens on traditional and informal dwellings in the place. Because of that, the initial cost of the dwelling group, gets reduced since each dwelling unit can be developed stage by stage as it usually occurs in informal settlements. However, this growth happens in a controlled and a systematic way. By being inserted in the urban tissue, these models can contribute and enhance the existent urban image. The use of support models also allows to introduce new elements and requirements such as green roofs and detachable elements which in turn, make the new dwellings more sustainable.

Plate 1: Domestic group transformations in S.L.T., (TAVI, 2009)

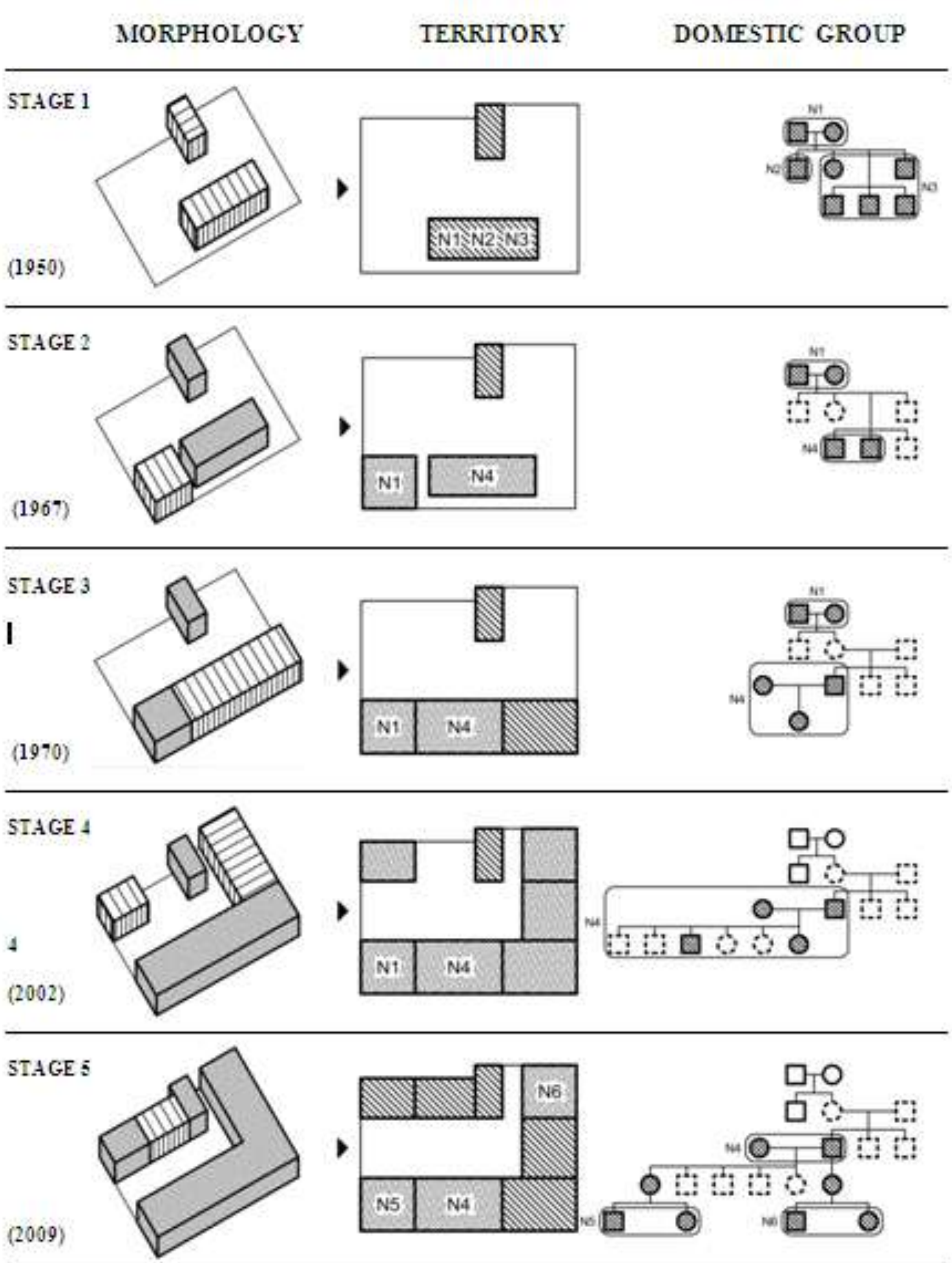

Plate 2: Incremental Growth of a Dwelling in S.L.T., (TAVI 2009)

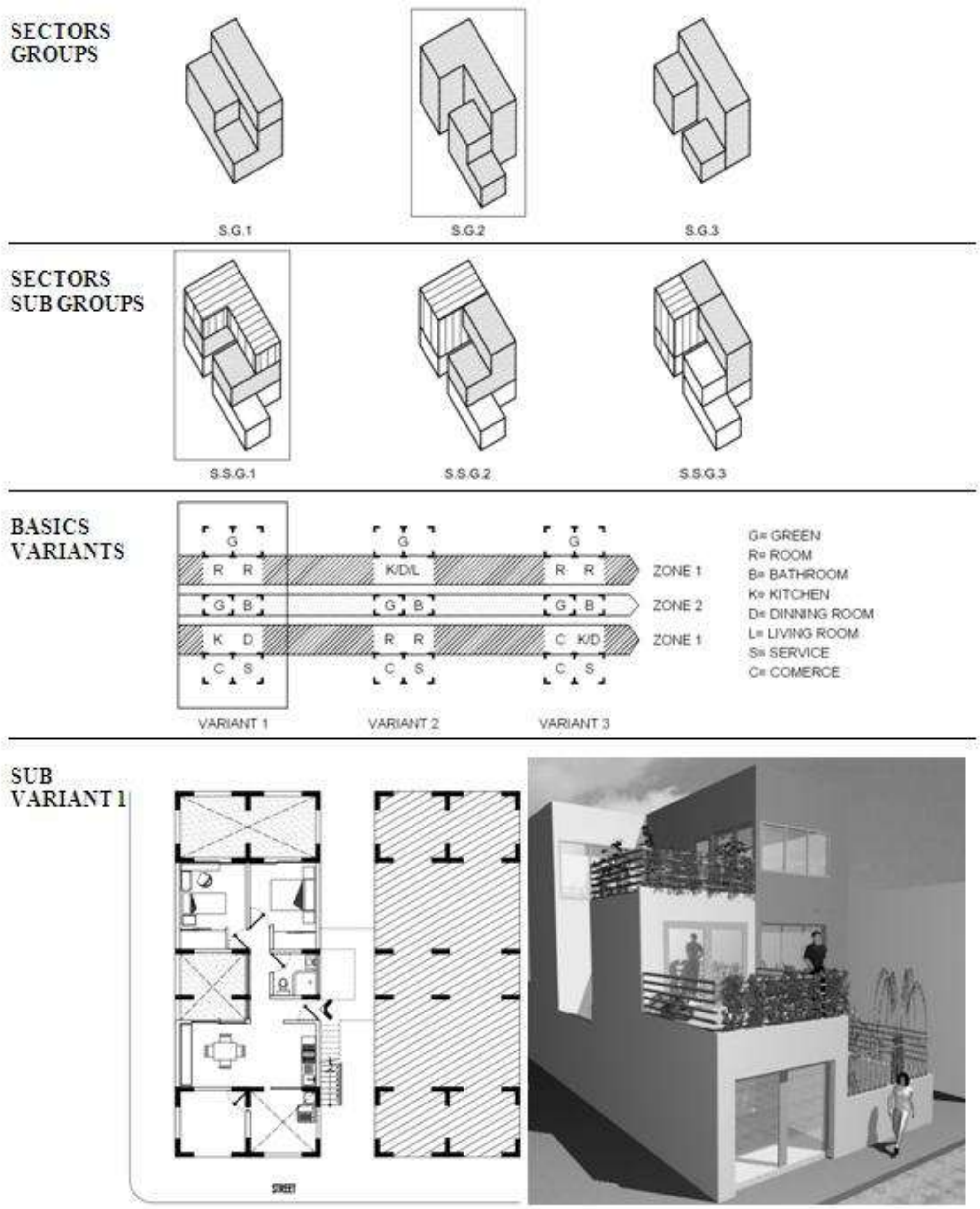

Plate 3: Example of Sustainable Incremental Support in SLT (TAVI, 2011)

Plate 4: Front facade of a Sustainable Incremental Support in SLT (TAVI, 2011)

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Informal Settlements: Myth or Reality in Sustainability Case Studies from Kolkata, India

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ABSTRACT
There are two cities in one—the legal and the illegal. Slums, squatter colonies and homeless people dominate the landscape of many large cities in India. Kolkata case study presents myth and reality in informal housing. Since 1970s slum improvement programmes have been taken up where basic infrastructure was provided keeping the slum structures. Later health, social and economic activities were initiated and ownership of land was vested with the Government in Kolkata. The redevelopment of slum area in the same area with cross subsidy failed as the slum dwellers refused to go except in a project where there was participation of entire community. A number of sites and services projects for informal housing were taken up but with poor delivery system to target group higher income group took over. As the ownership was vested in some colonies developers are building structures in an illegal way. An integrated comprehensive plan with subsidized building materials, freedom to build by themselves and credit facilities are important in a sustainable development, with informal housing community.

KEYWORDS:
Affordable, Barefoot architects, Basic Services, Shadow cities, Squatters.

INTRODUCTION
With rapid economic growth and globalization, many large cities in Asia are becoming larger. In many countries such as Thailand and Bangladesh, most of the urban population live in one or two cities. A big city is therefore an oasis in the desert of rural poverty. About 30 to 40 percent of urban population live in slums and squatter colonies both in the periphery and inner city forming shadow cities. In fact there are two cities in one, one following the town planning zoning laws and building rules and another one built illegally. Urbanization includes urbanization of poverty and informality. If housing is the step child of urban planning, informal housing is the illegitimate child of urbanization.

The definitions of informal housing are context specific. The UN Habitat programme defines informal settlements as (i) residential areas where a group of housing units has been constructed on land where the occupants have no legal claim or which they occupy illegally (ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing). It excludes units where land titles, leases or occupancy permits have been granted. It does not cover homeless (UN, 1996).

Informal housing is built by poor people with cheap or salvaged building materials on sites often vulnerable to various kinds of disasters, fire, flooding etc. One World Health Organisation report says about significant health and hygiene problems with the poor such as water and sanitation and there is indoor pollution (WHO, 1999).

Conventional urban planning excludes this and by contrast actively seek to formulize the informal sector. The formulization process frequently destroyed livelihood and shelter and serves to exacerbate exclusion, marginalization with poverty (UN Habitat, 2009). International laws now regard forced eviction as a human right violation. Yet people are being evicted for construction of large projects and informal housing is on the increase as rural people come to cities as unskilled labour. Informal sector employment and informal sector housing are two dominant features of the development of third world cities. With decline in industrial employment in many large cities of India, informal sector employment forms two thirds to 70% of the total employment and new urbanization is often called urbanization of informality arising out of poverty and inequality.

Informal Sector Housing
In major cities of India, Thailand, Indonesia and other developing countries there are attempts by the Governments to provide 'affordable housing' for the low income people. Research was carried out for the minimum size, use of cheap building materials etc. As the land is expensive, demonstration projects were set up in the periphery of cities but the people did not like to move away from their place of work and even subsidized cost is not affordable and often these housing units built by the Government were later occupied by the higher income group.

Delhi Development Authority undertook four types of projects (i) Resettlement schemes (ii) Regulation of unauthorized colonies (iii) Environment improvement scheme and (iv) Development of urban villages. Trilokpuri Resettlement Colony, Tughlokabad extension and Navjeevan camp, mostly built in 1970s are examples. An evaluation was made by School of Planning and Architecture, New Delhi on the following criteria (Saha, 1996). (1) Socio economic viability, (2) Quality of infrastructure, (3) Cost recovery, (4) Maintenance and management of infrastructure (5) Standards and planning of infrastructure and (6) Community participation. The evaluation brought out several issues like absence of community participation, cost recovery for maintenance of infrastructure was not effective and space standards are not related to the affordability of the people and higher income group occupied many households etc. and no management for maintenance of infrastructure.

More than a quarter of a century ago, the Planning Commission Govt. of India evaluated shelter for the urban poor and slum improvement concluded that the bulk of public investments went to formal housing and even the cheapest housing was beyond the means of economically weaker section of community. As the bulk of housing for the poor is built by themselves or supplied by the private sectors, the task force suggested budgetary allocation for serviced sites to the poor. (Govt. of India, 1983)

Indian Parliament approved a National Housing Policy for India in August 1994. It consisted of 14 main elements and focused on - reduce homelessness, provide large supply of developed land and finance to different income groups, promote use of appropriate building materials and cost effective technologies, assist in the upgradation of all unserviceable houses and provide the minimum level of basic services and amenities (Govt. of India, 1995). However very little was done and the Govt. Housing Departments built conventional housing with small percentage on low income group and financial institutions started giving loans to middle and high income groups only.

Affordable housing has become a myth and the booming real estate market is using the word ‘affordable’ for sale of expensive apartments in a high density development.

John F.C. Turner propagator of ‘freedom to build’ and housing by people advocates three principles (a) the principle of self government in housing (b) the principle of appropriate technologies for housing and (c) the principle of planning for housing through limits (Turner, 1977).

Reality Case Studies, Kolkata

Calcutta Metropolitan Planning Organisation with the help of the Ford Foundation initiated the bustee (Slum) improvement programme in the middle of 1960’s at the same time Jakarta, Indonesia adopted Kampong (Slum) improvement programme. Actual implementation in Calcutta (now Kolkata) started in 1970’s by the Calcutta Metropolitan Development Authority (CMDA, now KMDA) with the help of the World Bank assistance. The programme was for the improvement of infrastructure - water tap, toilet blocks, sewerage and drainage, street pavement, lighting etc. without changing the slum structures or huts (Fig. 1). The upgrading programme was adopted in other cities and slum dwellers accepted this (Ghosh, 1996).

The scheme was extended to numerous refugees colonies but limited to the Govt. settled land. A complimentary Small Scale Entrepreneur programme (SSEP) was introduced (1988 – 1991) to extend credit facilities to multitude of informal sector activities pursued by slum dwellers. Thika Tenancy Act 1949 was replaced by the State Government with new legislation Calcutta Thika Tenancy (Acquisition and Regulation) Act 1981 and by this slum land was vested with the Government. The change of ownership from private to public created new initiative.

A concept of slum modernization was introduced where slum dwellers were proposed to be rehoused in the same area on vacant land in four storey walkup apartments thus releasing surplus land for building high and middle income group housing and selling it at higher price in order to make the project self financing with cross subsidy. A project in Chetla, South Calcutta was taken up but the slum dwellers refused to move and political problems developed. A small housing estate with small dwellings was built in Salt Lake township in Calcutta to rehabilitate the evicted fishermen but all of them refused to occupy. The project was abandoned and finally sold to higher income group and renamed ‘Sukanta Nagar’(Fig. 1 & 2).

Figure 1 & 2: Sukanta Nagar – original dwelling units near Salt Lake Township, Kolkata.

However there is a success story. Ram Krishna Mission, a charitable organization of international repute, known for dedication and organizational ability, took up redevelopment of Rambagan slum in North Kolkata, within a congested locality. The slum dwellers themselves and some donor agencies provided fund for 4 storey walk up apartments (Fig. 3 & 4).

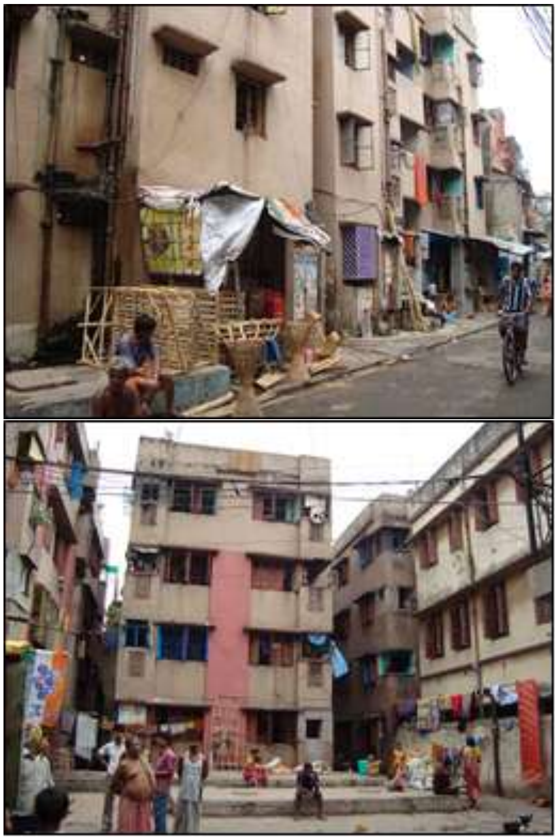

Figure 3& 4: Rambagan Slum redevelopment – self help housing.

Kolkata Metropolitan Development Authority initiated some sites and services projects with the assistance of the World Bank. The largest was Baishnabghata – Patuli in East Calcutta for about 40,000 people and it did not reach the target group as many suppressed their income. There were inordinate delays in delivery of plots. Core house plots, sold to lower and middle income group, were demolished and rebuilt new. (Roy, 1996).

A comprehensive approach for slum settlements was taken in the form of Calcutta Slum Improvement Programme (CSIP) with assistance from the Department for International Development (DFID) of UK. The project has four district components: (a) physical infrastructure (b) health care services (c) Community development and (d) training and evaluation. Economic support, literary campaign, women participation etc. were encouraged. Later, under DFID assistance, Kolkata Urban Services for Poor (KUSP) was initiated to cover all municipalities in Kolkata metropolitan area.

State Planning Board, West Bengal, identified essential preconditions such as access to land, building materials, finance and civic services supply of building materials, utilization of local labour, formation of cooperatives with tenure and involvement are necessary (SPB, 1990). Here, in slum development and sites and services, Barefoot architect system can guide the poor how to build themselves.

In 1960s Calcutta Metropolitan Planning with the Ford Foundation suggested work cum living centres for a solution to informal housing and employment. For quicker and cheaper construction a precast concrete construction system was developed but bureaucratic problems overshadowed the concept. Small plots of land with core toilet blocks was suggested for self help housing scheme but it was never implemented.

Recent endeavours by the State and the Central Government has included integrated informal housing development schemes in the form of Basic Services for Urban Poor (BSUP) project under Jawaharlal Nehru National Urban Renewal Mission (JNNURM). These projects have aimed at providing housing at affordable costs directly to the beneficiaries with the Urban Local Bodies as monitoring agencies. These projects had a social and livelihood development component and specific slums were earmarked by the Urban Local Bodies. The target for this project was to make the city slum free. Beneficiaries were given funding and they were also involved in the construction of their own houses with their desired alterations and modifications on their own lands. Introduction of Social Audit in these projects by the Government has also been a first step to ensure delivery and implementation of social services. It remains to be seen how these projects fare eventually over a period of time amidst bureaucratic interventions and market thrusts.

A CRITICAL REVIEW

Slum or Bustee Improvement Programme was carried out successfully by the State Government agency, Calcutta (Kolkata) Metropolitan Development Authority and other associated agencies in various municipalities in Kolkata Metropolitan Area and later when the administrative management was handed over to the municipalities or urban local bodies, there was reluctance in maintenance of the infrastructure provided.

The State Government enacted legislation where slum land was vested with the Government. In case of colonies set up by the refugees who came to Kolkata after the partition of India, the settlers were given ownership and even temporary structures with the help of real estate developers are being changed into apartments. In the slum area in the name of sustainable development with lease of land the real estate promoters are building high rise apartments after giving cash money to slum dwellers. These are often illegally built with poor construction but these are at prime land in inner-city. This is encouraged by a 5 years short term action plan (2004-05 – 2008-09) which under slum development plan for slum (KMDA, 2005) suggested physical development of slum by building houses together with infrastructure and loan from financial institutions. In all these programmes, homeless people or pavement dwellers are excluded.

One UN Habitat Report on slums says that adequate housing is a middle class concept based on space per person, permanent structure, and housing in compliance with local standards. The focus should have been on eradication of poverty and municipal services (UN Habitat, 2003).

At one time the slum clearance projects failed due to eviction and rehabilitation problems and now with money offered by the developers many slum dwellers are leaving. The pattern of employment has also changed. The cost of apartment during the last 30 years has increased by 50 to 100 times depending on the location. The land is scarce, obviously the urban poor is used as pawn in the real estate money market. Slowly housing development in Kolkata and other cities is shifting towards the rural fringe or periphery.

CONCLUSION

To the urban poor sustainability is survival with basic services. Employment has higher priority with credit facilities and food subsidy. Ownership with conventional housing comes much later. Realistic policies are still absent. A broader perspective of sustainable and inclusive development is long overdue. Architects and Urban Planners need to take an increasingly important role in guiding the government towards realizing sustainable informal housing. Integrated community development is the future where open architecture can be realised with community participation leading to diversity of ideas and implementation processes. A multidisciplinary approach on behalf of the architects and urban planners can mitigate this gap between rigid functionality and actual requirements of the end users. It can be viewed not just a powerful tool but a necessary one in creating success stories for housing the urban poor. Sustainability lies in the successful functioning of this fourth dimension of Informal settlements.

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Shared Processes in the Production of Space

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ABSTRACT
The article aims to share experiences due to the research project DIALOGUES, which has the major goal of setting strategies for communicative, reciprocal and desired dialogue among architects and dwellers. The research aims to (1) deconstruct hierarchies between scientific or encoded knowledge, proper of the academy, and the practical knowledge of the residents, inserted into their daily lives; (2) share information relevant to housing among all in order to support better decision-making processes; (3) preserve trial, opinion and experience of residents, ensuring the prevalence of their own decisions; (4) promote the exercise of communicative skills of those involved and the autonomy in decision-making processes. We present the community Irmã Dorothy as our exercise of Dialogues; an area of approximately 10,000 m2, located in Belo Horizonte, with 75 families earning up to three minimum wages (89,4% of the Brazilian housing deficit is represent by families with incomes up to 3 minimum wages - around US$ 980,00/month).

KEYWORDS
Urban occupations, housing, mediation of information.

INTRODUCTION
DIALOGUES is a research project, which understands housing as a process of living and not as product. The article begins by the theoretical debate about 'right to housing' in Brazil, referring to the historical conditions faced by the poor people to access adequate housing and urban services. Briefly, the paper discusses the main instruments established by the Federal Constitution and the Estatuto da Cidade (City Statute). Then we explicit the universe of Brazilian irregular occupations of land for housing and the popular struggles for answering their demands; we take the city of Belo Horizonte, Brazil, as an example. Following, we place the housing productive processes within the universe of users who individually take their decisions on these processes. And from there, the patterns of mediation as a social practice, meaning real advances to society.

RIGHT TO HOUSING IN BRAZIL
Until the early 1980's, the centralized making-decisions processes at the federal level characterized the public policies promoted by the Brazilian government, whereas the states and municipalities were executors of such policies. The reform of the State was driven by the country's democratization process, consolidated in the 1988 Constitution.

The right to housing is explicitly incorporated there through the Constitutional Amendment 26, Article 6, 2000. It stipulates that education, health, labor, housing, leisure, safety, welfare, protection of motherhood and childhood, and assistance to the destitute are social rights. Social rights are associated with a set of economic, social and cultural conditions, which are taken as an assumption of fundamental rights. So there is no doubt that the basis of housing rights is constitutional (Canuto 2010, p.171).

It doesn't mean that the state or municipality is required to provide housing for every citizen. The Government should institute guidelines for city development that include housing, sanitation and urban transport. The legal means to protect the possession and ownership of housing should be available to anyone, as it should be prohibited to prevent anyone from conquering his/her house. Furthermore the rights and guarantees expressed in the Constitution don't exclude principles aroused from international covenants internalized by Brazil.

The Universal Declaration of Human Rights (UNITED NATIONS 1948)
Article 25 (1) Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

International Covenant on Economic, Social and Cultural Rights (OHCHR/UN 1966)
Article 11 (1) The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions. The States Parties will take appropriate steps to ensure the realization of this right, recognizing to this effect the essential importance of international co-operation based on free consent.

Vancouver Declaration on Human Settlements (UNHABITAT 1976)
The needs for shelter, infrastructure and services are nearly always greater than the capacity of public authorities to provide them. That is why, throughout the world but especially in the developing countries, people have traditionally provided housing and rudimentary services for themselves and will continue to do so in the future.

Istanbul Declaration on Human Settlements (UNHABITAT 1999)

We reaffirm our commitment to the full and progressive realization of the right to adequate housing as provided for in international instruments. To that end, we shall seek the active participation of our public, private and non-governmental partners at all levels to ensure legal security of tenure, protection from discrimination and equal access to affordable, adequate housing for all persons and their families.

Global Report on Human Settlements, New York (UNITED NATIONS 2001)
The challenge is to develop enabling strategies that are not narrowly restricted to the economic functioning of markets, but that also include support for the exercise of citizenship – of 'the rights to the city', including the realization of housing rights.

In order to meet the specified above, but essentially to combat social inequality and to make urban spaces more human, expanding the population's access to housing, sanitation and transport, the Ministério das Cidades was created in 2003 by the Brazilian Federal Government. Through the Caixa Econômica Federal, the financial resources' operator, the Ministry shall work in coordination and partnership with states and municipalities but also with social movements, NGOs, private sector and other segments of society.

At the same time, legal instruments were created in order to guarantee that the international treaties and the fundamental rights would be extended to all Brazilian citizens. One of the main instruments so far is the Estatuto da Cidade, which reflects the intention of promoting the development of economic activities allied with quality of life and social justice, emphasizing the right to housing. It is a legal instrument, which aims to enforce and regulate the implementation of urban public policies.

Another important debate is the one about the National Policy for Prevention and Mediation of Urban Land Conflicts, promoted by the Conselho das Cidades (Cities Council). Such policy is based in two assumptions. First, the human right to adequate housing is fundamental component for fulfilling the social function of urban property and of the city. Second, urban land conflicts are characterized by the collective dispute in the possession or ownership of urban property. Thus, involves low-income families who demand the protection of the State in ensuring their human right to housing and to the city.

However, the gap between what is regulated by the treaties and policies and what is really applied indicates the complexity of the issue, which has much more to do with the imposition of economic interests than the legal parameters. The mere existence of agreements and laws has proved insufficient in a negotiation process among housing associations, social movements, landowners and public agencies, primarily with regard to urban land access. Prejudice and discrimination against the poor and their way of living, along with the annihilation of their interests, hide the reasons for the failure of urban policies. Political and social mobilization, still not present in the Brazilian public institutions and society, seems to be urgent if the execution of egalitarian urban policies is desired.

HOUSING CONTEXT IN BELO HORIZONTE, BRAZIL

> "The right to adequate housing should not be interpreted narrowly. Rather, it should be seen as the right to live somewhere in security, peace and dignity" (UNHABITAT 2009).

Belo Horizonte has been seen as a 'good' example of a huge typical Brazilian city from the mid-twenty century, even with the diversity of its problems and challenges (Caldas, Mendonça & Carmo, 2008). Following the urban principles from the new republican order and functioning as the political and administrative center of the State of Minas Gerais, the new capital named Belo Horizonte was inaugurated in 1897. Throughout its history, Belo Horizonte has not changed its exclusionary urban production logic. On the contrary, the city has established a prevalence of central-peripheral pattern, with a clear predominance of elites in the central areas and of growing low income population in the peryphery. The Construction Commission didn't provide in their original plans, area for the working population, which was "distributed" in the suburban zone and agricultural villages with any urban services and social equipments, starting a historical process of socio-territorial segregation. Beyond that, the solution to the housing deficit given by the public power in Belo Horizonte still favors the construction of buildings in the peryphery.

Since its inauguration, Belo Horizonte's production has been specialized in services and commerce, along the mechanical-mineral-metal tripod of activities based on exportation. A third sector is also presented, but because of the underdeveloped urbanization process of the city, it absorbs an expressive low qualified and/or informal activities aligned with low payment and aggregated value.

The high cost of the land has raised development barriers for certain sectors, specially the industry and the social housing. Due to the above, it can be easily recognized the high concentration of commerce and services activities from the center of the city (able to generate capital and to concentrate people) to its periphery, through the major avenues towards neighborhoods characterized by precarious social, physical and economic conditions.

MEDIATION OF INFORMATION: WHAT IS THIS?
The capitalist mode of producing urban space is associated with the real state market and supported by the legislation on the use and occupation of land. On the one hand, the privilege embodied by formal urban structures and, on the other, the poverty

manifested in informal settlements (the autoconstruction).
Formal production shelters the scientific knowledge, legitimated by the academy, while autoconstruction is structured by the practical knowledge, experimented along time by the residents/builders. Usually accompanied by illegality or informality, the autoconstruction represents 77% of the Brazilian housing production (Abramat 2005). Due to all these, creative and dynamic approaches seem to be necessary if academy, essentially the architectural field, aims to face the historically built distance between architects and poor people.

The mediation of information process intends to be a possibility to include students and professors into the social housing reality through a consistent and critical action towards the housing processes. It consists in the establishment of a social place in which residents can associate their practical and experimental knowledge to the technical one, which comes from architectural students and professors. In this sense, mediation of information is a process structured for families with incomes up to 3 minimum wages who demonstrate desire and commitment to its essential premise: work together. On the horizon of the proposal is the real and unrestricted possibility for residents to autonomously decide about their houses.

The mediation of information embraces:

- An encounter place where people together search information and knowledge;
- A communicative, reciprocal and desired process;
- The deconstruction of the existent hierarchies between the codified or scientific knowledge from the academy and the practical knowledge from the residents, inserted into their daily lives;
- Transference and communication of information about the housing universe (production and use), which will feed a better making-decision process;
- The preservation of judgment, opinion and experience from the residents, regarding their prevalence on their own decision;
- The understanding of housing as a process and not a product;
- The promotion of the communicative capacity and of the autonomy of all the involved.

As a form to enable the dialog, mediation of information also demands the use of non-traditional methodologies and languages, which have nothing to do with the platform of technical information (the architectural drawings - plans, sections, facades). The search for informational means that can be understood by all involved is an important part of the process.

IRMÃ DOROTHY COMMUNITY

Since June 2010, we have been working with the families from Irmã Dorothy Community, an urban occupation located in the sectional Barreiro, Belo Horizonte.

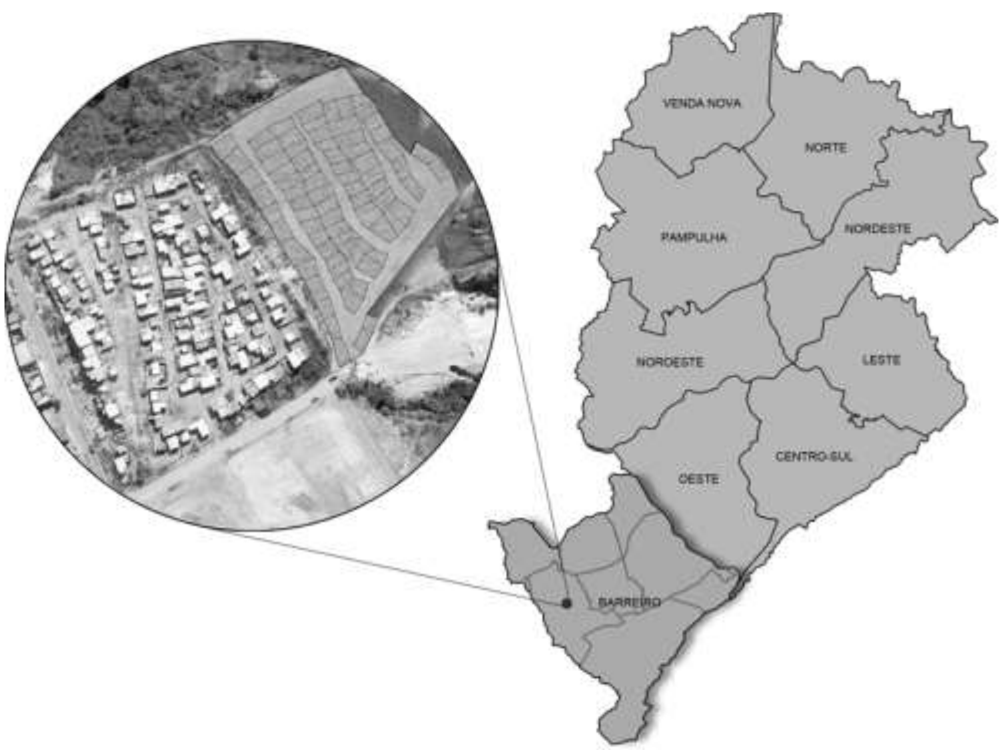

Figure 1: Irmã Dorothy Community located in the sectional Barreiro

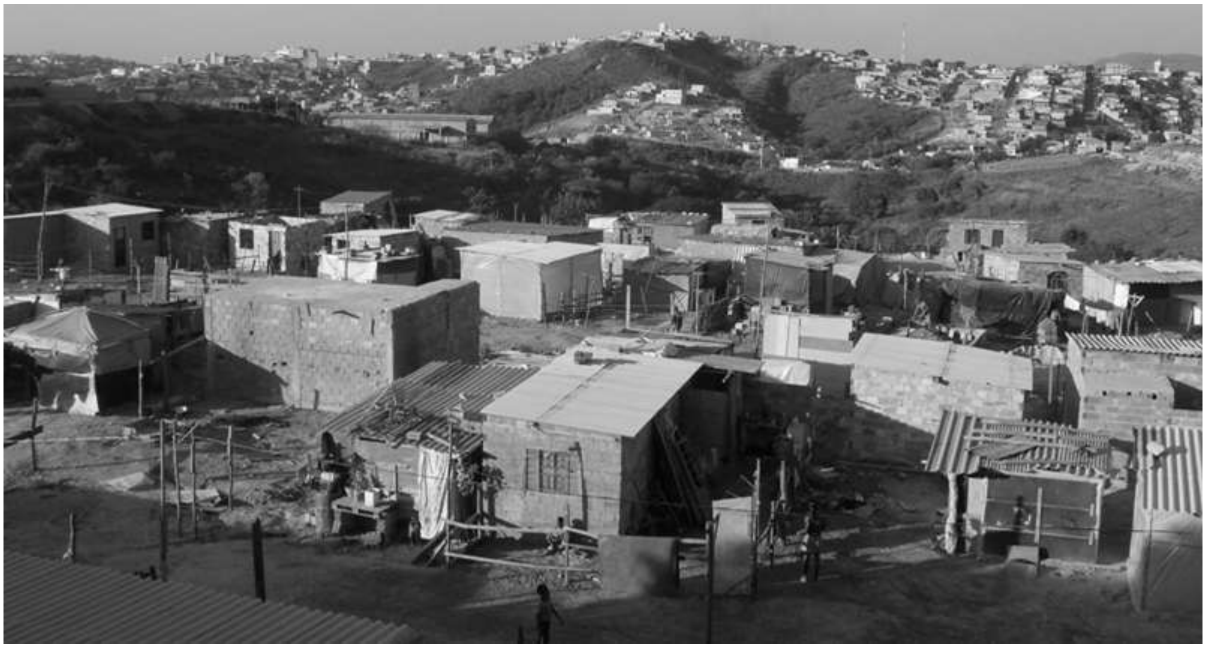
Figure 2: Irmã Dorothy Community View

It is a plot of about 10 thousands square meters in which are living, since March 2010, approximately 75 families with incomes up to three Brazilian minimum wages. The plot is part of an area composed of three different urban occupations: Camilo Torres, Irmã Dorothy 1 and Irmã Dorothy 2 (which happens to be an expansion of the first one).

The occupation plot belonged to the public power, Companhia de Desenvolvimento de Minas Gerais (Development Company of Minas Gerais), who donated the land to a private company in order to create an industrial plant along twenty months. This company, however, did not fulfill the agreement and, five months later, it ilegally sold the land to another private developer. Even with the successive transfers to private companies, the property was abandoned as a solid waste disposal area for more than ten years.

In 2010, aware of the conflict, families have occupied the land and named the area Irmã Dorothy (a tribute to the murdered Sister Dorothy). The families occupied the area along three parallel streets, which received the 60 square meters standardized lots. The residents themselves inaccurately defined the limits in order to fast expedite the construction phase. The lots' occupation did not follow a pattern: some have occupied a large part of the lot, while others have chosen to build just a small room. The left spaces, either in the front or in the back of the lot, are used as a yard to raise chickens, to cultivate vegetables or to dry clothes.

After the occupation, the supposed landowner registered a housing project to be financed by Caixa Econômica Federal. Since then, not only Irmã Dorothy 1 and 2 but also Camilo Torres have been facing forced eviction threats; the Warrant of Possession Reintegration has already been consigned. The communities, along with Brazilian Prosecutors, are pressuring the municipality and the State of Minas Gerais, to urgently take measures to protect them, reverting those areas into public property and suspending the warrant. Despite the National Policy for Prevention and Mediation of Urban Land Conflicts, the 1988 Constitution and the Estatuto da Cidade, along the international treaties, which all establish and guarantee the right to adequate housing and the social function of property, the warrant is still valid.

The mediation of information process

At the first meeting, we introduced ourselves as potential partners who would work closely together in order to minimize their housing problems. However, we also warned them that we were not able to make any financial contribution and, furthermore, we would not play the role of the State or even the role of "saviors", as someone who knows everything and solves all the problems. Our clear and stated intention was to set a social 'place' in which we would be able to share experiences and information about building/renovation their homes, and the urban area as a whole. The process, named Dialogues, would be essentially based on the mutual commitment to the process - the formation of a third knowledge that would be resulted from both the practical knowledge (the residents) and the technical knowledge (the academy).

Undeniably we all agreed that our partnership should improve the political image of the occupation in opposition to the mistaken understanding of what is an urban occupation, generally seen as a place invaded by squatters and unemployed people. Perhaps, the Dialogues' researchers presence shall help the residents in the legal process regarding the housing rights.

The most majority of the residents were enthusiastic and willing to participate. The common issue to be worked by all was stated: "we need to clean the houses", meaning that the sewage and drainage systems were common priorities. A resident gave a powerful and emotional speech, claiming everybody to work together since it was a serious matter concerning everyone’s health: “my grandson had almost lost his foot due to an infection caused by the inappropriate destination of sewage and garbage.” Moreover, a ‘clean’ occupation could be a positive factor through the eyes of the neighborhood and the public power.

The next step was to investigate how we could together answer this demand, trying to access the legal sewage system of the city. A non-conventional sewage system was also suggested, but later discarded because of its high costs of implementation and maintenance. The residents collectively decided by the construction of condominium sewage system, which was easier and cheaper to implement. We developed models and manuals to show to the residents how it should be executed. The residents participated during all the collective meetings, especially the construction workers who questioned about the pipes dimensions or suggested cheaper ways to execute the connections.

The process described above shows how the sewage system was collectively conceived and built. However, despite the transparent and collective process, some questions were driven: why the dwellers were not massively present in the execution day of the first sewage fragment? Why the building materials were not available at that moment? Why the collective decisions were not respected during the construction of the next sewage fragment?

FIRST DEBATE

Let's try to answer the previous questions using a statement from a leader: "they are not yet a community; but if anyone says something bad about the community, they put themselves together to fight against her/him”.

When criticism and disapproval, which may come from the neighborhood and the authorities as external pressure (for example, a possibility of expulsion from their territory), are present, the residents get together. The people living in Irmã Dorothy have no previous social bond, except for two or three families; but if a threat of expulsion is suddenly faced, the sense of community emerges in defense of the land. The sense of community is continuously confronted by the real condition of urban and social exclusion.

Other examples have shown us that when a specific problem is solved, the group ceases to work as a community, at least for some time, and keeps waiting for a sequential fact, which would provoke the community reconfiguration again. For each new circumstance, it might happen a new mobilization process and a new configuration of the group.

Not only problems catalyze the reconfiguration process. The festivals and rituals also play this role. One resident told us, for example, that at a particular moment, a priest was called for a celebration with the clear intention of “bringing people together.” Another example occurred at the end of 2010, when a group of residents decided to create and to feed a pig - named by them as "Christmas" - to ensure a good and an abundant party in the end of the year.

The urban occupants are not a priori communities; actually, the mobilization process constantly changes. In the case of parties or rituals, the families come together because of their social identification. On the contrary, when some kind of urgent problem is faced, the mobilization process occurs within a political arena. Thus, the communities are autonomously formed and consolidated sometimes as a reactive game, sometimes as a collective game. This continuous, but non-linear process could be the basis for the gradual establishment of a "sense of belonging" among the residents.

Given this, we can affirm that the contribution of our work for the residents can be seen beyond a simple technical information sharing. We dare to say that the sewage problem and the search for a solution also worked as a catalyst factor, perhaps contributing to the future social and political mobilizations around other issues, with involvement of more residents.

In a posterior mediation round, for the execution of another sewage fragment, we noticed that the technical information has been used and contributed to the formation of a shared knowledge. The collective decisions initially were not respected but, later on, we testified that the sewage system is being built at the end based on shared information. Besides, most of the residents declared they have been somehow transformed after the mediation process: “two minds think better than only one”. The same occurred to the researchers.

SECOND DEBATE

Until the eighteenth century, the "design" (from the Italian disegno) was the only instrument to involve the three dimensions of ideazione (= previous intellectual exercise), the graphic representation (= the reasoning embodied in the paper) and intention (the viability of any purpose, not only the architectural one). Design was the mediator between the knowledge of reality and the action upon reality, meaning the reflection on the performance of the whole (Bueno 2000).

The word design (as "project") started to assume the role of planning work, from the moment that the codes and conventions in its construction were adopted. Thus, from the emergence of the project, the architectural profession institutionalization, the formalization of architectural education and the distance between the studio (art) and the work site (technical) were crystallized. We have, then, from the eighteenth century, the design to conceive (think the planning) and the project to demonstrate (represent the planning).

Such architectural 'logic' cannot be applied to an urban occupation since the identification of a problem and the implementation of a solution occur at the same time. This means that any attempt at planning is discarded since another factors, and not the project, define the production processes, which are: (1) social mobilization capacity around a particular issue, (2) financial and physical ability of those involved.

The logic of planning, which means how the architecture field has been historically working, doesn't structure the practice of the architects who are interested in working together with low-income families. Due to this, the researchers in the Irmã Dorothy have been worked on the application of non-traditional methodologies to promote efficient, meaningful and shared processes – manuals, booklets, models and collective discussions.

THIRD DEBATE

Paulo Freire (2007) draws attention to a possible construction of an ideal transformation of the oppressed, which is associated to the role of his/her oppressor. Freire characterizes this condition as the "immersion" of all in a specific reality, which would adhere the oppressed to the values of his/her oppressor.

A sentence of one resident illustrates such adherence: "most of all, I wanted to win the lottery and be out of here." We can even infer that adherence previously takes place when we realize the spatial configuration of the area: private plots with well-defined limits without open spaces, reinforcing the formal logic that excludes and oppresses the urban poor. When we proposed the construction of common bathrooms and laundry facilities, which would minimize the sewage situation at lower cost and greater speed, the residents showed no interest.

In this sense, we believe that the role of the political leaders throughout the community mobilization process is very important. In Irmã Dorothy there are strong and representative leaders, all women hardly working in favor of the community. However, a much more organized and coordinated leadership should be able to aggregate residents in order to politically mature them, giving them the opportunity to discard ambiguous references of ascension (the adherence of Freire), intensively based on the cruel and perverse capitalism logic.

Within this context, the way we introduce ourselves to an urban occupation's residents can also define the nature of a partnership. Paradoxically, the greatest capitalist statement "supply creates demand" can guide an effective partnership. Our research group – Praxis – has been contributing, through the mediation of information practice, to the deconstruction of a discourse adhered to the already known oppressive values but not necessarily the best options to be used in a singular reality. To build and to renovate houses can be set as actions and interactions' places of discussion, exchange, sharing and dialogue.

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Informal but Planned Settlements:
A Case in Guayaquil

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ABSTRACT
Urbanization has been very strong since the middle of the 1900s and from 2007, 50% of the population in the world has become urban. Today almost one third of this urban population, around 1 billion, is living in areas classified as slums with substandard housing and a lack of land rights. In some cases more than 50% of the growth of cities in developing countries has been implemented by the informal sector. The development process of those settlements seems to follow an irrational pattern making legalization and consolidation very expensive and a process that can take several decades, when compared with the logical process of planning settlements in the formal city.

This study deals with an informal settlement in Guayaquil, Ecuador and the main objective is to understand the logic and virtues behind informal but planned settlements and to extract lessons from them to achieve a more harmonic urban legalization for governments and societies in developing countries.

The case studied shows an informal settlement which is the result of an organized and collective management, planned in advance and accomplished in a manner of precision and discipline. Observations, deep interviews with municipality town planners, land dealers and community leaders and questionnaire surveys with residents show that in only 4 years, 1,500 families classified as poor or very poor, established their neighbourhood, behind the back of the authorities and outside the urban border.

KEYWORDS:
Informal settlements, community organization, land use planning, land dealers, Guayaquil

INTRODUCTION

> Cities contain both order and chaos. In them reside beauty and ugliness, virtue and vices....
> Cities are the materialization of humanity's noble ideas, ambitions and aspiration but when not planned or governed properly, can be the repository of society's ills. (UN-Habitat, State of the world's cities 2008-2009)

Urbanization has been very strong since the middle of the 1900s, and in 2007, 50% of the population in the world has become urban. Today almost one third of this urban population, around 1 billion, are living in areas classified as slums with substandard housing and lack of land rights. In some cases more than 50% of the growth of cities in developing countries has been implemented by the informal sector. The development process of those settlements seems to follow an irrational pattern making legalization and consolidation very expensive and a process that can take several decades when compared with the logical process of planning settlements in the formal city.

There is a wide knowledge among urban professional planners, architects and technicians working in the production of sustainable and effective modern cities, in optimizing the urban soil, and in making social cohesion possible and creating harmonious formal cities. But there is limited knowledge about and a lack of understanding of the informal cities, the cities built by the efforts of the citizens themselves outside the law – these cities that are often seen only as chaos.

According to the UN Millennium Development Goals, MDGs (UNDP 2005) the UN has set the goal to significantly improve the quality of life of the world's poor by 2020. Both the United Nations Development Programme (UNDP) and the housing and settlements agency UN-HABITAT, as well as many government agencies in developing countries, are focusing on incremental improvements, legalization and integration of informal settlements into the formal sector (UN-HABITAT 2003). This transformation, however, is going very slowly.

Today, in some cases more than 50% of the growth of cities in developing countries has been implemented by the informal sector. The development process of those cities seems to follow an irrational pattern of consolidation of the precarious human settlements; a process that can cost from 5 to 10 times more, and can run for several decades, when compared with the logical process of formal planning for new neighbourhoods. Informal settlements tend to be low-rise contributing to the urban sprawl, leading to inefficient land use which, in turn, leads to higher transportation costs and more extensive and costly infrastructure (Jenkins et al. 2007).

There is a need to understand the logic and virtues behind slum formation and everyday life when carrying out public interventions. Professionals working in city planning need to develop tools to bridge the gap between formal and informal cities. Today violent urban conflicts for land appropriation are well known both when informal occupation occurs, and when legalization processes are initiated. Often dwellers are trampled between the personal interests of politicians in charge and informal land developers, making the life of poor families very insecure.

GUAYAQUIL

The urban development of the city of Guayaquil, Ecuador runs parallel to the history of the informal settlements. Guayaquil, the largest city in Ecuador, has a population of 2,5 million, 60% of them live in slums. 70 % of the population started to settle in informal areas that have become neighbourhoods; some of the dwellers have suffered a long process of neighbourhood consolidation, a process that in some cases has taken more than 20 years (INEC 2005).

More important than the lack of opportunities in rural areas near Guayaquil, is the weakness of the authorities, the lack of national housing programmes to allocate land to the new urban families and especially the strong commitment of the "informal housing promoters" or illegal land dealers. The fact that land ownership is often unclear in informal settlements has been one of the major problems for the dwellers (Werlin 1999, UN-habitat 2003).

Illegal land occupation started in Guayaquil during the 1960s in the suburbs to the south. A large area of mangrove swamp south of the city started to be filled up after the construction of the bridge that connects Guayaquil city with the island of Trinitaria. During the 1980s illegal occupation of this land occurred, prolonging the extension of the city to the south. Agricultural production farms like Hacienda Guasmo or nationally protected areas became urban areas. These neighbourhoods toward the south are the result of illegal land occupation without the consent of the owner, and by more or less organized groups of low-income families. This form of self-provided homes is known in Guayaquil as invasion (the term in Spanish is invasión). Today these suburbs are formalized or in the process of formalization. During the 1990s, with the construction of two municipal roads in the north, the illegal land occupation phenomena continued in this area using experience gained from the previous occupation in the south. Their experience was that land is an efficient political tool and also very profitable merchandise. Some of the illegal land dealers who started their activities in the south, moved to the north, to settle new families. This time it was not invaded land but land purchased by private owners; to be divided in lots and informally sold to future dwellers. This organized way of management of a neighbourhood is usually categorized as invasion, since there is an owner or a group of owners with legal titles that agree to informally manage the land and the neighbourhood.

Today, the suburbs of the south represent almost a million dwellers and the suburbs in the north are more than half a million in a city of 2.5 million. 60% of land occupation is informal (Huertas 2011). Informal settlement development is a well organised and collective effort that is planned in advance and accomplished in a manner of precision and discipline (C. Bengs 2009).

METHODOLOGY

The research includes several informal neighbourhoods in Guayaquil. Three study areas were selected: Nigeria (about 6,000 families), Monte Sinai (about15,000 families) and Sergio Toral phases I, II and III (about 10,000 families). To triangulate data, data was collected from three main sources: the formal sector at the municipality town planning office, top leaders from the informal sector at the neighbourhood, and the dwellers. During the period of October - November 2010, twenty one in-depth interviews were done in the informal sector including interviews with land dealers, top leaders of the organization and dwellers. A total of 50 questionnaire surveys focusing on both quantitative and qualitative issues were also answered by the dwellers of the three informal neighbourhoods. From the formal sector, seven in-depth interviews were done with professionals working in the town planning office of the municipality of Guayaquil.

Both the in-depth interviews and the questionnaire surveys were based on the same content, since the questions were specifically formulated for the focus group and/or the person. Some of the in-depth interviews took more than an hour, sometimes two or more and were adapted to the person and the situation. The content of this data collection is always related to informal housing and informal neighbourhood situations and includes items such as: the background and history of the occupation, relation and comparison with formal neighbourhoods, land issues in legal terms, urban planning and patterns of land occupation, rules in the neighbourhood, local culture and patrimony services, house quality and the environment.

Considering the virtues of the informal and illegal settlements, this paper will focus on the organization of the pre-cooperative Sergio Toral, since it seemed to be the most organized at management level and in morphological structure. In terms of dwellers' satisfaction and neighbourhood security it shows the highest acceptance among the neighbourhoods studied.

THE CASE OF THE PRE-COOPERATIVE SERGIO TORAL

Sergio Toral is located at the northern part of the city. 'Pre-cooperative' is a local term which refers to a cooperative entity in the process of being formalized. The neighbourhood is partly developed outside the urban border. With previous experience in informal land management, the pre-cooperative Sergio Toral started development of their settlement.

The price for a plot of land 15x8 sqm without services at Sergio Toral is 1,000 USD, and the traditional bamboo house costs 1,000 USD. The formal low income housing programmes by the municipality of Guayaquil, 'Mucho Lote' and 'Mi Lote', today deliver plots of land of 12x6 sqm. at a minimum price of 2,000 USD and houses in concrete blocks cost at least 10,000 USD. The minimum monthly salary in the formal sector in Guayaquil is 220 USD and in Sergio Toral a rough calculation shows that a minimum monthly income of 150 USD is necessary.

As a result of the observations, in-depth interviews, and questionnaire surveys it has been possible to define the organization that has made it possible to develop a neighbourhood for 1,500 families classified as poor and/or very poor in only four years. The organization chart presented below is based on information from the interviews and surveys. This is an attempt to create a formalized organisation chart for an informal settlement. The chart indicates that active dwellers in this neighbourhood have developed leadership skills that could be used during the formalization, consolidation and management processes.

Organizational structure

The graphic below illustrates the results of the research so far. There is a diffuse border between what is "inside" the neighbourhood corresponding to the informal and what is "outside" the neighbourhood corresponding to the formal city. Some actors move easily over the border, some do not.

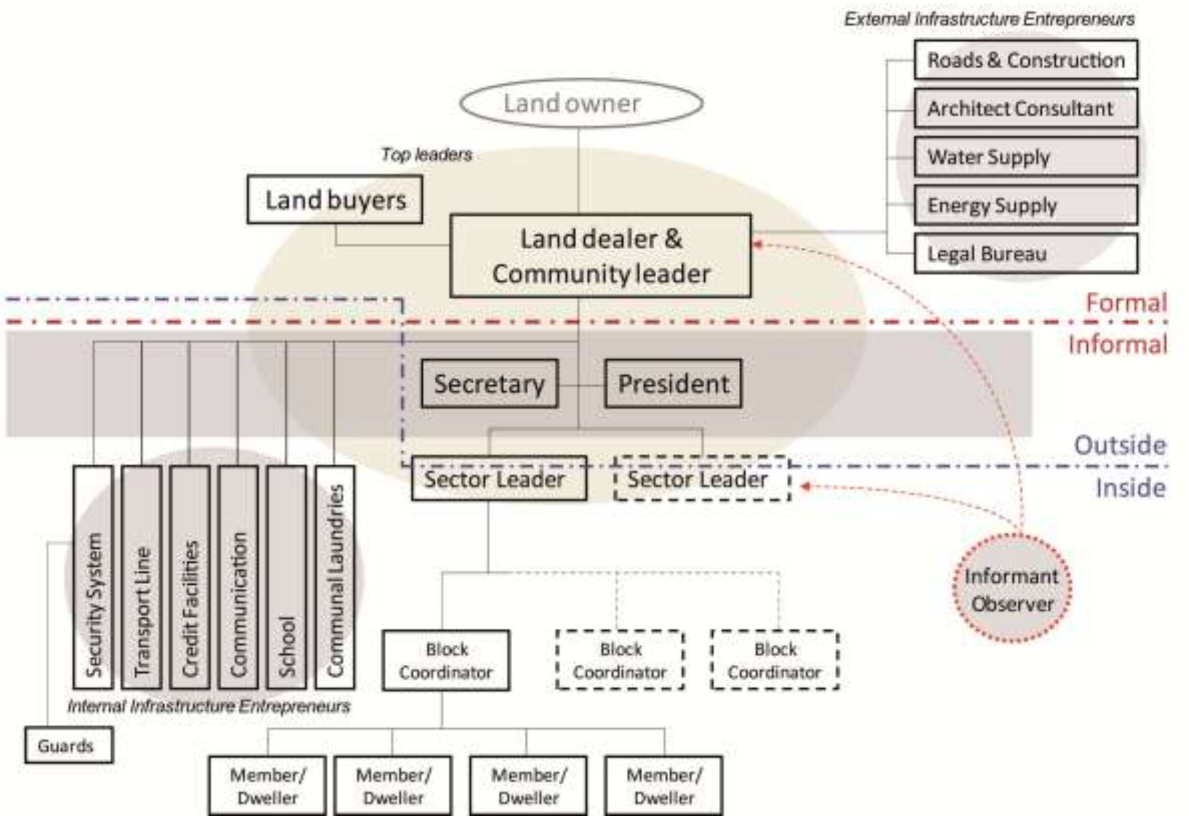

Figure 1: Organizational Chart

Member or dweller

Most of the families are poor, young urban families that have moved from the formal city looking for affordable land and homes of their own. Families become not only residents in the new neighbourhood, but also members of the pre-cooperative, sharing benefits such as credit possibilities for land, houses or household appliances. In some specific cases, weak families became beneficiaries obtaining land for free or at a low price. That is the case for widows, single mothers or handicapped people. The families are willing to work on the construction of their own houses, starting with the septic tank and participate in the community meetings and workshops to build the streets, green areas etc. Meetings include political mobilization when the top leaders of the pre-cooperative ask for it.

Block coordinator (Coordinador de manzana)

A block is composed of a double row of 13 lots, meaning more or less 26 families, and a block coordinator manages these families. Block coordinators are appointed by the sector leader and are accepted by the families. These coordinators are in dialogue with the families and inform the sector leaders. They become key persons for the community and for the leader, especially when the leader decides to cancel public meetings with the large community due to the increased amount of members. The block coordinators collect not only complaints but also suggestions, needs, and ideas of the members to improve the neighbourhood, which are submitted to the sector leaders, who in turn submit them to the top leaders. Block coordinators also collect money for lotteries or for families with health needs, house repair after tropical rains, or infrastructure work such as street repair, electricity connection in informal way, etc. The block coordinator lives on the block.

Top leaders

The top leaders include the sector leader, a secretary, a president, a community leader, a land dealer, and land buyers.

Sector leader (dirigentes)

A sector is composed of 10 blocks. A sector leader manages those blocks. The sector leader is appointed by the top leaders of the organization; however, community members cannot always identify them. These leaders have a dialogue with the block coordinators, and submit the information received from the block coordinators to the top leaders. They ensure that rules are followed (see section on rules) and are met by all. The sector leaders are present during the special fortnightly meetings with the top leaders. Some sector leaders have good businesses such as shops in the neighbourhood, although they rarely talk about it. They do not necessarily live in the neighbourhood.

Secretary

The secretary of the pre-cooperative fulfils several administrative and economic functions, first as secretary for the sector leader, second as a contact for the new possible clients for plots or new members of the pre-cooperative. The secretary also collects the weekly payment for the lots from the established families which still owe money for the land. Third, the secretary handles payments for specific services such as safety and security. The secretary is always present during fortnightly meetings and lives in the neighbourhood. The secretary is the one that introduces the new members into the pre-cooperative, and explains the rules. The secretary receives a salary for his work. The internal, informal transportation line is run by the secretary as his own business.

President

There is not much information about this role, since he was no longer part of the organization when the field study was carried out. He was living in the neighbourhood, and had a status similar to the secretary, being very close to the leader.

Land dealer and community leader (The same person in this case)

A land dealer is a person that, in an informal way, buys and sells land, usually to the poorest people in the city, through unofficial transactions, not recognized by the legislation of the country. The land dealer in the case studied was the initiator of the settlement. He made an economic investment of magnitude in the neighbourhood. He, together with the land buyers, is the legal owner of the land. In this case, he, as lawyer, had been dealing with housing eviction cases and illegal land tenure. As a previous informal developer in the south of the city and as a politician, he arrived with experience in management of informal settlements. He established the rules for living in the community, and even if there are public consultations and meetings with dwellers, he makes the decisions. He sets the agenda and leads the fortnightly meetings, where sector leaders, the secretary and specific entrepreneurs both formal and informal are invited, according to the agenda.

He has several levels of communication with the community, for instance through the sector leaders, but also through anonymous informants. He, as a leader of the community, organizes private meetings or dialogues with residents with social behaviour problems which can result in the person and their family having to leave the neighbourhood. Some dwellers referred to him as “our leader”, or as “after God, him”. He does not live in the neighbourhood.

The sector leaders and the community leader are the two entities that manage both systems, the “outside” system in the formal city and the “inside” system, the system developed by this informal pre-cooperative. They have access to experts and consultants that work in formal companies. The sector leaders and the community leader act in and belong to both the inside and outside systems.

Land buyers

The land buyers do not have any important role in the management of the pre-cooperative. Their importance is that they paid for the land, knowing that it would be subdivided and sold on the informal housing market.

Internal Infrastructure Entrepreneurs

The internal infrastructure includes a security system with guards and informants, an informal transportation line, communication points with telephones and Internet facilities, some stores and credit offices, communal laundries and schools. These are some of the places with local job opportunities for skilled or unskilled labour.

Security System, Guards and Informants

The security in the neighbourhood was very much appreciated by the dwellers. Several ways of maintaining the security at the neighbourhood level were implemented and paid for individually by each family (1 USD per week). There are security coordinators to manage the security. Groups of guards are placed at the main vehicular entrances, as check points controlling who or what goods come in or leave. There are uniformed guards per sector, with bicycles, portable radios and whistles 24 hours per day. Dwellers inform the coordinators in case of transporting their own belongings, to avoid property robbery. Parallel to this system, the leader has anonymous informants that watch and control the social behaviour of the dwellers. People do not talk very much about them, but they say that cases of the abuse of women and children have been brought to light and been solved.

Transportation Line
Since the neighbourhood is placed outside the city, and no means of formal urban transportation reaches these families, a private and informal bus line services the dwellers. There are also a few small motorized tricycle transports that only circulate within the informal settlement.

Credit facilities
The members of the pre-cooperative have several benefits related to credit. For members it is easy to buy a bamboo house at the NGO Hogar de Cristo, which delivers the most economical housing solution of Guayaquil (less than 1,000 USD) on credit. The only paper they need to provide is the informal land ownership document given by the pre-cooperative. Most of the families living in this neighbourhood do not apply for national housing support, since they work basically in the informal sector. In agreement with the sector leader and the community leader, members receive facilities to pay for the lot on credit (5 to 10 USD per week. They can also get a reduction of weekly payments by extending the time for payment in case of, for instance, unemployment or familiar difficulties, or in extreme cases reduction of the price or lots for free. Members receive credit facilities at the household appliance shops, to buy refrigerators, radios, TV, etc. The shops are owned by the community leader.

Communication
The neighbourhood has offices with telephones and Internet access, which are strategically placed and are also points for the collection of payments for security guards and credits.

Among the other facilities in the neighbourhood are an informal school and communal laundries. The laundries are provided for free, though the water supply was not functioning during the study. There are a few green areas for sports. All of these facilities are managed by the pre-cooperative and are appreciated by the dwellers.

External Infrastructure Entrepreneurs
The infrastructure also includes roads and construction enterprises, architectural consultants, water supply companies, an informal energy supply and a legal services bureau.

Roads and construction enterprise
The pre-cooperative hires road enterprises with heavy machines for the construction of the non-paved streets. Sometimes those who live in the neighbourhood learn to drive the machines and start to work in an informal way with the layout, filling and construction of roads. For the construction of the neighbourhood, it is common that the pre-cooperative buys second hand materials, such as electricity poles and public street lamps. Filling for the streets is usually taken from the open quarries on the site.

Architectural consultant
The land division and urban plan of the neighbourhood has been drawn by an architect who made a very simple and rational orthogonal urban pattern, using as much of the land as possible for housing.

Water and energy supply
Dwellers buy their water from water tanks, paying higher prices than formal residents. Few families pump their own water from underground sources. Dwellers buy and pay to install the electricity connection, coupled illegally to the municipality's electricity source. They do not pay for electricity consumption.

Legal Services Bureau
The cooperative, with the consent of the leader, delivers free legal assistance in land tenure and especially in family legislation. Women in the neighbourhood are proud of being well informed of family rights, in comparison to other similar neighbourhoods.

This organizational structure is governed by several written and non written rules, once again reflecting part of the logic and discipline required when managing an informal and illegal settlement. These rules are defined by the top leaders. Some of the written rules are well detailed such as the requirements to dwell on the site and to build a septic tank and a toilet within a maximum period of 60 days. Other examples of rules include: the plot should preferably be "registered" in the woman's name; payment for the lot and the guard security and the connection to electricity must be made on time; dwellers must be ready to collaborate in community activities and political demonstrations; dwellers must inform the leader of a robbery, drug dealing or child abuse; dwellers should plant a fruit tree on the lot and educate their own children.

What is not allowed in this cooperative are: robbery, drugs, rape, gangs, or men with ear rings; alcoholic beverages in public places, billiards or electronic games; scandals inside and outside the home; or pig breeding on the lot.

Possible reasons for expulsion from the cooperative are: robbery, drugs, rape or not dwelling on the lot. The expulsion could include relatives of the family living in the neighbourhood. The community can take an active role when evictions are carried out.

Members of the pre-cooperative expressed that they were satisfied with the existence of these rules, especially those to educate and protect children.

The interviews and questionnaire surveys show that there are also unwritten rules, most of them related to sexual, religious, or ethnic attitudes.

DISCUSSION

Human and financial resources have been invested for the formalization of human settlements in developing countries; however the results are far from being effective or causing significant impact on communities. Among the professionals in Guayaquil working in neighbourhood improvement and with citizens of slums, there is a common feeling of dissatisfaction when looking at the results of interventions. (Huertas 2011)

Focusing on the logic and virtues of a slum and not only on the vices may give architects and urban planners working in developing countries some answers to face the challenge of neighbourhood improvement intervention that can act as strong motors of change in societies.

In the neighbourhood studied, one key issue was identified: the organizational structure for management, including the regulation of behaviour and the rules of the pre-cooperative.

The organization of the community (see chart above) has encouraged their actors/participants to develop leadership skills. Some of them became committed community leaders that could be used during the formalization, legalization, consolidation and management processes for neighbourhoods. These skills are assets in the neighbourhood that, according to Moser´s theory, could contribute toward poverty reduction (Moser 2009).

The organization includes "inside" and "outside" actors/participants; land dealers, community leaders and communities that have developed their own fragile, internal management system; including sector leaders, community leaders, block leaders, security guards and informants. They also developed their own external management system to deal with the weak formal sector in the country, which includes professional consultancies, private enterprises and private investors. Together they have built a neighbourhood, classified as poor and/or very poor, and hosting families excluded from the housing programs supported by the government. Management mechanisms introduced by this type of informal settlement could improve land rights (Durand-Lasserve 2002, Payne 2002).

Regulation of behaviour with the rules of the pre-cooperative are common norms to be followed by every dweller. They are explicit and have strong impact on the quality of life and safety in the neighbourhood.

Certainly, there are many weaknesses in these issues regarding democracy, human rights and in breaking national laws. The unequal power relationship between the land dealer and dwellers deprives many people of their freedom to decide over their own lives, (Tannerfeldt 2006) which is a sign not only of a lack of democracy and inequality, but of poverty (Sida 2002).

CONCLUSIONS

The preliminary results of this study of three settlements in Guayaquil, Ecuador, especially the Pre-cooperative Sergio Toral, show that the informal sector has provided five times more "homes" or places to live than the formal sector; plots are larger than in the new formal housing projects delivered by the municipality; and the management system of weak basis payment facilities combined with credit to buy a bamboo house; has made it possible for poor families to afford to build a neighbourhood in very short time.

The credit system in the cooperative, a micro credit system based on the payment of small amounts relatively often also included a social component of flexibility and charity, recognizing the diversity of the users and being aware of the unstable informal economy. This has made housing affordable for the poor families in Guayaquil.

Safety and security, is very much appreciated by the dwellers, possibly because in contrast with the violence in rest of the city, formal or informal, rich or poor residential areas; is a result of the pre-cooperative organization and the behavioural rules for their members.

There is no restriction for current dwellers to move outside of the informal neighbourhood, to the other neighbourhoods in the city; however many members in the pre-cooperative who manage very well in the informal neighbourhood system, are not able to be citizens in the formal city. This includes an inability to use urban transportation, fill out documents in municipal offices or attend formal schools. This dual system becomes extremely complex for most of the families.

Note: The neighbourhood presented in this paper, the Pre-cooperative Sergio Toral, is today controlled by the military and in January 2011 was declared a security zone by the central government of Ecuador as a measure to combat the "trafficking of land". Many families have been removed from the neighbourhood and most of their homes and properties have been destroyed. Further studies in the area are intended to be made. However, the focus of further field studies and research will depend on the political situation and the development of the informal settlements in the north of Guayaquil.

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Sustainable Upgrading of Informal Settlements in Developing Countries: Brazil, Indonesia and Thailand

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ABSTRACT
Informal settlements have transformed the image of the city in the south. The inner-city has experienced the occupation of vacant land by the urban poor in an attempt to become part of the urban society. Slums modify the urban structure and create parallel societies where informality emerges in the absence of the state. Hence, slums are the response to the negligence of governments and lack of opportunities.

The slum problem is challenging the ability of governments to respond to urbanisation in the presence of an expanding low-income population calling for participative decision-making processes that include the urban poor in the policy agenda. Simultaneously, sustainable upgrading challenges institutional structures, since the success of these programmes relies on the development of integral policies to produce approaches to the slum problem which combine physical and social development with legitimation and governance, understanding the need for flexible networks and institutional innovation to support community-driven initiatives.

This research aims to understand the feasibility of achieving sustainable upgrading of informal settlements in developing countries exploring the causes, problems, consequences and potentials of informal settlements, which provide foundation for the analysis and comprehension of the similarities and main components of successful slum upgrading programmes implemented in Brazil, Indonesia and Thailand.

KEYWORDS:
Sustainable upgrading, community participation, social development, governance, informal settlements.

INTRODUCTION

The livelihood of the urban poor dwelling in informal settlements can be substantially improved by comprehensive upgrading programmes based on sustainable development and participation. Community-based initiatives have shown the multiple strengths of communal work, financial effectiveness of investments and the efficiency of results to meet the specific needs of slum dwellers, thus, ensuring the sustainability of improvements through sense of place and empowerment. However, self-help has limitations and setbacks related to improvement of public spaces, urban infrastructure and mobility, as these communities lack, in many cases, the technical, financial and legal resources for upgrading the built environment and connecting themselves to the city. Therefore, community-based initiatives require support of government agencies, as well as involvement of the private sector and the academy in order to promote holistic approaches to solve the problem of slums.

Comprehensive upgrading programmes can confront the challenges of exponential population growth in the presence of poverty, especially in the south, where 70% of the global population increase is expected to occur (UN- Habitat, 2003); a projection that questions the ability of governments to plan for the future. Understanding the importance of integral public policy in addition to the need for comprehensive slum upgrading programmes tailored to the needs of the inhabitants could diminish the vulnerability of the existent low-income communities and empower them to improve their living conditions.

The problem of burgeoning informal settlements led this study to enquire about the feasibility of upgrading slums in developing countries based on sustainable development. The research explored the growth, problems and consequences of informal settlements, as well as, the successful responses of governments to alleviate the problems of the urban poor. The analysis of specific upgrading strategies implemented in Brazil, Indonesia and Thailand gave an answer for the main question of this research which states that sustainable development of informal settlements in developing countries can be achieved through comprehensive upgrading programmes. Likewise, the analysis presents a framework for the formulation of sustainable upgrading programmes based on four components with flexible structure which could be adapted to the specific needs of the community in order to reach real improvements in the life quality and guarantee the continuation of community-initiated projects focused on community participation and incremental improvement.

The results illustrate the necessity for flexibility in planning, execution and financing of projects when working with disadvantaged communities. Government support must come with deep institutional changes to cope with unexpected factors associated to informal settlements. Likewise, advice and guidance from agencies and professionals should address the needs of the people, solving local and context-specific problems but empowering the people with skills to repeat the procedures and replicate projects in settlements with similar characteristics or similar projects adjusted to emerging needs. On the other hand, societies must recognise the potentials of the urban poor to organise and influence public policy and acknowledge them as an active part of the contemporary city.

Methodology

The research was designed in three stages: i) study of the background of urbanisation comprising globalisation, sustainable development and informal settlements through literature review. ii) Analysis of three case studies which represent the best practices of upgrading informal settlements in developing countries: The Favela-Bairro Programme in Rio de Janeiro, Brazil; the Kampung Improvement Programme in Jakarta and Surabaya, Indonesia; and the Baan Mankong Programme in Bangkok, Thailand. iii) The comparison of findings in each case study led to a proposal of an upgrading programme framework for sustainable improvement strategies.

The scope of this research comprises urbanisation problems of inner-city informal settlements with high densities and scarcity of land for expansion; peripheral slums were not considered as those experience different evolution processes and relationship with the city and rural areas. The selection of the case studies was defined by the following elements: i) Development level of the country. ii) Location of the city. iii) Size and relevance of the city in the national context. iv) Structure of the programme. v) Upgrading strategy.

COMPREHENSIVE UPGRADING PROGRAMMES

Development of cities and urbanization are processes shaped by internal and external factors of cities. Understanding the intrinsic dynamics of population growth in the last decades is recognizing the inclusion of poverty in urban spaces, as well as, the consequences of deliberate negligence from the state towards a rising problem of migration, scarcity of land and social decline.

The manifestations of poverty are shaped by culture and the causes of informality differ accordingly to the cultural characteristics of communities. However, the research has evidenced similarities in the origin and evolution of informality, where global political and economic pressures play a fundamental role in development. The main cause of slum population increase is migration; nevertheless, migration itself is not the problem as it is the lack of vision of governments to foresee the consequences of liberalisation of the economy and "laissez-faire" policies (Davis, 2006). Land use zoning and automobile dependence in the context of weak economies led to segregation of the society along with marginalisation of the poor. Exclusion, stigmatisation and economic crisis strengthened the position of the informal sector, where informality shelters middle and low-income population producing a critical mass which finally made the urban poor visible in the city, accounted as 30% of the total urban population (UN-Habitat, 2007).

The case studies presented in this paper illustrate three different countries that experienced the challenges of rapid urbanisation, where unstable political and social structures have driven the population towards informality as the means to survive in the absence of flexible and participative policies. The ability of informality to adapt in size and scope becomes a significant factor in the role as an actor in urban development (Pugh, 2000). The urban image declined, poverty became customary rather than exceptional and forced the governments to implement institutional transformations in order to address the rising urban problems in a holistic way (Briassoulis, 1999).

Evolution of Upgrading Strategies

The resemblance in former upgrading strategies along with the evolution from eviction, paternalism and site-&-services, towards self-help are associated with the influence of international institutions in urban policy throughout the 1970's and 1980's. Governments continued to be providers of infrastructure and housing, approaching low-income communities through a top-down policy, where exclusion of the community from decision making processes diminished the efficiency of programmes, as well as the satisfaction of the residents with the outputs. These schemes addressed one aspect of poverty neglecting its multidimensional complexity, e.g. the benefits of security of tenure were obscured by economic obligations of land ownership and mobility to the city, resulting in gentrification and expansion of the city´s boundaries due to the emergence on peripheral settlements. On the other hand, modernisation of cities demanded more than physical improvement. A deep institutional reform was needed to allow competition in global networks; hence, a decentralisation process was initiated, delegating to certain extent, policy implementation to local governments. Decentralisation was higher in Brazil and Indonesia allocating urban development on the hands of metropolitan authorities. The case of Bangkok illustrates different characteristics, as the urbanisation process in secondary cities was slower and weaker. Increased participation of low-income communities in decision-making combined with the inclusion of the private sector in public-private partnerships gave rise to holistic upgrading strategies which addressed the problem of slum from a bottom-up perspective.

Other influential element in the transition from top-down approaches to participation was the acknowledgment of existence of the urban poor. These upgrading programmes, although not completely comprehensive of the dimensions of poverty, provided slum dwellers "De facto" tenure which is based on the people´s perception of security and the age of the settlement (van Horen, 2000)., recognising the right to shelter and promoting self-help as the means for improving their own through incremental construction.

Coherent and flexible approach to sustainable upgrading

The success and failures of slum upgrading strategies led governments to understand the importance of community participation and locally-driven initiatives to improving the livelihoods of the urban poor.

In Brazil the Statute of the City and the Social Function of the land opened the possibilities for municipalities to exercise control over urban land and granted property right to slum dwellers. This paved the way for the Favela-Bairro Programme, where the design of the project was outlined with the community (Brakarz & Engel Aduan, 2004). This programme experienced a compulsory evolution from phase I which focused essentially on physical improvements to phase II where the community played a major role in decision-making processes.

Indonesia was as the first country to implement upgrading schemes with the Kampung Improvement Programme - KIP- (Kenworthy, 1997); however the strategy implementation in the early years of the programme in Jakarta was unsuccessful. A revision of the programme led to a more inclusive strategy implemented in Surabaya (Silas, 1992) (Kenworthy, 1997) (Santosa, 2000), allowing participation of the community in the conception of the project and discharging maintenance responsibilities along with shared ownership on the residents. A holistic approach to ensure sustainability of outcomes

The Baan Mankong Programme is the result of community cohesion and organisation. The need of the government to display power through physical improvement forced the stakeholders to seek in local partnerships the financial means to improve the life quality of the poor, motivating communities to organise themselves and empowering residents to look for opportunities beyond the common upgrading practices (Boonyabancha S. , 2009).

A FRAMEWORK FOR SUSTAINABLE UPGRADING PROGRAMMES

The comparison of the essential attributes of these successful upgrading programmes produced a flexible and decentralised framework, adjustable to the needs of communities in terms of knowledge and finance. The main characteristic is Participation, creating context-specific projects tailored to the needs of a particular community. Nevertheless, the framework consents the replication of projects, since the programme would be grounded on an open structure which allows adaptation of measures depending on the conditions of the neighbourhood, with the inclusion of the urban poor in the formal city as the crucial outcome, empowering them to become active participants of development.

The different elements of the programmes have been categorised into four components, each comprising diverse topics which are fundamental for sustainable development. This classification highlights the strengths, as well as the shortcomings, introducing preliminary conclusions about the feasibility of implementing sustainable upgrading in informal settlements.

Physical Development

The decayed condition of the built environment is the first challenge in upgrading schemes. Deterioration of the physical condition imposes economic burdens to the household and exposes residents to health and environmental hazards. The case studies demonstrate that small scale improvements have great impacts on the livelihood of the urban poor, empowering them to organise and execute community initiated projects as incremental construction of housing and social space, which guarantees the sustainability of outcomes.

Basic packages of infrastructure and connection to urban networks reduce living costs. Likewise, reliable public services could result in the creation of home-based enterprises upgrading the socio-economic condition of the whole settlement by offering on-site employment. Mobility and accessibility allow physical, mental and structural connection with the city; footpaths and roads also provide open spaces to develop community cohesion, since the streets become an extension of the housing space for recreational, social and economic activities. Simultaneously roads and walkways reduce environmental risks of flooding and erosion. However, as observed in the KIP Surabaya the access of the automobile must be restricted to avoid risks concerning use of open spaces by motorised traffic along with environmental problems. The control of automobile promotes the use of non-motorised transport modes which protect the household income and prevent gentrification of upgraded areas. (Newman & Kenworthy, 1999).

Housing construction and landscape planning are usually not included in the project objectives, although, construction of infrastructure and community facilities generate an overall improvement in the sense of place of the residents, which combined with increased incomes encourage incremental construction of dwellings, consequent with the needs and resources of the community. The Baan Mankong Programme produces finished housing for all the settlement dwellers. Conversely, economic burdens compromise a large share of the income, which endangers the inclusion of the poorest residents in the upgrading project. Furthermore, in order to create a homogenous appearance and minimise the delays in construction, the community usually chooses a standard design for housing which could challenge the identity and cultural diversity of the settlement along with private activities and modes of living. On the other hand, in low-income settlements is common the personalisation of dwelling through additional construction and decoration. This inevitable transformation of housing would bring back the identity and ensures the adaptability of homes to specific household needs.

Table 4: Physical Development. Components of Comprehensive Upgrading Programmes

	FAVELA-BAIRRO	KIP	BAAN MANKONG
Infrastructure & Public Services	Water, sanitation, lighting and garbage	Water, sanitation, drainage and waste collection	In-Situ, Community work: Infrastructure & Housing
Mobility & Accessibility	Paved roads & walkways, connection to urban structure	Footpath and road improvement. Restricted access to automobile.	Reblocking: layout adjustment, infrastructure & housing improvement
Public Space	Improvement and expansion of open spaces.	The street as stage for social cohesion and development	Reconstruction: urban renewal & housing construction
			Land Sharing: urban renewal & housing construction
Environment	Elimination of natural hazards, reforestation	Greenery and reforestation	Relocation: Infrastructure & housing construction in other location
	Construction of new dwellings for essential resettlement	Soft approach to urban renewal: Walk-up Flats for essential relocation	

Table 5: Legitimacy. Components of Comprehensive Upgrading Programmes

	FAVELA-BAIRRO	KIP	BAAN MANKONG
Tenure	Collective ownership and property rights	De facto tenure and property rights	Collective land tenure: purchase or lease.
Legality	Recognition of incremental construction as production of housing	Acknowledgement of the settlement as part of the city	Partnerships for negotiating with stakeholders
	Financed by the government. Upgrading for legality		Community Saving Fund: financial sustainability
	Regained access of the state to the neighbourhood	Community leadership legitimised by dwellers and government	Local Joint Committee: Community, NGO´s & Networks
Participation & Sense of Place	Legitimacy of CBO's and acknowledgement of social responsibilities by all parties	Shared ownership, mutual commitment and responsibility	Community-Driven initiatives planning, operation and supervision are responsibilities of the community
			Financial support: subsidies and soft loans
	Community participation and partnership with private sector in planning and implementation	Partnership between the community and the municipality	Assistance of the municipality and professionals in design and implementation

Legitimacy

The central evolution of upgrading programmes is the acknowledgment of the importance of legitimacy for sustainable development in low-income communities, as illegality hinders the possibilities of self-help, access to welfare, education and labour. Upgrading programmes grant instant de facto tenure, eliminating the fear of eviction and mending the relation of the inhabitant with the city. Legality encourages social integration as well as community cohesion through enhanced feeling of security and stability.

The degree of participation in decision-making processes, from planning to execution and supervision, legitimates the programme in the community promoting trust, as well as commitment from the city and the inhabitants. A difference has to be made between legitimacy and legality; although legality is necessary for social development, legal tenure is no guarantee for legitimacy and community participation. Legitimacy in the community is a tacit agreement determined by the understanding of the programme and the possibility to participate in decision-making.

Individual tenure symbolises risk of gentrification and emergence of new slums. An alternative is conferring collective ownership or property rights to the community organisation. Collective property rights prevent gentrification, since individual trade of the dwelling in the formal market is not accepted. Additionally, self-organisation is essential for securing the means to finance the improvements protecting, in some way, the poorest residents. Finally, community legitimacy and cohesion are encouraged through the recognition of the ability of the poor to manage their own resources, granting them renewed citizenship which encourages the community to search for new partnerships with the municipality and the private sector.

Horizontal partnerships between communities, governments, NGO´s and the private sector are necessary. Joint efforts to upgrading increase the commitment; shared ownership imposes responsibilities for both community and government in the success of the programme as well as the achievement of outcomes and maintenance of improvements.

Social Development

Although physical outputs are important for legitimacy, social development signifies an evolution in the socio-economic condition; building community capacities encourages integration to the society. The isolation of the poor is not a physical limitation, is also a problem of restricted access to opportunities, ignorance about their rights and negligence.

Partnerships, shared ownership, collective tenure and legitimacy generate networks and spread knowledge. The role of networks in upgrading programmes is education about citizenship, rights and obligations together with identifying opportunities for physical and social development. The horizontal structure of networks demand open spaces for discussion and participative decision-making, thus, generating confidence in the institutional layout and mobilising the people towards integration and community cohesion (Newman & Jennings, 2008).

Community empowerment mobilises people, resources and institutions to work, becoming the base for social development and incremental self-help. Empowerment reduces vulnerabilities by promoting community-driven initiatives for physical, social and economic improvement. However, the strength of communities relies in the stability of their organisations and legitimacy of actions. Community-Based Organisations - CBO's- build social capital, educate the population in participatory processes and provide them working skills that could be employed later in the development of other settlements or in the formal labour market

These upgrading programmes expose the results of empowerment and pressure on the government to initiate comprehensive upgrading; the Favela-Barrio was redesigned to include the urban poor in the policy discussion. The Asian programmes had as prerequisite the establishment of community organisations to manage finances, implementation and mobilise the community.

Governance

Decentralisation is the institutional transformation which allowed the emergence of comprehensive upgrading programmes. The process initiated a broader comprehension of causes, dimension and conditions of poverty. Local authorities realised the need for institutional reorganisation and flexibility in order to answer the call for empowerment; likewise, self-organisation demanded participative approaches to implementation and planning. The governments experienced a learning process where they understood the limits of the internationally-driven initiatives caused by rigid programme frameworks.

Table 6: Social Development. Components of Comprehensive Upgrading Programmes

	FAVELA-BAIRRO	KIP	BAAN MANKONG
Empowerment	Reduce vulnerabilities of the residents	Community cohesion and empowerment	Community commitment as requirement for eligibility
	Integration of the population to the city		Creation and strengthening of community networks
Social Capital	Social services for diverse segments of community	Health care and education facilities	Local welfare and cooperatives
	Training and education to improve competitiveness	Education and working skills, management and financing	Community Building Groups, management of finances and execution of projects
Community Capacity Building	Encouragement for self-organisation and participation	Economic sustainability through home-based business	Economic development: small scale business and training
		Preservation of local social networks and cultural identity	Open spaces suitable for community activities

Table 4: Governance. Components of Comprehensive Upgrading Programmes

	FAVELA-BAIRRO	KIP	BAAN MANKONG
Institutional Development	Local Initiative, flexibility and innovation	Decentralisation, innovation and reorganisation	Decentralisation and Institutional autonomy
Inter-Institutional Cooperation	Coordination between government agencies	Diversity of stakeholders: government, professionals, community	Inclusion of stakeholders: city, private sector, professionals and community.
Inclusive Decision-Making	Encouraged through community participation	The city as enabler and guide	City-wide Community Upgrading Plan
Integral Planning	Preventive strategies to control emergence of new informal settlements	Kampung Forum: renewed relationship between the city and communities	City-wide survey to identify conditions of the slums
	Mapping the city´s favelas provides understanding	Projects as learning centres for other communities	Pilot Projects as learning centres

Participation steered municipalities to innovate in policies and institutional structure, opening to social networks and including diverse stakeholders in decision-making processes. The urban poor need guidance and financing since community organisation is not enough to overcome poverty, illegality and stigmatisation. The municipality provides funding and guidance in management while the academy assists in planning; the private sector, in partnership with government agencies and the community, support implementation and sustainability.

CONCLUSION

The analysis of successful upgrading schemes shows the main factors to address in order to encourage sustainable development of informal settlements. The similarities in the foundation of the programmes suggest that, although understanding the cultural context is essential to formulate integral strategies, the main factors to promote sustainable upgrading are similar in every context and can be classified in terms of physical development, legitimacy, social development and governance. Thus, these components can be the basis for comprehensive slum upgrading programmes:

Physical development comprises provision of infrastructure, enhanced accessibility and mobility within the neighbourhood and to the city and better quality of the open spaces. These changes in the public realm encourage incremental construction and upgrading of housing, which result in an overall improvement of the built environment.

Legitimacy is a basic component allowing the community to become part of the formal city, promoting sense of place and participation. The urban poor understand their rights and obligation to the city as well as the opportunities and responsibilities in the development of the community.

Social development is, in a sense both the cause and consequence of sustainable development. It can be seen as a continuous cycle where empowerment, building social capital and community capacity can foster further social and economic activities to support the development of the settlement. Social development was the main component missing in former upgrading strategies, also the reason for the limited scope and success.

The government´s role must go beyond implementation to enabler, bringing together diverse sectors of the society, empowering people to participate and including the community in the definition of public policy. Inclusive approaches demand the construction of city-wide networks to spread knowledge and foster social integration throughout the whole society, otherwise improvements of informal settlements become isolated projects with restricted relevance in the overall development of the city. Helping the poor to help themselves requires guidance and flexible finances to support community-driven upgrading, rather than imposing foreign or top-down strategies on the urban poor.

Upgrading programmes based on the combination of these components can indeed improve livelihoods by defining real necessities of communities and understanding the importance of flexibility; but it is clear that the dynamic combination of these is rarely found in upgrading schemes. However, improving the quality of life of one sector of the population without a national and local vision towards inclusive sustainable development would result only in localised development, while the origins of the problem remain neglected.

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URBox, High-Tech Energy and Informal Housing

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ABSTRACT
The URBox concept encompasses the high tech end of solar energy and informal low cost and affordable housing. This paper aims to contribute to solving the global energy crisis by building solar energy settlements in deserts where land is affordable and sunshine in abundance. To that purpose, new solutions in the field of housing have been developed with the URBox formula, advocating a different approach of the complete building manufacturing, marketing, using and re-using process. Its formula is based on construction rules applied toan urban pixel of housing, the smallest identifiable practical dwelling unit. The URBox units can then be combined as multifunctional houses, and settlements. The same idea can be applied on the industrialized world with its own housing crises, presenting themselves in niche markets of housing for starters and low-income housing.At this moment URBox can be illustrated by sketching scenarios, in order to demonstrate its universality.

Like solar power knowledge is indestructible and infinite. This is a call for academic support to make the knowledge and design power available in order to tacklethe crises we face.

KEYWORDS:
Open Building, Lean Construction, Affordable Housing ,URBox

INTRODUCTION
In 1961 John Habraken wrote 'We should not try to forecast what will happen, but try to make provision for what cannot be foreseen' (Habraken, 1990). Although the future is hard to predict we do not completely stare in the blind. Some developments indicate what is to happen. Today's demographic data give indications about the world's population in the near future. Maslow (1943) gave us psychological insights in the hierarchy of needs. Alvin Toffler (1980) identified the sociological context of the agricultural, the industrial and the information wave societies go through. The Club of Rome warned us for the depletion of natural resources (Meadows, 1972). Looking back many of these visions proved to be true and their inertia generate a momentum that make the observed forces hard to stop or bend. At the same time it is dangerous to extrapolate these forces towards tomorrow. Technological developments have made communication available to the masses at a higher speed than anticipated, and the 2011 earthquake in Japan and its nuclear crisis sows that the unforeseen can throw a spanner in the works. This is the context of certain certainties and certain uncertainties ideas were developed to use solar energy as an endless source of energy to replace the consumption of carbon energy and to use locally available building materials and human resources of owner dwellers to create a built environment that works.

SOLAR CITY 2050
First the award winning Solar City 2050 is described and already existing technology is mentioned. In addition to the energy crisis there are the potential food, water, health, housing and immigration crises that need to be faced and dealt with. Although it is understandable and tempting to copy the affluent world technology to developing countries: value is created at the price of more energy, natural resources and pollution, rather than less. Therefore new ways need to be explored.

The Proposal
In 2008 Frans Cuppen and Dirk Smets proposed a framework for a Solar City to be operational in 2050. It aims to be a large infrastructural scheme to accommodate the social-economic development of North Africa. In addition it could complete a fully sustainable energy supply for European countries. North Africa faces the task to build millions of dwellings in a short period of time. Consequently complete new towns need to be developed that offer jobs for millions and that need to be supplied with food, water and sustainable energy.

North Africa lies at the brink of Europe, in search for solutions for climate related problems. Therefore it needs serious consideration to connect the development of North Africa and the repair of Europe. The Solar City 2050 project is based on the hypothesis that the new settlements in North Africa will be equipped with large solar energy plants, not only for the local energy demand but for export to energy hungry Europe as well. Large-scale desalination plants can win fresh water from the sea in order to irrigate the dry land and transform it into fertile ground for growing crops. This will boost the already existing biological way of farming, in turn feeding the cities in the region, newly developed tourist resorts as well as exporting their products abroad (Cuppen et. al., 2008).

The proposal illustrated
The artist's impression (figure 1) gives an indication of one of a 100,000 inhabitant solar city in North Africa. The settlement includes a harbour, industry zones, desalination plants, bio nurseries, forests and areas for leisure and tourism. The solar energy parks with plants and turbines cover an area of 330 km2. Crops are grown partly shaded by thermo-solar and photo-solar panels that deeply penetrate the hot desert. At both sides of this solar power ribbon 220

km2 of algae fields extend surrounded by untouched nature.

Every aspect of this settlement is sustainable and climate neutral;

- The conversion of solar heat and light into electricity;
- Desalination of seawater;
- Production of bio-fuels and bio-chemicals;
- Farming crops, life stock and fish;
- Mining and processing of resources and regaining waste;
- Traffic and transportation on electrical power and bio-fuels;
- Living, communication, services and trade;
- Leisure and tourism

Figure 1: Solar City 2050

1 sun tower
2 trough mirrors
3 fresnel mirrors
4 desert road with water supply piping
5 power stations
6 water basins
7 transformer station
8 ultra high voltage direct current cable to Europe
9 water desalinisation and pumping station
10 pisci-culture in salt and brackish water
11 agriculture and horticulture
12 sylvi-culture with dates, figs and almonds
13 chemical industry: salt, chlorine, cement, glass, technical gases
14 aluminium production (factory walls are rigid giant trough mirrors)
15 blotter fields with effluent recovery
16 new founded band shaped city; on central axis runs electric shuttle
17 recreation and tourist resorts
18 primordial natural areas
19 tanker for bio synthesis gas from organic waste
20 zeppelin for solar mirror transport and trips poor in CO2
21 yacht-basin
22 intercity station on the Trans Maghreb line
23 electro-genic blimps
24 mobile solar power units with dish mirrors
25 experimental solar chimney
26 solar furnace for heat technology
27 drip irrigation with desalinated marine water
28 market in the city with locally extracted products
29 methane production from hydrogen and CO2
30 horticulture and pisci-culture below the fresnel mirror fields
31 upper town for pedestrians with traditional shady lanes
32 downtown with electrical traffic
33 technical installations in the downtown
34 logistic centre
35 warm marine water spa
36 giant construction robots laying new mirror fields
37 building blocks and panel bakery with solar heat technology
38 embarking and disembarking of goods
39 low accumulation lake for nocturnal current generation
40 water turbines in the low lake dam
41 wind turbines assisting the drain of the low lake for nocturnal current generation
42 CO2-free cruises to solar city-resorts
43 xerofites on aride soils for vegetable oil: yatrofa, ricinus etc.
44 factory pressing feed cakes, oils, greases and biodiesel xerofites
45 conversion and recycling of solid waste
46 algae basins and bio-fuel refineries
47 maglev line, cargo tube, aqueduct, high tension line and service lane
48 solar energy plasma reactor
49 Fischer-Tropsch gasification for bio-fuels and bio-char
50 sustainable air traffic with bio-fuels

translation: De Jong (2008)

Table I: Legend for Solar City 2050, figure 1

The 10,000 megawatts power plants generate enough energy to compensate the future electricity shortage of a country like the Netherlands, including its electrical cars. Its algae plants can contribute to fuel for cargo and passenger transport by air. To this aim the countries involved are connected to a smart intercontinental High Voltage Direct Current grid with low transmission loss and equipped with the latest in energy recovery and storage. Approximately forty large settlements of this kind in North Africa and the Middle East as well as many smaller settlements in Southern Europe do not only cover the local need for energy, water and food, they also quench the energy thirst of Europe. They aim to contribute to a climate of political and economical stability, reduction of the green house effect and to prosperity and well being of millions. The ambitions and feasibility of this concept can be seen as an international Apollo project. In the final analysis globally less than one percent of all deserts are sufficient to supply ninety percent of the world population with sustainable energy, water and food. FransCuppen and Dirk Smets as members of the Dutch Society for Concentrated Solar Power (VZKC) developed this conceptwith support of the Foundation for Large-scale Utilization of Solar Energy, GEZEN It complies with the European 'Plan Solaire pour la Mediterranée' and the Desertec Industrial Initiative, launched in 2009.(See website references). This scenario can be made with technologies that exist today or are within reach. It could take the pressure off the looming energy, air, water,food and migration crises for the millions. But how would a matching technology be to house the millions? That is the subject of the next paragraph.

URBox

URBox advocates a different approach. Using local construction materials and local labour resulting in a built environment that can be managed and controlled on a local scale should challenge the housing crisis. URBox is based on basic construction rules applied on the pixel of housing, the smallest identifiable unit, less than three by four meters, with a column and beam based load bearing structure, separate inner and outer skins and guide lines for running ducts and services in the unit. The URBox units can then be combined as houses, housing structures and settlements. The same idea can be applied on the industrialized world with its own housing crises, presenting themselves in niche markets of housing for starters and low-income housing.

At this moment URBox can be illustrated by sketching scenarios, in order to demonstrate its universality.

The design, construction and maintenance are only a small part of the housing crisis. It has to comply with the constraints dictated on higher levels of decision-making. These decisions can be of (inter-) national political and economical order, hard to influence, but still negotionable or from a more phenomenological order, such as an earthquake: it happensand cannot be negotiated. In acting to shape day-to-day life we cannot wait for all the constraints to be clear. We have to act now and prepare ourselves for the unknown. This paragraph describes the URBox (Urban-Rural-Box) concept, guidelines to design, build and operate low cost and affordable housing. U and R indicate that the concept is applicable in different environments, Box refers to the smallest pixel of the urban fabric. The concept is explained with examples that make the concept suitable for emerging economies; it can also be applied in the industrialized world for upmarket niches.

The Formula

URBox is an assembly system of connectable spatial units for living, small workshops, leisure and internal traffic, for urban and rural environments. It can be finished according to the vernacular. The units can be connected horizontally and are stackable. Its normal size, the pixel, 3.6 x 3.6m allows every free standing and attached configuration as well as placing on slanting and sloping lots. Both the Very Low Cost URBox variant and the Affordable URBOx variant are a dedicated mix of existing well-proven technologies and innovations, based on the strategies of Open Building and Lean Construction (Cuperus, 2001). In both systems parts and tools are manufactured project independent off-site: Parts for Very Low Cost URBox are made locally from nearby produced materials with lend-lease tools by an all-out effort of local cooperatives, minimizing physical and project waste of adapting and transportation. Affordable URBOx, meant for people that have to buy or rent, is realised by a specific interpretation of mass customization: parts are fabricated fully-automated off-site and completely project independent, thereby exploiting at maximum the economics of numbers, elements are assembled from parts off-site but nearby and project dependent, complete elements are then assembled on the site without intermediate storage. Finally cladding and finishing are added.These can be traditional building materials, elements chosen from trade catalogues to be fixed with hand tools or can be custom made by third parties. The standard URBox core unit enables variable additions to respond to geographical conditions, as well as local and individual cultures and styles. Call it Vernacular Staged Mass Customization.

The key to combining on-site and off-site production lies in an Open Buildingcoordinated dimension system and rules for positioning and interfacing the parts. Then the unit is ready for finishings, such as decoration and appliances. Off site production and on site assembly results in a very short building time, thus eliminating the interest cost of financing time, on site security, material and process waste. As URBOx is an incremental system with cavities to accommodate ducts and services, its units can be re-subdivided and grow with additions to follow the user's needs and budget. URBox real estate does not depreciate; it accumulates capital and thus becomes a pension for the future:its adaptability and sustainability is meant to counter the uncertainties of the fourth dimension.

In addition to the physical system, URBox can also be extended as a service provider. Imagine a web based network of sellers and buyers to exchange ideas, a market place for sites, parts new and used, financial and legal services, guarantees and insurances, contracts for connection to and delivering from water and energy, before, during and termination of use. In the final analysis, URBOx is sustainable. It is lightweight, the on site construction is low on water consumption, can be demounted, repaired and re-used. URBox applies a blend of Lean Construction and Open Building principles: It creates value and to banishes product as well as process waste.

From settlement to building parts, decision-making and control are decoupled on the private, communal and governmental levels in a such a way that in each level specific persons can make specific choices, decisions and provisions about specific aspects and parts of the built environment and know by which specific experts they can be assisted, advised and supported. In the practice of very low cost housing and informal settlements for instance, it means that urban dwellers become builders who not only create value but can assist country dwellers building their farms who in their turn yield value as farmers by providing bio building materials to the urban dwellers; thus on the micro levels a micro economy can emerge, assisted by micro credits and infrastructure management from the mesolevel.

The System

The technical system is based on a 1.2 m module and its halves dimension system (figure 2), the smallest possible inhabitable unit measures 2.4 x 2.4 m. The structural integrity of the Very Low Cost/low tech variant is based on four in situ poured concrete columns rigidly connected to four beams (figure 3). The industrialized version is made with a steel structure, the lightest possible option with cold rolled steel profiles (figure 4). To the four sides of the floor plate walls or facades can be added at choice (figure 5).

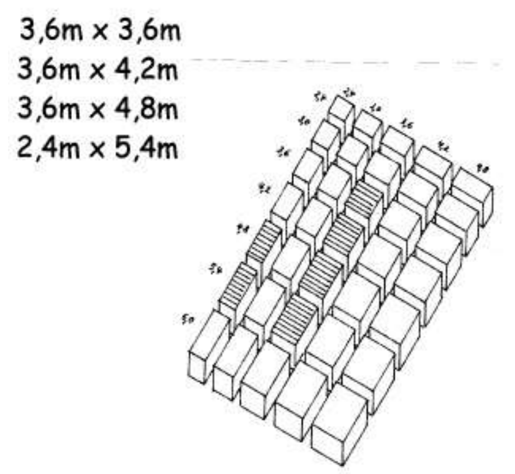

Figure 2: dimensioning system

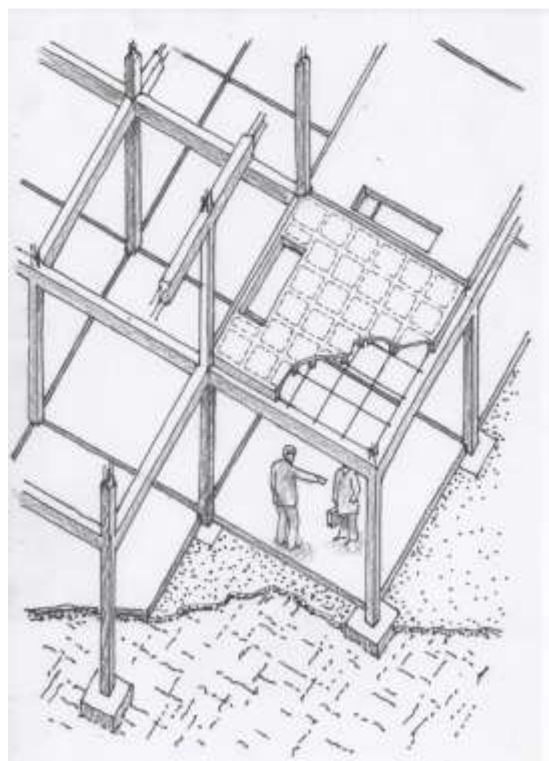

Figure 3: concrete skeleton

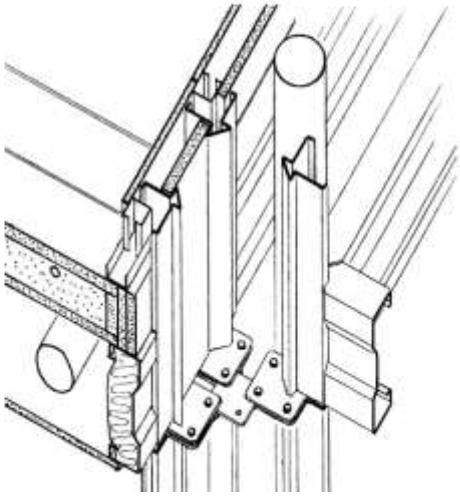

Figure 4: steel columns and beams

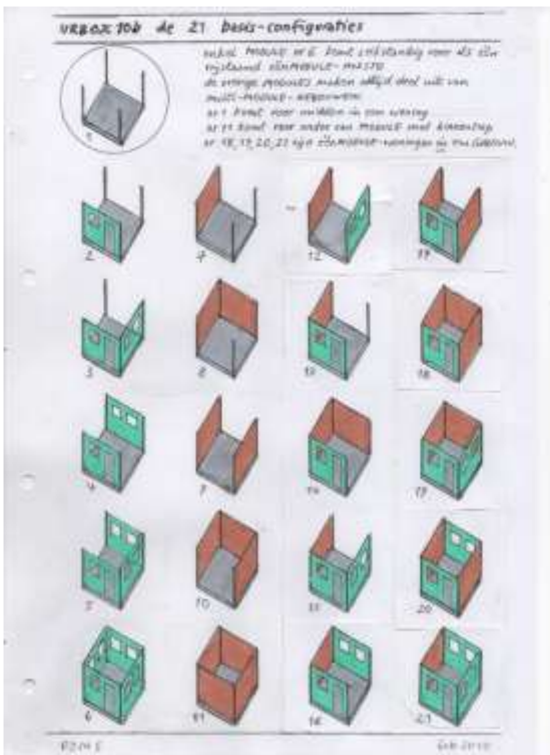

Figure 5: floor plates with walls and facades

Mechanical, Electrical and Plumbing

Positioning building parts such as skeleton, partitions, the mechanical and electrical engineering as well as the plumbing makes usable space (figure 6). By their different nature MEP conflict with columns and walls. They do not mix well and they compete for the same space. In the industrial version, all units have their own load bearing structure and they are always separated by a cavity that fulfils a dozen functions, the most important being to run ducts and services (figure 7).

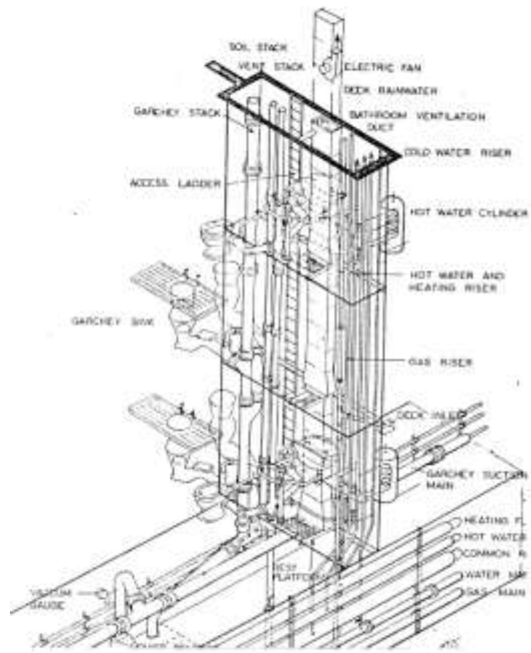

Figure 6: traditional duct shaft in stacked configurations

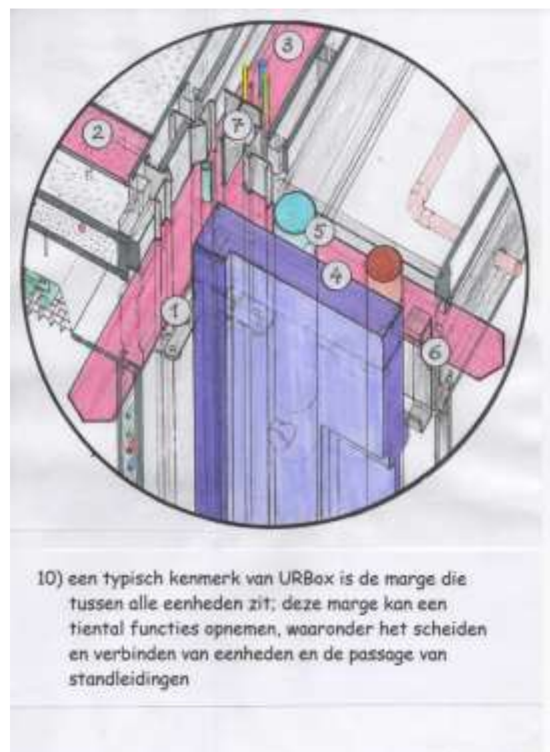

Figure 7: MEP in cavities between units and inner-partitions

Especially in URBox applications like multifunctional buildings or hospitals this MEP-cavity will allow for extensive installations without disturbing the other building subsystems, which again is a typical Open Building feature (figures 8, 9).

Figure8:URBox hospital structure

Figure9: URBox hospital

URBox includes a set of rules for zoning space and material and for interfaces of building parts. The rules do not affect the choice of materials and the level of their sophistication. As such URBox can be used as a blueprint for low cost housing as well as niche markets in the industrialized world, such as affordable housing or roof additions to existing buildings.

A Scenario

The minimum URbox to live in measures 3.6 x 3.6 m. In order to determine the lowest possible cost the cheapest available building materials need to be identified. In very low cost housing communities labour is by definition not on the critical path of the construction process, it needs to be taken into account. The costs of construction materials even if they are local, are related to the world market of natural resources. There are minimum costs to cement, steel, copper and plastics. Nevertheless, apart from the cost of the site and its infrastructure and under strict conditions like lend-lease of toolcontainers and the installation of cooperatives, it will be possible to realise a four-box or 50m2 very low cost house for about US$ 5000 (figure 10). It is also realistic to determine the lowest level of feasibility for affordable housing. Here we leave the world of construction and enter the realm of politics and economics which exceed and not the subject of this paper.

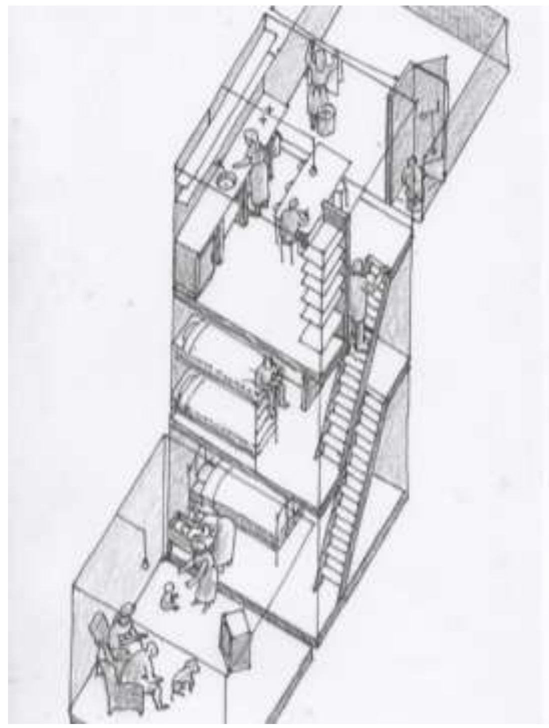

Figure10: very low cost 4 pixel urban dwelling

Figure 11: URBox neighbourhood in Solar City

CONCLUSIONS

Construction in the industrialised world is a source of mistakes and waste we can learn from. Rather than learning from our mistakes it is more efficient to learn form successes. The concepts of Open Building (how to build for a changing demand in an uncertain future), Lean Construction (create value and banish waste, by doing things right the first time), modern energy concepts and material science are some of the fields we can adapt. In this paper some of these concepts were explored and combined in a scenario for low cost and affordable housing. The pixel as the smallest building bloc has been described as a contribution to a vision on tapping solar energy as an infinite carbon free resource. The field of town planning falls out of the scope of this paper and is left to the higher Open Building decision making and control levels that provide the border conditions in which the urban pixels can thrive freely (figure 11). For the urban fabric creates capacity for placing the smallest pixels to configure streets and urban spaces that make society work. Transformations on the urban scale touch the powerful interests of landlords, economics and politics. They also create conditions for and constraints to low cost and affordable housing. This paper has been limited to constructing the pixel.

Like solar power knowledge is indestructible and infinite. This is a call for academic support to make the knowledge and design power available in order to confront the crises we face.

It could take the pressure off the looming energy, air, water, food and migration crises for the millions. The real obstacles may have a political and power nature. Energy is a hot commodity with well-divided interests. In Toffler's terms: Introducing third wave technologies that can tap infinite resources such as seawater, sand and solar energy may result in a dangerous power-shift, not appreciated by second wave parties who now control the energy supply. There is an underlying economic rationale that the very poor live in least fertile places such as deserts. Developing areas occupied by the very poor potentially creates enormous cultural conflicts; first wave societies are propelled into a third wave world, without being asked. The best third wave inspired intentions should not be experienced as neo-neo colonialism, but as a genuine common effort to make provisions that are fit for the foreseeable and adaptable to what cannot be foreseen.

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Where She Lived, Where He Lived: A Case of Family Homes Connected By "I Do's"

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ABSTRACT
Human beings regularly engage with the built environment, which comprises of the house, the street outside the front door as well as the local neighbourhood. They may occasionally socialise and/or interact with each other in the local environment (i.e. village, city, or suburb). This regular social interaction provides a platform for the development of the trust and relationships which form the basis for the creation of partnerships and networks. Therefore, it is safe to posit that good-quality spaces (within the built environment) promote social inclusion, socially cohesive behaviour and citizenship; whilst poor quality of urban spaces may contribute to anti-social behaviour. In South Africa, the built environment was shaped by the separate development of the colonial and apartheid planning, and later on the post-apartheid attempts to create human settlements that are more inclusive.

This paper explores the use of space in the authors' respective family homes during the cultural practice of lobola post-apartheid. The paper highlights the impact of political, social and economic changes on spatial use and community interaction related to these homes.

The intimacy, the authors have had with their family homes has positioned them perfectly to positively influence the improvement of their current environment and/or the design of more sustainable human settlements in line with Outcome 8 (Sustainable Human Settlements and improved quality of household life), one of government's 12 Cabinet Lekgotla outcomes.

KEYWORDS:
Lobola, cultural practices, integrations, settlements, developing countries.

INTRODUCTION

As people, we engage with the built environment on a daily basis. This environment comprises of their home, the street outside their front door and their local neighbourhood (Dempsey, 2008). We find it comfortable to socialise and interact in our local environment (i.e. village, city, or suburb), all the while building social networks among our neighbours (Castells, 1997 in Forrest and Kearns, 2000). Regular social interaction provides a platform for the development of the trust and relationships that provide a basis for the creation of partnerships and networks (Desjardins et al, 2002).

The built environment is not static; the quality of changeability is an integral part of houses globally (Habraken 1998:7 in Osman and Hindes 2005) as they change many times throughout their lifetime to suit changing social status, economic status and lifestyles (Osman and Hindes 2005). This dynamic perception of house is therefore relevant to all types of houses across the economic spectrum (Osman and Hindes 2005).

Colonial and apartheid planning have left a negative legacy in South African settlements (DOH, 2004). Under the apartheid regime, urbanisation placed extreme pressure on the family structure, essentially destroying the support structures offered by the extended family. Traditional and customary legal structures were used to gain social control (Petty and Brown 1998). Spatially, the result has been the development of course, mono-functional patterns of South African cities characterised by low density, urban sprawl and fragmentation.

In the post-apartheid era (i.e. after 1994), the concept of one family per plot continues to contribute towards the sprawling nature of South Africa cities. In addition, cheaper land in the outer parts of cities and beyond is attractive to developers; much of it being converted from agricultural use. This urban sprawling has resulted in an increase in the cost of provision for public infrastructure, higher costs for residential and non residential developments, reduction of transportation effectiveness and limited selection of transport modes, higher energy consumption, reduction in community interaction, greater stress, destruction of the environment and inner city deterioration (Yusuf and Allopi 2004).

Indeed, after almost two decades of resolute post-apartheid urban development policy action we are confronted with the harrowing fact that South African cities may be as segregated, fragmented and unequal as they were at the dawn of political liberation (Pieterse 2004).

Aims and questions

This paper aims to investigate two aspects related to the authors' family homes, including the spatial use of the built structure and the connections to neighbours and community within the local settlement, during lobola, an age old African marital custom, as experienced by the authors.

The research questions derived from this aim are therefore as follows:
How are spaces been used during the lobola process?
What level of social interaction took place within the neighbourhoods during the lobola process?
How have political, social and economic change influenced the use of space and social interactions during such events?

Scope of the paper

The authors have observed the spatial use and social connections within their family homes and it is these observations that the paper will present. It will not review the design, architecture, or process of delivering the selected family houses, nor does it seek to study the processes and debates about the custom of lobola.

Relevance of the paper

The basic shelter of a family home is regarded as an extension of body image and clothing (Osman 2004) and is therefore closely linked to identity and culture (Ragab 2007). Spatially, the family home may be perceived as patterns of organised spaces – whose structure follows the same social principles – which affect the size, connections and configuration for rooms and the relation between inhabitants (Ragab 2007).

This paper explores the use of space in the authors' respective family homes during the cultural practice of lobola in the post-apartheid era; and offers a historical overview of how modernism, colonialism and apartheid shaped the form of South African settlements. The case studies presented in this paper provide the authors' lobola experiences within the built environment in the post-apartheid period. According to Breed (2009), people form meaningful relationships with the spaces they occupy and the built form affects and may even hamper social interactions and activities. Globally, houses are dynamic (Habraken 1998 in Osman and Hindes 2005) changing numerous times throughout the peoples' lifetime to suit their changing social status, economic status and lifestyles (Osman and Hindes 2005).

Structure of the paper

The paper has been structured into the following sections: (i) Introduction – introduces the problem, identifies the aims and research questions, and defines the scope and relevance of the paper; (ii) A historical background of South African settlements – presents an outline of the development South African settlements; (iii) Approach – outlines the approach undertaken in the development of this paper; (iv) The case of family homes – presents and reviews the authors' family homes; (v) Findings and discussion – presents the findings and discusses the family homes reviewed in light of how political changes have impacted on the use of spaces; (vi) Concluding remarks – presents the conclusions and final remarks of the paper; and References – lists all the references cited in the paper.

A HISTORICAL BACKGROUND OF SOUTH AFRICAN SETTLEMENTS

The structure and form of South African urban environments has historically been shaped by two main ideologies; namely modernism and the policy of apartheid (Dewar 2004; Adebayo 2010). However, it should be noted that the primary elements of separation and dispossession had already been established in South African urban areas during colonial (pre-1910) and post-colonial (1910-1948) periods (Swanson 1968 in Napier 2007) by means of the native reserve system of the early colonial towns, the 1913 Land Act (which prohibited black people from owning land outside the Native Reserves of that time) and the Native (Urban Areas) Act of 1923 (Lemon 1991 in Napier 2007). The Group Areas Act of 1950, introduced by the apartheid government, expanded the concept to other parts of life and ensured that this was spatially entrenched.

Firstly, in terms of modernism, South Africa's city planning and management systems and policies were almost entirely imported from the United Kingdom, Europe and the United States. This is evidenced by the development of free standing houses on their own plots, the separation of major life activities (i.e. work, play, movement), and the development of settlements scale to accommodate the domination of the private car as the primary mode of travel (Dewar 2004).

Secondly, the policy of apartheid had at its core the separation of racial groups (Dewar 2004) which dictated the development of the inherent current pattern of South African cities (Osman and Kausseit 2008). The planning strategies adopted during apartheid, disadvantaged black people by locating them to their respective underserviced 'group areas' and townships in peripheral locations (Adebayo 2010; Todes et al 2000) resulting in exclusion of large portions of the population from economic, social and environmental benefits (Landman 2002).

Within three decades of forced removals from existing formal and informal settlements, more than a million black people in urban areas were affected (Lemon, 1991); thus, resulting in the destruction of many settlements in the process (Napier 2007). Between 1950 and 1991 more than 1 million hectares of urban land were racially zoned. This had ramifications in relation to huge proportions of the South African population having to be moved in order to fit the population to the plans, which had built-in disparities among groups in accessing the urban land (Christopher 1997).

This separation made housing a key area of marginalization, which further perpetuated inequalities in the South African cities (Adebayo 2010). Although the Group Areas Act was repealed in 1991, there has been very little practical change in the manner that the settlements continue to be developed. Consequently, the South African cities still exhibit apartheid planning heritage, with an urban form that remains predominantly racially defined (Dewar 2004; Shoonraad 2000b; Christopher 1997).

Since 1994, a new planning paradigm was adopted in South Africa. This aimed to dramatically change the structure of South African cities from the mono-functional forms to settlements that are sustainable, integrated, with higher densities and mixed in terms of income, use and tenure. Nevertheless, despite the development of policy documents to reflect this, it may be argued that fragmented unsustainable urban forms continue to be developed in South African cities (Schoonraad 2000a).

APPROACH

In response to the aim and research questions, the lobola process is briefly described and the use of space analysed in terms of levels of privacy and location of activities during the events. Following this analysis the impact of the political, social and economic changes on the manner in which the spaces were used during the lobola process will be discussed.

CONNECTING TWO FAMILY HOMES

Traditionally (across the majority of South Africa's African traditions) when a man wishes to marry a woman, he makes his intentions known to his family and the process of establishing a connection with the woman's family commences. An old Age-African custom of lobola is adhered to. This may appear to be a complex and highly formal process, as the representatives of the two families negotiate and mutually agree on the bride price that the man has to pay in order to marry the woman. However, the relevance of the practice for the couple's marriage is that the process brings the two families together (http://www.essortment.com/marriage-tra, dition-africa-lobola-36599.html).

For the purposes of this paper, the process of lobola as experienced by the authors and their families is briefly described. The family homes are approximately 500km (i.e. approximately 5-hour journey) apart and can only be accessed by means of a vehicle. There were three visits related to the lobola process, which are described in Table 1 below.

B Description of the visits during the authors' lobola process

No.	Date (season)	Activities taking place during visit	Duration of visit	Location
1.	March 2003 (Summer)	Negotiations of the bride price.	±2 hours	Witbank
2.	July 2003 (Winter)	Lobola paid, sheep is slaughtered*, gifts presented to groom's family and a meal is shared with the groom's family.	±6 hours	Witbank
3.	October 2003 (Spring)	Sheep is slaughtered*, gifts presented to bride's family, a meal is shared with the bride's family and the bride's family sleep over.	±6 hours	Kromhoek

* In both instances, slaughtering of the sheep represented the acceptance of the groom or bride by their future spouse's family.

The family homes selected for this study have been selected because of their connections to the authors' lobola process. These homes are described in more detail in the following sections.

Where she lived: The bride's home

Background on the settlement

The bride's family home is located in Witbank on the Highveld in the former Transvaal. Witbank was established in 1890 and coal mining began in 1894. It was proclaimed a town in 1903 and became a municipality in 1914. Witbank is the Afrikaans name for White Ridge, a white sandstone outcrop where wagon transport drivers rested. Witbank is in a coal mining area with more than 22 collieries in the municipal radius. There are numerous power stations, as well as a steel mill in close proximity, all requiring coal. There are four townships east of the city, which are home to blacks and coloureds. Indians reside in northwest of the city. In the post-apartheid period, Witbank is part of the Mpumalanga province.

The bride's family moved to Witbank in 1992. Prior to the move, they had been living in a coal mining village 30km from Witbank. The family moved to the bride's family home in 1995. She lived here with her family for about a year before commencing with her tertiary education. Her parents lived in this home from 1995 - 2009 before moving to a security complex in another Witbank suburb following a series of burglaries in 2009. The main house has the following accommodation; foyer, living room, dining room, kitchen and scullery, four bedrooms, passage, 2 bathrooms. The living room and three of the bedrooms are north-facing. The outbuilding includes a double garage with an attached bachelor flat with en-suite bathroom.

Description of the family home

The bride's family home is a standalone house located in a sparsely populated suburb in Witbank, Mpumalanga.

The site on which the bride's home is positioned consists of a main building, a double garage with an attached servant's quarters and a pool. The site is accessed via a vehicle or pedestrian gate north of the main building. It is bordered by a 1,8m high concrete wall on the southern side. The eastern and western boundaries cascade from the south to the north from 1,8m to 1,2m in the front yard. The northern boundary is made of brick and steel palisade allowing visual links to the street. There are four internal gates within the yard, with the gates attached to the western and southern sides of the main house being most frequently used.

Where he lived: The groom's home

Background on the settlement

The groom's family is located in the village of Kromhoek which was a product of the forced removals of the 1970s. It was incorporated in the Lebowa bantustan (established under the Bantustan system in 1954) in the former Transvaal. Although it was seen as home primarily for the Northern Sotho speaking tribes, other tribes such as the Northern Ndebeles, Batswana and VhaTsonga also lived in this bantustan. Lebowa was granted internal self-government in 1972. In the post-apartheid period, it was reincorporated into South Africa and became part of the Limpopo province.

The groom's family moved to Kromhoek in the late 1970s and gained communal land tenure under the local chief. Until then, they had been part of the farming community that served a local farmer.

Description of the family home

The groom's family home is a homestead consisting of three buildings constructed around a courtyard. The buildings were built by the groom's parents. The groom's family lived in this house for close to three decades before the groom commenced with his tertiary education. The home is currently inhabited by three people, the groom's mother, his sister and nephew.

The site on which the groom's house is positioned consists of three buildings. The first building consists of a garage, a living room and bedroom; the second, a kitchen, dining room and two bedrooms and the last building is a kitchen where the water is stored and the open-fire cooking takes place. A pit latrine is situated at the south-eastern corner of the site within the vegetable yard. The site is accessed via a pedestrian gate on the western boundary and is bordered by a wire fence, approximately 1,2m high, on all four sides of the site allowing 360 degree visual links to the neighbouring buildings. All the buildings have north-facing windows.

DISCUSSION OF THE FINDINGS

Figure 1 below presents a schematic analysis of the activities common to both the bride's and groom's family home, which were during the second and third visits. This figure shows the levels of privacy (i.e. private, private/public and public) as well as the location (i.e. external or internal) for these activities within the family homes.

For the purposes of this paper, the levels of privacy may be viewed as the number of people interacting within a given space as follows: private: <10 people (i.e. family and close family friends), private/public: 10 and 20 people (i.e. family and family friends) and public: >20 people (i.e. family, family friends and neighbours). In order to diagrammatically illustrate these levels, each have been given a score (i.e. private (1), private/public (2), public (3). Due to the nature of the lobola process, which includes family members and numerous guests and therefore does not require the performance of daily/mundane tasks (i.e. bathing, sleeping, relaxing, etc.), the locations for the lobola activities are limited to one or two internal spaces and all external spaces.

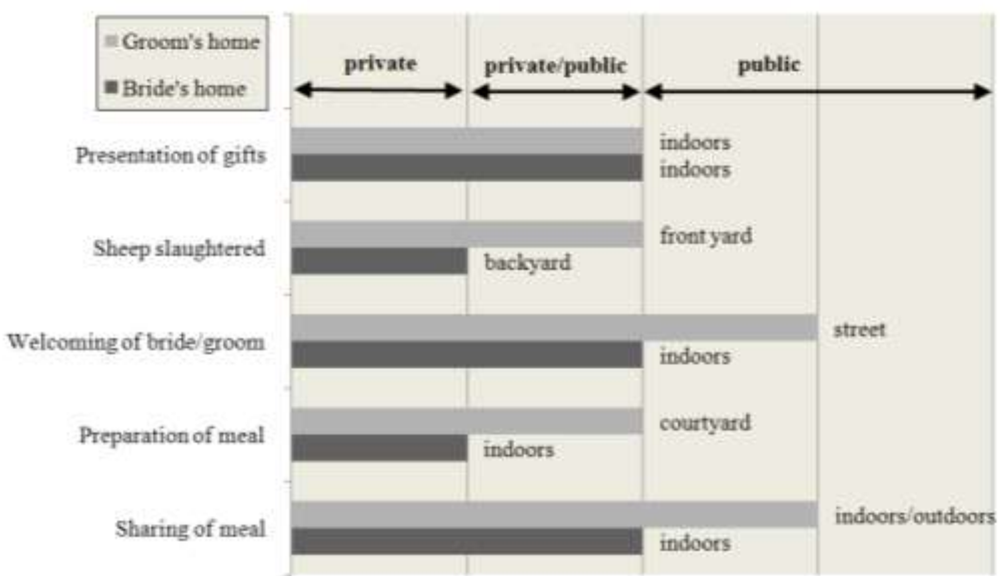

Figure 1: Lobola activities within the bride's and groom's family homes

The uniting of two families through the lobola process is a joyful occasion for many black African families. This tradition generally takes place at the family homes of the betrothed couple and is widely celebrated by the community that the bride or groom has grown up in. The common lobola activities which took place at each family home are significant in bringing together not just the couple, but their respective families (Figure 1).

The figure above illustrates the following:

A majority of the activities within the bride's home were private and private/public. Apart from the slaughtering of the sheep (which took place in the bride's back yard), all activities took place indoors. It should be noted that at the time of the lobola procedures, the bride's family had been residing in this home for eight years and none of the neighbours were invited or attended the first and second visits.

At the time of the lobola process – the decade into the post-apartheid period – the black families, like the bride's, had not been fully integrated into the (previously majority white) community they had lived in. What was evident during the first and second visits is that no neighbours were invited or attended; the slaughtering of the sheep was done in the backyard (hidden from public scrutiny) and the private nature of the gathering in welcoming the groom to the family.

The integration by black families into previously white communities is still a challenge. This is because during apartheid, privileged white communities in both urban and suburban areas developed social order and local norms, resulting in the new residents remaking the norms of suburbs by avoiding the received cultural rules of the neighbourhood (Ballard 2010).

In contrast to the bride's home, a majority of the activities within the groom's home were private/public and public. Apart from the sharing of the gifts (which took place in the lounge), all activities took place outdoors, with the welcoming of the bride taking place publicly in the street. Unlike with the bride's family, the groom's family had been living in their family home for nearly three decades and a majority of their neighbours were invited and attended the occasion during the third visit.

With the groom's family, a decade (at the time of the lobola process) post-apartheid his family had already been living in the village and had been fully integrated into the community they had lived in for approximately thirty years. In contrast to the bride's family, the family's neighbours were invited and attended the gathering, the slaughtering of the sheep was not hidden and the bride was publicly (i.e. in the street) welcomed into her new family.

Unlike the white suburban communities, the challenge for underdeveloped areas like the groom's village is the upgrading and integration of these areas into serviced urban areas (Landman 2002). As with the urban community, during apartheid the rural community developed their own shared identity and values, which were reflected during the occasion by the order of the division of responsibilities and the organization of the large crowd present during the event. The order and organization exhibited during the event (and many such events in the village) is an indication that regular social interaction exists between neighbours. This regular social interaction provides a platform for the development of the trust and relationships that give a basis for the establishment of partnerships and networks (Desjardins et al. 2002).

CONCLUDING REMARKS

The built environment is not static; the quality of changeability is an integral part of houses globally (Habraken 1998:7 in Osman and Hindes 2005) as they change many times throughout their lifetime to suit changing social status, economic status and lifestyles (Osman and Hindes 2005). This dynamic perception of house is therefore relevant to all types of houses across the economic spectrum (Osman and Hindes 2005).

Post-apartheid, South Africa continues to confront numerous challenges with regard to addressing the legacy that apartheid has left on the country's urban environments. The Presidency (2011) in the National Planning Commission: Diagnostic Overview acknowledges that apartheid's spatial legacy primarily affects the poorest people who live in remote rural areas far from places of work and economic activity and that the reversal of this legacy on South Africa's housing environments will be an ongoing challenge in decades ahead.

There are many cultural traditions (i.e. births, weddings, burials) that take place within South Africa's housing environments. These occur within the built environment, many within the homes. Given that people form meaningful relationships with the spaces they occupy and that the built form affects and may even hamper social interactions and activities; designers need to be aware of the social dynamics and symbolic connotations a community may have for the spaces created (Breed 2009).

The paper suggests that there is a need for further research in order to adequately address the transformation of South Africa's housing environments. The following suggestions are made:

The study of cultural practices within different settlements and housing typologies within a city (i.e. townships, inner city, gated communities) needs to be conducted in order to refine and guide the development of housing and settlements; and

Housing policies and standards should in part be shaped by the cultural experiences (which directly impacts on the built environment) of all affected communities in order to accommodate the changeability of the built environment.

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Slovo Park, Soweto: Community Participation in Urban "Acupuncture"

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ABSTRACT
As part of their Honours year, a group of architecture students were involved in the design and construction of a central meeting space in Slovo Park, an Informal Settlement south of Soweto, Johannesburg.

In a society where the physical fabric comes into being within the lifetime of most of the urban residents, it follows that there may be a correlation between the habitat created and the immediacy of this generation's dreams or frustrated aspirations: an "Urban Vernacular" that is culturally informed and potentially informing.

The architectural question that we grapple with in such an emergent society is how to determine an appropriate translation or response to this vital pulse. This paper investigates the point of balance between the autonomy of the designer (the students) and the expression of will by the client (the Slovo Park community) as seen in the dynamic, qualitative interaction resulting in the production of place.

It is proposed that participation becomes a key factor in the design and implementation process, resulting in an architectural manifestation of emerging community identity.

KEYWORDS:
Architecture, Identity, Informal Settlements, Community Participation

INTRODUCTION

It is my belief that architecture cannot describe an identity without grappling with its own story of origin. In an emergent society, that story of origin rests in the present continuous tense, the reflection of which is to be seen in the formation of informal settlements. There is an organic expression of shelter that meets the most pressing needs of the moment, with a persistence of pattern-making that is habitual, regional and ultimately, culturally informed and potentially informing.

As detailed studies of archeological sites offer vast insights into the living patterns of past civilizations, so too an analysis and understanding of informal settlements offers a valuable laboratory for research into emergent societies.

However, where the archeologist may have an interest in reflecting on past life patterns, the architect has an interest in understanding current and historical patterns in order to better inform future planning.

It is for this reason that an added dimension becomes important, namely participation. Due to the fact that the subject matter is not removed by history, the validity of any findings and proposals can only be established within the interactive domain.

The architectural question that we grapple with in a society where the seeds of its own identity are slowly coming to fruition, is how to determine an appropriate translation or response to this vital pulse. The notion is forwarded in this paper that a dynamic, qualitative interaction between a community residing in an informal settlement and a team of post-graduate architecture students can offer insights into such a production of place.

The intention is to discover the point of balance between the autonomy of the designer and the expression of will by the client (in this case, the community). In particular, it is considered important that the client/community must remain empowered to repudiate any suggestions or interventions that do not meet with their expectations. In this way, it is proposed that participation should be a key factor in the design and implementation process, resulting in an expression of community will translated into responsive architecture.

THEORY

Authorship & ownership in design

Prescription

In the grand tradition of twentieth century architecture, the heroic age of the modernists was greatly influenced by the views forwarded by Le Corbusier in his book "Towards a New Architecture"14. In this seminal work, he advocated a new approach to architecture in which the architect had to take up arms in the realm of aesthetics and describe a new world order that would be in keeping with the mechanised spirit of the age (1986: 269).

To his way of thinking, there is no greater indication of sophistication and idealism than in the production of Mass Housing (especially for the "workers" of the Industrial Age). It puts the architect in the same prescriptive position as a mechanical engineer, reducing (or elevating?) the complexity of architecture and urbanity to a "quantitative" science. He forwards an inherent assumption that "all men have the same needs" (1986: 136) thereby validating the blanket approach to standardisation. Based in this assumption, his argument is weighted in favour of technological innovation, from which he intends to unearth and establish a novel aesthetic that should be true to its age.

By focusing so exclusively on the issues of aesthetics (although there is an avid denial that this, too, could ever become a stylistic approach), the voice of the client, the end-user, the actual "worker" was completely ignored. Reflecting on the clients' perceptions of Le Corbusier's designs, Alain de Botton5 relates the reaction of Madame Savoye to the iconic "Villa Savoye": "It's raining in the hall, it's raining on the ramp, and the wall of the garage is absolutely soaked. What's more, it's still raining in my bathroom, which floods in bad weather, as the water comes in through the skylight." (2006: 65).

Similarly, in a project Le Corbusier designed for the workers of a factory in Pessac, near Bordeaux, the intention was to create exemplars of Modernism: Cubist, undecorated, the epitome of sophistication and an expression of the Age of the Machine. However, the workers did not relate to this and accordingly "they added to their houses pitched roofs, shutters, small casement windows, flowered wallpaper and picket fences in the vernacular style…and gnomes in their front gardens." (2006: 164).

In this era, however, questioning the integrity of the architect became almost blasphemous. In his commentary on the Bauhuas era, Tom Wolfe22 describes Walter Gropius as "The Silver Prince" (1981: 8) and all his followers as members of the elitist "compounds" that achieved near-clerical status (1981: 14).

Gropius was hugely in favour of standardisation9. He considered the industrial process as a civilizing one, something to be embraced and expressed. He was not concerned with the individuality of the client: "The fear that individuality will be crushed by the growing 'tyranny' of standardization is the sort of myth which cannot sustain the briefest examination." (1965: 34). In his argument, he considers repetition to have a civilizing influence that brings about civic dignity and coherence. Despite the manifest interest in designing worker's housing that is meant to elevate the soul, the architects turned a deaf ear to any complaints by these workers. They considered these workers to be "intellectually undeveloped" (Wolfe 1981: 26) and therefore continued to see themselves as the engineers of the soul, beyond the capabilities of the masses to comprehend.

Such blatant disregard for the more complex social needs of people who are meant to inhabit these "projects" culminated in the highly publicized implosion of the Pruitt-Igoe housing scheme in 1972 to the chants of the inhabitants: "Blow it up!" (Wolfe 1981: 63)

Eventually the voices that doubted the sovereignty of the modernists became louder and most specifically, the prescriptive nature of the architectural profession came under fire. Robert Venturi published "Complexity and Contradiction in Architecture" in 1966 and, as Wolfe states: "Venturi seemed to be saying it was time to remove architecture from the elite world of the universities and make it once more familiar, comfortable, cozy, and appealing to ordinary people; and to remove it from the level of theory and restore it to the compromising and inconsistent but nevertheless rich terrain of real life." (1981: 81).

Supporting this break from idealistic prescription is the book written in 1977 by Christopher Alexander: "A Pattern Language"2. Although it is meant as a guideline for designers, the greatest intention of the book is to achieve richness from an understanding of existing context and behavioural patterns. Great value is placed in the participation of end-users in the design process, making use of workshops and questionnaires to ensure that assumptions are not favoured above a response to the true needs of the end-user. Working within the realities of collective consciousness and historical validity, he relates, for instance, how the importance of the pavement café cannot be ignored: "The most humane cities are always full of street cafes." (1977: 437). Such a concern for humanity was in direct contradiction to Le Corbusier's view in which he considered cafes and places for recreation to be "that fungus which eats up the pavements of Paris" (Le Corbu 1986: 60).

Participation

The approach to housing in the architectural debate was coloured by the same shift from extreme idealism and prescriptive authoritarianism to a greater regard for the client's needs and cultural expression. In this process it was recognised that, far from having created worker utopias, social crises had arisen in some cases precisely because of the clumsy mono-dimensional solutions offered by "starchitects".

In his book "Housing by People"19, John Turner argues that housing is a natural human activity: "The moment that housing, a universal human activity, becomes defined as a problem, a housing problems industry is born" (1976: 4). He ascribes the greatest malaise of the housing situation to the fact that people (end-users) do not have enough control over the process.

He specifically points to the balance between autonomy and heteronomy (subjection to the rule of another being or power) (1976: 17) and argues for greater autonomy in the hands of the inhabitant. This then results in a greater sense of responsibility as well as richness and variety in the ensuing environment.

The core proposition of the architect as sole arbiter of taste and "engineer of the soul" as forwarded by the "Modern Masters" is therefore brought under scrutiny. Turner notes that "Large-scale systems have created the most segregated cities the world has ever known" (1976: 46), recognizing the need for a more humane approach, a more realistic understanding of the way people appropriate spaces, in the same vein as Alexander.

Emotional ownership is the key factor that changes housing from what it is to what it does, because of the implication of empowerment. "While people intolerantly look a centrally administered gift horse in the mouth, they show a surprising facility for multiplying the blessings of something they have done for themselves." (1976: 41). Ultimately, the most valuable human resources are "initiative, commitment and responsibility, skill and muscle power" (1976: 48), none of which can be used by an external party against people's will. In the quest to position architecture closer to the will of the end-user, it therefore becomes requisite to create a mechanism by which these resources can be activated in favour of the design process.

Lucien Kroll actively pursued such methods in his design approach to student housing and wrote in 1986 in his book : "The Architecture of Complexity"13 about the possibility of diversity to encourage creativity, avoiding the anaesthetising effects of repetition in design. His pioneering work in participation was seen as a "joyous rejection of the Modernist canon" (1986: 2), aiming to achieve the ambiguity and contradiction which represents an organic and natural development of an urban environment.

This same concern for a return to an understanding of natural processes and cultural veracity can be read into the history of development theories. Much in the same vein as the architects of the modern era, the propagators of Western Development in "Third World" countries were confident in their assumption of superiority in terms of planning and implementation of systems and environments that would ultimately reinforce the economic prowess of the "First World".

Critique against such attitudes started to evolve towards the second half of the twentieth century, however, as cultural misunderstanding, bias and oppression were gradually identified as reasons contributing to the failure of so many projects. In his commentary on the single-mindedness of western development, Thierry Verhelst20 makes a powerful argument for the acknowledgement of cultural diversity. He insists that: "People's right to be different need not put an end to all forms of development…programmes and projects should be based explicitly on the cultural identity of each individual people." (1990: 159) He sees such recognition to be a key factor in the process of breaking away from dependence, establishing the basis for self-development and self-reliance that eventually allows for an intercultural solidarity to arise.

Exerting an influence on this changing paradigm, was the work of Abraham Maslow15 which investigated basic human motivation. He produced an understanding of universal human needs which, although valid across cultural divides, assumed acknowledgement of identity (and therefore differentiation) as part of the aspiration towards self-actualisation. His famous "hierarchy of needs" became a widely quoted representation of a shift in Western consciousness. No longer was an aspiration to an idealism seen as a simple solution to the complexity of life. A deeper understanding would be required to afford solutions that would contribute to a socially more balanced environment.

Further to this thinking, Manfred Max-Neef16 proposed that such a hierarchy of needs was even in itself too simple a model to underpin developments that would truly support a particular community. He therefore produced a complex matrix of needs, satisfiers and destroyers that could establish a far more detailed analysis of any particular group of people, whether joined by culture or physical context, which could be applied to the interventions in such a group. He is particularly interested in the development of self-reliance from "the bottom up", as opposed to authoritarian or simplistic notions that are exerted from "the top down". He also recognises that dependence and dominance are prime frustrations in the satisfaction of human needs and insists on the importance of self-reliance:

"Understood as a process capable of promoting participation in decision-making, social creativity, political self-determination, a fair distribution of wealth and tolerance for the diversity of identities, self-reliance becomes a turning-point in the articulation of human beings with nature and technology, of the personal with the social, of the micro with the macro, of autonomy with planning and of civil society with the state." (1991: 58)

Such a recognition of the inherent need for complexity and differentiation has been taken up in architectural debate, both locally and internationally. David Dewar6,7,8 has suggested in various proposals that an approach to the design of urban environments should be informed by greater participation of the end-user; that the spatial, cultural and temporal qualities of a total living environment should embrace the opportunities of variety, choice and richness. In the same spirit as Max-Neef and Maslow, he insists that human development requires self-actualisation (1979: 7). He proposes that "Self-Help" becomes a vital part of the notion of housing as the infill in the urban framework, within the following assumptions and precedent: "…management by individuals and communities who are controlling the decisions, taking responsibility for their housing and environments." (1982: 33) This, he argues, gives rise to an improved environmental quality and greater richness in the physical fabric.

Supporting this thesis is the work of John Habraken10. In his book "The Structure of the Ordinary" (1998), the levels of control exerted by the end-user are seen as the critical factors of self-determination that contribute to the cultivation of a living environment.

"To use built from is to exercise some control, and to control is to transform. There is thus no absolute distinction between those who create and those who use. A complex hierarchy of control patterns within a continuity of action emerges." (1998: 7) He analyses the historical evolution of cities and suggests that there are various conditions of control, from major arteries to furniture and utensils (1998: 67). However, a distinction is made between the two major levels of control, namely the infrastructure and civic space which often remains within the control of planning agents and the level of infill (seen mostly as housing and retail) which, in his argument, should remain mainly under the control of the end-user. This he sees as a model within which robust and transformative environments can be facilitated.

Although they have based their observations in similar models, it is interesting to note the difference between Habraken's conclusions and those of Alexander. Whereas "A Pattern Language" seeks to capture the underlying truisms of spatial conditions in order to provide the designer with a set of guidelines, Habraken looks more closely at the actual role of the designer in the process of decision-making. He similarly acknowledges the existence of patterns, but warns against the assumption of the designer's autonomy. Alexander does make allowance for the voice of the end-user and certainly opens the debate against the Modernists' totalitarianism in design, but it is Habraken who furthers this consciousness and truly questions the designer's prerogative in determining an environment beyond the most elementary of systems.

Influenced by this way of thinking is the work by Nabeel Hamdi. In his most recent book, "The Placemaker's Guide to building community"11, he forwards an approach which virtually removes the designer entirely from the manipulation of form in favour of the facilitation of inherent energy within a community. He promotes an intensely interactive and interdisciplinary approach, in which he equips the team with "Toolkits" that are borrowed from various action planning theories, from transect walks to problem trees and thought fountains. Workshops, board games and poetry are given preference over drawing boards and computers. Architecture, Urban Design and Town Planning are all considered to be an integrated part of Development Theory, Anthropology and Social Science (among others), all falling under the same intention of "Placemaking".

This is essentially a radical shift in consciousness in terms of the role of the architect (and other professionals), especially in the arena of public participation. The question becomes increasingly pertinent: How much should the designer intervene, if at all? As Habraken puts it: "The idea that a living environment can be invented is outmoded: environment must be cultivated." (1998: 327)

"Public Participation" theories have emerged in the last two decades as significant barometers of this changing view of authorship and authoritarianism. The key issue underpinning most of the theories appears to be an understanding of the control exerted by the role players, much in the same vein as Habraken's analysis. In his book on Community Participation in Urban Management, "Sharing the City"1, John Abbott offers a comprehensive documentation and analysis of the various theories developed since the 1960's. From a simplistic diagrammatic understanding as forwarded by Shirley Arnstein (1996: 34) to the often quoted duality of power as forwarded by Freire and Moser, Abbott suggests that community participation is, in fact, an extremely complex power relation between oppressor/oppressed/facilitator. He maintains that, depending on the specific geographical, cultural and political context, there could be four successful approaches to community participation, namely: Community development; political empowerment; community management; negotiated development (1996: 63).

He emphasises the fact that community empowerment should focus on the commonality of purpose, which is capable of developing a powerful sense of community cohesion (independent of the heterogeneity) (1996: 95).

The concern with creating a clear understanding of the potential for participation to make a positive contribution to development is shared by Sam Hickey and Giles Mohan in their rebuttal against critique leveraged at participation: "Participation: from tyranny to transformation?"12. They present a similar argument to that of Abbott in arguing for a greater understanding of the overall power structures that form part of the context of participation.

"The importance of participation in development can no longer juxtapose the alleged benefits of bottom-up, people-centred, process-oriented and 'alternative' approaches with top-down, technocratic, blueprint planning of state-led modernisation." (2004: 4) They argue for an understanding of "histories, overlapping temporalities, and the unfolding of political processes in relation to catalytic participatory interventions and critical moments." (2004:15) Within such a complex political and social context, they maintain that participation can contribute to positive transformation in development and governance.

Literature supporting the convergence of architectural theory and development theory is not in abundance and has been reduced for the purposes of this paper to the two authors already mentioned, namely Habraken and Hamdi, although Dewar's work circumscribes the same principles. The investigation of this paper relates to this convergence and seeks to position the role of the architect more specifically within the debate surrounding autonomy/ control.

THE PROJECT

Participants

The laboratory chosen for this research is a social movement within South Africa that has acquired an increasing legitimacy of representation that is considered to be largely unaffiliated with any particular political grouping within the country. This social movement has its roots in a savings scheme and has as its agenda the provision of housing for the poor. They are affiliated to a global social movement represented by Shack Dwellers International (SDI). With its origins dating back to the 1990's, an alliance consisting of the Federation of the Urban Poor (FEDUP), Community Resource Centre (CORC) and the UTshani Fund came to an agreement with the Minister of Housing in 2006 to take delivery of 6000 housing subsidies to kick-start the "People's Housing Process", the government's official recognition of community-driven housing delivery. (Swilling18 2008: 18)

The significance of this movement lies in the fact that they consist of self-organised poor communities that are able to retain their autonomy over time, despite conflict, negotiated engagement or co-operative partnering.

"They have plaited together strands of development knowledge that are normally compartmentalized into separate types of development practice: The key role of micro-finance in development; grassroots community-organizing to build collective solidarities; technical innovations aimed at doing more with less; challenging existing inequalities at the political level; pragmatic autonomism within civil society; subordinating professional knowledge and roles to the organized chaos of community leadership." (2008: 2)

By transcending the traditional dualism of participation (as suggested by Abbott and Hickey), this level of self-organisation and self-determination becomes the key to "transformative amelioration"(Swilling 2008: 3).

FEDUP therefore represented a self-driven social movement that would have the confidence to have form given to their own voice. The research process would be interactive, the participation mutual. The representatives of the architectural community would be post-graduate students enrolled for their Honours course at the University of Pretoria after having had various levels of practice experience. The experiment would be situated in Slovo Park, to the south of Johannesburg and would consist of two modules of six weeks each.

Process

Analysis

As is requisite in any good architectural design practise, the process commenced with a thorough analysis and understanding of the physical context both on a macro-urban scale as well as on the scale of potential building site. Interspersed with the analytical process, the community was consulted for information regarding particular use patterns, in recognition of the pragmatics of every-day behaviour.

The first design process, relating to various sites as identified by the students, remained relatively undeveloped, largely due to time constraints. More attention had been paid to the sensitive development of an Urban Design Framework, which eventually proved to be of great value in the second module.

Having the community's response to both the Urban Design Framework and the individual design proposals created a critical background of understanding for the students from which a very spontaneous and educated reaction could be used in the design proposal for the second module.

Intervention

The community were gathered around the post boxes, basking in the heat and dust of the midday sun. A redundant shed that had been erected for the '94 elections stood to one side, unused. The voice of the community was clear, the apparent social cohesion the greatest asset, the eventual goal: a neighbourhood with civil and civic services and the opportunity to improve one's home. The immediate question: Where to begin?

By focusing on the upgrading of the shed and the creation of a large public gathering space, the students relied on the principles of historically proven models of Placemaking. (If the heart of the Athenian democracy could be expressed in the Agora, certainly an opportunity for public gathering could facilitate the evolution of this community!) Basic principles such as the definition of edges, corners and the intimation of enclosed vertical space, offered an architectural language and set of parameters which would guide the ensuing process. The design was presented as a phased intervention, proposing that the community would be able to continue with further elaboration of the initial project after the students had gone.

Once the design had been agreed to by the community, detailed variations on site frustrated, inspired and eventually influenced the process and the product to the point that all who were involved were comfortable to claim authorship.

[Editors Note: The following figures were not available at the time of publication:]
Figure 1: Foundations cast
Figure 2: North Wall built
Figure 3: Surface bed cast
Figure 4:Steel frames for screens manufactured
Figure 5: Reeds harvested and installed into screens
Figure 6: Steel structures painted
Figure 7: Surface bed tiled
Figure 8: Piazza area shaped, compacted and fully paved
Figure 9: Vertical posts planted, cast into concrete
Figure 10: Terrace created, grassed over
Figure 11: Trees planted
Figure 12: Water point moved, re-plumbed
Figure 13: Benches built at water points
Figure 14: Tar surfacing done around water point
Figure 15: Benches built around play area
Figure 16: Post Boxes moved, refurbished, painted
Figure 17: Ferns planted around edges

Discussion
Beyond the quantitative (and naturally incentivised because of it), however, lay a far deeper achievement for both the students and the community of Slovo Park. For the students, the process had been hugely enriching, bringing concrete form to the theories they had been exposed to in the literature. It was possible for them to see the immediate effect their intervention had on the people of the area, understanding first hand what an impact the physical fabric can bring about within the social realm.

Due to their inexperience and open-mindedness, they were also malleable enough in their process to be directly influenced by the community members with some construction experience. This created a comfortable synergy, in which "ownership" and "control" remained pliable and spontaneity could be harnessed productively.

In terms of architectural research, the Slovo Park project enters into the field of facilitating participation as part of "action research" or "qualitative research". According to Shirley White21, a "community is a collection of people linked together by communication within a physical environment that can be altered by their collective action." (1999: 29). In her discourse on facilitation, she describes it as an art that engages creativity which energizes thinking and doing. By focusing on collaborative action, the participation process then contributes to the building of community. This is the same line of thinking as held by Hamdi in his "Placemaker's Guide to Building Community"11, underlining the potential of collective action that is well facilitated to lead to social cohesion.

There exists therefore, a powerful potential for an inherently academic exercise to contribute to the real-time transformation of the subjects of study due to the participatory process, otherwise considered to be qualitative research (or action research). Qualitative research, according to Rossman17, has its roots in phenomenology (questioning the structure and essence of the lived experience) and hermeneutics (questioning the conditions that shape interpretations of human acts or products) (2003: 7).

Reflection
In the case of the Slovo Park project, the context became the ideal laboratory for such a heuristic research process and the reports by the students and the community representatives yielded a narrative of understanding which proved insightful and meaningful:

Claudia Filipe
B. Arch (Hons)

> "The Slovo Park project presented an opportunity to learn a lot in a little time. Mistakes were made and things redone, but eventually the goal was achieved. At times it was difficult to know where the role of the designer started and stopped.
>
> What was the role of the architect?...A lot of drawings were made and we assisted in making the changes that (the community) would have liked to see on the design. Eventually we just had to take a leap of faith…and observe and participate in its making…
>
> We had asked ourselves often what was the goal of the project? Was it learning and getting the buy-in from the community to take ownership and invest in the site as a place, irrespective of the product, or was the goal a technically considered and perfect architectural product, to meet academic standards? Were we place-makers or technologists, and to what extent were we successfully both?"

Jacqueline Casson
B. Arch (Hons)

> "We generally choose not to talk about racism and segregation in my experience of academia, but in this project all those taboo subjects were raw and fresh in our interactions with the community… 'Top down' or 'bottom up' terms are perhaps not broad enough: things need to be holistically integrated. "

Isabel van Wyk
B. Arch (Hons)

> "While working on site during the Slovo Park project we learnt not to think we already know what needs to be known. The project was intensely participatory, small in scale, problem based, and based on achievable actions…The community self-organises in response to need, from the bottom up. We worked within this order and within the framework the community set for themselves…As a result of the community participation the design will evolve and change… The role of the architect might just lay in the overall facilitating, and in the details. The in-between is the space where the community finds themselves."

Jhono Bennet
B.Arch (Hons)

> "Energy and time strategies became key to the process on and off site…
>
> The connections between people who share food cannot go understated, the unspoken human bond around sitting, eating and observing the curious cultural rules around food went further in building strong community cohesion than anything else we did.
>
> Mutual benefit: The fact that we were getting something out (a beautiful learning

process) and the community was gaining a centre, while some individuals gained higher community status is key in such a project."

Andy Bolnick
Informal Settlements Network

"The students came with no resources other than their enthusiasm and technical skills…The community shared their ideas of how they wanted the hall and surrounds to look like after the upgrade.

At the community level they were mobilising people to work on the project…The energy and camaraderie on site was palatable.

(Such) initiatives are truly remarkable and inspirational."

Mohau Melani
Community representative: Slovo Park

"At the beginning of the project…we thought, maybe all these people want us to move far away from here, but also we wanted to find out what is it that they were interested in doing, so we told each that we need to give them a chance to prove themselves.

For me being able to design a working program and keeping to the timeframes was one the most valuable lesson learnt from the project. Being able to identify the resources within the community and outside of the community and tapping into them was also something for one to write home about.

The major achievement was that of meeting our timeframes and deadlines the efforts put in the project is overwhelming. Our ability to fix each others mistakes and respond to challenges as when they arise. The fact that we were mostly young and willing to learn from each other, from the mistakes we have made and from the elders who were part of the project."

Naledi Ntoahae
Community representative: Slovo Park

"I have learnt a lot from the project as I did not know what was meant the word project itself, when we first started the area was a mess but we managed to turn it into a beauty, what I have also realized is the fact most of the people have a passion for the area which we live on, I have also realized that people have sacrificed a lot for the project as they on daily basis worked for the project and not seeking an employment but to improve their area. I have seen that people like nice things. The students also managed to do their best to encourage us, whether by lifting spades and working as hard as we did everyone did the bit they had to do when they were supposed to.

When we started we were all not sure what was going to happen, what is it we were doing, but once we could see where we were heading the momentum was built and there was no stopping the project."

CONCLUSION

In the case of traditional "self-help" architecture, the designer, builder and end-user are one and the same. Climate, site conditions, economy and availability of materials become the design parameters. The result is a direct organic response. Throwing an architect into the mix often disempowers the end-user or distorts the material conditions due to the possibility of importation. In the case of Slovo Park, expressly because of the balance of energy between designer, end-user and materials, an evocative result has been achieved in which the identity of this emergent community has found translation in an appropriate architectural manifestation.

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Revitalize and Densify Housing Downtown Merida, Mexico

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ABSTRACT
Merida is the capital city of Mexico's state Yucatan, and a very important center of economic and touristic growth within the Yucatan Peninsula. It has a very rich cultural, artistic and gastronomic heritage that goes as far back as the Mayas and the Spanish conquistadores. It is a beautiful colonial city, like many in Latin America, in which the downtown area has been consistently abandoned by its original middle-class inhabitants in favor of suburban housing. Large housing areas are deserted and the patrimonial buildings are slowly degrading either by supporting uses ill-suited for them or by plain abandonment. In 1981, the Federal Government declared a large part of the central city as a Heritage Value Area and in 2003 the Fund for the Preservation of Downtown Merida was created (known as the 'Patronato'). The Patronato is a non-profit organization that coordinates and supervises all interested stakeholders and actions that want to contribute to preserve and promote the area. This paper is about the academic experience of two years working with our students and the Patronato, providing different architectural proposals to address the three main issues that our urban diagnosis brought about: 1. Improve Mobility. 2. Revitalize and densify housing. 3. Make the city "greener".

KEYWORDS:
revitalizing through housing, housing diversification, low income housing.

INTRODUCTION
The study area is located in the City of Merida which is the capital of Yucatan's state in Mexico's South East. Yucatan, along with the states of Campeche and Quintana Roo, form part of the Yucatan Peninsula. The Peninsula is surrounded by the Gulf of Mexico and the Caribbean, and has 1100 Km of coast. It was the cradle of the Mayan civilization and it is an important touristic destination. In fact, tourism is the main economic activity of Yucatan followed by commerce.

Merida was founded in 1542, over the original Mayan city of T'Ho adhering to the rules of the gridiron plan prescribed in the laying out of all new American cities founded by the Spaniards (called *Leyes de Indias*). The space is organized hierarchically in sections with different functions: religious, government, commercial and social. In its origins, as in any other city, there was a balance between these functions and the population inhabiting the residential and common areas imbedded in the urban grid. With the technological and industrial revolutions the density of the city changed. There used to be a generally smooth and respectful urban and architectural transformation of the building stock until the beginnings of the 20th century. With the modern view the old city was seen as an obstacle for progress. The former residents venture for the new ways of life in the suburban areas. Thus Merida downtown residences were progressively abandoned leaving large housing areas deserted with the patrimonial buildings degrading either by supporting uses not suited for them or by plain abandonment.

Figure 1: Yucatan Peninsula

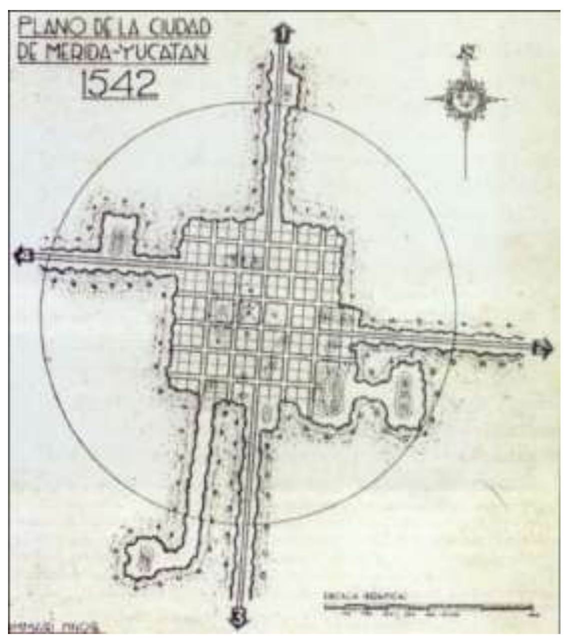


Figure 2: Plan of Merida 1542

Figure 3: Plan of Merida 1864-65

In 1981, the Federal Government declared a large part of the central city as a Heritage Value area. At that time, extensive damage had already taken place in downtown due to the rapid tertiary urban economy. In 2003 the Fund for the Preservation of Downtown Merida was created (known as the 'Patronato'). The Patronato is a non-profit organization that coordinates and supervises all interested stakeholders and actions that want to contribute to preserve and to promote the area.

In 2009 the Patronato partnered with UAM-X's school of architecture to encourage its faculty and students to develop design proposals for the rehabilitation and revitalization of the downtown area. The first opportunity to collaborate with the Patronato appeared when the University of Washington (UW) and Universidad Autonoma Metropolitana Xochimilco (UAM-X) decided to implement a Program where students of both universities would work together for the winter term of 2010. It was a great opportunity to have students from different cultural backgrounds work on proposals to revitalize the central area of Merida. At this time Professor Robert Hutchison and Michael Pyatok from UW, as well as Eduardo Basurto and myself, Andrea Martin from UAM-X, were part of the faculty. When the UW faculty and students went back to Seattle after the winter term was over, students at UAM-X continued to work with design proposals in Merida. Professor Sergio Puente, a PhD in Urban studies, rejoined the faculty team at UAM-X and worked alongside with me for the next four quarters couching students and adding the urban scale to their design proposals.

Merida has inherited from its pre-Hispanic and colonial past and more recently from the Porfiriato and the Revolution spatial manifestations that are still alive in its urban structure and have been helpful in its development. This is obvious in the seven historic neighborhood nuclei surrounding the central grid articulating the old central area with the modern suburban areas. These mostly residencial neighborhoods are Santa Ana, Santa Lucia (Cuarteles I y IV), Mejorada, San Cristobal, San Sebastian, Santiago y San Juan (Cuarteles II y III).

Figure 4: Merida's Heritage Area

Taking as a starting point the guidelines and urban diagnosis of the Cuartel I that Ana Paula Ballina produced for the Patronato, we decided to broaden the scope to all four Cuarteles, so students could have a better idea of the entire area. The Patronato gave us logistical support, information and a place for the students to work at. The scope of the work had three main components: 1. Examine and analyze the study area and its context, and work with community members and stakeholders to identify issues to address; 2. Identify sites with potential for intervention; and 3. Propose projects within the identified sites with programs that address the issues.

For the purpose of the urban analysis we selected the seemingly most interesting nine blocks of each cuartel: for Cuartel I the blocks between the Plaza de la Mejorada and the Old Train station; for Cuartel II the blocks surrounding the Market place; for Cuartel III and Cuartel IV the blocks adjacent to the main Plaza. The students teamed in groups of three to four. Each group documented several blocks as well as important and relevant information for the analysis including land use, history, demographics, and hydrology. Based on this analysis, three primary issues to be addressed in the area were identified, as follows: a) Improve Mobility: There is a problem of public transportation saturation that generates chaos, noise, pollution and pedestrian insecurity because of narrow sidewalks; b) Make the city "greener": Apart from the squares that each cuartel has there are no open green spaces in the central area of the city; there is much need to provide the city with more green open spaces; and c) Revitalize and densify housing: The housing stock in the area is either deteriorating or very archaic; it badly needs modernization and diversification (only single housing is available).

Three major catalytic sites were then identified as central areas which the student's individual projects could relate to: the market area, the old train station area, and the many scattered empty lots which currently remain vacant or are often used for ground parking.

IMPROVE MOBILITY AND MAKE THE CITY GREENER

To address the problem of mobility and to create more open spaces several projects were developed in two of the major catalytic sites: The Old Central Station in the north perimeter of the Heritage Area and the Market Place to the south of the main plaza.

Old Central Station

The first and most important site is the Old Central Station. It is located in a very large rectangular lot. This lot is segmented from another one with a quadrangular shape by two secondary streets. By making these streets underground the two large pieces of land were incorporated for the purpose of the academic exercise. The quadrangular lot is still used as freight train station. The Patronato had already identified the site for its potential to be intervened: a large piece of land, mostly abandoned, housing the Arts School in the historic building of the train terminal. Their proposal was to turn the long rectangular lot into an Arts Garden. But the urban potential of the site demanded for an intervention as huge as the two lots put together. The need for green space was already identified, as well as the need for a multimodal station to address the current public transportation chaos. Envisioning the beautiful city of Merida as a most within the Mayan tourism route required a bold intervention. The students developed a Master Plan for the site with this idea in mind. A system of multimodal stations was proposed and the students designed a multimodal station that would link downtown Merida with the suburbia and the region with a modern, sustainable transportation system. At the same time it would reorganize public transportation within downtown by providing bus and taxi terminals and a light train interconnecting the plazas of the cuarteles and barrios. The idea of the *Circuito de Barrios*, a circuit that would link cuarteles and neighborhoods providing a sense of identity as well as a sustainable means of public transportation was developed previously by Marco Tulio Peraza, Professor at Universidad Autonoma de Yucatan.

Conceptually the Master Plan proposed the following: 1. Relocate the Museo del Ferrocarril in the Old Central Station, where the Arts School is now at the south end of the site, representing the past; 2. A Recreational and Cultural Park full of activities and green spaces representing the present and; 3. A multimodal station with commercial, lodging and corporate facilities at the north end of the site where the future takes place. The idea of conceptualizing the future in a very tall and modern corporate building was to link Merida's XXI architecture to the iconic monumentality of Mayan architecture. The multimodal station would substitute the actual freight station. The Yucatan Peninsula is Mexico's only flat landscape and its railroad network used to be one of the best in the country not long ago. The idea behind the new station is to restore, modernize and expand the railway network to reach important beach resorts and cultural sites in the area. Each student designed different projects following the master plan. Some examples of that work are shown here. The first one is an interesting proposal for the multimodal system in Downtown as well as for the station. The second one is a Hotel that is part of the facilities surrounding the station. The third is a Museum whose building articulates both sites and programs: the Recreational Park and the multimodal station with commercial and tourist services.

Figure 5: Circuito de Barrios

Figure 6: Multimodal Circuit

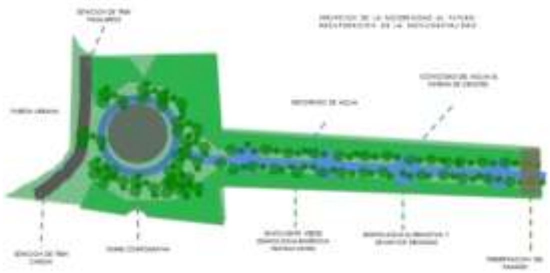


Figure 7: Master Plan for the Old Central Station area.

The Market Place

The projects proposed in this area attempted to resolve the congestion caused by overcrowding informal markets and the public transport that feeds it with users. A beautiful new Mercado designed by Augusto Quijano was built in 2004 to solve the informal vendors problem. It did not solve the problem because vendors refuse to move to the second and third floor of the market, thus making the overcrowding in the ground floor area worse. One of the students projects reconfigured this space through the insertion of an elevated bus stand to relieve the ground plane within this highly congested market district for pedestrian activities and open public space. The reconfiguration also redirects the users of the bus through the upper floors of the existing market building, activating what was originally intended to be a vibrant market space and right now in an underutilized space. Another project relocated the public van stops to the underground parking lot and created an elevated pedestrian access to the market area, to activate the upper market floors and free open space for an open plaza linking the different markets.

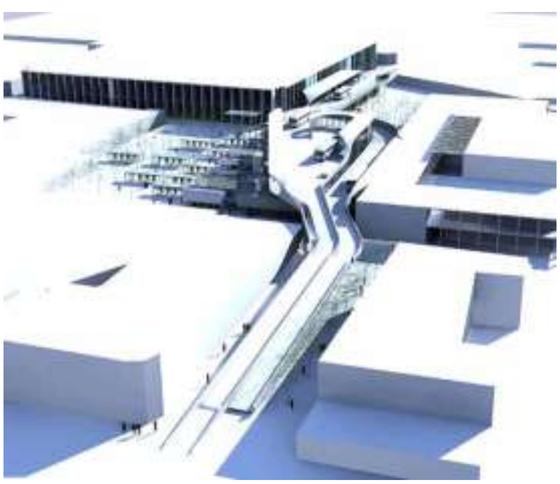
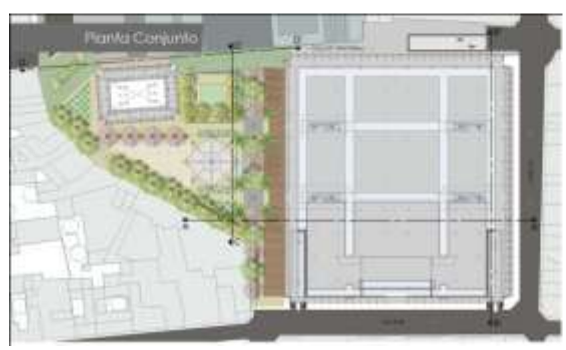


Figure 8: Amitt Ittyerah's proposal for the Market Place

Figures 9: Amitt Ittyerah's proposal for the Market Place



Figures 10 and 11: Ernesto Escobar's proposal for the Market Place

REVITALIZE AND DENSIFY HOUSING

During the 20th century, as a response to population growth, our cities have expanded towards the periphery with the resulting abandonment of the old patrimonial buildings. At the peak of Yucatan's buoyant henequen economy, around the 1940's, the city of Merida had 100,000 inhabitants. Since then up to our days the city's population growth has been almost six fold and the downtown area has been consistently abandoned by its original middle-class inhabitants in favor of suburban housing. Speculation as well as the transformation of the area into one of tertiary activities is full of warehouses, office buildings, parking lots and bus terminals have helped to perpetuate this trend. Large housing areas are deserted and patrimonial buildings are slowly degrading either by supporting uses ill-suited for them or by plain abandonment.

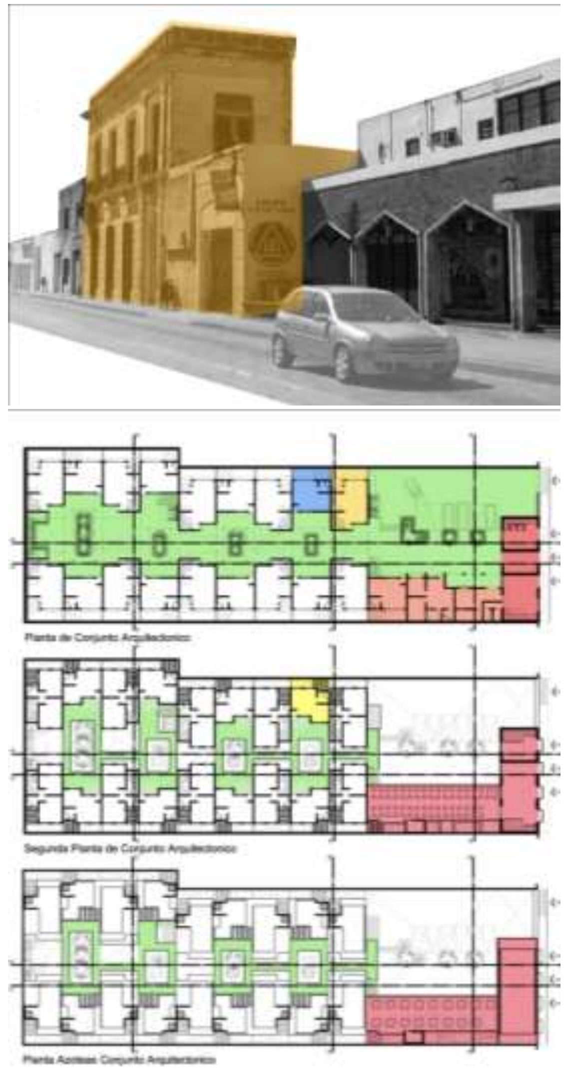
Figure 12: *Central area land use map*

The housing stock in the area is either deteriorating or very archaic; it badly needs modernization and diversification. At the moment only single housing is available. There are many vacant lots used as temporal parking. The Patronato is implementing a program to make the parking spaces greener, encouraging owners to plant trees. We understand that there is a need of parking in the central area but our students approach was different. The idea was to discourage car use and together with the proposed mobility plan encourage eco public transportation within the central area. Parking lots would be provided nearby the modal stations and streets will be used by public transportation, bikes and pedestrians providing wider sidewalks. Merida's sidewalks are very narrow making them very uncomfortable and unsafe for pedestrians. Instead of using the vacant lots for greener parking, students proposed several housing projects in some of them. Some lots had old buildings in them susceptible of being reused. The idea was to provide modern, affordable housing of different types: multifamily, mixed use, duplex, student housing, hostels, low income, etc.

It is well known now that one effective way of revitalizing the downtown areas is by increasing the density and providing different types of housing. That has been the case in Mexico City's downtown. With more people living in it the area becomes safe and lively by night and new types of services, less destructive for the patrimonial building appear.

The darker color in figure 12 map corresponds to commercial use and the lighter to residential use. The empty lots that the students selected for their housing designs were adjacent to the residential areas and into the commercial areas. The following are some examples of those.

Figures 13 and 14: David Sanchez's proposal for youth hostel



Figures 15 and 16: Manuel Gutierrez's proposal for mixed housing.

Figure 17: Juan Arias's proposal for student housing.

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The Small-Scale Private Rental Market in Two African Contexts: Appropriated Space and Missed Opportunities in the Sudan

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ABSTRACT
Following on a previous paper titled "Social rental housing: the South African experience and its relevance in the Sudanese context" which assessed the, relatively new, social housing context in South Africa, and identified possible lessons for an emerging field in the Sudan, this current paper continues the discussion by focusing on the informal rental housing market in the Sudan.

While far from ideal, the South African social housing experience offers some insight with regards to addressing some housing issues in Khartoum. The South African scenario was seen to offer guidelines that might be more relevant than European examples, in terms of social housing policy, financing, design and management.

This paper attempts to elaborate on the topic by investigating the issue through using existing case studies in Khartoum, both of them accommodating for lower cost rentals. The focus will be on how the private sector provides for this gap market and what kind of service they are able to deliver. This analysis will then be used to determine the potential (often missed) role of government in this segment of the housing market. The intention is to follow up this paper with a similar study of comparable South African case studies.

This research is carried out with a view towards the potential of rental housing to act as a driver or catalyst in the uplifting of decaying inner city areas. In addition, through the support of strategically located, medium- to higher- density rental housing in the city, governments would be able to facilitated the development of viable neighbourhoods, achieve economic and social developmental aims and guide the activities of the private sector in the realisation of a vision for participative and integrated development.

KEYWORDS:
private small-scale rental housing, South Africa, Sudan

BACKGROUND

Following on a previous paper titled "Social rental housing: the South African experience and its relevance in the Sudanese context" which assessed the, relatively new, social housing context in South Africa, and identified possible lessons for an emerging field in the Sudan, this current paper continues the discussion by focusing on the informal rental housing market in both contexts and presenting case studies from Khartoum, Sudan.

The private sector in both contexts continues to offer small-scale, low-cost rentals for a gap market with high levels of demand. This is a missed opportunity for governments in both countries who continue to focus on ownership options as a part of national housing projects. In South Africa more emphasis is being placed on a perceived critical role for government-subsidised social housing.

This study explores these concepts further and is part of an on-going longer term project which attempts to better articulate the potential (often missed) role of government in this segment of the housing market.

APPROACH TO THE RESEARCH, DEFINITIONS AND LIMITATIONS

An open building approach for residential architecture forms the basis for this project where buildings are understood to be in constant transformation and adaptation throughout their lifetimes. This keeps the residential stock relevant and the spatial and formal qualities of these buildings able to accommodate for changing needs of the inhabitants as well as changing lifestyles and taste. Some of these changes have important environmental, social and economic benefits.

By looking at residential buildings through an open building perspective it become easier to assess buildings objectively with regards to qualities that are restrictive or supportive of future adaptation; it also facilitates for comparisons to be made between different building types and their long-term sustainability features with specific focus on adaptation potential.

Open Building is an approach to architecture which conceives of buildings as having several "levels" some of them being more permanent while other levels are more transient and undergo transformation over time.

Private rental in this study implies small-scale rental opportunities provided by private landlords usually as a sub-dived section of their own homes or as vertical or horizontal extensions of their houses.

In South Africa, a definition of small-scale private rental is as follows: "...generally a small-scale activity, seldom exceeding five units per property, produced on privately held land and managed by private individuals. It is offered to occupants who are separate households through private rental treaty, whether formal (written) or informal (verbal) in nature..." (Urban Landmark; 2011, p. 3)

The Urban Landmark definition therefore focuses on the nature of the delivery system and not on the form of the accommodation. The definition also excludes corporate and publicly owned accommodation, rental options in informal or illegal settlements and social housing and housing co-operatives.

In this study, reference to South Africa usually implies a fairly accurate portrayal of national trends in terms of informal rental in urban areas specifically – despite inevitable nuances and unique trends from province to province. Enough has been researched and published on backyard rentals to allow for a better understanding of informal landlords and rental stock. However, reference to the Sudan might be somewhat deceptive as currently it would be more accurate to refer to Khartoum only until a broader based study is initiated and more data gathered for the rest of the country.

SMALL-SCALE PRIVATE RENTAL HOUSING IN SOUTH AFRICA

The Urban Landmark study elaborates on the concept of small-scale private rental as being "...an international phenomenon, and is not unique to South Africa. This sub-sector is generally one of the most successful, efficient and pervasive accommodation delivery systems in South Africa. Of the 2.4-million South African households that rent their primary accommodation, 850 000 (35%) occupy small-scale private rental units. This equates to approximately 10% of all South African households."

It is also elaborated that: "Contrary to popular belief, 53% of all small-scale rental units are formally constructed (houses, flats, or rooms), with the balance (47%) being shacks in backyards. The small-scale private rental sub-sector achieves this with no direct state support, and at times in contravention of a hostile policy framework. It is also interesting to note that the fastest-growing sub-sector within the small-scale private rental sector is houses, flats and rooms built on properties with existing dwellings, with a growth rate of 83% between 2002 and 2006. The average delivery of formal, small-scale private rental units between 2002 and 2006 was 33 500 units per annum – without direct state support."

It is continued: "The sector is currently estimated to be generating a rental income in excess of R420 million per month, or just over R5 billion annually. The majority of landlords are otherwise unemployed. In the townships, many are elderly women with little or no other sources of income." The sector is therefore considered to be of immense importance as a sole source of income for many small-scale landlords. The system also produces a wide variety of accommodation types and is considered important in providing more rungs on a perceived "housing ladder" which is considered to be inadequately catered for by government housing programmes and other forms of private housing provision.

The Urban Landmark study also explains that small-scale rental options are found across the economic sectors and include "...backyard rooms and shacks, domestic workers' quarters, communes, converted garages and small-scale tenements, and 'garden' or 'granny' cottages associated with middle- and upper-income neighbourhoods..." thus recognising and understanding this continuum of small-scale private rental options, delivered by the same basic delivery system, leads to a more balanced policy response and concentrates attention on the factors that will lead to the delivery of improved small-scale private rental outcomes, rather than simply on those elements deemed undesirable, for example that they are slums, unhygienic, chaotic or unsafe." (Urban Landmark; 2011, p. 4)

In South Africa, the most recognisable form of small-scale rentals are township backyard shacks. There are many concerns regarding this form of rental including legal issues, increased pressure on service systems, structural concerns, comfort and social issues.

More focus is being placed on rental options for the poor through various government programmes and increased institutional support. Social housing intends to located lower-income groups closer to job opportunities and social amenities. This is mostly through a social housing programme, government-subsidised rental, and Community Residential Units (CRU). These programmes usually exclude the very poor (those earning below R1500 ($250)/month) as these are catered for by another government programme that focuses on ownership options. The social housing programme intends to cater for income groups between R1500 ($214) and R7500 ($1070) with the intention that a particular percentage of the projects focussing on the group that earns less than R3500 ($500).

SMALL-SCALE PRIVATE RENTAL HOUSING IN THE SUDAN

The Sudan National Baseline Household Survey of 2009 "...provided information on various socio-economic aspects such as household and housing characteristics, employment pattern, education level and income distribution etc. of the rural as well as urban market centres where the households were situated." Some of the main findings showed that, regarding the tenure status of the main dwellings, "...89% of all households owe their dwelling while 5% are renting." Thus ownership is the dominant tenure status with 75% of urban households owning their dwellings and 15% renting. However, it is perceived that there is high demand for rental options if residential extensions and additions on existing buildings are presenting an accurate picture of the demand – however, this will need to be verified through proper research and investigation.

The Fund for Housing and Reconstruction is part of the Ministry of Housing and Planning which was established in 2001. This body governs the involvement of government in housing provision. There are some employer-assisted housing options as well as major rental developments by the private sector. Similar to the situation in South Africa, most institutional support through government programmes focus on ownership options. There are some programmes that aim for ultimate ownership but start of on a rental basis. Al Iskaan Al Shaabi provides single storey houses 3.5 Million Sudanese Pounds ($1150) as an advance payment with 24-27 Million ($6800-$7800) paid as monthly instalments over 12 years (Ayoubiy; date unknown). Like South African government-subsidised housing, these projects are low density and peripheral and contribute greatly to urban sprawl. The units are intended as starter units and additions are therefore common, despite the fact that extensions are developed in rudimentary materials associated with informality. Rentals are currently rare in these areas.

The government programme also provides Al Sakan al Igtisadi, another form of housing mostly built in the same locations with similar architectural specifications but with only three years for the repayments. Al Sakan al Istismari is different in that it is usually better located and the typology is either stand-alone villas or apartments. Both these types of housing are intended to cross-subsidise the lower-cost houses. A point system is used for allocation of these houses and takes into consideration place of birth, no of children etc. However, anyone can access these projects irrespective of income level.

Also similar to the South African situation, Khartoum is strictly separated in terms of zoning and mixed use is not done in any structured manner. In many higher-income residential areas demand for commercial and residential rentals has led people to extend vertically and horizontally. This has resulted in very high densities and great pressure on services and in terms of parking needs which have rarely been considered as the neighbourhoods have transformed. The developments are therefore happening with minimal government control or supervision and there are no clear programmes that support these changes that have transformed neighbourhoods beyond recognition in the span of a few years.

As these processes were well underway, authorities started exerting more control and licences then have to be issued for re-zoning. These are expensive to obtain and therefore a form of gentrification has happened where lower-income groups are displaced through selling their homes to higher-income groups who are able to obtain these licences.

The typologies are mostly detached family houses which have been vertically extended and apartments included in the upper levels. The issues of concern are services and parking compromised, structural issues and legality.

PRESENTATION OF THE KHARTOUM CASE STUDIES

In this paper two of the considered case studies are presented as part of this on-going research project. These have been selected to represent two very different contexts and different typologies. It is also fair to say that the examples represent different income levels for the landlords and tenants.

Case study 1

The project is in Shambaat, Khartoum North, Square 18. It is a house typology that is typical of that area, the plot being 400sqm. The building has approvals for ground + three storeys – this is usually done with a vision for future investment and on-going income for the family through the development of rental stock. It was built as a family house on the ground floor including three bedrooms, a saloon (visitors room) and a family hall. The service area is on one corner of the plot and the staircase is accessible from the outside of the building permitting the tenant's access to the upper level units.

After building, the ground floor was further adapted to accommodate for more rental space. The changes that were implemented were:

- The saloon was sub-divided into two spaces including a bedroom and a sitting room
- One of the bathrooms was also split into two allowing for an additional toilet
- A section of the small courtyard in the middle of the house was used to extent the internal space to accommodate for a kitchen
- A separate entrance door was thus possible allowing for another rental unit
- Service lines were also affected by the changes, the water and waste piping was changed in a major way with more minor changes made to electrical connections
- The electrical meter is still one for both apartments which might cause future conflicts

Many of the designed features of the base building have permitted ease of change and adaptability. Firstly, the building is a frame structure with non load-bearing internal partitions. Secondly, the building was initially conceived of as being adaptable and the structural, circulation and servicing systems, these being the most critical with regards to change potential were designed to accommodate for future changes.

The upper floor plans also underwent changes and were sub-divided to allow for two rental units per floor instead of one. As these were initially intended for rental, the electric meters were included for each rental unit.

Conflicts also arose due increased pressure on water and an additional tank was added on the roof. A water pump is used. In some older areas with old piping this might be problematic. However, this area is recently planned and built and the networks are new and may tolerate this additional pressure due to the higher densities.

These changes and some images are presented in the next few images and photographs.

Figure 1

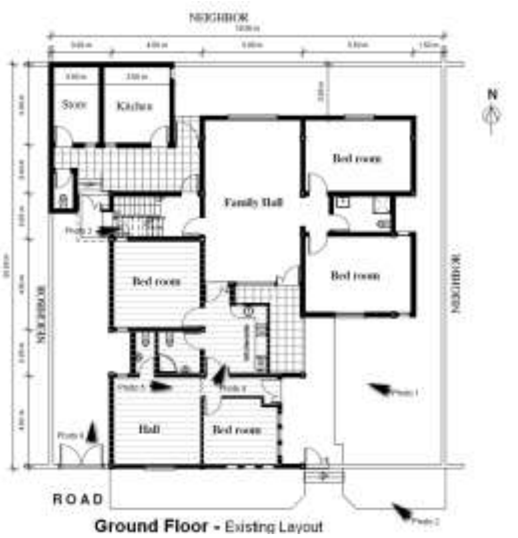

Figure 2

Figure 3

Figure 4


Photo 1


Photo 2


Photo 3


Photo 4


Photo 5


Photo 6

Case study 2

This second case study is in Haj Yousif, Block 1, Khartoum North. This semi-detached house was initially built on land distributed through traditional systems of ownership. The area was then upgraded and formally planned. The area is 675 sqm and the buildings are of red brick and mortar with timber planks for the roof, covered with a waterproof layer and khafgi (a thermal barrier made from a mix of crushed brick, lime and cement).

The owners inhabit a section of the house on the southwest corner. The courtyard was sub-divided on the northwest corner around the existing outside room and an attached kitchen was built as well as verandas. The buildings are made from rudimentary materials, with corrugated sheeting as roofing and cane screens.

The existing pit latrines were replaced by two full bathrooms for the landlord and tenants. An on-site septic tank and well were constructed. The family was able to access bank finance to upgrade the sanitation system and the landlord was able to repay the loan through renatl income.

The large size of the site has permitted sub-division and adaptation as well as the incorporation of on-site sanitation

The size of the site has also permitted the complete separation of the tenant's courtyard thus having privacy for both families

Water and electricity meters are shared and this is perceived to be problematic for the future

The semi-detached typology did not cause any problems, maybe due to the fact that the neighbours are family – however, this might be problematic in other contexts and situations

Disputes do arise in some cases due to confusion with regards to maintenance responsibilities – however, if it is possible to manage this relationship between the neighbours the semi-detached typology might be a viable option with regards to reducing thermal gain on the walls as well as reducing the costs

The by-laws in this area permit for ground + two storeys – the existing buildings are not conducive to vertical expansion and this would probably only be an option through re-building after demolishing the existing buildings – there would probably be financial limitations for the family and this option is difficult to achieve

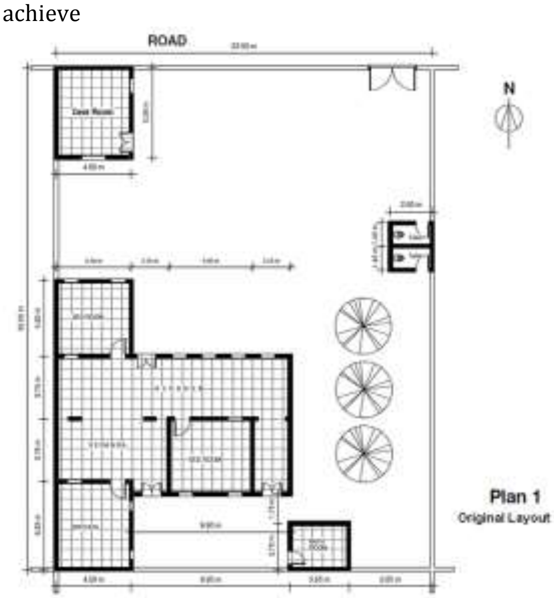

Figure 5

Figure 6


Photo 9


Photo 10


Photo 11

DISCUSSION AND CONCLUSION

This paper highlights the importance of rental housing in two African contexts with a focus on small-scale private rentals. It then presents two selected cases studies from Khartoum where rental options were added through adapting existing buildings. Mention has also been made with regards to the importance of social housing.

While far from ideal, the South African social housing experience offers some insight with regards to addressing some housing issues in Khartoum as the South African scenario is perceived to offer guidelines that might be more relevant than European examples, in terms of social housing policy, financing, design and management.

This study is carried out with a view towards the potential of rental housing to act as a driver or catalyst in the uplifting of decaying inner city areas. Through the support of strategically located, medium- to higher- density rental housing in the city, governments in both contexts would be able to facilitated the development of viable neighbourhoods, achieve economic and social developmental aims and guide the activities of the private sector in the realisation of a vision for participative and integrated development.

The case studies will be further analysed in a future paper and lessons drawn with regards to addressing and supporting small-scale rentals as well as harnessing the potential of rental housing to further develop government housing programmes.

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