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A comparative longevity study of traditional buildings between rural and urban areas in Pearl River Delta, China

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ABSTRACT

The rapid economic development and urbanization in Pearl River Delta of China, have changed the physical environment dramatically but also led to a crisis of the short life span of contemporary housing. When the green building concept cannot help provide the appropriate answer, many scholars turn to traditional buildings. Unlike in rural cases, traditional buildings in urban area obviously exhibit diversity and long-term usage. However, most of current studies focus on the preservation of historical features but do not analyze why and how such buildings can last a such long time. Historical cases in both two areas might have a certain number of common sustainable factors because they evolved from a similar prototype in history. For a better understanding of their common features and why they have different performances, theories closely related to the longevity and the “level” strategy will be introduced. These theories aimed to increase the life span of buildings and pay more attention to the interrelation between people and built environment in the temporal dimension. Within this framework, several historical cases from the urban area and a traditional village will be compared and studied by using the “level” division method, and abundant longevity evidence will be revealed and analyzed. As part of a complex and consistent research aimed at constructing an evaluation system, the results of this investigation will initially evaluate their long-lasting performances qualitatively under the two different contexts.

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KEYWORDS

Sustainability; long-lasting; “level” strategy; traditional village; historical building

1. Introduction

As the most advanced area in the largest developing country, Pearl River Delta (PRD) area of China has taken the advantage of “National Reform and Opening-up Policies” in the last several decades. It is the first area in the country to open its housing sector to the market, accompanied with a rapid urbanization process. Whereas, contemporary housing in PRD commonly has a short life span. Since the 1990s, a large amount of midrise housing built in the 1970s and the 1980s have been demolished to lease enough lands for new development.

Local scholars and practicing architects realized this phenomenon and attempted to find out the major causes. They first paid attention to the environmental problems because this area strove to develop the industry during this period. Accordingly, the green building concept gradually gained popularity and is treated as an ideal solution for building sustainability.

However, the green building concept focuses on the physical environmental aspects that would lead to a purely scientific approach to architectural design, construction, and usage. According to Cole, the contents of comparison and analysis of green buildings are typically based only on technical issues, and the success of the

assessment tools has dwarfed all other mechanisms for instilling environmental awareness (Cole 2006). In recent years, an increasing number of studies on traditional buildings have been conducted because such buildings have existed more than a hundred years.

2. Research problem

From a historical point of view, PRD also has a long history. Its urban and rural areas have a large number of long-lasting buildings. Its centric status in South China and frequent communication with foreign countries, results that this area featured with inclusiveness and diversity. Accordingly, its architectural and building typologies have combined with integration and variation.

Nevertheless, most current studies on traditional buildings focus on historical features preservation but ignore the analysis of why and how they can last such a long time. For instance, on the national scale, the latest version of documents such as “Law of the People’s Republic of China on Protection of Cultural Relics” and “Regulation on the Protection of Famous Historical and Cultural Cities, Towns and Villages” only list the criteria for identification and protection

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guidelines (*State council, 2014, 2017*). On the provincial scale, the books *Guangdong Ancient Village* and *Guangdong Vernacular Dwellings* pay more attention to presenting and describing the characteristics of traditional villages (*Lixiang, Xueguang, and Linafu 2010; Qi 2008*). Other local scholars have narrowed down the scope of study to a specific village and a building, or a specific aspect like street pattern and water system.

As for green building concept, its limited scope cannot precisely resolve the short life span phenomenon of contemporary housing. The preservation focus of historical cases, which lack a longevity-oriented analysis, cannot identify the underlying reasons. Hence, this paper seeks an appropriate approach to analyze and find out the factors that traditional building can last such a long time in this region. In order to provide valuable references for contemporary urban and housing design. Although these traditional buildings have existed more than a hundred years, cases in rural and urban areas have different performances. In the village area, where are facing hollow phenomenon, a large amount of buildings are in danger of being abandoned. In contrast, urban cases obviously exhibit diversity and long-term usage. A further study is therefore necessary.

3. Theoretical framework

Even so, cases in urban and rural areas might have a certain number of common sustainable factors since they evolved from a similar prototype. In fact, the decline of most villages is neither due to physical damage nor environmental pollution, but because of abandonment by local residents and without attractions for newcomers. The decline of urban cases mainly refers to inappropriate use for the new demands of citizens. Both of their similar and different factors are closely linked to the interrelation between human behavior and the built environment, which is also the core issue of theories of Long-lasting buildings.

3.1. Theories of long-lasting building

In the 1960s, many theories and practices emerged with the aim of resolving the problems caused by the modernism movement and to achieve longevity, such as Structuralism, Open Building (OB), and Typology. They attempted to reveal and emphasize on the essence of the interrelation between human behavior and the built environment. Structuralism is the belief that the phenomena of human life are not intelligible except through their interrelations. These relations constitute a structure, and behind local variations in the surface phenomena there are constant laws of abstract culture (*Blackburn 2008*). Many architects and researchers, especially the group of Team 10, have made many efforts to apply

this method in architectural domain. As the key members of Team 10, Alison and Peter Smithson and Aldo van Eyck have advocated several major concepts with affinity of human being concerns, including “belonging,” “transitional space,” “in-between,” “growth patterns,” and the later comprehensive concept of “cluster”. These concepts are all closely connected to the human behavior (*Yuan and Wang 2009*). As a theory and methodology with strong connection to structuralism, OB theory offers clear illustrations by systematically integrating the built environment, people, and temporary dimension. It was proposed by N. J. Habraken in the 1960s that aimed at enhancing the efficiency of the building process, while increasing the variety, flexibility, and quality of the product. In general, the best buildings are those that are most able to provide capacity to changing functions, standards of use and lifestyle, and improved parts over time (*Kendall 2012; Kendall and Teicher 2010*).

Compared with structuralism and OB theory, Aldo Rossi paid more attentions to the connection to culture and history. Alan Colquhoun stated that the critical criteria of structuralism needs a transformational mechanism to be applied in architecture, namely, typology (*Colquhoun 1969*). According to Rossi, the architecture of the city has two different basic meanings: the city as a huge artificial object evolving in the time dimension and the city as featured by its own local history and unique morphology. He also divided these constructions into two major categories: primary elements and dwelling areas (*Rossi 1984*).

Many of Rossi's proposals were also emphasized by Dietmar Eberle, but he employed a holistic view beyond the role of traditional architects and still insisted on the important architectural issues, including long-lasting cultural factors. This framework can balance social service life and physical life, along with openness and inclusiveness for people's demand changes and technology upgrades. As he pointed out, “In a global scene, we need to look at building as a process. We need to correct and complete information about people, energy and resources. If we understand this, then it is clear to me that design is not about creating new things, but rather about creating a building, which will last at least 200 years” (*Eberle and Simmendinger 2007*). Although Eberle constantly promotes building technology development, including facade, energy-saving system, structure, and material, his understanding of sustainable architecture not only focuses on the technical aspects, but also includes social sustainability factors, such as public cultural acceptance in a macro scale and user demands in a micro scale.

3.2. Initial longevity issues

Based on the core value of long-lasting theories, several initial longevity issues can be concluded. First, in OB theory, housing development cannot be treated

independently apart from its surroundings (Habracken 1980). According to Rossi and Eberle, collective memory and public pleasure play an important role in enduring public space systems (Rossi 1984). Many scholars frequently associate longevity with the structure system, which can ensure the entire building's longevity. This term is also not limited to the structure system and can be extended to the durability of construction and materials. For instance, Fabbrocino et al. (2019) introduced a simple seismic vulnerability and risk assessment tool specific for structural performance. Michele et al. (2019) further discussed several tools, including simplified and complicated ones, and compared their applications of several traditional territorial cases. They found out that, all these tools can be well applied but should be used according to different circumstances and requirements. Furthermore, adaptability and flexibility are widely mentioned and applied in relative theories and practices, such as OB theory, Stewart Brand's "learning building," the SAR's studies, the practices in the Netherlands, and SI or KSI systems in Japan (Bosma 2000; Brand 1995; Fukao 2011). Recently, these factors were introduced by some Chinese scholars and used to analyze the traditional Chinese buildings, which has been proven are important longevity issues (Beisi and Yingying 2011; Tan 2011). Last, the increasing attention to material and environment issues is due to the growing environmentalism, which is another long-term issue in conserving the "embodied energy" of buildings and cutting down on the enormous solid waste burden of demolishing buildings. However, technology prioritization is dominant in concepts such as green building and ecological building. They are, indeed, unstable elements that can be replaced over time, thereby providing an opportunity to refocus on the traditional

building's passive strategies. Many of the initial issues are relative in multiple levels. For example, longevity/durability and passive design strategy will definitely cover more than one level but will have different focuses and detailed contents in the different levels. Furthermore, some of them are complicated, covering several key aspects of the three spheres (social, cultural, and economic) according to the classic definition of sustainability. These issues are therefore, can be eventually generated into a more complex indicator set.

3.3. Level strategy: an appropriate framework and tool for analyzing building's longevity issues

Traditional Chinese buildings have a strong identity that it is an obvious open and "level" division system. In the urban level, the concentrated building arrangement enables the facade to connect to the open space directly. A general building can be basically divided into four parts: foundation, facade, structure, and roof. Among these parts, facade system is very weak and is flexible enough to open the inner space to the courtyard and street. The modular construction system, including standard plan depth, width, and wood structure system, further strengthens its "level" intention (Figure 1).

Actually, a similar concept can be found from relative long-lasting building theories. In the 1960s, M. R. G. Conzen conducted a comprehensive study of Alnwick, Northumberland in England. He argued that the city is a physical form accumulated through time, and it is complicated both in temporal and spatial dimensions. In order to better understand them, different scales must be clarified first and then divided into specific and clear aspects for analyzing

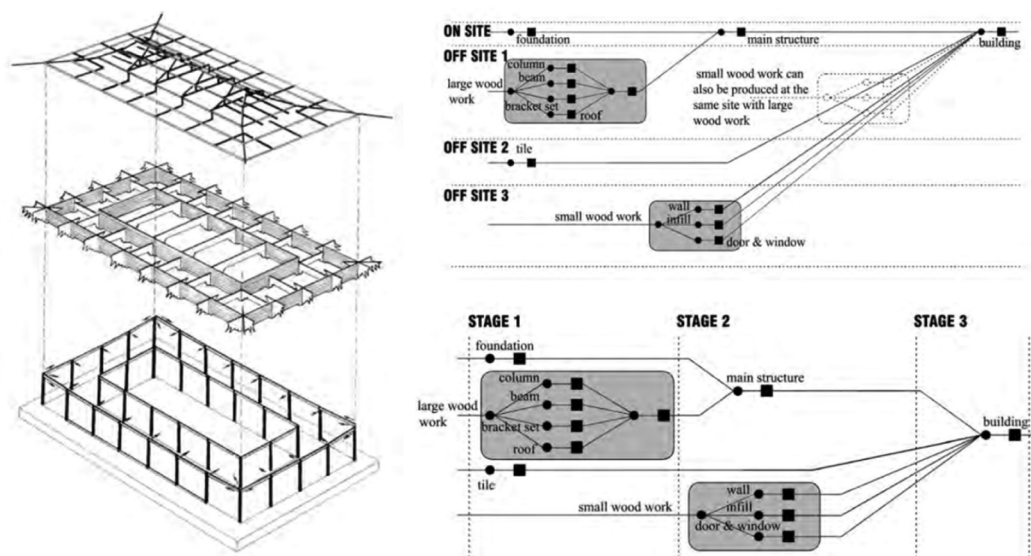


Figure 1. Main structure of large wood work and the "maps of control" in traditional Chinese construction chains (sources: (Beisi and Yingying 2011)).

respectively (Conzen 1960). Conzen focused on both the urban center and the urban fringe. By using Conzen's method, English scholar Whitehand together with Gu Kai from China comprehensively analyzed a Chinese historical city: Ping Yao (Whitehand and Gu 2007). Later, they conducted some similar studies for a historical neighborhood near the Forbidden City in Beijing.

The "level" strategy of OB has similar concept of organizing and balancing the interaction between physical and behavioral aspects, as well as between physical and service life. Habraken divided residential building into "support" and "detachable unit", and eventually proposed the "level" concept (Nikolaas John Habraken 1972 N John Habraken 2002)(Figure 2). OB projects are structured to subdivide technical, aesthetic, financial and social decisions into distinct levels of decision making (Kendall and Teicher 2010). More similar works can be found from Stewart Brand and Diemer Eberle, the former focused on theory study, whereas the latter focused both on theory and practices (Brand 1995; Eberle and Simmendinger 2007).

The "level" division strategies of Conzen, Habraken, and Eberle are different. Owing to his geographical background, Conzen's division is more precise from urban to building block levels, without further considerations of the interior level. As architects, Habraken and Eberle divided the build environment into five levels. But Eberle integrated fabric and support levels into one building structure level because the public spatial dimension is largely determined by structure. Facade is important as well, it has great potential for climatic adaptation, public spatial atmosphere, and flexibility. Therefore, four divided levels will be used

in this study. Infrastructure and public space are suggested an independent level higher than the building level. The clear division of structure and facade levels and their relative elements, such as staircase and service core, is also necessary. They are the second and third levels, respectively. In the interior scale, regardless of the division of infill and furniture – or the division of program and infill – they can be treated as a group of strong interactive elements, and a function or program change will normally be accompany by changes in the physical part. The fourth level will then combine with the interior and function layouts.

Eventually, a combinative and 2D basic structure is suggested to build up an appropriate assessment framework for long-lasting buildings in the focused area. Vertically, four levels are divided with different life span targets. Horizontally, four groups of longevity issues will be allocated in each level. Some initial longevity issues that included complex contents will cover several key aspects of the three spheres (social, cultural, and economical) according to the classic definition of sustainability (Table 1). At level one, a scale with largest number of comprehensive factors, social, environmental, and economical issues will be categorized respectively, and the three issues can affect the most important issue from classic long-lasting theories – urban form and public space. At levels of two and three, social and environmental aspects continue to provide significant influences. Moreover, as discussed above, the longevity and flexibility will be independently treated as crucial factors corresponding to stability and adaptability. They are also influenced together by social, environmental and economic

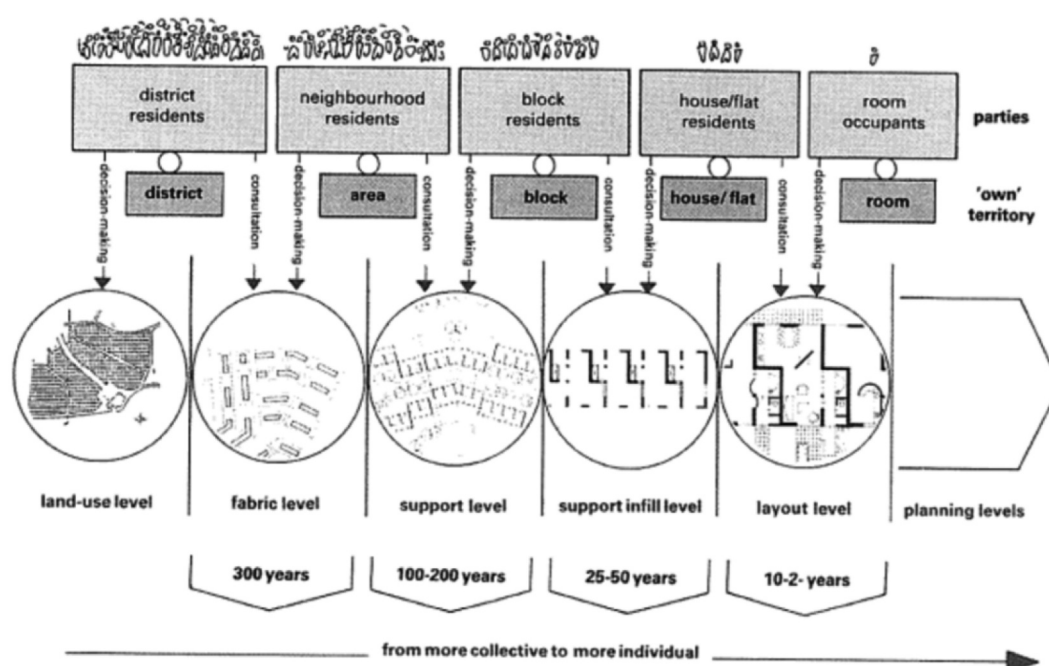


Figure 2. Decision-making levels in open building (sources: (Kendall and Teicher 2010)).

Table 1. Interrelation between longevity issues and three sustainability aspects in the “levels”.

Levels	Initial Longevity Issues	Sociocultural Aspect	Environmental Aspect	Economic Aspect
Level One: Infrastructure and Public Space	Social and Cultural Environmental Strategy Urban Morphology and Public Space System Economic			
Level Two: Load Bearing Structure and Staircase	Social and Cultural Longevity/Durability Flexibility and Adaptability Environmental Strategy			
Level Three: Facade and Service Core	Social and Cultural Longevity/Durability Flexibility and Adaptability Environmental Strategy			
Level Four: Interior and Function Layout	Social and Cultural Flexibility and Adaptability Environmental Strategy			

aspects. Level four has similar issues with the level two and three, but longevity is not that important since life span at this level is approximately 20 years.

4. Case study

4.1. Case selection strategy

Residential settlement in the PRD is clearly multicentric and the wealth distribution is more even than that in most areas of the country. Historically, the clan system flourished for a long period, allowing resources to be concentrated and the local cultural features to be reflected easily. In Guangdong Province, wealth concentration is the highest in PRD. All these factors had profoundly impacted buildings' longevity in this region. However, the development level and architectural identity between city and village are still different. Economically, cluster arrangement patterns and architectural typologies have close relations with commercial activities. Culturally, frequent communication with other areas resulted in diverse cases with long-lasting factors in towns and cities, especially those that emerged in the last 100 years. However, the cases in villages have many commonalities and less diversity. They have weaker traffic, clan system power, as well as cultural and commercial impacts.

Thus, two different case selection strategies will be applied under the “level” strategy framework. Four traditional cases from cities, which have representative identities of each level, will be analyzed in each level respectively. At level one, Shawan town will be selected. It is a historical town next to Guangzhou city center with more than 800 years, and it has been influenced by clan and commercial factors, but the entire urban pattern is still preserved well until now. At level two, Chen Clan Academy in the Guangzhou city center will be selected. It is a clan donation building with sufficient funds, a large-scale form and the highest local construction level. At level three, Shangxiajiu Street in the Guangzhou historical

shopping center will be selected. It is featured by a strong commercial oriented façade along with other comprehensive factors, gradually becoming a three-dimensional adapted space system. At level four, Donghuali in Foshan city center will be selected. It is a national historical street that consists of diverse residential typologies evolved from the local standard unit.

In terms of village, which is a relatively stable built environment system with less diversities, Daqitou will be chosen and analyzed in all four levels. As the first “national historical and cultural village” in PRD (*“The First List of Historic and Cultural Villages and Towns in China,”*), Daqitou has been completely preserved and is regarded as the most typical traditional village. It consists of 200 constructions built from the Qing Dynasty, covering residential and public functions (Figure 3). In summary, three advantages for better achieving the research target can be summarized from this theoretical framework and case selection method.

- The case study conducted by applying the “level” strategy can initially test the cases' basic longevity performance in a holistic way, and verify if the method is applicable.
- Owing to different locations and contexts, a comparative study between cases from towns and villages can help to better understand their pros and cons.
- By choosing the representative cases from cities specific in each level, the disadvantages of Daqitou village can be revealed in a detailed and comprehensive manner.

4.2. Case study

4.2.1. Level one: infrastructure and public space

Shawan town is one of the oldest towns in PRD. It is located in the south-central part of Guangzhou City and is a preserved and concentrated area with intact






Levels	Rural	Selected Reasons	Urban	Selected Reasons	
Level One: Infrastructure & Public Space	Daqitou	rural cases have many commonalities and less diversities , Daqitou is the first “national historical and cultural village” in PRD	Shawan Town	the entire town pattern has maintained over 800 years	
Level Two: Load Bearing Structure & Staircase			Chen Clan academy	highest local construction level	
Level Three: Façade & Service Core			Shangxiajiu Street	a strong façade feature with comprehensive influences	
Level Four: Interior & Function Layout			Donghuali	typical housing typology with local standard unit	

Figure 3. Traditional case selection from rural and urban areas under the “level” strategy.

urban pattern and traditional South China folk architectures (Zeng 2013). Along with the transformation of the functions, services, and other factors, the basic structure of the cluster is still well adaptable until nowadays. Shawan town is regarded as an attractive cultural and commercial area both for visitors and local residents. At level one, it will be analyzed together with Daqitou village from a holistic perspective (Figure 4).

• Social and Cultural

Deep-rooted clan system: Sophisticated and deep-rooted clan system is an important factor that affects the habitat formation, especially during its early time in PRD. In Daqitou village, “Zheng” has been the dominant clan since the Qing Dynasty. At the end of the 19th century, Zhang Shangzhong, who was born in this village and had served as the admiral of Guangdong province, was permitted by the central government to rebuild and expand his hometown (Xunhou 2007). The entire shape of the village has a symbolic meaning that looks like

a general on the battlefield. Its component buildings also have diverse cultural implications, such as brush pen, ink slab, and sheet. In Shawan town, land properties are mainly owned by several big clans, eventually causing the “Mingtian – Shatian” spatial pattern. Residents of these clans live in the area until today and still compose most of the population. Mingtian is the major residential area, and Shatian is the rural cluster adjacent to the farmland and canals (Ying and Xiaolan 2014). Although some clans have declined or developed, the basic clan structure and urban morphology are relatively stable.

• Environmental Strategy

Fengshui: The location selection of Daqitou village and Shawan town are based on the fengshui/geomantic concerns and have many similar strategies. Figuratively, they are the places of a Dragon’s lair surrounded by mountains, gathering universal energy and facing the mouth of water to the south. Geographically, the location was helpful for military defense in the early

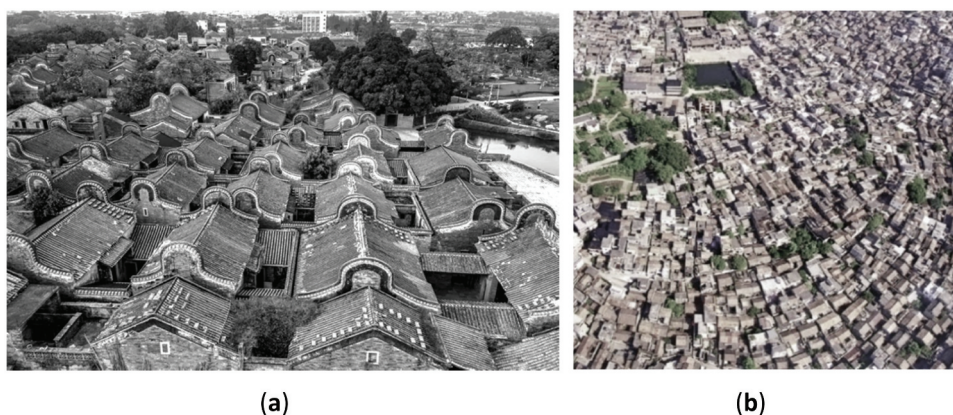


Figure 4. Urban form comparison: (a) Urban pattern of Daqitou; (b) Urban pattern of Shawan.

times. Environmentally, it can block winter wind from the north. Visually, it can maximize the gorgeous view toward the south. Psychology and substance can be therefore mutually influenced under this context.

Topographical adaptation: Climate and topography factors are the other key preconditions for the building arrangement in Daqitou village. Geography is higher in the northern mountainous area and lower in the southern water side. The high area is beneficial for better drainage and ventilation, especially during the rainy spring and hot summer seasons. A similar arrangement strategy can be seen in Shawan town. The higher ground area was developed earlier and is much denser. Later, it extended toward the lower southeast part. Both of their overall layouts can utilize the different wind pressures generated from different urban spaces and surrounding areas (Qian and Zhengzang 2014; Yue 2013) (Figure 5).

• Urban Morphology and Public Space System

Compact urban form: The cluster forms of Daqitou and Shawan are both compact. In order to enhance the ventilation and the adaptation of slope topography,

the clusters were planned as a comb pattern. Major streets were planned in the southwest-northeast direction, and the lanes were planned in the northwest-southeast direction. Their arrangements were designed in accordance with the prevailing wind direction during summer. Most constructions in the central area are two to three floors high, with a density of more than 70% (Figure 6a). A high density and a compact shape can guarantee sufficient shadow and accelerate the wind speed during hot, humid summer time.

Highly connected and abundant public space system: The public space system in Shawan town is a three-hierarchy system that consists of street, lane, and courtyard (Yue 2013). In front of some public buildings and water spaces such as temples, academies, or pools, streets are enlarged, serving as important spaces that function as grain-sunning grounds, daily social spaces, holiday events, or playgrounds. Other streets and lanes serve as public spaces for occasional communication among acquaintances or strangers. The courtyard is regarded as another type of public space mainly for a single family or several blood-related

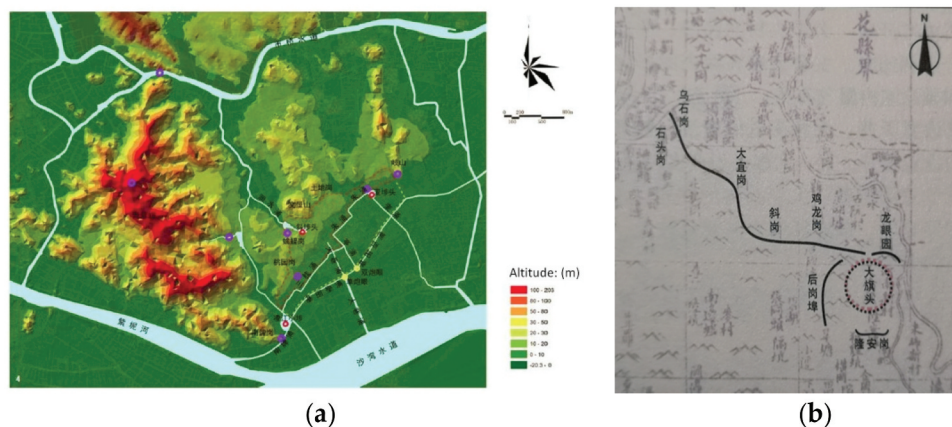


Figure 5. Topographical adaptation: (a) Topographical context of Shawan Town (sources: (Qian and Zhengzang 2014)); (b) Topographical context of Daqitou (sources: (Li Fan and Zheng 2005)).



Figure 6. Compact urban form: (a) Building cluster pattern of Daqitou; (b) Public space system of Shawan.

families. The degree of publicity decreases from the city scale to the building scale accordingly. During its long history until the commercial development period, its public spatial structure has been proved to be a stable and a flexible system (Figure 6b). Although the three-hierarchy public space system is also obvious in Daqitou, its size is smaller. Comparatively, not too many public buildings like temple and academy exist, and their scale is smaller as well. Public activities are mainly performed by local residents (Li Fan and Zheng 2005). Most importantly, very few residents live here today that its vitality cannot be guaranteed.

• Economic

Location and size: As the economic and commercial center in South China and even Southeast Asia, the economic and commercial factors deeply influenced the morphology and urban vitality of PRD's cities and towns. It first affected the scale and size of the clusters. Shawan town is located at the transportation center of PRD and the marine outfall of South China Sea. Its superior location had promoted its commercial activities and economic development for a long period. "Sanjie-Liushi" was given as a name card in Shawan, which refers to its three major commercial streets and six major trade markets. Owing to the limited land resources of the delta area, high density is also an outcome of economic concerns that can release more lands for the agricultural activities.

Mixed mode: Commercial activities relied strongly on the main streets and markets in Shawan town. They gradually became the most important public spaces with strong connections on the regional and global scales. They brought wealth to the residents, and such increased wealth affected back to the urban morphology. Obvious outcomes are the mixed use of buildings facing commercial streets, increased dimension and length of streets, abundant decorated street facades,

and the transformation of mansion organization behind the main streets.

In summary, both cases pay attention to the most positive issues of cultural, environmental, and urban morphological concerns at this level. Economic aspect plays an important role in the longevity of Shawan town, whereas Daqitou village lacks of this consideration (Figure 7).

4.2.2. Level two: load bearing structure and staircase

Clan halls/academies have been common and popular in Guangzhou city since the Qing Dynasty. Among those clan halls, Chen Clan Academy is the most famous one. It is one of the biggest clan temples in Guangdong Province and is the representative of Linnan (normally referring to Cantonese culture) folk architectural decoration and arts (Figure 8). During its history more than one hundred years, it has adapted well to complicated external situations (Li and Zheng 2011; Zhi 2011). In this structure level, it will be analyzed together with different buildings of Daqitou village under the category division of long-lasting issues.

• Social and Cultural

Local construction way: In this region, gable wall is the most important structure wall system, which was both applied in Chen Clan Academy and Daqitou. Its construction method integrates with local material and technology. Several local bricklaying methods can ensure flexible requirements; gray bricks could be constructed regularly or with a little gap in between. It can be divided into two typologies: "people character" shape and "wok ear" shape (the shape looks like it). The "wok ear" shape gable wall is widely used in residential and public buildings in Daqitou, while the "people character" shape gable wall is mainly used in Chen Clan Academy.

Level One: Infrastructure & Public Space	Daqitou	Shawan
Social and Cultural		
Deep-rooted clan system	●	●
Environmental Strategy		
Fengshui	●	●
Topographical adaptation	●	●
Urban Morphology and Public Space System		
Compact urban form	●	●
Highly connected & abundant public space system	●	●
Economic		
Location and size	—	●
Mixed mode	—	●

Legend

● Good Performance

● Weak Performance

— Missing

Figure 7. Performance of longevity issues of Daqitou and Shawan in level one.

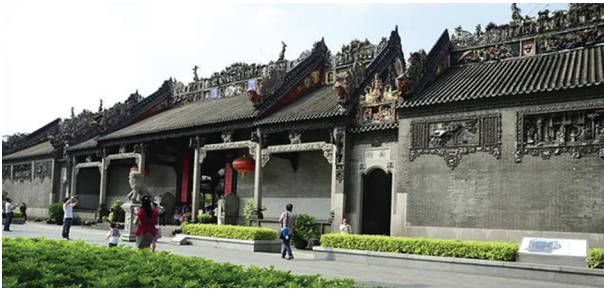


Figure 8. Front façade of Chen Clan Academy.

High aesthetic value of decoration: Daqitou village has a good collection of wood carving, stone carving, brick carving, plaster engraving, lime carving clay sculpture, ash sculpture, and grotto, and so forth. These elements are normally integrated in the beam, column, foundation, and gabled roof. Gabled roof is the most decorated area and is normally divided into front and vertical ridges. The front ridge is located in the highest position of the slope roof, and the vertical ridge is in the highest position of the gable wall. Both decorations are grey carving, which is a common craft in this region. The front ridge is more abundant and includes local natural elements. The vertical ridge is more modest and abstract, because it is not the visual central area according to the hierarchy concerns (Figure 9a).

Due to the strong concentration of donations from the Chen family beyond the blood relation, Chen Clan Academy is notable for featuring rich decorations in almost every beam, ridge, wall, and column. One of its most distinguished features is the 11-pottery ridge crest, which was installed in the nine great halls of the academy (Figure 9b). Each ridge crest has a theme taken from famous traditional dramas. With summering and exaggerating, the pottery ridge crests show the featured drama scene in comic series (*Li and Zheng 2011*). The pottery ridge crest on the roof of the gathering hall has the largest scale and most delicate manufacturing among all halls. Secondary, the brick carving here represents the highest level of its kind of carving at that time. First-class bricks should be selected in accordance with the pattern. Thirdly, the stone carving in the structure

level is mainly integrated with the foundation, combining the traditional techniques of rounded sculpture and intaglio. After being polished by a craftsman, the heavy stone becomes elegant and delicate. Last, wood carving is the most common decoration. It is mainly integrated in the beam frame system and usually tells the story of the past.

• Longevity/Durability

Local material: The structure of Chen Clan Academy is a mixed brick-wood system. In the south and north sides are column-beam systems, while in the west and east sides are brick wall systems. These two systems are combined together and have mutual complementarity. Brick gable walls can prevent excess solar radiation, especially during hot summer time and daily afternoons. The column system can maximize the wind flow to penetrate courtyards and other interior spaces to improve the indoor environment. Vertically, the column-beam system can also be divided into foundation, column, beam, and roof system. The foundation is made of stone with good water resistance and acid corrosion prevention. Stone materials such as granite are also used in outer column systems to better adapt to the local humid and rainy climate. Wood materials, such as belian, a kind of wood from a local subtropical area, are used in areas away from exterior sun and rain exposure. In Daqitou village, most of the structure materials are combined with brick and wood as well. The majority are residential buildings in which the purlin frame and staircase structure are made of wood material. The roof system is made of tile. All materials are local, environment-friendly, and easy to obtain.

Gable wall system: Gable wall is a local grey brick wall structure that is common in the two cases. It can form a cool lane as a comfortable public space and has good fire resistance. Gable wall is constructed by using good quality brick from Dongguan, which is a nearby city. It is normally constructed as a hollow wall system with a mature local method. The hollow brick wall system is proved helpful for thermal insulation and ventilation during summer time.

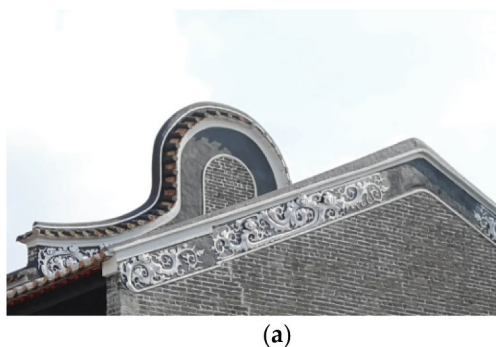


Figure 9. (a) Vertical ridge decoration in Daqitou; (b) Pottery ridge in Chen Clan Academy.

• Flexibility and Adaptability

Basic modular unit: Local grey brick wall is also an important construction strategy forming the standard width: “Jian”, which is the basic unit of a building (Qi 2008). Various housing typologies categorized by “Jian” can be found in Daqitou village, including bamboo house (one “Jian” width), Ming shape house (two “Jian” width), and Sanjianlianglang (three “Jian” width). All plan shapes are rectangular or square, which is an important prediction of flexibility. Since the basic unit is “Jian”, the residential unit can be easily adjusted and changed horizontally and vertically. Horizontally, flexibility can vary within one “Jian” through different arrangement from front to the back, or by the combination and arrangement of several “Jian” side by side. Residents in Daqitou village who are wealthy and have high social status normally lived in bigger houses with several standard widths (Figure 10b). Vertically, the modular basic unit and structurally constructed way can also be repeated or transformed into two or three floor spaces.

Although Chen Clan Academy was also constructed based on the “Jian” strategy, its scale is different and its structure system is more diverse (Figure 10a). The entire construction has dimensions of 80 meters \times 80 meters. It comprises three houses, three lanes, and two wing rooms, with an interlude of six yards and eight corridors. The basic structural unit is unified but has various adjustments in different positions. This square shape can provide a precondition for maximizing flexibility and adaptability. Thus, central halls, side halls, and wing rooms have different strategies and advantages to achieve this target.

Flexible structure system: Normally, the residential typologies of Daqitou village have no column system. The bearing wall structure mainly defines the plan size. To satisfy the residential and other functions in

this limited space through time, several strategies were applied. Less cross wall and the wood material floor system can ensure the changeability in the vertical and horizontal directions. In some houses, a reserved orbit for flexible interior wall installation can help in subdividing and combining small rooms. Modular systems of wood beam system are easy to replace and prefabricate. Moreover, the staircase position is flexible; some are at the back side, while some are placed in the hall. Some staircases are independent, while some are designed in the middle of two houses for common use to save space.

The main central hall of Chen Clan Academy is 27 meters wide and 12–16.7 meters deep. Thus, it can adapt varied functions. Brick walls are arranged in the west and east edges only. Column systems are arranged only inside the hall with an average distance of approximately 5 meters. This combination can minimize structural interference and maximize usage possibilities. For the side halls, their width is around half that of the central hall and the depth is the same. Although the entire spatial size is smaller, fewer columns can provide enough freedom for different usages. The modular and lightweight structure system can be replaced easily and flexibly.

• Environmental Strategy

Plan orientation: Building orientation in Daqitou is mainly an outcome of environmental adaptation (Li Fan and Zheng 2005). Given the long hot-humid period in this area, the short side of the plan has a south-north direction and the long side has a west-east direction. These directions were formed by the arrangement and dimension of the structural wall system. A high gable wall can help avoid direct solar radiation. Hence, the modular enclosed high wall system can guarantee a shady indoor environment and provide neutral

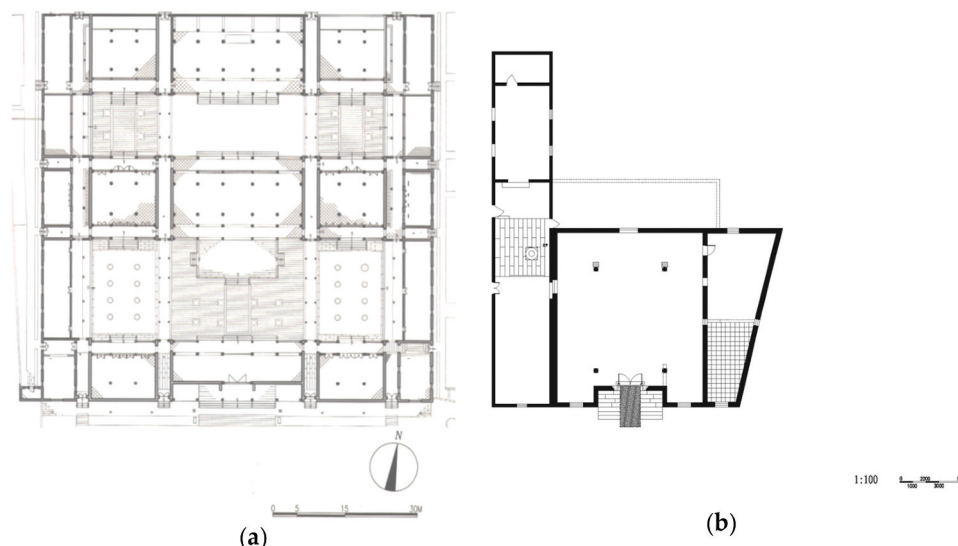


Figure 10. (a) Structure plan of Chen Clan Academy; (b) Shangshudi house in Daqitou.

space for interior flexible ventilation strategies. Although Chen Clan Academy focuses on cultural concerns for its orientation, it can still prevent excess solar radiation, especially from the west, and enhance the prevailing wind from the southeast during summer time. Flexible and diverse structural strategies can satisfy different usages and rich cultural representations, as well as adapt to local climate conditions and enhance the indoor/outdoor environment.

Patio strategy: The patio is an important spatial strategy in Daqitou. It is usually the central space not only for family social public functions, but also a core climate regulator. The patio can become a heat transitional space to reduce the large temperature difference between the outdoors and the indoors, as well as use the pressure difference for ventilation. A unit designed with a patio has good performance of heat reduction, natural ventilation, and lighting. In comparison with several residential units in Daqitou, the scale of the patio space is the core value in climate adaptability. Vertically, it should be at least two floors high to enhance the sun shading effect and promote the heat pressure difference for ventilation. For the Chen Clan Academy, the patio/courtyard is also important, and its scale is bigger. This construction can generally be treated as a group of buildings within a boundary physically and psychologically. The structure system has defined the basic dimensions vertically and horizontally. Large-scale spaces, together with the permeable facade system from the south and north sides, can ensure sufficient ventilation and lighting penetration. Courtyards with different scales were arranged in between and act as micro-climate regulators.

In summary, both two cases can perform well in most longevity issues of cultural, environmental, durability, and flexibility concerns in this level. However, the artistic level and richness of cultural impacts from Chen Clan Academy are better compared with those of Daqitou (Figure 11).

4.2.3. Level three: facade and service core

Located in the most important commercial core of Guangzhou city, the facade system of Shangxiajiu street is not only for daily communication of the community, but also for commodity trading beyond the regional scale. With influences from adjacent British colonized areas, such as Singapore and Hong Kong, which have a similar climate context, its facade system was transformed into the facade of an arcade house. It is a unique system aimed at dealing with new public-private relations, climate concerns, and a wide range of cultural interactions (Figure 12). The facade features of Shangxiajiu will be analyzed and compared with those in Daqitou village at this level.

• Social and Cultural

Tightly interactive space between public and private: In Shangxiajiu street, the commercial and communication orientations can be obviously found in the facade facing the commercial street. The arcade building was transformed from a bamboo house with a narrow width, and each construction was arranged side by side. Their differences could vary within a similar width horizontally and the “three-part” proportion vertically. Commercial space, colonnade public space, and residential space are clearly divided as well. The arcade model was first introduced in Singapore by Thomas Stamford Bingley Raffles from Britain. It subsequently spread to wider areas of Southeast Asia, including PRD. Although this model later became a government regulation especially during the 1920s, it can still be regarded as an ideal model integrated with different cultures, daily living requirements, commercial activities, and daily communication activities (Figure 13).

Comparatively, only the front facades of public buildings in Daqitou village contain rich interactive spaces. Their wider width and the set back of main

Level Two: Load Bearing Structure & Staircase	Daqitou	Chen Clan academy
Social and Cultural		
Local construction way	●	●
High aesthetic value of decoration	●	●
Longevity/Durability		
Local material	●	●
Gable wall system	●	●
Flexibility and Adaptability		
Basic modular unit	●	●
Flexible structure system	●	●
Environmental Strategy		
Plan orientation	●	●
Patio strategy	●	●

Legend

● Good Performance

● Weak Performance

— Missing

Figure 11. Performance of longevity issues of Daqitou and Chen Clan Academy in level two.



Figure 12. Form and atmosphere of Shangxiajiu street.

entrances could create a temporary gathering space offering safety and environmental comfortable feelings. The rich spaces can also enrich the visual feeling of users and visitors, eventually enhancing the symbolic image (Figure 14).

Local cultural feature mixed with different cultures: The linear arcade street of Shangxiajiu includes the elements and styles of Ancient Greek, Ancient Rome, Baroque, Rococo, and eclectic, together with traditional Chinese roof forms, pavilions, and Manzhou window (Figure 15). The Manzhou window is a window type mixed with Chinese and local Guangdong window wood carving frame and Western color glasses. “Three-parts” is a typical architectural and constructed method of Chinese traditional buildings, including foundation, body, and roof. The bottom colonnade is mainly Western style. But the middle and upper parts are mostly mixed style, with Manzhou window and arch window lintel, as well as Western parapet or Chinese roof form. Furthermore, both Chinese elements and Western elements were transformed or simplified to improve their

integration in the entire facade system. The balcony is an important element in a facade. Some balconies are not real ones that only for enriching the façade’s rhythm. Even real balconies also play a decorated role apart from a functional role. The diverse types of windows, eaves, and pediments are also the outcomes of changeability actions taken by residents.

The facade features of residential and public buildings in Daqitou village were mainly influenced by local culture. High gable wall and high roof ridge can create a more solemn and majesty ambiance, as well as preserve additional spaces for complex decorations. Wood carving combined with glass is dominates the window and door areas. Decorations are inspired by local typical objects, natural elements, and abstract patterns related to independent and combined topics (*Yiqiang and Hankun 2013*). Stone carving is highly integrated with functional usage with a similar color tone in foundation, platform, and handrail system. Grey carving together with color tone can vividly depict the stories from nature in this region.



Figure 13. Interface of arcade facade system.

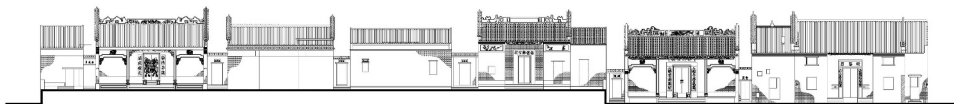


Figure 14. Front facade of public buildings in Daqitou.

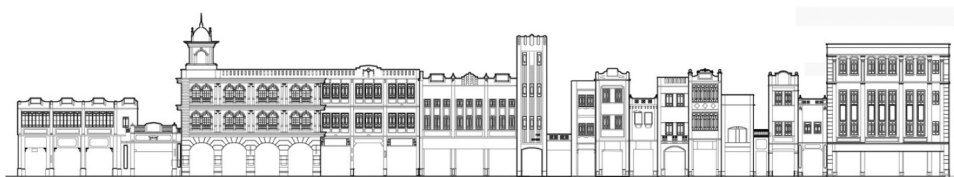


Figure 15. Facade system mixed with different cultures of Shangxiajiu.

• Longevity/Durability

High quality and durable material: Wood and brick are the major facade materials in Chinese traditional buildings. The outer walls of the buildings in Daqitou were mainly constructed by using good quality brick from nearby Dongguan city (*Li Fan, 2005*). For the inner facade, the wood frame dominates not only the roof, window, and door, but also the hand rail, hanging scroll, and other facade elements. The mass usage of local wood material decreased the transportation costs and enhanced the environment-friendliness. A high-level local craft is another strong precondition for facade maintenance. Facade materials of the arcade house in Shangxiajiu are mainly stone and brick; the column is usually made of stone, and the facade surface is made of brick, both of which have good water and solar resistance. Wood is mainly used for windows as an operable element. Its surface is finished with tung oil to prevent rotting and to enhance the interior atmosphere perception.

• Flexibility and Adaptability

Easy operable and replaceable: The window and door are the most flexible facade areas in Daqitou. A large proportion of the facade system of the two cases are constructed by using lightweight elements that are easily operable and replaceable. A hollow frame can greatly reduce its own weight and is good for operation. The method of brickwork and its modular size can enhance the convenience of replacement. Moreover, the facade facing the inner patio was designed by using a lightweight window-door combination method, which can enhance the flexibility degree of the entire construction. The interior spaces are limited because most of the arcade houses in Shangxiajiu are only two or three floors high. Hence, a flexible connection between different floors is necessary. This approach is reflected not only in the flexible position of the staircases but also in simple temporary ways like a bamboo ladder, which can be easily and flexibly used by residents going upstairs and downstairs.

Light-weight material: Lightweight strategy does not only refer to the construction method but also to

the material selection. Wood material is one of the lightest building materials and widely used in the facade systems of Shangxiajiu street and Daqitou village. Black and hollow bricks are widely used in the gable wall, which are relatively light-weight materials that are easy to transport, construct, and replace.

• Environmental Strategy

Ventilation and shading strategy: Owing to the deep depth of bamboo and arcade houses, ventilation and shading strategy are the most important factors for ensuring acceptable indoor comfort. In Daqitou village, where most houses have a purely residential function and a narrow width, and only face neighborhood public spaces, the facade system is relatively simple (*Figure 16*). The patio is one of the significant micro-environment regulators. Hollow carving is likewise an important facade strategy integrated with cultural and environmental concerns. These concerns include varied patterns of windows and doors, open tracery of the outer wall, bamboo partition, and decorated hanging scroll between the roof and the window. All these elements can enrich cultural representations, ensure air permeability, and avoid direct solar radiation. In addition, louver window is another important method. Compared with the stable hollow window, it is operable and flexibly adjustable, with a fine-tuned angle to control sunlight and wind flow.

When the public space is being upgraded, the facade system starts to bear more functions and responsibilities. In the case of Shangxiajiu street, although some similar strategies above can be found, the facade of the arcade house has to ensure and ideal indoor environment for residents and provide comfortable communication spaces and areas where the public can pass by. Hence, vertically, it has different strategies within its “three-parts”. For the most public part, bottom colonnade spaces can physically provide a shelter for the passengers escaping solar radiation, frequent rain, and typhoons. According to Xiao Yiqiang, a street with two sides of arcade houses and aspect ratios between 1 and 1.25 can have better performance. This indentation can also shorten the depth of the first floor plan that facilitates wind flow into the deeper parts (*Yiqiang*

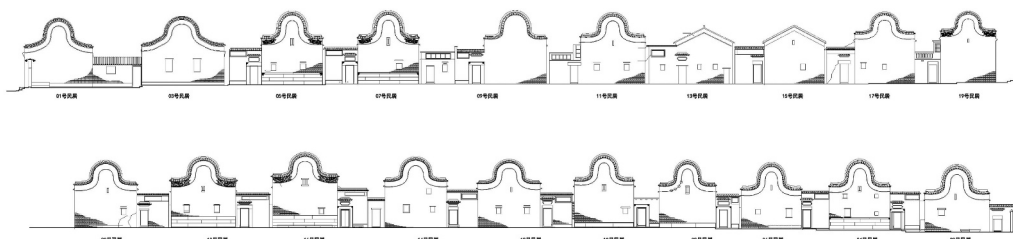


Figure 16. Typical lane facade of Daqitou village.

2015; Yiqiang and Hankun 2013). Horizontally, the side-by-side arrangement can provide continuous comfortable spaces and strong wind flow channel. For the middle part, the public function becomes mainly for visual representation that a surface ambience is obvious. But it also considers enhancing environmental performance, such as the eave and balcony. For the upper part, a hollow handrail is usually used in the parapet wall to improve ventilation, or a set-back is applied to shorten the deep plan.

In summary, both cases can perform well in most longevity issues of cultural, environmental, durability, and flexibility aspects in the facade level. However, the interactive spaces between public and private, as well as the diversity and inclusiveness of cultural representations from Shangxiajiu street perform better than that of Daqitou village (Figure 17).

4.2.4. Level four: interior and function layout

Located in the core area of Foshan, which is also the core area of the Guang-fu cultural district, Donghuali street is the most completely preserved street and consists of all typical housing typologies in PRD. This street has a good adaptability in facing complicated situations over the last 100 years. The alternation of ownership in Donghuali is from simple to complicated,

from two big families to diverse small families, from private living to public-operated rent (Jiajie 2012). At this level, the study will focus on the housing interior of Donghuali and compare it with the buildings in Daqitou village (Figure 18).

• Social and Cultural

High aesthetic value decoration: In the houses in Donghuali and Daqitou village, the density of purlin is relative to the social and wealth status of the residents. A high density means high social and wealth status. This direct proportion can also be found in the interior elements, such as the attic floor, handrail and furniture. The houses of richer families have more complex and elaborate details, which were tactfully integrated with functional uses. Given the location within the city center, the concentration of wealthy residents in Donghuali accelerated their mutual influences. The concentration of highly educated residents further enhanced the atmosphere and taste of indoor spaces. Moreover, its adjacent location to furniture studios and the commercial streets brought huge convenience to the families in ensuring high cultural representations.

Integrated interior atmosphere: The major material of the enclosure wall in the houses of Donghuali and Daqitou is brick without plastering, creating a calm

Level Three: Façade & Service Core	Daqitou	Shangxiajiu Street
Social and Cultural		
Tightly interactive space between public & private	●	●
Local cultural feature & mixed with different cultures	●	●
Longevity/Durability		
High quality & durable material	●	●
Flexibility and Adaptability		
Easy operable and replaceable	●	●
Light-weight material	●	●
Environmental Strategy		
Ventilation strategy	●	●
Shading strategy	●	●

Legend

- Good Performance
- Weak Performance
- Missing

Figure 17. Performance of longevity issues of Daqitou and Shangxiajiu street in level three.

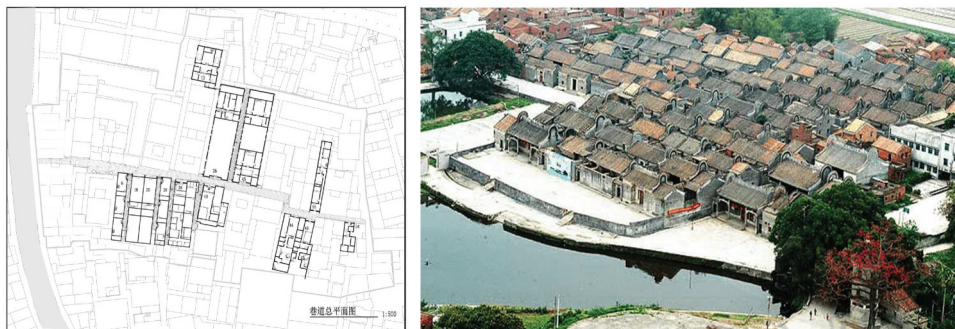


Figure 18. Typology comparison of Donghuali (left: diverse) and Daqitou (right: homogeneous).

and solemn ambience. Different from royal construction, which uses a more colorful and decorated method, it is a simple and compact solution. Furthermore, political and religious issues impact royal construction substantially, but folk culture and local residents' actual demands are well represented in these two cases. Two aspects can be found: the way they decorated and the contents they represented. In case of the public buildings of Daqitou village, plenty of decorations, such as grey, wood, and stone carving, are integrated in the construction, with the same color tone and similar material texture feeling, which could generate a subtle, modest, and thought-provoking atmosphere. Abundant and colorful decorations appear mainly in the upper positions, like ridge and eave, where are the supplemented areas of visual range and the interspersed parts of the entire atmosphere.

• Flexibility and Adaptability

High adaptable interior spaces: In Donghuali and Daqitou, although structure walls limit the plan width, flexibility and changeability movement in the houses can take place through the plan depth extension, including various spatial organizations from the front side to the back side, and vertical repeat or transformation. To further reveal the adaptability potentials of the houses, an interior adaptability study was conducted, as shown in the following two figures (Figures 19, 20). The typologies of two extreme scenarios, one "Jian" from Donghuali and "multi-jian" from Daqitou, were analyzed. The possible uses of the study are relative to the contemporary context, which reveals that they can still adapt to contemporary uses in different scenarios.

Light-weight and flexible interior partition: In Donghuali and Daqitou, low floor-height partition walls could be arranged in areas that require small spaces. Hence, the upper wood frame structure system was left to maintain its cultural visual effect and enhance ventilation and lighting effect. The partition wall, attic floor and handrail, and furniture are all made of light-weight local wood.

• Environmental Concerns

Local material: The interior decorations are mainly wood carving, stone carving, pottery sculpture, and grille screen door, among others. Local wood is the major interior material, which is environmentally friendly. It is used for the partition walls and furniture, and has low carbon density and short transportation distance. Especially in the case of Donghuali, the adjacent location to the furniture workshop also brought the convenience in the replacement, repair, and other uncertain requirements.

Indoor comfort by interior partition strategy: Environmental concerns of structure system and facade systems can provide strong preconditions for internal ventilation and lighting performance. In Donghuali and Daqitou, the interior partition wall is built with lightweight materials and is usually lower than the interior building height. It is also constructed with a perforated structure, which can help improve the indoor environment. Other strategies, such as a two-story-high living room, lightweight and permeable handrail, and staircase, can also enhance the comfort level.

At this level, most longevity issues of both cases, including cultural, environmental, and flexibility concerns, can be identified and concluded well. However,

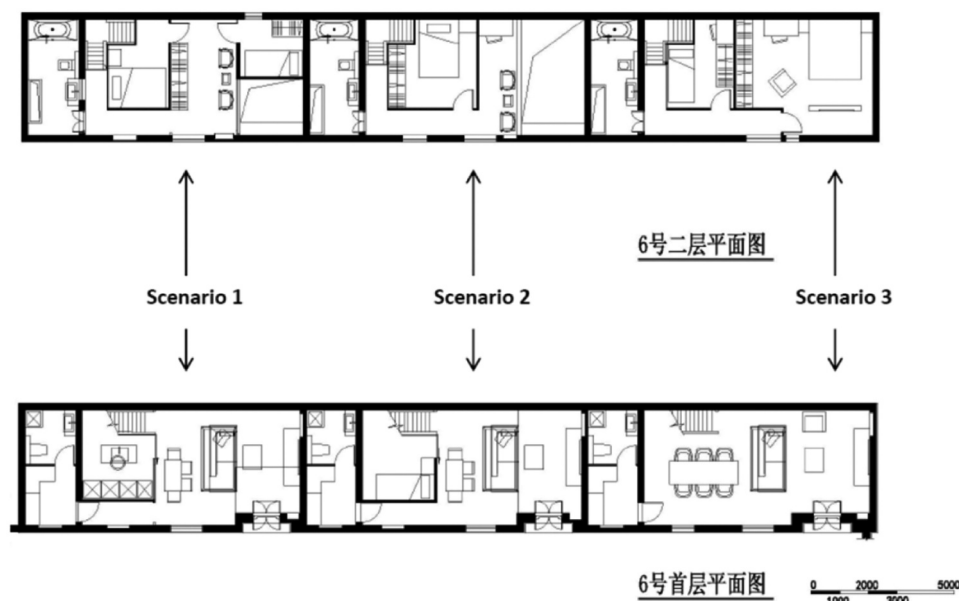


Figure 19. Interior adaptability study of the house in Donghuali.



Figure 20. Two scenarios of housing adaptability study in Daqitou (a) Scenario one; (b) Scenario two.

Level Four: Interior & Function Layout	Daqitou	Donghuali
Social and Cultural		
High aesthetic value decoration	●	●
Integrated interior atmosphere	●	●
Flexibility and Adaptability		
High adaptable interior spaces	●	●
Light-weight and flexible interior partition	●	●
Environmental Strategy		
Local material	●	●
Indoor comfort by interior partition strategy	●	●

Legend

- Good Performance
- Weak Performance
- Missing

Figure 21. Performance of longevity issues of Daqitou and Donghuali in level four.

Daqitou is slightly far away from the manufacturing center of interior furniture and other interior components (Figure 21).

5. Conclusion and discussion

With the use of the theoretical framework of long-lasting building, four traditional cases of urban areas and the traditional cases of Daqitou village were studied, to reveal and better understand why and how they can last for a long period, as well as what are their differences. All traditional cases from the village and the urban area can be well analyzed through the theoretical framework of long-lasting building and the “level” strategy, which proved to be a systematic and efficient method to be applied. In conclusion, several crucial points of this study are summarized as follows:

All traditional cases from the village and the urban area contain abundant evidence of most initial longevity issues at different levels. However, village cases do not consider some issues or perform poorly in some instance, which could be the decisive factors of long-lasting uses until the present. Further speaking, compared with the long-lasting buildings in Daqitou village, cases from the urban area have better performance, especially in terms of strategic location

and mixed mode in level one, and tightly interactive space and mixed cultural influences in level three.

Among such longevity issues, it is significant that a long-lasting building must not only have physical longevity, but must also be suitable for long-term usage. The differences between traditional cases in the urban area and the village should be given additional attentions, as these can become valuable references for contemporary constructions in both urban and rural areas in this region.

Although the results of this investigation summarize a set of longevity indexes, and can initially evaluate the cases’ long-lasting performances under two different contexts, further research is needed. This qualitative work can be treated as the foundation of a consistent research for constructing an entire evaluation system. Expert questionnaire survey (Delphi), data analysis (AHP), and the study of other evaluation systems, which aim at precise indicators collection, weighting defining and detailed evaluation methods respectively, will be introduced and applied.

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References

- Beisi, J., and J. Yingying. 2011. "Flexibility of Traditional Buildings and Craftsmanship in China." *Open House International* 36 (4): 20–31. doi:10.1108/OHI-04-2011-B0003.
- Blackburn, S. 2008. *Oxford Dictionary of Philosophy*, 2 Ed. Oxford, UK: Oxford University Press.
- Bosma, K. 2000. "Housing for Millions John Habraken and the SAR (1960-2000)." *Stephen Kendall and Jonathan Teicher Residential Open Building E&FN SPON2000 年日本におけるオープンビルディングについては*. Rotterdam: NAI.
- Brand, S. 1995. *How Buildings Learn: What Happens After They're Built*. England: Penguin.
- Cole, R. J. 2006. "Shared Markets: Coexisting Building Environmental Assessment Methods." *Building Research & Information* 34 (4): 357–371. doi:10.1080/09613210600724624.
- Colquhoun, A. 1969. "Typology and Design Method." *Perspecta* 12: 71–74. doi:10.2307/1566960.
- Conzen, M. R. G. 1960. "Alnwick, Northumberland: A Study in Town-Plan Analysis." *Transactions and Papers (Institute of British Geographers)*, no. 27: 3–122. doi:10.2307/621094.
- D'Amato, M., R. Gigliotti, and R. Laguardia. 2019. "Comparative Seismic Assessment of Ancient Masonry Churches." *Frontiers in Built Environment* 56 (5). doi:10.3389/fbuil.2019.00056.
- Eberle, D., and P. Simmendinger. 2007. *From City House-A Design Theory*. In: Zurich: gta Verlag.
- Fabbrocino, F., G. Vaiano, A. Formisano, and M. D'Amato. 2019. "Large-Scale Seismic Vulnerability and Risk of Masonry Churches in Seismic-Prone Areas: Two Territorial Case Studies." *Frontiers in Built Environment* 102 (5). doi:10.3389/fbuil.2019.00102.
- Fukao, S. 2011. "The History of Developments Toward Open Building in Japan." *New Architecture* 6: 14–17.
- Habraken, J. 1980. "The Leaves and the Flowers. VIA, "Culture and the Social Vision." *Architecture Journal of the Graduate School of Fine Arts University of Pennsylvania* 45–57.
- Habraken, N. J. 1972. *Supports: An Alternative to Mass Housing*. New York, USA: Praeger.
- Habraken, N. J. 2002. "The Uses of Levels." *Open House International* 27 (2): 9–20.
- Jiajie, W. 2012. *Research on the Vernacular Architecture of Donghuali District in Foshan*. (Master Thesis), South China University of Technology, Guangzhou, China. Available from Cnki
- Kendall, S. 2012. Open Building Concepts. Retrieved from <http://open-building.org/ob/concepts.html>
- Kendall, S., and J. Teicher. 2010. *Residential Open Building*. London, UK: Spon Press.
- Li Fan, H. Y., and T. Zheng. 2005. *Exploring Daqitou*. Hong Kong: China Review Academic.
- Lixiang, C., L. Xueguang, and L. Linafu. 2010. *Guangdong Ancient Village*. Guangzhou, China: South China University of Technology Press.
- Li, Z. Q., and L. P. Zheng. 2011. *Chen Clan Academy Memoir (Guangdong Folk Craft Museum; South China University of Technology Ed.)*. Beijing, China: China Architecture & Building Press.
- Qi, L. 2008. *Guangdong Vernacular Dwellings*. Beijing, China: China Architecture & Building Press.
- Qian, G., and Y. Zhengzang. 2014. "The Practice and Reflection of Conservation and Regeneration in Shawan Ancient Town of Panyu District." *South Architecture*, no. 02: 37–43. doi:10.3969/j.issn.1000-0232.2014.02.037.
- Rossi, A. 1984. *The Architecture of the City*. Cambridge, Massachusetts: MIT press.
- State council, P. s. R. o. C. (2014). Law of the People's Republic of China on Protection of Cultural Relics. Retrieved from http://english.gov.cn/archive/laws_regulations/2014/08/23/content_281474983042361.htm
- State council, P. s. R. o. C. (2017). Regulation on the Protection of Famous Historical and Cultural Cities, Towns and Villages. *Protection of Famous Historical and Cultural Cities*. Retrieved from http://www.pkulaw.com/en_law/b31e2876c41231e8bdfb.html
- Tan, G. 2011. "The Open and Adaptive Tradition: Applying the Concepts of Open Building and Multi-Purpose Design in Traditional Chinese Vernacular Architecture." *Journal of Asian Architecture and Building Engineering* 10 (1): 7–14. doi:10.3130/jaabe.10.7.
- Whitehand, J., and K. Gu. 2007. "Urban Conservation in China: Historical Development, Current Practice and Morphological Approach." *The Town Planning Review* 78 (5): 643–671. doi:10.3828/tpr.78.5.6.
- Xunhou, Z. 2007. "Restore the Truth of Historic and Cultural Villages in China: The Pursuing Process of Zheng Family Data of Daqitou Village." *Guangdong Record* 2: 42–45.

- Ying, P., and Z. Xiaolan. 2014. "Comparative Study on Traditional Settlement Patterns of Guang-Fu Area and Chao-Shan Area." *South Architecture*, no. 03: 79–85. doi:[10.3969/j.issn.1000-0232.2014.03.079](https://doi.org/10.3969/j.issn.1000-0232.2014.03.079).
- Yiqiang, X. 2015. "Research on Sustainability-Based Regional Green Building Design." *Urbanism and Architecture*, no. 31: 21–24. doi:[10.19892/j.cnki.csjz.2015.31.005](https://doi.org/10.19892/j.cnki.csjz.2015.31.005).
- Yiqiang, X., and L. Hankun. 2013. "The Study of Climate-Adaptable Model Scale of Space in Bamboo-House in Guangzhou." *South Architecture*, no. 2: 82–86. doi:[10.3969/j.issn.1000-0232.2013.02.082](https://doi.org/10.3969/j.issn.1000-0232.2013.02.082).
- Yuan, Z., and S. Wang. 2009. "The View of Time-Based Association from Team 10 to the Contemporary Urbanism and Architecture." *Architectural Journal* S2: 130–134.
- Yue, X. 2013. *Research on the Conservation and Renewal of Public Space in Shawan Town*. (Master Thesis), South China University of Technology, Guangzhou, China.
- Zeng, Y. 2013. *Shawan County Annals (Communist Party of China Shawan Town Committee; People's Government of Shawan Town Ed.)*. Guangzhou, China: Guangdong People's Publishing House.
- Zhi, W. F. 2011. *Linnan Clan Hall*. Guangzhou, China: South China University of Technology Press.