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# Development of a New Elevator Addition System for Aged Residential Buildings

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**Paper**

## 1 Introduction

In Japan, a huge volume of public housing was built in the mass-housing era between 1955 and 1973, and many related problems have arisen in recent years. Today, due to an increase in the number of aged residents, one of the most significant pending problems concerning public residential buildings is barrier removal and customization for elderly people. Several local authorities and housing corporations have added new elevator towers to the old walk-up buildings, however, certain problems remain. This paper proposes a new elevator addition system that solves the problems of the existing methods, and presents the results of an evaluation of an experimental construction of this new system.

## 2 Actual Circumstances Concerning Addition of Elevators

Firstly, we analyzed architects drawings of approximately 30 public residential buildings to which elevators have been added, and classified the buildings according to type. The most common type is that of buildings with the addition of an elevator tower to the outside of each of the staircases in the building. This method does not result in totally barrier free access to the dwellings because the elevator car has to stop at the landings of stairways, so that residents have to go up or down half the story height on foot.


**Figure 1. Building before and after the renovation work involving the addition of elevator towers, and section view**

## 3 New Elevator Addition System

The new method we propose is an elevator tower unit consisting of an elevator shaft and stairs installed in a spiral design encircling the shaft. The construction is very simple. Firstly, the tower unit is installed on the outside of the existing staircase. Next, the existing stairs are removed and new floors are installed in the vacant stairwell on each floor level. Finally, the tower unit is connected with these new floors.

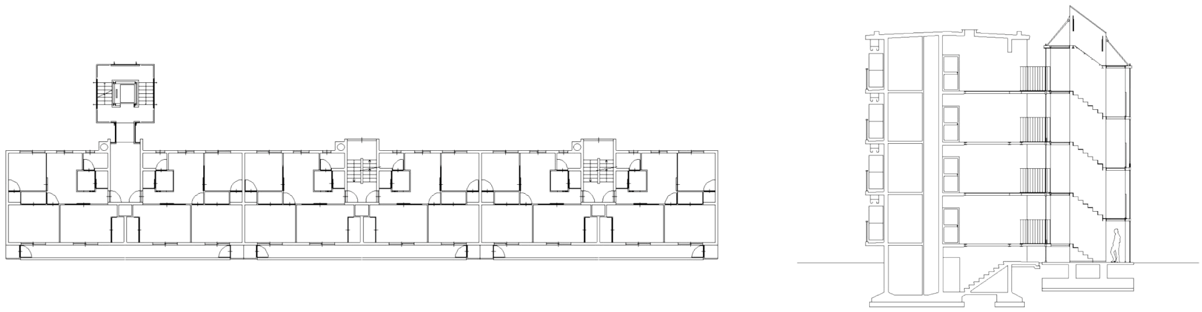

**Figure 2. Plan and section of the building with the new elevator system**

The advantages of the new system are: achieving barrier free access and facilitating renovation work. Moreover, new, attractive spaces are also created. The first space is a new approach lobby for all residents sharing the same elevator unit, generated at ground level within the unit. This lobby consists of a space for waiting the elevator and a space for mailboxes. The other space is the new entrance porches for each dwelling, which are generated on the additional floors in the stairwell. These spaces contribute to improving the utility of old buidings.

**Figure 3. Structural diagrams of new system and photograph of the new elevator addition system applied**

We designed this system to be compatible with a compact elevator. In Japan, elevators are generally high quality, but large and expensive. Although large elevators are structurally stable, it makes the existing staircase dark and unattractive. So, we propose a structural system that uses slender tension rods around a compact elevator shaft, which provides not only structural enforcement, but also gives a lighter impression of the elevator tower unit.

## 4 Outline of Experimental Construction

We constructed an experimental construction to evaluate the effects of new system. This new system was applied to a vacant residential building located in 'Y' housing estate, including a typical selection of aged residents.

The first phase of the construction took place from December 2005 to February 2006. In this phase, only an elevator tower unit consisting of an elevator shaft and stairs were constructed. Inside the elevator shaft, the elevator machine and lift did not need to be constructed. In the next phase, it is scheduled that the existing stairs are removed, new floors are installed and the elevator tower unit is connected to the floors.

**Figure 4. Process photographs of construction site**

After finishing the design in detail, steel pieces were fabricated in a factory. At the same time, the ground was excavated and the foundations was laid. After finishing the prefabrication, the steel pieces were delivered to the site and the steel skeleton was errected. Then, the steel rods around the elevator shaft were tensed up. Hereafter, construction work was carried out in series; the exterior wall of the elevator shaft was set, the elevator shaft was covered with a roof, metal work was completed, the steelwork was painted, glass panels were set in the stair landings and the floors were finished.

## 5 Analysis of Experimental Construction

We recorded the progress of construction work, noting each task and the time requqried for each task. After completion of work on site, we analyzed the relationship between each task using the data obtained. The analysis was important in order to reduce the construction period and lessen the residents' burden so that construction could take place while the building was occupied by residents.

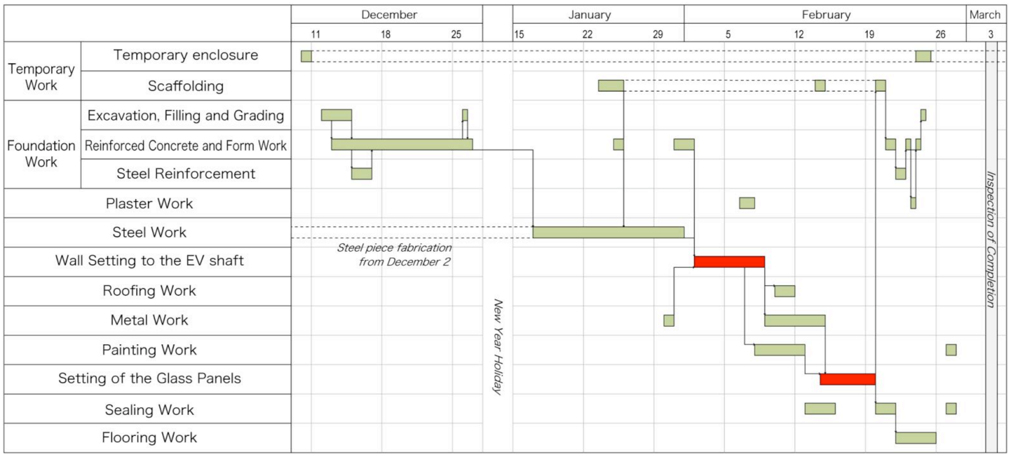


**Figure 5. Construction flow diagram showing relationship between each task**

The construction flow diagram shows that in the first half of construction, tasks were completed one at a time, such as laying the foundations and errecting the tower unit. In the latter half of construction, many tasks were carried out simultaneously. When tasks are tightly scheduled, it is essential to prioritize the wall setting to the elevator shaft and the setting of the glass panels. Once these tasks are completed, other tasks can begin. Thus, it is important for reducing the construction period that working these tasks promptly and scheduling tasks to be worked simulataneously with other works where possible.

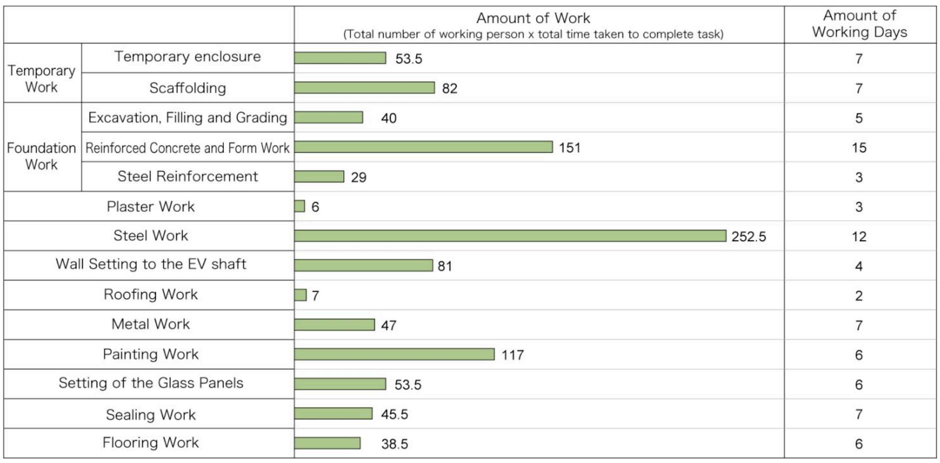


**Figure 6. Total amount of work**

Figure 6 illustrates the total amount of work, which was derived by multiplying the total number of working persons and the time taken to complete each task together. In this construction, increase in the amount of steel work was unavoidable but the amount of work in laying the foundations should be decreased. Laying reinforced concrete foundations was time-consuming, so another foundation material such as steel should be used.

Figure 6 also shows the increase in the amount of painting work, wall setting to the elevator shaft and temporary work, compared to other tasks. The increase in the amount of painting work and wall setting are avoidable by careful organization of construction progress and arrangement of designs in detail. In addition, decreasing the amount of temporary work would reduce the overall construction time, so we should arrange the tasks to be completed without temporary scaffolding, especially in setting the glass panels.

## 6 Conclusion

Evaluation of the progress of the experimental construction reavealed that in this system, arrangement of construction progress and changing the foundation material increases the efficiency and reduces construction time. In addition, the new space generated as an approach lobby at ground level provides a good place to wait for the elevator, check mail, and enter the building. This experimental construction is still in the first phase, in the next phase the existing stairs will be removed and new floors will be installed. After completing phase two, we will analyze all construction data and consider how we can improve the system.

The records of experimental construction were updated on the website (Japanese). For further details of the construction process, see *"Under Construction : Elevator Addition System for Aged Residential Buildings,,* http://coea111.exblog.jp/

## 7 Acknowledgments

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