A Post-Occupancy Evaluation of Layout Changes Made to KEP Adaptable Housing

Kazunobu Minami Ph.D.
Professor of Architecture, The Shibaura Institute of Technology, Japan

Abstract

This research examines how the apartment units of a 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 of KEP to suit their individual needs and how they have adapted their living environments to changes in their lifestyles over time. The 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. We studied the movable partitioning system that had been used by residents as it was planned originally. We visited all the 184 residences individually, and when we were allowed to enter a unit, we observed the actual changes that had been made to it and asked the residents why and how they changed their units. This paper reports on the results of our studies, especially on the changes in room arrangement (layout changes).

Keywords: housing; adaptability; flexibility; POE; customization; industrialized components

1. Research Purposes
Since the 1970’s, multifamily housing in Japan has been focusing on quality more than quantity. We investigated the "Tsurumaki -3" housing estate of Tama New Town, a suburb of Tokyo. 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. The most important object of our research was to investigate how residents have adopted the design concepts to suit their living environments to 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 the KEP movable partitioning system.

2. 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. 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.

3. 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 plan for units in the estate: A, B and C. 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 unit. 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 1. shows the plan and the location of the movable partitioning system in each type of unit.

*Contact Author: Kazunobu Minami, Architect, Professor of Architecture, The Shibaura Institute of Technology, Room 8C25, 3-7-5 Toyosu, Kouto-ku, Tokyo, Japan 135-8548
Tel: +81-3-5859-8400 Fax: +81-3-5859-8401
E-mail: k-minami@sic.shibaura-it.ac.jp
(Received April 5, 2007; Accepted, August 20, 2007)
The residents' interest in permanent occupancy changed 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 years of age (Cmf) and about 34% of households were childless couples at least 40 years old (Co -). 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.

Table 2. indicates that interest in permanent occupancy has increased and 63% of residents were thinking of living permanently in their units in 2005.

Table 1. The Plan of Each Type and the Location of the Movable Partitioning System

| Type A | Type B2 | Type A2 | Type A3 | Type B3 | Type A1 | Type A3 | Type A3 |
|--------|---------|---------|---------|---------|---------|---------|---------|
| ![Diagram](multi-purpose-room-kitchen) | ![Diagram](living-room) | ![Diagram](multi-purpose-room-private-room) | ![Diagram](living-room) | ![Diagram](private-room) | ![Diagram](living-room) | ![Diagram](private-room) | ![Diagram](private-room) |
| ![Diagram](private-room) | ![Diagram](living-room-private-room) | ![Diagram](multi-purpose-room-kitchen) | ![Diagram](living-room-private-room) | ![Diagram](private-room) | ![Diagram](living-room-private-room) | ![Diagram](private-room) | ![Diagram](private-room) |
| ![Diagram](private-room) | ![Diagram](private-room) | ![Diagram](private-room) | ![Diagram](private-room) | ![Diagram](private-room) | ![Diagram](private-room) | ![Diagram](private-room) | ![Diagram](private-room) |
| NA | NA | NA | NA | NA | NA | NA | NA |
Table 3. shows the changes in concept of permanent occupancy of the residents who have lived there continuously since 1982. Similar to Table 2., 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.

4. Changes in Room Arrangement
4.1 Rate 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 29.8% \((28/94)\) of apartment units have made some changes to their room layout. Residents of 36.8% \((14/38)\) of Type A units and 50% \((10/20)\) of Type B units have made at least some room layout changes. On the other hand, only 11.1% \((4/36)\) 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.

Table 2. 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  | 62                  | 5                   | 30        | 2         | 93               |

Table 3. 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| Undecided| Permanent| 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|           |          |          |          |
4.2 An example of the room arrangement changes in a Type A unit

Fig.4. 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.

4.3 An example of the room arrangement changes in a Type B unit

Fig.5. 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.

5. Analysis of the Room Arrangement Changes

5.1 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. Ten 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 acquired 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.

5.2 Layout changes to make private rooms larger

As in the case of their living rooms, residents can make their private rooms larger by moving the partitioning wall and/or partitioning storage walls.

Fig.4. An Example of the Room Arrangement Changes in a Type A Unit
(The symbols M, F, f in the figure show the rooms where the residents slept.)
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 moved 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.

5.3 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 in the late teens.

6. Conclusions

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.

Acknowledgments
I wish to thank Prof. Manabu Hatsumi of the Tokyo University of Science for kindly allowing us to continue with his preceding research. I also wish to thank my students Mr. Ishimi Yasuhiro and Mrs. Mamiko Takuda who worked with me for this research.

Notes
*1: In the Tsurumaki -3 estate, there are 192 units in four-storey flats and 29 units in two-storey terrace houses. This paper reports on the survey of the four-storey flats that was implemented in 2005.
*2: 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

*3: The number of effective answers

References
1. Hatsumi, M. (1991) Juuko-keikaku ni okeru Kobetsuei-taiou ni kansuru Kenkyu (in Japanese): Housing Research Institute, Tokyo.
2. Hatsumi, M. and Toshi-seibi Planning. (1996) Kahen-gata Shugou-jutaku no Kyojireki ni kansuru Chousa (in Japanese): Japan Housing Corporation, Tokyo.