

**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****ASSESSMENT OF VERTICAL ADAPTATION IN AFFORDABLE APARTMENT
HOUSING: THE CASE OF RUSUNAWA SURABAYA****Dimas Pratama 1****1 Professor, Department of Architecture, Institut Teknologi Sepuluh Nopember (ITS),
Surabaya, Indonesia**

DOI: 10.5281/zenodo.187559

ABSTRACT

A dwelling should be a place for families to conduct activities to meet their needs. The actually needed space is often greater than that available on the existing. The family's need of space grows with the passage of time.

Rusunawa is a type of shelter for the poor. It usually includes a multifunctional space, a kitchen, a bathroom/WC, and a balcony. The space to live in, the multifunctional space, should serve for living, sleeping, studying, TV watching, eating, storing, child-caring, and sometimes home-based business. Additional space that must occur in the multifunctional space may be done by occupying the corridor and extending or changing the function of the balcony which are illegal. The appropriate way for meeting the additional space demand is by adapting vertically.

This study observes how much space is actually needed by the families and what these families did when they experiencing space shortage. 100 families living in Rusunawa Surabaya spreading across 14 locations are taken as respondents. The outcome is a recommendation of which type of space could be created by installing a mezzanine.

KEYWORDS: inadequate space, vertical adaptation, low cost apartments Surabaya**INTRODUCTION**

Besides eating and drinking, dwelling according to Maslow (1970), is included as the basic need of humans. Therefore housing development especially for the poor people is attended or prioritized by the Indonesian government. This is evidenced by the existence of Decree no.24 (2003) that provides easiness given to the poor so that they can have a home more easily either by renting or by purchasing.

The Indonesian government in 1985 started to promote the construction of flats or apartments, which were primarily reserved for poor families. This happened because the land to develop individual houses horizontally was no longer enough, as the urban land was getting scarcer and more expensive. Moreover, the Ministry of Public Works (2012) found the need to improve the greenery, so the scarce land must be used to increase the amount of green open spaces.

For the sake of sustainability of residential buildings, the design of apartment units should be able to accommodate all activities of its users including the adaptation made by the families as their spatial needs also keep growing in accordance with the growth of family members. The adaptation meant here is primarily the vertical adaptation, as this is the only legal adaptation that may be made by users of low cost apartments. In fact, not all units of low cost apartments allow vertical adaptation as the unit space dimension especially the height is too small, so there is no possibility to implement this kind of adaptation.

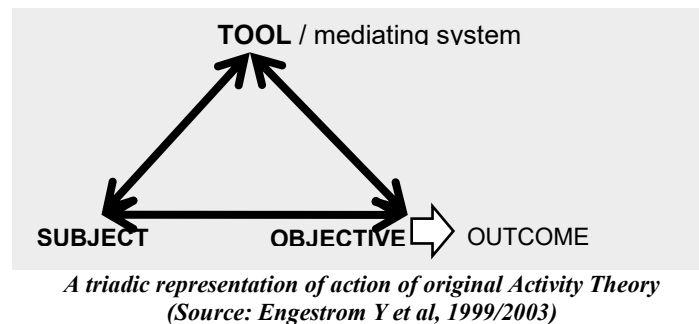
Low cost apartment units provided by the government so far did not anticipate and provide opportunities for residents to develop to meet their real spatial needs either it is caused by the increase of family members or the number of space types. As a result, users of low cost apartments mostly occupy the corridors that sometimes disrupt the function of the corridor which is actually a public space. This study aims to examine the chance or opportunity of low cost apartments in Surabaya for vertical adaptation. The adaptation meant is the installation of mezzanine in order to extend the area of space caused by the increase of spatial need.

<http://www.ijesrt.com> © International Journal of Engineering Sciences & Research Technology

METHODS

This study is based on theory of activity by Engestrom (1999) which said that an activity involves interaction between two components namely individual and object or technology. Individual or subject (S) who is working on the activity using an object or technology as a tool (including the space for working) will produce a goal that is the objective (O). In this study, a person (S) who performs activities (daily works) will produce its objectives, including the size of the space that is used to perform the activity. So if a person (S) is doing cooking activity, in addition to the food as the result, the dimensions of the space that was used for cooking (kitchen) can also be found. The use of the above theory is also supported by Manning (1987) and Voordt (1997) who stated that the need for space could actually be traced from the activities conducted that are always in accordance with the characteristics of the actors.

Figure 1:



This study examines every activity undertaken by the family members to determine how much space is actually needed. Each activity will involve furnishing and circulation that are needed in the conduction of such activities. The total area required to perform all activities of the daily living is often (much) larger than the area of space provided (existed). To cover or solve this space shortage, users usually try to expand their space, among others, by installation (construction) of a mezzanine or a loft in the multi-functional space. Compared to corridor occupation and balcony extension, this vertical adaptation is the best (most appropriate) way in solving the space inadequacy.

A mezzanine (or in French, an entresol) is an intermediate floor, similar to a balcony, in a building whose centre is open to the double-height ceilinged floor below. Mezzanines may serve a wide variety of functions, it can be a bedroom, a library, a work area or whatever desired it to be. It aims to maximize the use of vertical space. It provides additional room above and below and can be built free of existing structures (Wikipedia)

Figure 2:



An example of a mezzanine in section and plan
 (Source: homedesignlover.com; trendier.com; primeroofingsolutions.com)

The method used for data collection in this study is by questionnaires and checklist. Both of these tools are used primarily to assess the position where (refer to the checklist) each household activity is undertaken. On the checklist (which includes floor plans of each unit) surveyor sign the activity according to the position, as well as add any furnishings involved that are contained in the unit. This data is used to determine the true extent of the space required by the respondent in conducting her/his activities.

After the real spatial need is found, then the lack of space can be obtained from the difference between the actual space requirements and the living space in the existing unit provided by the government as the provider of

low cost apartments in Surabaya. Investigation on what occupants did when overcoming the space shortage would be explored from whatever changes occurred on the unit occupied or space usage.

For sampling, this study involved 100 respondents from Rusunawa (low cost apartment) units scattered in 14 locations throughout the city of Surabaya. Thus, there are seven families in the data at each location, except Simolawang that involved nine families for the sake of fulfilment to 100 respondents. The main purpose of the data collection is to get the dimension of space required for each activity, from which the amount of space that is actually needed can be found.

RESULTS AND DISCUSSION

The Provided Space

The following table is the list of space area available in each Rusunawa in Surabaya that are scattered in 14 locations throughout the city in accordance with the availability of facilities on the existing space. The space areas listed in the table are in square meters.

Table 1: Area of room facilities

	SOMBO	SIMOL	DUPAK	PENJAR 1	PENJAR 2	WONO R	RANDU	GN. SARI	WARU GN	URIP S	TANAH MERAH	PENJAR 3	ITS	UNESA
Total area	22.5	22.5	22.5	22.5	22.5	22.5	22.8	31.4	20.9	24	22.5	26.9	21.7	18.7
R. Multi-fungsi	18	18	18	18	16.5	16.5	15.6	23.4	15.2	18	13.5		17.6	18
Dapur					1.8	1.8	2.7	2.8	1.5	2	2.25	4.05		
KM/WC					2.4	2.4	2.7	2.4	2.7	2	2.25	2.7	3.5	
Balkon	4.5	4.5	4.5	4.5	1.8	1.8	1.8	2.8	1.5	2	4.5	2.7	0.6	0.72
Kamar												8.4		
R. Keluarga												9		

The total area of the units provided by the government has grown from 22.5 m² at the beginning of the construction to nearly 32 m² in the most recent construction. So, the average area of the space provided is 23.14m². However, although the space area has developed extensively, the latest unit space is still insufficient when compared with the actual space required by the users.

The Actual Space Required

From the survey it was found what activities were done by each household in the sample, as well as where they did on each activity. From the location, as well as the furniture used for activities described in the checklist, it could be calculated how much space was used when the activity took place. The real spatial need resulted from survey questionnaire and checklist was found to be 35.46m².

From the survey resulted by questionnaire about what activities were done by families in their daily life, it was found that there were a total of 19 activities which are detailed as follows: A. washing; B. drying; C. ironing; D. storing-1 (cleaning utilities); E. cleaning; F. cooking; G. eating; H. dish-washing; I. storing-2 (clothes); J. bathing; K. sleeping; L. praying; M. learning; N. child-caring; O. storing-3 (money/valuable things); P. TV-watching; Q. relaxing; R. playing; S. entertaining; T. storing-4 (other than previous items).

The number of daily household activities based on the survey was as much as 19 activities. However, not all families did all these activities. There were families who did not do certain activities, for example families that did not have small children, did not perform child-caring, and playing. If the children were grown up only learning activity was occurred. Families living in units that do not serve facilities provided privately were certainly not doing laundry, dish-washing, and bathing, as shower and washing facilities were provided collectively outside the units. Single occupants especially career women often did not cook themselves as they preferred to have lunch in the office and in the evening they chose to buy ready (fast) food. Many households also preferred not to wash their clothes but used laundry services outside.

Problems that were caused by the space inadequacy

The space that is used to do all the daily activities in reality is always larger than the area available on the existing space. However, due to the smartness of residents in managing their time, many activities that were

undertaken on the same place, were conducted at different times. So, occupants of Rusunawa were families who knew well how to manage time, particularly in order to utilize the existing space.

This can be seen from the results of the survey of data collection in which the actual spatial need is proven to be much larger than the space provided. From the tabulation of survey results, it appeared that the living space needs withdrawn through median was 34.85 m², while the result pulled by average was found 35.46 m². Meanwhile, the average space on the existing unit was 23.14 m². So the average shortage of space is 12.32 m². Each activity should have its own space, as it is important to ensure the comfort and privacy of residents to do activities.

Privacy for family members is crucial, especially for an activity that is really private. The nature of the activities can be considered in three possibilities: private, semi-private, and public. Activities that are private must be conducted in a private space as well. If it is done in a multi-functional space, it can impair its quality which in turn could disrupt health psychically, also the peace of mind, which in turn it might interfere the welfare of the family.

In this case, at least occupants need more private space in addition to a multi-functional space that already exists. This happens in Rusunawa units. In addition to shortage of living space, it also lacked private space. This condition can be solved by dividing the existing multi-functional space. For a family with many members, it needs to expand the room for adapting to the real spatial needs.

Adaptations made to meet the actual spatial need

Adaptation must be carried out by the occupants who live in low cost apartments in Surabaya in order to adjust to their real space need which essentially is always greater than the space provided. Adaptations made depend on how big the space is required, and how the existing space dimensions allow for adaptation. Results show that adaptations made are: partitioning, corridor occupation for horizontal adaptation frontward and the expansion or functional change of balcony for backward adaptation. The other adaptation is vertically by installing a mezzanine. The pattern of vertical adaptation varies, but most patterns are covering the rear half of the floor area of multi-functional space.

The percentage of occupants who did each adaptation showed: residents who did corridor occupation were as much as 29%, residents who installed mezzanine was as much as 16%, changing the function of the balcony was done by 13% of residents in the sample, while 12% of them extended the balcony, and residents who just put up a partition to divide the multi-functional space was 72%.

This study focuses discussion on the vertical adaptation because only this kind of adaptation is legal, in addition to the installation of partitions. Corridor occupation and balcony extension are considered illegal actions. But not all Rusunawa spatial dimensions allow residents do vertical adaptation because of the lowness of unit height. The height of the upper and the lower mezzanine space does not allow human to live there decently and comfortably, because one cannot stand up in it freely.

The construction system they used was very simple and almost always a wood construction. The installation of ladder was also improvised without calculating the stampede and pose, the rule that should be obeyed for the safety of stair users. The condition of limited living space and space height also resulted in limited slope of the disproportionate stairs, regardless of the safety factor, even many of them made it perpendicular only. Similarly, the holing to enter into the upper space seemed to be done as simplest as they could. They did not care about the position as well as the comfort of the entrance way. Sometimes holing was made on the floor space, sometimes on the side wall space, basically wherever there was space that could be used, as illustrated in the figure below.

Figure 3:

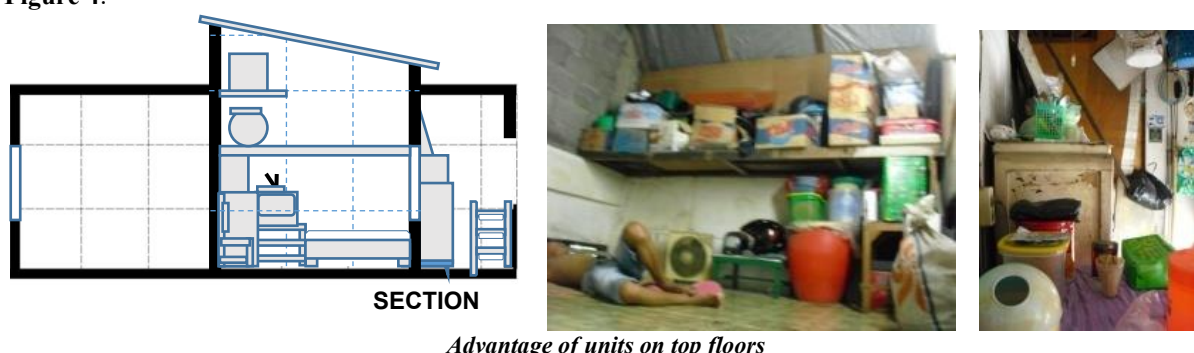


Stairs and holing for entrance to the space

The space height determines the adaptability of Rusunawa units. To be installed a mezzanine the unit space height should be at least 3.7m net, because the lower space should not be less than 2m high while the upper space should be at least 1.7m (the height of an Indonesian man according to the standards of the national survey), so that occupants can stand freely. When added by the thickness of flooring construction, plus a minimum height of 3.7m, the net height of floor to ceiling becomes 4m. This was why it was difficult in Rusunawa in Surabaya to provide an opportunity for residents to do vertical adaptation in order to meet their spatial needs, because the existing unit height only ranged from 2.65m to 3.40m. No unit height reached 3.7m as required.

The space dimension of Rusunawa unit in Surabaya was not only less spacious but there was also a shortage in unit height. With the limited height, only units on the top floors of Rusunawa were able to perform the installation of mezzanine more freely. Residents on the top floors were easier to develop their space vertically as there was an opportunity to break down and utilize the roof space. The following image is an example of a mezzanine construction that penetrates to the roof space (attic).

Figure 4:



The figure shows that the upper space can be made as high as they need, it looks quite comfortable in the use of space as a living and sleeping room. This upper space looks more habitable where one can stand more freely to do various activities, because the height of the room can be determined by themselves as long as it still under the roof line of the building. From the figure it is seen that the upper space is used by the family members to store things and as additional sleeping space. This space can also be a private room when the multi-functional space below is used entirely for other activities.

Although this is an illegal act, but up to date there has been no sanctions applied, it may be because the government tolerates the space shortage condition. So in terms of vertical adaptation, units on the lower floors are not as advantageous as those on top floors.

TYPES OF SPACE CAN BE MADE FROM MEZZANINE INSTALLATION

With the space height of Rusunawa units which are in fact relatively low, the benefits or uses of the space above the mezzanine is limited and depends on how the occupants divide the height of the space above and below the mezzanine. When the height of the lower space is made as high as 2m, then the use of the upper space is limited only as a storing space with space depth only within the reach.

However, if the occupants set the height of the lower mezzanine space for example 1.80m, then assuming that the thickness of the flooring construction is 15cm to 20cm, use of upper space can be better, that can be considered as more flexible storing space. It can even be a space to live in although only limited for sitting and sleeping activities (limited liveable space).

Limited for storing space

The use of the space above the mezzanine which is limited as a storing space is particularly true for Rusunawa with low units: Penjaringan 1, Penjaringan 2, Wonorejo, Waru-Gunung, Tanah-Merah, Penjaringan-3, ITS, and UNESA which unit height is only 2.65m-2.85m. With flooring thickness of 15cm and height of space below mezzanine is 1.80m, the height of the remaining space above is 0.70m-0.90m, which only can be used as just a storing space with depth within arm reach.

Figure 5:



Just a storing space

Flexible storing space

There are three Rusunawa which height of the unit allows for installation of mezzanine although only to be used as storing space, but in an emergency they can be used for sleeping by the family members. This occurred on units of Sombo, Simolawang, and Dupak which unit height is approximately 3.00m.

In these oldest Rusunawas, social relationship among occupants is very close. Besides, they are classified as occupants having the longest length of stay, and their ethnic familiarity also strong. The tradition like gathering of citizens, Al-Qur'an reading, and celebration takes place continuously/regularly and more frequently. When the multi-functional space is being used for social routines by seniors, the junior family members or children can use the mezzanine to live or do activities.

By having unit space height of 3.00m, the height of the above space is 1.05m, as the height of below space must be at least 1.80m and the thickness of the flooring construction is 15cm. This 1.05m height of the space is not comfortable to live, but still possible for sleeping, and mattress is always available there for sleeping anytime. Example of flexible storing space can be seen in the following figures.

Figure 6:



Flexible storing space

Limited livable space

The only Rusunawa units in Surabaya which allowed installation of mezzanine that is tolerable to live were Randu and Gunungsari, as both of them had the highest units i.e. 3.40m. However Gunungsari was a Rusunawa that was newly developed, so mezzanine installation could not be seen. In addition, the unit floor area of Gunungsari was also quite large, so it seemed that they did not need to extend yet.

Randu units could have a bigger height of upper space. Of the 3.40m unit height, reduced by the height of lower space 1.80m, as well as the flooring construction thickness of 15cm, results in the height of the upper space is 1.45m, it is nearly 1.5m, in which kids could still stand freely. Although adults have to walk down or squat, but for sitting activities it can be more flexible. This space can be used as sleeping area when the multi-functional space is used for other activity, so that all the multi-functional space underneath can be used for other purposes. Therefore, this space can be considered as a tolerable living space or limited liveable space, because the use for conducting household activities is also limited. Example of this type can be seen in the following figure.

Figure 7:



Limited livable space

CONCLUSION AND RECOMMENDATIONS

Conclusion and recommendations regarding space area

It can be concluded that the dimensions of residential space, especially about the space area should be determined based on the needs of the family, so that all family members can do their daily household activities comfortably. The types and ways in doing the activities are very contextual, and cannot be generalized. The way of life of Europeans and Asians is different. How to eat between the rich and the poor is also different. Even in Indonesia, the way of life of the Balinese is different from that of Javanese. So, in designing Rusunawa for the poor in Surabaya it should also be based on their daily activities.

The decision on the dimensions of the living space in the design stage should be preceded by field research about what activities are carried out by prospective families who will reside in the dwelling unit, as well as how they perform their respective activities. It is proved that there are seven kinds of household activities that are not listed in the National Standard on the area of residential space. Existing standards also need to be re-checked periodically in order to adapt to the circumstances on the field. This is because by the development of time there are certain things that would also be developing.

The other reality is the finding of extensive real space requirements which are much larger than the existing space provided by the government that were made based on the national standards. The real spatial need is 38.46m², while the size of existing unit space averagely is only 23.14m², ranging from 22.5m² for the smallest, to 31.4m² for the largest unit size. Extensive difference between the real needs and the available space can lead to discomfort of the family which could further affect the health and lead to the need for doing adaptation.

Conclusion and recommendations regarding space height

Besides meeting the needs of the living space area, the need for height of the unit space must also be met. Throughout the history, family is always growing or evolving with time. This development would be coupled with the development of number and type of space need. Not only the number of family members can develop, the social life of the family can also be growing.

Family life starts from newlywed couple of marriage who do not have children. Almost all couples want to have children, including dwellers of low cost apartments. This process is natural, so anticipation in the design to gain additional space for family members is very absolute. Also, many couple of grandparents were found entrusted to take care of grandchildren by their own son/daughter, who already got married and had their own home. These children were usually picked up after working hours.

Besides developing naturally, families also develop socio-economically. In time after their children grown up, definitely they need space for at least separating the space for men and women. More fundamentally a family will need a more private space. So the separation of multi-functional space into a space that is public and private is also absolute. The designer must be observant that a household needs a separation between the two functions of this space. Further, the development of the social economy has also led to the increase of this kind of space, such as the creation of new home based businesses that often require a separate space as there will be a contact with outsiders (clients). This space will be entirely public, so anticipation should be made to protect against the family's privacy.

In conclusion, design of Rusunawa unit should be able to provide opportunities for residents to develop its space at the time when their spatial need increases. Architects must be sensitive in anticipating this situation. The volume of unit must be made in order to allow the increase of space. It would be even better if the vertical adaptation opportunities are designed in modular pattern development. Patterns supported by the structure of the building construction could facilitate residents to perform the installation of a mezzanine in an easier, cheaper and secure way independently. Installation of mezzanine area can be staged based on the needs gradually starting from the smallest to the largest area that cover the entire floor of the multi-functional space.

In anticipating the adaptation of space vertically, it should be noticed that the height of unit space required for the below space should allow men to stand and move freely. By the international standards the minimum height of lower space is 2.20m, but for Indonesia 2.00m could still be accepted. Meanwhile the height of the upper space minimally should be 1.80m (height of Indonesian according to a national survey agency is 1.70m). So, plus the thickness of the flooring construction of 20cm, the total height of floor-to-floor ideally is 4.00m.

REFERENCES

- [1] Engestrom Y, Miettinen R, Punamaki R. 1999. Perspectives on Activity Theory: Learning in doing Social, Cognitive, and Computational perspectives (book). Press Syndicate of the University of Cambridge 1999. The Pitt Building. Trampington Street Cambridge UK. Reprinted 2003.
- [2] Kementrian PU, 2012. Rusunawa Komitmen Bersama Penanganan Permukiman Kumuh. Directorate of Settlement Development (Pengembangan Permukiman). Ditjen Cipta Karya jl. Pattimura no.20. Kebayoran Baru Jakarta Selatan. www.ciptakarya.pu.go.id
- [3] Manning PK, 1987. Environmental Evaluation. Journal of Building Environment 1987. 22 (3). 201-208. <http://www.sciencedirect.com/science/article/pii/-360132387900084>
- [4] Maslow, 1970. Motivation and Personality (book). New York. Harper & Row.
- [5] Voordt DJM van der, Vrielink D, Wegen HBR, 1997. Comparative Floor Plan Analysis in Programming and Design. Journal of Design Studies (18). No.1. 67-68.