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Flexible Housing Concept in Fulfill the Space Needs of Occupants

Rozaifis Rofiei, Mohamad Shahir Naim Abd Latif, Esuryati Kamarudin
Kolej Komuniti Kuching

Abstract: The concept of flexible housing has become a priority in several countries and even various studies for the purpose, philosophy and benefits of this concept in long term have been conducted thoroughly. However, in Malaysia, the concept of flexible housing is still new and lacks research or implementation. Therefore, this paper discusses the concept of flexible housing in terms of purpose, philosophy and benefits based on external studies, precedent study of long-term housing projects in Japan and also get the views of Malaysians citizen on the implementation of flexible housing in Malaysia.

Keywords: *Flexible Housing, Occupants*

1.0 Introduction

There are several definitions of flexible and flexibility that all lead to a consistent understanding. According to Shuchi et al., (2012), flexibility (or adaptability) can be defined as the ability to adapt with the environment without making permanent changes to the environment. Lelieveld et al. (2007) stated that flexible architecture is a specific component of a building that can be modified in response to external stimuli, such as users or the environment. These changes can be implemented by the building system itself, modified manually or other ability to change with external force (Altan et al., 2015).

According to Estaji (2017) and Groák (1992) flexibility is the ability to change physical arrangements and adapt to different social use capabilities. It can be achieved by changing the physical shape of building space through cutting, elongation, and space merging (Schneider & Till, 2007). Flexibility can be found in various types of architecture such as homes, offices, sports centers, and care centers for the elderly and the disabled (Paris & Lopes, 2017).

In the housing aspect, flexible housing is housing planned to be selected at the design stage, both in terms of social use and construction, to enable lifelong change (Schneider & Till, 2005). Schneider and Till (2005) added flexible housing as housing that can adapt to consumer needs change. It includes the possibility of selecting different housing layouts before occupancy and the ability to adjust housing from time to time. It also includes the potential to apply new technologies from time to time, adapt to demographic changes, or even change the use of buildings entirely from housing to other purposes (Till & Schneider, 2005).

Raviz et al. (2015) also agreed by stating that a flexible housing is a residential layout that can adapt to change in needs and patterns both in terms of social and technical issues. Changing demand needs might be due to demographic, environmental or economic factors such as technology updates, an increase in housing age, or family growth. Therefore, flexible housing implements all housing development processes. Gerard Maccreanor (1998) stated flexible housing often works in a very simple way and uses effective techniques and prolonged (Schneider & Till, 2005).

Based on the definition that has been stated in previous writings, it can be concluded that flexible housing is interrelated between physical change and social change. Social change requires physical change and physical change will make the need for social change realised. In the aspect of housing, the application of flexible housing concept is catalyse of symbiosis between physical change and social change (figure 1.0).

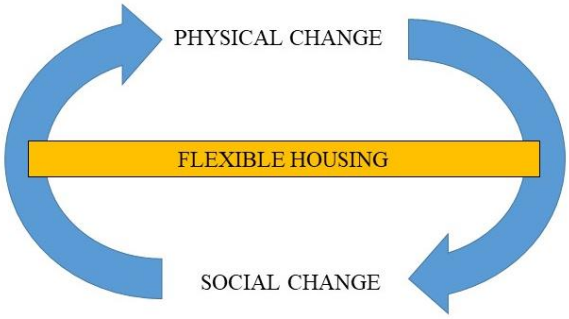

Figure 1.0: Flexible housing concept as catalyse of symbiosis between physical change and social change

2.0 Literature Review

2.1 Purpose of Flexible Housing

The main purpose of the flexible housing concept is to meet the complex and human needs change in general (Shuchi et al., 2012). Flexibility is a useful and effective method that has been used in different architectural spaces to achieve functional efficiency. It has a comprehensive function in architecture that can be determined by open plan and space, mobile and changeable elements or furniture. Thus, flexibility as an early solution in today's housing, is the effect of residential use at various stages in different time periods (Raviz et al., 2015).

Hence, housing must be flexible enough to handle two situations. First, the need to adapt to the changing needs of individuals as they age or become physically less able. Second, housing that can respond to change in the family's development (Schneider & Till, 2007; Raviz et al., 2015). This is because household structures and socio-economic factors are different and changing, showing dynamism in life and most often reflected in the construction space (Agyemang et al., 2018). Occupants often transform and remodel their living space by rebuilding, decorating, equipping, remodeling, landscaping or simply living in the form and space of domestic architecture (Raviz et al., 2015). The application of flexibility in the home is also a solution for occupants to adapt effectively to social behavior change (Altan et al., 2015).

Thus, occupant flexibility in layout planning is one of the main objectives of architectural design, which aims to meet the specific needs of occupants within a given period of time (Shuchi et al.,

2012). It is also an important consideration in housing design if it is to be done socially, economically and in a viable environment (Schneider & Till, 2005). Changes in usage may be less dependent on the physical transformation of space but more dependent on changes in occupant perception (Imrie, 2006; Raviz et al., 2015); and a complete housing system must adapt to the changing lifestyle of the population, and be easy to install and remove (Lu & Juan, 2019).

Flexible housing concept is necessary in the aspect of housing in Malaysia because we know that the needs of the occupants are constantly changing together with social changes, namely households and financial ability. Houses that can undergo changes based on the social conditions of the occupants can help ensure the quality of life of the occupants. Occupants do not have to look for other housing if the household increases and can change the size of the space depending on social needs. It makes housing more sustainable and brings towards improvement to the quality of life (figure 2.0).

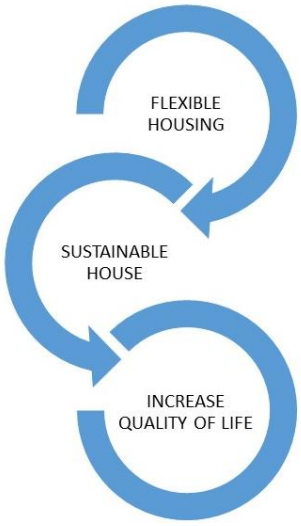

Figure 2.0: Flow of flexible housing concept, sustainable house and life quality

2.2 Philosophy of Flexible Housing

As described in the purpose of flexible housing that emphasises the aspect of occupancy, the philosophy in implementing flexible housing is to involve the occupant aspect. Lamounier et al. (2019) outlined the question of who controls what and when, obtained through agreements and negotiations. Level of flexibility intervention by Lamounier et al. (2019) includes physical differences (support and filling), organisation (from community to individual), region (from city to room) and duration (from 10 to 1000 years).

Shuchi et al. (2012) stated that flexible housing solutions can be divided into two basic components such as planning, namely building level, unit floor and room level (figure 3.0) and

construction (figure 4.0). Planning refers to specific ways to promote flexibility to adapt on the changing and construction refers to the way homes should be structured and constructed to accommodate uncertain future changes.

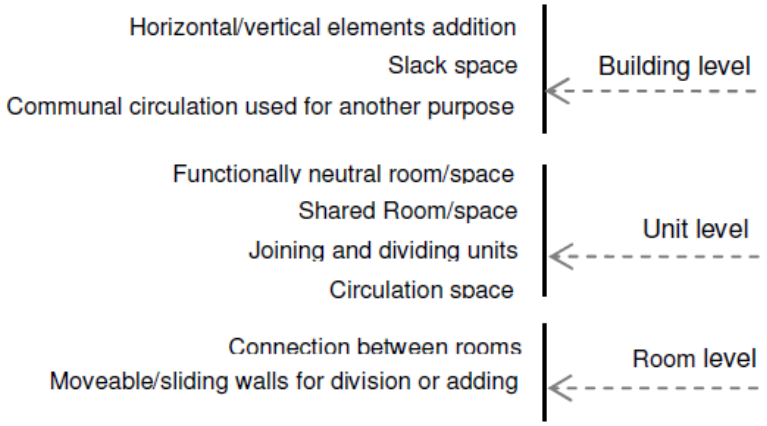

Figure 3.0: Basic Component Planning of Flexible Housing (Shuchi et al., 2012)

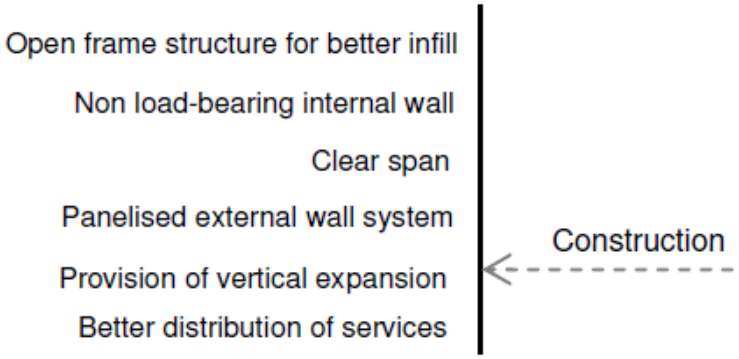

Figure 4.0: Basic Component Construction of Flexible Housing (Shuchi et al., 2012)

Raviz et al. (2015) through Forty (2000) stated that flexibility can be understood through several types. First is flexibility with the movement or rearrangement of complex residential elements. Second is technical flexibility which refer to interior use that can be adjustable through open plan design such as movable floor, wall and ceiling panels. Therefore, the flexibility aspect becomes an approach in building open plan design (Hill et al., 2003) through as many descriptions of its form use, and characterized by a versatile combination of space and use. The modular approach also plays a role in flexibility because the strength of modular housing is in pre-cast structures that can be easily installed, and can be moved to other areas when needed (Kim & Kim, 2016).

2.3 Benefits of Flexible Housing

The benefits of flexible housing can be addressed to two aspects, which are occupancy and sustainability. For the occupancy aspect, the benefit gained is the flexibility allows the occupants to participate in the design process based on the different possibilities of their respective living space use (Raviz et al., 2015). It is in line with the view of Schneider & Till (2005) that flexibility is seen as something that gives occupants a choice for how they want to use space, rather than the architecture that determines their lives.

Schneider & Till (2005) also quoted the words of French architect Arsène-Henri (Rabeneck et al., 1973) that flexible housing provides a personal domain that will meet every expectation of occupants without having to plan the layout arrangements that are supposed to be 'good' or 'correct' but aim to provide space that can accommodate changes in daily use in the long term. Thus, occupants as end users can decide on components such as floor finish, living room size, furniture layout, etc. compared to architects (Alaraji & Jusan, 2015). In economic terms, allowing occupants to be involved in residential design will minimize the financial burden due to major renovation work in the future (Alaraji & Jusan, 2015).

In addition, the benefit to the occupants is to show proof of ownership, sense of identity, control, security, respect for privacy, respect for personal space and space designation because the purpose of personality is an important factor driving consumer satisfaction (Yavari et al., 2015). It is acknowledged by Asad Poor Zavei (2015) that in order to meet the needs and preferences of end users, the involvement of occupants in home manufacturing is important, as it can enhance the taste of the home. This is in line with the study of Sarkom et al. (2017) which a number of homeowners argue that terrace houses built by developers do not provide adequate privacy.

Occupants can also change the layout of the living room's furniture to hold a party or make some big changes such as dividing the house into two parts for rent (Estaji, 2017). Even based on the study of Alaraji & Jusan (2015), occupants are more concerned with flexibility in the design of living room, kitchen, dining room, master bedroom, as well as bedroom; and the most preferred method of flexibility is the use of portable partition walls and flexible furniture.

In terms of sustainability, it benefits several factors because flexibility can accommodate various functional demands in a limited space because design modifications require less material, energy, and work and therefore sustainable in terms of design (Altan et al., 2015) as well as having good ecological potential, especially in relation to energy and resource savings (Altan et al., 2015). Energy efficiency also occurs when the arrangement of the interior space of housing can be arranged taking into account the factors of the direction of the sun (Altan et al., 2015). It is supported by Raviz et al. (2015) who stated that flexibility provides the creation of buildings that can be used for a long

time in fulfill current needs due to occupant's involvement opportunities, acceptance of new technologies and economically and ecologically viable.

Furthermore, flexibility provides benefits in resolving the changing demographic needs of occupants, especially internal micro changes at the housing unit level (Raviz et al., 2015) because if occupants can adapt in terms of number of dwellings then they do not need to move out therefore good to their financial and social. Geldermans et al., (2019) also stated that the involvement of occupants leads to a variety of materials and product cycles that bring to more effectiveness, suitability, and the latest interior materials thus opening to new supply and service models in the surrounding economy.

As described for the purpose of flexible housing, it also provides benefits in increasing the lifespan of buildings and reducing the need for demolition (Paris & Lopes, 2017). Lu & Juan (2019) stated that long-term housing is ready for future residential environment changes (Kim & Hwang, 2017) based on resilience, flexibility and maintenance.

2.4 Precedent Study: Long Term Housing Project in Japan

The writing of Minami (2016) about long-term housing projects that have been implemented in Japan can be used as a reference study to understand the concept of flexibility in housing. This long-term housing project in Japan is an initiative of the Japanese government and private sector in the late 1970s that initiated research and development projects to plan and build long-term housing that can be adapted to time, such as the Kodan Experimental Housing Project (KEP) and Century Housing Project (CHS). It is started from comparison of the age of public housing in Japan is in the range of 30 years compared to foreign countries such as the United Kingdom which can reach up to 77 years.

Through Minami's writing, Japan started the Kodan Experimental Housing Project (KEP) whose implementation purpose was to compensate for the shortage of construction workers at that time by applying the concept of home interior systems that can be installed without the need for high-skilled manpower. It is done by applying simple design, the use of self-built furniture as well as space divider walls that are easy to install and replace by occupants. Minami has evaluated the effectiveness of KEP after 30 years of its implementation period by comparing previous studies from 1982, 1995, 2005 and 2014.

For example, through figure 5.0 which shows the basic plan of the KEP house for type B with a dotted line showing the main variable separation wall, and figure 6.0 which shows the change of the unit plan over a period of 30 years, it turns out that the occupants make changes to the interior space interior wall separator system to suit lifestyle needs. Based on the study, 59% (19/32) of unit B occupants have made at least some changes to the residential floor plan. In most cases, occupants change the layout to make the living room or bedroom bigger as children grow up and move away from home. Changes also involve other spaces according to the suitability of their lifestyle changes.

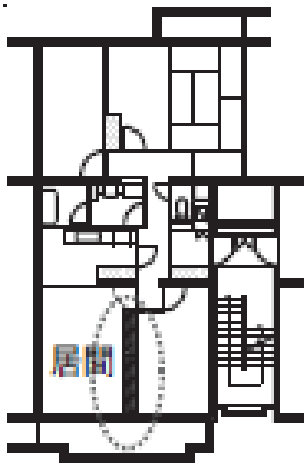

Figure 5.0: Basic Plan Unit B of KEP (Minami, 2016)

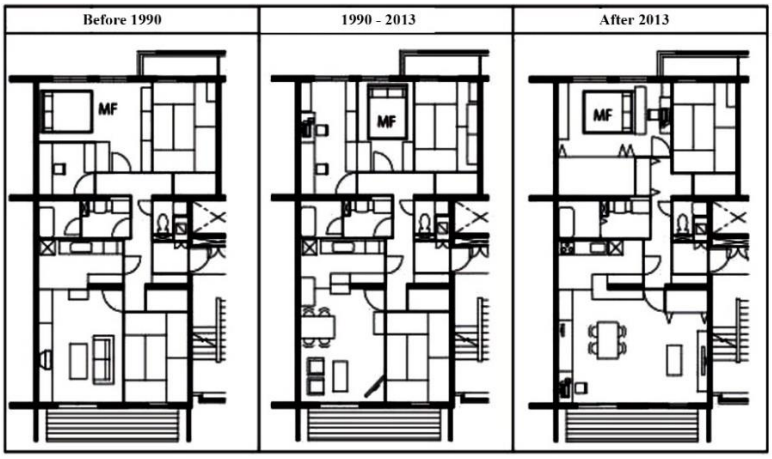

Figure 6.0: Change of Unit B of KEP within 30 Years by changing the position of the interior walls (Minami, 2016)

Occupants also become more willing to stay in residential units when they are older where 67% of them in 2014 want to continue living in their units. Thus, the KEP system runs as planned more than thirty years ago. Subsequently, the Japanese government issued the Century Housing System (CHS) certification in 1986 as a result of KEP research and development. The purpose of CHS is to meet the needs of housing and the daily lives of occupants on the need for changes in family structure and lifestyle. This is because Japanese public housing at that time was less in terms of durability of internal construction and shorter equipment compared to the durability of basic construction as well as failing to meet proper maintenance. The CHS Handbook sets out the following guidelines as a basic standard for CHS certification:

i. Building foundations have long-term durability.

ii. For post-construction maintenance, a brief inspection is carried out.
iii. Floor plans, interior finishes and equipment (fittings) can be replaced.
iv. The finish and walls of a home can be easily repaired, refurbished, replaced, or moved without affecting other parts.
v. Building drawings are provided to provide information to occupants on CHS housing features.
vi. The above can be done for a long time.

Based on Minami's study on Building A, Complex E, in the Chiba private condominium complex applying CHS certification, from 1987, 1994, 2003 and 2010, the most frequent floor plan layout changes were four (4) times during the period as shown in Figure 7.0 . Changes to the layout of the residential floor plan are done by modifying the walls of the interior divider.

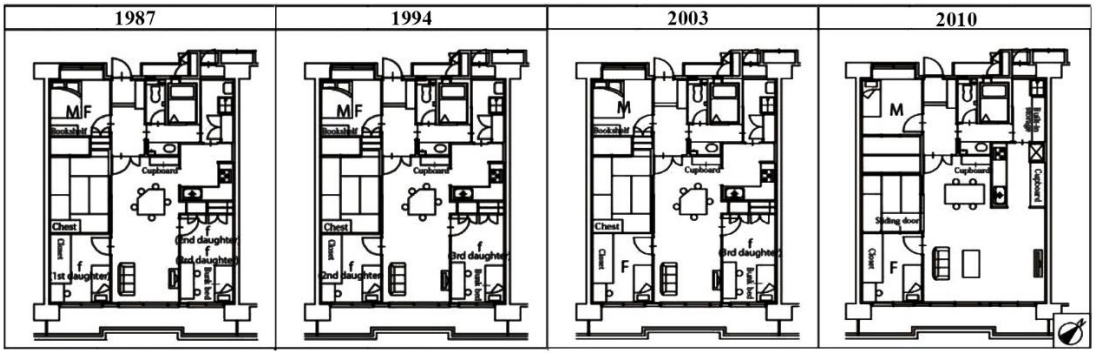

Figure 7.0: Layout Changing of CHS's Implementation Housing (Minami, 2016)

In addition, Minami's study found that 47 out of a total of 58 occupants (82.8%) experienced making modifications to their residential units with an average rate of 1.75 times. Most of the changes in the interior space are due to lifestyle changes such as maturity and freedom of the child, new birth, family sharing and the death of family members.

3.0 Methodology

The methodology for this research is by the questionnaire method. A total of 300 respondents conducted this questionnaire. Respondents cover the general public throughout Malaysia and the age limit is set between 20 to 35 years. The setting of this age limit is to get the views of the so-called youth who are mostly involved in the search for housing. Therefore, the views of this age group can strengthen the findings of the questionnaire and can help in framing the direction of the concept of future housing. The question items were constructed based on the literature review that has been described in the writing of this research, which about flexible housing. The main purpose of this questionnaire was to obtain the views and perceptions of the public on flexible housing concept. Questions include a willingness to own

and live in flexible housing and a willingness to build flexible interior space. Descriptions of flexible housing were also stated in the questionnaire to enhance respondents understanding of the purpose of the questionnaire.

4.0 Analysis and Discussion

Table 1.0 Respondents' Acceptance on Flexible Housing Concept

Respondents' Acceptance on Flexible Housing Concept		N	%	Overall Mean
Willingness to own and live in Flexible Housing Concept	Strongly Disagreed	3	1.0%	3.9097
	Disagreed	18	6.0%	
	Satisfy Agreed	55	18.4%	
	Agreed	**150**	**50.2%**	
	Strongly Agreed	73	24.4%	
Willingness to build house's interior space by flexible method	Strongly Disagreed	1	0.3%	3.9899
	Disagreed	9	3.0%	
	Satisfy Agreed	51	17.1%	
	Agreed	**168**	**56.4%**	
	Strongly Agreed	69	23.2%	

Table 1.0 shows respondents' acceptance on flexible housing concept. On average, respondents agreed on the willingness to own and live in flexible housing concept with a mean value of 3.91. Respondents also agreed on the willingness to build house's interior space by flexible method with a mean value of 3.99.

Table 2.0 Prioritize Interior Space Order

	Prioritize Interior Space Order	N	%
Higher Priority	Master Bedroom	146	48.7%
	Wet Kitchen	86	28.7%
	Bathroom	86	28.8%
Priority	Living Area	66	22.0%
	Family Area	46	15.3%
	Second Bedroom	54	18.0%
Less Priority	Dry Kitchen	53	17.7%
	Third Bedroom	81	27.3%
	Yard	96	32.1%

Table 2.0 shows the order of prioritize interior space by respondents. Respondents are ordered the nine spaces from 1 to 9 as higher priority to less priority accordingly. There are three types of higher priority interior space by respondents, namely the master bedroom with 48.7% choose (146 people), wet kitchen with 28.7% (86 people) and bathroom with 28.8% (86 people). The next order is living area with 22% (66 people), family area with 15.3% (46 people) and second bedroom with 18% (54 people).

Furthermore, the less priority interior space by respondents are dry kitchen with 17.7% (53 people), third bedroom with 27.3% (81 people) and yard with 32.1% (96 people).

Table 3.0 Preferred Additional Space.

	N	**%**
Garage or porch	7	2.30%
Wide kitchen and dining area	3	1%
Green Area	10	3.10%
Balcony	30	10.00%
Prayer Room	25	8.10%
Entertainment Room	21	6.80%
Study Room	33	10.6%
Laundry	7	2.30%
Extra Room	11	3.40%

Table 3.0 shows the preferred additional spaces to have by respondents their house, although generally this space is not offered in a housing plan sold in Malaysia. The variation of this space indicates that the respondents have their own tastes towards the interior layout of the house and want to create spaces that should exist according to their own wishes.

Table 4.0 Estimated Expenses for Home Renovation in One Time.

	N	**%**
< RM 10, 000	83	27.7%
RM 10, 000 – RM 20, 000	94	31.3%
RM 20, 001 – RM 30, 000	77	25.7%
RM 30, 001 – RM 40, 000	16	5.3%
RM 40, 001 – RM 50, 000	13	4.3%
> RM 50, 000	17	5.7%

Table 4.0 shows the percentage distribution of respondents' selection on estimated expenditure to be incurred for house renovation in one time. For an estimated value of less than RM 10,000, 27.7% (83 people), RM10,000 - RM20,000 31.3% (94 people), RM 20,001 - RM 30,000 25.7% (77 people), RM 30, 001 - RM 40,000 for 5.3% (16 people), RM 40,001 - RM 50, 000 for 4.3% (13 people) and over RM 50, 000 for 5.7% (17 people). This shows that highest estimate value is below RM30, 000.

Overall, it is found that the concept of flexible housing should be one of the main housing concepts in Malaysia. The results of the questionnaire showed that the average respondents agreed to own and live in flexible housing and agreed to build their own interior space flexibly. It is response to

the purpose of flexible housing that has been stated which is to meet the changing human needs in general. The findings showed that respondents have the preferred of additional space to be created in their house reinforces the benefits that have been stated such as occupants participate in the design process based on different possible use of space, give occupants options to define space, provide evidence of ownership and taste identity, and make the occupants the primary determinants of their respective residences. It also benefits the changing demographic needs of the occupants in the long run and can increase the life expectancy of the housing.

In addition, the interior space that is the priority of the occupants, namely the master bedroom, wet kitchen and bathroom can be used as a guide in designing the basic layout of the housing to encourage the implementation of the flexible housing concept. The level of the estimated expenditure of occupants for renovation which is below RM30, 000 in the majority should also be used as a measure in determining flexible construction techniques that should not only be easy to build but at the same time financially affordable.

5.0 Conclusions

The flexible housing concept should have begun to be implemented in the housing aspect in Malaysia. Long term housing projects in Japan that assess aspects of housing for 30 years by applying the concept of flexibility should be exemplified and studied thoroughly. The Japanese way of cultivating this concept to the occupants with various incentives proved that the concept has been successful in their country. Therefore, Malaysia should also take similar steps in increasing the level of house ownership of the citizen.

Various studies need to be carried out but at the same time, the initiative in starting it should already exist. Various parties in the housing sector such as the ministry of housing and local government, architects, engineers, contractors and developers need to work together so benefits of this concept can be achieved while improving the living standards of Malaysians in becoming one of the competitive countries.

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