

**FLEXIBLE WINDOWS AS A MEAN OF ACHIEVING USER
SATISFACTION IN MASS HOUSING**

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DEDICATION

To my beloved mother and father

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In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my thesis supervisor, Assoc Prof Dr. Mahmud Bin Mohd Jusan, for encouragement, guidance, critics and friendship. Without their continued support and interest, this thesis would not have been the same as presented here. I am also very thankful to Universiti Teknologi Malaysia (UTM) staff member for a great cooperation during the data gathering. Librarians at UTM and UTM management office staff members deserve special thanks for their assistance in supplying the relevant material. Unfortunately, it is not possible to list all of them in this limited space. I am grateful to all my family members.

ABSTRACT

The current trend in mass housing provision in Malaysia is providing housing unit designs which are not easily adaptable with the changes in lifestyle of end users. As a result, various architectural elements of housing unit including windows subject to modification. This phenomenon is evident when 42% of the respondents of this research experienced windows replacement in the housing. This study investigates flexible window design with particular focus on users' reasons for having flexible windows, their tendency to be involved in the process of windows replacement and the expected characteristics of flexible window. To achieve these, quantitative surveys were carried out among Universiti Teknologi Malaysia's staff. The results indicate that 74.4% of the users show enthusiasm for adopting flexible windows in their houses. Sixty nine percent (69%) of the respondents believe that applying flexible windows would increase their level of satisfaction with their houses. Respondents' reasons for having flexible windows are mainly to fulfill their housing needs within the physical and psychological levels. The results also demonstrate that existing problems with the window designs are derived from the installation method, window structure and material. Systematic design of flexible window can be achieved by simplifying its structure and layout, having versatile frame and simplified installation and self-locating techniques. In addition, the results suggest that permanent integration, heavy weight and sharp window components should be eliminated. Materials for flexible windows need to be non-toxic, reusable as well as recyclable which offers users variety of design, ease of maintenance and preservation. In conclusion, flexible windows could revolutionize the fenestration industry, and this can be an approach to meet individual housing needs to enhance housing satisfaction.

ABSTRAK

Tren semasa dalam penyediaan perumahan besar-besaran di Malaysia ialah dengan menyediakan rekabentuk unit rumah yang tidak mudah diadaptasikan dengan perubahan gaya hidup pengguna. Akhirnya, pelbagai elemen binaan unit rumah termasuklah tingkap tertakluk kepada pengubahsuaian. Fenomena ini amat jelas apabila 42% daripada responden kajian ini mempunyai pengalaman dalam pengubahsuaian tingkap di rumah mereka. Kajian ini menyelidik rekabentuk tingkap fleksibel dengan fokus khusus ke atas sebab-sebab pengguna menggunakan tingkap fleksibel, kecenderungan mereka untuk terlibat dalam proses penggantian tingkap, dan ciri-ciri yang diharapkan daripada tingkap fleksibel. Untuk mencapai matlamat ini, kajian kuantitatif telah dijalankan melibatkan staf-staf Universiti Teknologi Malaysia. Hasil kajian mendapati 74.4% pengguna menunjukkan minat untuk menggunakan tingkap fleksibel di rumah mereka. Enam puluh sembilan peratus (69%) daripada responden pula percaya bahawa dengan menggunakan tingkap fleksibel, ia akan meningkatkan tahap kepuasan mereka terhadap rumah mereka sendiri. Sebab-sebab utama responden memiliki tingkap fleksibel ialah untuk memenuhi keperluan perumahan mereka dari segi tahap fizikal dan psikologikal. Hasil kajian juga memperlihatkan masalah-masalah yang wujud berkaitan rekabentuk tingkap adalah berasal daripada kaedah pemasangan, struktur tingkap, dan bahan. Rekabentuk tingkap fleksibel yang sistematik dapat dibuat dengan memudahkan struktur dan susun aturnya, menggunakan bingkai serba boleh/versatil, dan teknik pencarian sendiri ('self-locating technique'). Seterusnya, hasil kajian juga mencadangkan bahawa integrasi kekal, beban yang berat, dan komponen tingkap yang tajam harus dihapuskan. Bahan-bahan untuk tingkap fleksibel perlulah terdiri daripada bahan yang bukan toksik, boleh diguna semula dan dikitar semula di samping menawarkan kepada pengguna kepelbagaian rekabentuk, kemudahan

penyelenggaraan, dan pemeliharaan. Kesimpulannya, tingkap fleksibel mampu merevolusikan industri bukaan, dan ini boleh menjadi satu pendekatan untuk memenuhi keperluan perumahan individu yang meningkatkan kepuasan perumahan.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	viii
	LIST OF TABLES	xiii
	LIST OF FIGURES	xv
	LIST OF APPENDICES	xvii
1	INTRODUCTION	
	1.1 Background of the study	1
	1.2 Statement of the problem	3
	1.3 Purpose of the study	6
	1.4 Objective of the study	6
	1.5 Research questions	7
	1.6 Significance of the study	7
	1.7 Scope of the research	8
2	LITERATURE REVIEW	
	2.1 Introduction	9
	2.2 Flexible Housing	10
	2.3 Exigency of flexibility	12

2.3.1	Roots of neglecting human's motivational factors in living environment	12
2.3.2	Necessitates of flexibility within Malaysia	13
2.3.3	Demolition waste in Malaysia	16
2.4	Benefits of flexibility	17
2.4.1	Flexibility and sustainable housing development	18
2.4.2	Promoting Person Environment Congruence	18
2.4.3	Being ready for demographic changes	19
2.4.4	Internal dynamic	20
2.4.5	Economical feature	20
2.4.6	User participation	21
2.4.7	Flexibility and sustainable construction	21
2.5	Windows and human needs	24
2.6	Windows evolutionary process	25
2.6.1	Evolution of windows design	25
2.7	The essential windows problem	26
2.7.1	Material	27
2.7.1.1	Vinyl (PVC)	27
2.7.1.2	Wood	28
2.7.1.3	Aluminum	28
2.7.2	Windows installation method	28
2.7.3	Neglecting Flexibility in windows design and consequences	30
2.8	Design for disassembly as a mean of promoting flexibility	31
2.8.1	Design for disassembly	32
2.8.2	Design for disassembly features	33
2.8.3	Disassembly	33
2.8.4	Design for ease of changing and disassembly guidelines	34

	2.9	Conclusion	35
3		RESEARCH METHODOLOGY	
	3.1	Introduction	37
	3.2	Study Area	37
	3.3	Methodological approaches	38
	3.4	The research process	39
	3.5	The methods of the study	41
	3.5.1	The survey	41
	3.5.1.1	Sampling procedure	41
	3.5.1.2	Selection of the respondents	41
	3.5.1.3	Sampling frame	42
	3.5.1.4	Questionnaire	42
	3.6	Instruments	44
	3.7	Data analysis	44
	3.7.1	Frequency	45
	3.7.2	Cross tabulation	45
4		Data Analysis	
	4.1	Introduction	46
	4.2	Respondents' profile	47
	4.3	Flexible windows and housing satisfaction	49
	4.3.1	Flexible windows and housing satisfaction cross different variables	50
	4.4.4.1	Gender	51
	4.4.4.2	Marital status	51
	4.4.4.3	Age	52
	4.4.4.4	Type of employment	54
	4.4.4.5	Level of education	55
	4.4.4.6	Income	56
	4.4	User participation	58
	4.5	Demand for flexible windows	62

4.6	Users and windows replacement	64
	4.8.1 Experience of windows replacement	65
	4.8.2 Reasons of windows replacement	69
4.7	Desirable housing development	70
	4.7.1 Flexible windows affordances	71
	4.7.1.1 Physical	72
	4.7.1.2 Psychological	74
4.8	Priorities of flexible windows advantages	78
4.9	Reasons of refusing flexible windows	79
4.10	Conclusion	79
4.11	Identifying deficiency of flexibility within the recent windows	80
	4.11.1 Problems as the obstacles of user involvements	80
4.12	Priorities of modifying windows components features for user encouragements	83
4.13	Required design improvement	84
4.14	The eligible flexible windows characteristic	85
	4.16.1 Preferred windows type	86
	4.16.2 Preferred material	89
4.15	Flexible windows	93
	4.17.1 Product structure and its layout	93
	4.17.2 Ease of disassembly efforts	96
	4.17.2.1 Insert windows installation method	96
	4.17.2.2 Full frame windows installation	97
	4.17.2.3 Insert vs. full frame windows installation	98
	4.17.3 Parts	100
	4.17.4 Material	101
	4.17.5 Accessibility	102
	4.17.6 Fasteners or joints	103

5	CONCLUSION AND RECOMMENDATIONS	
	5.1 Conclusion	104
	5.2 Recommendation	110
	BIBLIOGRAPHY	113
	APPENDIX	120

LIST OF TABLES

Tables NO.	TITLE	PAGE
Table 2.1	Definitions of flexibility. Source: albostan (2009)	11
Table 2.2	Principles of sustainable construction and design for disassembly as well as flexibility	23
Table 2.3	Percentage types of waste management options. Source hurley (2003)	31
Table 3.1	Sampling frame	42
Table 4.1	Summarized demographic/housing characteristic frequencies	48
Table 4.2	User motivations and tendency to be involved the process of windows replacement	62
Table 4.3	Reasons of windows replacement	69
Table 4.4	Categories and expected consequences	77
Table 4.5	Priorities of flexible windows advantages	78
Table 4.6	Available problems and difficulties in the current design in users' opinions	81
Table 4.7	Level of importance for user influence in the process	83
Table 4.8	Users' agreement on windows improvement	84
Table 4.9	Windows type preferred to be done by the users	86

Table 4.10	Reasons of preferences for the preferred windows	87
Table 4.11	Reasons of preferring windows based on the characteristics	88
Table 4.12	Preferred windows material	89
Table 4.13	Reasons of preferences for the preferred material	90
Table 4.14	Reasons of preferring material based on the characteristics	92
Table 4.15	Comparison of advantages and disadvantages of full frame windows replacement	99
Table 4.16	Comparison of advantages and disadvantages of insert windows replacement	99

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
Figure 2.1	The diagram of sustainability in construction. Source: nazirah zainul abidin (2005).	23
Figure 3.1	Data collection procedure	40
Figure 4.1	Flexible windows and increasing housing satisfaction	49
Figure 4.2	Gender and increasing housing satisfaction by use of flexible windows	51
Figure 4.3	Marital status and increasing housing satisfaction by use of flexible windows within	52
Figure 4.4	Respondents age and increasing housing satisfaction by use of flexible windows	54
Figure 4.5	Type of employment and increasing housing satisfaction by use of flexible windows	55
Figure 4.6	Percentage within the respondents' level of education and increasing housing satisfaction by use of flexible windows	56
Figure 4.7	Percentage within the level of education cross group age	56

Figure 4.8	Level of income and increasing housing satisfaction by use of flexible windows within	58
Figure 4.9	Do it yourself willingness and gender	59
Figure 4.10	Do it yourself willingness and marital status	59
Figure 4.11	Do it yourself willingness and age	60
Figure 4.12	User tendency to be involved in the process of windows replacement	60
Figure 4.13	Do it yourself willingness and level of income	61
Figure 4.14	Demanding flexible windows	63
Figure 4.15	Demanding flexible windows by percentage within the level of respondents income based on the type of dwelling	64
Figure 4.16	Experience of windows replacement	66
Figure 4.17	Level of respondents' income and windows replacement experience	66
Figure 4.18	Flexible windows as the assist of weak group	68
Figure 4.19	Reasons of windows replacement through three levels of dwelling	70
Figure 4.20	Sash installation as well as reinstallation by means of self-locating in slider windows	95
Figure 4.21	Procedure of insert window replacement. Source: renewal by Andersen 2002.	97
Figure 4.22	Procedure of full frame window replacement. Source: renewal by Andersen 2002	98

LIST OF APPENDICES

FIGURE NO.	TITLE	PAGE
A	Questionnaire survey A	121
B	Questionnaire survey B	125

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Constructing adaptable living environment with minimal conflicts is one of the critical factors in the current architecture. These types of buildings aim to promote abilities of accepting new technologies, new life styles and being much more harmonious to residents' desires (Kendal, 1999). The issues of flexible housing within the 20th century has been debated under three main titles: "1920s Modernity and the minimal dwelling", "1930s-1960s The industrialization of housing" and finally "1970s Participation and user choice". Limited space standards, minimum dwellings, standardization, polyvalent organizations, base structures, convertible space, modular design prefabrication, support and infill system, customization, user participation and future intended designs are themes which are related to flexible housing according to Schneider & Till (2007).

The prosperity of Malaysia in providing adequate houses by employing modernity and industrialization of mass housing is undeniable but the salient importance of users participation within the living environment has not been noticed remarkably. As a result, living in a house rather than a home is experienced. Therefore, in order to relieve the stress and discomfort within their living environments, users should leave the house or experience a difficult process of housing personalization which not only brings forward several disadvantages in economical aspects but also in environmental and social one. Consequently, housing

personalization is seen as a culture among Malaysians. In fact, necessity of flexibility within Malaysia becomes really tangible due to illustrating considerable amount of personalization within this country by abundances of literatures. (Jusan, 2007; Omar *et al.*, 2010; Omar *et al.*, 2012; Nurdalila Binti Saji, 2012; Rahim & Hashim, 2012). Within the mentioned researches, there are several minor and major types of personalization such as physical and horizontal extension, spatial modification, increasing the number of bedrooms, facade components modification and etc. However, rigidity within the current construction method does not let an easy process of housing personalization as well as modification.

Studying the area of housing personalization identified the fenestration as one of the renovated building components. Within the all aforesaid researches, windows are one of those sorts of building components which had been personalized purposely either affected due to unintentional incident during housing personalization. Windows personalization has been experienced due to various reasons such as unwanted occurrence during spatial modifications, changing the windows design, physical condition defects, changing the number of windows within a specific area, using windows for enlargement of spaces and etc. However, in spite of windows personalization intention within dwellings, available difficulties as well as product shortcomings put obstacles in the way. As a result, this might be asked, while windows need to be personalized “Why shouldn’t new building components be improved by promoting the feasibilities of assembling and disassembling to enable an easier process of personalization?”

Jusan (2010: 94) believes that modification and personalization of the dwellings will be much more perfect and efficient, when demolition process and other components disturbances are at the lowest level. In addition, accommodating easier future modification or personalization would not be possible unless current rigid construction industry would be transferred to flexible ones by enrichment of disassembling and assembling techniques. As a result, easier spatial arrangements would be available. However, could easier spatial arrangements be successful without availability of those flexible interconnected building components? Innovating in building structure design leads to applying flexible structure.

Moreover, transferring rigid conventional walls to the movable ones have promoted the possibility of flexibility in spatial arrangements. However there is insufficient discussion on the potential of flexible fenestration (windows) and user expectations and motivations for the mentioned component.

A flexible design that facilitates easy changing of door and window (fenestration) must be developed.

(Jusan, 2010: 94)

1.2 Statement of the Problem

Actually, exigency of considering flexibility within fenestrations arises from two main issues. This necessity first and foremost originates from neglecting the users' needs, demands, and preferences within shaping their environments which has brought forward remarkable housing personalization. The second issue which is the subject of debate derived from insufficient consideration of the design for disassembly principles and producing huge amount of damaged windows components.

In order to solve housing needs over the past forty years the amount of construction throughout Malaysia had been noticeable but it has not been exactly what the residents expected. Actually, "one design fits all is not logical" (Omar *et al.*, 2010). In fact, issues arise from the rejection of the fact that users are central to prepare a home. House can be called the physical structure but a home is a structure which fulfills humans' needs in terms of physical, psychological and social. A suitable living environment should give the chance of personalization to its residents (Jusan, 2010). As housing designs are not easily accepted in tandem with the changes in lifestyles of the people, housing personalization has become monotonous and acknowledged as a Malaysian culture (Ahmad Hariza & Zaiton, 2010). Virtually, Malaysians are not satisfied with their houses so, they try to make it fit in accordance with their desires rather than fitting themselves according to the situation. Residents have been doing both minor and major process of personalization before and after occupancy in different level of intensity such as physical and horizontal

extension, spatial modification, increasing the number of bedrooms, facade components modification which includes windows, doors, fencing, and etc.

Generally, previous experiences lead to influencing the occupants' attitudes towards window preferences. This illustrates that various social and cultural factors result in different expectations and responses (Lau *et al.*, 2006). There are several researches which studied windows as one of renovated building components both purposely and unintentionally. Different sorts of reasons were the roots of windows personalization such as windows physical condition defects, changing the windows design or type, increasing or decreasing the windows number within specific areas, using as an enlargement tools of spatial dimension, unwanted disturbances due to physical modification and etc. (Jusan, 2007; Omar *et al.*, 2010; Omar *et al.*, 2012; Nurdalila Binti Saji, 2012; Rahim & Hashim, 2012). Despite the fact that windows are renovated remarkably, the current rigid construction method for interconnected building components such as windows is imperfect. Although, the aforesaid reasons were some of the roots of windows replacement, there might be other sorts of reasons which users look for windows replacement within their dwellings. However, this incident is not possible easily due to available problems which have resulted in decreasing the level of windows replacement.

As, the second main issue, this might be asked "why is there lack of further reusability?" "Why windows components are damaged during the process of renovation?" In fact, building components have a different lifespan and expectancy. As a result, some sorts of building components are affected unintentionally due to just being interconnected to the expired building attributes. As the scope of this research, this question might be asked "are windows produced and installed to be as durable as walls?" No. In fact, marketing survey by American Architectural Manufacturers Association (AAMA) within the USA reveals that the replacement window manufacturing was almost as enormous as manufacturing for the new constructions (Katsaros & Hardman, 2007). Besides that, by this huge amount of renovation and replacement "is the current method of windows installations economic efficient and perfect?" Moreover "could current design of building components affect the quality of them for further decision making?" Unfortunately,

damaged windows components such as timbers, aluminum, PVC, glasses, sealants, coatings, membranes, flashings and etc. that had been affected during the process of windows replacement are land filled which this event leads to insufficient possibility of further reusability and environmental side effects. The reason of such an event has been imputed to the lack of flexibility within the fenestration (Hurley, 2003). Because of this, the author wondered: why should not it be as easy to replace a fenestration product as it is to replace other less durable components of the wall, such as light fixtures? Shouldn't the ability of removing a fenestration without causing destruction to a wall be expected?

Living environment studies show that each building attributes characteristics can influence the users housing satisfaction (Zavei *et al.*, 2012). Windows have been listed as one of the components which can lead to residential satisfaction (Onibokun, 1974). Dwellings windows have renovated as well as modified several times throughout Malaysian. Living environment studies reveal that fulfillment of users' needs and wishes within their living environment can increase the level of housing satisfaction. Therefore, it is plausible to conclude that identifying the intention of windows replacements through employing flexible fenestration for an easy manipulating living environment may result in enhancing the level of housing satisfaction and supporting housing development. In fact, housing satisfaction and sustainable housing development are inseparable as Nooraini Yusoff (1993) states that residential satisfactory is a critical factor in the sustainable housing development. So, a combination of the aforesaid facts highlights the necessities of the objectives. Therefore, investigating possibility of promoting flexibility within buildings components such as windows, doors, walls and etc. in order to increase the capability of being easier fit in accordance with the residents' desires and preferences becomes necessary.

1.3 Purpose of the Study

Several user-uncontrolled housing developments, noticeable amount of housing personalization as well as the trends toward to this phenomenon within those housing developments in Malaysia make necessity of developing flexible building components more required. This is a precautionary approach to make the process of personalization much easier as well as to keep the users in a safe position from the social, environmental as well as economic side effects.

Although, there have been some researches about tracking the amount and the areas of personalization in residential buildings within Malaysia, there is insufficient study on the reasons of demanding flexible windows as well as seeking appropriate features of these kinds of product based on user expectations. If, users expectations of flexible building product and personal factors of demanding flexible building components within those attributes and components which create a living environment would be recognized, the idea of providing an environment which is in congruence with the users' needs hence a suitable living environment in housing would be achieved. In fact, if the problems and shortcomings of today's windows which decrease the possibilities of flexibility as well as user involvement would be recognized and improved, the idea of flexible windows can be prospered. It can be summarized that flexible building components develop a fully flexible housing which can prosper a good housing and sustainable housing developments.

1.4 Objective of the Study

In order to achieve the goals, the following objectives are formulated:

- i. To establish the level of user interest in the needs of flexible windows.

- ii. To explore those factors that lead to the importance of flexible windows.
- iii. To identify which particular window's components should be optimized to be much more related to the flexibility.
- iv. To investigate windows design that match to the flexibility.

1.5. Research Questions

This study seeks to address the answers of these questions:

- i. Are users interested in installing new windows by themselves?
- ii. Why is a flexible window important to the users?
- iii. Which components of a window should be optimized?
- iv. How does the available windows' design match the needs for flexible design?

1.6 Significance of the Study

Although, today there is no evidence to show exactly how a flexible window can influence human's lives, the findings from the relevant literatures show that, generally, flexibility is a great supporter of sustainable housing development. In addition, when we talk about flexible housing, how can the needs of flexible buildings' components as needed instruments of prosperity be overlooked? Developing a flexible window enhances enrichment of flexibility within the houses, decreases unintentional incidents and expands the residents control on their living environment. As a result, increasing level of housing satisfaction as one of the cornerstone of sustainable housing development is plausible. Moreover, success of Person Environment Congruence as one of the main tools of achieving the sustainable housing development will be in a better secured situation. Finally, results

of this research can be valuable for Malaysian construction as well as fenestration industry.

1.7. Scope of the Research

This research basically includes the following aspects; examining the Malaysians' participation interest in installing and removing their building windows based on their reasons, finding out the level of users' tendency to have flexible windows in their dwellings, realizing those factors which users look for flexible windows, problems that affect their desires due to probability of insufficient consideration of flexibility in the current design of windows and finally, seeking an appropriate flexible window by studying the existing problems. It should be notified that everything within this research is based upon users' expectations on a flexible window and the scope is not to design a flexible window which can be done by mechanical engineers. This research goes deeply through users' expectations and preferences. There is a close tie between user's preferences and the success of a product (Baxter, 1995). Considering the users' expectations in different areas can also help the designer to have an easier way of producing a flexible window.

The area was chosen based upon the pervious study relating to the problems and difficulties that the residents have faced due to lack of flexibility in their living environment. This study has been conducted in Malaysia- Johor Bahru- Skudai which users can be categorised in to two groups, academic and non-academic UTM staff. The subject of the study has been considered as the possibility of considering the flexibility in windows which would be able to be installed and removed by the users as a normal people based on the user expectations.

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