

*Full Length Research Paper*

# Housing and analysis of design defects: A post occupational evaluation of private housing in Malaysia

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Accepted 31 December, 2010

**Housing provision and quality housing are two issues, which remained the subject of research and interest to researchers' and designers'. Whenever a designer completes the project, they are not fully aware of consequences of their design. Only through post occupational survey, the designer usually realizes the shortfall they have made during the design process. Unfortunately, such unforeseen conditions are the part of daily life for the end user of residential buildings in developing regions. The main purpose of this research is to understand and identify the causes of design tribulations and their effects on residential buildings at post occupational stage. This research circumscribes the issues and problems faced by the users of private housing at post occupational stage, which results in because of deficient design. These problems affect the users through unplanned maintenance to major repairs leading to danger of collapse. In order to evaluate these effects on buildings, case studies were conducted in housing stock of metropolitan areas of the Klang Valley in Malaysia. The finding reveals that the housing is experiencing common building defects for housing such as dampness, facade deterioration and sanitation problem.**

**Key words:** Building maintenance, building survey, design maintenance, design tribulation, material selection, post occupancy survey, user implication, workmanship

## INTRODUCTION

The concentrations of planning and design solution are cradled for maintenance issues related to design faults in built forms. Maintenance which emerges from design faults indicates that design has not been practiced in the perception of building maintenance, or that the construction phase has remained unchecked by the field experts. Reviewing the maintenance problems in various built forms reveals that the housing sector is the most effective of these activities.

House is an enclosure which presents the perception of peaceful and protecting environment. A house is

supposed to be a place/enclosure which is capable enough to accommodate ideas of living and work. In prehistoric days, caves were used to fulfil that requirement of living space as well as protecting its user from extremes climatic conditions. With the passage of time and advent of technology, the perception of shelter has changed its form in modern day housing. Under developing countries which normally have an unplanned growth, development and law, transient in almost all spheres of life, particularly in urban centres. Alarming rate of population growth is another problem faced by these countries which ultimately creates the demand for increased number of housing facilities. In modern days, house is a basic icon of shelter where people can plan to live and work under a protected environment. House or

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its multiple form of housing has remained subject of research and discussion on number of reputable plat forms. Around the globe the importance of housing has increased many folds and it is still growing with every day past. Its importance gain more momentum when the state of housing in developing nations is taken into account.

The importance of housing design is pronounced by Chowdhury (1985), as design of the house is one of the most difficult tasks in the field of architecture. A proper understanding of the nature of human needs is of crucial importance in the formulation of houses and space standards. Chowdhury further stressed that, a shelter provides people with functional, social and spiritual needs. The life of an individual and family unfolds in the space within shelter. Conceivably it can be declare that any attempt at formulating housing and space standards should start by recognizing the quality of space and social aspects of society or individual to avoid the design deficiency at post occupational stage.

Towards the need to improve the housing quality and its design in under developed world is highlighted by renowned architect, Correa (1980) is that the wonderful thing about third world is that there is no shortage of housing. What is in short supply, of course is the urban context. The real task and responsibility of the third world architect is to help generate this urban context. The study of Correa reveals that urban amenities are missing in the housing sector of underdeveloped regions. These amenities should be considered and properly planned at design stage to facilitate the user and to avoid nuisance of reworks or redesign at later stage.

### **THE FACTORS OF DEFICIENT DESIGN AND MAINTENANCE: A REVIEW OF DEVELOPING REGIONS**

Study by Okpala (1992) regarding housing in developing country is precised; as the larger faction of population living in third world has a little access of quality housing. In the housing sector of developing world it is worth mentioning that unlike other parts of world, private sector is much more efficient than public sector in providing housing to residents (Okpala, 1992).

According to report on housing conditions in Pakistan published by Human Right Commission of Pakistan (HRCP) (2005), it is mentioned that the estimation suggest that more than half a million housing units are required in Pakistan. In other words, a small city is required annually to meet the severe housing shortage in the country and the increasingly dilapidated state of existing housing presented new threats.

Reviewing the history of housing and it related issues in Pakistan, Syed (1996) describe it as; Pakistan has faced formidable housing problems from its very birth in August 1947, as an independent nation; in the wake of the mass influx of millions who migrated to the country from India. The situation has not changed much almost 50 years

after independence due to various factors, particularly with reference to the biggest metropolis of the country namely Karachi.

The supply and demand of housing scenario in Karachi is told by Hassan (1998) as the Karachi city requires 79,000 housing units per year. However, an average of about 26,000 housing units per year has been produced through formal processes over the last 5 years. The rest of the demand has been met through informal and illegal subdivision of state land or through densification of existing homes and settlements.

Celebrated intellectual, newspaper columnist and writer from Pakistan, Cowasjee (2003), enlightened the housing/built environment problems and its business as; the people of Karachi should know that all the commercial and residential high-rises are unsafe and dangerous to live in. Most of the builders and contractors, their attorneys or the entity they have established to construct a particular building, disappear from the scene as soon as a building is semi-complete and all spaces sold. The Cowasjee work is incomparable over the issues of built environment. Cowasjee also criticized the role of professionals and development authority in multiplying the problems of housing in Karachi. The study addressed the problems of built environment ranging from faulty design to defects that emerged during the construction phase of buildings in Karachi. Cowasjee describes the status of buildings and its trade in Karachi as "environmental nightmare". Here Cowasjee's report presents clear picture of continuing severe deterioration in different phases of housing/commercial building design and construction activity in Karachi, Pakistan.

However housing state in Malaysia is not similar to other undeveloped countries, but at the same time it's not very encouraging and satisfactory. To most Malaysian individuals housing is still considers as the largest single investment of lifetime. Although housing has remained the priority of Malaysian Government after independence, but there is still a long list of measures required to fill the gap of demand and supply of low and medium cost housing in the country. The report of Shuid (2004) highlights the several inadequacies of Malaysian housing and their design quality. The challenges and issues illustrated in Shuid's report is presented as;

1. There is a clear miss-match between supply and demand of low and medium cost housing.
2. Due to low profitability, developers are not keen to participate in low and medium cost housing.
3. There are no specific planning and design guidelines for low and medium cost housing.
4. Local building authorities have fading control over completion and construction of low and medium cost housing.

The report of Shuid has workout these broad base problems which could be divided into further sub issues

and problems, for example, issue mentioned in paragraph 3 of the report. Since every problem of housing is coupled with some degree of defects or compromising design quality, therefore there are high chances for end user to experience the end results of these issues.

By developing an understanding for issues mentioned by researchers, organizations and expertise of field in above paragraphs, it is revealed that lack of housing is not only mounting pressure on available housing but ever growing housing demand in these regions have paved the track for improper and faulty design and construction.

Design deficiency and its implications on the house maintenance has remained a neglected part in field of research and modern society, especially in developed and developing nations. The theme of this study can be understood in terms of Architectural Eco System. Whenever designer completes the project, the designer was not fully aware of consequences of their design. It is only through post occupational survey that designers usually realize that mistakes or bad decision they have taken during design process. Those decisions mostly emerged in form of certain types of defects in building. Unfortunately, such unforeseen conditions are the part of daily life for end user of residential buildings in proposed areas of research. Therefore the main purpose of this research is to understand and investigate the causes of faulty design and their implication on residential buildings.

The proportion of the maintenance is highly controlled and governed by the quality of design. In fact, these two characters of building are inversely proportional to each other, that is, the higher the quality of the design, the lower the maintenance and the lower the quality of the design, the higher the maintenance. It is well phrased by CIOB (1982) as; it is at the design stage that the maintenance burden can be positively influenced for better or for worse. Hence it could be concluded that skilful design can reduce the amount of maintenance work.

In this perspective, Seeley (1987) added that design team frequently neglects the consideration of maintenance aspects and there is great need to reduce the gap between design and maintenance. Seeley identified the problem of design and maintenance as the gap between design and maintenance. Conceivably Seeley stress that maintenance is important issue to be consider right from the design stage to prevent its unplanned reappearance at post occupational stage of building. This could be more implicating and it has effect on the building. But how would this gap be reduce the answer may be found in developing understanding for design and maintenance in the light of definition given by RICS (2000), according to which the building design should consider a design of the auto. The auto are usually provided with schedule of planned and emergency manual, thus it could be recommended that one way to reduce the gap between the maintenance and design is to provide the residents with manual of house/building design and product used

in that design.

The caption of this research has gained certain momentum and attracts good number of researchers to address the similar problem in other parts of globe and they have highlighted the vitality of topic through their publications and also developed a reliable link between the design and maintenance issues. Research by Ramly (2006) shows that, the design plays a major role in determining the condition of the building after completion, mainly in aspects of defects and maintenance. Ramly further stresses that indirectly, design influences the performance and physical characteristic of building and its durability to withstand environmental condition, social interfaces such as graffiti and vandalism. Therefore the link between design and maintenance should not only be seen from the point of increasing the repair work or cost involve, but it need to consider also the impact of design on structure and material installed as well as the life cycle of each component of building.

The discussion above reveals that mostly the researchers have agreed on the importance of emerging issue of faulty design and building maintenance. Through their work they highlighted the various issues and aspects of design tribulations and their effects on building maintenance. Identification of issues and their causes had remained major task for researches.

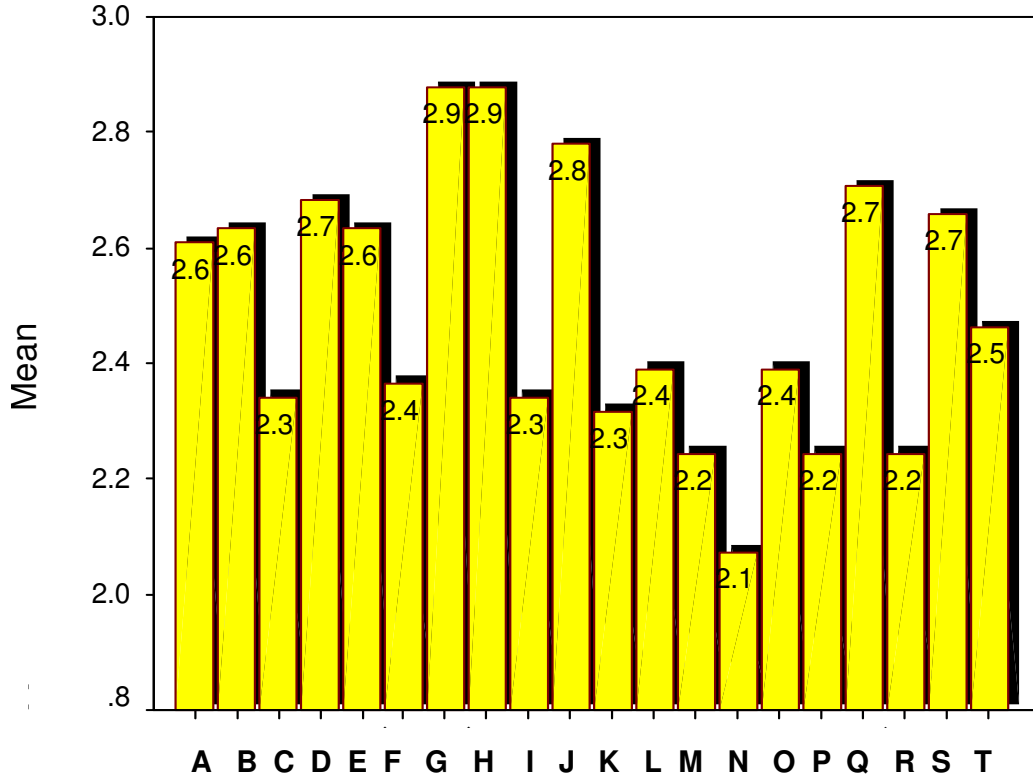
## DISCUSSION OF STUDY

### Methodology

The study adopted the distinctive and reliable pattern of research which consists of site visited for unstructured interview, photography and questionnaire survey. This study has been carried out in three distinctive stages. In the first stage, sites visited by the researcher and issues of building defects and maintenance have been identified through coordination of the literature review. In the second stage, a surveying tool was designed and the survey was conducted at housing locations in Klang Valley, while in the third stage, the data obtained from questionnaire survey were analysed and summarised in the form of findings and were finally condensed in conclusion.

The survey tool in form of questionnaire has been designed for the purpose of conducting questionnaire survey among residents. The function of questionnaire survey was to determine the significance of issues related to design tribulations and housing maintenance. The questionnaire addressed the issues of design consideration and their implications on housing in general. However each question has a tendency to further break-up in number of issues. Residents and people from different income groups living in housing location served as the respondent of this survey. Respondents were asked to answer all the questions regardless of their status and sections of questionnaire. The questionnaire was translated in Bahasa Melayu (native language of Malaysia) for convenience of respondents and their better understanding for the issues mentioned in questionnaire.

A total of 20 broad based questions has been asked from two types of the respondents, that is, owner and tenant. In order to get specific answers, the questionnaire was provided with three ranked evaluation scale and among which one was neutral scale, that is, 'Yes', 'No' and 'Not Sure'. In order to adopt the quantitative mode of research, the given scale was provided with numerical value such



**Figure 1.** Mean frequency of study factors. A: Maintenance issues needs attention. B: Design faults causing maintenance. C: Satisfied with finishes material. D: Maintenance reduces bldg life. E: Building services causing maintenance. F: Satisfied with ventilation design. G: Satisfied with ventilation design. H: Dampness is problem of building. I: Surface cracking is problem of building. J: Design causes improper building function. K: Satisfied with performance of doors and windows. L: Satisfied with construction quality. M: Satisfied with weather controlling elements. N: Satisfied with electrical design. O: Satisfied with material of openings. P: Presence of maintenance measures. Q: Intensive inspection can prevent maintenance. R: Cracking in structural elements. S: Activities of end-user causes maintenance. T: Feed back importance of end-user to building design.

as Yes =3, Not Sure=2 and No=1. The data obtained through survey tool was analyzed on SPSS computational resource (version 12.00) and each question was calculated as mean significance and cross tabulation.

**FINDINGS**

A total of 70 questionnaire surveys has been conceded among the residents of different blocks in case study. The totals of 41 respondents from both housing schemes have timely delivered their feed back thus maintain rate of response at 59% (approximate). Figure 1 shows the data analysis in form of means obtained for each question from respondent’s feedback.

The data obtained form the survey has been analysed as ‘mean’ (significance) and ‘cross tabulation’. The shaded cells which shows descriptive statistics of survey (Table 1) indicates the significance of issues attained by the respondents. The significance of the issues is shown in the table by the value of the mean. In this analysis, consent of respondents about different issues can be judged through notion of higher value of mean.

Among 20 factors, 9 factors shown in shade have gained the higher mean ranges between 2.61 and 2.88. A notion from range of means depends upon the question asked to the respondent. This trend of response indicates the importance and existence of design tribulation in their respective buildings. In the following lines, the background of those design deficiencies are discussed which constituent an integral part of building design and gained the significance through maximum mean in data analysis, as shown in the Table 1.

The data is interpreted and findings are summarized to evaluate the type of defects and maintenance issues results from design deficiencies at both locations. However these summaries are also responsible to accomplish the objectives set for this study. Summaries of defects are based on the site inspection and analysis of questionnaire survey which has been carried by the researcher at sites.

Data analysis of the factor “maintenance issues need attention” shows that this factor has gained the mean of 2.61 in descriptive statistics, as shown in Table 1. Since the highest value of mean is 3.0, this range of mean in

**Table 1.** Descriptive statistics for Kuala Lumpur housing.

<b>Design Faults</b>	<b>N</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>
Maintenance issues needs attention	41	1	3	2.61
Design faults causing maintenance	41	1	3	2.63
Satisfied with finishes material	41	1	3	2.34
Maintenance reduces bldg life	41	2	3	2.68
Bldg services causing maintenance	41	2	3	2.63
Satisfied with ventilation design	41	1	3	2.37
Building facades subject to deterioration	41	2	3	2.88
Dampness is problem of building	41	2	3	2.88
Surface cracking is problem of building	41	1	3	2.34
Design causes improper building function	41	1	3	2.78
Satisfied with performance of doors and windows	41	1	3	2.32
Satisfied with construction quality	41	2	3	2.39
Satisfied with weather controlling elements	41	1	3	2.24
Satisfied with electrical design	41	1	3	2.07
Satisfied with material of openings	41	2	3	2.39
Presence of maintenance measures	41	1	3	2.24
Intensive inspection can prevent maintenance	41	2	3	2.71
Cracking in structural elements	41	1	3	2.24
Activities of end-user causes maintenance	41	1	3	2.66
Feedback importance of end-user to building design	41	1	3	2.46
Valid N (list wise)	41			

N = Number of respondents.

**Table 2.** Maintenance issues needs attention.

Count		Maintenance issues needs attention			Total
		Not sure	No	Yes	
Type of respondent	Owner	2	6	14	22
	Tenant	1	4	14	19
Total		3	10	28	41

**Table 3.** Design faults causing maintenance.

Count		Design faults causing maintenance			Total
		Not sure	No	Yes	
Type of respondent	Owner	1	5	16	22
	Tenant	1	6	12	19
Total		2	11	28	41

**Table 4.** Maintenance reduces building life.

Count		Maintenance reduces building life		Total
		No	Yes	
Type of respondent	Owner	9	13	22
	Tenant	4	15	19
Total		13	28	41

**Table 5.** Bldg: Services causing maintenance.

Count		Building services causing maintenance		Total
		No	Yes	
Type of respondent	Owner	7	15	22
	Tenant	8	11	19
Total		15	26	41

Figure 1, shows that people have acknowledged the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 2 reflects that equal number of both owners and tenants concede this factor in their respective buildings.

Data analysis of the factor 'design faults causing maintenance' shows that this factor has gained the mean of 2.63 in descriptive statistics, as shown in Table 1. Since the highest value of mean is 3.0, this range of mean in Figure 1 shows that people have acknowledge the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 3 reflects that higher number of owners has conceded this factor in their respective buildings.

Data analysis of the factor 'maintenance reduces building life' shows that this factor has gained the mean

of 2.68 in descriptive statistics, as shown in Table 1. This range of mean in Figure 1 shows that people have recognized the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 4 reflects that 28 numbers of respondents, both tenant and owners have acknowledged this factor in their respective buildings.

Data analysis of the factor 'building services causing maintenance' shows that this factor has gained the mean of 2.63 in descriptive statistics, as shown in Table 1. Since the highest value of mean is 3.0, this range of mean in Figure 1 shows that people have acknowledge the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 5 reflects that 26 numbers of respondents have conceded this factor in their respective buildings.

**Table 6.** Building facades subject to deterioration.

Count		Building facades subject to deterioration		
		No	Yes	Total
Type of respondent	Owner	3	19	22
	Tenant	2	17	19
Total		5	36	41

**Table 7.** Dampness is problem of building.

Count		Dampness is problem of building		
		No	Yes	Total
Type of respondent	Owner	2	20	22
	Tenant	3	16	19
Total		5	36	41

**Table 8.** Design causes improper building function.

Count		Design causes improper building function			
		Not sure	No	Yes	Total
Type of respondent	Owner	2	2	18	22
	Tenant		3	16	19
Total		2	5	34	41

Data analysis of the factor 'building facades subject to deterioration' shows that this factor has gained the highest mean of 2.88 in descriptive statistics, as shown in Table 1. Since the highest value of mean is 3.0, this range of mean in Figure 1 shows that people have recognized the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 6 reflects that 36 numbers of respondents have voted for this factor in their respective buildings.

Data analysis of the factor 'dampness is problem of building' shows that this factor has gained the highest mean of 2.88 in descriptive statistics, as shown in Table 1. Since the highest value of mean is 3.0, this range of mean in Figure 1 shows that people have acknowledged the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 7 reflects that 36 numbers of respondents have voted for this factor in their respective buildings.

Data analysis of the factor 'design causes improper building function' shows that this factor has gained the mean of 2.68 in descriptive statistics, as shown in Table 1. This range of mean in Figure 1 shows that people have recognized the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 8 reflects that 34 numbers of respondents have acknowledged this factor in their respective buildings.

Data analysis of the factor 'intensive inspection can prevent maintenance' shows that this factor has gained the mean of 2.71 in descriptive statistics, as shown in Table 1. This range of mean in Figure 1 shows that people have recognized the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 9 reflects that 29 numbers of respondents have approved importance of this factor in buildings design process.

Data analysis of the factor 'deterioration of building facades' shows that this factor has gained the highest mean of 2.66 in descriptive statistics, as shown in Table 1. This range of mean in Figure 1 shows that people have recognized the presence of this factor at their respective locations. Cross tabulation of respondent's types for this factor, as shown in Table 10 reflects that 29 numbers of respondents have voted for this factor in their respective buildings.

### Relation of questionnaire survey and building survey

The summation of data analysis and the site visits by the researcher can be up recorded as that, the inspection and data obtained from both sites presents almost similar picture of design faults and implicating defects. However, this study revealed one important aspect that, the housing stocks are infected with common defects such

**Table 9.** Intensive inspection prevent maintenance (This research).

Count	Intensive inspection can prevent maintenance			
	No	Yes	Total	
Type of respondent	Owner	9	13	22
	Tenant	3	16	19
Total	12	29	41	

**Table 10.** Activities of end-user causes maintenance (This research).

Count	Activities of end-user causes maintenance				
	Not sure	No	Yes	Total	
Type of respondent	Owner	2	6	14	22
	Tenant		4	15	19
Total	2	10	29	41	

as, different types of dampness, facade deterioration, improper weather protecting elements etc. (All photos were captured during the site visit).

Figure 2 and its details reveal that housing stock in Klang valley is provided with substandard finishes and especially material of doors and windows is not capable enough to perform the satisfactory function. Windows are not provided with shutters in fact they are like large size ventilators, which usually not provided with shutters (Figure 2e). The internal wall surfaces are provided with low quality cement rendering/plaster thus making it impervious and vulnerable to fungi/mould and dirt accumulation (Figure 2d). Flooring is not provided with proper screeds, which results in cracks in various directions (Figure 2c). Water proofing in wet areas was not satisfactory which causes dampness in external walls of wet spaces (Figure 2e). Weather protecting elements were also absent from design of housing block.

Looking towards the building, it would be appropriate to use the term 'low design' instead of 'medium cost', visit of housing stock reveals very grim condition of building design. Basic feature of weather protecting elements were barred from design. Defects from thermal expansion is visible in (Figure 2c), substandard material selection is evident in (Figure 2d) However building is heavily infected with plague of water seepage and improper water proofing which results in dampness, visible in (Figures 2 d and e).

Figure 3 and its detail reveals that the other housing apartment is more infected with defects results from design as compare to previous apartments. Damaged sanitation drain in (Figure 3e) shows the state of maintenance in this housing stock. The facades are also infected with poor design and construction of the wet areas, which results in substantial seepage and dampness in walls (Figures 3 b and d). This situation is just enough for plants to growth. Structure defects are visible in (Figure 3f) it shows the cracks and water

penetration through the beam. Sagging in floors of ground floor is also visible in (Figure 3c).

Site visit of this housing stock does not presents better state of housing at post occupational stage. Deterioration of facades is visible in picture, which is rooted in improper surface material, poor workmanship of wet areas with resulting leakage and dampness. Sagging in floors is also witness in Figure 3c. Structural cracks in beams are visible in Figure 2f whereas lack of maintenance and use of substandard materials is evident in Figure 3e. Failure of DPC (damp proof course) is also visible in Figure 3d which is surfaced in form of dampness.

## CONCLUSION

Housing districts in Klang valley have different design and economic backgrounds that control the value of land and quality of homes. However housing provision presents an improved picture; housing finance is available to most of people thus making the population capable to have their own house. Some families in this study have made very small design moves to create very liveable and pleasant environments. Others have made drastic renovations that show the extent of how inappropriate some of these housing projects are. It has also been revealed that medium cost buildings are experiencing defects caused from design, in addition to lack of maintenance consideration in their respective design. It somehow shows that design professionals do not bother to improve their practice in radiance of post occupational surveys. It could also be concluded that except the luxury of open space planning, residents of medium cost apartment are facing the similar problems, which perhaps can be associated with low cost housing blocks.

Designing a home should not be done in the isolation of an office or only by some building professional. To design





a



b



c



d



e

Figure 2. Details revealing the housing stock in Klang valley.



**Figure 3.** Façade and services defects at post occupational stage.

a tribulation free house, it requires some consultation and rethinking of the housing design programme. The maintenance experts along with user's interaction and interventions are important to incorporate at design stage, in order to consider it responsible design practices for user based tribulation free homes. The following criteria can be taken into consideration to effectively address the existing design problems and also to identify

the features of good design.

1. To workout and implements the minimum standards for medium cost housing.
2. Users feed back to identify the objects and features that need to be included for minimum design standards of medium cost housing.
3. To work out the solutions to accommodate essentials

of house economically and efficiently.

The survey of this study is only limited to low and medium cost housing at selected location. The survey tool has been designed with broad base question. Therefore each question could be further elaborated in number of design tribulations and implicative factors of maintenance. The response of each question has been closely monitored and analyzed on SPSS computation system.

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