

## **Evaluation of User's Satisfaction towards Construction Faults in Medium Cost Housing of under Developing Metropolis**

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### **Abstract**

It has been observed that designers are not always fully aware of consequences of their design solution, only through post occupational survey the designer usually realizes that what mistakes or bad decisions have been taken during the design process. It is a common conception that present day buildings are more vulnerable to design faults and resulting maintenance as compare to older counter parts. Despite the technological advancement of contemporary time prevention of building from unplanned maintenance is still an unsolved riddle. It is factual to mention that building still suffers from the various faults' causes from design and construction stages, which subsequently cause dissatisfaction in users.

The key purpose of this research is to comprehend the causes of construction faults and their effects on residential buildings, through perception of users at post occupational

stage. Unfortunately, unforeseen construction faults and resulting maintenance conditions are the part of daily life of the end user in developing regions. These problems affect the users through unplanned maintenance to major repairs leading to danger of collapse. In order to evaluate the effects of deficient construction on buildings, a case study was conducted in housing stock of metropolitan areas of the Karachi Pakistan. The data was collected through site visits, unstructured interviews and questionnaire survey and analysed through SPSS computer software. And it is interpreted to understand the far reaching effects and implications of construction faults in low rise medium cost housing stocks of the study area. Eventually, an index of construction faults and their implication has been prepared.

**Keywords:** Construction faults, Building maintenance and Users satisfaction

## 1. Introduction

In under developing countries, which normally have an unplanned growth, the development and law transient in almost all walks of life, particularly in urban centres. Alarming rate of population growth is another problem faced by these countries which ultimately creates the demand for the increased number of housing facilities. A modern day house is a basic icon of shelter where people can plan to live and work under a protected environment. Housing design has remained subject of research and discussion on the number of reputable plat forms. Around the globe, the importance of quality housing has increased many folds, and it is still growing with every day pass. House is an enclosure presents the perception of peaceful and protecting environment. A house is supposed to be an enclosed space which should be capable enough to accommodate ideas of living and work. There is considerable evidence to suggest the physical conditions and quality of the house environment impact both physical and mental health of its users (Evans et.al 2000; Thompson et.al. 2002).

Means has argued that good quality housing is the foundation of community care programs (Means, 1991). Conceivably, the study of Means suggests that a stock of quality housing provides base for promising future of neighborhood and eventually for society. The importance of good 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 quality space of the house provides people with functional, social and spiritual needs. The life of an individual and family unfolds in the space within this space. Conceivably, it can be declared that any attempt at formulating housing and space standards should start from 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) as 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 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 redesigns at later stage.

Simply providing housing units does not measure the success of housing programs in either developed or developing countries. The suitability of the living environment to the needs of residents is essential for housing programs to be judged successful (Weidemann et al., 1982). Whereas Kaitilla, (1993) mentioned that building features (doors, windows, building protection elements, façade materials, etc.) are strongly related to housing satisfaction. Conceivably, the study of Katila suggests

that admiration of beauty is natural phenomena among human and users feel content when they have a gorgeous housing.

Study of Garling (1990) has developed the interrelation between housing design and residential satisfaction with children's accident risk and narrated that ambiguities in housing design are responsible for children accident. Whereas, research of (Bonnes .et.al. 1991; Shaly 1985) has identified user's satisfaction in the context of spatial density, crowding and neighbourhood characteristics in housing design.

Research out come of (Amerigo and Aragones 1990; Galster and Hesser, 1981; Marans and Rodger, 1975) suggested that, the residential satisfaction is considered as a criterion of residential quality. Perhaps the studies insist that residential satisfaction is a true standard for evaluating housing quality. Studies of (Awotona, 1991; Vrbka and Combs, 1991) records that, the facilities and services quality available in a housing unit are vital in determining satisfaction with the housing units. The study further adds that the housing satisfaction is influenced by variables such as users' characteristics, dwelling unit characteristics, management, and environmental and location factors.

Whereas Morris and Winter's has presents the Theory of Residential Adaptation and Adjustment presented housing norms appropriate to the United States for examining residents' satisfaction with their housing and their desire to make adjustments (Morris and Winter, 1978). Areas of housing norms include structure type, space (building features), quality (housing conditions), neighborhood facilities, expenditures, and tenure. This theory provides an appropriate framework for examining research related to housing satisfaction.

## **2. The Issues of Housing Design and Faulty Design: A Review of Housing Condition**

According to Weidemann et al. (1982) suggest that, the failure of many public housing projects to meet users' needs illustrates a lack of knowledge about the physical aspects of housing quality and design criteria that would satisfy residents. Residents' satisfaction is not absolute, and housing conditions are not static, thus, the housing condition or residents' satisfaction with these conditions at any given time can be measured only in relative terms. Moreover, poor housing conditions are generated by problems posed by design inadequacy of internal facilities (Ozo, 1986). These internal facilities (kitchen, bath, and toilet), when shared by residents, exacerbate the problems of privacy inconvenience and maintenance (Muoghalu, 1984).

Housing in the developing country is précised as; the larger faction of population living in the 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 the world, private sector is much more efficient than the 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 suggests 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) describes 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 concerning 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 five 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 to 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 emerged during construction phase of buildings in Karachi. Cowasjee describes the status of buildings and its trade in Karachi as *an environmental nightmare*. Here Cowasjee's report presents the clear picture of continuing severe deterioration in different phases of housing/commercial building design and construction activity in Karachi, Pakistan.

Account of above suggest that the 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. The studies above further suggested that the situation gets more aggravated when the role of developing and building control authorities become dubious thus make housing design and construction more vulnerable to faults and maintenance.

However, 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, i.e. higher the quality of design lower the maintenance and lower the quality of design 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 as that skilful design can reduce the amount of maintenance work and increase the rate of user's satisfaction.

In this perspective, Seeley (1987) adds that design team frequently neglects the consideration of maintenance aspects and there is a great need to reduce the gap between design and maintenance. Seeley identified the problem of design and maintenance as the communication divide between design and maintenance. Conceivably, Seeley stress that maintenance is the important issue to be consider right from the design stage to prevent its unplanned reappearance at post occupational stage of building and to ascertain the higher rate of user satisfaction. This could be more implicating and affecting on the building.

Whereas the gap could be reduced through understanding design, maintenance of explanation given by RICS (2000), according to which the building design should be considered as a design of the automobile. The automobiles are usually provided with the schedule of planned and emergency manual, thus it could be recommended that one way to reduce the gap between the design, maintenance and users satisfaction is to provide the residents with manual of house/building design and product used in that design. This would facilitate the end users to get familiarity with the design outlines and type of periodic maintenance required in housing for proper functioning.

Discussion above reveals that mostly the researchers are agreed on importance of emerging issue of faulty design, maintenance and users satisfaction. Through their work, they highlighted the various issues and aspects of design faults and their effects on building maintenance and users satisfaction.

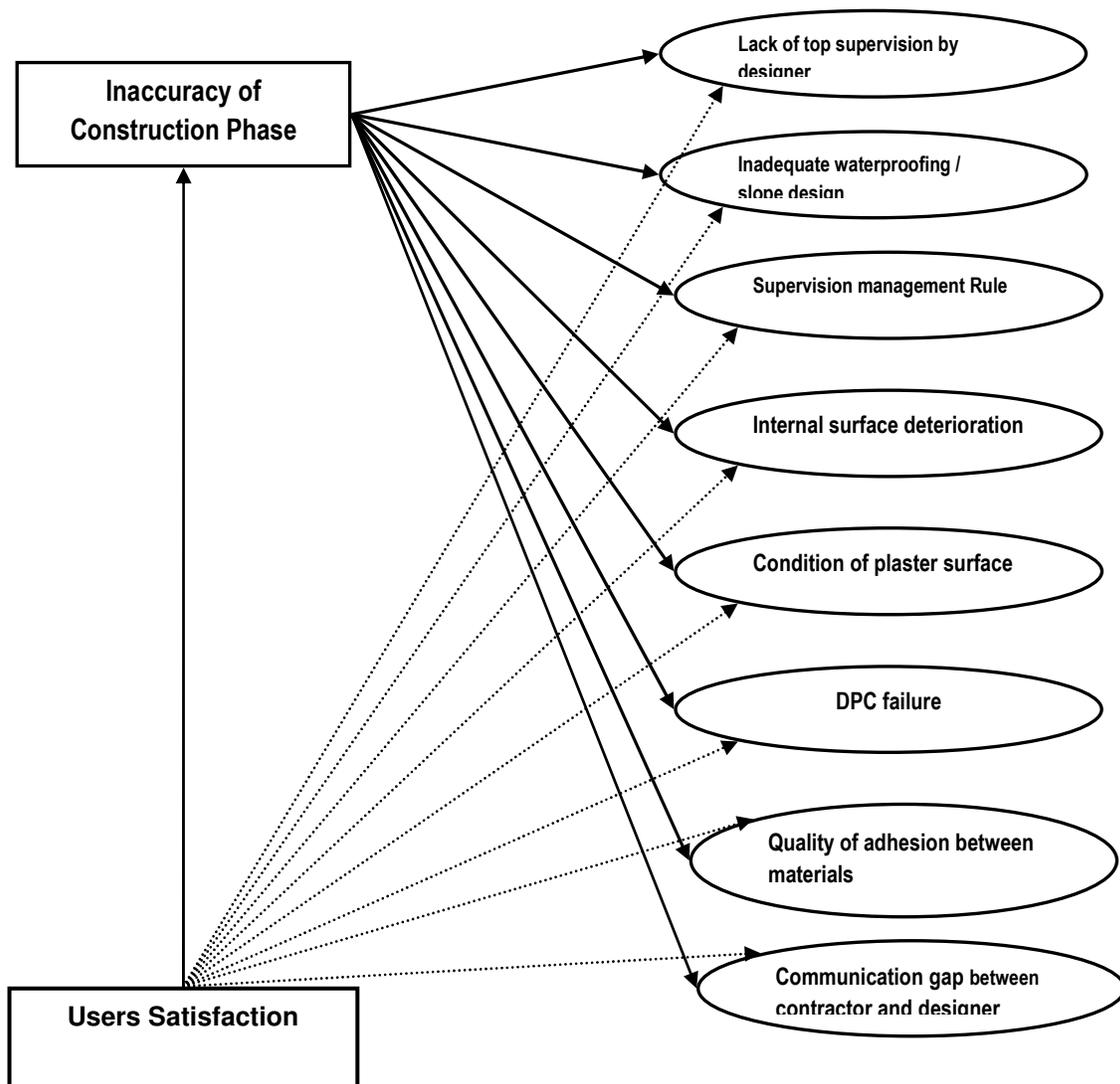
### **3. Conceptual Model**

The discussion of housing design, construction faults and user satisfaction indicates that each normative perception is comprised of various design and construction factors.. Design faults and users satisfaction with housing become a multifaceted analysis to fit between a range of housing features and

personal and family characteristics. This paper has examined the factors that comprise the features related to construction deficiencies and housing satisfaction in Karachi and explains the relationships between satisfactions with these specific design features.

The conceptual model in Figure 1 is developed through site visits, participation and review of literature; it proposes the correlation of the independent variables (single-item measures of construction inaccuracy and the multiple-item measures of the specific features of the house construction characteristics) and the dependent variable (overall housing satisfaction). The model indicates that overall housing satisfaction is directly affected by satisfaction with house construction factors (single-item measures) and indirectly affected by the specific features of the construction factors (multiple-item measures). Whereas the multiple-item measures indirectly influence the single-item measures of housing satisfaction.

**Figure 1:** Conceptual Model of Construction Inaccuracy



#### 4. Objectives of Study

In addition to explore the precedent research works on core issues, the main objectives of this study are as under;

1. To identify the implication of construction faults and its possible causes
2. To workout the users satisfaction towards construction phase

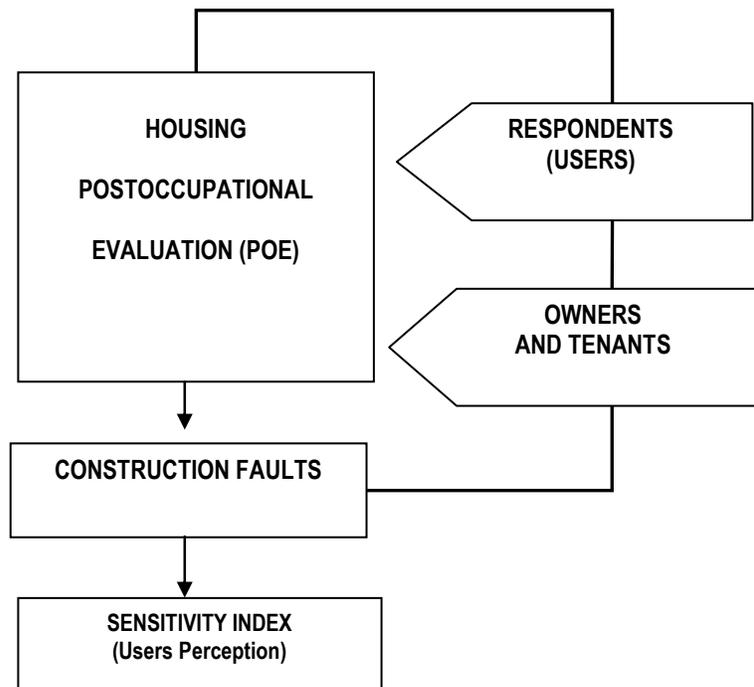
In order to get query from users the housing construction quality determinants have been assembled in form of questionnaire. The function of questionnaire survey was to determine the user’s satisfaction and significance of issues related to construction faults and housing maintenance in their respective housing stock. The questionnaire has addressed the issues of design consideration and their implications on housing in general. Residents and people from different income groups (low to medium) living in housing location served as the respondents of this survey. Respondents were asked to answer all the questions regardless of their status and sections of questionnaire. A whole questionnaire was consist of nine section related to building design and construction but here in this paper only “construction faults ” would be taken into consideration.

**4.1. Methodology**

In order to carry out the questionnaire survey in existing residential built forms, a group of 60 buildings have been identified in targeted area of research. Questionnaire survey has been conducted among users represented by (owner-tenant), the users of selected buildings.

The study has adopted the distinctive and reliable pattern of research which is consist of site visits, unstructured interview, photography and questionnaire survey. This study has been carried out in three distinctive stages. At **first stage**, sites had been visited by the researcher and issues of building defects and maintenance have been identified through coordination of literature review. In **second stage** surveying tool has been designed and verified through unstructured interviews and at later stage the survey was conducted among 60 housing stocks in Sadder town of Karachi Pakistan. At **third stage** data obtained from questionnaire survey has been analysed and summarise in form of findings and finally condensed in conclusion. The research path has been illustrated in Figure 2

**Figure 2: Research Path**



The data obtained through survey tool and was analyzed on SPSS computational resource (version 12.00). The section of construction faults is consisting of 08 determinants related to architectural design faults. As some of the factors are more implicating as compare to others thus

severity of influence was formulated for each question. Hence each question is provided with 5 rank Likert (interval) scale denoted with; 1= does not implicate, 2= slight implicate, 3= not sure, 4= fair implication and 5= strong implication.

## 4.2. Analysis and Findings

Analysis of data is carried out in domain of architectural faults causing maintenance in housing and following protocol has been adopted for analysis of data.

### 4.2.1. Profile of Respondents

In the conduct of the survey a total of 127 respondents were interviewed and the data were collected using a specially designed survey tool. The category of the users respondents comprised of the tenant and owner constituting of 46 (36.22%) of the total collected data, as shown in Table 1 below.

**Table 1:** Category of Respondent

Category	Frequency	Percent (%)
Tenants	21	16.54
Owners	25	19.69
Total	46	36.22

### 4.2.2. Internal Consistency of Scale

In any survey work high quality of the data obtained is crucial in the decision making process. Low quality data may lead to wrong or biased conclusion. Incidentally, the quality of the data collected is strongly related to how the instrument used to collect the data was constructed and handled. In this survey the instrument is basically the questionnaire used. Hence, to determine whether the outcome of this study is highly reliable, therefore, it is pertinent that the quality of the data collected be assessed. For this purpose, the Alpha's coefficients were calculated for each of the attributes, related to design faults, being investigated. The results are presented in Table 2 below. From the results obtained, the values of Alpha coefficients calculated were found to float at about 0.7. Thus, we can conclude that the data obtained have some amount of consistency of the scale. The table 2 is showing the all eight sections of questionnaire survey but in this paper the aspects of faults occurs during construction phase (shaded) would only be discussed.

**Table 2:** Reliability Coefficients

Design Faults	Number of Items	Alpha's Coefficient
1. Architectural	10	0.780
2. Maintenance measures provision	3	0.778
3. Consulting firm/individual	7	0.714
4. Detail drawings	3	0.763
5. Construction phase	10	0.740
6. Contractor/construction team	10	0.763
7. Construction materials	7	0.741
8. Lacking of Building Control Authorities	3	0.778

### 4.2.3. Data Analysis of Design Faults

As shown in Table 2 eight major types of design faults were identified. Within each of these eight major design faults several sub-attributes were listed. The respondents were then asked to rank these sub-attributes from 1 to 5 according to their perceptions on the implication of these sub-attributes to the maintenance of the building. The value of 5 indicates '*strong implication*' and the value of '1'

indicated 'no implication'. This means that the higher the value of the mean score the stronger would be the implication level and vice-versa.

**4.2.4. Faults at Construction Phase**

The respondents perceived ten (09) types of faults could be present during the construction phase. These faults are listed in Table 3 below. Among these, the fault due to 'Lack of top supervision by designer' was highly perceived to contribute to the maintenance problem with an average mean implication score of 4.70. On the second spot with highly perception of implication on the maintenance is 'Inadequate waterproofing and slope design' which registered a mean of 4.65. Lack of communication was not found to develop significant perception since the fault 'Lack of communication between contractor and designer' only registered a mean of 4.05.

**Table 3:** Mean Score of Users Perceptions towards Faults at Construction Phase

Faults at Construction Phase	Mean score		Overall Mean Score
	Tenant	Owner	
1. Supervision by designer	4.90	4.88	4.70
2. Waterproofing and slope design	4.76	4.52	4.65
3. Supervision management Rule	4.71	4.64	4.55
4. Conditions of painted surfaces	4.57	4.64	4.50
5. Condition of plaster surface	4.05	4.48	4.44
6. DPC at various surfaces	3.86	4.24	4.33
7. Loss of adhesion between materials	3.48	3.64	4.07
8. Communication between contractor and designer	3.86	4.64	4.05

**4.2.5. Investigation of Significant difference of Respondents Perception towards Design Faults Between Categories**

In this study an investigation was also made to determine if there is any difference between the perceptions of the two groups of user's respondents, i.e. tenants and the owners on each of the seven main architectural design fault designs (Table 4).

Towards this end null hypothesis tests using the analysis of variance method (ANOVA) were conducted with the assumption that there is no difference in the mean perception between the two categories of respondents. The results of these tests are presented in Table 4.

The results of the tests shows that overall there is no significance difference in opinion among two groups of users respondents results. Both owners and tenants are agreeing that on existence of construction phase faults at their respective locations. However a slight difference is visible in means perception levels of two construction phase fault (determinants 5 and 9) which indicate that one group of user's respondents consider these factors having slight implication on housing.

**Table 4:** Results of One-Way ANOVA (Construction Faults)

Construction Faults	Mean score users perception		df	ss	ms	f	p-value
	Tenant	Owner					
1. Supervision by designer	4.90	4.88	1	0.022	0.022	0.0944	0.9638
2. Waterproofing and slope design	4.76	4.52					
3. Condition of Painted surface	4.57	4.64					
4. Supervisor management rule in work execution	4.71	4.64					
5. DPC at various surfaces	3.86	4.24					
6. Condition of plaster surface	4.05	4.48					
7. Quality of adhesion between materials	3.48	3.64					
8. Communication between contractor and designer	3.86	4.64					

#### 4.2.6. Results and Discussion

The findings of this research has furnished with high implicating factors, which are recorded as under;

- i. There are various construction defects, which are caused because of lack of top supervision, for example, leaks in sanitary and plumbing installations, insufficient concrete cover over reinforcement, misalignment of sliding windows and doors, etc. This construction factor has secured uppermost significance among the implicative factors. This shows that designer is quite reluctant in management of this issue and because of less or no supervision the defects in wet spaces cause the irreparable loss to housing at the site and caused dissatisfaction among users.
- ii. Because of improper slope design and construction the users were complaining about water ponding at both roof tops and ground surfaces. This has caused dampness and paint decay in ceilings and disturb function of paved surfaces. In few houses, this fault also causes scalping in reinforcement and attrition in plaster. This construction fault also holds the attention of the respondents, and it has been identified as the implicative factor of the construction phase. This factor could arise from poor workmanship, construction and incomplete details drawings.
- iii. Users at most housing sites were not satisfied about paint quality and prepared surfaces. Query into a matter revealed that surfaces subjected to paint were not fully prepared, for example, plaster ramming marks were visible to various wall surfaces and dampness marks in ceiling (not under rooftops) were visible, which is evident that trapped moisture from material has been surfaced and caused paint decay. The material has not been allowed to dry out completely, conceivably this factor is aggravated by speedy construction.
- iv. Users were not satisfied about a price hike and higher expectations of contractor and developer, during unstructured interviews owners complained that even after regular payment possession of their respective house was delayed. The phenomenon of delay in construction shows the weakness of supervising management. This factor causes anxiety and frustration among users and therefore, gained higher means from respondents.
- v. Dampness at various surfaces was one of major cause of dissatisfaction among users; the cause of dampness was identified as improper DPC material use and DPC failure. Rising dampness in housing external walls were due to DPC failure at the plinth level, whereas dampness in floors was caused by inferior quality membrane or non application of DPM.
- vi. The factor of cracks has caused doubts among users about overall construction quality and stability of their respective hosing. During housing inspection cracks at various plastered surfaces has been noted, ranges from hairline to 1 mm cracks. Mostly, these cracks were visible either in straight line along the window sill and soffit line or randomly short run spread. This pattern of cracks suggests that these cracks were caused either because of thermal expansion of two different material used to gather without matching their expansion properties. For example, aluminum window fixed in cement block, Iron hold fast used to fix door frames, use of low quality PVC conduits (concealed) caused expansion under plaster surface, etc. In addition to this another reason of random cracks at the floor surface suggest that curing process was not sufficient during floor construction, therefore caused material shrinking and random cracking at the floor surface.
- vii. Loss of adhesion in materials was noted in vertical surfaces (ceramic tile) of wet areas and wooden veneering in the kitchens. This factor was major concern for users because this construction fault has directly affected the aesthetic values of the house interior, for example, tossing of ceramic tile at the vertical surface in bath and toilets, raising of veneer surfaces in wooden cabinets. This failure pattern perhaps caused by lack of supervision, poor workmanship and use of expired or near to expire in adhesive materials in pasting and fixing of materials.
- viii. During interviews the factor of a communication gap between designer and contractor is mostly identified by owners of the house. This determinant is also correlated to factor of lack of supervision by designer. Therefore, implications of a factor are similar in nature. However, an important aspect about this factor was identified by users as, that communication gap among both

designer and contractor set the contractor to use and propose the materials and techniques as per its experience, which is not always well tested. The housing under the effect of this factor noted with the problem of door and window fixtures, problems with door locks, failure of electric switches and fixtures, etc.

Base on the above analysis this research has produced the index of user's sensitivity in the context of construction faults, which shows the state of design and construction practice and vulnerability of users to such awesome housing conditions. This index as shown in Table 5 illustrates the severity of each factor and its implication on housing maintenance.

**Table 5:** Users sensitivity Index for Construction Faults

Construction Faults Determinants	Index of Defects and Maintenance in Housing Stock											
	Leaks in pipes work	Seal/joint failure in pipes work	Dampness in walls and floor	Water penetration	Paint decay	Failure of electric & door fixtures ,	Water ponding	Thermal Expansion of conduits & holdfast	Loss of joint in ceramic & wooden surfaces	Cracks in plaster surfaces	Poor function of oriels	Cost inflation
1. Lack of top supervision by designer	√	√				√		√	√	√	√	√
2. Inadequate waterproofing slope design			√	√			√					
3. Conditions of Painted surfaces			√		√							
4. Supervisor management rule in work execution	√			√		√			√		√	√
5. DPC at various surfaces			√	√	√							
6. Condition of plastered surface			√					√		√		
7. Quality of adhesive material	√								√			
8. Communication gap between contractor and architect	√	√				√		√			√	√

### 5. Conclusion

The survey of this study is only limited to low and medium cost housing at selected location in Karachi city . The survey tool has been designed with close ended questions. Therefore each question provides affirmative response form respondents. However there is a possibility to divulge the various defects into principal causes. The response of each question has been closely monitored and analyzed on SPSS computation system. The users sensitivity index Figure 1 results from higher value of mean marked for each factor of construction faults, mentioned in questionnaire.

The resultant sensitivity index from users reveals that the most of faults occur through the effects of external factors and agencies on building materials. In broader spectrum these factor and agencies can integrated in three principal components such as

1. Lack of supervision during construction phase
2. Poor workmanship.
3. Insufficient knowledge of field

Housing districts in Karachi have different design and economic backgrounds that control the value of land and quality of homes. However housing provision presents a depressed picture; housing finance is not available to most of people thus making the population incapable to have a quality house. Some families in this study have made very small design shift to make 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 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 to have a house in down town, residents of medium cost apartment are facing the similar problems, which perhaps can be associated with low cost housing blocks.

Most of condition which results the housing defects are avoidable: they occur, in general not through a lack of basic knowledge but by non-application or misapplication of it. The level and nature of defects in building construction currently encountered at site suggest that more guidance is required on the avoidance of failures. A need is seen for such guidance to be a positive part of a design and construction phase. Indeed there are good arguments for suggesting that, as the first essential in design and construction is to ensure that the structure provided is stable and durable however precise awareness in the prevention of failure should be a main part of any design and construction process.

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