

Development of Conceptual Framework for Design Improvement in Urban Housing of Karachi, Pakistan

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ABSTRACT

Need of housing and need of quality housing are two issues which remained the subject of research and interest to researchers and designers. It is generally observed that not all designers are fully aware of consequences of their design and only through post occupational survey; the designer usually realizes that what mistakes or bad decisions they have made during design process. Unfortunately, such unforeseen conditions are common in residential building projects in developing regions.

This research has identified the causes of design deficiencies and their effects on residential building at the post occupational stage in Karachi Pakistan. In this context housing designs and conditions have been closely monitored and issues of deficient design have been identified. Furthermore, this research has circumscribed the implication of deficient design faced by users of private housing in Karachi. The study has established the criteria that these problems affect users through unplanned maintenance to major repairs, leading to danger of collapse. In order to evaluate these effects on buildings, a case study of private housing projects was conducted in Karachi, a metropolitan city of Pakistan. The collected research data was analysed through SPSS computational software and interpreted to understand the far reaching effects and implications of design deficiencies in the selected site of housing stocks. Based on literature review and findings of research, the study has eventually proposed a conceptual framework for improving design practice.

Key Word: Building Maintenance, Design Deficiency and Construction Faults.

1. INTRODUCTION

The concentrations of planning and design solution are cradle for the maintenance issues related with design faults in built forms. Unplanned maintenance emerges from design faults indicates about two aspects of design development, firstly that the design has not been practiced in perception of building

maintenance. Secondly, the construction phase has remained unchecked by the field experts. Reviewing the maintenance problems in various built forms reveals that housing sector is most effective from this activity; since all the population of the world is living in some form of enclosure called the house.

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House is an enclosure that presents the perception of peaceful and protective 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 a passage of time and advent of technology, the perception of shelter was changed its form to modern day house. 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 increased number of housing facilities. In modern days, house is a basic icon of family enclosure where people can plan to live and work under a protected environment. 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 defined by [1], 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, I., [1] 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 the shelter. 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.

Housing quality and its design in under developed world are highlighted by renowned architect [2] as the wonderful thing about third world is that there is no shortage of

housing, but there is short supply of the urban context. The real task and responsibility of the third world architect is to help generate this urban context. The study of Correa [2] further 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.

2. LITERATURE REVIEW

Study by Okpala, D.C.I., [3] regarding housing in developing the country is summarised 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 a public sector in providing housing to residents [3].

According to a report on housing conditions in Pakistan published by HRCP (Human Right Commission of Pakistan) [4], 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, A.M., [5] 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 with concerning to the biggest metropolis of the country namely Karachi.

The supply and demand of housing scenario in Karachi is highlighted by Hassan, A., [6] 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, A., [7], 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's research on the issues of built environment is incomparable. Cowasjee has 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, [7] describes the status of buildings and its trade in Karachi as the environmental nightmare. The study of Cowasjee's presents a clear picture of continuing severe deterioration in different phases of housing/commercial building design and construction activity in Karachi, Pakistan.

Poor design and its implications on the house maintenance have remained neglected part in field of research, both in developed and developing nations. Whenever the designer completes the project, the designer was not fully aware of consequences of their design. Only through post occupational survey designer usually realises that what mistakes or bad decision they have taken during the design process. Those decisions mostly emerged in the form of certain types of defects in building. Unfortunately, such unforeseen conditions are the part of daily life of the 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, 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, [8] 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.

In this perspective Seeley, I.H., [9] suggested 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, I.H., [9] has identified the problems of design and maintenance as the gap between design and maintenance. Conceivably, Seeley stress that maintenance is an 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 affecting on the building. Whereas this gap could be reduce by developing understanding for design and maintenance in the light of definition given by Royal Institute of Chartered Surveyors RICS [10], 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 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 the number of researchers to address the similar problem in other parts of the globe and they have

highlighted the vitality of topic through their publications and also developed a reliable link between the design and maintenance issues. Ramly, A., [11] explained that the design plays a major role in determining the condition of the building after completion, mainly in aspects of defects and maintenance. Ramly, A., [11] further stresses that, design indirectly influences the performance and physical characteristic of building and its durability to withstand against the environmental conditions, 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 also needed to consider the impact of design on structure and material installed as well as the life cycle of each component of building.

Account of above reveals the importance of emerging issue of faulty design and building maintenance, the studies have highlighted the various issues and aspects of design tribulations and their effects on building maintenance. In these studies identification of issues and their causes had remained major task to researchers and it is believed that most of the researchers have adopted the quantitative mode of research methodology. This usually requires a specific site, data collection through questionnaire survey and gets it analysed through computational resource. It is important to consider that researchers through their studies also want to create awareness among people in general that design deficiencies are responsible for both igniting and accelerating the maintenance operation at post occupational stage. Based on this account, two important aspects can be recorded at this stage.

- (1) Residential buildings are most affected by various types of design deficiencies.
- (2) Buildings in under developing regions are infected by the issues of deficient design but developed regions are also under the heavy burden of such issues.

3. OBJECTIVE OF STUDY

The objective of this study is to find out the nature of design defects and their possible causes in private housing stock. Furthermore, to propose a framework for improving design practice.

4. METHODOLOGY

This study has adopted the distinctive and reliable pattern of research, which is consisting of site visits, unstructured interview, photography and questionnaire survey. At first stage, sites have been visited by the researcher and issues of building defects and maintenance have been identified through coordination of literature review. Eventually, Gazderabad, Union Council -6, Saddar Town Karachi has been selected for case studies. It is a neighbourhood of private housing and residential buildings. The neighbourhood of site presents the most favourable conditions for conducting survey. In second stage a survey was conducted among low to medium cost housing. Every fourth building at site has been targeted for study. Therefore, from a total of 120 residential buildings 30 low rise housing were selected for conducting a survey at site and at least two responses from each selected building were collected. At third stage data obtained from a questionnaire survey has analysed and summarised in the form of findings and finally condensed in conclusion.

The survey tool in a form of the questionnaire has been designed for the purpose of conducting a questionnaire survey among residents. The function of a questionnaire survey was to determine the significance of issues related to design tribulations and housing maintenance. The questionnaire has addressed the issues of designing consideration and their implications on housing in general. However, each question has a tendency to be further break-up in the 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 the questionnaire. The questionnaire was

translated in Urdu language (native language of Pakistan) for convenience and better understanding of the issues mentioned in the questionnaire.

The total of 20 broad based questions were asked from two types of the respondents, i.e. owner and tenant. In order to get specific answers, the questionnaire was provided with nominal scale with one neutral level, i.e. 'Yes', 'Not Sure' and 'No'. According to Gay, L.R., [12], a nominal scale represents the lowest level of measurement and the lowest measurement level you can use, from a statistical point of view, is a nominal scale. However, [13] according to www.csse.monash.edu.au, the only measure of average, which can be used in the nominal scale is simply a set of frequency counts. Perhaps the studies assert that nominal scale is feasible for basic measurement, and it categorize the individuals or issues into mutually exclusive and jointly comprehensive groups. The information that can be generated from nominal scaling is to calculate the percentage. Thus the nominal scale gives some basic, categorical gross information.

In order to adopt the quantitative mode of research, the given scale was provided with numerical value such as Yes=3, Not Sure=2 and No=1. The data obtained through the survey tool was analyzed on SPSS computational resource (Version-12.00) and each question was calculated as mean significance and cross tabulation.

5. RESULTS AND DISCUSSION

The initial visit to case studies revealed that the designs of buildings were carried out without consideration of maintenance factors. In addition to this it was also observed that chipping away the client feed back at the design stage was possible source of series of unexpected maintenance works in finished building, which resulted in the lowering the efficiency of building coupled with high maintenance cost.

However, rest of the defects identified at the site could have resulted from improper material selection and

underestimating the climatic conditions or physical environment of the site. In addition, the original design was inadequate or completed with sub-standards workmanship. Other miscellaneous factors which also caused defects in housing can be named as the financial constraints, speedy construction, and higher profit margins.

The total of 100 questionnaires were sent to the residents of different buildings at the site and total of 62 respondents timely delivered their feedback, thus maintained a 62% rate of response (approximate). Table 1 shows the data analysis in the form of means obtained for each question from respondent's feedback.

The data obtained from the initial survey has been analysed as 'mean' (significance) and 'cross tabulation' of questions mentioned in the initial survey, as shown in Table 1. The significance of the issues were shown by the value of the mean, which resulted from analysis of data obtained through three ranked scale was employed in the questionnaire. In this analysis, concern of respondents about different issues was judged through higher value of mean.

Among twenty questions, twelve questions have gained the mean ranges between 2.66-2.97. This statistics demonstrates that more than 75% of issues mentioned in questionnaire have been calculated at above average mean. This trend of respondents indicates the importance and existence of design deficiencies at the site. The values of mean shown in Table 1 have been rounded to next higher value of mean, i.e. 2.97 shown as 3.0. In the following lines back-ground of only those issues of design deficiencies issues have been discussed, which constituent as the integral part of building design and gained the higher mean, shown in Table 1.

The need of building maintenance has gained the 2.8 mean, as shown in Table 1 from respondents feed back, the need of immediate attention to maintenance issues has been

levelled through this question. There are two aspects of this question, first it outlines all the issues of deficient design and defects visible in buildings of the site and second it inquires about gravity of their presence in building. In fact, this question is pivot for most of the existing design issues causing maintenance in residential buildings. The perception of those issues can be drawn as faults of design stage, services and its layout, construction phase, poor workmanship and material selection. Cross tabulation of this question is shown in Table 2, which shows that 20 owners and 33 numbers of tenants have acknowledged the existence of this problem in their respective site.

The factor of design causing maintenance has gained the maximum level of 3.0 mean as shown in Table 1 from

feed back of the respondents. The question has been asked with intentions to identify the design deficiency related with architectural faults at design stage. Those issues can be stated as lack of architectural detailing, improper material selection, lack of detail drawings and architectural planning. Cross tabulation of this question is shown in Table 3. According to statistics, 23 numbers of the owners and 37 numbers of the tenants have shown accordance with the existence of the problem, however very few respondents have given the negative remarks for same question.

The issue of the role of building services was questioned to magnify the responsibility of services in the buildings. Respondents have recognized this issue by allowing it the 2.8 mean. These maintenance issues can be identified

TABLE 1. DESCRIPTIVE STATISTICS OF INITIAL SURVEY (SOURCE: AUTHORS)

Design Faults Maintenance Issues	Number of Respondents	Minimum	Maximum	Mean
Buildings need maintenance at site	62	1	3	2.77
Design causing maintenance	62	1	3	2.97
Residential buildings are major affective	62	1	3	2.44
Lack of maintenance reduce life cycle	62	1	3	2.29
Services play role in maintenance	62	1	3	2.71
Ventilation plays role in maintenance	62	1	3	2.60
Deterioration of building facades in site	62	1	3	2.73
Solid waste disposal rising health and safety concerns	62	1	3	2.95
Design consideration causes faulty design	62	1	3	2.84
Faults emerged from construction phase	62	1	3	2.56
Incomplete drawing causes faulty design	62	1	3	2.73
Design causes poor performance of building	62	1	3	2.66
Building components effects maintenance	62	1	3	2.58
Absence of building maintenance measures at design level	62	1	3	2.77
Communication gap sparks faulty design	62	1	3	2.77
Random decisions of construction team causes faults	62	1	3	2.74
Non awareness of owner about design	62	1	3	2.68
Non awareness of responsibilities for building maintenance	62	1	3	2.42
Activities of end-user contribute in building maintenance	62	1	3	2.71
Buildings design are capable to minor emergency	62	1	3	2.61
Valid Number of Respondents (list wise)	62			

as leakage in the waste and sanitary pipe, seepage of ceilings, thermal expansion of services material, and improper layout of services. Cross tabulation of this question is shown in Table 4. It shows that nineteen owners and 32 tenants have regarded the issue of building services as maintenance causing factor.

Front elevation of the buildings is the first impression of any built form no matter how well, or poorly it is planned. This question of a survey was an aim at to draw the attention of people to the buildings façade as well as to identify the issues, causes their deterioration and ultimately triggering the maintenance in buildings. This

issue has maintained the value of 2.7 mean as shown in Table 1. The contributing issues of maintenance towards this question are building fabric decay, lack of architectural detailing, dampness and poor layout of services. Cross tabulation of this question is shown in Table 5. It is revealed that 16 owner and 34 tenants living in selected sites have agreed with the existence of the problems of facade deterioration.

The provisions of building maintenance measures are similar to first aid medical box in building. Their absence not only causes maintenance but also causes delay in repair work. Aim of this design factor was to develop

TABLE 2. BUILDING NEED MAINTENANCE (SOURCE: AUTHORS)

Category of Respondent	Buildings Need Maintenance at Site			Total
	No	Not Sure	Yes	
Owner	1	2	20	23
Tenant	4	2	33	39
Total	5	4	53	62

TABLE 3. DESIGN CAUSING MAINTENANCE (SOURCE: AUTHORS)

Category of Respondent	Desing Causing Maintenance		Total
	Not Sure	Yes	
Owner	-	23	23
Tenant	2	37	39
Total	2	60	60

TABLE 4. SERVICES PLAY ROLE IN MAINTENANCE (SOURCE: AUTHORS)

Category of Respondent	Services Play Role in Maintenance			Total
	No	Not Sure	Yes	
Owner	2	2	19	23
Tenant	5	2	32	39
Total	7	4	51	62

TABLE 5. DETERIORATION OF BUILDING FACADES IN SITE (SOURCE: AUTHORS)

Category of Respondent	Deterioation of Building Facades in Site			Total
	No	Not Sure	Yes	
Owner	4	3	16	23
Tenant	1	4	34	39
Total	5	7	50	62

awareness among people for its importance as well as to inquire about the extent of its existence in buildings. This issue achieved the mean of 2.8 results with negative loading through cumulative response of respondents, as shown in Table 1. This shows that majority respondents have voted for non availability of maintenance measures like accesses for repair, access for maintenance tools, maintainable waste pipes, etc. in buildings. Cross tabulation of this question is shown in Table 6, briefs that 20 owners and 33 tenants come up with a negative answers regarding availability of maintenance measures in buildings.

The communication gap is highly influencing defect causing factor in building design. The presence of this factor is being observed during the site visits. Respondents have recognised and understood the importance of this factor and thus this factor gains significance through 2.77 mean, a shown in Table 1. This

factor implicates building maintenance by causing faults in correlation with phases like design and construction stage, for example, early removal of form work, non availability of recommend material and non awareness of intend use. However, cross tabulation of this factor is shown in Table 7 shows that 20 owners and 33 tenants have recognized this factor in their respective locations.

The random decisions of the construction team, the researcher has noticed that implications of this factor at the site in the form of poor workmanship, ignorance of standards, speedy construction and non compliance of byelaws. Respondents of the survey have also shown their concern about this factor, and this implicative factor has gained the significance by maintaining 2.74 value of mean, as shown in the Table 1. Cross tabulation of this factor is illustrated in Table 8, shows that 33 tenants and 20 owners have recognized the existence of this issue in their buildings.

TABLE 6. ABSENCE OF BUILDING MAINTENANCE MEASURES AT DESIGN LEVEL (SOURCE: AUTHORS)

Category of Respondent	Absence of Building Maintenance Measures at Design Level			Total
	No	Not Sure	Yes	
Owner	3	-	20	23
Tenant	2	4	33	39
Total	5	4	53	62

TABLE 7. COMMUNICATION GAP SPARKS FAULTY DESIGN (SOURCE: AUTHORS)

Category of Respondent	Communication Gap Sparks Faulty Design			Total
	No	Not Sure	Yes	
Owner	1	2	20	23
Tenant	4	2	33	39
Total	5	4	53	62

TABLE 8. RANDOM DECISION OF CONSULTANT TEAM CAUSES FAULTS (SOURCE: AUTHORS)

Category of Respondent	Decisions of Construction Team and Faults			Total
	No	Not Sure	Yes	
Owner	2	1	20	23
Tenant	5	1	33	39
Total	7	2	53	62

The design considerations cause the design faults is one of the most influencing defects causing factor, in building design. The presence of this factor is being observed during the site visits. Respondent were recognized and understood the importance of this factor and this gains significance through 2.84 mean a shown in Table 1. This factor implicates building maintenance by causing faults in correlation with phases like design and construction stage. For example, poor detailing, improper slopes of flat surfaces, improper selection of materials, poor ventilation in stair cases, early removal of form work, etc. However, cross tabulation of this factor is shown in Table 9, which shows that 21 owners and 36 tenants have recognized this factor in their respective locations.

The drawing and schedules are considered as the language of communication between designer, builder and owner. The absence of complete drawings also causes design faults, during construction phase in the absence of absolute instruction about a design construction team takes the random decision according to their knowledge and thus causes problems at occupational stage. The presence of this factor is being observed during the site visits and respondents have also recognised and understood the importance of this factor and thus this factor gains significance through

2.73 mean, a shown in Table 1. This shows that most of respondents have voted for presence of defects results from incomplete drawings. This factor implicates the building, for example, water penetration through windows and wall joints, thermal expansion of materials, failure of drainage system, etc. Cross tabulation of this question, brief that 21 owners and 31 tenants come up with consent that incomplete drawing is one of the causes of defects at post occupational stage, as shown in Table 10.

The factor of design causing poor performance has gained the maximum level of 2.66 mean as shown in Table 1. The question has been asked with intentions to identify the design deficiency related with architectural and construction stage. Those issues can be stated as improper space planning, poor ergonomics, ignorance of building bylaws and standards. Cross tabulation of this question is shown in Table 11, according to statistics, 19 numbers of the owners and 31 numbers of tenants have shown accordance with the existence of the problem. However, very few respondents have given negative remarks for the same question.

The problem of owner's awareness about design is the issue relates more towards ethics of business but this problem is persisting at locations selected for study.

TABLE 9. DESIGN CONSIDERATION CAUSES FAULTY DESIGN (SOURCE: AUTHORS)

Category of Respondent	Design Consideration Causes Faulty Design		Total
	Not Sure	Yes	
Owner	2	21	23
Tenant	3	36	39
Total	5	57	62

TABLE 10. INCOMPLETE DRAWING CAUSES FAULTY DESIGN (SOURCE: AUTHORS)

Category of Respondent	Incomplete Drawing Causes Faulty Design			Total
	No	Not Sure	Yes	
Owner	2	-	21	23
Tenant	5	3	31	39
Total	7	3	52	6

There are two aspects of this issue; one is that developer or builder is ignorant of user's feed back and basic requirements of residence. The second is that developer or builder is reluctant to fulfill the agreement and design requirement. These condition highlights the dubious role of the building control authority in region. The respondents have recognised this issue and thus gained the mean of 2.68 as shown in Table 1. However, cross tabulation of this question is shown in Table 12 explain that 20 numbers of the owners and 30 numbers of tenants have shown accordance with the existence of the problem.

5.1 Summary of Results

Summarizing the above discussion and survey results, it is affirming that private residential buildings at the site in Karachi are exposed to several types of design deficiencies. Therefore, these results causing maintenance in these built forms justified the further extensive study in each sector of design consideration ranging from a simple sketch to final finishes. Each factor mentioned in the questionnaire is representing the group of issues causing design deficiency at the site. Although most of the factors have gained above average significance but only multifaceted design

deficiencies has been discussed. Number of influencing factors has been identified in buildings, which are related with various stages of design and construction.

The highly influencing factors identified at design stage are ignorance of by-laws, lack of detailing, a material selection and communication gaps. These factors implicate the building at post occupational stage in the form of various defects and thus causing maintenance and reduce the life span of building. However, at construction stage these influencing factors of design deficiency can be named as lack of top supervision, quality of workmanship, lack of specification, speedy construction and fading control of building control authority. The most of these factors are correlated and implicate the building in cycle reaction. For example, speedy construction occurs when there is a lack of supervision or absence of by-laws in design and fear of exercising the building control law also accelerates the speed of construction.

Summation of influencing factors of design deficiency and suggestion for improvement of conditions is shown in Fig. 1.

TABLE 11. DESIGN CAUSES POOR PERFORMANCE OF BUILDING (SOURCE: AUTHORS)

Category of Respondent	Poor Design Causes Poor Performance of Building			Total
	No	Not Sure	Yes	
Owner	3	1	19	23
Tenant	6	2	31	39
Total	9	3	50	62

TABLE 12. NON AWARENESS OF OWNER ABOUT DESIGN (SOURCE: AUTHORS)

Category of Respondent	Non-Awareness of Owner About Design			Total
	No	Not Sure	Yes	
Owner	2	1	20	23
Tenant	6	3	30	39
Total	8	4	50	62

6. CONCLUSIONS

This research suggests that designing a home should not be done in the isolation of an office or only by some building professional. In order to design a tribulation free house it requires some consultation and rethinking of the housing design programme. The maintenance expert along with user's interaction and intervention is important to incorporate at the design stage. 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 implements the minimum quality standards for private housing.
- (2) Users feed back to identify the objects and features that need to be included for minimum design standards of private housing.
- (3) To work out the solutions to accommodate essentials of house economically and efficiently.

The data analysis has revealed several causes of the deficient design and resultant maintenance has been identified at various stages of the design and construction

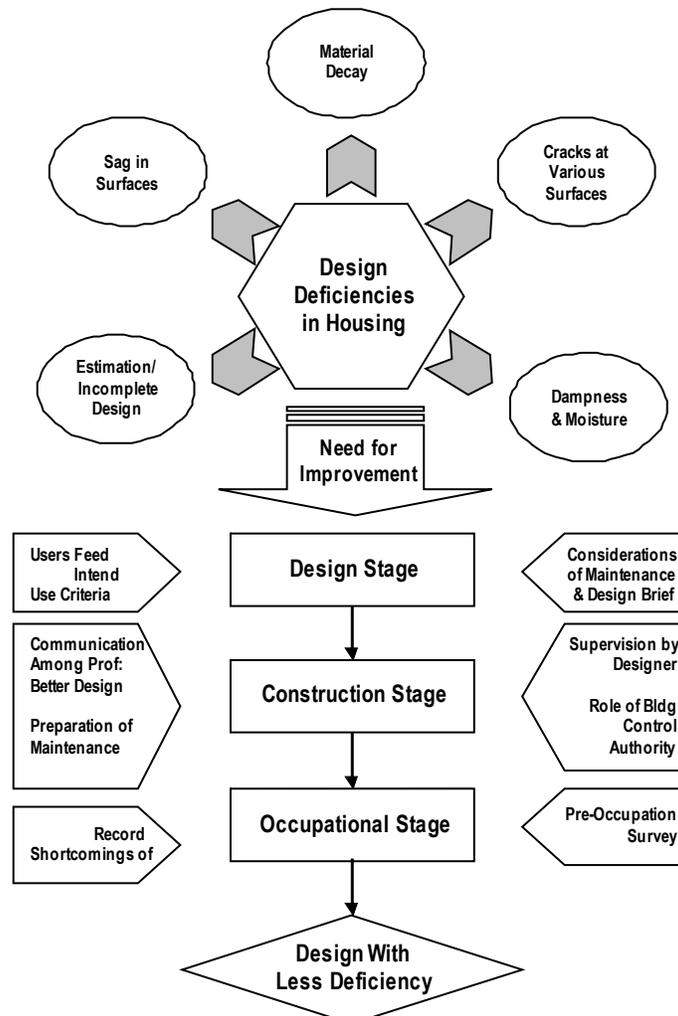


FIG. 1. CONCEPTUAL FRAMEWORK OF DESIGN DEFICIENCIES IN PRIVATE HOUSING AND DESIGN PRACTICE IMPROVEMENT IN KARACHI PAKISTAN (SOURCE: AUTHORS)

phases. Among them some of the causes act as independent manner but most of them are correlated. But the common element among these identified causes is that their severity influences the maintenance procedure in building. Few of these factors implicate the building as a single defect but most of them implicate in multifaceted. The following factors have been identified by this study as defect causing elements in built forms.

- (1) Lack of construction detailing and incomplete constructions specification.
- (2) Communication gap.
- (3) Lack of feed back from the end user.
- (4) Lack of standardization.
- (5) Poor workmanship.
- (6) Use of substandard quality of materials.
- (7) Improper services design.
- (8) Ignorance to in design maintenance provision.

These listed factors effectively address the numerous design problems of residential building at selected site. These factors are important to successful design solution and their presence in design is highly advocated by the precedent researchers. Perhaps it could be asserted that the presence of these factors in design solution could promise the success of residential design and other built form. Subsequently effectiveness of these factors has assisted to develop the framework for improvement in housing design procedure. The designers could use these factors as self guiding and design assessing tool during the process of design development. A simple comparison about presence of these factors in design could lead the designer to have more effective design to cater different conditions and users.

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