International Journal of Engineering

Journal Homepage: www.ije.ir

Investigation of Generic House Components and Their Practical Ways to be Assessed by House Buyers During Defect Liability Period in Malaysia

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PAPER INFO

Paper history:
Received 16 May 2016
Received in revised form 04 August 2016
Accepted 27 August 2016

Keywords:
Defect Liability Period
House Components
Practical Ways To Assess
House Buyer

ABSTRACT

The newly built residential house basically had undergone a period where any defects toward the house will be rectified by the particular developer. Defect Liability Period (DLP) which is commenced from the day of Vacant Possession (VP) by house owners generally in effect between eighteen (18) months and twenty-four (24) months. During DLP, new house owner has the right to issue any complaints regarding the quality of the said building. Unfortunately, complaints were believed to widespread in the recent era where profitability is the main concern to most of the developers. Since the quality of the finished product is of minor consideration, added with less knowledgeable new house owners on issues of house defect, the situation is going from bad to almost heedless. To add salt to the wound, scarcity on research and dissemination of knowledge were deemed to shut the issue until almost to no existence. Therefore, the research is taking a leap by focusing on sense perceptions of house components that received recurring complaints and providing corresponding practical ways to check for defects on behalf of new house owners. A mixed method of methodology has been imposed, starting with literature analysis, questionnaire survey, and structured interview, respectively. Questionnaire surveys were conducted using online distribution towards developers and contractors within southern states of Malaysia, namely; Johor, Melaka, and Negeri Sembilan. Meanwhile, the latter method was accomplished by interviewing several senior construction practitioners. In order to ease the analysis processes, SPSS, and NVivo were used as the main software. The findings suggest that, in terms of sense perceptions, house components consist of several important parts such as roof, walls, and floors, along with their sub-components. However, not all components received similar trend of complaints from the house buyers. Interestingly, most of the senior construction practitioners proposed several unique and unaware practical ways for defect identification, such as by using torch light, water, and other simple testing methods. This research contributes in that it embarks on application-based software as knowledge management and distribution effort, which is anchored on Android by Google Incorporation.

***doi**: 10.5829/idosi.ije.2016.29.10a.05*

1. INTRODUCTION

The upward trend of the construction industry has generated a lot of new housing constructions either in urban or rural areas. The growth of construction industry can be proved by the statistics released by the Construction Industry Development Board Malaysia (CIDBM) in 2013, where the country's construction sector has contributed a total of RM108.29 billion to federal government expenditure (KDNK) [1]. According to the Secretary General of the Ministry of Works, Datuk Seri Zohari Akob, housing construction, non-residential and infrastructure projects are the sectors that contributed to the construction industry [2]. This sector has many benefits and profits especially to the developer and the contractor and also the house buyer himself [3].

However, despite the grandeur and the rapidity of the housing construction sector in Malaysia, there are many problems aroused especially towards the quality

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Please cite this article as: N. Kariya, Z. Yaakob, M. N. Mohammad Sairi, H. Mohammad, S. K. Yaman, N. H. Abas, Investigation of Generic House Components and Their Practical Ways to be Assessed by House Buyers During Defect Liability Period in Malaysia, International Journal of Engineering (IJE), TRANSACTIONS A: Basics Vol. 29, No. 10, (October 2016) 1354-1363

of finished products [4, 5]. More often than not, most of the new house buyers ended up in living within defective houses [6]. Since house buyers were generally not having proper knowledge in term of quality inspection [7], the circumstances are not just limited to defect liability period (DLP), but beyond that period (where they were forced to rectify themselves). Complaints of dissatisfaction with houses that have been completed, either in terms of quality of work or materials used are believed to increase every year in line with developments of construction sector due to the high demand for housing needs [6, 8].

In addition, relating to a defect liability period, it is the responsibility of developers to attend to new house buyers' complaints in order to rectify any particular defects [9]. However, when referring to new house buyers, it is believed that they typically focus on components of a house that can be inspected through sense perception (i.e. vision, hear, touch, and smell). These statements are evident if the buyers are those who do not have technical or building construction background. However, grief is seen where a complete list of generic house components is fragmented, and the circumstances are exacerbated by limited developers' assistance right after the said vacant possession (i.e. starts of DLP). This will directly impact the inspection that will be carried out by the house buyers, which is often than not, many house components will be left unchecked. To add salt to the wound, lack of practical guidance offered by the industry indirectly hampers the effectiveness of the particular inspection.

In line with the above, the Construction Industry Development Board of Malaysia (CIDB) has developed Quality Assessment System in Construction (QLASSIC) for measuring and assessing the quality of a construction as according to the relevant standard requirement [10]. However, preliminary observation shows that the provided document is too complicated (with jargons, technicalities, and specialized tools) for those who have no history of learning in technical fields (especially in civil and construction realms). Therefore, the need to propose a practical assessment for house components is paramount in order to address prior issues.

Thus, as far as the study is concerned, the need to delve into the issue of defects in house components during DLP period is indeed crucial in order to solve the problems faced by new house buyer. Therefore, as a preliminary study, several major questions were posed in order to unravel this problem, namely; what are the generic components of a house? What are the frequencies of complaints about generic house components during DLP? What are the practical ways for assessing generic house components during DLP? In order to answer these questions, several objectives have been outlined, which are; to identify generic house components according to sense perceptions, to analyze the frequency of complaints about generic house components during DLP and to propose practical ways for assessing generic house components during DLP.

The finding is anticipated to be used as a reference by all those who are involved in the construction sector and house buyers in Malaysia. Apart from providing tacit knowledge through the establishment of practical assessment, the outcome is believed to shed some light on the particular issues, and to a certain extent paved the direction for subsequent study. At the end of the study, it is expected that a mechanism of disseminating the knowledge is provided in order to give direct benefits towards the end users.

2. LITERATURE REVIEW

Generally, the process of housing development project in Malaysia is not far from typical project life cycle (PLC) which is divided into three phases namely; pre-development phase (i.e. planning stage), construction phase, and post-development phase [3, 11-13]. Every phase involves various activities, processes, and has to engage with professionals (i.e. architect, engineer, quantity surveyor, construction team, etc.) [14]. The pre-development phase is the phase where client/developer will state their intention, purpose, concept, location, etc.. Later, architects will prepare a draft design concept as per required. Once the design concept agreed by client/developer, the next stage will begin which is planning stage [15]. Planning stage is the most crucial part in developing a project [3]. Development of proposal plan needs to be prepared by the planner and will be submitted together with the detailed documents required for obtaining the permission of development planning, which is approved by the state authorities [11]. After the approval from the state's authorities has been obtained, the implementation or construction stage is commenced. At this stage, the construction team will start realizing the sketches of the buildings and facilities into a physical structure on proposed site. Coherently, the developer has to engage with qualified consultants such as architect, engineers and quantity surveyors in order to develop and construct the buildings and facilities on the land [15]. Meanwhile, the post-development phase is the closing phase of construction, where the completed property is handed over to the owner. Before that, the Certificate of Practical Completion (CPC) will be issued by architect once the construction is finished. Upon the issuance of CPC, the defect liability period (DLP) between client/developer and contractor will begin for a particular time or period before issuance of Certificate of Making Good Defect (CMGD) is made by the architect. After that, the Certificate of Completion and Compliance (CCC) will be issued. After the issuance of CCC and completed property is handed over to the

owner, the DLP between owner and client/developer will start [12].

Defect Liability Period (DLP) is a common term in all standard form of contracts such as Pertubuhan Arkitek Malaysia (PAM 2006), Jabatan Kerja Raya (JKR 203) and Construction Industry Development Board (CIDB 2000). PAM 2006 (sub-clause 15.0, Practical Completion & Defect Liability) specifies that "architect shall deliver any defects in works which appear within DLP period to the contractor not later than fourteen (14) days after the expiration of the DLP period. Contractor shall make good the defects specified within twenty-eight (28) days after the receipt of the schedule of defects (or within such longer period as may be agreed in writing by the architect) at the contractor's cost" [16]. Clause 45(a) of JKR 203 (i.e. Defects Liability and Making Good) specifies that "the contractor is responsible for any defect, imperfection, shrinkage, or any other fault which appears during the Defect Liability Period, which will be six (6) months from the day named in the CPC issued, unless some other period is specified in the Appendix" [9]. Whilst in CIDB 2000 form of contract, Clause 27.1 (i.e. Defects Liability after completion) specifies that "the contractor shall complete any outstanding work and remedying defects during the Defect Liability Period" [17]. Here, the relationship between the client/developer and the contractor is clear, where an emphasis is given towards the obligation and liability of contractor to rectify all defects that appear during DLP between the dates of CPC issuance until the end of the period [13].

On the other hand, a relationship between the new house buyer and the respective developer is generally governed by the Sale and Purchase Agreement [14]. In that agreement, clause(s) on DLP are normally stated, which among the highlighted note is on the duration of DLP itself (e.g. 18 months, or 24 months). Therefore, the role of buyers within DLP is to inspect the house components and report to the client/developer. Usually, at the time of Vacant Possession (VP), buyers are given a blank form of defect's complaint. Should any defects or damages occur, buyers need to fill in the form and submit to the client/developer within a grace period of one (1) week to a month. After that, the developer will point their main contractor to rectify the defects entirely at the contractor's own costs, unless otherwise stated in the prior contract [18]. However, throughout the DLP itself, house buyer is still able to report for any forthcoming defect to the respective developer.

Meanwhile, house components are divided into four categories which are structural (e.g. roof), architectural (e.g. finishes), mechanical & electrical (M&E) and external work (e.g. fence) [10]. Additionally, there are sub-components which support the whole component in order for them to be able to operate as designed (e.g. formwork for structural work, drain for external work, etc.) [10, 19]. There were a number of literatures (e.g. articles from journal, government reports, proper standard and guidelines, etc.) that outlined common house components including foundation, wall, floor, window, door, roof, ceiling, staircase, house finishes (e.g. paint, plaster, tile, mosaic, etc.) and house fixtures (e.g. kitchen and toilet fitting, etc.) [10, 15, 20-44]. However, since the perspective of normal house buyer becomes the concern in this paper, proper screening process needs to be embedded in order to give a better paradigm on behalf of them (see Methodology section).

Separately, the quality of the house components can be measured based on their functionality of the components, for example, the role of the roof is to protect the house from rain and outside heat, and the use of waterproofing under the floor is to avoid water absorption onto the surface. In line, defects or damage to house component is a common event that frequently occurs to the envelope of the building during construction, DLP and post DLP [45]. In general term, defects or defective works is where the standard and quality of workmanship and materials as specified in the contract is deficient. Defects can be classified into two main categories, Patent Defects and Latent Defects [18]. Patent defects are defects that can be discovered by normal examination or testing, whereas Latent Defects are defects that are not discovered by normal examination or testing, which usually manifests itself after a period of time [16]. Based on a recent study conducted by Md. Dalib, there are some house component defects that frequently received as complaints from the Customer Support & Service (CSS) within 14 days after the date of VP, which are floor, wall, door, window, ceiling, roof and fixtures for toilet and shower [13].

In Malaysia, the Construction Industry Development Board of Malaysia (CIDBM) has developed Quality Assessment System in Construction (QLASSIC) in 2006 for measuring and assessing the quality of a construction as according to the relevant standard requirement. This system is an independent method to measure and evaluate the quality of workmanship and finishes of construction works based on approved standards. One of the objectives is to assist contractors to achieve defect-free when carrying out construction work [10]. This is one of the government efforts to improve Malaysian construction industry. Nevertheless, in neighbouring country (i.e. Singapore), quality assessment system is called Construction Quality Assessment System (CONQUAS), which has been around for more than two decades and widely applied for government and private building projects within and outside of Singapore [19, 46]. However, given the fact that both systems are directed to be used by a professional inspector with specialized tools, the need to delve into practical assessment is crucial in order to establish self-assessment measures to be used proactively by house buyers.

3. METHODOLOGY

This paper is embarked in mixed qualitative and quantitative approaches, comprising literature analysis, questionnaire survey, and structural interview (see Table 1), which mostly guided by the work of Creswell [47]. It was delimited towards landed housing (e.g. Detached, Semi-Detached, and Terrace) that were available in Malaysia [10]. In order to identify the generic house components, it is wiser to embed the element of sense perception, namely; vision (through eye; e.g. for any surface defects such as cracks, and unevenness), hear (through ear; e.g. for any hollowness sound mostly towards construction finishing materials), touch (through hand; e.g. for any unevenness and testing of small house components), and smell (through nose; e.g. for any unpleasant odours related to house finishes) [10]. Along with that, the literature review process was employed. The list of house components obtained from numerous published sources (e.g. journals, guidelines, government reports, and past research documents) was subsequently analysed through a screening process called 'Multi-layered Thematic Process' to ensure the data are within the scope. This process (Figure 1) is the process of producing an output from a combination of one or more different layers of themes beforehand [14, 47, 48]. These screening processes consist of two parts which are the generic components of the house after completion and components that were able to be assessed by using sense perception (see description above). After that, the house components were gathered and the completed list of house components was documented.

Apart, the recurring complaints of house components during DLP (i.e. second objective) is carried out by using the quantitative approach through a questionnaire survey towards construction practitioners who are mostly engaged in building housing schemes (i.e. contractors, and developers) in the southern states of Malaysia, namely; Johor, Melaka and Negeri Sembilan. Understandable that complaint records were deemed confidential for most developers, and pursuing new house owners for data requires greater substances, the authors believed that the chosen approach was appropriate. Purposive respondents were selected randomly based on information published by the Construction Industry Development Board Malaysia (CIDBM) and Real Estate and Housing Developers' Association Malaysia (REHDA). It was then distributed by using an online method in order to reach larger audiences with minimal cost. The Likert scale was used to evaluate the frequency of complaints received by them during DLP (1= no complaint to 5 = very often received complaints). The data were analysed using descriptive analysis and inference analysis with the help of the SPSS software.

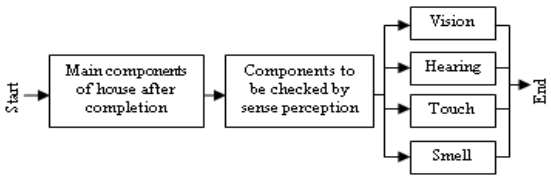

Figure 1. Multi-layered thematic process

TABLE 1. Summary of research methodology

Objective	Method	Unit of analysis	Analysis
To identify generic house components according to sense perceptions	Literature analysis	Past literatures	Multi-layered Thematic Process
To analyse the frequency of complaints about generic house components during DLP	Questionnaire Survey	Construction practitioners (i.e. housing developers and contractors)	SPSS Software
To propose practical ways for assessing generic house components during DLP	Structural Interview	Selected senior construction practitioners	NVivo Software

After the previous processes were ended, subsequently structured interviews has been conducted to capture practical ways towards assessing house components on behalf of the house owner (i.e. third objective). The interview has been done towards four purposely selected senior construction practitioners based on their specific experiences and knowledge on house construction. Checklist was prepared from previous data collection, which eventually became the basis for interview questions (i.e. the practical ways to check for house components defects). House components that frequently received complaints were given imperative priority. In order to ensure the interview data will not be missed, an audio recording was employed during the interview sessions. Further, guided by the works of Gibbs [49] and Welsh [50], the data were transcribed and analysed using the qualitative approach with the help of NVivo software. This software allows users to classify, sort and arrange information, examine relationships in the data and combine analysis through linking, shaping, searching and modelling [51]. The results were in the form of word frequencies, where it was displayed according to the most recurring words recorded from the interviews.

4. ANALYSIS AND RESULT

The first objective of this study is to identify the house components according to sense perception.

Through multi-layered thematic analysis, a complete list of generic house components with frequency number of reviews that were gathered from several works of literature [10, 15, 20-44] are documented (see Table 2). A table below shows that there are nine (9) main components and thirty-one (31) sub-components of a house that can be seen and checked using sense perception specifically based on Malaysia's environment.

A questionnaire was employed to measure validation and to make a generalization. The pilot test has been carried out in order to evaluate the validity of the questions' structure and the reliability of the questions. Initially, the questions were given to several expert persons (i.e. academicians, and senior practitioners) due to precarious concern on the overall questions' structure. As responds from expert persons, this questionnaire has been improved. After that, samples of ten (10) random responses from senior practitioners were gathered in order to check for prior data reliability. According to Sekaran (2013), the instrument is reliable when the Cronbach's Alpha (α) (internal consistency value) is approaching to one [52, 53]. A collective value of 0.981 was observed from the pilot respondents. It shows that the preliminary questionnaire was reported a high level of internal consistency, where the preferred measure of internal consistency is more than 0.7 [54, 55].

TABLE 2. List of generic house components

Component	Sub-component	Frequency	Means	Cronbach's Alpha (α)	IQR	Shapiro-Wilk (Sig.)
Wall	External wall	14	3.000	0.976	2.00	0.0530
	Internal wall	12	2.931	0.976	2.00	0.0630
Roof	Roof covering (e.g. roof tile, roof sheet, metal deck, etc.)	17	2.7333	0.974	2.25	0.0180
	Roof gutter	4	2.300	0.975	2.00	0.0130
	Flashing	9	2.300	0.975	2.00	0.0040
	Fascia board	1	2.100	0.974	2.00	0.0030
	Roof eave	1	2.138	0.974	2.00	0.0040
	Structure of the roof	6	2.133	0.974	2.00	0.0010
Floor	Floor surface (e.g. upper floor, floor covering, etc.)	22	2.276	0.974	2.00	0.0280
	Skirting	6	2.000	0.974	2.00	0.0010
Staircase	Stair (e.g. riser, nosing, tread, riser, etc.)	5	1.900	0.974	1.25	0.0010
	Platform	1	1.867	0.974	1.25	0.0000
	Handrail	2	2.100	0.974	2.00	0.0050
	Baluster	1	1.867	0.974	2.00	0.0000
Overall finishes	Paint	7	2.786	0.975	2.00	0.0530
	Rendering process	4	2.821	0.974	2.00	0.0530
Window	Frame	12	1.900	0.974	1.25	0.0010
	Railing	2	1.967	0.974	2.00	0.0000
	Hinge	1	1.900	0.974	1.25	0.0000
	Lock	2	2.267	0.975	2.00	0.0070
	Glazing	7	1.700	0.976	1.00	0.0000
Door	Frame	13	1.667	0.975	1.00	0.0000
	Hinge	2	1.767	0.975	1.25	0.0000
	Door knob	1	2.400	0.974	3.00	0.0110
	Door panel	5	1.833	0.975	1.25	0.0010
Ceiling	Ceiling board	7	2.321	0.975	1.00	0.0170
	Frame	1	2.100	0.976	2.00	0.0020
Overall fixtures	Piping	16	2.833	0.974	2.00	0.0290
	Electric (e.g. 13Amp. socket, fuse box, etc.)	16	2.400	0.974	1.25	0.0410
	Shower/Toilet (e.g. sink, faucet, toilet)	15	2.655	0.974	2.00	0.0620
	Kitchen (e.g. sink, faucet)	6	2.367	0.974	1.25	0.0320

Further, Table 3 provides a summary of the demographic information obtained. There were four related questions which cover; type of organization, grade registration under CIDB for contractor only, years of housing construction experienced, and respondents' position. Table 3 shows that out of 400 disseminated questionnaires with two waves of distributional effort (i.e. cycle within stipulated time frame), only 30 were successfully completed with a response rate of 7.5%. The respondents were from 17 contractors (57%) and 13 developers (43%). The majority of the respondents (19 out of 30 respondents; 63%) had more than 10 years' experience in housing construction, while the rest of them had below 10 years of experience in housing construction. Besides, most of the respondents have their positions in managing the project on the site, which consists of project managers, site supervisors, and construction coordinators.

Additionally, subsequent section of the questionnaire required respondents to indicate their opinion on a Likert scale based on the regularity of complaint on the defect of house component. Before any succeeding analyses were conducted, all data was subjected to multiple screening analyses, namely; reliability test (Cronbach's alpha), outliers test (interquartile range) and normality test (Shapiro-Wilk). From the actual study, the overall value of Cronbach' alpha (α) is 0.971, whilst for individual house components, projected values are not lower than 0.974 (see Table 2). In short, those constructs were able to measure their intended purpose, and as preliminary evidence that items were closely related as a group and support high reliability. For outlier's test, interquartile range (IQR) is selected as an indication of any extreme value, where an item that is above than 3 of IQR value is considered extreme [56, 57]. From Table 2, it can be observed that there are no evident for an extreme outlier, where deducing any items is not necessary.

Separately, through normality test by using Shapiro-Wilk (S-W), their significant value is considered [58]. Generally, a hypothesis is made towards the results as follows, H^0 = there are no significant of normality, H^1 = there are significant of normality, and reject H^1 if p-value < 0.05. Therefore, based on Table 2, the majority of data are non-normal data (i.e. rejecting H^1). For that reason, subsequent analysis will rely on the non-parametric type of analysis [59].

Afterwards, descriptive analysis was conducted to give an overview of a particular data on numerical values, where mean value was reported as the central tendency. From the descriptive analysis, not all components received similar trends of complaints from the house buyer. The highest mean for house components' complaint is 3.000 (external wall) which signifies slightly often receiving complaints, and the lowest mean is 1.6667 (door frame) which signifies the range from no complaint to very little complaints. Overall tabulation of means according to their components can be found on the similar table (Table 2) as in chapter 4.1.

On the other hand, statistical inference analysis was conducted to draw conclusions regarding the population based on the characteristics of the sample. A series of hypothetical assumptions were made, anchored towards null hypothesis of; "the distribution of control variables is the same across all respondent's category". Before performing the analysis, Chi-Square goodness of fit test has been done in the first place to determine the suitable distribution of control variables (e.g. types of organisation, respondent experience on housing construction and respondent position) to be selected in the inference analysis [60]. Following the analysis, the findings recommend that the types of organisation are appropriate to be further analysed. Thus, the Mann-Whitney U test is executed to compare differences between two control groups [47]. From the analysis, all dependent variables were reported to accept the null hypothesis, except for door knob, which the null hypothesis is rejected due to their significant value (α) is less than 0.05. Therefore, it is concluded that only the perception of complaints' frequency on the door knob is not the same across contractors and developers.

Objective 3 is directed to capture respondents' knowledge on practical ways of assessing generic house components' defects. All respondents (four) are coming from housing construction with the previous record of managing housing construction for more than ten years. Findings from the previous analysis were set as a guideline, where emphasis have been poured onto components that have recorded higher means value. From the structured interviews, data were recorded by using the voice recorder and it was further transcribed into a text format in the NVivo software.

TABLE 3. Summary of Questionnaire Survey Analysis

Respond Rate	Types of Organisation	Years of housing construction experience	Position
Sent = 400, Receive = 41, Completeness = 30 (7.5%)	Contractors (17 = 57%) Developers (13 = 43%)	· 4 years and below = 7 (23%) · 5 years — 9 years = 4 (13%) · 10 years and above = 19 (63%)	· Director = 6 (20%) · Project Manager = 7 (23%) · Contract Manager = 2 (7%) · Construction Manager = 5 (17%) · Site Manager = 1 (3%) · Site Supervisor = 7 (23%) · Engineer = 2 (7%)

Every word is scrutinised for their importance and meaningful substances before coding exercises were taken placed. Coding was based on predetermined nodes, which basically arranged according to house components. Since all interview respondents are comfortable with conversing in the Malay language, therefore the authors suited their preference during the sessions (see Figure 2 for example). However, excerpts from the analysis were conveyed in English as can be found in Table 4 (as findings summary). The result shows that most of the senior construction practitioners proposed several unique and unaware practical ways for defect identification, such as by using torch light, water, and other simple testing methods.

Figure 2. Example of the interview analysis using NVivo, represented by words' cloud (translation: *'lampu'* = lamp; *'lihat'* = see)

TABLE 4. Summary of structured interview analysis

Components	Sub-components	General Sense Perception	Practical ways
Wall	Outer wall	Vision, touch	Use of torchlight / a piece of wood (for surface evenness)
	Inner wall	Vision, touch	Use of torchlight / a piece of wood (for surface evenness)
Roof	Roof cover	Vision	Examine during/after rain (for any leaks)
	Roof gutter	Vision	Examine during/after rain (for any leaks)
	Flashing	Vision	-
	Roof fascia	Vision	-
	Roof eaves	Vision	-
	Overall roof structure	Vision	-
Floor	Floor	Vision, hear	Examine during house cleaning by splashing water (for surface evenness), use of stick (for hollowness)
Staircase	Skirting	Vision	-
	Step and Riser	Vision, touch	Test by walking on it (for ergonomic and comfortability)
	Platform	Vision, touch	Examine during house cleaning by splashing water (for surface evenness), use of stick (for hollowness)
	Handrail	Vision, touch	-
	Baluster	Vision, touch	-
Overall finishes	Paint	Vision, smell	Compare colour with nearby similar house (for inconsistency)
	Rendering work	Vision, touch	Use of torchlight / a piece of wood (for surface evenness)
Window	Window frame	Vision, Touch	Check specification as in sale and purchase contract, test for functionality
	Window railing	Vision, Touch	
	Window hinge	Vision, Touch	
	Window lock	Vision, Touch	
	Glazing	Vision, Touch	
Door	Door frame	Vision, Touch	Check specification as in sale and purchase contract, test for functionality
	Door hinge	Vision, Touch	
	Door knob	Vision, Touch	
	Door panel	Vision, Touch	
Ceiling	Ceiling board	Vision	Use of torchlight (for any inconsistency of surface and colour)
	Frame	Vision	-
Overall fixtures	Piping	Vision, Touch	Check water pressure by opening all the tap, test for functionality
	Electrical	Vision, Touch	Check electric point number as in contract, test for functionality
	Toilet	Vision, Touch	Check water point number as in contract, test for functionality
	Kitchen	Vision, Touch	-

5. DISCUSSION AND CONCLUSION

Overall, the objectives of this paper were achieved through mixed methodology, starting with literature analysis (for the first objective), a questionnaire survey (for the second objective), and a structured interview (for the third objective), respectively. The approach embedded in document analysis is a screening process called 'Multi-layered Thematic Processes', where one of the layers consists of 'sense perception'. Catering for new house owners that do not have any background in construction, it can be concluded that there are several prominent generic house components which most likely were able to be inspected by them during DLP.

Apart, a questionnaire survey that was distributed by using online method towards respective respondents was considered to receive cold responses (although twice attempts were made). However, since the feedback number is reasonably acceptable, it was further analysed by using statistical analysis based on

classical test theory (CTT) with the help of SPSS software. It was found that almost all of the components tend to receive complaints from house buyers during DLP. Walls topped the list, while bottomed with a component of doors (i.e. door frame) by the least recorded mean. Besides, the majority of the components have documented similar feedback from different organisation' clusters (i.e. developers, and contractors).

After that, structured interviews were commenced towards four selected senior construction practitioners based on their experiences and knowledge, in order to accomplish the last objective. Interestingly, the findings revealed that there are several practical ways in assessing defects on house components. In summary, any components that have large vertical surfaces such as walls, their evenness is paramount. The usage of handheld torch light, and or any wood stick which are place onto the wall surfaces are believed to detect unevenness. Similarly, for horizontal surfaces such as floors, water plays an important insight on detecting unevenness.

Due to the fact that reference for house assessment during DLP which is dedicated to house buyers was scarce (at least in Malaysia), findings from the study is deemed beneficial to bridge those gap. Additionally, since an average number of residential property transaction per year is around 100,000 units (and counting) [61], the authors posited that house buyers need to have basic knowledge regarding the pertaining matter, as customers' right is concerned. Moreover, spill over effects might materialise in term of forthcoming scientific research and the practices of housing construction practitioners. Owing to bottom-up approach (house buyers as end user – construction practitioners as the top layer), change is imminent; for house buyers to equip with proper knowledge and construction practitioners with proper practices to streamline their product (i.e. minimising components defects and damages).

In a nutshell, it can be concluded that the findings have fulfilled the knowledge gap by publishing the complete list of generic house components that need to be assessed during DLP, together with their practical ways to be assessed. Nonetheless, further betterment and exploration are certainly necessary for similar research to be flourish. Lest, current results might useful for immediate usage for the convenience of new house buyers, in order for them to assess their new house for the first time appropriately. Within the same vein, the authors provide a very useful yet friendly usage of application based software with a simple user interface (UI), based on Google Android platform as a medium for knowledge management and distribution (see figure 3). Last but certainly not least, a research on the life expectancy of house components are humbly deemed needed to accompany current research to provide the proactive venture after the DLP is ended.

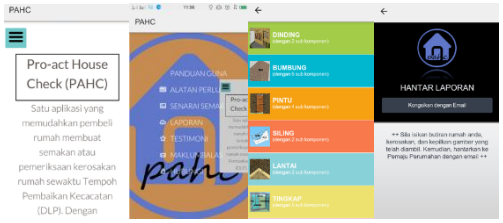

Figure 3. Proposed Android Apps

6. ACKNOWLEDGEMENT

The paper has been sponsored by MARA Japan Industrial Institute of Malaysia (MJII), besides several assistances by the University of Tun Hussein Onn Malaysia (UTHM).

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Investigation of Generic House Components and Their Practical Ways to be Assessed by House Buyers During Defect Liability Period in Malaysia

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P A P E R I N F O

Paper history:
Received 16 May 2016
Received in revised form 04 August 2016
Accepted 27 August 2016

Keywords:
Defect Liability Period
House Components
Practical Ways To Assess
House Buyer

چکیده

خانه های مسکونی تازه ساخته شده در واقع در یک دوره ای دستخوش این مسئله قرار می گیرند که هر گونه نقص در خانه توسط توسعه دهنده خاص مورد اصلاح قرار خواهد گرفت. نقص مسئولیت (DLP) که از روز خالی شدن ملک (VP) توسط صاحبان خانه آغاز می شود، به طور کلی بین هجده (۱۸) ماه و بیست و چهار (۲۴) ماه است. در طول DLP، صاحب جدید خانه حق صدور هر گونه شکایت در مورد کیفیت ساختمان را دارد. متاسفانه، اعتقاد بر این است که در دوران اخیر که در آن سودآوری نگرانی اصلی بسیاری از توسعه دهندگان است، شکایت گسترده شده است. از آنجا که کیفیت محصول نهایی مورد توجه کمی قرار گرفته است، با صاحبان جدید خانه که در مسائل مربوط به نقص خانه کمتر آگاه هستند، وضعیت از بد به تقریبا غافل بودن تبدیل می شود. اضافه کردن نمک به زخم، کمبود در زمینه تحقیق و انتشار دانش به تعطیلی این موضوع تا تقریبا نبود آن می انجامد. بنابراین، پژوهش به تمرکز بر حس ادراک اجزای خانه با دریافت تکرار شکایت و ارائه راه های عملی برای بررسی نقص نمایندگی از صاحبان جدید خانه مربوط می شود. روش مخلوط کردن روش کار تحمیل شده است، که با تجزیه و تحلیل ادبیات، پرسشنامه و مصاحبه ساختاری شروع می شود. جستجوی پرسشنامه ای با استفاده از توزیع آنلاین نسبت به توسعه دهندگان و پیمانکاران در ایالت های جنوبی مالزی، یعنی جوهور، ملاکا، و نگری سمبیلان انجام شد. در همین حال، روش بعدی از طریق مصاحبه با چند تمرین کننده ارشد ساخت و ساز انجام شد. به منظور سهولت فرآیندهای تجزیه و تحلیل، نرم افزار SPSS و NVivo به عنوان نرم افزار اصلی استفاده شد. یافته ها نشان می دهد که، از نظر ادراکات حسی، قطعات خانه از چندین بخش مهم از جمله سقف ها، دیوارها و کف، همراه با خود زیر اجزاء تشکیل شده است. با این حال، تمام اجزا روند مشابه ای از شکایت از خریداران خانه دریافت نکرده است. جالب توجه است، بسیاری از وکیلان ارشد ساخت و ساز چند راه عملی منحصر به فرد را برای شناسایی نقص، مانند استفاده از نور مشعل، آب، و دیگر روش های ساده تست ارائه کرده اند. این تحقیق کمک می کند در آن با نرم افزار مبتنی بر کاربرد به عنوان مدیریت دانش و تلاش توزیع شروع شود، که به اندروید توسط اتحاد و پیوستگی گوگل وصل است.

***doi**: 10.5829/idosi.ije.2016.29.10a.05*