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Comparing the Level of Housing Defects in Sell-Then-Build (STB) and Build-Then-Sell (BTS) Housing

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Abstract: The Build- Then- Sell (BTS) system is a novel implementation of the housing delivery system in Malaysia. The advantage of the BTS system shows in the fact that house buyers may evaluate the house first before they decide to buy it. In this case, developers are compelled to be more professional in providing quality house as housing defects are able to be eliminated. However, there is a lack of empirical study done on whether the new system (BTS) has lower defects than the conventional Sell Then Build (STB) system. Thus, the aim of this paper is to compare the defects level in the STB and BTS housing. The fifteen (15) building elements namely: roof; external and internal doors; windows; external and internal floor; ceiling; stairs; external and internal wall; sanitary equipment; electricity installation; water service; plumbing facilities and drainage were used to measure the defects. The result for the Independent t-test has revealed that the defects mean score in the STB is higher than in BTS system. However, only a significant difference of defects in the STB and BTS housing has been observed in the aspect of external and internal walls. The result implies that the STB housing would be of the same quality as the BTS housing if some effort is made to improve the external and internal walls of the STB housing.

Key words: Housing delivery system · Housing defects · Defects index · Housing quality · Housing development

INTRODUCTION

The most important, or probably most accurately fundamental function of a house is to provide shelter. It also provides a living space for families [1]. As such, it offers protection to people from bad weather and danger, of any forms. It is also a place where people live their lives, keep their belongings and rest after work or school. Because of these basic needs, people are willing to spend a considerable sum of their money to buy or rent a house. When it comes to occupying a house, whether purchased or rented, one may view that defects are unavoidable in a housing construction [2], but the fact remains that a house with full of defects will have negative impact on the occupiers. Consequently, defects may cause hardship in terms of physical or mental health to the occupiers, and even result in the house not deemed safe to live in.

In Malaysia, the conventional delivery system of Sell then Build (STB) is argued to contribute to defects as houses are sold before their completion [3]. The STB system allows developers to sell houses and collect progress payments while houses are being constructed and as such, the selling is made when the unit is not yet fit for habitation [3]. The STB system is more common in Asian countries such as Hong Kong, Indonesia and Malaysia. Chau *et al*. [2007] exert that it is not surprising for a dwelling in Hong Kong to be completely sold although the construction has not yet started [4]. Similarly in their review of housing delivery system in Malaysia, Yusof *et al*. [2007] reveal that the STB system is widely implemented since the early of 1980s, when more roles were given to the private developers through mass housing production to help to overcome the problem of housing backlog [5]. Although the developers claim that the STB system has been successful in achieving the housing target, the system is argued to cause other problems as well [3]. A typical Sale and Purchase (S&P) agreement signed between developers and house buyers which requires that the developer adheres to good, fair construction standards, seems to have had little impact on the actual quality of completed houses [6]. There are many possible causes for the defects, however, where the characteristics of STB system which are based on the forward- selling delivery system, has encouraged what

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Chau *et al.* [2007] have coined as a moral hazard problem [4]. According to Chau *et al.* [2007] moral hazard problem arises because there are fewer incentives for the developers to provide quality houses since the houses have already been paid for although they are not yet built [4]. This opinion is also shared by Ong [1997] who argue that pre-completion selling introduces disincentives to developers to provide optimal level of effort of building quality housing [2]. Moreover the STB system is argued to result in less monitoring effort in each housing project because the developers have received payment for the incomplete houses [6]. The use of model house by some developers to give an indication to house buyers of how the actual house would look like when completed has often been a poor indicator of the quality of actual unit purchased and built [7]. The House Buyers Association laments that the quality of the workmanship, the finish, and the fittings provided in the completed housing units often differ from those set in the show unit [7].

In an attempt to address the above problems, in April 2007 the Malaysian government had introduced a new housing delivery system, popularly known as the Build Then Sell (BTS) [3]. The new BTS system will run in parallel with the conventional system STB for a trial period of two years. The proposed solution is a move towards a system that allows houses to be sold only after completion and aims to promote better quality housing and to provide greater protection for house buyers [6]. There are two models of BTS system; first is the 100 percent BTS and second, is the 10:90 BTS model. In the 100 percent BTS, houses are sold only after the construction is completed and a Certificate of Completion and Compliance (CCC) is issued [8]. Contrary to this, in the 10:90 model, house buyers must pay a deposit of 10 percent upon signing their S&P agreement, with the remaining 90 percent payable upon completion of the house and the issuance of a CCC [9]. The 10 percent deposit will be temporarily held by the developer's lawyer and it is further protected by means of the Fidelity Fund pursuant to the Legal Practice Act [5]. The major advantage of the new BTS system is that the potential house buyers may view the house first before they decide to buy the house. If the house has lower quality than expected, these potential buyers may refuse to buy the house. Proponents of the BTS system argue that the new system will increase housing developers' motivational level to provide quality houses with less or zero-defect [10]. In addition, it is argued that the new BTS system will encourage housing developers to be more cautious about the project's completion time, to be better organized and to improve their working practices [8]. The BTS system has been the norm in the developed countries such as Australia, United Kingdom, Netherland and the United States of America. However, this system is still a foreign idea and uncommon in some Asian cities especially in Malaysia, Indonesia, Singapore and Hong Kong.

However it is still debatable whether the practice of BTS can result in houses that are less or free from defects. According to Sufian and Ab. Rahman [2008] many authors and practitioners alike seem to accept the argument that BTS will result in better quality housing [11]. Nevertheless there is a lack of empirical studies to prove the argument. Ong [1997] has developed a model of effort aversion in an attempt to explain defects in housing development [2]. But no data have been presented, indicating that it would bring little value to the present study. The work done by Malaysian authors; Mohd Fauzi *et al.* [2009] and Yusof *et al.* [2010b] do not provide any clue on the issue either [10, 8]. In Hong Kong, Chau *et al.* [2007] have worked on utilized sales data of the real estate market to explain that despite the housing quality problem, forward sales houses are still popular among house buyers in Hong Kong [4]. They found that even though housing quality was not observable during presales, house buyers were able to capitalize on developers' reputations that the house prices are paid without fail. Nevertheless, their study does not give any indication on the level of defects of the forward sale houses.

Based on the above background, in order to fill in the gap, this paper aims to compare the level of defects in STB and BTS housing delivery systems. Thus, the contribution of this paper works in three sections. Firstly, it compares the two systems in a context which has not been examined by previous studies. In particular it identifies empirically whether the BTS housing system results in less defects in the housing development by comparing the level of defects in the STB and the new BTS systems. This comparison is vital to prove whether the BTS is a better system than the STB. Secondly, it applies Pedro's [2008] Defects Index Method in a context of housing in tropical climate (that is Malaysia) that has not been covered by previous researchers [12]. Specifically DI method with five scales of defects' severity is applied on the fifteen building elements of housing units in Penang, Malaysia which adopt either the STB or BTS system to measure the defects level. Thirdly, in terms of its practical contribution, the findings of the present study may serve as a guideline to the policy maker before deciding to make the BTS system compulsory to all housing developers. The findings may provide evidence to boost the confidence of housing developers to embark into the BTS system. The findings will also help the house buyers to make informed decision on which system delivers better housing.

The organisation of the paper is as follow. Firstly, this paper will provide the definitions of the BTS and STB systems and housing defects, followed by a discussion on how does the housing delivery system relate to housing defects. Secondly it will review the method in measuring defects and identify the building elements to be used in the measurement. At the end of the paper, the results and some discussions of their implication to the housing industry will be presented.

Defects in Housing: A defect can be defined as a failure in appearance, performance or function of structure, services and other facilities in a building [13]. According to Olubodun [2000], defect is to be expected when there is complaint about the condition of the building [14]. Karim *et al.* [2006] seem to suggest that a defect is an outcome of a work which does not fit in with the contractual documents [15]. In this study, defect is defined as a failure in appearance; performance and function of building elements that impairs the house's value and prevents the building from being perfect to the would-be buyers.

As discussed in Chong and Low's [2005] study, defect might appear in the construction stage as well as the occupancy stage [16]. However in this study, we will only place our concern on the defects appearing in the occupancy stage. A report provided by Members of Homeowner Against Deficient Dwelling (HADD) [2004], shows that the most common defects in new home construction is the foundation (which affect doors, windows, wall and floor), concrete (affecting the floor), windows, paint, roof, plumbing (impact on the toilets, shower, sink, drain, wall and floor), doors, structural (which affect floor, wall and roof) and electrical aspect of the house [17]. This list of defects is compiled from the homeowners, reviews of news articles and complaints by several agencies [17].

The defects will occur over time through the effects of climate, usage, and wear and tear [18]. However, the defect is not an exception to a newly- built house. For example, in the case of houses in the UK, a large number of defects can be found in the newly-built houses and this has dissatisfied the house buyers [19]. Nevertheless the degree of the defects and their frequency for each building are not the same. Chong and Low [2005] study the comparable defects in construction and occupancy stages and learn that the floor defect is the most prominent element [16]. It is due to the poor workmanship, use of material quality as well as the fact that developers tend to rush in completing the job. The most frequent floor defects that occur at occupancy stage are cracks, water seepage, delaminated tiles, unevenness, stains, hollowness, discolored tiles, efflorescence and chip off. On the other hand, Olubodun and Mole [1999] have found that, wall cracks are the most frequent defect followed by dampness in solid floor, condensation, slab failure and rot problem [20].

Intervention from industrial practitioners and workers practice may slow down the process of defects. However there are cases where the practitioners themselves may be the one who have committed the defects. In a study by Sufian and Ab Rahman [2008] twenty six house buyers' complaints on the quality workmanship of the workers and the failure of the practitioners to detect them during construction are received [11]. The complaints are about the asbestos ceilings that are not installed, the water PCC vent with only one layer instead of the required two layers, roof rafter of various sizes and the fact that they are not made from the required hardwood. According to the researchers, all of the problems above occur because developers are not following the specification in the approved plan [11]. This problems are in support of Yusof *et al.* [2007] study which states that one of the severe problems in the STB system is that the construction of the houses does not follow the specification [5].

Measuring Defects: Basically, there are two ways in measuring housing defects which are in terms of frequency and severity as noted in Johnsson and Meiling's [2009] study [21]. Firstly, defects can be measured in terms of frequency e.g. how many defects are present in a house. However it is hard to measure the frequency of defects as Sommerville [2007] stresses that, there is no standard way to express defects as it varies from one to another [22]. For example, there is double line crack on a wall with different lengths- therefore, do we perceive them as one defect or two? On the other hand, Straub [2009] suggests that if the building components show more that one defect, the condition should be calculated using the "defects score" [23]. Secondly, defects can be measured in terms of the severity. Severity of defects is an important consideration when discussing the issue of defects [24]. Pedro [2008] believes that the effects of defects on the functional condition, type of repairs and the degree of repairs needed are all related to the severity of defects [12]. This is supported by Johnsson and Meiling [2009] who assert that the severity of defects is related to not only the type of defects, but also the cost in correcting it [21].

Georgiou *et al.* [1999] and Stephenson *et al.* [2002] classify the severity of defects into major and minor severity [24, 25], whereas Pedro [2008] extends this further by segregating the defects into critical, severe, medium, slight and minor [12]. Major or critical defects can be defined when the elements fail to operate and cannot be used for their intended purpose [25], also endanger health or safety, and may cause major accidents other than requiring complex repair [12]. Minor defect is more aesthetic. Minor and slight defects may cause slight problems to the occupiers [25] and only require simple repairs [12].

In order to measure and compare the level of defects, this study will utilize the Defects Index (DI) method. This method measures defects by points based on the severity of defects. A scale will be used to know the condition of a building. A study by Pedro [2008] in discussing the DI method, has found that the method is adequate to measure the housing condition compared to the traditional method, which is too simple that it fails to meet the objective in assessing the building conditions [12]. The defects scores are based on the severity of defects occurring in the house. The explanation for each severity is as stated in Table 1.

Then there is also a question of what to measure. As stated by Josephson and Hammarlund [1999], it is essential to have knowledge about where the defects occur, in order to concentrate on where the improvement measures are most impressive [26]. In this case, the measurement can be done by compartmentalising the house e.g. kitchen, living room, bedroom, bathroom, balcony, entry and laundry as suggested in Karim *et al.* [2006]'s study [15]. However, if the measurement is by space or compartment, it will have an exhaustive checklist of defects and the element such as floor or wall is repeated, as done in Frey *et al.* [2007]'s study [27]. Although it will provide more detailed results, the occupiers as the respondent might feel inconvenient at having to supply the details for literally, every inch of the house [28]. In order to address this issue, we follow the suggestion of Chong and Low [2006] and Oladapo [2006], to measure defects by building elements rather than by housing compartments [29, 30].

Building elements can be defined as the representative units which is part of the whole building [31]. Aygun [2003] in his study classifies building elements into functional elements (for example floor and wall), the structural system (for example beam and foundation) and service system (mechanical and electrical) [32]. While in Pedro's [2008] study, he organizes the building elements into three groups namely the building as a whole, the shared parts and the unit [12]. This study makes close reference to Pedro [2008], but only the building as a whole and the units are brought to light, as the shared parts is only for the high rise building and this study only focuses on land properties [12]. There are a number of advantages where measuring the defects by elements is concerned. Firstly, it is more comprehensive as each of the important elements in the building is evaluated by the occupiers themselves [12] and secondly the researcher may identify which elements have high level defects [14] and correcting can then be focused to the elements.

The selection of building elements is based on the importance of the building elements to the occupiers. Apart from the building elements identified by Pedro [2008], we add plumbing facilities and drainage system, which are important in the context of tropical housing [12]. In total, fifteen building elements have been selected namely roof; internal and external floor; internal and external wall; internal and external doors; windows; ceiling; stairs; electricity service; plumbing facilities; sanitary equipment; water supply and drainage. Table 2 presents all the building elements manipulated in this study and their sources.

Table 1: Explanation for each defect score

Minor Defects	No defects or defects without noteworthy
Slight Defects	Defects that affect the aesthetic value
Medium Defects	Defects that affect the aesthetic value and use or comfort
Severe Defects	Defects that affect the use or comfort and endanger health or safety and may cause Minor accidents
Critical Defects	Defects that endanger health or safety and may cause major accidents

Source: Pedro (2008, p.329)

Table 2: Building elements used in this study and their sources

Building element	Author (s) Source
1. Roof	[11-12]; [29-30]; [33]
2. External Wall	[12]; [29-30]; [34-35]
3. Windows	[12]; [29-30]; [34-35]
4. External doors	[29]; [12]; [34]; [30]; [35]
5. External floor	[11-12]; [29-30]; [33]
6. Ceiling	[11-12]; [29-30]
7. Stairs	[12]; [34]
8. Internal Wall	[12]; [29-30]; [34-35]
9. Internal Doors	[12]; [29-30]; [34-35]
10. Internal Floor	[11-12]; [29-30]; [33];
11. Sanitary equipment	[12]; [29]
12. Electricity services	[29-30]; [35]
13. Water supply	[12]; [35]
14. Plumbing facilities	[29-30]; [35]
15. Drainage	[30]; [35]

Research Method: A questionnaire survey is used as a data collection mechanism and the respondents for this study are naturally, the occupiers of houses in both housing schemes. The rational of appointing the occupiers of the houses as respondents is because they are the best first-hand informer for the conditions of their houses in the post- occupancy stage. The choice of such respondents is also decided, considering their experiences as users and their perceptions that will add value to the house [36]. The occupiers of both housing schemes are approached personally by the researcher so that any doubt about the question can be clarified. Moreover, the questionnaire can be collected within a short period of time.

The questionnaire is divided into two sections. Section 1 asks for the respondents' identification and section 2 enquires on the housing defects. Section 1 consists of eight (8) questions asking about the respondents' background. Section 2 has fifteen (15) questions dealing with the defects level on the 15 building elements as previously identified. These building elements were adopted from previous studies. Adopting the Defects Index (DI) method by Pedro [2008], the five scales of defects severity: 1= minor; 2= slight; 3= medium; 4= severe and 5= critical were used to measure the defects in one element to another [12]. Based on the above discussion, a conceptual framework which describes this study is presented in Figure 1.

In order to effectively compare the STB and BTS systems and thus to avoid biasness, two criteria have been recognized in selecting the developers; (1) developers must have implemented both systems; (2) the STB and BTS projects are developed within one housing scheme. The BTS system is, as we have been reminded before, still new in Malaysia. Therefore, there is still no record of developers who implement this system. Because of this reason, the authors have to rely on the media such as newspapers, banners or brochures as to identify and be familiar with the nature of these BTS projects. Three housing projects were been identified to develop both the STB and BTS systems in one housing scheme; to ensure the anonymity of the developers and housing projects, we have named the three projects as Queen Park (Penang), Seri Luxury Park (Penang) and Harmony Country Homes (Kedah). However, the management in Queen Park have refused to cooperate while in Harmony Country Homes, the houses have just been completed and the buyers have yet to move in. Hence, the data can be obtained only in Seri Luxury Park (SLP).

The SLP housing scheme is located in Batu Maung, Penang. It consists of 108 unit houses whereby 60 units are built according to the STB and remaining 48 units are built according to the BTS housing delivery system. Both projects are developed by the same developer. This developer is well- established and active in developing land and high- rise properties. Hundred percent (100%) sampling is used in this study. This type of sampling is deemed appropriate as the population is small.

In this study, a self-administered questionnaire is used as data collection tools. The advantage of a self-administered or personally administered questionnaire is that any doubt about the question can be raised and clarified. Moreover, the questionnaire can be collected within a short period of time [37]. In this study, following Neuman [2000] the questionnaire is given directly to the respondents [38]. The doorstep technique was applied in doing this survey, where smiling and being brief in

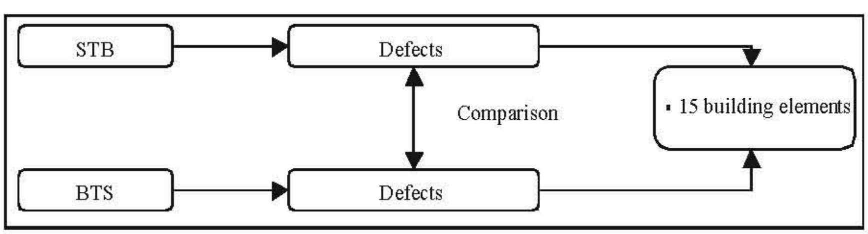

Fig. 1: Conceptual framework

informing the respondents the purpose of the author's presence are the technique's main characteristics. Then, they were briefed about the content of the questionnaire and purpose of this study. The respondents also were told that the questionnaires will be left with them for awhile as suggested by Islam [2008] in order to give room to the respondents to answer the questionnaire and that it would be collected later [39]. The survey was done during the weekends, from morning until the evening as an effort to gain a high response rate because at this time the respondents were most readily available.

The data were analysed using a descriptive statistics to describe the characteristics of the sample and to compute the mean score in measuring the defect level of the STB and BTS systems. Descriptive statistics is also essential prior to doing statistical analyses such as the t-test [40]. It is to check whether the data have met the assumption for the statistical technique that the authors intend to use. An independent sample t-test is used to compare the mean score on some continuous variables [40] and to check if there are any significant differences in the mean scores for all elements in both the housing delivery systems [37, 40].

RESULTS AND DISCUSSION

Out of 60 units of the STB houses, only 34 units can be included in the study because the remaining units are either under renovation or yet to be occupied. From the 34 STB houses, only 16 responses are received, making the response rate 67%. The missing respondents were either not at home while the survey was being distributed or they had simply refused to answer the questionnaires. Similarly with regards to the BTS houses, out of 48 houses which are developed using the system, only 29 units can be included in this study. From the 29 houses, only 16 responses had been received making the response rate 55%. Table 3 shows the portion of respondents in both systems.

In the SLP residence, 66% male and 34% females had taken part in this survey. The occupiers in SLP consist of various ethnic groups. The composition of the ethnic was 91% Chinese, 6.3% Indian and 3.1% Malay. The majority of the respondents are 30 to 39 years old that is 31.3%, followed by the age group of 18 to 29 years old (28.1%). Respondents above 50 years old constitute the lowest percentage (15.6%) from the population. In the category of the respondents' education level, 41% of them have finished secondary school level, 25% have obtained their master's degree, followed by 13% graduate with the diploma and bachelor's degree. The remaining 6.3% have finished the primary school. From the 32 responses received, 69% of them are the owners and the remaining 31% are the tenants. The majority of respondents (65.6%) have lived in SLP within 1 year followed by the period range within 1 to 2 years (28%). Only 6.3% have lived there for 3 years.

Table 3: Portion of Respondents in STB and BTS houses

	STB Scheme		BTS Scheme	
Respondents'	Units	Percentage	Units	Percentage
Population	60	100%	48	100%
Response	16	27%	16	33%
Refusal	14	23%	9	19%
Renovating	1	2%	7	15%
Not occupied yet	8	13%	10	21%
Not at home	14	23%	4	8%
Foreigner	7	12%	2	4%

Firstly, we conducted a reliability test to ensure that all the elements used are stable and consistent in measuring the defects. The result of the reliability test showed that the cronbach alpha value for all 15 elements is .899 which is above .7. This goes on to show that the scale is considered reliable for the sample [39, 40].

After that, the mean scores for both defects in the STB and BTS systems were calculated using the descriptive statistics in the SPSS software. The mean score is used to rate the defects for the building elements. Descriptions below exhibit how this study rates the defects based on the mean score.

- If the defects mean score is below 1.49, then the defects are considered minor.
- If the defects mean score is between 1.50 and 2.49, then the defects are considered slight
- If the defects mean score is between 2.50 and 3.49, then the defects are considered medium
- If the defects mean score is between 3.50 and 4.49, then the defects are considered severe
- If the defects mean score is between 4.50 and 5.00, then the defects are considered critical

Table 4 then summarizes the frequency of defects in five scales, mean score and rate of defects for both housing delivery systems.

Results from the descriptive statistics in Table 4 show that in general, the mean score has pointed out that the defects' level for both STB and BTS systems range from minor to slight defects; indicating that the defects only affect the aesthetic value of the building. However, for all housing elements, the mean score for the STB system is higher than the BTS except for the water

Table 4: Summary of defects' distributions for both housing delivery systems (STB & BTS)

	Evaluation term								
Building elements	MI	SL	ME	SE	CR	Mean STB	Mean BTS	Rate of Defects STB	Rate of Defects BTS
1. Roof	25	4	3	0	0	1.50	1.13	SL	MI
2. External wall	20	4	8	0	0	1.94	1.31	SL	MI
3. Windows	25	5	2	0	0	1.44	1.13	MI	MI
4. External doors	23	6	3	0	0	1.44	1.31	MI	MI
5. External floor	23	6	3	0	0	1.44	1.31	MI	MI
6. Ceiling	25	3	3	0	1	1.56	1.25	SL	MI
7. Stairs	29	1	2	0	0	1.19	1.13	MI	SL
8. Internal wall	19	6	4	2	1	2.31	1.19	SL	MI
9. Internal doors	18	8	4	2	0	1.88	1.50	SL	MI
10. Internal floor	25	3	3	1	0	1.63	1.13	SL	MI
11. Sanitary equipment	18	6	7	1	0	1.94	1.50	SL	SL
12. Electricity installation	22	6	3	0	1	1.75	1.25	SL	MI
13. Water service	24	2	5	0	1	1.50	1.50	SL	SL
14. Plumbing facilities	25	1	3	3	0	1.75	1.25	SL	MI
15. Drainage	24	3	3	1	1	1.63	1.38	SL	MI

Notes: MI - Minor; SL - Slight; ME - Medium; SE - Severe; CR – Critical

Table 5: T-test Result to compare STB & BTS

Building Elements	F	Sig.	t	df	sig. (2-tailed)	Mean Difference	Std. Error Difference
Roof	15.411	.000	1.695	20.094	.106	.375	.221
External wall	18.855	.000	2.145	24.643	.042	.625	.291
Windows	11.230	.002	1.555	21.308	.135	.313	.201
External doors	1.040	.316	.530	30	.600	.125	.236
External floor	1.040	.316	.530	30	.600	.125	.236
Ceiling	.976	.331	.969	30	.340	.313	.322
Stairs	.378	.544	.338	30	.737	.063	.185
Internal wall	11.757	.002	3.301	20.483	.003	1.125	.341
Internal doors	2.069	.161	1.145	30	.261	.375	.328
Internal floor	10.470	.003	1.852	22.615	.077	.500	.270
Sanitary equipment	.641	.430	1.357	30	.185	.438	.322
Electricity installation	4.608	.040	1.581	22.383	.128	.500	.316
Water service	.000	1.000	.000	30	1.000	.000	.354
Plumbing facilities	8.528	.007	1.414	23.356	.170	.500	.354
Drainage	.253	.619	.690	30	.495	.250	.362
Total score	7.193	.012	2.025	21.106	0.56	5.625	2.778

services where the mean score is the same. This indicates that, other than the water services, the defects level in houses built according to the STB system is high compared to houses built according to the BTS system. Most building elements in the STB-type houses are rated as having slight defect (which affects the aesthetic value of the house) except for the windows, external doors, external floor and stairs which are rated as minor (no defects or defects without noteworthy) compared to the BTS where most building elements tend to record minor defects. Based on the mean score, the highest defects have reportedly been seen at the internal wall followed by the external wall and sanitary equipment of the STB system.

The result for the STB system is in contrast with the BTS system that almost of the elements in the BTS system are rated as minor defects except for the water service, stairs and sanitary equipment which were rated as slight defects. The highest level of defects in the BTS system has been observed at the internal doors, sanitary equipment and water service with the mean score of 1.5 respectively but they are still among the lowest if compared to defect levels in STB houses.

The independent sample t-test was then conducted to identify which elements significantly influence the defect levels of the STB and BTS systems. The value in Sig. (2-tailed) column for total score shows a significant level at .56 that is higher than .05 indicating that in general there is no significant difference between STB and BTS systems. However, the value in Sig. (2-tailed) column for external and internal wall is lower than .05 that is .042 (external wall) and .003 (internal wall) indicating that the difference is significant for the two elements. Meanwhile, for others elements, there is no significant difference between the STB and BTS housing delivery systems. It can be concluded that these two elements (internal and external wall) significantly influence the defects level of the housing system. This implies that if we improve the external and internal walls, the defects in the STB system might be improved and could be the same level as BTS. The summary of the t-test result is showed in Table 5.

CONCLUSION

This paper has attempted to contribute to the new knowledge of the effectiveness of the build first and selling later system (better known as the Build Then Sell system in Malaysia) as compared to the forward selling system (or the Sell Then Build system). By comparing the level of defects in both housing delivery systems, it extends the debate as to which housing delivery system is the best in providing houses that are less or free from defects. The second major contribution of this paper lies in furthering the use of the DI method proposed by Pedro [2008] to the context of tropical housing [12]. The five scales of defects utilized in Pedro's [2008] study is adopted to analyse the level of defects that appear in the occupancy stage in both STB and BTS housing delivery systems [12]. Fifteen (15) important housing elements have been chosen to be assessed using the scale. The fifteen (15) important housing elements are: roof; external and internal doors; windows; external and internal floor; ceiling; stairs; external and internal wall; sanitary equipment; electricity service and water service; plumbing facilities and drainage.

The findings indicate that the defects level is higher in the STB compared to the BTS system for all elements except for the water service where the mean score is the same. The same level of defects obtained for the water service might be due to the fact that both STB and BTS in SLP residence use the same source of water. The findings which show that higher amount of defect appears in STB houses compared to BTS houses support the arguments of Ong [1997] and Chau *et al.* [2007] that pre-selling delivery system would lead towards less quality housing [2, 4]. Although the defects show higher score in the STB approach, only external and internal walls exhibit significant difference of defects level. This implies that if we improve the external and internal walls, the quality of STB houses could be the same as BTS houses.

The study has some notable limitations which warrant further improvement. Because there are limited projects that fulfill the research criteria at the time we carry out the study, and not all developers are willing to participate, we are only able to compare one project which develops both STB and BTS systems. For future studies, a good recommendation would be to cover other areas or states especially in the major cities where there is a possibility to have more BTS projects in addition to the STB ones, so that clear distinction can be seen in terms of defects level between the STB and BTS systems. Our study has leant on information gathered from the perspectives of occupiers. Other methods which collect data from the professional points of view may add interesting comparison as to the quality of the sell- after-completion delivery system than the forward- selling system that has long been adopted by developers all over the country.

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