

# The Divergent Dwelling Design (D3) Concept for Low Income Group Housing in Klang Valley Region

Ihfasuziella Ibrahim,  
Construction Research Institute of Malaysia (CREAM)  
(email:ihfasuziella@cidb.gov.my)  
Ir. Dr. Zuhairi Abd.Hamid,  
Construction Research Institute of Malaysia (CREAM)  
(email:zuhairi@cidb.gov.my)  
Maria Zura Mohd Zain  
Construction Research Institute of Malaysia (CREAM)  
(email:maria@cidb.gov.my)  
Natasha Dzulkalnine  
Construction Research Institute of Malaysia (CREAM)  
(email:natasha@cidb.gov.my)  
Intan Diyana Musa  
Construction Research Institute of Malaysia (CREAM)  
(email:intan.diyana@cream.my)  
Jung Wai Hooi  
(email:axxuhoi@axialdesignworks.com)

## Abstract

Housing has been recognised as an important development tool for restructuring a society and eradicating poverty. Beside the challenge on the number of units to build, construction speed, cost effective and sustainable design are the key words in order to make the construction projects successful. The construction methodology must be innovative and effective to bring down the total construction cost and shorten the construction time. By using the multifunctional concept, the mass housing through the repetitive procedure and building components could optimal the scale of economy and number. Design, in other hand should be in focus to provide a flexible, sustainable and well-being consideration but not scarify due to low cost orientation mind-set. The paper focus on requirement of quality housing satisfaction in low income group in Klang Valley region. The data was analyse using SPSS software. To come out with the quality housing matters, the convergent design system D3 (Divergent Dwelling Design) was proposed as a new approach reverse from convergent design like existing industry practice, is found to be a better cost, time and design effective; The convergent design system implies to extreme compartmentalization and dissociation of internal elements, where service space are plugged internally in a house, interlocking with its space fundamentally, the layout can change in time followed by the change of family structure and needs. D3 design fits to vary financial scheme like rent to own because all the components that build up the unit could be renewed and re-arranged. It is an integrated design together with construction solutions that should be adopted in the future housing design in the country.

**Keywords:** Quality housing, Divergent Dwelling Design (D3), Industrialized Building System (IBS), construction, vernacular design

## 1. Introduction

Typical design high-rise unit in Malaysia mostly criticized for their lack of storage area, small size and deep location of the kitchen, complicated partitions, less cross ventilation, inhabitable and small bedroom etc. At the launch of the National Housing Policy 2018-2025 in January 2019, the new National Housing Policy has outlined five focuses, 16 strategies and 57 action plans. The five focuses include improving accessibility and affordability; quality housing for all; cohesive neighbourhood; improving coordination between housing development and transportation; and strengthening institutional capability for the National Housing Policy. The use of industrialized building systems (IBS) has the potential to eliminate building site inconveniences, reducing the lapsed time and cost of construction, and contributing to an end product that conforms to the same standards and codes as site-built housing (Hullibarger, 2001). In some housing developments, industrial approaches to construction coupled with value engineering, were found to help reduce cost by about 30% and delivery times by up to 50% (MGI, 2014). According to Adam (1984), housing satisfaction is recognized as an important component of home owners' general quality of life. Moreover, the degree to which home owners' needs and aspirations are met by their housing conditions is a concern for housing developers. Besides that, measures of housing satisfaction offer necessary information to appraise the performance and achievement of the current and future housing projects (Preiser 1989, Natham 1995).

## 2. The Quality of Life Housing

The concept of lifestyle has been the subject of interest in housing research. The emergence-of lifestyle living environment can be seen in many real estate developments particularly in urban neighborhood.

The Department of Economic Planning Unit (1999) defines quality of life as, "Self-development, healthy lifestyles, access and freedom to pursue knowledge and standard of living beyond basic needs individual and psychological needs, to accomplish the level of social welfare equivalent with national aspirations". Nurizan (1998) highlighted that quality of life in the early stages has been measured through the development of social-economy and is followed by education, health, housing and other common facilities.

### 2.1 The Indicators for Quality of Life

Home comfort and the level of satisfaction upon the physical elements used as an indicator of quality of life which are the physical design elements and the physical environment elements. Housing satisfaction is an important component to achieve good quality of life. A household's housing satisfaction is a major factor affecting the feeling of general well-being (Campbell, C. et.al, 1976; White & Schollaert, 1993) and an indicator of quality of life (Wish, 1986). According to the Economic Planning Unit (1999), quality of life refers to the changes in the community and social system from the unsatisfactory situation to a satisfactory situation. A typical new design specification that were introduced by the Ministry of Housing and Local Government to be implemented for all building houses is tabulated in Table 3. Good quality houses very important and can give a higher quality of life for the occupants. A house that cannot fulfill the needs and values of families can cause problems such as mental and physical problems, environmental pollution, congestion, and various family problems. Nurizan,1998).

*Table 1: New Design Specification*

<i>Elements</i>	<i>Residential buildings</i>
Bedroom Minimum number and minimum area of habitable room	
1 <sup>st</sup> Room	11 m <sup>2</sup>
2 <sup>nd</sup> Room	9.3

3 <sup>rd</sup> Room	6.5
kitchen	4.5
Living and dining room	Provided as one combined space or separated with adequate area according to the internal layout
Toilet	2.0
Drying area	Adequate provision for each unit.

Sources : Uniforms Building by Laws (2013)

## 2.2 Design of Lifestyle Housing

Over the years, there were tremendous changes in the housing image in Malaysia from the simple living to more modern integrated townships today. In line with the rise in the living standards, people now demand "an environment or high quality that conveys a sense of well-being and satisfaction to its population through characteristics that may be physical (housing style and condition, gated and guarded environment, landscaping and available facilities such as clubhouse), social (friendliness of neighbours. ethnic, racial. or economic composition), or symbolic (sense of identity, prestige values, etc.) (Lansing and Marans, 1969). Studies show that residents of mass housing in Malaysia are generally not satisfied with their housing conditions, in terms of construction activities, materials used, aesthetic value, amenities, and so on (Karim, 2012; Isnin et al., 2012). Most of them end up renovating houses to tailor-suit their needs before occupancy (Rostam et al., 2012; Nurdalila, 2012; Erdayu et al., 2010). This is largely due to the nature of the current mass housing architectural strategy, namely the convergent design system which is a "one its all" design initiative where housing is likely to be designed around the capability of a given product, instead of around the end-user (Zuhairi et al., 2015).

Thus, houses designed for the average family are deficient in meeting the mass housing sustainability objectives as they are leading to further compromise the occupant's needs. Besides, the convergent design system implies extreme compartmentalization and dissociation of internal elements, where service spaces such as the kitchen, bathroom, and so on, are built internally by interlocking with space, making the service spaces difficult to interchange (Zuhairi et al., 2015). The concept of lifestyle housing development was first introduced in Malaysia way back in early 1990's where the first gated and guarded community and master plan township developments are seen in Malaysia's property development landscape. In line with the changes of house buyers' preferences and their demand for lifestyle fulfilment, there was an evolution of the types of products being offered by the property developers over the years in the context of major cities in Malaysia. The design and materials used for traditional Malay house are highly influenced by socioeconomic, cultural and environmental needs. Most of the material used is readily available locally such as timber, bamboo and palm (Kamal, 2004). The traditional Malay house is almost near to perfection due to its unique design, multifunctional use of space, building temperature control, and the flexibility of extending the house with growing number of family members. That's the reasons why today the styles of the Malay vernacular architecture have inspired many young architects in designing Malaysia's contemporary houses that comprises the merits of the Malay vernacular and western designs (Lim, 2009).

## 3.0 Methodology

The method of this study using SPSS software to analyse the data. The survey was conducted of 600 residences of low-income cost housing in Klang Valley. The questionnaire is distributed by face interview to fourteen (14) PPR residents in Klang Valley including PPR Bukit Jalil I, PPR Bukit Jalil II, PPR Cochrane, PPR Intan Baiduri, PPR Kerinchi, PPR Kg. Baru Air Panas, PPR Kg. Batu Muda, PPR Kg. Muhibbah, PPR Lembah Subang, PPR Pantai Ria, PPR Permai, PPR Serendah, PPR Seri Semarak dan PPR Taman Wahyu. Klang Valley region including Wilayah Persekutuan Kuala Lumpur and Selangor. The data was conducted in 2 months. The Cronbach alpha for this study is 0.898 as shown in [figure...](#) The alpha coefficient for the four items is .898, suggesting that the items have

relatively high internal consistency. (Note that a reliability coefficient of .70 or higher is considered “acceptable” in most social science research situations.).

*Table 2: Cronbach alpha analysis*

Reliability Statistics	
Cronbach's Alpha	N of Items
.898	78

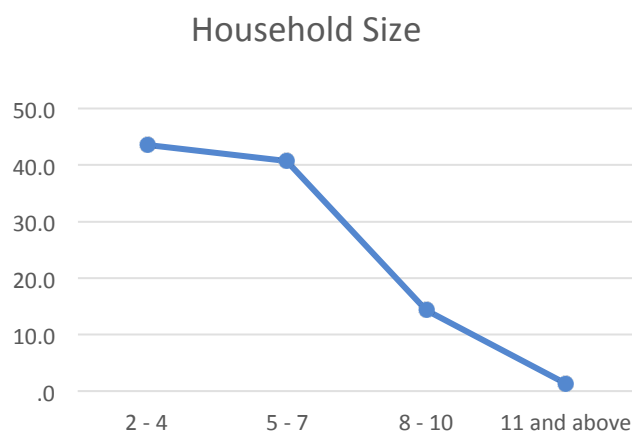
#### 4.0 Result and Discussion

According to Human Rights Commission of Malaysia in 2013 was criticised that the Malaysian government only carried out official planning and implementation of the low-cost housing schemes for the poor but failed to address the issues related to habitability, suitability, defects and shoddy workmanship, lack of maintenance and physical safety of the occupants. Therefore, the aim of this study is to get feedback and perception of users on existing condition and their “wish list” for quality home.

Quality is a measure of the extent to which customer (low-cost housing owners/ tenants/users) requirements and expectations are satisfied. The three (3) prominent quality management by Deming, Juran and Crosby, agreed that quality means meeting customer requirements and that increased productivity is the result of quality improvement (Bauer, et al., 2002). The survey objective is to study the influence of residential satisfaction. The summary of number of respondents in the questionnaire survey was presented in Table 3. Majority of the respondents have household size of from 2 to 4, with mean of 1.74 (see Figure 1).

*Table 3: Total number respondents in the survey*

Race	Number
Malay	326
Chinese	108
India	156
Others	10
<b>Total</b>	<b>600</b>



*Figure 1: Survey household size*

Using a 1 to 5 scale, where 1 means, strongly disagree, 2 means disagree, 3 means neutral, 4 means Agree and 5 strongly agree. The average degree of strongly agree and agree of satisfaction and average degree of appropriateness given by the respondents were tabulated with the method as stated below. Physical and social aspect are important in the satisfaction of the resident to occupy in the

units of house. The analysis undertaken in this study state insufficient of size bathroom, washing room area, size of kitchen, size of bedroom and ventilation of the house. The result of satisfaction level of physical and social factor shown as Figure 2 Maximum of respondents agreed for the physical aspect factor including size bedroom (44.0%), size of bathroom (42.7%), size of kitchen (28%), washing room area (27.3%) and ventilation of the house (53.2%). Respondents stated existing kitchen space only able to house a small fridge, small counter space for food preparation. Heavy cooking normally carrying out at the yard space. Also, to prevent smokes from cooking to enter the house. Common corridors using as blankets and clothes drying area. In general, having satisfactory accommodation is one of the most valuable aspects of people’s lives and it is a major element of people’s material living standards. It is essential to meet basic needs, such as for shelter from weather conditions, and to offer a sense of personal security, privacy and personal space. Good housing conditions are also essential for people’s health and affect childhood development. (Streimikiene, 2015)

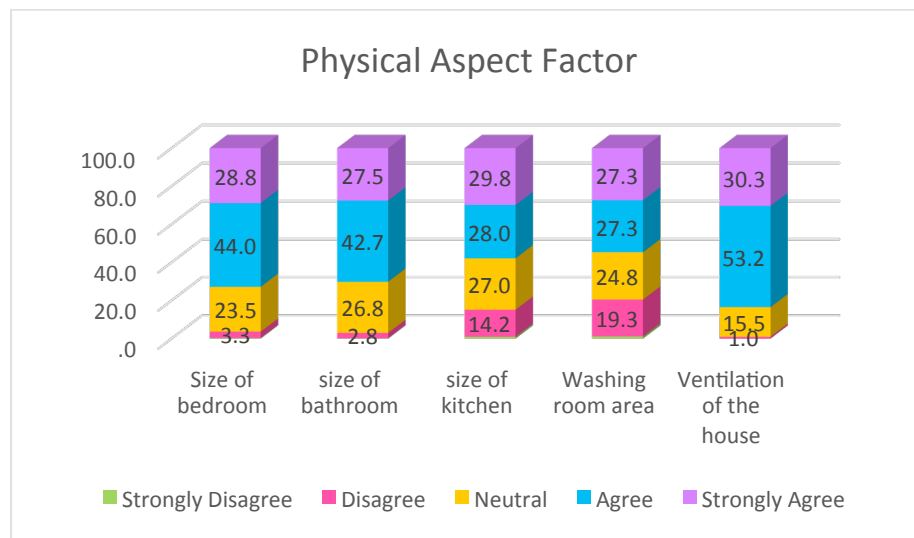
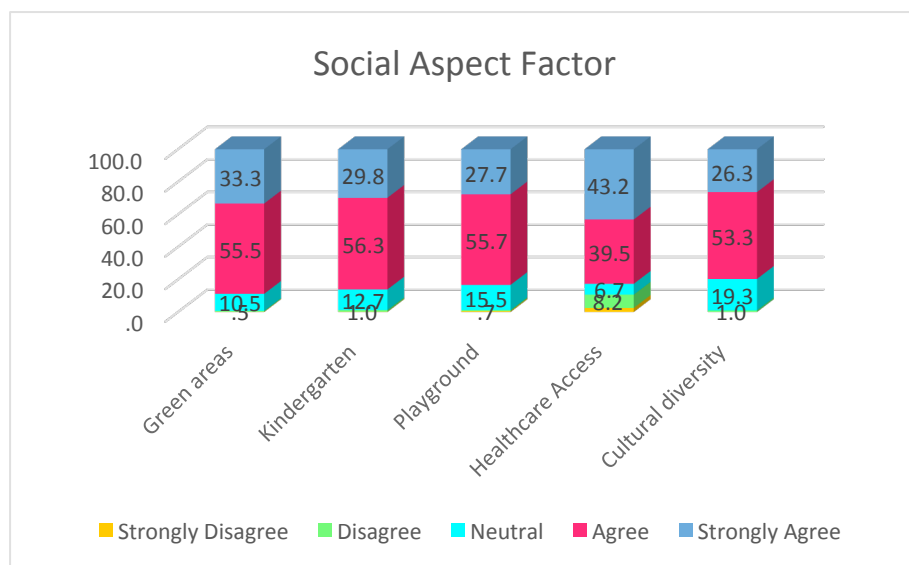


Figure 2: Physical aspect factor

Figure 3 shows the social aspect factor including green areas, kindergarten, playground, healthcare access and cultural diversity. Majority respondents agreed green area (55.5%) factor is important in low income housing, kindergarten (56.3%), playground (55.7%), healthcare access (39.5%) and cultural diversity (53.3%). The term quality of life is used to evaluate the general well-being of individuals and societies. As this is the key issue of sustainable development it is very important to develop the system of measurement of quality of life. The term of quality of life is used in a wide range of contexts, including the fields of international development, healthcare, environment and politics. (Dolan, et.al, 2010).



*Figure 3: Social aspect factor*

Besides that, neighbourhood environment, public facilities and housing characteristics are the main factors that influence residential satisfaction (Huang & Du, 2015). The social aspect in neighbourhood environment of a residential is important in satisfaction of the resident to create a calm and safe environment. Therefore, the survey has indicated that the residents are concerned about theft, vehicle theft, robbery and fights by gangs of young people. The respondents shared their views on the types of the crime activities in PPR housing. There are nine (9) crime activities including robbery, theft, vehicle theft, rape, molest, causing injury, fights, murder and attempted murder. The data, as illustrated in Table 2 shows highest types of crime is vehicle theft, 84.7% with 22.2% frequency happen more than once in a week. They also indicated that frequency of theft happens is 17.2% once a week and 14.3% once in two weeks. The crime activities of fights stated 27.2% once in a month. Robbery is rarely happening with 24.2% and attempted murder is never happening with 85.1%. The effects of crime are not only felt by individuals, but also by whole areas and communities. Tenants of social landlords often suffer from high levels of stress as a result of crime and anti-social behavior in the area in which they live. The crime and insecurity can make housing in certain areas difficult to let, it makes community participation difficult, it affects people's perceptions of communities and can lead to the rapid deterioration of areas (National Housing Federation, 1999). The indicator measuring the share of population exposed to the crime, violence or vandalism in the area is very important indicator providing the quality of living conditions. Living in unsecure area reduces the housing comfort and the price of living area tremendously therefore this is important indicator of quality of life related to housing environment. (Streimikiene, 2015).

*Table 4: Types of Crime in PPR residents*

Types of Crime	Yes	More than once in a week (%)	Once a week (%)	Once in two week (%)	Once in a month (%)	Rarely happens (%)	Never happens (%)
Robbery	62.3	10.2	4.8	6.0	16.8	24.2	37.7
Theft	82.2	13.5	17.2	14.3	21.8	15	18
Vehicle theft	84.7	22.2	18	11.3	18.7	15	14.7
Rape	16.0	4.8	4.0	2.0	3.5	2.3	83.2
Molest	17.3	4.0	4.3	2.7	3.5	3.0	82.3
Causing injury	21.8	3.2	4.7	4.2	4.7	4.3	78.7
Fights	68.8	7.8	11.5	11.7	27.2	11.2	30.5
Murder	15.8	3.3	3.3	3.0	3.5	3.2	83.3
Attempted murder	14.7	4.0	2.8	1.7	3.0	3.3	85.1

#### **4.0 Recommendation: Proposed Mass Housing System (Divergent, Dwelling, Design)**

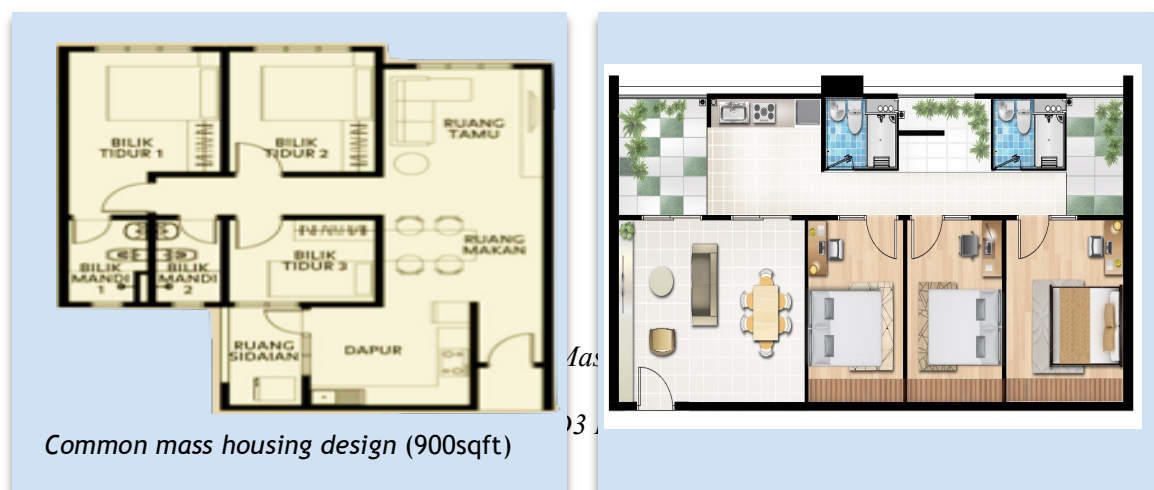
Because of factors including physical, social and environment factors is very important in quality of life, the recommendations the architects play a major role in producing efficient layout and innovative design for low-income group flats in order to meet the ceiling cost of the low-cost flat without compromising on the quality and comfort of living in the flats. Among all size of rooms, kitchen, ventilation and bath are the three most important rooms in determining the quality of low-cost flats. It is found that existing kitchen and ventilation were at the need for improvement. Design characteristics were the measurable aspects of quality elements. Therefore, a set of design elements to match the demanded quality elements provide by the customers could be developed by the designer (architect and engineer). The degree of importance of a demanded quality is converted to the degree of

importance of the quality element by the independent scoring method (Abdul- Rahman, 1999: Akao, 1990).

However, the proposed mass housing design system – Divergent Dwelling Design (D3) – is an inherent design strategy of sustainable development that fully utilizes the idea of flexibility. Each function unit (rumah ibu, dapur, serambi, anjung, etc.) combines divergently to reduce the immense intricacy of architectural phenomenon to simple constant units and brings about an effective formation of a flexible dwelling system. The sustainability issues focus on providing spaces to be used for a variety of purposes over time, be it the changes of household demography or the changes of resident's living satisfaction. Since this kind of functional change can be done by merely switching independent units within the configuration through a simple process, the function of the dwelling unit can be cultivated and adapted to the occupant's need whenever it is required. For example, a residential space can be converted into a café by just incorporating a larger kitchen and more toilets; a laboratory or playroom or computer room when added with a unit space for teaching can be used as an educational institution.

Similarly, D3 is that the system utilizes amply science, technology and industrialization in the formation of a unit. For example, bathroom and kitchen dimensions are fixed for mass production. The occupant has wide spectrum of choice with regards to products in the market. Since each unit is independently constructed by machine production, the development entails the use of technology and innovation, without the involvement of excessive site labour, time, and cost. In this sense, divergent design concept comprehends the advances of science and technology over time, thereby resulting in faster production at economical rates. More crucially, it helps to boost a greater productivity, better quality, and an assurance of a growing and interested housing market in the twenty-first century. Figure 2 shows the differentiation of common mass housing design and D3 mass housing design. Once the design system is in tandem with serial production and standardization, there will be no bounds for the development of sustainable community. The benefits of D3 design as following:

- Improves standard of living without the penalty of high prices
- Improves livability with superior designs
- Improves construction speed with the use of Industrialized Building System (IBS)
- Improves site safety and lower labor dependency via off-site fabrication
- Reduces material wastage and preliminary cost through modularization



The Industrialised Building System which is more commonly known as the IBS among the parties involved in the construction field is a system that is often explained as an approach in building and construction with several limitations (CIBD, 2007). In Malaysia, all the government projects need to using the IBS method in construction. Low income housing is one of the government initiatives. In D3, the construction flexibility is achieved through adopting the full-fledged prefabrication. All



building components are manufactured in factory to ensure the product quality. The whole D3 system is divided into six independent modular components, namely: structure, partition, bathroom, kitchen, landscape, and façade, which are prefabricated independently but are configured according to D3's modular coordination (Figure 5). When all components are delivered on site, they are assembled to become a home. The assemblage of components is easy and simple, where it does not require a highly skilled work force or special machinery, even less a heavy mill.

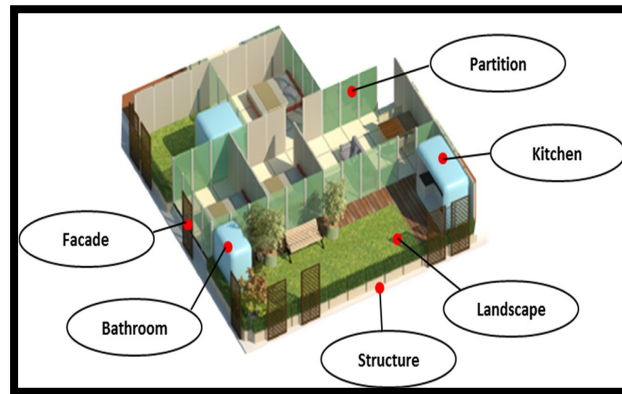


Figure 5: D3 major independent components

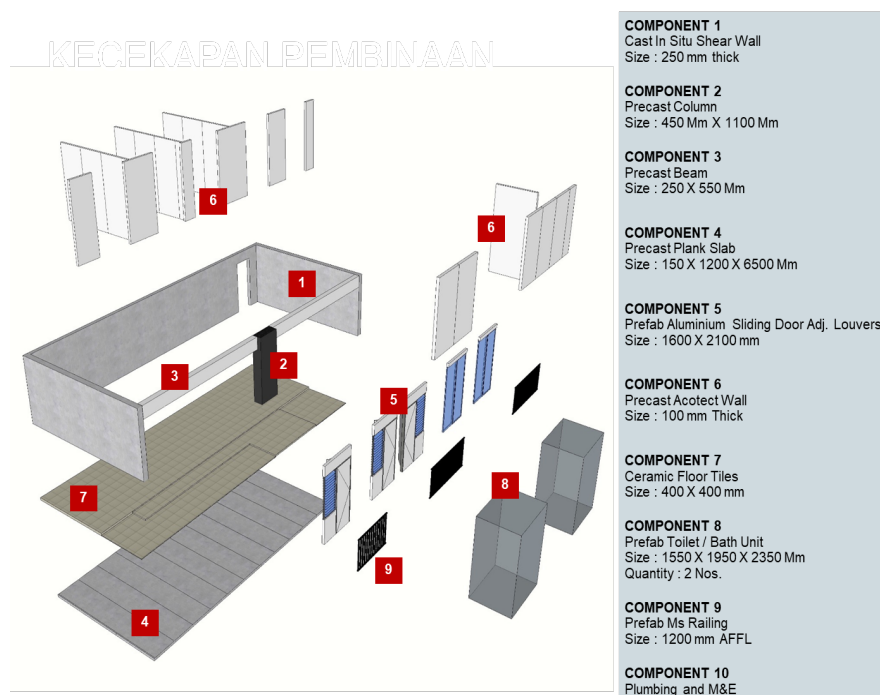


Figure 6: Components of D3 Housing Design

## 5.0 Conclusion

D3 design can solve the problem of physical factor, social factor and environment factor in low income housing that is very crucial in quality of life. On a much larger scale, D3 can facilitate the shift towards a higher quality housing in the country, and eventually create sustainable dwellings for everyone in anywhere in the country, which is a goal that in-line with the thrust of the Construction Industry Transformation Plan (CITP) 2016-2020. It is focusing on providing the better housing that



meet satisfaction of home owners. D3 is a new design approach to the sustainable living system that derived from the tropical vernacular architecture. D3 design has lots to offer towards sustainable construction solutions in the development of housing, as it is not only able to reduce both the initial build cost and running expenses of housing construction, but also balance affordability, durability, and adaptability in designing sustainable solutions that are resistant to obsolescence. In the case of D3 design system, cross ventilation is optimized by having an elongated dwelling shape together with minimal partitions or interior walls. D3 design has using the IBS method which is cleaner, neater and safer construction sites, Able to uphold the sustainability of the environment, cost reduction, reduced labour, high and controlled quality of end products, faster completion time, and not effected by adverse weather conditions. D3 prototype already build in Elmina West, Selangor that collaboration project between Construction Research Institute of Malaysia (CREAM), Sime Darby Property and G&A Architects with 0.53ac. D3 has two type which is Type C (900 sqft ) and Type D (1000 sqft). For the development of D3, there are 562 units with 76.6 unit/acre and total GFA is 763.307 sqft that will be launch in April 2019. This project received positive feedback from others because of its flexibility and sustainability of design. In short, flexibility in terms of architectural and construction process is the key strategy of sustainability in D3 housing.

## Acknowledgements

The authors would like to acknowledge the support by the Construction Research Institute of Malaysia (CREAM) and Construction Industry Development Board (CIDB), Sime Darby Property and G&A Architects for the information and supporting towards successful project in D3. The authors would like to thank the relevant parties that have directly or indirectly contributed to the success of this research. Furthermore, the authors wish to express their gratitude to the anonymous referees for their helpful comments and numerous suggestions to improve the paper.

## References

- Adam (1984), Comparison Study Between Haener Interlockin Load Bearing Block Other Materials For Low Cost Housing. Unpublished Bsc. Horns, University Teknologi Mara.
- Abdul-Rahman, H., Chow, L.K., Woods, P. C. (1999), Quality Function Deployment in Construction Design: Application in Lowcost Housing Design, International Journal of Quality & Reliability Management, Vol.16 No 6, 1999, pp.591-605, MCB University Press, 0256-671X.
- Akao, Yoji and Mizuno, Shigeru (Ed), (1994), QFD: The Customer-Driven Approach To Quality Planning and Development, Asian Productivity Organization.
- Association ANZAScA. "Contexts of architecture", Launceston, Tasmania.
- Bauer, J. E., Duffy, G. L., and Westcott R. T. (ed), (2002), *The Quality Improvement Handbook*, Quality Management Division, American Society for Quality, ASQ Quality Press, Milwaukee, Wisconsin.
- Campbell, c. et. al., (1976), The quality of American life: Perceptions, evaluations, and satisfactions. New York: Russell Sage
- D. Streimikiene, (2015), "Quality of Life and Housing". International Journal of Information and Education Technology, Vol. 5, No. 2.
- P. Dolan, T. Peasgood, and M. White, (2010). "Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being," Journal of Economic Psychology, vol. 29, pp. 94-122.

- Huang, Z and Du, X. (2015) Assessment and determinants of residential satisfaction with public housing in Hangzhou, China. *Habitat International*, 47, 218-230.
- Hullibarger, S. (2001). *Developing with manufactured homes*. Arlington: Manufactured Housing Institute.
- Isnin, Z., Ramli, R., Hashim, A. E., & Ali, I. M. (2012). Sustainable issues in low cost housing alteration projects. *Procedia – Social and behavioural Sciences*, 36, 292–401.
- Kamal. K. S, Wahab.L.A, & Ahmad, A.C. (2004). The 38th International Conference of Architectural Science IBS Roadmap Review. (2007). IBS Centre, Construction Industry Development Board, Malaysia, Kuala Lumpur, pp: 11-15.
- Karim, H. A. (2012). Low cost housing environment: Compromising quality of life? *Procedia – Social and Behavioral Science*, 35, 44–53.
- Lansing, I.B. and Marans, R.W (1969). Evaluation of neighborhood quality. *Journal of the American Planning Association*, Vol. 35 (3), p. 5
- Lim, J. Y. (2009). *The Malay house: rediscovering Malaysia's indigenous shelter system*, Institute Masyarakat/Central Books, Malaysia.
- McKinsey Global Institute (MGI). (2014). *A blueprint for addressing the global affordable housing challenge*. McKinsey & Company
- Natham, V. (1995), Residents' satisfaction with the sites and services approach in affordable housing. *Housing and Society*, 22(3), 53 – 78.
- National Housing Federation, (1999). *Displacement of Lower-Income Families in Urban Areas Report*.
- Nurizan (1998), *Kualiti Perumahan dan Kualiti Hidup (1&2)* : 133-149.
- Preiser, W. F. E. (1989), *Towards a performance-based conceptual framework for systematic POES*. In W.F. E. Preiser (Ed.) *Building evaluation*. New York: Plenum Press
- Rostam, Y., Hamimah, A., Mohd R. E., & Norishahaini, M. I. (2012). Redesigning a design as a case of mass housing in Malaysia. *ARNP Journal of Engineering and Applied Sciences*, 7(12), 1652–1657.
- Uniforms Building by Laws* (2013). MDC Publishers Sdn. Bhd. Act 33. Laws of Malaysia
- White & Schollaert (1993), Home ownership and well being. *Housing and Society*, 20 (1), 31-40.
- Wish, N.B. (1986), Are we really measuring the quality of life? *American Journal of Economics and Sociology*, 45 (1), 93-99
- Zuhairi, A. H. Foo, C. H., & Gan, H. B. (2015). Crossing the unlimited Architecture possibilities: Advancing the art of design and aesthetic using precast innovation. *Concrete Plant International*, 3, 168–171.