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# Potential implementation of light steel housing system for affordable housing project in Malaysia

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**Abstract.** An unparalleled number between housing demand and housing supply in Malaysia has increased the housing prices, which gives consequences to the homeownership issue. One way to reduce the housing price is by faster increase the number of affordable housing, but the construction sector faces difficulties in delivering as expected number by using conventional and current industrialised building system (IBS) due to the issue related high project cost, time and labour. Therefore, light steel housing (LSH) system as one of another type of IBS method can be utilised in housing construction project. This method can replace the conventional method that was currently used in the construction of affordable housing project. The objectives of this study are to identify the potential of LSH and influencing factors of system implementation. This is an initial stage to review the previous study related to LSH implementation in developed and developing countries. The previous study will be analysed regarding advantages and disadvantages of LSH and factors that influence the implementation of the system. Based on the literature review it is expected to define the potential and influencing factors of the LSH system. The findings are meaningful in framing and enhance construction housing method of an affordable housing project in Malaysia.

## 1. Introduction

Nowadays, Malaysia is facing a great challenge towards living a happy life. More worried when based on the Annual Report 2015 by Bank Negara Malaysia, the demographic research analysis demonstrates that the cost of housing in all major cities in Malaysia is at the 'severely unaffordable' stage [1]. The main factor for this problem is when the housing price in Malaysia was increased drastically due to the high housing demand and unparalleled housing supply [2]. Various actions have been taken by the government to settle down the homeownership issue through the implementation of the Malaysian plan each year. However, the record under the PR1MA housing program is worsened when to date just only 560 units of houses have been completed from the total number 158,807 units' plan, while 41,187 are under construction [3,4]. The number of the affordable house completed is too low compared to the total of 102 million of scheme registration by household [3].

Thus, one way to reduce house prices is by fastest increase the quantity of housing supply for the middle household income. However, conventional construction methods are still widely used in the construction of affordable housing in Malaysia while it is high cost and unable to respond to this huge demand in a short time with standard quality [5]. The method is based on-site works include building the reinforced concrete frame and brick, beam, column, wall and roof are cast in-situ using timber framework while steel reinforcement is fabricated off-site [6]. But, the contractor generally faces other



problem involving capital turnover, rising raw material prices, low margin and source degradation which will cause project delayed. Therefore, IBS system as one of the forms of off-site manufacturing (OSM) technique was introduced by the Malaysian Government since 1966 but until now just a few developers and contractor had used the method because of high cost, high risk and high level in setting up the programs [7]. For reducing the complexity of the system, the government should introduce the simple construction methods but reliable to be applied in all projects rates in Malaysia including affordable housing projects in the rural areas. Therefore, this study will establish the framework for improving residential construction system by utilisation of light steel housing system as one of the types of IBS system.

The light steel housing (LSH) can be built quickly and economically due to the installation method carried out in pre-manufactured which has saved construction time and labour [8]. The installation process starts from connecting the wall and roof framing components in a factory. The framing components then brought to the site and the labour starts joining the components using thousands of self-drilling screw. These erection steps implemented with the simple procedure and will shorten the projections time. LSH systems found extensive usage, due from that this system is extensively used for the construction of commercial and residential buildings with the low and moderate rise in United States, Canada, Australia, Japan and many other countries [9]. Therefore, to have a deep understanding about LSH system this study will focus on the influencing factors and advantages of LSH implementation for affordable housing projects in Malaysia.

## **2. Overview of affordable housing**

Life will be more meaningful when basic needs have been met. Normally, every individual will allocate a portion of their income for housing expenses. In many countries, affordability issue is regard between salary and housing budget imbalance and synonyms with the affordable housing problem. A household is considered to face unaffordability problem when they spend more than 30% of their income on rent and utilities, and severely cost burdened when it spends more than 50% [10]. In Malaysia, cost burden situation has turned them to the difficulties to the homeownership. Most of them do not have the ability to buy their own homes because of lower salary rate and high housing prices. High housing price particularly in large cities caused by an imbalance between a number of housing supplies and housing demands. It is based on assumptions that have mentioned the house prices function as a trigger, inducing rapid movement towards the equality of housing supply and demand [11]. The lower number of housing supply is caused by several factors including high construction cost and high premium rates need to pay to the government for every housing project. Two factor has given burden to the costs incurred, and consequence to the developer or contractor reluctant to build an affordable housing.

In order to meet current housing needs, especially for the low and middle income, the government and the private sector has played their respective role to social responsibility in agenda to build the shelter for people. However, by utilising current constructions method the stakeholder face difficulties to push up the number of housing supply exceeds the housing demand. Construction skills by using conventional methods are a technique that has been widely used in the field of residential construction for centuries of years. The conventional method can be defined as fabricating components for the building on site through the process of installation timber or plywood formwork and steel reinforcement [12]. The cast in-situ process is mainly conducted by labour and overall process done on site work.

There are mainly a lot of advantages and disadvantages of the conventional housing system. Advantages of the conventional system include; first, the construction work can be carried out at any time because it is easy to get the skilled labour in the construction field. It is not surprising when a lot of contractors using too many labour crews to expedite the construction work [13]. Second, the structural cost of the conventional building including material, labour and transportation cost are not significantly influenced builder decision to choose others constructions method [13]. The structural cost is almost same compared other system, the increasing cost currently occurs due from other reason

such as high labour cost and delay problem. Third, Conventional methods of construction are capable of produce a high level of stability concrete structure [14]. The stable concrete structure makes residential home looks sturdier and shape. Fourth, the concrete structure has a high resistance to the fire [14]. Lastly, it is easy to get a supplier of building materials for the conventional concrete house because it is based on 100% natural products such as sand, cement, and timber [14].

However, by using the conventional construction method, it will cost more in the whole construction project in such cost for the labour, raw material and transportation besides slow down the overall time duration of the project [12]. The conventional construction method is related to work done on-site, so it involves more on cost and resources inefficient [15]. In this case, the contractor needs to make a good estimation and high control a number of materials involved in the housing project. Besides that, delay problem always occurs when using unskilled labours consequence of the poor quality of work [16]. This is a major issue to be solved by contractors because almost part of the project costs is influenced by labour cost. Generally, conventional construction method involves major components of construction wastes such as wood, concrete, bricks, metals and others. The waste area always generated from finishing works, such as packaging of materials, ceramic tiles and insulation [17]. Thus, conventional housing construction system does not meet the sustainability housing standard which has been actively promoting by the government.

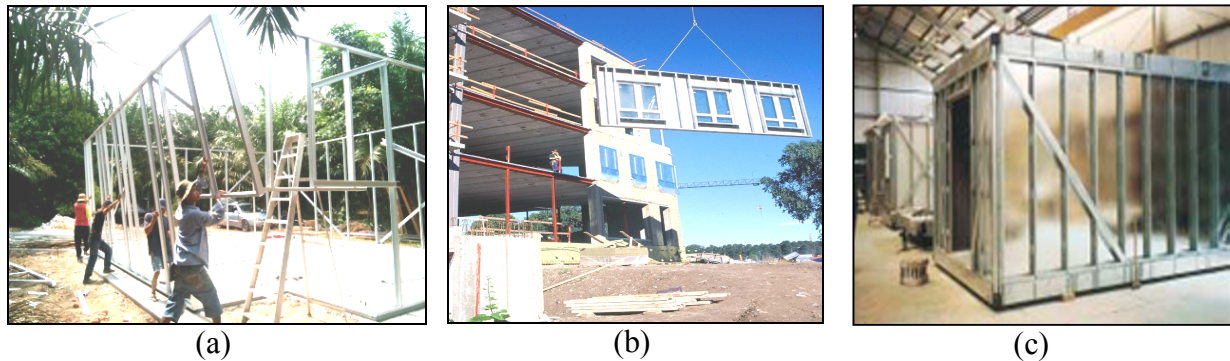
Admittedly, another alternative system that can replace the current method of construction work is by utilising IBS system. The government has encouraged utilisation of IBS system which mainly promotes precast concrete material. Since the year 2005, Construction Industry Development Board (CIDB) has given exception full levy imposed to developers that have used IBS component exceeding 50% [18]. Because of that, many of the contractors have applied the IBS precast concrete material in a housing project to earn IBS score by using the precast components [19]. By using IBS system it gives a lot of advantages include; overall work process has been done in the factory, so it will reduce the labour incentive on-site construction work. Less labour used will further reduce the construction cost [20]. In addition, building the house by using off-site construction will enable faster work processes. Work can quickly complete, will reduce labour costs and enable them to move to other projects [21]. Additionally, the system's workflow has good features include less construction site wastage, less environmental impacts, and reducing the consumption of electricity and water become an important medium which can bring country towards sustainability [21]. This step will automatically solve the problem of waste disposal site of landfills as one of the important issues in Malaysia.

However, there are some hinder to further utilisation of current IBS system which particularly it's involved a higher structural cost than conventional methods. The higher cost is mainly caused by the lack of supplier, purchasing expensive moulds and high transport cost [22]. Moreover, due to the complexity of the system and the needs to buy materials in volumetric it increases the initial capital to start the projects which can only bear the cost by the contractor that have strong financial position. Due to the elements of precast concrete that usually big, bulky and heavy, it needs to use a high cost of cranes for hoisting especially by installing the components [20]. Other critical issues related the system is by using the wrong technique to joining the prefabricated elements have caused the leakage problem [20]. Hence, based on the advantages and disadvantages of current IBS system, it is less suitable to be used as the system that can help to increase the number of affordable housing. In Malaysia, the authorities need to allocate different funding sources and ready to uptake more systematic delivery models that encourage the involvement of the various players in the supply chain and marketplace [2].

### *2.1. Potential implementation of light steel housing*

Light steel housing system as feeling under IBS component is one of the building concepts that can enhance the current system of construction for affordable housing in Malaysia. Light steel housing system was made by galvanised sheet steel which readily transformed onto shapes used for framing are has been utilised in the housing for about 70 years [23]. The extensive use of light steel housing was given a confidence to the several countries including United State, Canada, Australia and Japan in

utilising the technology for construction of commercial and residential buildings with the low and moderate rise [24]. Malaysia also needs to recheck the current building code to allow the utilisation of LSH system in housing construction industry. There are three types of the assembly method of light steel housing as shown in figure 1 [25].



**Figure 1.** Three type of assembly method of light steel housing. (a) Stick-built construction system (b) Panelized system [33] (c) Pre-engineered system [34].

Stick-built construction usually suitable for small-scale construction projects such as build houses under the program of Perumahan Bantuan Rakyat (PBR) and MESRA RAKYAT, which refers to the house that is built on applicant own land. While the panelized and pre-engineered system is commonly for the medium and large-scale housing project. There are many advantages of light steel housing over to the other structures including higher in factory production quality and more simple, more reliable, much more consolidated and rapid connections system [8]. Lightweight house allowed high degrees of prefabrication, which major part of houses was made at the manufacturing firm under control production environment [26]. In addition, speed constructions work and precise steel material has further given a greater economic performance [27]. Moreover, the system can be applied whether for small and large scale housing projects without the use of heavy lift cranes [8]. Besides that, LSH system as a simple construction method, in which the installation technique same as wooden framing system given much easier to trained the new builder [25]. LSH also fulfil the green building specification which there are less scrap and waste from constructions process and high recycle ability [27].

Although light steel housing system has present many of advantages to the construction industry, there is a lot of disadvantages of this system. First, the framing labour needs to enter a phase of learning the techniques of installation and it will extend for the project's completion date. The costs incurred for the initial application of light steel housing system quite high due to the labour training process [28]. Second, there is very less or neither theoretical analysis and nor relevant experimental data of the structure exist as a guide for local designer and architecture to develop the systematic lightweight steel specification [28]. Third, the new housing system is very strange to the people in term of structure and they still have low confidence about its security, stability, comfort and etc. Fourth, fewer technicalities test regarding sound modes forces exerted by the wind and determines the effect due from the earthquake [29]. However, the disadvantages of LSH can be solved by several actions such as labour training, further experimental research and promotion. Therefore, several important requirements need to be aware to ensure LSH system can be implemented without fail; it includes the availability of capital, supplier, technology and labour.

## 2.2. Influencing factor of implementation of light steel housing system

To bring the new systems successfully, needs to concern regarding several influencing factors includes the regulation requirement, sustainable issues, market opportunities, social demand, economic assessment and industrial capability. Firstly, regulation requirement needs authorities to build

partnering relationship amongst stakeholder under the industry, such as high promotion action have been taken in China since there is a positive growth of steel in the construction industry [30]. Secondly, the utilisation of light steel housing system will ensure that Malaysians can enjoy the housing affordability standard. The best step is to articulate that the housing development carried out has meet sustainability standard in wide-ranging criteria including economic, environmental and social aspects [31]. Thirdly, in order to promote green building practices, authorities must expose the public about the factors and impacts of human activities on the environment once stimulate market demand for environmentally friendly products [27]. Sustainable products indeed meet the standards for economic, environmental and social.

Fourth, one of the factors that make a country being developed is to have people open-minded, creative and analytical. Thus, as long as they have facing great increasing housing prices and in addition to the burden of high debt relative to income, it will cause a great stress on the residents [32]. Hence, one way to increase the quality of life is in faster increase number of housing especially for affordable housing in the target to reduce the housing price. Fifth, all the metal stud come in precise measurement let the easy maintenance operations without great material loss, contribute to fewer expenses, faster constructions time, less waste, less water bill and hence to obtain a greater economic performance in the life-cycle costs indicators [27]. Lastly, the manufacturer of steel product should be involved in the initial process for introducing light steel housing in the constructions market. This is in order to strange industry capability to fulfil the future huge demand for metal product consequence from the implementation of light steel housing method in the delivery of affordable housing [32].

### **3. Methodology**

This paper is written based on an overview of literature from books, journals, articles and conference papers related to this topic. The review focus about local and other country experience regarding housing affordability issue, and the way to solve the problem by emphasising on the need for improving current construction method. From this, the key point is in recognising the advantages of light steel housing, how it has covered the disadvantages of conventional and IBS (precast concrete) method. The important look for the potential of the LSH system is to faster increase the quantity supply of affordable housing. So that, many people can own the house without cost burden. To ensure the light steel housing can be implemented and accepted by clients and contractor the requirement of light steel housing system is identified. Requirement focus on the factors that enable the utilisation of the system in the construction field, it includes capital, technology, supplier and labour. While identification about influencing factor of implementation of LSH system also needed as a guideline for authorities to accepting the implementation of the system.

### **4. Results and discussion**

After reviewing the literature related to light steel housing system, it is obvious that the utilisation of light steel housing system of the construction industry in Malaysia is sparse. The majority of studies focused on industrialised building system (IBS) as an alternative to conventional construction method in term of concept, system performance, improvement, promotion and barriers of adoption to the system. The literature suggest that if construction industry utilised the light steel housing system in affordable housing project there will found it can give a great economic performance to the contractor [27]. The economic performance is depends on three main aspects which are oriented on time, labour and cost. Firstly, the contractors get to reduce the constructions time due to the majorities of work is mainly involve metals panel installation by using the easy step of assembly works. The simple erection step has eased contractors to train the construction workers for utilising the system [25]. It is because the erection step is almost same, the difference is in which the steel house use screw system rather than a nail. Finally, if the time and labour have been reduced it will further lessen the housing cost. In addition, LSH implementation is suitable for small and large scale housing project. This because major part of metal component was made by bending machine and the production performs under control environment [26]. Generally, manufacturing firm will fulfil the supply order for the LSH component

within one week whether for small scale or large scale housing project. In fact, with the light weight characteristic have enabled the workers to easily move the component material without using heavy crane [8]. In the other hand, since the material ship according to the requested size it results to very less scrap and waste from constructions process [27]. The interesting is, all the scrap and waste will send to the recycle centre to enter to the recycling process.

Based on the previous study, there are six influencing factors that are very important to be as guidelines for the authorities to implement the new approach that can improve the current constructions method, refer table 2. The literature have review that one of the way to reach affordable housing standard is by applying sustainable concept in housing development [31]. The government need set up the regulation regarding the sustainable issue to encourage the demand of LSH. This is a chance to the authorities to introduce to the society about green house building concept [27]. Government have the wide right to change the people mindset through a training program and promote the new housing concept from time to time [30]. In the other hand, as one of promotion strategy, the authorities need introduce the utilisation of LSH in the project of subsidies house such as PBR house, home placement of flood victims and others in early stage of method utilisation. Through this way government and stakeholders will obtain great economic and environment performance, also at the same time will fulfil the gap of affordable housing delivery. As a result, when people have met their needs to own an affordable housing they will less stress and will live in happy life. In fact, the difficulties to own the house due from high housing price and cost burden will cause to the stress life amongst the resident [32]. Therefore, the government needs to take an immediate step to reduce the gap of housing supply and demands, in order to have open-minded and creative society.

**Table 1.** Potential of implementation of light steel housing system for affordable housing project.

No	Potential of Light Steel Housing System	Author
1.	Greater economic performance	[27]
2.	Faster construction period	[27]
3.	Ease training labour	[25]
4.	Production system under controlled production	[26]
5.	Reduced usage of heavy lift cranes	[8]
6.	Less waste	[27]
7.	Long life span	[27]

**Table 2.** Influencing factor of implementation of light steel housing system for affordable housing project.

No	Influencing Factor of Light Steel Housing System	Author
1.	Regulation requirement	[30]
2.	Sustainable issues	[31]
3.	Market opportunities	[27]
4.	Social Demand	[31]
5.	Economic Assessment	[27]
6.	Industrial Capability	[32]

## 5. Conclusion

Mass housing targets can be achieved by implementation of light steel housing system in replacing the conventional methods in the construction industry. This is in advance to fulfil the needs of affordable housing supply. When a number of affordable housing supplies have fulfilled, it also will reduce the housing price. Therefore, it's put under authorities' decision to uptake the LSH system and promotes it to the public.

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