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The Unsung Heroes of Green REVOLUTION

Gaming Up in Human Resource Capability Training • Keep the Flag Flying: Opportunities and Challenges Facing Malaysian AEC Software Engineering Houses • Overview Plug & Play Concept of Industrialized Housing in Malaysia • Energy Efficiency for Reducing Carbon Footprint in Historic Buildings: Comparing Cases in the UK and Malaysia

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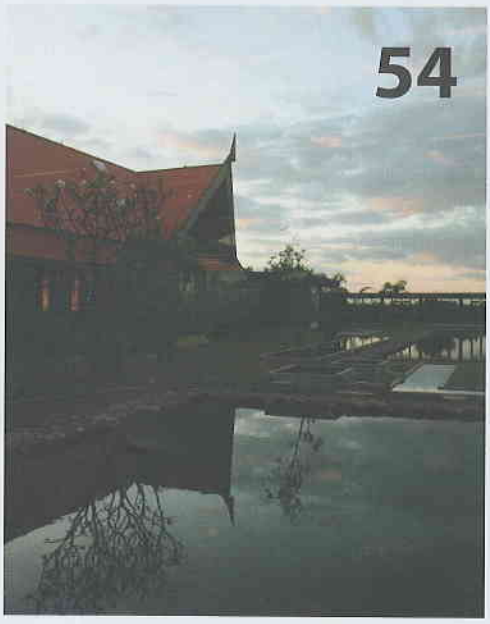

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OVERVIEW PLUG & PLAY CONCEPT OF INDUSTRIALIZED HOUSING IN MALAYSIA

The preliminary idea to this research come from the Construction Industry Master Plan (CIMP) that is to transform and industrialized the Malaysian construction industry towards more systematic and mechanized system. The previous studies show that the elimination of onsite construction has limit the environmental impact to the site, affords greater accuracy in construction, and allows building to be developed faster. This study aims to investigate the effectiveness of plug and play concept and how this results for adaptable architecture in terms of design, construction and operational. The plug and play concept is the design and protocols which are taken from the computer industry that allows for any additions in building to be adaptable. The chrysalis of this concept will be joints and connections which should be designed to receive other components from all sides. It may result in manufacturing home that could be easily dismantles and reassembles elsewhere such as the Malay Traditional House. Fast deployment and adaptability will increase the value added of the house. This will ease for renovation and extension that currently limited in Industrial Building System (IBS) housing. In addition, this concept will promote in reducing wastage by implementing the adaptability approach during construction and renovation. As a result it will foster a strong sense of identity between user and architecture towards sustainability and in harmonize with the Malaysia Standard.

INTRODUCTION

The advancement of technology has touched every part of our lives over the last century – including construction industry. A conventional construction is the result of many factors which can be technological or social, and this gap still exists between manufacturing and construction industries in Malaysia. However, construction industries practically continue to produce residential buildings in conventional ways. Therefore, in the last decade, industrialized construction was promoted to enhance the importance of prefabrication rather than conventional construction.

HISTORY OF PREFABRICATION TECHNOLOGY IN MALAYSIA

Construction industry in Malaysia began in the early days of Federation of Malaya in 1948, together with the formation of the various states in the country. The construction of the Malay traditional house mainly relies on its strength of a complex jointing system made rigid by the use of timber wedges (Wan Hashimah, 2005). According to Rodd (2003), timber that is relatively light-weight has always been at what might be regarded as the cutting edge of the building technology of the era. However, Kamaluddin (2009) claimed that concrete is the material of choice for residential buildings in Malaysia by a significant margin.

Industrialized housing is not new to Malaysian construction industry. Projects utilizing large architectural precast panels called Danish Larsen-Neilson System were undertaken at the Pekeliling Flats in 1966 (the building has been recently demolished) and French Estiot System in Riffle Range Road Flats in Penang after a year. Malaysia adopted the British Precast System where 1,200 units' houses were built in Penang in 1978 and 2,800 units in Lumut in 1980 using Hazama Gumi System from Japan. However, its adoption has been limited to the use of proprietary, stand-alone systems rather than open system. Nonetheless, the building design was very basic and did not consider the aspects of serviceability and culture of living such as the need of wet toilet and bathroom.

Following these pilot projects, Malaysia adopted Modular Coordination that acquired precast concrete technology from the Praton Haus International, Germany and took up numerous housing projects from 1981-1993. Praton Haus International has fit to the production system of which not all factories can produce at that time (Mohd Sufian, 2009). There are two (2) types of construction systems which have been introduced by Praton Haus; architectural large panel systems and skeleton systems.

JOINTS AND CONNECTIONS IN PREFABRICATED COMPONENTS

Connections in such system of reinforced concrete structure are potentially the most critical part of the architectural precast panel (Tan, 2006). Joint are required for durability, fire-proofing and water-proofing for architectural performance, strength, rigidity, and ductility for mechanical efficiency and the ease of handling and clearance for expansion as well as for contraction. Constructively, it is the main factor in controlling the performance of industrialized housing.

Essiz and Koman (2006) in their study found that design demands (artistic and technical) increase with each further step towards industrialization. The combination of sociological and ecological standards together with functional and aesthetic designs could utilize the full advantage of industrialization without creating lifeless buildings and environment. Erman (2002) claimed that aesthetic considerations became an inseparable part of the joint without putting its primary function aside.

On the other hand, the mechanical fasteners that have been developed as a substitute for intricate interlocking joints played the major role for industrialization, mechanization and mass production. Feasibility of demountable joints can be improved with the advance working tools. The highly developed electronic working tools enable the prefabrication of intricate interlocking joint (Erman, 2002). Therefore, the concept of adaptability and flexibility for homes could be realized.

PLUG & PLAY

Adaptability in general is the ability of individual modifications to suit new conditions. A basic adaptability for homes is defined by Friedman (2002:1) as "providing occupants with forms and means that facilitate a fit between their space needs and the constraints of their homes either before or after occupancy". Practically, adaptability covers all internal changes in both the availability and the structure of spaces. However, homes in Malaysia have followed another path. It has always been conceived as something necessarily static and safe. What happened to the adaptability and 'machine à habiter' that Le Corbusier proposed at the beginning of the 20th century?

The organized and accessible systems such as industrialized housing will no longer be useful except for the lowest commodity products for which competition is weak or nonexistent, or for which there is a public monopoly (Kendall, 2005). Therefore, the Open Building System is vital to avoid monopoly of architectural panel component in Malaysian construction industry. In addition, it will enhancing the ability to access, repair, and modify over the lifecycle of the house. Similarly, the design of interior space can be reconfigured in a relatively straightforward manner as occupant living requirements change over time. Thus, the concept of adaptability and flexibility strongly overlaps in this matter. In fact, the ultimate goal of industrialized housing research is to develop solutions that satisfy both of these principles.

According to Abu Hammad et al. (2008), research and project experience shows significant savings can be made when applying this approach. The potential to develop adaptable architectural panel for industrialized housing in Malaysia needs combination of innovative design and construction methods. It is important for an industry that is constantly alarmed by the increasing cost of building maintenance and lifecycle issues (Construction Industry Development Board, 2009). Hence, it is very significant to select the appropriate building systems and components that require minimum maintenance (Chew and Das, 2008) to form industrialized housing.

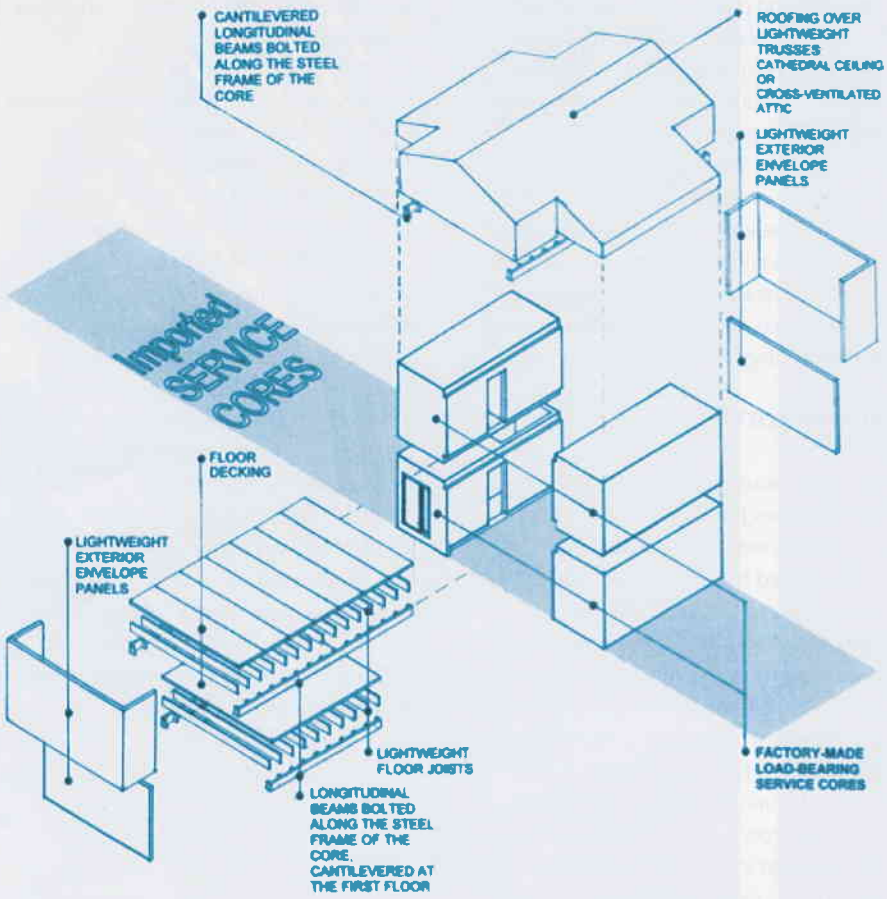
Durability is a key point to prevent the deterioration of structures and members of buildings over time and to maintain the safety, comfort and health of the users. According to Asiah et al. (2009), most of the users in industrialized housing in Malaysia are fairly satisfied with their house finishing, such as noise transmission from outside into the room, and the defect of building component. Crack remains the highest case of defect recorded in their houses, especially for single and double storey terrace housing. As for these cases, maintenance of external wall tiles is needed once every 20 – 30 years, simply in terms of masonry joint repair. In addition, most Malaysians prefer to improve their house by doing renovation and extension.

Therefore, the plug and play architectural panel for external walls is suggested as their potential to enhance the durability and waterproofing properties of the connection. The plug and play panel could be fixed manually in place to maintain constant performance quality as well as ease for maintenance and renovation. Since the architectural panels have a fine surface irregularity in order to maintain the high hydrophilic properties, they remain clean for a long period. Unlike painted external walls and siding board external walls, this may considerably reduce the amount of maintenance work, such as waterproofing and repainting, which may be required.

ADAPTABILITY

Malaysian households prefer to be different from their neighbours and have varieties in terms of needs through time. Thus, industrialized housing should provide adaptability to display similar features from one to another. As prefabrication technology is mostly factory-related, the components reach for the best practice to implement plug & play concept into industrialized housing in Malaysia. This optimal solution could be offered by a hybrid approach; concentrating on the serving areas in compact factory-made 3D modules called Service Cores (Richard, 2008). On site, the Cores are positioned perpendicularly to the façade, while locally built floors and exterior walls span longitudinally between them to generate the served areas. The Service Core is to housing as what the engine is to the body of an automobile.

The Service Core approach that considered as a Plug & Play concept will fully meets the adaptability agenda when mechanical (dry) joints are used in order to permit reconfigurations without any demolition. Therefore, the served areas generated between the cores are functionally adaptable, open to a diversity of scenarios and accommodating either loft or partitioned arrangements. The construction of the served areas, and its adaptability to suit changing needs, is a simple activity which deserves to be done locally, both for economic and cultural reasons. The exterior architectural wall panels that connected to the Cores constitute as an open sub-system in terms of materials and forms, and they can play a determinant role in responding to the local culture and harmonizing with the Malaysia Standard.



binaTECH: Pushing the envelope by introducing a new method of building houses in Malaysia is no easy task as Malaysian '...are fairly satisfied with their house finishing, such as noise transmission from outside into the room, and the defect of building component

Figure 1:
Typical combination of Japanese factory-made Service Cores with local technology
Source: Richard (2008)

CONCLUSION

The conclusion is a recommendation to consider the existing Japanese technology of 3D volumetric module as Load-Bearing Service Cores for industrialized housing in Malaysia. The conclusion is based on the fact that these modules are structurally rigid and close to the size of a container. As they are framed at the edges, each horizontal and vertical plane completely adaptable. The combination of such module with the available local technology of Industrialized Building System will form a plug and play concept of adaptable housing in Malaysia.

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