Raised Flooring; a Traditional Designed Architectural Element as "Passive Design" System in Future Building. Case Study: Masjid Kampung Laut, Kelantan.

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Abstract. Building Industries contributes to a great number of carbon footprint through all these years. Through a proper planning, this industry can reduce the impacts to the earth generally and towards the environment specifically. This study was dedicated to propose an old traditional design found in 400 years building to be reapplied in modern construction as a "passive design" system. Raised timber flooring was commonly applied in South East Asia's traditional buildings due to the availability of the material and suitability for the climate. Masjid Kampung Laut was chosen as the case study due to its excellent reputation compared to the age period of the building. Till this moment, Masjid Kampung Laut is still function very well and benefit excellently to the community where it was located; Nilam Puri, Kelantan. This study was conducted in qualitative method, involving several types of data collection. The intention of this research whereby proposing towards the architects, designers, developers, engineers, and all the main players in the construction industry to reuse the design element of "raised floor" in modern buildings such as residentials, resorts and hospitality, mosques, retails, transit shelters and terminals, restaurants, schools, office buildings and etc. This revolution in design will at the end push the authorities to consider the design to be used in government buildings, as it also represent our architectural identity, energy sustainable, as well benefits the environment. In conclusion, the traditional architecture element of raised timber flooring could be redesigned and recommercialised to suit the future buildings. This design should be given a chance as it surely can benefit the building itself, the users, and the environment globally.

INTRODUCTION

The phrase "Sustainable design" can be described as the connection or interdependence between the built and natural environment; the efficiency of energy, land, and other natural, finite resources use; the enhancement of communities; and nurturing of physical and emotional well-being. Besides, the word "environmentally sensitive design" means a building design that considers the impacts of the construction on the environment. While "eco-effective design" emphasizes on working on the right things, such as the right products, systems, and services instead of making the wrong things less bad [1].

Green building design can be divided into two types, which is passive design and active design.

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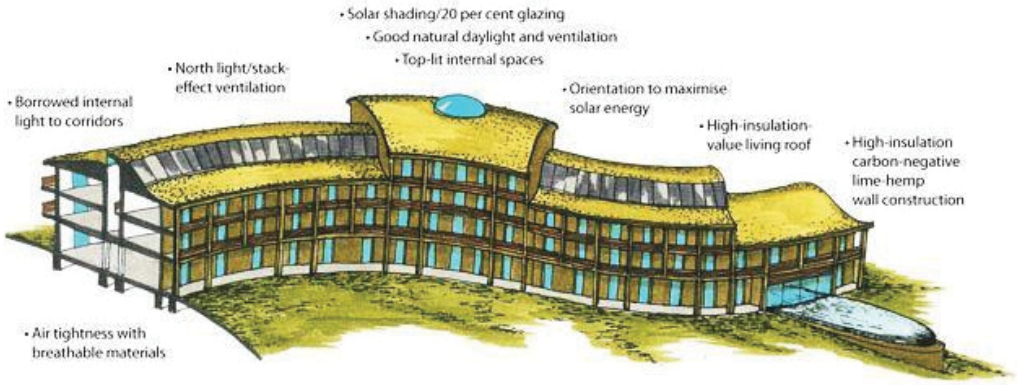

FIGURE 1. Passive building design system [8].

Figure 1 shows an illustration of passive building system and how it works. Passive building design normally incorporated some "passive" design features such as the use of insulation and the orientation of the building itself helps to maintain a comfortable and stable interior temperature without the need for active heating and cooling systems. Alike, optimum usage of natural lighting reduces the need for artificial lighting system [8].

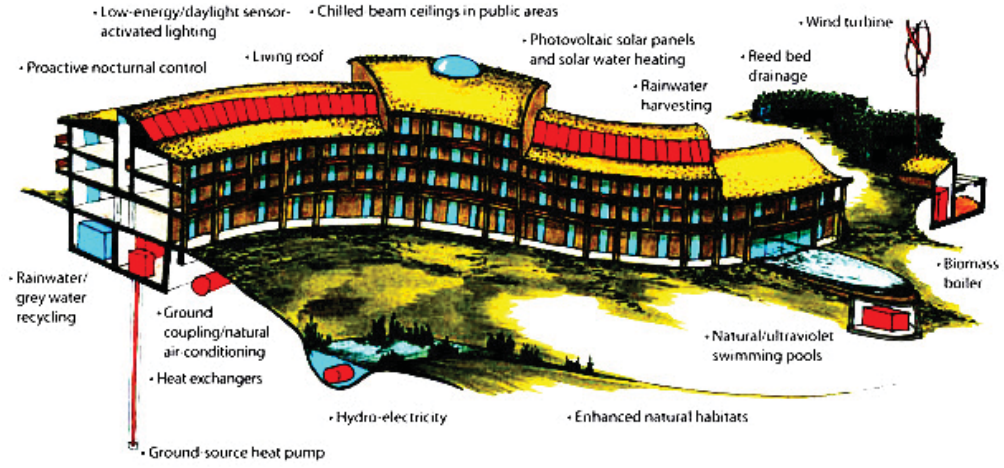

FIGURE 2. Active building design system [8].

Figure 2 illustrates the "active" design concept in a building. Active design buildings bring together the cutting-edge technologies to reduce the buildings' resource use and other disadvantageous environmental impacts. For instance, biomass boilers and wind turbines are used to produce green energy; pipes are installed, heat exchangers replace the air conditioners; rainwater harvesting and grey water recycling to reduce the usage of water [8].

TRADITIONAL BUILDING

Evidences proved that the earliest people in Southeast Asia live in caves. Discoveries by archeologists discovered stone artifacts and human remains in Niah Cave, Sarawak and Tambun cave in the Peninsula. Then they move to an elevated floor shelter made from sticks and leaves due to warm and humid climate [3]. The revolving developments of the indigenous house are resulting from social and physical adjustment, adaptation and integration of people to their natural surrounding [4]. Furthermore, traditional building especially Malay houses are designed with some special

features such as large openings, open concept plan, double tiered roof, and elevated floor. These characteristics permit natural ventilation to flow in and out of the structure [9].

Masjid Kampung Laut

Masjid Kg. Laut is the oldest mosque in Malaysia. This mosque has taken place at Nilam Puri, Kelantan. Till now, this traditional building takes its role for spreading and learning Islamic teachings, especially in Kota Bharu [6]. This statement was supported by a writing from Ahmad Robert bin Abd. Rahim, a director of Kelantan State Museum Corporation or Perbadanan Muzium Negeri Kelantan in a book written by Mohd. Akib [7], which stated that the mosque is the one and only existing symbol of Islamic history and believed is one of the oldest mosques in the Archipelago. By the development of this mosque hundreds of years ago, it is appears as the basis which then contribute to the development of the spread of Islam, particularly in Kelantan state. This mosque is a fully raised and in timber structure, believed to be the oldest mosque in the country. Further, it even claimed to be older than Demak Mosque in Java Island by some people [6].

According to Malaysian Historical Society or Persatuan Sejarah Malaysia (PSM), this building was transferred from its original site in Kampung Laut a year after a big flood in 1966 which sweep Kelantan. Besides that, this building was built between 300 to 500 years ago. Referring to some quotes, this mosque is older than Masjid Demak in Java Island [6]. Besides, other opinion state that there is no specific date has been traced relating to the construction of this mosque. According to the old generations of Kampung Laut, the mosque has existed approximately the last five generations. An assumption was made that it was existed nearly 400 years ago [7].

The Kg. Laut Old Mosque has a floor-measurement of 15.86 metres by 15.86 metres [10]. The whole floor area is raised over a meter from the ground level [6]. Masjid Kg. Laut floor plan can be divided into 9 main spaces as shown in Fig. 3, and they are:

i) Serambi Besar
ii) Balai Lintang
iii) Ruang Besar Masjid
iv) Serambi (Verandah)
v) Mihrab
vi) Wakaf Orang kaya
vii) Merara (minaret)
viii) Beduk Area (Drum Area)
ix) Kolah (Pool Area)

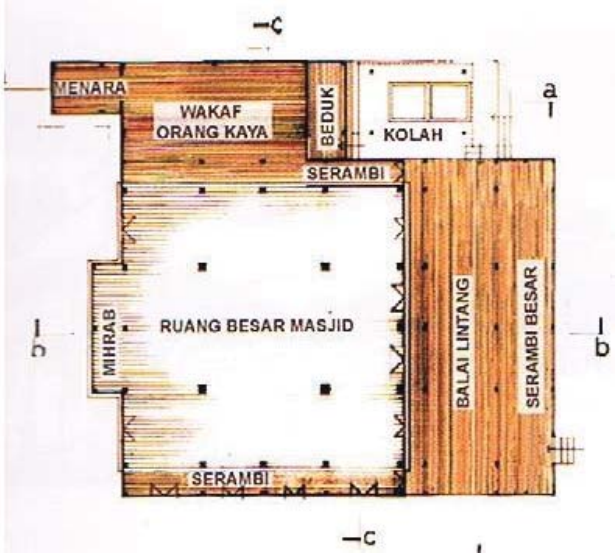

FIGURE 3. The Floor Plan of Masjid Kg. Laut. Courtesy: Mohamad Rasdi, M. T. (2010)

Raised Timber Flooring

"Rumah Panggung" is a term used to the most of Malay houses as they are built on stilts as shown in Fig. 4. One of the main feature of traditional Malay houses or *"kampung"* house is built on loads or stilts. These features are function to evade from floods, prevent thieves, avoid wild animals, and to enhance ventilation [5].

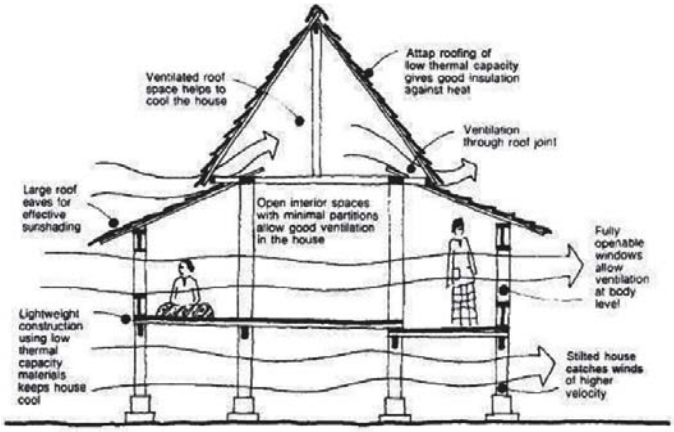

FIGURE 4. CLIMATIC DESIGN OF THE TRADITIONAL MALAY HOUSE [2].

The benefit of having floor raised on stilts is allowing cross ventilation to flow underneath the building. This feature further cools the floor materials and the same time let the air to move and enter the building [9].

METHODOLOGY

Research approach used for this research is qualitative. During data collection, the researcher has applying several methods such as site measurement, observation and survey. Physical measurement on site has been conducted to gain data, and was transferred into AutoCAD software to construct a comprehensive drawings. A set of drawings was produced to help the researchers to have more clear view of the whole building including detail of the spaces, openings, and later advocate the air flow. Figure 5 and Fig. 6 showed a floor plan and side view of building Masjid Kg. Laut.

FINDINGS

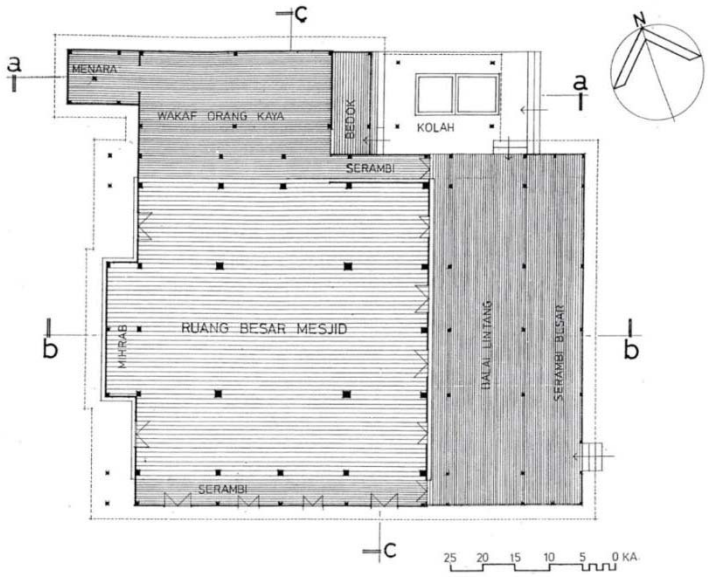

FIGURE 5. Floor Plan.

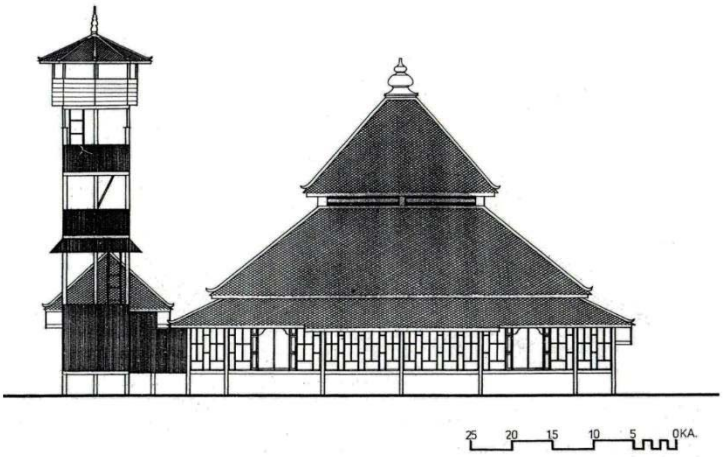

FIGURE 6. Side View.

The whole building of Masjid Kg. Laut was built on stilts as shown in Fig 7, Fig. 8, Fig. 9 and Fig. 10. This feature is a common scene of traditional Malay architecture. The idea of building on stilts is not only serve design aspect, but it plays an important role as a passive design building. The floor which is built raised over the ground allows the wind circulation to flow under the building, helps the building to cool of the temperature, especially in daytime.

FIGURE 7. An external view of Masjid Kg. Laut which was built on stilts.

FIGURE 8. An external view of Masjid Kg. Laut which was built on stilts.

FIGURE 9. A closer view of Masjid Kg. Laut which was built on stilts.

FIGURE 10. Underneath the floor (view from under) (Hassan & Nawawi, 2014).

Not just flowing under, the wind that flows beneath the building are also allows absorbing into the building and cooling the whole interior as the flooring panels are arranged with small gaps. According to measurement on, site, the

ranges of the gaps are between 1mm to 15 mm varying between floor panels with 190mm to 120mm wide as shown in Fig. 11 and Fig. 12.

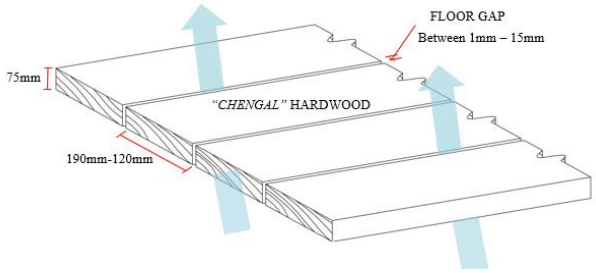

FIGURE 11. Detail drawing of the timber floor and simulationof air flow through the floor gaps.

FIGURE 12. *Chengal* hardwood timber floor (view from inside) with the gaps between each panel.

RESULTS AND DISCUSSIONS

Through the study shown in Table 1, the researchers found that the architectural design of the building play a huge role to create a comfortable temperature inside of the building. Through series of interview at the site, when asked about the indoor temperature in three different times in a day towards 20 persons of the occupants, this is the result of the interview:

TABLE 1. Result of the survey towards indoor temperature of Masjid Kg. Laut.

TIME	TEMPERATURE		
	COLD	MODERATE	HOT
MORNING	16	3	1
NOON	2	14	4
NIGHT	11	6	3

The result of the survey shows most of the users think that the interior temperature of the building is cold in the morning (80%), moderate at noon time (70%), and goes cold at night (55%). Least of them says that the indoor temperature is hot the whole 3 times in a day.

This data does support the early idea that the building was built on stilt with a purpose; it is for the building's self-cooling system, which utilize the wind flow in cooling down the whole interior without the usage of air-conditioning or other active support system. This is one of the attributes of "passive design" in modern Green Building system.

CONCLUSIONS

Traditional building is a result of master understanding of human and nature, translated into a design that respect both of the elements. This study concludes that the traditional architecture element of raised floor is still relevant to practice, hence is a better option to build buildings that consider the environment, or in Architectural terms: Green Building. The material could be replaced with more durable material that appropriate to the building, but the idea of raised flooring should be reconsidered to be reapplied in modern construction. This research suggests all the players in the industry especially architects, designers, engineers, developers and the authorities to consider their buildings to be built on stilts as it is proven to be the solution to certain building problems such as excessive power usage and heat. Moreover, this design leave minimal footprints to the site when it was no longer needed later. Further, built on stilts design shows regards to the local identity of architecture itself, while at the same time did not bothering water flows on ground especially on raining season.

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