



and conservation projects conducted by Malay Heritage Museum of Universiti Putra Malaysia (UPM) (Malay Heritage Museum, 2019). The Kelantan house is under the project by Universiti Kebangsaan Malaysia (UKM) and the Department of National Heritage, located at Taman Pantun UKM. Site observation and interview were conducted to determine the application of sustainability approaches in traditional Malay houses.

#### TRADITIONAL MALAY HOUSES

Oliver (2006) defined vernacular houses as being environmentally related to its context and available source that it evolves as their needs and circumstances change. While Seo Ryeung Ju et al. (2012) stated that vernacular

houses are buildings for common living, built under participation from the owner from local materials and techniques, persistent and have evolved over a long time in a specific place. Traditional Malay house can be classified as vernacular architecture. It is built by the local people as the owner of the building with deep understanding and respect of nature, using local materials and technique, built with the idea to suit their everyday specific needs and accommodate their values, economies, and culture.

Looking into the physical aspect of the traditional Malay house, which suits the intent and purpose of this research, most of the Malay traditional houses share common principles. They are built out of timber as it is easily found local materials, raised on stilt, and have internal spaces consisting of *rumah ibu*, *rumah tengah*, and *rumah dapur*. All of these spaces are covered by a long

TABLE 1. Green approach strategies for traditional Malay houses

No.	Strategies	Brief Description
1	Large window opening (half/full opening)	Encourage natural ventilation and lighting.
2	Wide roof overhang	To protect from rain and direct sunlight from hitting the wall and into the house.
3	Built on stilt with concrete or stone base	To overcome flood and as protection from animals. It is also easy to maintain and can give sense of privacy to the user.
4	Steep roof	To speed up the flow of rainwater.
5	Area with open space	Multifunctional space for various events with good natural ventilation and lighting.
6	Opening at roof attic	To allow for natural ventilation and daylighting.
7	Roof made of leaves or clay (senggora)	A good heat insulator that reduces heat transfer into the house and does not absorb a lot of heat from sun radiation.
8	Opening on wall (i.e., wooden craft/timber louver)	To allow for natural ventilation and daylighting.
9	Natural construction materials (i.e., timber/bamboo)	Indigenous and abundantly found material which is a good heat insulator and does not absorb a lot of heat from sun radiation.
10	Open floor plan	To encourage cross ventilation and natural lighting without physical barrier.
11	House plan with small width	To encourage good natural ventilation and daylighting.
12	Modular house plan	To allow for easy construction, as well as future extension and relocation.
13	Rain harvesting and use of water well	For domestic water uses such as for shower, irrigation, and cleaning.
14	Different floor levels	To differentiate between various purpose of spaces, to suit timber joint construction and to allow ventilation between the floor gap.
15	Seating area underneath house	As a social space and multifunctional area such as large gathering.
16	Construction using wood joint	Joining technique using wood for stronger construction as well as easy assemble and disassemble.
17	More than one entrance	To separate men and women entrances, and to allow for appropriate access or exit for various activities and purposes
18	Connecting space between two indoor spaces	To encourage natural lighting and cross ventilation. It also serves as a place to dry clothes and foods, and other family activities.
19	Flooring with gaps	to allow for natural ventilation as well for cleaning, urinate, give birth, draining, etc,
20	High indoor spaces	To allow for efficient natural ventilation.
21	Attic space below the roof	For additional floor area for room that can be used for multipurpose such as for hiding, bedroom (especially for daughter) and storage.
22	House oriented towards Qiblat	Due to religion factor and subsequently lead to the housing to face west sun light (the house protected from the direct sun light by building elements such as long overhang and verandah)

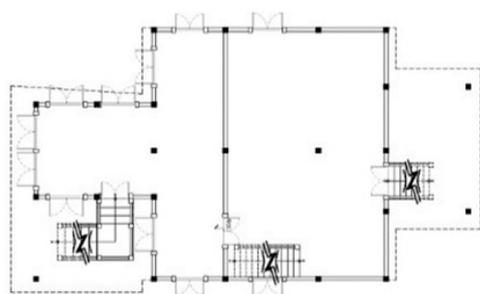
roof but with regional variations including decorations and symbolizations.

Table 1 shows the 22 green approaches that are commonly found in the traditional Malay houses throughout Peninsular Malaysia (Yuan 1987; Surat 2016a; Nasir 1985; Hashim & Nasir 2011; Surat et al. 2012; Hosseini, Mursib, & Raja Shamninan 2016; Surat 2016b; Mohammad Yusoff & Mohamed 2017; Mohamed 2018a; Mohamed 2018b; Surat 2018; Nik Muhammad Japlus & Mohamed 2018).

The 22 green approaches are slightly improved compared to the published list by Mohamed (2018). This proves that the Malay has successfully developed their house designs throughout hundreds of years with positive response to local environmental context and their social-culture needs. Unfortunately, in this modern day, these strategies are given less attention. Some of these strategies are even replaced by some less sustainable modern construction approaches due to various factors such as cost, new technologies, and fast construction technique. Therefore, it is important to understand the characteristics of the traditional Malay houses.

CASE STUDY 1: NEGERI SEMBILAN TRADITIONAL MALAY HOUSE

The Negeri Sembilan traditional Malay house named *Rumah Dato' Raja Diwangsa* was built by the owner himself, Datuk Raja Diwangsa Muhammad Yunus Jabar or affectionally called Tok Tonso by the village people, a nobility of Seri Menanti in the 1920s (Figure 1). It was



(a)



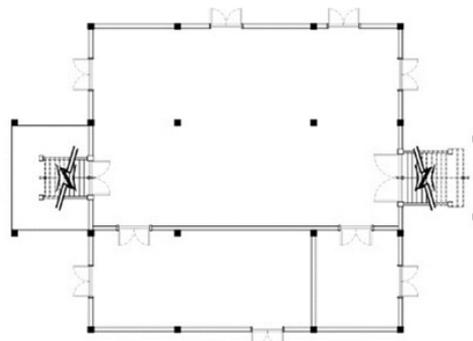
(b)

FIGURE 1. (a) Ground floor plan, and (b) Front photo of *Rumah Dato' Raja Diwangsa* at UPM Malay Heritage Museum

handed over to Malay Heritage Museum of UPM in March 2013 by Darwinshah Muhammad Yunus, the successor of Tok Tonso to be restored and preserved. It consists of five main sections which are porch, closed veranda, main room, attic, and kitchen. It was built using cengal wood for the main pillar, while wall and floor were built using meranti wood (Mazlan, 2013a). According to an interview with Dr. Pauzi Muhammad Abdul Latif, the Director of Malay Heritage Museum of UPM, the reconstruction of this house started with Malay traditional ritual, a prayer recitation, followed by raising the house's *tiang seri* (Mazlan, 201a3). This house has one unique feature of hanging pillar (*tiang gantung*) that serves as a spiritual and logical purpose as an indicator of incoming disaster if its position is tilted (BH Online, 2016).

CASE STUDY 2: PERAK TRADITIONAL MALAY HOUSE

The Perak traditional house is also known as *Rumah Kutai* (Figure 2). The word *kutai* means old or ancient among the people of Perak, and such houses are said to have existed along the banks of Sungai Perak in the olden days (Juferi & Anuar, 2013). It was owned by late Putih Halimah Uda Noh bin Kanda Jaafar, a Malay warrior and built in 1901. It originated from Sungai Perak's riverbank in Kampung Pediat, Bota Kanan. It was handed over to Malay Heritage Museum of UPM on 2013, not long after the Negeri Sembilan traditional house arrived there (Mazlan, 2013b). According to Mazlan (2013b), the design of the relocated



(a)



(b)

FIGURE 2. (a) Ground floor plan, and (b) Side photo of *Rumah Kutai* at UPM Malay Heritage Museum

*Kutai* house is unique as it incorporates defense mechanisms with two approaches. The approaches are construction of rifle pits at the main entrance as well as kitchen entrance and the creation of the 90° steep staircase that makes harder for enemies to climb. Mazlan (2013b) also stated that it is also very unique compared to the other Malay houses because this house uses planks of cengal trees that is usually used to build columns or pillars. It also has attic as a safety area for the occupants with no permanent staircase connected to the lower level.

#### CASE STUDY 3: TERENGGANU TRADITIONAL MALAY HOUSE

The Terengganu traditional house, which is also known as *Rumah Bujang Selasar* Terengganu, was originated from Kampung Tanjung in Kuala Terengganu and handed over to UPM in March 2014 (Figure 3). In a video interview for Project Tunas (2014), it was said that the house was built by its owner himself, Wan Muda Wan Hassan, a boatman with the help from the villagers. It consists of only veranda (*selasar*) and the main house space.

According to Aisyah, a representative of Malay Heritage Museum, UPM in a video from Majalah Infiniti TV (2017), another uniqueness of this house is it is high on stilt to prevent from the attack of wild animal and splashing sea water since it was built near the beach. It was built only

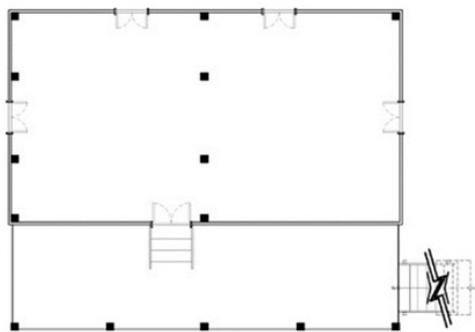
using wood jointing, *senggora* tiles for roofing and it also has connecting doors (*penyambung*) served as an opening for future extensions of the house.

#### CASE STUDY 4: PAHANG TRADITIONAL MALAY HOUSE

Figure 4 shows the Pahang traditional house, which is also known as *Rumah Serambi* Pahang. It was built in 1924 and originated from Kampung Kelola in Pahang (Utusan Online 2015). It was once owned by the village head, late Ismail Khatib Abu Bakar and has gone through massive floods in 1926, 1971, and 2014, but it still stands in a good condition. A team from UPM dismantled the house from its origin, transported, and reconstructed it at the Malay Heritage Museum in February 2015 (New Strait Times 2015). This house consists of three main spaces. It has two main columns (*tiang seri*) for easy relocation and the house is built using hardwoods without using a single nail.

#### CASE STUDY 5: KELANTAN TRADITIONAL MALAY HOUSE

The Kelantan house or palace was originated from Kelantan and relocated in Taman Pantun, Universiti Kebangsaan Malaysia (UKM) in 2006. The house is known as *Istana Puteri Bongsu*. The house was sold in 2000 and belongs to the Department of Museums and Antiquities, now known

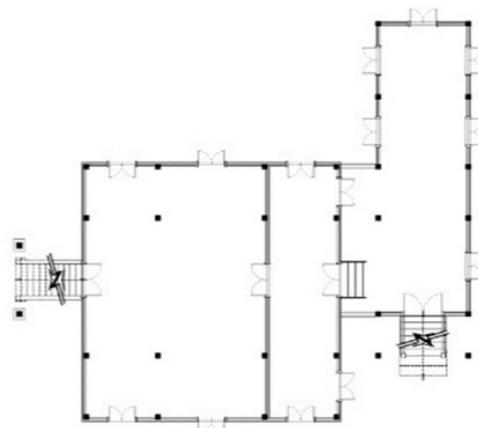


(a)



(b)

FIGURE 3. (a) Ground floor plan, and (b) Photo of *Rumah Bujang Selasar* Terengganu at UPM Malay Heritage Museum



(a)



(b)

FIGURE 4. (a) Ground floor plan, and (b) Photo of *Rumah Serambi* Pahang at UPM Malay Heritage Museum

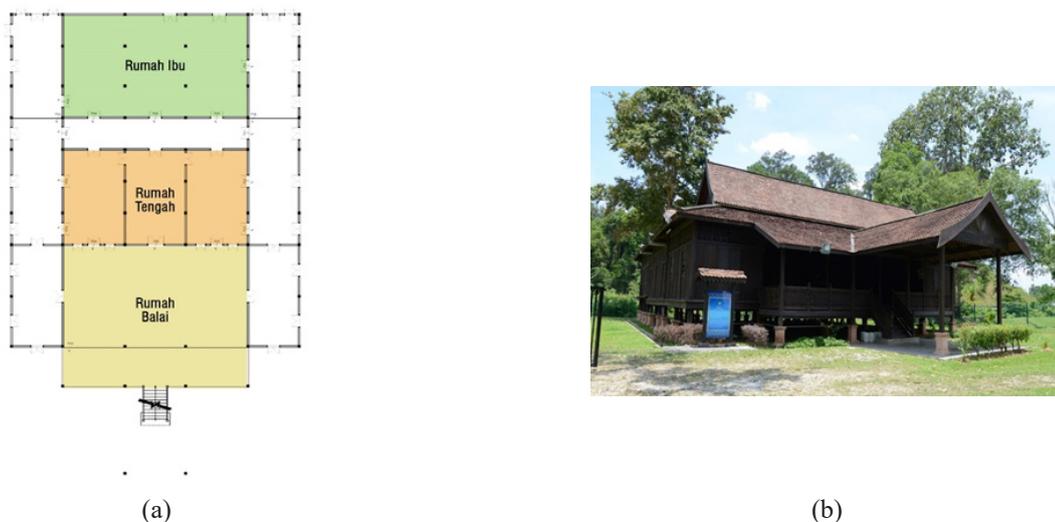


FIGURE 5. (a) Ground floor plan, and (b) Front photo of relocated *Rumah Tengku Bongsu* at Taman Pantun UKM

as Department of Museums Malaysia (JMM). This house initially belonged to Tengku Fatimah Zaharah binti Tengku Chik, the descendant of Sultan Muhamad IV (Sultan Ahmad) who ruled Kelantan in the late 19<sup>th</sup> century (New Strait Times 2000; Surat 2013; Ahmad Zakaria 2016; Pusat Rujukan Sehenti Penyelidikan Alam Melayu 2019). According to Mastor Surat, only 50% of the house is restored and conserved at the site, while the other 50% is not at the site (Pusat Rujukan Sehenti Penyelidikan Alam Melayu 2019).

Figure 5 shows the ground floor and photo of the house at Taman Pantun UKM while Figure 6 shows the illustration of the original extension of *Rumah Tengku Bongsu* according to the initial findings and assumptions (Surat 2013). Only *rumah ibu*, *rumah tengah*, and *rumah balai* are available at Taman Pantun UKM. The authors are still conducting further research on this house to investigate the original layout plan. Initial finding shows that current layout at Taman Pantun also does not hundred percent similar to the original layout. Further investigation is required on this, nevertheless, this house still a good

example of the traditional Kelantan house that belong to royal family.

#### ANALYSIS AND DISCUSSIONS

Based on the observation and literature review, there are similarities and differences between all the houses. Not only the design of the houses varies due to culture and context, but also the application of green or sustainability approaches into the houses is different. The comparison between the case studies is listed in Table 2.

From Table 2, it can be observed that the selected traditional Malay houses were designed with green approach strategies as listed in Table 1. However, it may not have adopted all the 22 green approach strategies due to various factors such as cultural and local context. In terms of basic criteria of a traditional Malay house such as large and many openings, raised floor system, use of basic construction materials, and construction method, there are not much differences between those traditional houses.

TABLE 2. Comparison of green approach strategies between traditional Malay houses

No.	Strategies	Rumah Dato' Raja Diwangsa (N. Sembilan)	Rumah Kutai (Perak)	Rumah Bujang Selasar (Terengganu)	Rumah Serambi (Pahang)	Rumah Tengku Bongsu (Kelantan)
1	Large window opening (half/full opening)	/	/	/	/	/
2	Wide roof overhang	/	/	/	/	/
3	Built on stilt with concrete or stone base	/	/	/	/	/
4	Steep roof	/	/	/	/	/
5	Area with open space	/	/	/	/	/

cont.

*cont.*

6	Opening at roof attic	/	×	×	/	×
7	Roof made of leaves or clay (senggora)	×	×	/	×	/
8	Opening on wall (i.e., wooden craft/ timber louver)	/	×	/	/	/
9	Natural construction materials (i.e., timber/bamboo)	/	/	/	/	/
10	Open floor plan	×	×	/	×	×
11	House plan with small width	/	/	/	/	/
12	Modular house plan	/	/	×	/	/
13	Rain harvesting	/	/	/	/	/
14	Different floor levels	/	×	/	/	/
15	Seating area underneath house	/	/	/	/	/
16	Construction using wood joint	/	/	/	/	/
17	More than one entrance	/	/	×	/	/
18	Connecting space between two indoor spaces	×	×	×	/	/
19	Flooring with gaps	/	/	/	/	/
20	High indoor spaces	/	/	/	/	/
21	Attic space below the roof	/	/	×	×	×
22	House oriented towards Qiblat	*Data not available due to house relocation				

#### CONCLUSION

The traditional Malay houses in Malaysia implemented various green or sustainable design strategies. This study outlines 22 common green design strategies that are generally found in the traditional Malay houses in Peninsular Malaysia. The strategies outlined are mostly appropriate to be applied in modern houses to ensure sustainable development especially on strategies associated with passive design strategies. Part of the strategies also parallel with

Even though it has common design strategies, these traditional Malay houses from five states vary in design approaches which may be due to the local context such as specific local cultural and environmental context. Thus, it has a distinct local and individual identity. Each element and component of the Malay traditional houses play an important role to reflect the beauty of the culture.

The use of materials, construction method, space arrangement, and a touch of distinct identity make them worth to be recognized, conserved, and applied in modern house designs. Therefore, it is important to educate the community, especially designers and developers, on the true meaning of beauty by taking the cultural and environmental context into consideration when it comes to designing habitable spaces. This is important to ensure sustainable development in Malaysia.

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#### DECLARATION OF COMPETING INTEREST

None.

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