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**SUSTAINABLE BUILT  
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# THE IMPORTANCE OF SINGGORA ROOF TILES ON TRADITIONAL AND CONTEMPORARY BUILDING.

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## ABSTRACT

*Singgora roof tiles were so popular back then because the shape was very eye-catching and lightweight. Other than that, Singgora roof tiles can absorb water during rainy days and able to give cooling effect to the internal house during the day while making occupants feel comfortable. It also has a longer lifespan than organic roofs which decompose quickly and are flammable. But nowadays, the demand of Singgora roof tiles is decreased. One of the main factors is due to emergence of modern architectural materials such as cement roof tile that replacing Singgora roof tiles. The objective of the study is to know the importance usages of Singgora roof tiles in traditional and contemporary buildings in Kelantan and identify the decreasing factors of Singgora roof tiles. The qualitative method was conducted by doing site observation and interviewing Mohamad Salleh, the owner of Singgora Homestay at Pasir Hor, Kelantan and Noraini Hj Jusoh, the owner of Craft Atap Singhora factory, a Singgora factory in Bachok, Kelantan. Four buildings (both traditional and contemporary buildings) constructed with Singgora roof tiles were chosen. The buildings are i) Istana Tengku Nik at Terengganu, ii) Istana Jahar at Kota Bharu, Kelantan, iii) Masjid Kampung Laut, Tumpat, Kelantan and iv) Istana Syarqiyyah at Terengganu. There are four stages of Singgora tiles process. The properties of Singgora tiles itself, Singgora tiles has small scale industry and people's perceptions towards Singgora tiles are the three major factors that contributes on declining of Singgora tile's demand.*

**Keywords:** *Singgora roof tiles, traditional, contemporary, homestay*

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## INTRODUCTION

The architecture of a house is a significant cultural symbol that represents greater worth of the inherited history. The traditional Malay house's uniqueness imbued with its own function, aesthetic and rich with cultural identity which this uniqueness always portrays by the character of pitch roof. There were three parts that are important in traditional Malay house which is, the walls, the pillars, and the roof (Nasir & Teh, 2011). Roofs serve as a sign of racial origins as well as a means of protecting the body and the occupants from rain, sun and snow. Traditionally, organic, and flammable materials such as palm leaves and wood were used to cover the roofs of houses in Malaysia (Killmann et al., 1994). Singgora tiles, are the roofing material that has absorbed foreign influence due to historical and cultural traits with Thailand and Indo-China and are used to cover the roofs of Peninsular East Coast dwellings (Killmann, 1994).

Singgora tiles is made from clay on foot were used as roof covering since more than 200 years ago. The word Singgora was derived from word '*kra buang Songkla*' that means "Lion City," and was named after the lion shaped of a hill in Songkhla, Thailand. The other name of Singgora tiles is Singhora roof, Genting roof. While Kelantanese called it as Brick roof. This roof is commonly found on traditional timber structures such as houses, palaces, *wakaf*, mosques, wat Siam, gates, and tombs. Shaari Saud (2009), said, the single sheet of Singgora roof tiles in Thailand and Malaysian are differ in shape and size. There are two types of Thai Singgora roofs: V and U shaped at the end. Meanwhile, the Kelantan Singgora roof features a V-shaped end or a diamond-shaped pattern.

In this research, will identify the importance usages of Singgora roof tiles on traditional and contemporary buildings in Kelantan. Roofs made of Singgora tiles have a lengthy life span of over 150 years, as seen by historic structures like as Istana Jahar, Wakaf Tok Selehor, Wakaf Siam (Wat Chomprachthumthactchanaram), Rumah Wanpo, Masjid Kampung Laut, Mea Teak and many more. The earth rice paddy clay used in the Singgora roof is appropriate for use in hot tropical areas (Zulkifli, 1994). Its porous and thin nature allows it to absorb water when it rains, allowing it to organically cool the housing space.

Stackable roof pieces that allow air to circulate through a breach in the roof. The distinctiveness of Singgora roofs is also due to the traditional manufacturing method used from ancient times until today. During the preparation of clay, its production, and burning, the Singgora roof is made without the use of high-tech equipment. In comparison to thick modern roofs that absorb and store heat, the Singgora roof is thinner and does not absorb or store heat.

Despite the benefits of Singgora roofs, there are several drawbacks that are frequently mentioned. For example, it is easily shattered during the transporting and installation process due to its thinness and lightness. Also, homeowners that use Singgora roof tiles are frequently confronted with the issue of Singgora roof tiles are easily broken because of natural elements (wind, rain, and hot sun).

## **LITERATURE REVIEW**

### **The Usage of Singgora Roof Tiles on Palace and Mosque at East Coast in Malaysia.**

Traditional palaces and mosque with timber construction still exist and well preserved especially at Kelantan and Terengganu. These heritage buildings are maintained and care by respective State Museums and Majlis Pembangunan Wilayah Pantai Timur (ECERDC).

Traditional palaces and mosque preserve the identity, religious, culture and architecture which roofed with Singgora roofs tiles. Istana Tele or Istana Tengku Nik at Terengganu and Istana Jahar at Kelantan, are among the most notable traditional palaces at East Coast of Malaysia. Similarly, to masjid Kampung Laut at Kelantan that portrays the concept of a Muslim's prayer house by its architecture.

#### **Istana Tengku Nik, Terengganu**

Istana Tengku Nik also known as Rumah Tele, is a single-porch house that was erected in 1888 AD under the reign of Sultan Zainal Abidin III. After a devastating fire in 1882, this castle was reconstructed as part of the Tengku Maziah wooden palace complex. During a visit to Terengganu in September 1888, this palace was used as a brief stopover for King Rama V, King Chulalongkorn, and other Siamese nobles. Ms. Khaltum bt Haji Daud, one of the late Sultan Zainal Abidin III's wives, later lived there as well. The palace's design is divided into three sections with a total area of 18.8m x 10.9m, a height of 7.78m, and a floor-to-ground height of 2.12m. The outside structure of this house is designed in the ornate widow wall style. Due to the usage of cengal wood, the structure of this house appears to be strong and durable. The roof is also covered with roof Singgora from Songkhla, Thailand.

This palace, according to Tajuddin (2004), demonstrates innovative carpentry and royal design talents. Locals and Patani are the folks who build the houses. Carving is done by two guys who specialize in gold and silver carpentry. Tengku Nik owns this house after Tengku Ngah's death, and it is known as Tengku Nik Palace. Following Tengku Nik's relocation to Istana Bara, this palace became vacant. Eastern Mining and Firm Ltd, a Dungun-based iron ore mining company, later purchased the palace. In 1970, this home was relocated from Istana Maziah touala Ibai. The Palace Tengku

Nik was re-located and developed in the region of the State Museum Complex Terengganu, Bukit Losong, in July 1987.

According to Hafis (2011), an assistant curator of the Terengganu Museum, the Singgora roof is employed to highlight the peculiarity of the traditional architecture of the Terengganu palace. A single roof is used in the traditional house architecture seen in the Terengganu Museum Complex. This is owing to the fact that there were no Singgora roofing enterprises in Terengganu at the time. The Singgora roof, aside from being readily shattered, does not pose a challenge for the architecture under his direction. He also believes that, because to the design and nature of the material, the Singgora roof can bring comfort to residents.

The greatness and sensitivity of the old Malays are clearly reflected in traditional architecture (Alisa, 2011), head of the Terengganu museum's ethnology division. Good air circulation is supported by the design of pillared houses, wind lattice carved, the height level of the house corresponding to the wind flow, and the roof of the Singgora of clay material. These elements are capable of providing comfort to the house's occupants without the usage of fans or air conditioners. The usage of a Singgora roof in Tengku Nik's Palace poses no serious issues; nonetheless, if it is damaged by wind or tree twigs, it must be replaced with a new one.

### **Istana Jahar, Kota Bharu, Kelantan**

Sultan Sultan Muhammad II presented Istana Jahar to Long Kundor in 1880. Sultan Muhammad II's grandson, Long Kundor, had the title of Raja Bendahara. The palace was finished in 1887, a year after Sultan Muhammad II's death. This palace was afterwards renamed the King Treasurer's Palace. Sultan Muhammad IV (Long Senik) lived at this palace after his death on 2 Syawal 1890. He had beautified the palace courtyard by planting a Jahar tree. Istana Jahar has been the name of the palace since then.

The overall design, materials, and construction techniques employed in the creation of Istana Jahar demonstrate the beauty and subtlety of the architecture. The rafters of the palace roof are decorated with Singgora roofs manufactured in Kelantan. The Singgora roof utilized on the rafters of Istana Jahar attempts to show the authenticity of the design and original materials of this palace. The Singgora roof has a unique function that allows occupants to stay cool during hot weather. This roof, on the other hand, has the problem of being easily broken if the combustion is young. In the event of a severe wind, Singgora roofs can readily shift position. (Salleh, 2012). The arrangement of the Singgora tiles at the ridge (perabung) was called Sisik Naga.



## **Masjid Kampung Laut, Tumpat, Kelantan**

Masjid Kampung Laut is the oldest mosque that is still standing, functioning, and looking as it did when it was built in Malaysia. The vernacular architecture of the mosque is based on traditional Malay architecture, which employs a sustainable and passive design philosophy, said traditional architectural historians. Furthermore, it is the Malay world's only mosque built entirely of native materials such as "chengal" and "Merbau" hardwoods and Singgora roof tiles (Akib, 2003).

Even though the mosque is over a century old, it continues to serve the local community as a place of worship. The mosque is regarded as a living museum, and visitors continue to flock to this iconic mosque to learn more about its rich history and knowledge (Abdullah,2000). The exact date of construction of the mosque is debatable. However, many academics agree that this mosque is not only the oldest in Kelantan, but also in Malaysia (Nasir, 2004).

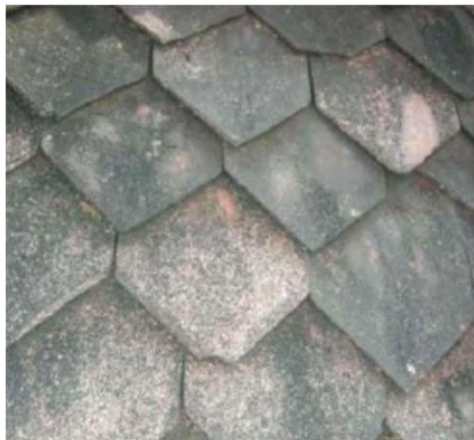
The mosque portrays the concept of a Muslim's prayer house by its architecture, which adapts to the location and surroundings, and so embodies the Islamic religion. The design is also in keeping with the local culture, climate, and environment, while also displaying the beauty of Islamic architecture (Sulaiman, 2007). Rasdi (2007) backed up the previous remark by stating that there are many different mosque styles and forms around the world. The main prayer hall, niche ("mihrab"), verandah, and ablution area are significant mosque spaces, according to Ariffin (2005) and Hassan (2010), whereas the mosque orientation must face the Kiblah direction.

The mosque's architecture is noteworthy, and it is claimed to be similar to Kuno mosque in Champa, Wadi Hussein Mosque in Thailand and Demak Mosque in Jawa. The mosque's design incorporates all of the typical Malay architectural components, including an elevated raised floor, three-layered roof, and carved supporting columns, all of which were constructed entirely of "Chengal" hardwood timber and "Singhorra" clay roof tiles (Nasir,2004). According to Akib (2003), the mosque was built in stages, which can be divided into three categories: early stage, developing stage, and final stage. Several areas, including "Balai Lintang," "Wakaf Orang Kaya," and the attic level, were added during the last stage of its building.

Traditional master builders, according to Said (2001), had best considered and made use of the natural air flow in this tropical climate. To address the demand of plenty of ventilation for constructing in this hot-humid climate, the traditional master builder developed numerous perforated building elements such as perforated floors, perforated walls, and ventilated panels at the tiered roofs. The ornamental designs on the architectural parts of this traditional building included geometrical patterns, floral patterns, and calligraphy patterns, all of which reflected the aesthetic and high value of traditional Malay culture.

The mosque's roof is divided into three sections. A space separates each of the roof layers to allow air to circulate. The roofs are supported by large wooden pillars at each of the four corners, sixteen inside pillars, and twenty-four verandah pillars, totaling forty-four pillars. Around the lowest roof tier, there is an overhang roof with a diameter of about 50 cm. This design element is crucial in tropical countries because it acts as a barrier, preventing precipitation and sun rays from entering the building through the openings. There are clerestory louvres that allow stack effect air flow and indirect natural light to pass through between the top and middle roof layers.

The roof is made of clay roof tiles, which are a local material, Singgora roof tiles (refer Figure 1). A sculpture feature serves as the roof cap for this classic mosque at the very top of the roof. The local master builder referred to it as "buah butung." Because the mosque has no ceiling, the roof structures are visible, emphasizing the elegance of Malay architecture (Nasir, 2004). There was no insulation installed in the roof construction, only Singgora tile and the roof framework. The roof of the Main Prayer Hall is approximately 417.2m<sup>2</sup>, while the roof of the "Balai Lintang" and Verandah is around 187m<sup>2</sup>. The "Wakaf Orang Kaya" has the smallest roof area, at only 72m<sup>2</sup>.



**Figure 1: Singgora tiles on Masjid Kampung Laut Tumpat, Kelantan (Ahmad Sanusi, 2014)**

### **Istana Syarqiyah, Bukit Chendering, Terengganu**

Istana Syarqiyah was located at Bukit Chendering was previously known as the Istana Bukit Chendering Complex until July 4, 2013. Later, the Menteri Besar Dato' Seri Haji Ahmad Said declared a new name, Istana Syarqiyah that means Eastern Germ, with the agreement of the Sultan of Terengganu, Sultan Mizan Zainal Abidin. Bil Bensley, the architect, spent over a decade creating Istana Syarqiyah, a RM1 billion architectural marvel that will be Malaysia's first Islamic-themed palace and royal dwelling. He has worked on over 180 real estate projects in 30 countries, with

a focus on luxury and exotic styles. Time Magazine also called him as “The king of exotic luxury resorts”.

The palace, which began construction in 2006 and was finished in 2014, was erected in four phases. According to Director of Jabatan Kerja Raya (JKR) Dato Shafii Mohamad, Earthworks, retaining walls, ponds, drainage, pipes, cables, administrative offices, ceremonial halls, TNB buildings, pump houses, and mechanical and electrical works are all included in the first and second phases of the palace complex's development. Earthworks, ceremonial halls, palace guards' offices, suraus, halls, roads, parking lots, Islamic halls, and the main residence of Istana Tuanku, as well as interior decoration works, are all part of the third and fourth phases. The palace consists of 6 floors which is 4 floors on the ground and two floors underground.

The palace is embellished with approximately 5,000 distinct paintings ranging up to 9 meters in length, and it is built in a blend of traditional Terengganu architecture and Islamic architecture that was inspired by a historic building in Andalusia, Spain. The 160,000-square-foot palace includes over 100 rooms, each with its own unique style. With the installation of fountains and towers that surround the park, the area of up to 865 acres is spectacular. This palace is the Sultan's principal palace, with a three-story hall where all official festivities will take place.

This palace was also designed with some combination of modern and traditional design. All the walls were made by brick, while the roofs were covered with Singgora tiles which is very well-known traditional roof covers in East Coast. The usage of Singgora tiles as the roof cover is to maintain the traditional identity of Terengganu. It also shows that Singgora tiles can go very well even with modern building design or materials nowadays. The Singgora tile used at the palace were modernize Singgora that made in Thailand. It's thicker and more durable than Malaysia's Singgora.

Bensley said, it's all about showcasing the very specific design language of Kuala Terengganu, which is different from anywhere else in Malaysia, and taking that into the 21<sup>st</sup> century. The biggest challenge was how to keep the smallness of traditional Terengganu architectural intact while constructing a larger building.

Other than the usage of Singgora tiles, there are other symbolic features of Terengganu that were used in the design. Such as, the wood carving that used at the façade, the boats were hanging on the hall as decoration and many more. With all this, the visitors can have a new experience where they are in the modern building but also can feels the traditional environment.

## METHODOLOGY

Qualitative method is used to understand the process of making the Singgora tile and the application on the buildings. Data are gathered through the, i) literature review on four traditional building that using Singgora Roof Tiles at East Coast Malaysia, ii) observation to two case studies (Homestay at Pasir Hor Kelantan and Craft Atap Singhора factory at Bachok, Kelantan) and ii) interview to both owners (homestay and factory).

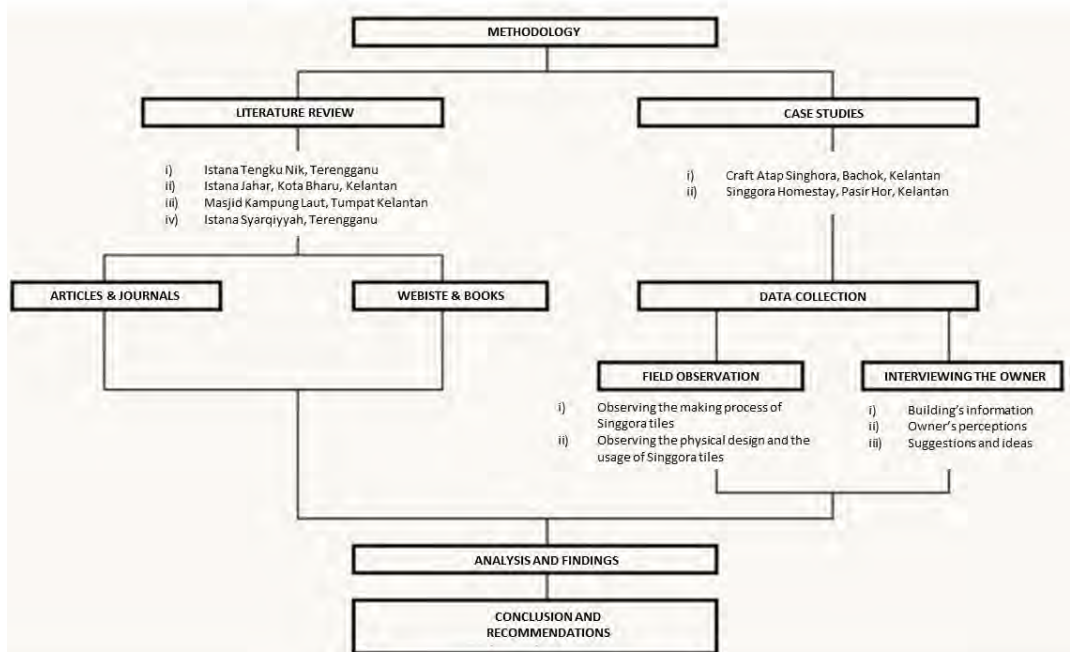
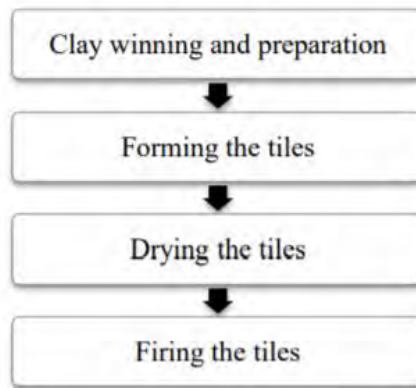


Figure 2: Flow chart for methodology process

## ANALYSIS AND FINDINGS

### The Process of Making Singgora Roof Tiles

During the site visit at Craft Atap Singhора factory at Bachok, Kelantan, there are four stages involved in the production of Singgora tiles were observed. Four phases of the production are as figure 3.



**Figure 3: Sequence of Singgora tiles production (Nor Hidayah, 2014)**

### **Clay Winning and preparation**

Singgora tiles are made with clay as the primary raw material. Beach ridges mixed with swales (Bris) are the type of clay used to manufacture Singgora tiles, which are mostly found on Malaysia's East Coast. This clay can be found in the Kemasin River's paddy fields. The former dug area may be seen near the stagnant water. According to the findings, when digging the clay, the excavation is done by unskilled employees. Besides, no raw material selection is done. A bulldozer excavates the clay at random to a depth of 1 m from the paddy field's surface. As a result, the humus and organic matter deposited on the soil's surface are also taken.

Next, the clay is transported to the factory by lorry once it has been extracted and stored abundantly in the workshop. The clay was a brownish grey color. It was discovered to contain numerous contaminants such as rotten wood, coal, coarse sand, dried leaf, bark, soil and stone. The clay is blended with the water and grogs after it has been stored. Until a consistent mud is created, the smooth process will be made using a machine (refer figure 4). Before the existing of the machines, they used men's power where they kneading the clay using their foots. The key to achieve a good quality of product is by grater quality control of the clay and the amount of water added to achieve a good texture of the clay (Natrah, 2021). It will provide a smoother tile surface, give the dry green tiles and fire goods more strength and make the clay simpler to shape.



**Figure 4: Machine used to smooth the clay (Field Observation, 2021)**

### **Forming The Tiles**

Men's power was used for shaping the tiles. The mould is stretched out on the ground and lightly coated with rice husk ash for easy release in this classic tile-making procedure. By hand, a lump of clay is poured into a frame mould and squeezed with the foot. Because the clay is kneaded while standing, it is less likely to direct into the corners of the mold. This can lead to the final product was non-uniform.

The wet green tiles are then placed on the pallet (refer Figure 5). Twenty-five green tiles are put on top of it. The green tiles deformed easily due to their tiny thickness dimension. In comparison to the top layer, the green tiles in the bottom layer have a flatter shape when placed on a level base. It also demonstrates the non-uniform thickness of the green tiles. The pallets were stored laying on the ground and covered with some clothes.



**Figure 5: The Wet Green Tiles Placed on the Pallet (Field Observation, 2021)**

## **Drying The Tiles**

The area where the green tile pieces are dried has an uneven ground surface covered with areas of grass, gravel, and sand. This drying process was located in front of the factory. The livestock and kids who roam freely in the neighbourhood have access to this open drying ground, and they occasionally stomp on the tiles. As a result of this, small stones, grass, and sand can become lodged at the foot of the green tiles. Depending on the weather, the drying period varies from one batch of green tiles to the next. According to Natrah (2021), The green tiles are normally dried for approximately two hours under the sun. In addition, during this process, the end part of the tiles was bent vertically to produce the hook.

When it rains, it does not really affect the drying process as the process will be done under the roof of the factory and it will take one day to finish the drying process (Natrah,2021). When the ground is still moist after raining, the green tiles will be lining with box or plywood to avoid the moisture from the ground effect the green tiles. It's critical to evenly dry the tile's surfaces since a lower moisture differential between the surface and the dry green tile's center reduces the risk of cracking (West & UNIDO, 1996). The green tiles are carried into a barrow and transported to the plant after drying.

The uneven surface of green tile is flattened with a wooden paddle before being stored. Each surface area is knocked after ten pieces of unbaked tiles are piled close together. This worked to shatter the tiles by disrupting and breaking the link between the plastic clay particles.

In the factory's working area, the green tiles were stacked without the use of racks, and only bamboo and wood were utilized to keep them from collapsing. Once the quantity of dried green tiles reaches about 35,000 - 38,000 pieces, they will be burned. According to Natrah (2021), if there were any defects before burning process happened, the green tiles will be dried again to remove any remaining moisture before being fired.

## **Firing The Green Tiles**

During the traditional firing of Singgora tiles, the workers will be divided into two groups. One group will passing the green tiles from the rack to the kiln while the other groups will stay in the chamber of kiln (refer figure 6) to arrange the Singgora tiles. Because there is no door built into the kiln wall, the green tiles are loaded from above. The worker uses the ladder to enter the kiln chamber. The green tiles are set in an alternating pattern, beginning at the kiln's edge. Broken Singgora tiles are utilized to fill the spaces between the tiles, which are tightly placed. It takes approximately eight hours to complete the loading procedure (Natrah,2021). The second layer of green tiles is laid on top of the first, and the process is continued until the final layer is

reached. In the kiln room, 35,000 – 38,000 green tiles were piled in ten layers with minor gaps between them.



**Figure 6: The Chamber Kiln used to do Firing Proses (Field Observation, 2021)**

The top layer of green tiles is covered with charred bricks that are tightly packed. Without the use of mortar, the heat is trapped inside the kiln's chamber. Prior to the firing. When the fire is lit, the fire-box is cleaned by removing the ash from the fire-mouth. As a fuel, dry rubber wood is used to start the fire. The mango wood (*kayu pauh*) also can be used but rarely because the cost is high (Natrah,2021). The gradual heating at the start of the firing process, which takes around two weeks, mild fire is utilized based on the weather.

When white powder, similar to chalk, emerged on the surface of the tiles, the firing process was continued with a huge fire. The crystalline deposit of soluble salts on the surface of tiles caused by water travelling within the tiles and evaporating on the surface is known as efflorescence. The full fire used the same fuel as the light fire, and it was kept at its peak temperature for three days to ensure that the heat was dispersed evenly throughout the chamber.

The cooling stage is allowed to proceed at its own pace, and both fire-mouths are bricked and plastered with a mixture of sand, wood ash, and water. Before being unloaded, the fired tiles are allowed to cool for one week within the kiln. The completed items. The quality of the fired tiles is tested by flicking them. Then the tiles will be packed in a box or wooden box before deliver it to the customers using a lorry. According to Natrah (2021), so far, chances of the Singgora tiles to be crack during the transportation from factory to the customers is very low.



## **The Physical Design and the Usage of Singgora Roof Tiles on Singgora Homestay, Pasir Hor, Kelantan**

During the observation at the second case study, Singgora Homestay, located at Pasir Hor, Kelantan, the ventilation system, layout, material of the homestay was observed. The importance as discussed below.

### **Give natural cooling effect for the building**

The roof of this homestay is designed with “Atap Pemeleh” roof structure and finished with Singgora tiles making the interior becomes cool naturally. The local weather condition, which is hot and humid, has been taken into mind to this homestay, which has maximized the opening to allow fresh air from outside and ventilation to occur to provide comfort to users.

A two-tiered pyramid roof design gives good thermal comfort because it will indirectly provide double volume, causing hot air to be high and far away from the user, and the gap between the roofs will remove hot air, which is referred to as stack ventilation or buoyancy. Raised floor also applied to maximize ventilation. Because of the thermal mass of the clay tile, the building can withstand temperature changes throughout the day. The tiles will absorb the heat during peak temperatures, resulting in a cool indoor temperature for the living space. During peak temperature hours, this maintains the interior of the room comfortable. The absorbed heat is released at night, keeping the room warm. As a result, Singgora tiles help to improve building comfort while also lowering energy usage.

According to Mohamad Salleh (2021), only one course of tiles is hung on each batten in this style of roof installation, known as double-lap tiling. Because the air may flow via predetermined hollow beneath the installation, it creates a ventilated roof covering. Mohammad Salleh (2021), the owner mentioned they don't need any fans or air conditioner when staying in the house because it is already cool naturally especially during raining season.

The cooling effect was also caused by clay's inherent ability to absorb rain and transform it into cold, refreshing air. Evaporation was the result of water when it hit the surface of clay, according to a theory promoted by Zainul Abidin Hassan (2010). In terms of physics, the cooling of water on the surface of clay can be accomplished through two processes: the addition of a water-holding surface and evaporation. Each roof tile's surface is porous, allowing water to pass through and meet the air. While a large overhang and lattice prevent direct sunlight from entering the building, they do so indirectly by reducing glare and heat. The dark tone of real wood also helps to reduce glare from sunlight reflections.

## **Keeping the heritage identity of East Coast, Malaysia**

Mohamad According to Mohamad Salleh (2021), all of the Singgora tiles used at the homestay was recycled Singgora tiles. Instead of buying new Singgora tiles, he tried to find the owners of an old traditional house that is going to be demolished and buy it from them. The price for the recycled Singgora tiles is 50 sens until 80 sens while the new one is RM1 each. He slowly collects all of the traditional recycled materials all over the years to complete this homestay. The problem that occurs during the installation if using various recycled Singgora tiles is because of the difference dimension and thickness. They cannot install the difference size at the same times because there will be a gap between it and will lead to leaking. He also added, some of the quality Singgora tiles that were used at the main building were as good as the Singgora tiles used at Istana Jahar, Kota Bharu, Kelantan. Even the quality of Singgora tiles that were used as Istana Jahar was very old, but they are very durable because back then, Singgora tiles was made thicker compared to nowadays. In addition, the older the Singgora tiles, it will look more aesthetic because the presence of mold changing its colors and will attract more heritage and photographer lovers (Mohamad Salleh,2021). With the presence of the mold at the Singgora tiles did not affect the quality of Singgora tiles itself.

Other than using recycled Singgora tiles, they also used recycled Chengal woods. They bought Chengal woods from an ancient house near the Muhammadi Mosque in Kota Bharu. Since 2006, they have been collecting used wood. And the number is steadily increasing. The government sought to create a settlement area surrounding the Muhammadi Mosque in Kota Bharu in early 2014, and there were residents who needed to migrate, and the government had paid for their land. They're seeking old timbers, and their original dwellings are among Kelantan's early Malay houses, old traditional houses built with chengal timbers, the best of which is over 100 years old. The piece of timber wall was also inherited from the ancestral house in Pasir Hor. It is over 100 years old, and priceless.

## **Factors that Contribute to Decline the Demand of Singgora Tiles**

There are three primary variables that influenced the drop in Singgora tiles demand.

### **The properties of Singgora roof tiles**

Thin The properties of Singgora roof tiles are the biggest factors that contribute in declining the demand of Singgora tiles. This is because, the Singgora tiles in Malaysia are very thin and lightweight. It can easily break by running cats or wolf, branches that fall from the tree and even rubber seed that fall down and explode at the Singgora tiles can make it broken (Mohamad Salleh,2021).

According to Abdul and Wan (2002), the usage of low-quality Singgora tiles adds to high maintenance costs in traditional Malay structures. The most prevalent issue with Singgora tiles is the breakage of the hook. After a break, the tile body will slide downwards, leaving a space, allowing water to enter the building. Furthermore, maintenance work had to be done from the interior of the structure due to the fragile nature of Singgora tiles. Unlike modern roofing materials, employees performing maintenance work on the roof are unable to walk on top of it due to its brittleness (Loh,1995). Broken tiles are replaced by inserting new tiles from below the roof. As a result, the ceiling installation is improper for a structure with a Singgora tile roof.

When it comes to leaking, it was very hard to identify which parts is broken. Some of the parts are easy to replace but some of the part like the edges of the roof is very hard to replace and needs to get an expert to help replacing it (Mohamad Salleh,2021). Mohamad Salleh (2021) said, they need to keep at least 100 to 200 Singgora tiles at the store for the backup since it is very hard to find Singgora tiles nowadays.

### **Singgora tiles has small scale industry**

Singgora Singgora tiles are still made in only one facility in Malaysia, which is located in Bachok, Kelantan. They go on to say that this industry is run by a family and that the product has a small market but is distributed across the country. This industry is run by artisans or traditional craftsmen who require aid in modernizing their skills, tools, and manufacturing technologies (UNIDO, 1969)

There are numerous obstacles and issues that the small-scale industry in Malaysia needs to deal with. These issues are the result of entrepreneur's lack of formal education, notably in management and leadership. Although they have experience on the production line, they are lacking in technical expertise as stated in terms of finance and marketing (Rosman and Rosli, 2011). As far, the Singgora tile industry is still employing antiquated tools and technologies. This occurs because small businesses lack financial resources and are wary of new technology.

Before this, the workers in Craft Atap Singhora factory were ten peoples. Since some of the workers is getting old and sick, there are only three main workers left. It took approximately two months for these three workers with the help of owner's family to make 35,000 to 38,000 of Singgora tiles. Since the shortage of workers, they can only produce less than 40,000 in one cycle compared to before where they can produce 45,000 above in one cycle (Natrah,2021). One of the factors people did not want to use Singgora roof tiles again because it may take a very long time to que for the order since there is only one factory that made Singgora roof tiles in Malaysia. (Mohamad Salleh,2021)

The Malaysian government has backed the small business sector because of its economic impact. This includes the Singgora tile industry, which has received funding

from the Malaysian Handicraft Development Corporation (MHDC) (Faizul, 2011). According to Natrah (2021), they also received some machines to simplify the works, but some of the machines cannot be used because it cannot achieve the standard sizing and thickness of the Singgora tiles (refer figure 7).



**Figure 7: Some of machines at the factory (Field Observation, 2021)**

### **People's perception**

Demand The reduction in demand for Singgora tiles was also influenced by changes in house styles (Zulkarnian and Norlizaiha, 2013). The use of Singgora tiles in construction is regarded outmoded, outdated, and unworkable in today's dwelling style. Singgora tiles have been displaced by new products in many cases, and users prefer to utilize current roofing. Furthermore, individuals today do not have the option of purchasing a home based on their desire for Singgora roof tiles. If they want to alter their roofs to Singgora styles, it will cost them a lot of money. Meanwhile The contractors themselves have been cited as one of the factors driving to the decrease in the use of Singgora roof tiles for new structures, particularly in Kelantan. They are afraid that the challenges in producing Singgora roof tiles, as well as the quality of each piece, would raise the price of residences, therefore they refuse to utilise these clay-based tiles.

In addition, the others factors that contribute in decreasing of Singgora tiles is because, people nowadays did not have interest in learning to produce Singgora tiles because it needs a lot of manpower. At the same time, there are also many things need to be considered during making the Singgora tiles as example, the mixture of the water and the clay, the degree of firing process to make sure the firing process become smooth. According to Noraini (2021), This job is 100 percent manpower. This work is also rough and rolling clay under the hot sun. Maybe that's why the current generation is not interested in defending this enterprise. Other than that, the payment

received when doing this work also one of the factors why the youngster not into this work (Natrah,2021). Mokyoh one of the oldest workers in the factory received almost RM37.50 in 4 hours working per day. The payment will be received according to how many pallets can be produced in a day. 1 pallet that consists of 25 pieces of green tiles will be paid RM1.50. Mokyoh can produce approximately 15 pallets per day. Noraini (2021) said, she did not know how this legacy of her family's roof would be inherited as none of her children were interested in continuing the enterprise.

## CONCLUSION

From the methodology that has been carried from the literature review, can be conclude that the usage of Singgora tiles as the roof finishes at the three traditional building which are i) Istana Tengku Nik at Terengganu, ii) Istana Jahar, Kota Bharu, Kelantan and iii) Masjid Kampung Laut, Tumpat, Kelantan can create natural cooling breeze for the occupants without any help from fans or air-conditioner. With the combination of other sustainable materials such as Chengal wood or Merbau hardwood, it can create a success natural ventilation and natural lighting to get the best thermal comfort for occupant.

For the contemporary building, which is Istana Syarqiyyah at Terengganu, shows that, the usage of Singgora tiles as the roof covering also can blend so well with the modern design building.

From the methodology that has been obtain from case study at Singgora homestay, Pasir Hor, Kelantan, it was found that the local weather condition, which is hot and humid, has been taken into mind to this homestay. With the Atap Pemeleh as the roof structure, a stack ventilation or buoyancy happened in the homestay making the interior cool naturally. In addition, with the thermal mass of the Singgora tiles, the building can withstand temperature changes throughout the day. This keeps the interior of the room comfortable during peak temperature hours. At night, the absorbed heat is released, keeping the room warm. The addition of a skylight between Singgora tiles, a veranda, and openings at windows and doors allowed natural light to enter the interior, reducing the need for electricity (no need artificial light during day time). Color selection for interior areas is also crucial; bright colours enhance light reflection and generate glare, whilst darker colours decrease glare. In order to get pleasant eye sight and cool emotions, a combination of light and dark colours is recommended.

The study reveals that improving the quality of Singgora tiles is crucial to prevent declining demand. The production process and handling of clay are critical steps in achieving higher-quality products. The improper choice of materials and improper drying of green tiles contribute to poor quality. The kiln's uneven heat distribution and the use of tightly packed bricks without mortar can be addressed by filling spaces

between bricks and mud. Additionally, caution should be exercised when loading green tiles into the kiln chamber, and a door should be built into the wall to prevent workers from stepping on them. By implementing these improvements, the quality of Singgora tiles can be improved, leading to a more durable and long-lasting product.

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Tarikh : 20 Januari 2023

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