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Islam Came to South East Asia From China:

Evidence from Traditional Chinese Roof Design in Kampung Laut's Old Mosque, Malaysia

L'ISLAM EST VENU EN ASIE DU SUD-EST DE LA CHINE:

LES PREUVES DE LA CONCEPTION DE TOIT DU STYLE TRADITIONNEL CHINOIS DANS LES MOSQUÉES À KAMPUNG LAUT, EN MALAISIE

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Abstract: The objective of this study is to analyse influences of traditional Chinese roof construction elements to the roof design of Kampung Laut's Old Mosque in Malaysia. The result of this study can be used as an evidence that Islam came to South East Asia (the Malay Archipelagos) from East (China) in contrast to the most arguments claimed that Islam came from West (India and Arabian region). This study conducts roof construction analysis on Kampung Laut's Old Mosque (KLOM), which is the oldest mosque in Malaysia. There are several historical studies already shows evidences to support this argument. This argument however will be supported through architectural study. The study on the roof design elements are made in the literature study. The analysis finds that KLOM has principle roof construction elements influenced by Chinese architecture but if compared to its details on construction elements, this analysis finds that there are differences between KLOM and the traditional Chinese buildings.
Keywords: Roof design; Chinese; Malay; Kampung Laut's Old Mosque; Construction

Résumé: L'objectif de cette étude est d'analyser les influences des éléments de la construction de toit traditional chinois sur la conception du toit de la vieille mosquée de Kampung Laut en Malaisie. Le résultat de cette étude peuvent être utilisé comme une preuve que l'islam est venu en Asie du sud-est (les archipels malais) de l'Est (la Chine) contrairement à la plupart des arguments affirmant que l'Islam est venu de l'Ouest (l'Inde et la région arabe). Cette étude procède à une analyse de la construction de toit de la vieille mosquée de Kampung Laut (VMKL), qui est la plus ancienne mosquée de la Malaisie. Il existe plusieurs études historiques qui ont déjà montré des preuves en tant que l'appui de cet argument. Cet argument, toutefois, sera soutenu par l'étude architecturale. L'étude sur les éléments de la conception de toit est faite dans l'étude littéraire. L'analyse conclut que les éléments principaux de la construction de toit de VMKL sont influencés par l'architecture chinoise, mais si on compare les détails des

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éléments de construction, on peut trouver qu'il existe des différences entre VMKL et les bâtiments traditionnels chinois.

Mots-clés: conception de toit; chinois, malais; vieille mosquée de Kampung Laut; construction

INTRODUCTION

The purpose of this research is to measure the level of influence of the Chinese roof construction elements to Kampung Laut's Old Mosque (KLOM) in the state of Kelantan, Malaysia. The Kingdom of Champa in Indo China plays a significant role in spreading Islam and Chinese architecture to the southern parts of South East Asia (known as the Malay Archipelagos, which constitute Indonesia and Malaysia). The importance of this study is to reveal through roof construction analysis to support an argument that the spread of Islam to Malaysia as well as South East Asia comes first from China (East), not from India and Arabian region (West). The study is very crucial because its findings can be used as a guideline to the design development of mosque architecture in Malaysia, especially to building roof construction in the state of Kelantan. KLOM is chosen as the case study because it is the oldest mosque not only in Kelantan, but also in Malaysia. There are several architectural research studies done before, related to this area but these studies do not focus like the title of this study. The studies instead are for the building conservation and inventory research study.

THEORETICAL BACKGROUND

The existence of Kampung Laut's Old Mosque as the oldest mosque in Malaysia becomes the evidence that Islam comes to the Malay Archipelagos from east in contrast to most written history text books in Malaysia which note Islam comes to this region from west. The spread of Islam in this region occurred through sea route's trading activities. The primary trades were along port cities in Sumatra, Java, Malacca, Kelantan, and Pattani. Location of Champa port cities (Indo China) was at the middle route before reaching port cities in China. There were many Islamic Empires established in Indo China, Peninsular Malaysia, Java, and Su.

This study attempts to prove by analysis of the building roof construction elements of KLOM that the spread of Islam comes much earlier to this region, not from the west but from the east. Ishak (1992, 67) noted that there is a written report during Dynasty Tang (618-905AD) that many messengers from the Abbasid Caliph were sent to China for political and economic relationship. Many Arab Muslims were awarded Chinese citizenship, and there were intermarriage between Arab Muslim and the local women. The Arab merchants also had participated in trades with South East Asian cities which were among important trading routes with China. The religion of Islam spread during the trading activities. In 878 AD, a rebellion however occurred in China by the Chinese people due to their jealousy to the Arab immigrants who were regarded as a noble and respective group (traders) in China because of their success in economy. About 100,000 immigrants were killed who were mostly Arab ethnic background. The tragedy had led the Arab immigrants to migrate to South East Asia and settle in this region.

Azmi (1980, 144) besides in his study argued that in case of Kelantan is the discovery of 'dinar' gold schilling in Kelantan in 1914 AD. There are several Arabic texts inscribed with Arabic number 'OVV' which means the date of the schilling, 577 Hijrah equivalents to 1181 AD, much earlier than the existence of Islam in the Kingdom of Malacca, Peninsular Malaysia in 14th century, which becomes the centre of Islamic study in South East Asia. This archaeological discovery becomes the evidence that the population in Kelantan at that time were Muslims. It also proved that Kelantan was one of the earliest regions located at the east coast of Peninsular Malaysia in South East Asia that populated by the local Muslims.

HISTORY OF KLOM

Kampung Laut's Old Mosque (Figure 1) is recorded as the oldest mosque in Malaysia. It is the oldest mosque and timber building in this country. Based on the folk story by the local villagers (Al-Ahmadi 1990, 11), KLOM was believed built by Muslim missionaries (who were at the same generation to *Wali Songo*, known in Indonesia as popular nine local pious missionaries who had spread Islam in this region) from

Islamic Kingdom of Demak, Java while sailing to Islamic Kingdom of Champa in Indo China. At that time, Champa and Demak Dynasty had a closed tie to each other. There was recorded that the King of Champa had married princess from Demak as a part of the efforts by these two nations to strengthen their brotherhood. Trading activities between these two nations, and other port cities along these routes were grown rapidly. Muslim missionaries from Kingdoms of Champa and Demak also played their important role in spreading knowledge of Islam and teaching Islamic education at these port cities.

The location of Kingdom of Champa is at the present day known as Indo China. Champa architecture is grouped under Indo China building styles. The architecture is from Kingdom of Champa. In present time, Indo China consists of several countries which are Vietnam, Cambodia, Laos and Thailand. This region is located at the north of Peninsular Malaysia. The specific location of Champa Kingdom is at the present day South Vietnam and southern part of Cambodia. At that time parts of Indo China (North Vietnam and Laos) were under Kingdom of China ruled by Han Dynasty.

Mohd. Akib (2003, 7-8) and Al-Ahmadi (1984, 67) argued Champa Kingdom had played a significant role in spreading Islam and having economic activities in Kelantan and Pattani in 16th century. Construction elements from Indo China were also introduced to many regions in the Malay Archipelagos along the trading routes to the Kingdom of Champa. The influence of Champa architecture can be traced at the traditional mosque architecture in several Malay Kingdoms such as Majapahit, Demak and Malacca. According to Wikipedia (2008), role of Champa people in spreading Islam to the Malay Kingdoms of Srivijaya, Majapahit, Demak, Malacca and Johore-Riau were significant through sea route's trades and cultural relations. The date of construction of KLOM is about slightly later than the date of construction of the other two oldest mosques in South East Asia which are Kudus Mosque at Demak in Java and Kuno Mosque in Champa, Indo China. This means that these three mosques can be grouped as among the earliest surviving mosques built at the same period in South East Asia. They have similarities in their roof construction style.

KLOM today still functions as a mosque (a living gallery) for Friday khutbah (sermon) and congregational prayers. Like other mosques, KLOM is a place for worships by the Muslims. Kuban (1974) noted that mosques are defined as a place for prayers. The word 'mosque' in Arabic language is 'masjid' which means 'sujud' (prostration) and 'sejadah' (prayer mat) (Nasir, 1984). The combination of these two words means an act of prostration by a person on a prayer mat. It is due to an obligatory to all Muslims (Antoniou, 1981) to perform five times congregation prayers a day as stated in the holy book of Al-Quran. According to Nasir (1984), the mosques were also used as a discussion and conference centre in governing the nation during the time of Prophet Muhammad (peace be upon him).

The location of this mosque is at Nilam Puri about 15 km from Kota Bharu, the state capital of Kelantan. The original location of KLOM is at Kampung Laut. It is where the name of the mosque was derived from. According to Mohd. Akib (2003), the relocation of KLOM was restored after the 1966-67's great flood occurred in Kelantan as well as other parts of Malaysia. During the opening ceremony of this restoration, Hamdan Sheikh Tahir, the chairman of Malaysian Historical Association had noted that the flood had risen to the roof level of KLOM. When the flood shrunk, the riverbank closed to the mosque had collapsed and damaged the pedestrian walkways. The floor and building structure had slanted, and it was dangerous for the local villagers to continue using KLOM for religious activities. This timber mosque was then disassembled by the State Government of Kelantan, and restored to a new site, Nilam Puri a distance away from Kelantan river to avoid from flood. The restoration was completed in 1970. The distance between Nilam Puri and Kampung Laut is about 18 km.

ROOF CONSTRUCTION ELEMENTS OF KLOM

The focus of this study is to analyse roof construction design elements which influence the architecture of KLOM. Before the analysis is made, a literature study on the design of the roof construction elements is conducted. The aim is to understand the definition of this roof design by identifying factors which influence the roof construction elements of KLOM. Roof construction plays an important role in defining the roof form of KLOM. The study finds that there are 10 elements of the roof construction. These elements become measurable factors for this analysis. They are as follows:

Pyramid Roof Form

Roof construction of KLOM has pyramid roof type (Figure 1 & 2). This roof type is commonly used for traditional mosque and *surau*[2] (*madrasah*) in South East Asia. It has a square base. According to Mohd. Akib (2003, 40), the roof's name in Malay language is *'bumbung son pecah empat'*. It means a 'mount shape' roof form with four different roof ridge slopes.

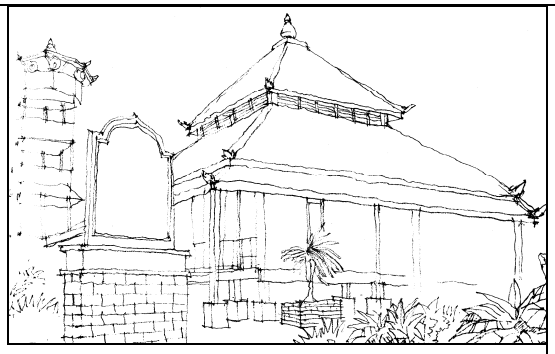

Figure 1: Perspective view of KLOM and its minaret. **Figure 2: KLOM with its triple roof form**
Source: Drawn by Mohd. Hafiz Muhamad Jubri Students Year 2, 2009 Architecture.

Tiered Roof Form

The roof design of KLOM has three-tiered pyramid roof form (Figure 1 & 2). The roof tiers are meant for multiple volume design in three segmented pyramid roof form. The roof is covered with roof tiles. There are two segments erected between the upper and middle roof layer, and between the middle and lower roof layer. These segments are fitted with upper and lower louvered windows known as *sisir angin* (clerestory window). The purposes are to provide airflow for stack effect and diffused natural sunlight inside the mosque prayer hall (Figure 3). The design is to give excellent level of thermal comfort and day lighting to tackle the design solution in the tropical climate.

The size of tiered roof form is proportioned to the size of the prayer hall. Mosques with three-tiered pyramid roof form are also found in traditional mosques in Malacca. According to Abdul Halim Nasir (1995, 59), three-tiered roof form is also used for construction of traditional mosques in Java and Sumatra (Ambary 2002, 164), Pattani (Southern Thailand), Perak (Peninsular Malaysia) and Cambodia. It creates an expression of triple volume architectural space, to the prayer hall (Figure 3 & 4). This triple volume character does not mean that KLOM has three floors' design. It has instead only a single storey building. There is no construction for the upper floor.

[2] A small building used for congregational prayers except Friday prayer

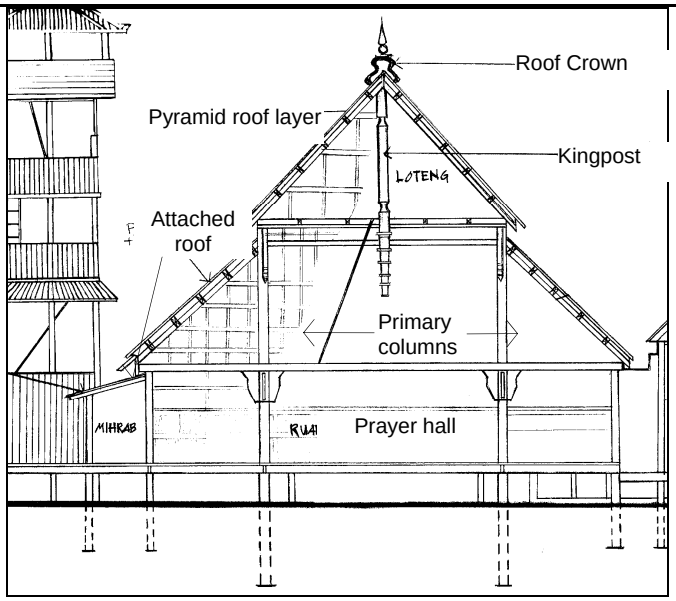

Figure 3: Section of KLOM
Source: Drawn by Dubashan Subramaniam Students Year 2, 2009 Architecture.

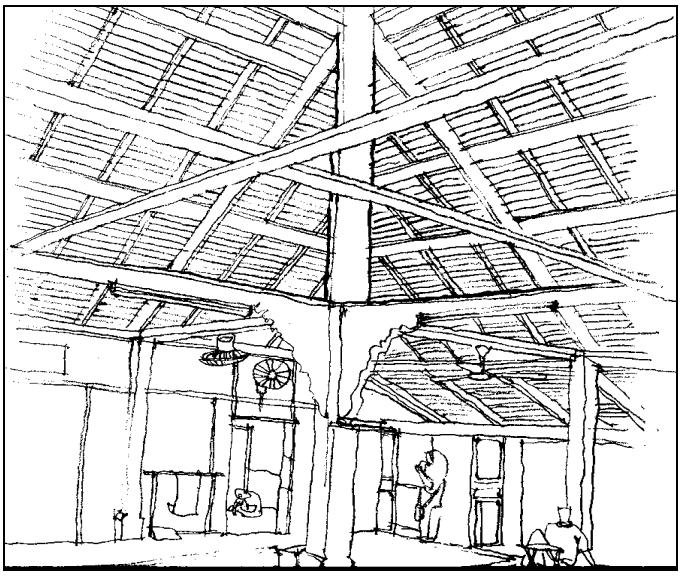

Figure 4: Interior view of the prayer hall with one of its four central pillars
Source: Drawn by Mohd. Hafiz Muhamad Jubri Students Year 2, 2009 Architecture.

Attached Roof Form

Construction of three tiered pyramid roof form of KLOM applies attached roof eave concept (Figure 5). The projected roof eaves give shades to the window openings and verandah (*serambi*) area from direct exposure to the sunlight. This roof overhang is projected about 1 metre's length from the building wall (or for the open verandah is its floor edge). There are four primary columns erected on the ground to give primary support to the roof structures. The same columns besides support the attached roof structures (Figure 3). The roof structures consist of roof beams which have two types of spans, primary beam for middle spans and secondary beams for the side spans. The side span is about 2/3 of the middle span.

Figure 5: A projected roof eaves with Senggora roof tiles

Figure 6: Roof crown

Roof Crown

KLOM has a roof crown (Figure 3 & 6), a structural element on its pyramid roof top supported by the kingpost. It is like a 'crown' for this building, an expression of its ultimate role as a religious centre, connoting its priceless and special symbol (Ambary 2002, 164). Local master builders call this element as *buah butung*. The crown has a 'dome like form' similar to the dome construction at mosques in Middle East, North Africa, Iran, Turkey and India. Compared to the dome size constructed in other parts of the Islamic World, the dome size of KLOM is relatively very small. In contrast to the size of the building (15.86m length x 15.86m width x 12.42m height), its size is only 0.76m in diameter and 1.15m in height. The roof crown was made from ceramic material. The crown has three tiers. The bottom layer has a domical shape (0.76m diameter x 0.57m height), and the middle layer has spherical form with about 0.19m, which is 1/4 of the diameter of the dome at its bottom or 1/4 of the overall height. The top layer has conical shape (0.38m height) marking the end point of the dome.

Roof Ridge

KLOM has dominant roof ridges (Figure 7). These ridges mark the horizontal line jointing corners of two roof slopes. The use of dominant roof ridges expresses the cultural identity of the traditional mosque design. The roof ridges are made from lime mortar. This material may be the same as the material used in the construction of roof ridges at traditional mosques in Malacca which is lime, sand and water as a mortar, available at that time. The lime is made from either limestone powder or seashells[3].

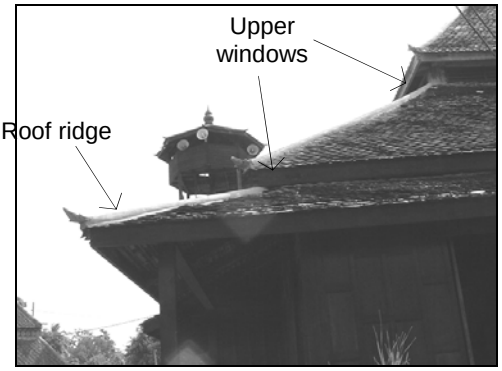

Figure 7: Roof ridges and tails.

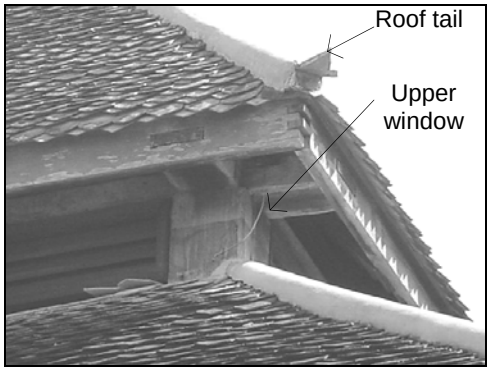

Figure 8: Roof tail.

Roof Tail

One of the most attractive decorative figures at KLOM is the roof tails (Figure 8). These roof tails are carved objects projected out from the roof ridges. These objects are known by the local master builders

[3] Based on information from Iesnordin Haji Malan, the curator of Architecture Museum in Malacca.

as 'duck tail' (*ekor itik*) because of their shape like a tail of a duck. This decorative figure is placed at all edges of the roof ridge. KLOM has 4 roof ridges at the pyramid roof, another 4 roof ridges at the middle attached roof, and the other 4 roof ridges at the lower attached roof. Therefore, there are a total of 12 duck tails placed to these roof ridges. Duck tails have a design emphasized on orientation to horizontal projection with curved surfaces. The duck tail has a design with 3 projected angles. Its middle projected angle is about three times larger than the size of its other two sides.

Roof Tiles

Senggora roof tiles (Figure 5) are commonly used as roof covers for traditional buildings in Kelantan and Terengganu, two states located at the east coast of Northern Peninsular Malaysia, and in Pattani and Senggora, a state at Southern Thailand. The word '*senggora'* is derived from the name of a place in Southern Thailand, Senggora (Mohd. Akid 2003, 87). These materials are made from clay, also known by the local people as *atap bata tanah* (clay brick roof tiles). The same type of clay is used to make the local bricks. The clay is compressed into specific moulds, and after that these moulds are placed into oven room for drying process. This process will make these materials become water resistance and durable. The local people call the factory as *Gak Bata* (brick workshop).

Upper Roof Window Opening

Three tiered roof construction are meant for the design of upper window openings (Figure 7 & 8) creating stack effect air flow and indirect natural lights. These openings provide passive design solution which is important for tropical buildings especially public places like the mosques (public building) used by a large number of people at one time. The local people call these windows as '*sisir angin'* which means 'louvered openings' to permits wind ventilation. In KLOM's roof design, the construction of three roof layers creates two types of upper roof window openings (clerestory openings). These upper windows do not function like windows built on the mosque's floor level, which is constructed using anthropomorphic scale (human proportion) with an emphasis of views and cross ventilation as important factors in the design. The upper windows however, are fitted to enhance for stack impact pressuring warm air to flow out from the upper roof windows while creating cool air suction from the ground. The design shows that the traditional master builder of KLOM understood the warm air is lighter than the cool air. As a result, upper windows are important elements for passive design approach.

Roof Overhang

KLOM has a design of roof overhangs (Figure 1). Roof overhangs are important for tropical buildings. It is projected roof eaves at the lower edge of a roof. The construction is possible by using cantilevered roof rafter to support the roof eaves. The overhang is cantilevered about 1 metre from the building wall. The purposes are to avoid rainwater sprinkle from deflected to the interior of the building and to provide shades against direct sunlight. The roof edge is fitted with fascia boards to protect the cantilevered roof structures from rainwater and sunlight. The fittings are about few inches under the layer of *Senggora* roof tiles. Fascia boards are decorative elements commonly carved with floral and leaf motives.

Roof Structure

Roof structures (Figure 3) at KLOM are a combination of four central pillars and four layers of cross beams. The lowest layer of these cross beams supports the building floor area, which is the main prayer hall. This floor has square in shape, elevated about 1 metre from the ground surface. Its dimension is 15.86m by 15.86m. The prayer hall has 26 columns and 4 central pillars. The middle structures have two layers of transferred cross roof beams. Both the upper and lower cross beams of these middle structures support the lower and upper attached roof. A series of rafters are placed on the upper and lower beams at 45 degree angle. The upper roof beams with one kingpost (transferred column) support entire loads of the pyramid roof. There is no ceiling construction in the traditional mosque. All structures are intentionally exposed and emphasised as parts of the beauty in architecture.

DEFINITION OF CHINESE ROOF DESIGN

Regardless to the regional diversity of the religions and geographies, Chinese roof design is adopted as a primary design of the religious buildings. Chinese architecture covers the regions at the present day's Republic of China, Indo China, Japan, Taiwan and Korea. Most people who live in these regions are Taoists and Buddhists. Besides, there are a small number of the population who are Muslims and in Japan, the primary belief is Shinto. In China, the local master builders had adopted Chinese roof construction technique in building the traditional mosques. The examples of Chinese mosques are Xian and Nunjie Mosque. The roof construction gives an influence to mosque design in South East Asia. Tran (2008) in his research argued that the Kingdom of Champa with its Hoi An port-city at once time marked as a transition area in disseminating Chinese cultures and influences to the Malay Kingdoms at the Malay Peninsular and Archipelagos.

This kingdom was established in 192 AD. Due to its lost in many wars against the Viet Kingdom (currently known as Vietnam) from 15th to 19th century, this kingdom fell under Vietnam, and assimilated with Vietnam cultures. Many Champa people migrated to Cambodia, Peninsular Malaysia, Java, Sumatra, Kalimantan and Celebes (Mohamed 1989, 8-9). Roof construction plays an important role in defining the traditional Chinese roof form. The study finds that there are 10 elements of the roof construction. These elements become measurable factors for this analysis. They are as follows:

Pyramid Roof Form

Roof form is emphasised as a dominant element in Chinese building construction. There are basically four types of Chinese roof forms, which are pitched roof, gable roof, half pitched and half gable roof, and pyramid roof. According to Kohl (1984, 26), the adoption of these traditional roof forms had been used in China since two thousand years ago during Ching Dynasty. Pyramid roof form is one of the roof types constructed in these regions. Sketch illustrations by Boyds (1962, 35) shows that this pyramid roof form is known as '*Cuan Jian*' in China. It is commonly used in roof construction for the temples, mosques and palaces. Chinese roof has a curved form at its edges (Figure 9). The construction is possible because it uses bracket system for its roof structures. No ceiling construction is made. All roof structures are intentionally exposed and clearly visible, an emphasis of the beauty in architecture.

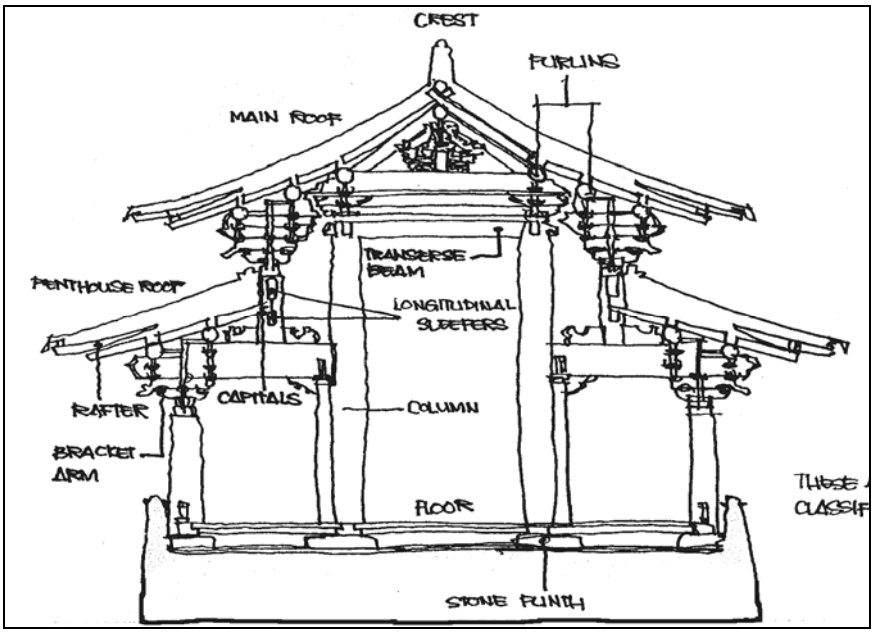

Figure 9: Section of the traditional Chinese building.
Source: Drawn by Goh Chee Haw Students Year 3, 2003 Architecture

Tiered Roof Form

Chinese architecture commonly emphasises on two tiered pyramid roof form (Figure 9) except the construction of pavilion with single pyramid roof form. The design is meant for double volume space to create air inlet and outlet for stack effect and to permit indirect sunlight. The top roof is elevated at certain height to separate from its attached roof. This separation allows the construction of upper louvered windows. The building does not have an upper floor construction. By applying bracket system in the roof construction, it is possible to design cantilevered lower bracket roof structures.

Attached Roof Form

Attached roof form is an important element in traditional Chinese roof design. The pyramid roof has four primary columns (central pillars) which are fundamental structures, supporting a series of transferred bracket roof structures. There are several layers of upper (primary) beam structures with bracket joints which carry the load of the pyramid roof form. Besides, these beams support the attached roof of the building. There is no attached roof beam at a middle span erected in the traditional Chinese roof structures. The attached roof beam constructed between primary column and secondary column, which support the attached roof structures. The central and side beams have about the same span. Application of Chinese bracket system makes possible to construction of the attached roof with curved roof form.

Roof Crown

Chinese pyramid roof commonly has a roof crown at its top. This roof crown is a roof's 'crest or pinnacle' (Figure 9), like a sacred jewel, a priceless decorative figure. The form of the roof crest in China has an influence from the Buddhist architecture originated from the architectural elements in the Buddhist stupa construction. It is a pot-shaped cupola built at its 'modest' size (Bussagli 1989, 32) fitted at the top of dome and pyramid roof.

Roof Ridge

Chinese roof design has an emphasis of dominant roof ridges (Figure 10) at the junction of two sloping surfaces at the pyramid and its attached roof. The roof ridges are overly constructed elevated above the roof slope (Knapp 1989, 101) to a certain height as if the roof ridges were parts of the building walls. The ridged boards have lavish decorative motives. According to Kohl (1984, 27-30), the construction material is lime mortar, a mixture of lime, sand and hemp straws. The ridges normally have decorated with floral and leaf ornaments on their walls. In addition, the ridges are fitted with figurative fishes and dragons as well as phoenixes, lions, chickens, goats, peacocks, crane, deer and unicorns.

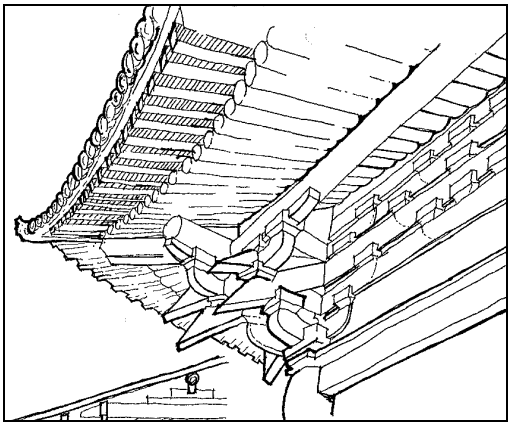

Figure 10: Bracket roof overhang.
Source: Drawn by Student Year 3, 2003 Architecture

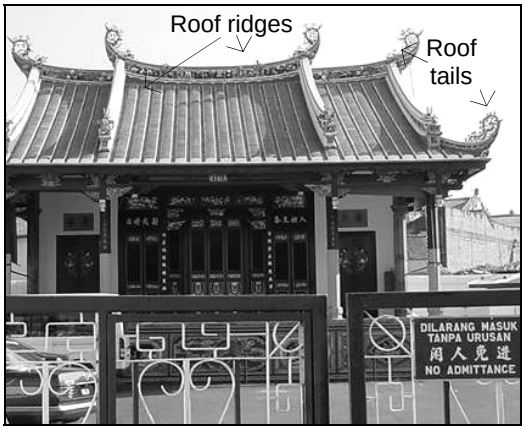

Figure 11: Bracket roof ridges and tails at Chinese Temple in Malacca, Malaysia

Roof Tail

One of the important elements in Chinese architecture is the roof tail. It is a decorative object which marks an expression of the roof edge as argued by Knapp (1989, 100-1) with either etched or sweeping profiles. This roof tail is known as dragon tail (the Chinese most sacred animal figure) in Malaysia (Figure 11). The design emphasises on the erection of dragon tails at the end of the roof ridges at the pyramid and its attached roof. The dragon tail's design has an emphasis on vertical orientation with curling tail's style marking as the end treatment to the roof ridge.

Roof Tiles

Chinese roof tiles (Figure 10 & 11) have bamboo design styles. The bamboo tiles are laid interlocking with half round tiles in vertical rows. The roof layout creates wavy pattern with a series of bamboo ridged tiles and furrows. Kohl (1984, 208) noted this roof tiles' pattern has 'ridge and pan' system, alternating the bamboo rows with alternated valleys for the rainwater's run off. It functioned as an alternated gutter system. The interlocking pattern between bamboo ridge tiles and curved half round tiles creates the roof gutters. The advantage of the roof gutters is to allow instance rainwater flow. The type used for the roof tiles are glazed roof tiles made from lime powder, sand and water cast in moulds, then burnt and glaze before ready for use.

Upper Roof Window Opening

There is a construction of roof window opening (Figure 9) in the traditional Chinese buildings. The window louvered opening is placed between the pyramid and attached roof of the building. Double roof construction creates one layer of segmented wall opening from the lower roof. This opening is a series of louvered windows. These windows are designed for air flow outlet due to stack effect to permit high pressured warm air ventilated out from the main hall through the roof windows while creating low pressure to allow cool air suction into this space. The other reason is to permit indirect sunlight into the main hall through these roof windows, functioned like a skylight.

Roof Overhang

Large projected eave (Figure 9) is one of the important characters in Chinese architecture. This projection creates a roof overhang, to provide shades from the summer sunlight (Ashihara 1989, 36-7). Application of cantilevered bracket system on beams and rafters makes possible to a large span construction of the roof overhang. No fascia board is placed as one of the roof elements in Chinese building. The large roof overhang is able to give shades and protection to the timber roof structures from rainwater sprinkles.

Roof Structure

Bracket system (Figure 8 & 9) is a key factor for Chinese roof construction technique. The system plays a crucial role in the roof design. Bracket system has roof structural trusses supporting transferred beams (cross beams, tie beams and purlins), columns (queen and king posts) and rafters in a series of bracket layer system.

METHODOLOGY OF ANALYSIS

It is the aim of this study to analyse the level of design influences by Chinese architecture to the roof design of KLOM. The methodology of this survey applies qualitative survey, a comparative analysis through observations to the level of similarity between Chinese and KLOM roof design elements. In other words, the analysis will measure the level of influences by the Chinese roof design construction elements using comparative method to the roof construction elements used in the roof design of KLOM. There are three types of measurable scale used in this analysis, represented by three levels of influences of Chinese roof design elements to those of KLOM. The levels of influence are based on the comparative analysis of each roof construction elements as discussed earlier in the literature study. These three levels of similarity are as Table 1.

Table 1: Comparative analysis of the roof design construction

	Roof Design	KLOM	Chinese Architecture	Level of Similarities		
				none	moderate	exactly
A	**Pyramid roof form**					**x**
	1	Linear roof slope	Curved roof slope	**x**		
	2	Upper beam	Upper beam			**x**
	3	No ceiling	No ceiling			**x**
B	**Tiered roof form**					**x**
	1	Three layers' system	Two layers' system		**x**	
	2	Triple multivolume	Double multivolume		**x**	
	3	Single storey	Single storey			**x**
C	**Attached roof form**					**x**
	1	One attached roof	Two attach roof		**x**	
	2	Linear roof slope	Curved roof slope	**x**		
		Lower & upper beams at middle span	Bracket lower & upper beam at middle span		**x**	
	3	Attached (secondary) beams	Attached (secondary) bracket beams		**x**	
	4	Secondary beam 2/3 span of the primary beam	Secondary bracket beam the same span as the primary beam		**x**	
D	**Roof crown**					**x**
	1	Small dome	Pot shape copula		**x**	
	2	Islamic character	Buddhist character	**x**		
	3	Fitting at the roof top	Fitting at the roof top			**x**
E	**Roof ridged boards**					**x**
	1	Dominant	Extremely dominant		**x**	
	2	No decorated floral & leaf motives	Decorated with floral & leaf motives	**x**		
	3	Not fitting with object sculptures	Fitting with object sculptures	**x**		
F	**Roof tail**					**x**
	1	Fitting with duck tail figure	Fitting with dragon tail figure		**x**	
	2	Horizontal form emphasis	Vertical form emphasis		**x**	
G	**Roof tiles**					**x**
	1	*Senggora* tiles flat shape	Bamboo roof tiles Curling wave shape	**x**		
	2	Clay tiles (no glaze)	Clay glazed tiles		**x**	
	3	Roof tile not with gutter concept	Roof tiles with gutter concept	**x**		
H	**Roof windows**					**x**
	1	Upper roof windows	Upper roof windows			**x**
	2	Lower roof windows	No lower roof windows	**x**		
	3	For air ventilation (stack impact)	For air ventilation (stack impact)			**x**
	4	For indirect sunlight	For indirect sunlight			**x**
İ	**Roof overhangs**					**x**
	1	Projected roof eaves	Projected roof eaves			**x**
	2	Cantilevered roof	Cantilevered bracket roof		**x**	
	3	With fascia boards	No fascia boards	**x**		
J	**Roof structures**					**x**
	1	One kingpost	Many bracket queen posts & one kingpost		**x**	
	2	One transfer cross beam	Layers of bracket cross beams, tie beams & purlins		**x**	
	3	Cantilevered beams & rafters	Bracket cantilevered beams & rafters		**x**	

- none (no similarity at all in the analysis)

- moderate (has some similarities in the analysis)
- exactly (has almost exact similarities or the same in the analysis)

By doing this qualitative analysis, it will help to identify the level of influences of Chinese roof construction elements to those of KLOM. Roof construction consists of 10 categories which are pyramid roof form, tiered roof form, attached roof form, roof crown, roof ridge boards, roof tails, roof tiles, roof window openings, roof overhangs and roof structures. There are two types of the analysis in this survey. The first type is a comparative analysis by categories. It is a general observation study. The other type is a comparative analysis by factors. The comparative analysis by factor is a detailed observation study. The results of the analysis are as above (Table 1).

ANALYSIS AND FINDINGS

This section discusses the result of the analysis and findings in the survey. The first part of the discussion is the result of the analysis by categories and factors. The results are as follows:

Analysis by Categories

The analysis finds that all roof design categories have the same (100% marks) roof design construction elements between KLOM and the traditional Chinese buildings.

Analysis by Factors

There are differences and similarities by factors in roof design construction elements between KLOM and the traditional Chinese buildings. These factors are:

- KLOM has linear roof form whereas the traditional Chinese building has curved roof form (no level of similarity).
- KLOM has triple volume roof construction while the traditional Chinese building has double volume roof construction (moderate level of similarity).
- The traditional Chinese building has attached curved roof construction using bracket construction system in contrast to ordinary prefabricated post and beam attached roof construction at KLOM (moderate level of similarity).
- KLOM has a small dome construction with Islamic influence for its roof crown compared to pot shaped copula with Buddhist influence in traditional Chinese roof crown construction (no level of similarity).
- Traditional Chinese roof design has extremely dominant roof ridge ornamented with floral and leaf motives and fitted with sculptures (animal figures) in contrast to those of KLOM (moderate level of similarity).
- KLOM has roof tails with duck tail's figure (horizontal form) in contrast to dragon tail's figure (vertical form) fitted as roof tails in the traditional Chinese roof tail design (moderate level of similarity).
- In contrast to KLOM, the traditional Chinese building has gutter concept of the bamboo roof design constructed from glazed roof tiles with curling wave shape (no level of similarity).
- KLOM has upper and lower roof windows while traditional Chinese building has only upper roof windows (moderate level of similarity).
- Unlike KLOM, the traditional Chinese building has projected roof overhangs constructed from cantilevered bracket roof structures. No fascia board is fitted to the projected eaves (moderate level of similarity).
- Unlike KLOM, the traditional Chinese building has more elaborated roof structures with bracket construction of transferred cross and tie beams, cantilevered beams and rafters, queen posts and one king post (moderate level of similarity).
-

DISCUSSION

The research findings are as follows:

- There are influences of traditional Chinese roof design construction in the roof construction of KLOM. The results by categories show that roof construction of KLOM applies the same design concept.
- Although analysis by categories shows that many basic concepts of Chinese building construction are used in the construction of KLOM, analysis by factors shows that there are differences in design details to the construction elements between KLOM and the traditional Chinese buildings.
- The differences in number of layers in roof construction between the traditional Chinese buildings (two tiered pyramid roof form) and KLOM (three tiered pyramid roof form) gives differences in design details of the construction elements.
- Impact on the religious influence has made differences in the building roof design elements.

Difference in structural construction technique used in building construction has influenced the design details of the roof design construction between traditional Chinese building and KLOM. Compared to KLOM, the traditional Chinese buildings are not erected using prefabricated post and beam construction but it is built based on bracket post and beam construction with bracket joints; as a result, this application creates differences in the structural layout and hierarchical order of transferred column and beam structures which make possible for curved roof construction.

CONCLUSION

The study concludes that construction of KLOM has an influence from traditional Chinese building construction. This influence can be traced to the roof design construction elements (pyramid tiered and attached roof form; roof crown, roof ridge and tails; roof tiles and windows; and roof overhangs and structures) However, there are differences in the roof design details of the construction elements of KLOM. These differences are:

KLOM has three tiered roof form concept compared to two tiered roof construction in the traditional Chinese buildings.

- Religious influence has made the roof design elements such as dome roof crown and duck tails in the construction of KLOM different to those in traditional Chinese construction, which emphasises on Chinese culture and Buddhist religion with animal and pot shaped copula figures.
- Construction of KLOM does not apply bracket post and beam construction technique with bracket joints but it uses prefabricated post and beam construction technique with mortise joints. As a result, building construction elements using bracket system such as curved roof form, flexible bracket upper transferred column and beam structures, and cantilevered bracket roof overhangs are not be able erected in KLOM.

The findings of the differences and similarities of the building construction elements between KLOM and the traditional Chinese buildings can be used as a guideline to understand architecture in the state of Kelantan as well as South East Asia. The findings is able to give an evidence to support the argument that Islam came to South East Asia from East (China), and the role of Kingdom of Champa was in disseminating Chinese cultures and influences to the Malay Kingdoms. Roof construction influences from China have shaped the design of KLOM as well as other traditional mosques in South East Asia. The construction elements can be used a guideline, which is important because it can be used as a reference to the development of local architecture which concerns to the local culture, spiritual perspectives in Islam and climatic approach as argued by Mohamad Rasdi (2005, 34) posturing an act and intention of the man's humility to the God's built natural environment. Future research study on mosque design in other parts in South East Asia is crucial because it can enrich more definitions to the regional construction elements of the mosque architecture. Construction of wakaf (kiosk/pavillion) structures (Figure 12) with triple roof form is widely designed in pre-colonial period across the region in Kelantan and other parts of South East Asia, imaged as a symbol of the traditional architecture.

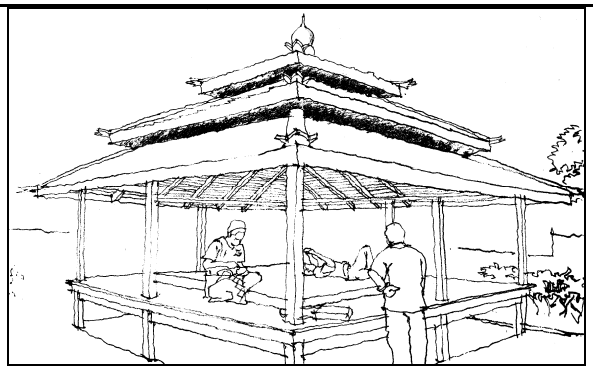

Figure 12: Traditional wakaf (pavilion) structures are widely constructed during precolonial period for public/community uses.

Source: Drawn by Mohd. Hafiz Muhamad Jubri Students Year 2, 2009 Architecture.

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REFERENCES

Abdul Ghani, M.I. (2003). *History of Makkah* (A.R. Mesyhadi, trans.). Jakarta: Ministry of Religion Menteri Republic of Indonesia. (in Malay language)

Al-Ahmadi, A.R. (1984). History of Relationship between Kelantan/Patani and South Celebes. *Warisan Kelantan III (Kelantan Heritage III)*. In N.M., Nik Mohd. Salleh (Ed.), Kota Bharu: Kelantan State Museum Corporation.

Al-Ahmadi, A.R. (1990). Kuno Building Kampung Laut Mosque: The Relationship between Champa and Demak. *Warisan Kelantan IX (Kelantan Heritage IX)*. In N.M., Nik Mohd. Salleh (Ed.), Kota Bharu: Kelantan State Museum Corporation. (in Malay language)

Ambary, H.M. (2002). Ancient Mosques in Indonesia and its Relation to Ancient Mosques in Kelantan. *Kelantan's Early Period: Archeological and Historical Analysis*. Edited by In N.H.S., Nik Abd. Rahman (Ed.), Kota Bharu: Kelantan State Museum Corporation.

Antoniou, J. (1981). *Islamic Cities and Conservation.* Paris: The UNESCO Press.

Ashihara, Y. (1989). *The Hidden Order*. Tokyo: Kodansha International Ltd.

Blaser, W. (1979). *Courtyard House in China: Tradition and Present.* Basel: Birkhauser Verlag.

Boyd, A. (1962). *Chinese Architecture and Town Planning*. London: Alec Tirannti Ltd.

Caffarelli, P.M.V. (1989). China. *Oriental Architecture 2 - China, Korea and Japan* (J. Shepley (trans.). In M., Bussagli (Ed.), New York: Rizzoli International Publications Inc.

Christal, E. (1991). Champa and the Study of Southeast Asia. *Le Campa et Le Monde Malais: Acts de la Conference Internationale sur le Campa et le Monde Malais* (66). Paris: Centre d'Histoire et Civilizations de la Peninsule Indochinoise. See Also Danny Wong, T. K. (March 2004), Vietnam-Champa Relations and the Malay-Islam Regional Network in the 17th–19th Centuries. *Kyoto Reviews of Southeast Asia*. Website: http://kyotoreview.cseas.kyoto-u.ac.jp/issue/issue4/article_353.html. Retrieved on 5th March 2009.

Colucci, C.S.A. (1989). Central Asia. *Oriental Architecture 2 - China, Korea and Japan* (J. Shepley (trans.). In M., Bussagli (Ed.), New York: Rizzoli International Publications Inc.

Dawson, B. & Gillow, J. (1994). *The Traditional Architecture of Indonesia*. London: Thames and Hudson Ltd.

Fletcher, B. (1999). *A History of Architecture*. In D., Cruickshank (Ed.), New Delhi: CBS Publishers & Distributors.

Gibbs, P., (1987). *Building Malay House*. Oxford: Oxford University Press.

Hussin, A.A. (1998). *A Place Named Kaabah*. Kuala Lumpur: Department of Islamic Development Malaysia. (in Malay language)

Ishak, A. (1992). *Islam in Malay Archipelago*. Petaling Jaya: Islamic Centre of Prime Minister Department. (in Malay language)

Inoue, M. (1985). *Space in Japanese Architecture* (H. Watanabe, trans.). New York: John Weatherhill Inc.

Knapp, R.G. (1989). *China's Vernacular Architecture: House Form and Culture*. Honolulu: University of Hawaii Press.

Kohl, D.G. (1984). *Chinese Architecture in the Straits Settlements and Western Malaysia: Temples, Kongsis and Houses*. Kuala Lumpur: Heinemann Educational Books (Asia) Ltd.

Kuban, D. (1974). *Muslim Religious Architecture: Part 1 The Mosque and Its Early Development*. In P.V., Baaren, L., Leertouwer, F., Leemhuis & H., Buning (Eds.). Leiden: E.J. Brill.

Leacroft, H. & Leacroft, R. (1976). *The Buildings of Early Islam*. London: Hodder & Stoughton.

Nasir, A.H. (1984). *Mosques of Peninsular Malaysia*. In A., Amin & A.S., Abu Bakar (Eds.). Kuala Lumpur: Berita Publishing Sdn. Bhd.

Nasir, A.H. (1995). *Mosque Architecture in the Malay World-Archipelagos*. Bangi: Universiti Kebangsaan Malaysia Press. (in Malay language)

Mohamad Rasdi, M.T. (2005). *Malaysian Architecture: Crisis Within*. Kuala Lumpur: Utusan Publications & Distributors.

Mohamed, A. (1989). The Malay decendents in Cambodia and Vietnam: Its Relationship to Peninsular Malaysia with special Reference to the State of Kelantan. *Warisan Kelantan VIII (Kelantan Heritage VIII)*. In N.M., Nik Mohd. Salleh (Ed.), Kota Bharu: Kelantan State Museum Corporation. (in Malay language)

Mohd. Akib, S. (2003). *Kampung Laut's Old Mosque*. Kota Bharu: Kelantan State Museum Corporation. (in Malay language)

Tran, K.P. (2008). Port of Great Champa/ Hoi An port-city: A reference to the historical geography in Central Vietnam. *Unpublished Paper presented at International Workshop on The Origin and Future of Southeast Asian Coastal Cities: Links, Layering, and Transformations*. Singapore: National University of Singapore, Asia Research Institute - Asian Cities Cluster.

_____. (2008). Champa: Islam. *Wikipedia*. Available at http://en.wikipedia.org/wiki/ Champa. Retrieved: March 01, 2008.