

Kampung Laut's Old Mosque in Malaysia: Its Influence from Chinese Building Construction

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ABSTRACT

This study discussed a comparative study on building structural construction between Traditional Chinese Building and Kampung Laut's Old Mosque (KLOM). The objective is to identify the level of influence of the traditional Chinese building structural construction to the structural construction of KLOM. The result is one of the ways to support an argument using evidence on the building construction that the religion of Islam was spread to South East Asia from China and Indochina (East) in contrast to most arguments from Arabian region and India (West). The scope was limited to the analysis of the building structures. There were 10 factors were identified as the measurable factors in the literature study. The results showed that there are influences from traditional Chinese construction on building structures of KLOM.

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1 Introduction

This research aims to identify the level of influence of Chinese construction elements to Kampung Laut's Old Mosque (KLOM). The result of this study can be used to elicit an argument that the Kingdom of Champa in Indo China plays a significant role in spreading Chinese structural construction concept in building erection as well as religion of Islam to the southern parts of South East Asia (known as the Malay Archipelago consisting Indonesia,

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Brunei and Malaysia). The result of this study will reveal whether Islam came to South East Asia from China and Indochina (East) or not, in contrast to most arguments from Arabian region and India (West). The outcome of this study can be generated for the design guideline to the development of Islamic architecture in Malaysia, especially to the state of Kelantan. The case study is KLOM, the oldest mosque not only in Kelantan, but also in Malaysia. Many research studies related to this subject were conducted before but they focus on historical, religious and social analysis and building conservation.



Figure 1: Perspective view of KLOM and its minaret.

Source: Drawn by M.H. Muhamad Jubri students year 2, semester 2, 2009 architecture studio, School of Housing, Building and Planning, Universiti Sains Malaysia.

The assumption of this study is to draw a conclusion through the result of the analysis on building structural construction of Kampung Laut's Old Mosque (KLOM) (Figure 1) as evidence that Islam comes to the Malay Archipelago from the East (China). This assumption is to elicit the statement from most written history text books in Malaysia which note Islam was spread to this region from Arabian regions and India. Most written history text books depict that the spread of Islam in this region is through sea route's trading activities at port cities in Sumatra, Java, Malacca, Champa, Kelantan, Brunei, Sulu, Celebes and Pattani. Champa port cities (Indo China) like Panduraga (Danny Wong, 2004), Indrapura, Vijaya, Kauthara (*Champa*, 2008) and Hoi An (Tran, 2008) were important port cities along this sea route, before reaching port cities in China. The Arab merchants from China had spread Islam to South East Asia.

Ishak (1992) in his book titled *Islam in the Malay World* argued that Islam was introduced to the Malay Archipelago from China and Champa. Story tellers from the Chinese Muslims in the Republic of China noted that trades between Arab and Chinese people had established before the birth of Islam. The Arab Muslims had first contact to China when Caliph Othman ibnu Affan sent Saad ibnu Abi Waqqas as a messenger to China and he lived in Canton. Many messengers of the Abbasid Caliph were sent to China during Dynasty Tang (618-907) for political tie and economic relationship (Ishak, 1992). Many Arab Muslims were awarded Chinese citizenship and there were intermarriage between Arab Muslim and the local Chinese women. The Arab merchants also had participated in trade in South East Asian port cities which were located along trading routes with port cities in China. In 878 AD, the Chinese people rebelled 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 relocate their trades in this region.

Kampung Laut's Old Mosque (Figure 1) is the oldest mosque which is still intact today in Malaysia. It is also the oldest timber building in this country. From the folk story by the local villagers (Al-Ahmadi, 1990) tells that this mosque was built by Muslim missionaries who were at the same generation to Wali Songo, known in Indonesia as the most popular nine local pious missionaries who had spread Islam in this region. These missionaries were from Kingdom of Demak, Java. They built KLOM while stopping at Kelantan on the way sailing to Kingdom of Champa in Indo China. At that time, Kingdom of Champa and Demak had a closed tie. Trading activities between these two nations and other port cities along its 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. Kingdom of Champa had played a crucial role in spreading Islam to Kelantan and Pattani in the 16th century (Al-Ahmadi, 1984 & Newman and Sproull, 1979) as well as to other regions in South East Asia. The record from Indonesia describes the role of Champa Princess, Princess Darawati who influenced her husband, King Kertawijaya of Majapahit converted to Islam and the same role from Champa Kingdom was to Malacca when its king, Parameswara converted to Islam. The evidence is the discovery of tombstone belongs to Champa Princess in Trowulan, the archeological site used to be a capital city of Majapahit

Kingdom, Java. This argument is supported by Emanuel Codinho de Eridia, the Portuguese who wrote in a report in 1613 that Islam was spread to Malacca from the east coast, Pattani and 'Pang'. Many historians argue to the place referred to the word 'Pang' to two different places in this region which are 'Pahang' in Peninsular Malaysia and 'Phan Rang' in Champa, Indo China (Al-Ahmadi, 1990).

The influence of Chinese architecture can be traced at the traditional mosque architecture in the Malay Kingdoms such as Majapahit, Demak and Malacca. In case of KLOM, its date of construction is about slightly later than the date of construction of the other two oldest mosques in South East Asia which are Kudus Mosque in Java and Kuno Mosque in 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 construction styles from Kingdom of Champa in the 16th century (Ambary, 2002). The style also has Nusantara influence, a mixture of Chinese and Malay architecture. KLOM today becomes a living gallery, still used as a mosque, a place for worships by the Muslims for Friday Khutbah (sermon) and congregational prayers. The definition of mosque is a place for prayers (Kuban, 1974). In Arabic language, the word 'mosque' is pronounced as '*Masjid*'. It means '*Sujud*' (an act of prostration) and '*Sejadah*' (prayer mat) (Nasir, 1984). In other words, it is an act of prostration on a prayer mat by a Muslim when he/she performing a prayer. Performing five times prayers a day is one of the five pillars in Islam (Antoniou, 1981) as stated in the holy book of Al-Quran.

KLOM is located at Nilam Puri which is about 14 km from Kota Bharu, the state capital of Kelantan. The original location of KLOM is at Kampung Laut, about 18 km from its new site. It is where the name of the mosque was derived from. According to Mohd. Akib (2003), the relocation of KLOM was made after the 1966-67's great flood occurred in Kelantan. The flood water level reached had to the level of the roof of the building. The flood caused the riverbank closed to KLOM collapsed and slanted building structures of the mosque. As a result, the building restoration was made to preserve the mosque from probable flood's occurrences in the future. Under an effort by the State government of Kelantan and Malaysian History Association, this timber mosque was disassembled at its original site and then restored to a new site at Nilam Puri which is a distance away from Kelantan River to avoid from flood. This study was completed in 1970.

2 Materials and Methods

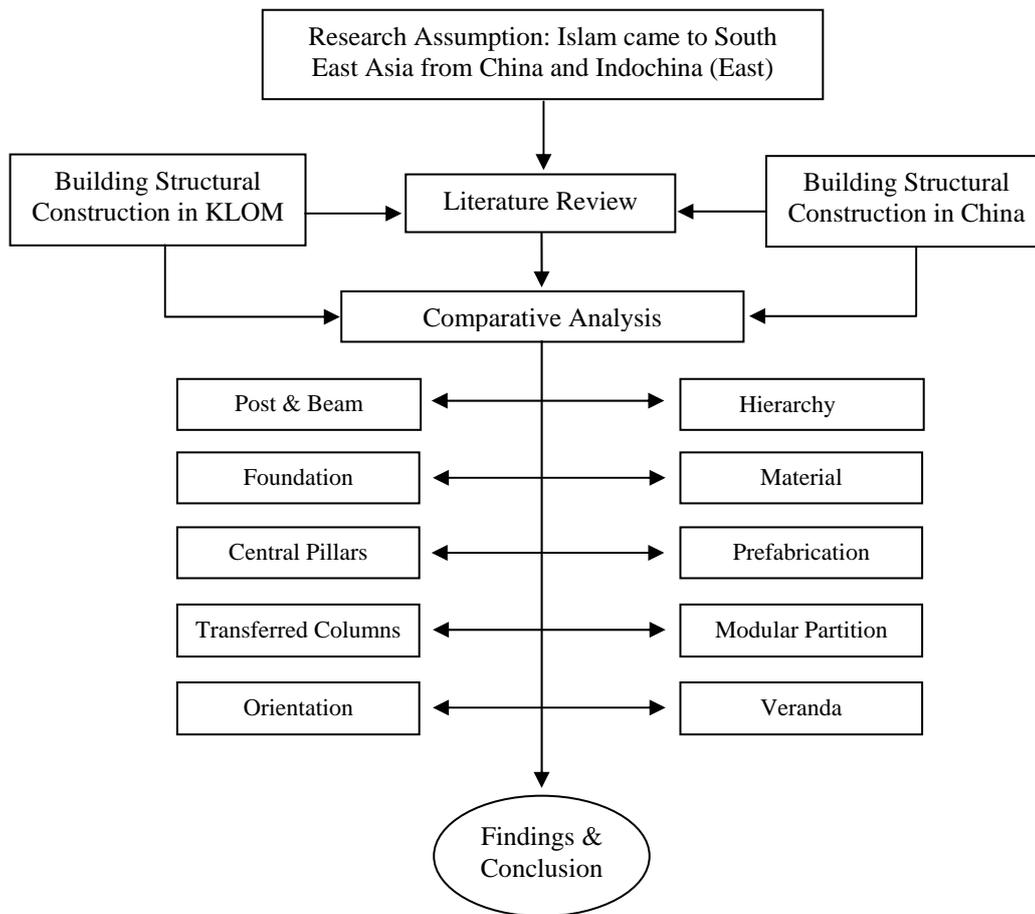


Diagram 1: Research methodology.

The scope of this study is limited to the analysis of building structures of KLOM and the traditional Chinese Building. Diagram 1 illustrates the research methodology. The research assumption as mentioned earlier in the introduction is to notify that “Islam came to South East Asia from China and Indochina (East) or not, in contrast to most arguments from Arabian region and India (West)” by referring to comparative study on structural construction of the building design. The other limitation in this study is that it does not focus to the study on the roof structures. Before the analysis is made, the study on the related building structures is conducted in the literature review. The aim is to identify factors and to understand each of the definition.

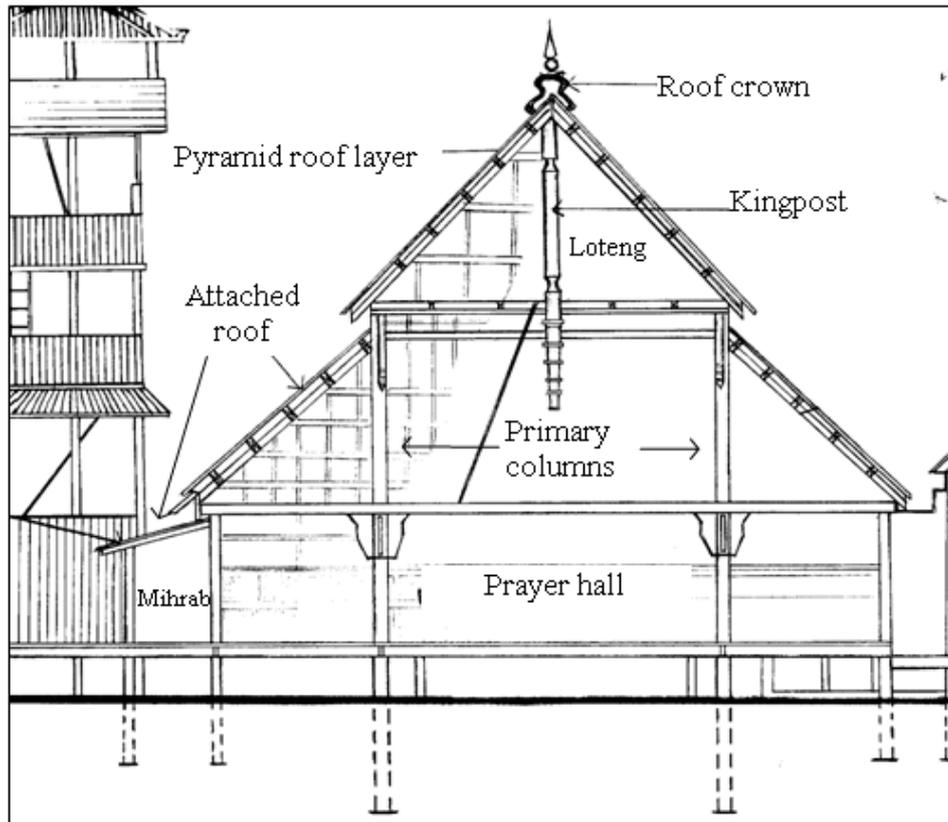


Figure 2: Section of KLOM.

Source: Drawn by D. Subramaniam students year 2, semester 2, 2009 architecture studio, School of Housing, Building and Planning, Universiti Sains Malaysia.

2.1 Building Structures of KLOM

With reference to the literature review, this study finally identifies the checklist factors which will be used as the measurable elements in the qualitative analysis. These measurable factors are as follows:

1. **Post and beam construction:** Construction of KLOM applies simple post (column) and beam (lintel) system (Figure 2). All beams are placed to the columns at 90° and the rafters at angle from $30-60^\circ$. This construction technique besides is used to build several layers of transferred column and beam system. Building structures like columns, beams and rafters are erected using mortise joints with wooden pegs. The design shows that the past master builders had understood to apply post and beam construction technique building a complex construction of three tiered pyramid roof structures of KLOM.

2. **Building foundation:** KLOM has a building foundation erected using ‘on stilts’ construction technique (Figure 2). ‘On stilts’ construction means erection of building floor system elevated at several feet above the ground earth’s surface. Mohd. Akib (2003) noted the actual height of the elevated ground floor is about 2.3 m from the ground when this building was at its original site in Kampung Laut. Today at Nilam Puri, the ground floor of KLOM has a level about 1 m from the ground. ‘On stilts’ construction begins with digging holes at certain depth for location of the column system. A series of stones (or a hardwood timber at the past before stones are introduced) are placed at these holes to function as the column bases. Timber columns are then erected on these bases and after that, with beams. The leveling process of the ground floor level at 0° is made during the erection of lower beams that supports the floor area.

3. **Four central pillars:** The construction of KLOM is primarily relying on its four inner columns (Figure 3). Dawson and Gillow (1994) called these columns as the ‘central pillars’. These central pillars are at prayer hall area. These columns are called *tiang seri* by the local people. These columns functions as the core structure supporting the floor and roof structures. The dimension of each column is 500 mm (length) by 500 mm (width) (Al-Ahmadi, 1990) and the height is 10.5 m. The columns’ span is about 6 m width to the *Qiblat* (direction for prayers facing *Kaabah* at Mecca, Saudi Arabia) orientation and 7 m length at the other side. These central columns become the landmark at the interior mosque’s praying hall. Their existence is due to become the primary columns supporting the three tiered roof structures. These columns are erected to the height of the pyramid roof structures where a series of transferred cross and tie beams are placed.

4. **Transferred structures:** The roof structures (Figure 2 and 3) have only one transferred column which is a kingpost. The roof structures also have only one joist where the kingpost is placed. This kingpost is erected to give a thrust and support to the rafters of the pyramid roof. It also supports the load of the roof crown (*buah butung*). This kingpost is known by the local master builder as *tunjuk langit*. The load from the kingpost is transferred to the joist and upper beams under a support from the central pillars (*tiang seri*).

5. **Structural orientation:** Orientation to *Qiblat* becomes a fundamental axis in the mosque design. *Qiblat* is an orientation to *Kaabah*. All Muslims are aware of the orientation to Kaabah as an important point of direction when performing prayers and pilgrimage (Hussin, 1998). Kaabah is a square form building or monument located in *Makkah* (Mecca) (Abdul Ghani, 2003). In Peninsular Malaysia, the direction is about 30° at North East direction. Like other mosques, KLOM has an orientation to *Qiblat*. The orientation gives influences to its structural layout, which becomes a fundamental orientation in defining a space for the prayer area. There is a *mihrab* design at the front mosque's façade. *Mihrab* is a narrow niche indicating the direction to *Kaabah*. It functions as a point of reference for the Muslims (especially to those who are strangers) to place their direction when performing a prayer. This area also becomes a place for the Imam when performing congregational prayers. The back façade is about at Southeast direction, where the primary entrance is placed.

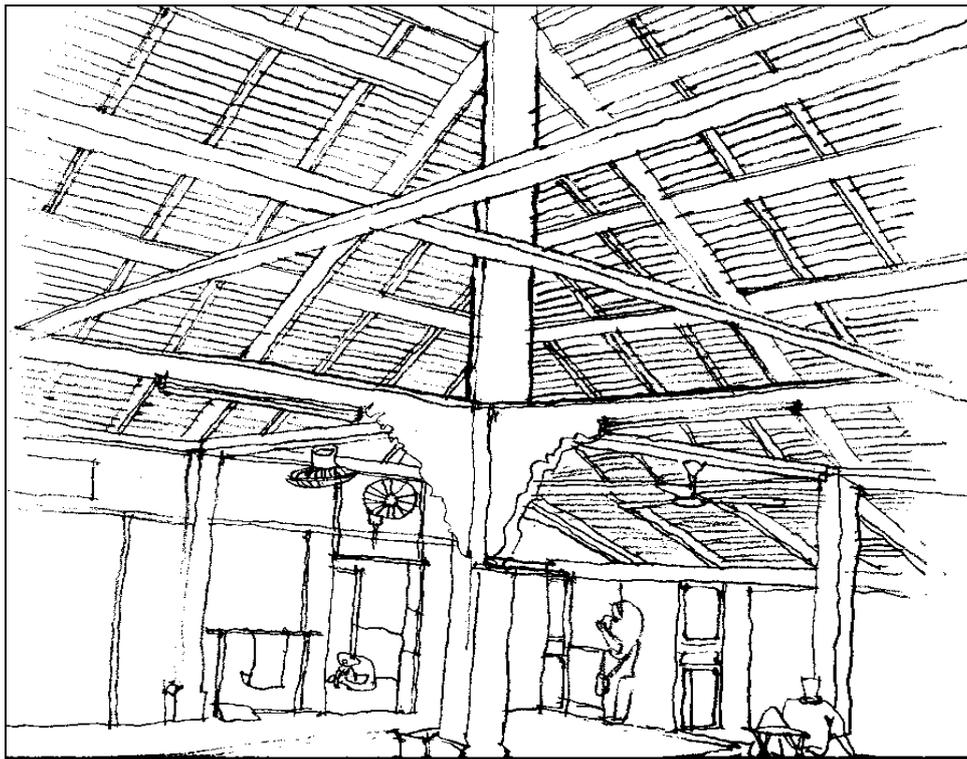


Figure 3: Interior view of the prayer hall with one of its central pillar.

Source: Drawn by M.H. Muhamad Jubri students year 2, semester 2, 2009 architecture studio, School of Housing, Building and Planning, Universiti Sains Malaysia.

6. **Hierarchical order of structural layout:** There are four central pillars (50×500 mm) supporting the upper roof (Figure 4) and middle roof structures while another 15 secondary columns (150×150 mm) (the other one only support the ground floor level) supporting the middle roof and ground floor level and the other 24 tertiary columns give a support to the lower roof and *serambi* (corridor's floor) area. The side facades have interior *serambi* (corridor area) except open *serambi* at the back façade. Only three of the tertiary columns are placed to support the *mihrab* area creating a small portion of *serambi* area at the front façade. The area is about 5.7 m in length and 1.5 m in width. Erection of beam construction is also important to build this three tiered pyramid roof form. There are four layers of beam structures to give a support to the elevated floor and roof of KLOM.



Figure 4: Modular wall's partition with interlocking style.

7. **Construction materials:** The construction materials of KLOM are timber, lime mortar and clay roof tiles. The material used to construct roof ridges and duck tails is lime mortar. All roof tiles (*attap Senggora*) and a roof crown are molded from clays. The primary material is timber. All structural components are from this material. The primary structural components like columns and beams are made from *cengal*. *Cengal* (dipterocarpaceae wood) is the finest and strongest hardwood in this region commonly used in making structural components like columns, beams, joists and rafters in the traditional Malay house, building and mosque construction. The other timber type

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material construction is *merbau* especially used for floor and wall panels (Mohd. Akib, 2003).

8. **Prefabricated construction technique:** The use of timber as the primary construction of KLOM is because of its harmony to the prefabricated construction technique (Figure 2 and 3). In this region, the past traditional master builders did not interest to use clay bricks, stones and mortars as the primary construction material. There are several parts of the KLOM applying the construction with mortar and clay tiles that shows the past traditional master builders understood using these materials in the building construction. Ancient Hindu temples in this region such as Brobudur, Bali and Bujang Valley, Peninsular Malaysia are constructed using stones and clay bricks by the past master builders. Selection of timber as the primary material has to do with tropical architecture, an expression of prefabricated construction concept primarily with post and beam system with mortise joints and pegs (Dawson and Gillow, 1994). All prefabricated components are made in the workshop before they are transported to the construction site for the next process which is the building erection.



Figure 5: Serambi (aisle) area at a perimeter of the prayer hall.

9. **Modular wall partition:** KLOM is one of the best examples that illustrate a modular system in curtain wooden wall construction (Figure 4). Each module is overlapped with wood panel as the perimeters. The layout of these wooden boards applies interlocking

system. The local master builders call this wall as *janda berhias*. The function of wood panels is to conceal the line joints of the wooden boards. The dimension of the wooden board is a rectangular shape with 2:1 ratio, a size about 0.6×0.3 m. The thickness of the wooden board is 15 mm. The width of the panel is 75 mm. Similar interlocking modular boards are used in window's and door's construction.

10. **Veranda concept:** *Serambi* or veranda at KLOM is an area where one shall enter after the entrance stairways or aisle at the perimeter of the prayer hall (Figure 5). It is the place where most guests are entertained. According to Gibbs (1987), the place of this space elevated about 300 mm lower than the primary floor level which separates it from the main prayer hall. The area always used by the users as a favorite when they perform individual prayer or *Iktiqaf* (stay in the mosque) while doing Ibadan; for example, reciting Al-Quran and read the books related to Islam. The low window design at the *serambi* area allows cross ventilation and views to the exterior. *Serambi* area is a long and narrow veranda. KLOM has *serambi* area at its both sides (13.2×1.5 m) and at its back façade (16.2×1.5 m). There is no *serambi* area at its front façade but a portion of projected area for *mihrab* is erected at this area. The dimension is 6×1.5 m. Unlike *serambi* floor, the floor for *mihrab* has the same height as the main prayer hall.

2.2 Chinese Building Structures

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. Regardless to the regional diversity of the religions and geographies, Chinese construction style is adopted as a primary design of the religious buildings. In China, the local master builders had adopted Chinese construction technique in building the traditional mosques. The examples of Chinese mosques are Xian and Nunjie Mosque. The construction style also has an influence to mosque design in South East Asia. Tran (2008) in his research argued that Champa Kingdom 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 Archipelago. This kingdom was established in 192 AD. Due to the lost in many wars against the Viet Kingdom (currently known as Vietnam) from 15th-19th century, this kingdom fell under Vietnam and assimilated with

Vietnam cultures. Many *Champa* people migrated to Cambodia, Peninsular Malaysia, Java, Sumatra, Kalimantan and Sulawesi (Mohamed, 1989). Building structures are important factors in defining the construction elements of traditional Chinese buildings. There are 10 factors of the building structures as follows:

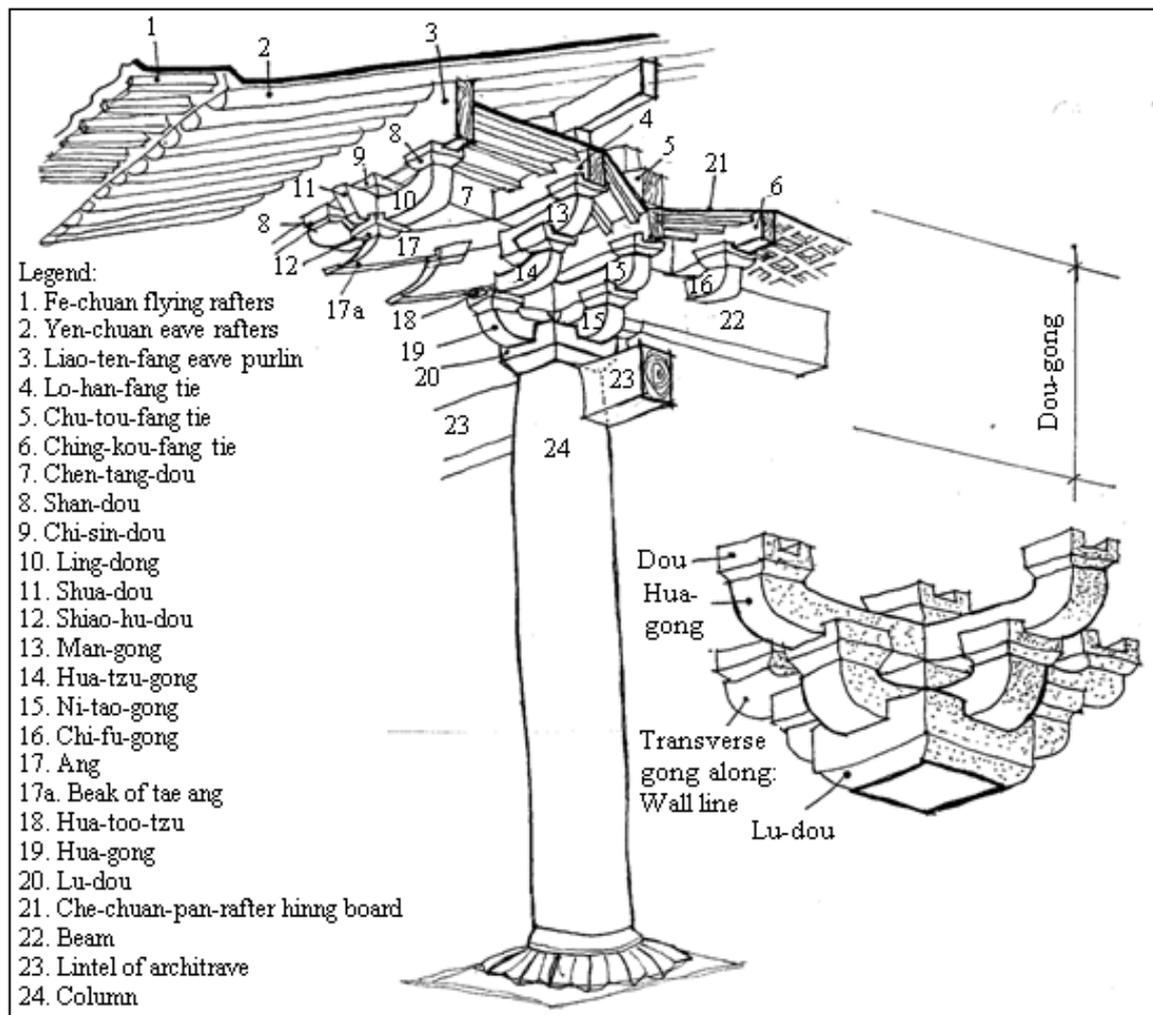


Figure 6: Bracket post and beam construction technique.

Source: Drawn by students year 3, semester 2, 2009 architecture studio, School of Housing, Building and Planning, Universiti Sains Malaysia.

1. **Post and beam construction:** Traditional Chinese master builders apply bracket post and beam system (Figure 6) in the construction. Bracket is a joint system made from timber to support the building and roof structures. It comprises two main components which are bases (*dou*) and cantilevers (*gong*). The fabrication of these objects constructs a cluster of cantilevered brackets known as *dou-gong*. Kohl (1984) noted that the construction

technique is adopted as principle structures in Chinese building design since Sung Dynasty. It is considered the formal technique (Imperial style) in Chinese construction which influences the architectural style in building palaces, temples, mosques, pagodas. By using cantilevered brackets, it is possible to project a large roof overhang's construction, to construct double roof form and to build curved roof structures (Boyd, 1962). In contrast to typical post and beam system, Chinese bracket post and beam system is a complex construction technique much relying on cantilevered brackets. It is a corbel bracket system used as a joint system to support column and beam framing structures.

2. **Building foundation:** The traditional Chinese buildings are erected on podium structure (Figure 7). Podium is a foundation platform base construction (Caffarelli, 1989). Building erection takes place after the base for the building foundation is constructed. The podium's height varies from several feet above the ground and possibly built to the height of two floor building levels. The examples are the Great Walls of China and Winter Palace in Beijing. Both have a high plinth foundation. The platform symbolizes the earth whereas the roof is as the heaven (Blaser, 1979). The podium commonly has either rectangular or square base. To build this platform, retaining walls are constructed along the perimeter of the area. The materials for the wall construction are stones or clay bricks or both. After the construction of the retaining walls, landfill of rammed earth is made. The rammed earth is densely compressed (tamped) using traditional compacted tool (rammers) by the construction workers. The works increase bearing strength of the building foundation (Knapp, 1989).

3. **Inner column system:** Traditional Chinese architecture commonly has inner and outer column system (Figure 7). For pyramid roof construction, there are four central pillars erected at the interior of the building, usually functioned as a main hall. These pillars give a primary support to the roof structures. These pillars are the most dominant structures and as written in Shinto manuscripts, they are regarded as 'sacred centre columns' (Inoue, 1985). The uniqueness of the traditional Chinese construction technique is that it applies bracket post (column) and beam system. The central columns therefore play a crucial role as a main building support to the roof bracket structures with a series of transferred columns and beams. These central columns are erected to the height of the building wall. A primary bracket system is then placed to give a support to

the cross-beams and tie-beams which cover the length and the width of the building. These beams support all transferred roof structures. These entire loads are under the support of the primary columns. Besides, the traditional Chinese buildings have an attached roof system. This attached roof structures are jointed by the bracket system which is supported by the central pillars and the secondary columns (aisle columns) at the other end.

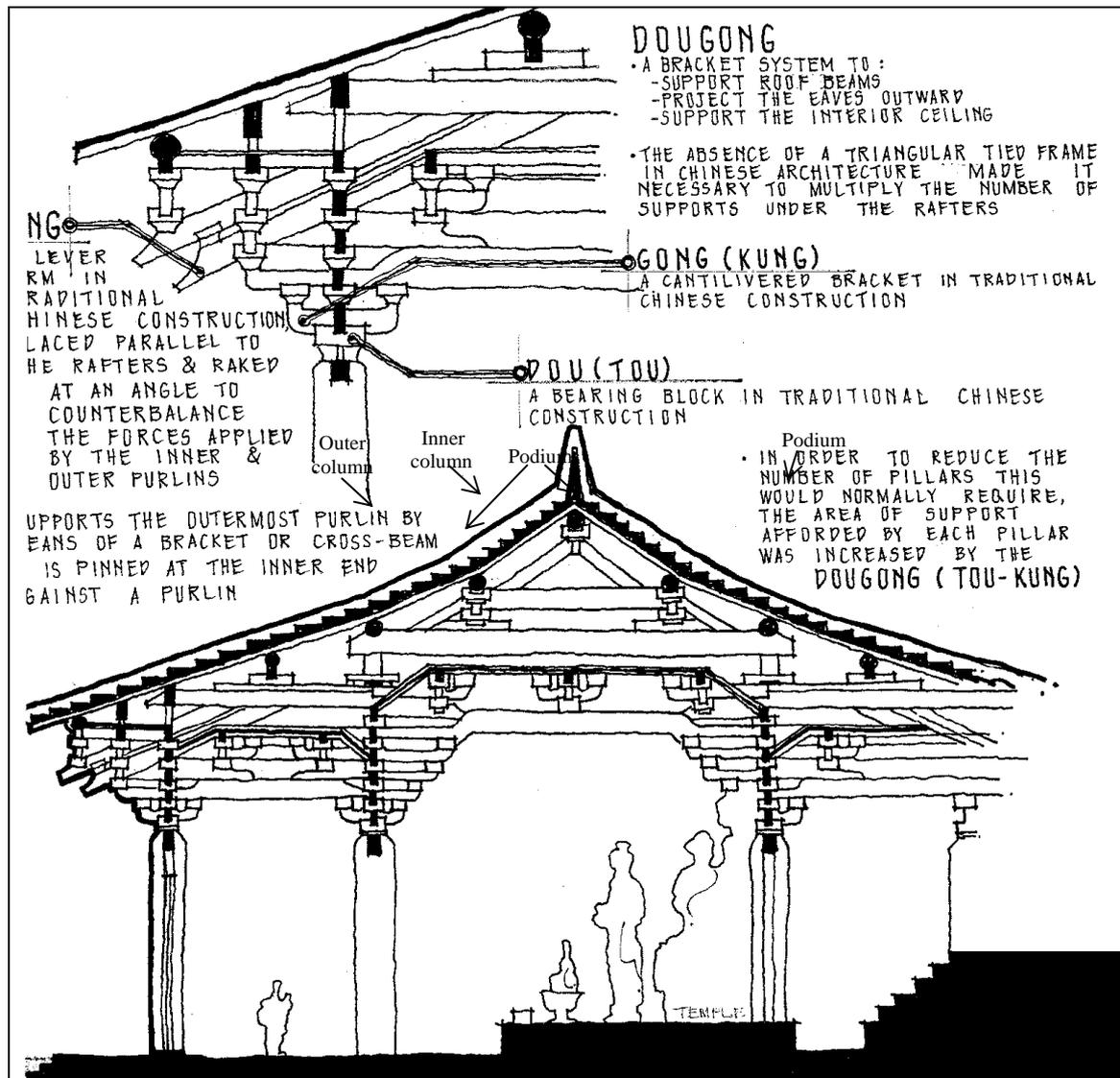


Figure 7: Section of the traditional Chinese building ^[29].

Source: Drawn by N. Zulkhaflee student year 3, 2003 architecture studio, School of Housing, Building and Planning, Universiti Sains Malaysia.

4. **Transferred structures:** Traditional Chinese bracket construction technique is heavily relying on transferred structures (Figure 6) in the building construction. Kohl (1984) argued that the presence of transferred beam and column system gives design flexibility

that determines the dimension of the roof form. This emphasis is on the horizontal axis which makes an important role of transferred beam frame system. Fletcher (1999) defined this construction as ‘beam-in-tiers’ technique. This bracket construction makes erection of the curved roof form possible. The system applies cantilevered bracket beam system that able to give the erection of cantilevered purlins to control the angle of the curved roof construction.

5. **Structural orientation:** The emphasis of traditional Chinese architecture is north to south axis. As a result, the structural layout has a design to this orientation. Kohl (1984) noted that this shows the ‘Chinese affinity’ for north-south building orientation with symmetrical plan layout. This orientation is influenced by the geographical factor of the region. Kohl (1984) argued that it is the ‘symbolism of the directions’ to the seasons and winds. The south orientation avoids from direct exposure of sand’s storm from Gobi desert (especially to regions at the Northern China). The south façade opening besides gives the building frontage orientated to intense sunlight which is necessary during the winter season. Furthermore, the design emphasis on central axis in defining the structural layout in lined to its south building entrance. The orientation becomes a fundamental element in defining layout of the building space and form. The front façade is at south orientation while the rear façade is at north orientation. The south façade therefore has a primary entrance and window openings. The south building wall is recessed inward for an open verandah exposed with a series of aisle columns.

6. **Hierarchical order of structural layout:** Application of double layer roof form influences the order of the building structural layout. Four central pillars give a main support to the pyramid roof form. A series of secondary (aisle) columns are erected to give additional support to the attached roof form. With application of Chinese bracket system, number of the aisle columns in building layout is limited. The bracket system emphasizes on transferred structures for roof construction. There are several layers of transferred structures which comprise beams, columns, purlins, rafters, queenposts and kingposts jointed by bracket system. The design gives flexibility order of the bracket structures, flexible number of upper beams and columns, used in the bracket roof construction. The number of layers used for the roof structures determines the size of the transferred structures.

7. **Construction materials:** Timbers, stones, bricks and rammed earths are the important material in the traditional Chinese construction (Knapp, 1989). Timber is the most important construction building material in Chinese architecture. Timbers are used in the construction of structural components such as brackets and joints, beams, columns, rafter and purlins. Timber is in many cases selected for the wall construction. Brick and stone blocks are used more frequently than timbers for wall construction in China. Lime cements mixed with gravel, sand and water, compressed earths, bricks and stones are the materials for retaining wall's, podium's and building floor's construction. This cement is the construction material for roof ridge boards and crown. The other building material is clay for the construction of clay roof tiles.
8. **Prefabricated construction technique:** Traditional Chinese construction applies prefabricated construction technique (Figure 6). The use of timber material is important for this timber framework construction (Knapp, 1989). All prefabricated components are produced before erection process takes place on the site. The most unique factor of the Chinese architecture is that it is heavily relying on bracket system. As a result, it reduces the number of the column structures designed in plan layout compared to ordinary post and lintel (beam) construction. The structural design has an emphasis on layers of roof structures with transferred column and beam system. The bracket system uses limited timber mortise joints for the structural components. The brackets function as a structural joint.
9. **Modular wall partition:** Curtain wall is commonly used in Chinese building construction. Brick, stone and timber are popular materials in Chinese wall construction. Box bond and cross bond patterns are commonly used for the brick or stone work's construction (Kohl, 1984). The wooden walls have lattice patterns carved and cut into various sizes and shapes of geometric frameworks (Knapp, 1989). The lattice pattern construction integrates modular, interlocking and repetitive system. The pattern is a combination of the wooden panel creating the building wall (Knapp, 1989). The wall construction is not in line with the column and beam perimeter. It is instead slanted back to the column and beam perimeter exposing the cantilevered bracket construction (Kohl, 1984).

10. **Verandah (Aisle) concept:** The building axial orientation with an entrance to the south creates the importance of open aisle or verandah to the building front facade. Construction of south building wall is recessed at several meters from the aisle columns to create a verandah area. The double pyramid roof form projects additional aisle. The length of this single aisle system is determined by the number of bays used in the construction. The number is always odd in number, for example; three, five and seven bays (Inoue, 1985). The use of cantilevered bracket system for the roof construction creates a large roof overhang providing shades to this area. It is the tradition in China to have an open lattice wooden frameworks at south verandah entrance toward positive warm sunlight (Yang concept) and a solid building wall at the northern side to avoid from negative cold direction (Yin concept) (Kohl, 1984).

3 Results

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

- None (no similarity at all in the analysis)
- Moderate (has some similarity in the analysis)
- Exactly (has almost exact similarity or the same in the analysis)

Table 1: Results of the analysis.

Building structures	KLOM Exactly	Chinese Architecture	Level of Similarities	
			None	Moderate
Post and beam construction				X
1	Post and beam	Post and beam bracket system	X	
2	Cantilevered post and beam	Layers of cantilevered bracket framing system	X	
Building foundation			X	
1	On stilt concept	Podium base	X	
2	Elevated columns	Retaining Wall	X	
3	Elevated floor leveling	Landfill (compacted) leveling	X	
Inner column system				X
1	4 main inner columns (<i>Tiang seri</i>)	4 main inner columns		X
2	Inner <i>serambi</i> (aisle) columns	Inner aisle column		X
3	Outer <i>serambi</i> columns	No outer <i>serambi</i> columns	X	
Transferred structures				
1	Fixed one transfer columns	Flexible transfer bracket columns		X
2	Fixed transfer beam	Flexible bracket transfer beam		X
3	Not able to construct curved roof	Creating curved roof	X	
4	Multi layer beams	Multi layer bracket beams		X
5	Horizontal emphasis	Horizontal emphasis		X
6	Purlin on rafters	Purlin on beams	X	
Structural orientation				X
1	<i>Qiblat</i> orientation	North-South orientation	X	
2	Entrance Façade orientation to <i>qiblat</i> with open <i>serambi</i> structures	Entrance Façade orientation to south with open aisle structures		X
3	Portion <i>serambi</i> space for <i>mihrab</i> façade while other <i>serambi</i> recessed	No recessed aisle at North facade	X	
Order of structural layout				X
1	Limited column number	Limited column number		X
2	Primary, secondary and tertiary columns	Primary and secondary columns	X	
3	Hierarchy order of upper column structures	Hierarchy order of bracket upper column structures	X	
4	Hierarchy order of upper beam structures	Hierarchy order of bracket upper beam structures	X	
5	Fixed order of structures	Flexible order of bracket structures	X	
Main timber construction materials				X
1	Main timber structures	Main timber structures		X
2	Timber walls	Timber and brick/stone walls		X
3	Timber planks floor	Lime cement floor	X	
4	Timber mortise/wooden peg joint	Timber bracket and joints		X
5	Lime cement roof ridge boards	Lime cement roof ridge boards		X
6	Lime cement ridge tails	clay ceramic ridge tails		X
7	Clay roof tile	Clay roof tile (glaze)		X
8	Clay ceramic roof crown	Lime cement/ceramic roof crown		X
Prefabricated construction technique				X
1	Simple post and beam system	Bracket post and beam system		X
2	Mortise joints with pegs	Bracket joints	X	
Timber wall partition				X
1	Modular wall grid partition with Malay decorative style	Modular lattice wall grid partition with Chinese decorative styles		X
2	Interlocking patterns	Interlocking patterns		X
3	Repetitive pattern	Repetitive pattern		X
Verandah construction				X
1	Double aisle/ <i>serambi</i>	Single aisle/ <i>serambi</i>	X	
2	Open <i>serambi</i> entrance	Open aisle entrance		X

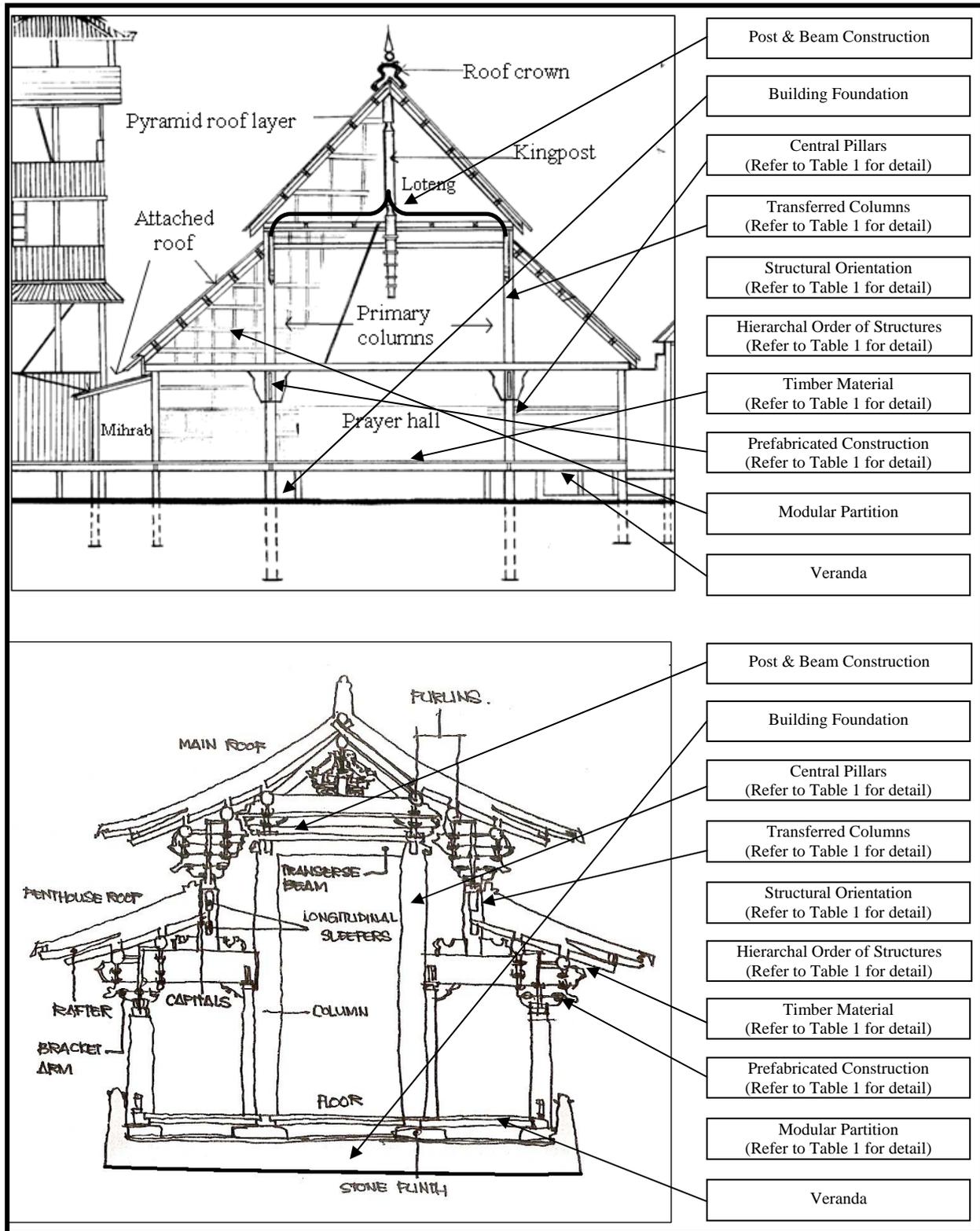


Figure 8: Results of the analysis with graphic description

Source: Drawn by D. Subramaniam (top) and Goh Chee Haw (bottom), student year 2, semester 2, 2009 and 2006 architecture studio respectively, School of Housing, Building and Planning, Universiti Sains Malaysia.

By doing this qualitative analysis, it will help to identify the level of influences by Chinese structural elements to the construction of KLOM. Building structures comprises 10 factors which are post and beam construction, building foundation, inner column system, transferred structures, structural orientation, order of structural layout, timber construction materials, prefabricated construction technique, wall construction and verandah construction. There are two types of the analysis in this survey. The first type is a comparative analysis by factors. It is a general observation study. The other type is a comparative analysis by sub-factors. The comparative analysis by factor is a specific observation study. The results of the analysis are given in Table 1.

3.1 Analysis by Factors

- From all ten categories, there are six categories in building structures which apply the same (60% mark) construction elements which are post and beam construction, inner column system, transferred structures, timber construction materials, prefabricated construction technique and verandah construction
- Another three categories have moderate level of similarity (30% mark) which are structural orientation, order of structural layout and wall construction
- The other one category is building foundation which has no similarity (10% mark) in construction element between KLOM and the traditional Chinese buildings.

3.2 Analysis by Sub-factors

- KLOM has post and beam structural construction whereas the traditional Chinese building has bracket post and beam construction (moderate level of similarity)
- KLOM has on stilts structural concepts with elevated floor a few meters from the ground level while the traditional Chinese building has a podium based foundation using landfill technique into squared and rectangular based retaining walls (no level of similarity)
- Both KLOM and the traditional Chinese building have 4 inner columns and aisle (*serambi*) columns supporting the pyramid tiered roof form. However unlike single aisle

used in traditional Chinese buildings, KLOM has double *serambi* (aisle) column system giving a support to its first and second attached roof (moderate level of similarity)

- The traditional Chinese building has flexible transferred bracket column and beam structures whereas KLOM has fixed structures. In contrast to bracket structural system, fixed structural system does not able to construct curved roof and erect purlins on transferred beam structures. However both building constructions have horizontal emphasis in building form's design and multilayer of transferred beam structures (moderate level of similarity)
- Traditional Chinese roof construction has north to south structural orientation with an emphasis of recessed south wall for the entrance while KLOM has a *qiblat* orientation with an emphasis of recessed entrance wall (*serambi*) and a quarter portion of projected *serambi* wall for *mihrab* area (no level of similarity)
- Both buildings are able to be built with limited number of column system because their construction emphasis is on transferred column and beam structures. As a result, the construction has hierarchical order of upper column and beam system (application of primary, secondary, tertiary and minor column and beam structures) (the same level of similarity)
- Both buildings use timber as a primary construction material with clay and lime cement for the roof construction. The difference is that unlike KLOM, traditional Chinese building has brick and stone wall construction for retaining wall's podium and some buildings have stone or brick construction (moderate level of similarity)
- Both buildings apply prefabricated post (column) and beam construction technique in the building construction. The difference is that KLOM was built using simple post and beam system and mortised structural joints with pegs whereas the traditional Chinese building was erected using bracket post and beam system with bracket structural joints (moderate level of similarity)
- Both buildings have modular concept of the timber wall partitions with interlocking and repetitive pattern (moderate level of similarity)
- Both buildings have open aisle (*serambi*/veranda) entrance with recessed wall design. The difference is that KLOM has double aisle design while the traditional Chinese buildings have single aisle design (moderate level of similarity)

4 Discussion

The study shows that the results of the analysis by factors support the argument of the research assumption that the structural design concept of KLOM has an influence from Chinese building construction using post and beam timber construction. However, the results of the analysis by sub-factors do not show support for the argument because it shows that the structural design details of KLOM follow the construction details from Chinese building construction. The important results are as follows:

- There are influences of traditional Chinese construction to the construction of KLOM. The results by categories show that the building structure applies 60% of the total categories with the same design and another 30% with a moderate level of similarity
- The only different design by factor is the building foundation. KLOM has 'on stilts design' in contrast to podium structure used in traditional Chinese construction
- Although analysis by factor shows that many basic concepts of Chinese building construction are used in the construction of KLOM, analysis by sub-factors shows that there are differences in structural details to the construction elements between KLOM and the traditional Chinese buildings. The differences are as follows:
 - The difference 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 difference in structural details of the construction elements
 - Impact on the religious and cultural influence has made building orientation with *mihrab* and entrances of KLOM different to those of the traditional Chinese buildings
 - Construction of KLOM applies post and beam construction technique. In contrast to KLOM, traditional Chinese buildings are built using bracket post and beam construction with bracket joints; as a result, this application creates difference in structural layout and hierarchical order of transferred column and beam structures which make possible for curved roof construction

The study recommends that KLOM has building structures influenced by Chinese architecture but if we compare to its construction details, there are differences between KLOM and the traditional Chinese buildings. The results show that the design of KLOM is not totally applied Chinese construction. The detailed construction has simple post and beam

structures which makes architecture of KLOM unique, and has its own regional identity. The results of the analysis can be used a guideline, which is important because it can be used as a reference to the development of the local architecture which concerns to the local culture as argued by Mohamad Rasdi (2005) 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.

5 Conclusion

In conclusion, the research findings show that there are similarities in construction of KLOM and traditional Chinese buildings. These similarities are post and beam construction, inner column system, transferred structures, timber construction, prefabricated construction technique and verandah (aisle) construction. However, the research findings find that there are differences in structural construction details between KLOM and traditional Chinese buildings. These differences give unique characters of KLOM. These differences are:

- Religious influence has made the structural design layout at KLOM such as building/structural orientation and projected *mihrab* different to those in traditional Chinese construction, which emphasizes on Chinese culture and Buddhist religion
- Construction of KLOM does not apply bracket post and beam construction technique with bracket joints but it uses regular 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
- Construction of building foundation at KLOM applies on stilts concept with elevated floor system in contrast to traditional Chinese building foundation based on podium concept of construction with retaining wall and landfill technique

The findings of the differences and similarities of the building structures between KLOM and the traditional Chinese buildings can be used as a guideline to understand construction design in the state of Kelantan. The findings give evidence of the influence of the Chinese

building construction to the construction of KLOM to support the argument that Islam came to South East Asia from China and the role of Kingdom of Champa in disseminating Chinese cultures and influences to the Malay Kingdoms. Building construction influences from China have shaped the design of KLOM as well as other traditional mosques in South East Asia. The findings do not support the argument written in most history text books that note Islam was spread to this region from Arabian regions and India due to lacks of design influences from these regions.

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