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The Structural System of Traditional Malay Dwellings in Sambas Town West Kalimantan, Indonesia

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ABSTRACT

The architecture of the Sambas traditional dwellings in West Kalimantan, Indonesia, one of the national heritage, has contributed particular characteristic structures. This study mainly focuses on these structural systems. A detailed investigation will be done on three type of Malay dwelling roof styles: Potong Limas (Limas style), Potong Kawat (Kawat style) and Potong Godang (Godang style). Analyzing the types of the structural systems used in the research objects, the author found an amazing endurance of these dwellings to toward the environmental conditions. This research is performed using the positivistic method and the data used were verified on the field and analyzed qualitatively. The utilization of local structures, such as the type of foundation, the wall construction and the roof slopes were built in unison with the nature.

Key words: traditional dwellings, structural system, architecture

ABSTRAK

Seni bina rumah-rumah tradisional Sambas di Kalimantan Barat, sebagai salah satu warisan nasional Indonesia, telah menyumbang sistem struktur dengan ciri-ciri tertentu. Kajian ini terutamanya memberi tumpuan kepada sistem struktur ini. Siasatan terperinci akan dilakukan ke atas tiga jenis gaya bumbung kediaman Melayu : Potong Limas (gaya Limas), Potong Kawat (gaya Kawat) dan Potong Godang (gaya Godang). Menganalisis jenis sistem struktur yang digunakan dalam objek penyelidikan, penulis mendapati ketahanan yang menakjubkan rumah-rumah ini ke arah keadaan persekitaran. Kajian ini dilakukan dengan menggunakan kaedah positivistik dan data yang digunakan telah disahkan di lapangan dan dianalisis secara kualitatif. Penggunaan struktur tempatan, seperti jenis pondasi, konstruksi dinding dan cerun bumbung dibina serentak dengan alam semula jadi.

Kata kunci: rumah-rumah tradisional, sistem struktur, seni bina

INTRODUCTION

The architecture of Sambas traditional residential homes as a part of the Indonesian national heritage has developed particular characteristic as stage dwelling structures. The tradition refers to procedures and material objects which are anchored in the inhabitants cognitive and accepted in their society. Waterson (1997 : xv) mentioned: "Architecture involves not just the provision of shelter from the elements, but the creation of a social and symbolic space". Noble (2007 : 1) mentioned "The word traditional refers both to procedures and material objects that have become accepted as a norm in a society, and whose elements are passed on from generation to generation, usually verbally, or more rarely by documents that have codified orally transmitted knowledge, instructions, and procedures".

Generally, traditional dwellings of Sambas use timber as main material of the construction and are built along rivers (Sambas, Subah and Teberau) crossing the town. In some cases, the facades are oriented to the street. Generally, they were, however, built nearby the river.

Traditionally, all buildings both domestic buildings and public buildings (like palaces or mosques) were oriented to the river. Thus the historical monument of the *Alwazikubillah* as Sambas king's palace in the past indicates that the river as main orientation of all buildings during that time.

TYPE OF THE INDIGENOUS DWELLINGS IN SAMBAS TOWN

In traditional Malay societies, types of indigenous dwellings are built on a hierarchy of three types (Figure 1): *Potong Limas* (*Limas* style), *Potong Kawat* (*Kawat* style) and *Potong Godang* (*Godang* style). The typology of floor plan of Sambas dwellings is square with building masses perpendicular to the backyard.

All steps in the building process of Sambas dwellings, such as planning the order of rooms in the floor plan, erection ceremony and so on, are linked to cultural values of Malay's life (bad or good values), the nature of human effort, the nature of human perception of time, the nature of human relation with environment, the nature of worship in the relation between human and God (*Hablumminallah*) and the nature of interrelationship of human beings (*Hablumminannas*).

The timber used as construction materials can be classified based on the structures, namely the main structure (foundation, posts, etc.) and

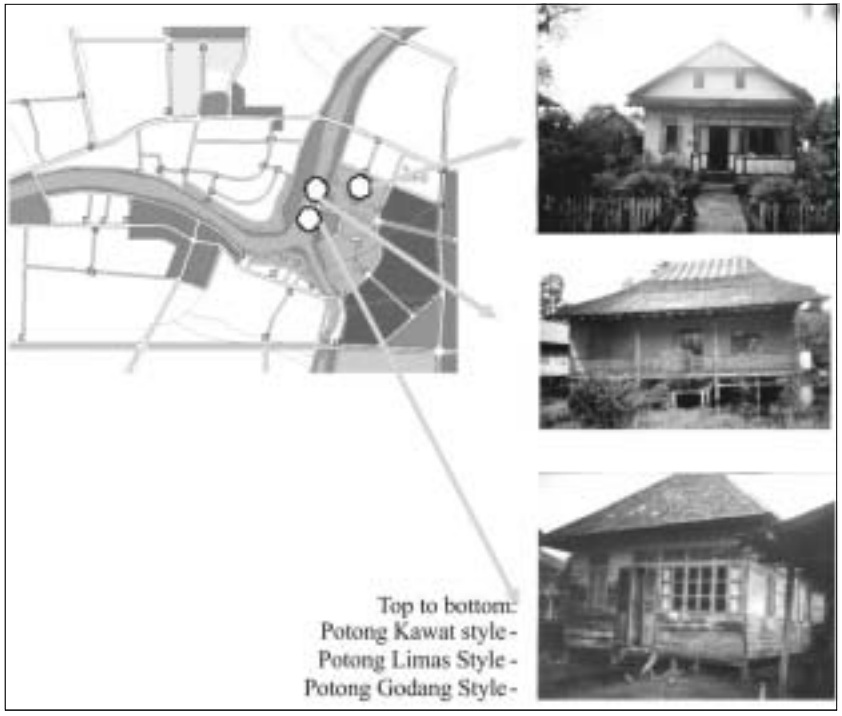

Figure 1. The roof style of indigenous dwellings in Sambas town

the support structure (wall, roof, etc). For the main structure, it used the first class timber such as *belian*, while the support structure used secondary class timber such as *jelutung*, *selimpau*, *rengas*, etc. The dwellings were constructed on stages by levels ranging between 1 to 1.5 metres from the ground.

The traditional Malay dwelling consists of two parts: the main house and the support house. These two parts are usually connected by a corridor (*pelataran*). The main house has a floor elevation level of 15 - 45 centimetres higher than the support house. The floor plan of the main house is divided into three sections; terrace (*serambi depan*), living room (*serambi tengah*) and family room (*serambi belakang*). The living room is usually divided into numbers of bedroom and a common place. The bedroom walls are designed to be removable if and when needed. A stair on the backside of the family room (usually in the middle) leads up to the attic (*parak*). *Parak* is the second floor where women and girls do their routine activities, such as sewing, reciting a holy book (*al-Qur'an*) etc. The support house consists of a kitchen and a small open space for

washing. The support house wall generally used second classification timber with a superimposed (*susun sirih*) installation (Figure 4).

OUTLINES OF THE INVESTIGATIONS

The research objects used in these case studies located in the Sambas town and they represent three types of the traditional Malay dwellings. They are located along the Sambas River: 2 dwellings (represented by *Potong Limas* and *Potong Godang*) were built at Kampung Tumok and 1 dwelling (represented by *Potong Kawat*) was built at Kampung Dalam Kaum.

Case #1: *Potong Limas*

This dwelling was built in 1920 and has been occupied by the third generation. The main house is raised 2.1 metres from ground and the support house has a 40 centimetres lower level than the main house (Figures 2 and 3).

Figure 2. Front side of #1: *Potong Limas*

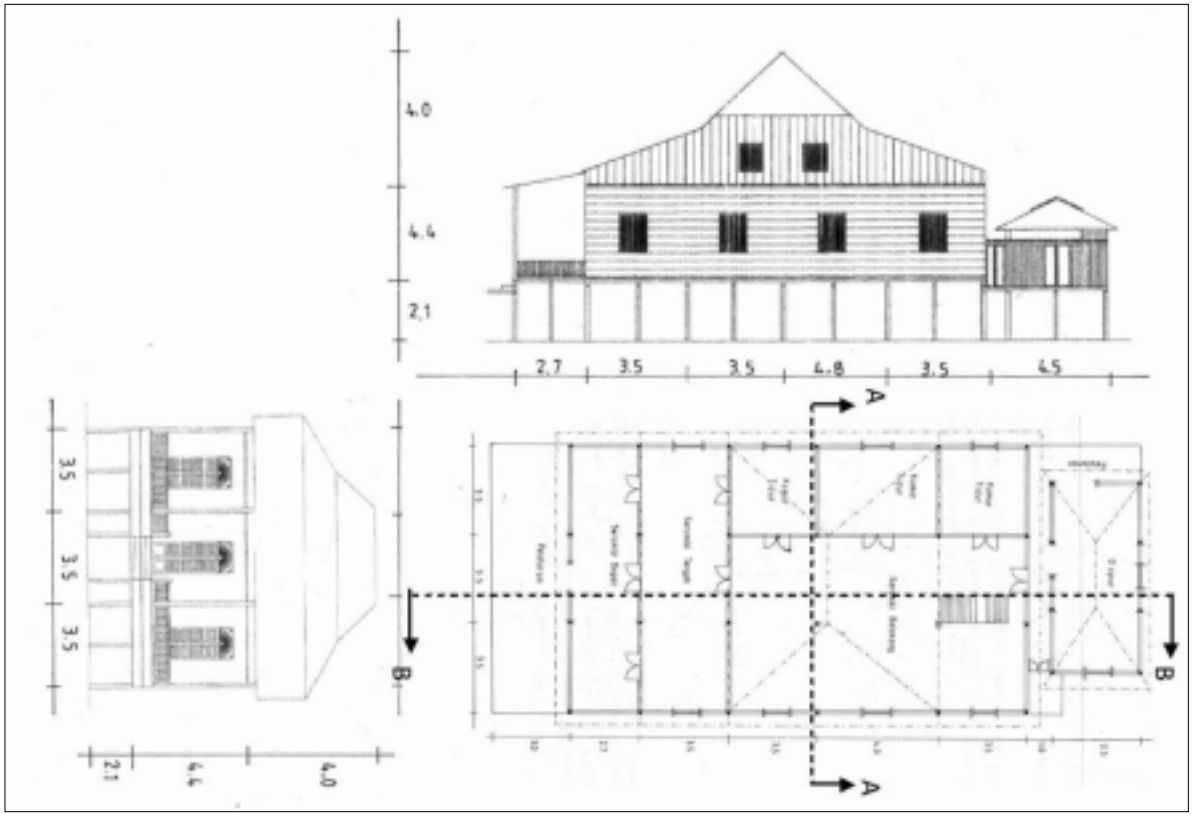

Figure 3. Facade of #1: *Potong Limas*

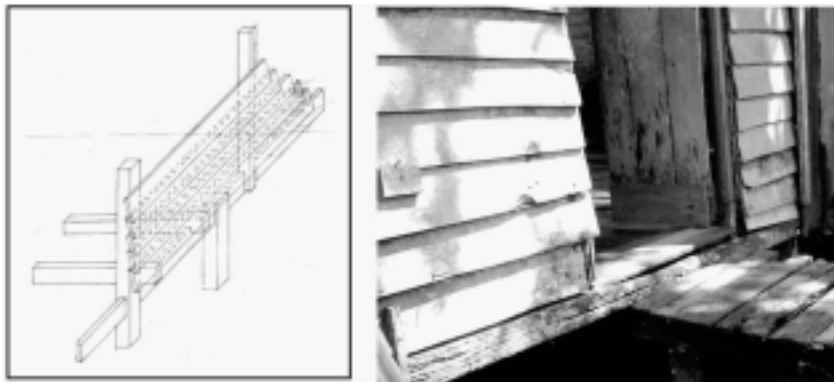

Figure 4. The *Susun sirih* wall installation of #1

For the outer walls of the main house, first classification timber was used at the front side of the facades. While at the right, the left and the back used first classification timber as high as 1 metre from the floor level and the upper part of it used second classification timber. The floor of the main house consists of first classification timber without joints with a length over 10.5 metres along the house.

No bracing is found to strengthen the posts. The bracings function as the framework for windows or doors. The roof of the main house is a combination of two different kinds of slope: > 45° and 30° (Figure 5). All the joints of posts and beams use traditional construction methods without nails. Round key timber was used as locking wedge to all joints of the structure (see the detail on Figure 7).

In the main house, all the foundation piles also serve as posts for the wall structure (Figure 5). This structure uses 14/14 timber. Continuous trunks or logs were installed under piles bearing up the whole structure (Figure 6). All these bearing covers were installed along river bank. The average foundation rises 2.1 metres from the ground level (Figures 5 and 6).

Case #2: Potong Kawat

This dwelling was erected in 1937 and located on Kampung Dalam Kaum. The main house is raised 1.3 metres on average above the ground level, meanwhile, the floor of the support house is 15 centimetres lower than the main house (Figures 10 and 11).

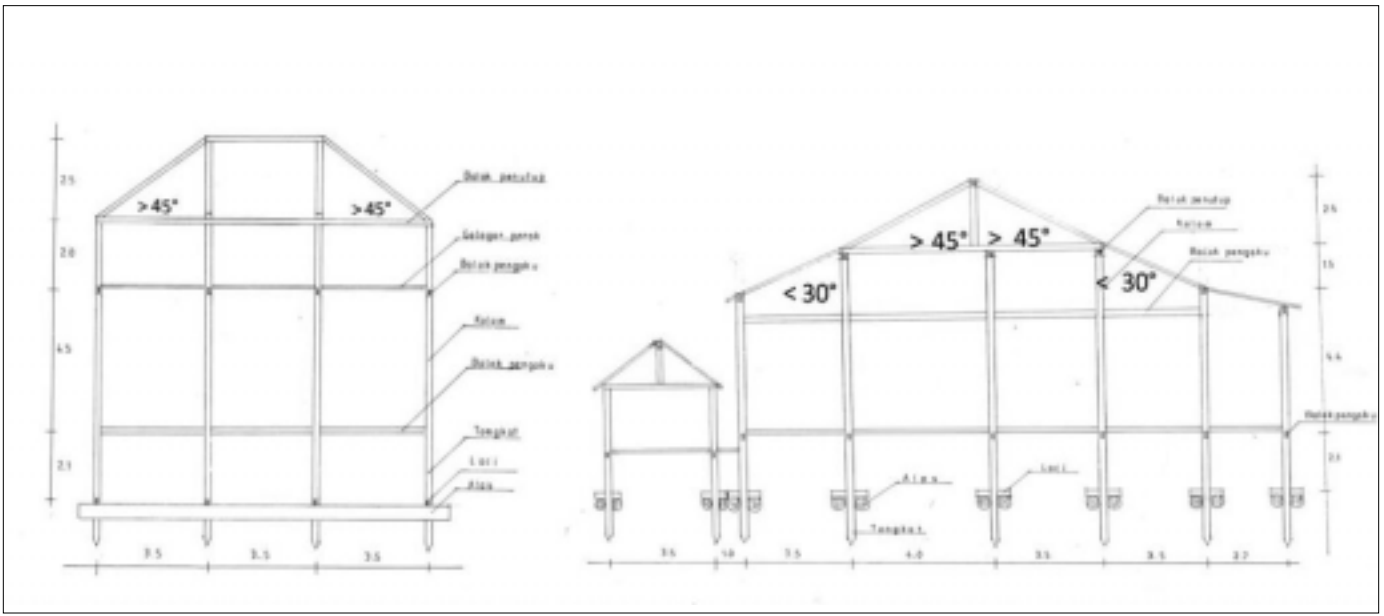

Figure 5. Sections and slope elevations of #1

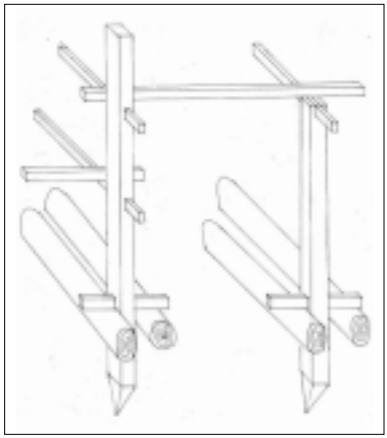

Figure 6. Piles timber foundations of #1

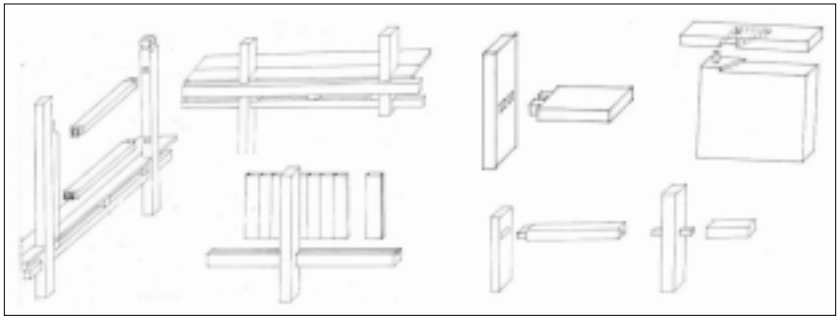

Figure 7. Wedge joints of structure # 1

First class timber was usually used for the foundation in the size of 14/14. These piles proceed as posts continuously to the top, also serving as supports of the wall structure (Figures 8 and 9). This dwelling is situated in a distance of 30 metres from the river but standing nearest of a canal (*parit*) at the right side. All piles are bearers up by continuous beam covers (*alas*) installed along the canal water flow (Figure 9).

First class timber was also used for the main house wall as high as 1 metre from floor level in the front, right and left facades while the upper part was formed using the second class timber.

No bracings found to strengthen the posts. The bracing is taken over by frame-work for windows or doors. The saddle roof is installed with >45° slope (Figure 8). All the construction elements functioned as posts or beams used a simple beam construction without any additional steel joints. Round timber was used as locking wedges to all joints of the structure.

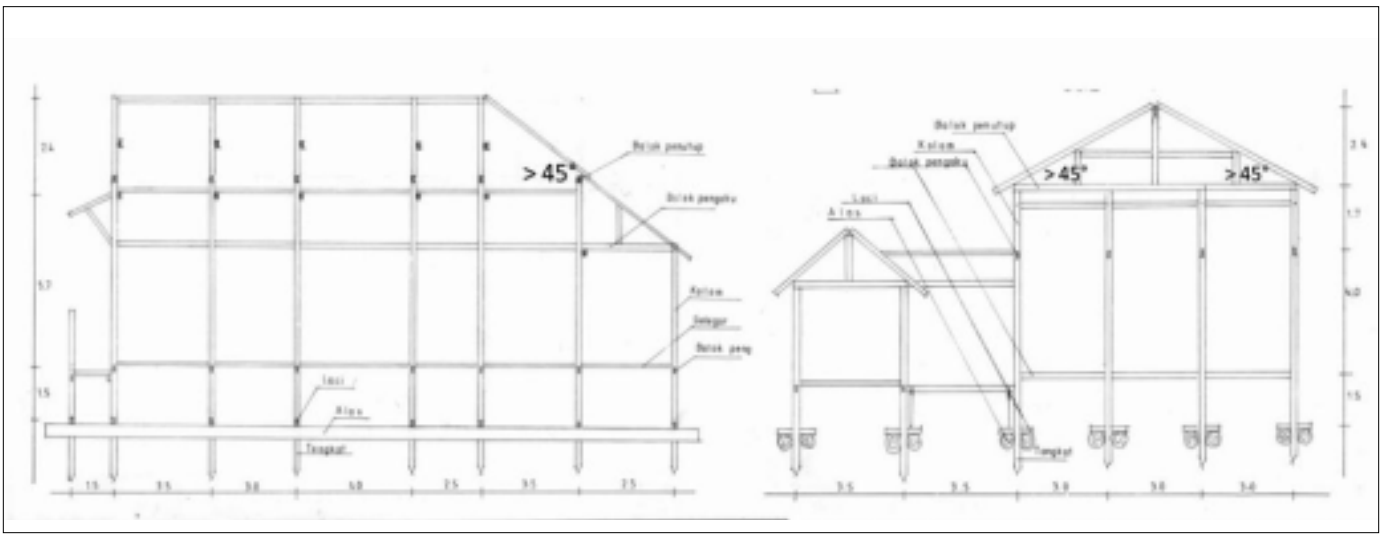

Figure 8. Structure of #2

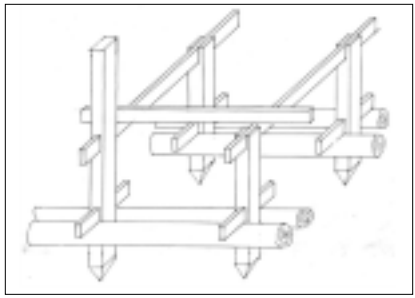

Figure 9. Foundation structure of #2

Figure 10. Front side of #2: *Potong Kawat*

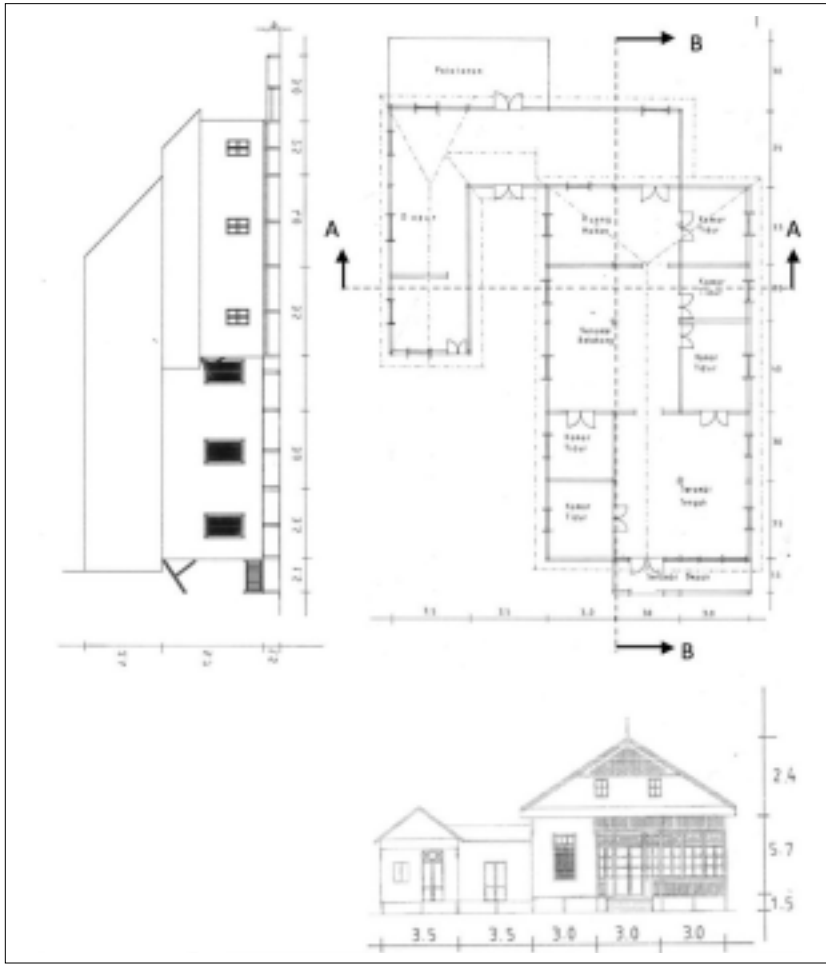

Figure 11. Facade of #2 *Potong Kawat*

Case #3: *Potong Godang*

This dwelling was built in 1954. The main house is erected exactly 1 metre above the ground and the support house floor is 25 centimetres lower than that of the main house. The floor plan of the main house symmetrically divided into two-row sections, one for the bed room and another one for the living room (Figures 15 and 16).

Belian timber with a size of 15/15 was used for the main house. In this house, the timber foundation piles also serve continuously as posts for the wall structure (Figure 13). Single bearing covers (*alas*) were installed under each pile and along the river flow to bear up the structure (Figure 14).

No bracing is found to strengthen the columns. The bracing is over taken by frame-work of windows and doors. The saddle Roof has a 45° slope (Figure 13). To support and strengthen the roof, a simple post and beam structure was used with 2 bracing in each corner to support the top beam (Figure 13). The joints for posts and beams are formed by a simple beam construction with steel pin joints. Some of the joints also use round key timber as locking wedges for all joints of the structure.

Belian and *meddang* timber were used as main materials to cover all wall in the main house. The front, the right and the left facades were covered by first classification timber material as high as 1 metre from floor level, but the upper was covered by second class timber.

The main house and the support house were connected by a corridor with transparent walls (Figure 12).

Figure 12. Transparent wall of #3

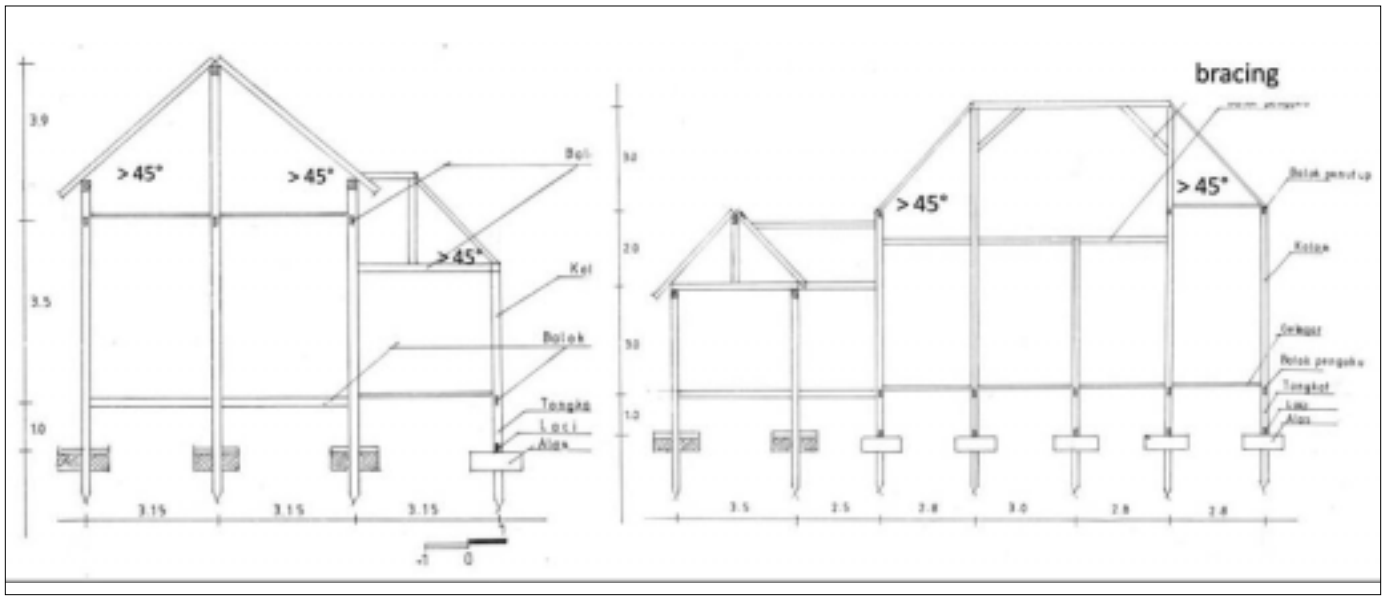

Figure 13. Structure of #3

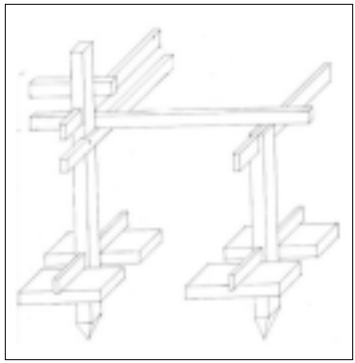

Figure 14. Foundation structure of #3

Figure 15. Front side of #3: *Potong Godang*

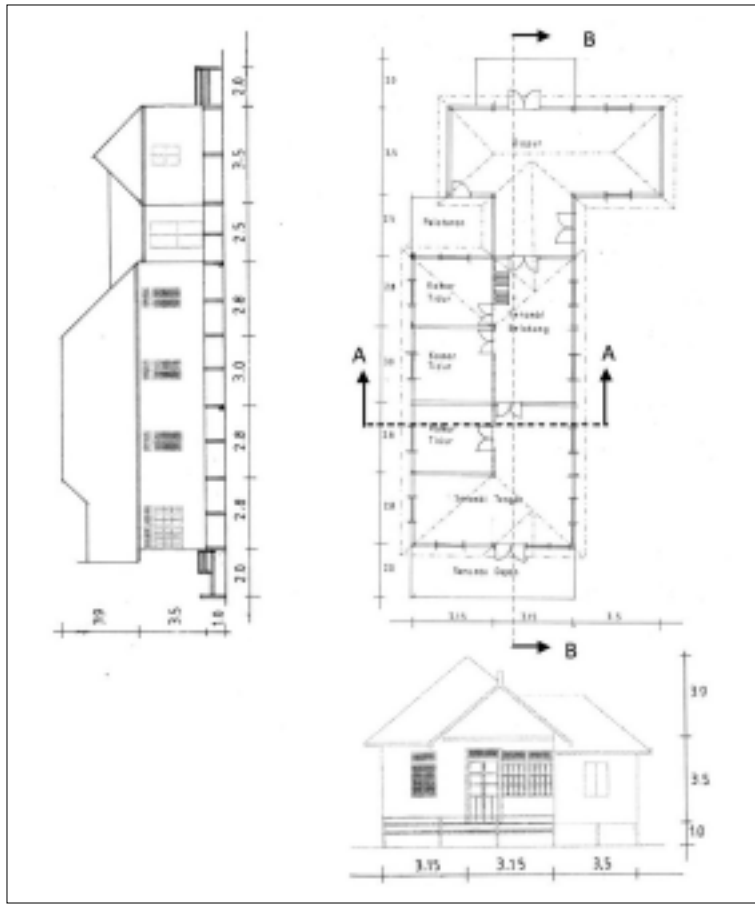

Figure 16. Facade of #3: *Potong Godang*

CHARACTERISTICS OF THE STRUCTURE

In all cases, the main structure made of hardwood and according to Sim (2010: 19), the hardwood timber usually used for Malay traditional house are *cengal (Neobalanocarpus heimii), belian (Eusideroxylon zwagerii), merbau (Intsia palembanica)* or *resak (Vatica spp.),* while only several cases which is using *belian* board as the skins of wall. Furthermore Sim (2010: 20) mentioned that the secondary structure (such as the rafters, floor joints, wall studs, window frames and door frames) and other non-structural members are made of moderately hard timber such as *meranti (Shorea spp.)* and *jelutong (Dyera costulata).*

Bottom Structure

The bottom structure of Malay dwellings can be categorized by 2 types (Figure 17), namely:

a) continuous pile foundation with continuous bearing up pads (*alas*) laid across the dwelling and along the dwelling,
b) continuous pile foundation with single bearing up pads (*alas*) laid across the dwelling.

In all cases, continuous timber was used as foundations and also as posts to bear up the whole structure. In the three cases showed different types of bearing pads were also used. In case #1 and #2, continuous logs connect all piles from side to side, meanwhile in case #3 single bearing pads at each pile was used.

In all cases, the river or the canal are considered as lifeline. Therefore, all dwellings were built in unison with the nature. On the other hand, the river or canal can erodes land so they installed bearing pads following the river or the canal to minimize structure damages. All bearing pads have an important function because the river or canal banks are not able to support heavy structures.

The type of the roof structure played important role on the bearing pads direction. The installation of the bearing pads was dependant on the roof facade direction. In all cases, bearing pads were extended in the same direction as the roof front (Figure 18).

Balks usually function for tightening middle structure. There are two types of balk found in these cases studied: balks spiked to the posts and balks placed on the posts. Balks spiked to the posts we found as a ring balk for the floor construction. Balks placed on the posts were found as

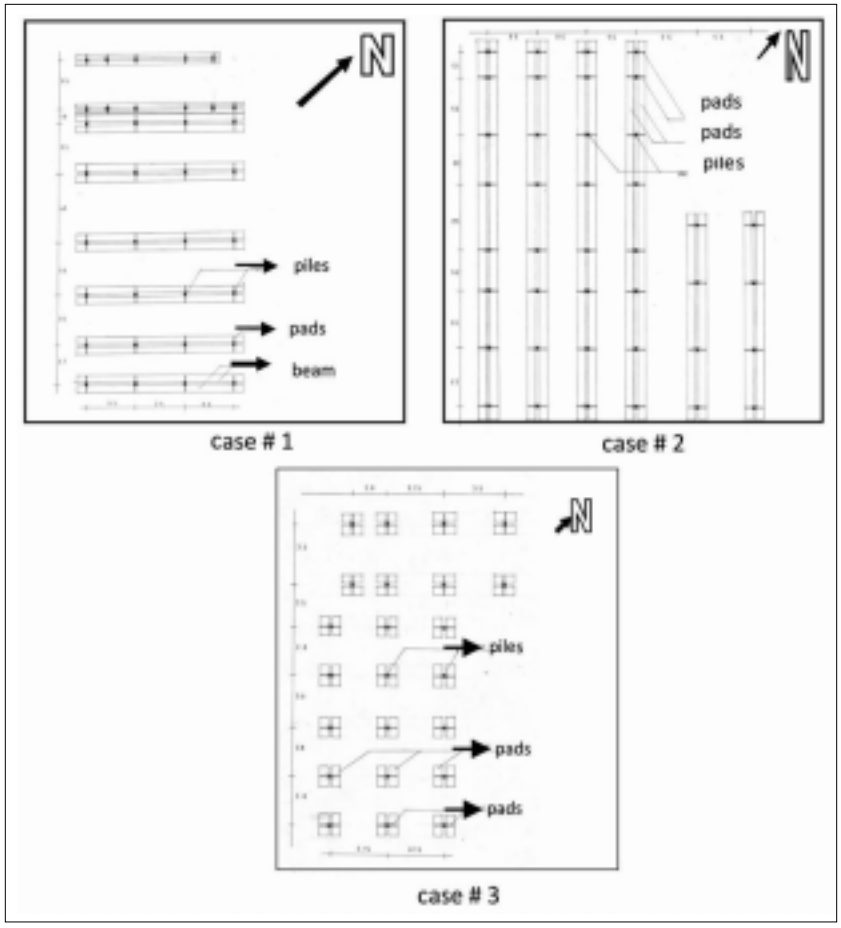

Figure 17. Positioning of piles and beams

a ring balk for the roof construction. Both ring balk for the floor construction and the roof construction stabilized the middle structure.

The most important measure in the construction of the middle structure, was the used of timber as wall structure (Figure 19). Timber covers all the facades were fastened by ring balks at the bottom, posts and ring balks at the top also ensure rigidity of the posts. Both the wooden board walls and small logs are like layers of skin that enable the structure to remain rigid and not shift. According to Cowan and Wilson (1981) and Schodek (1998), in skeleton structure, the cover will act as a locking plate. In this way, the whole middle structure is tightened.

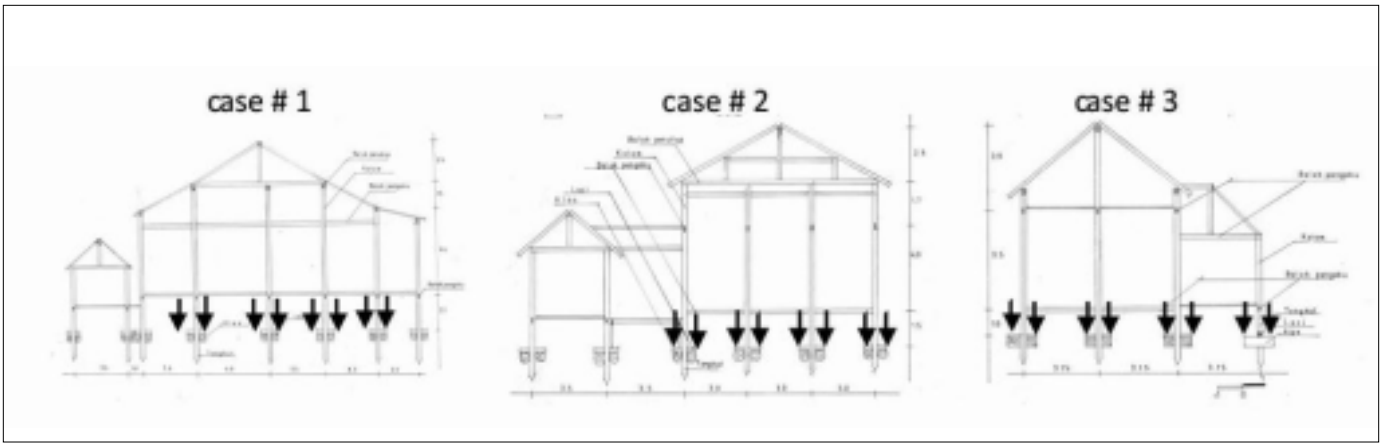

Figure 18. Roof style influences to the positioning of foundations

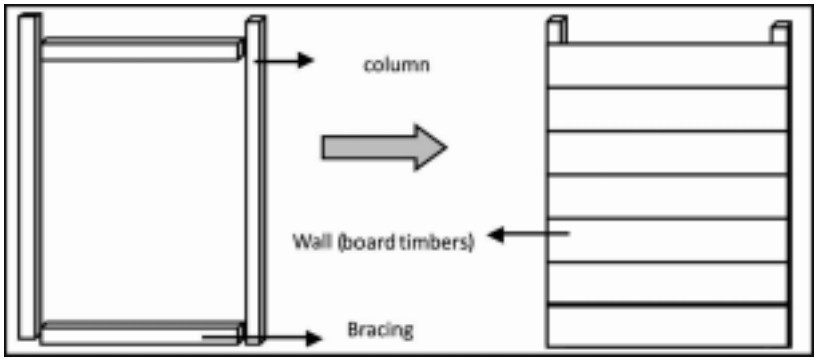

Figure 19. Timber wall tightened middle structure

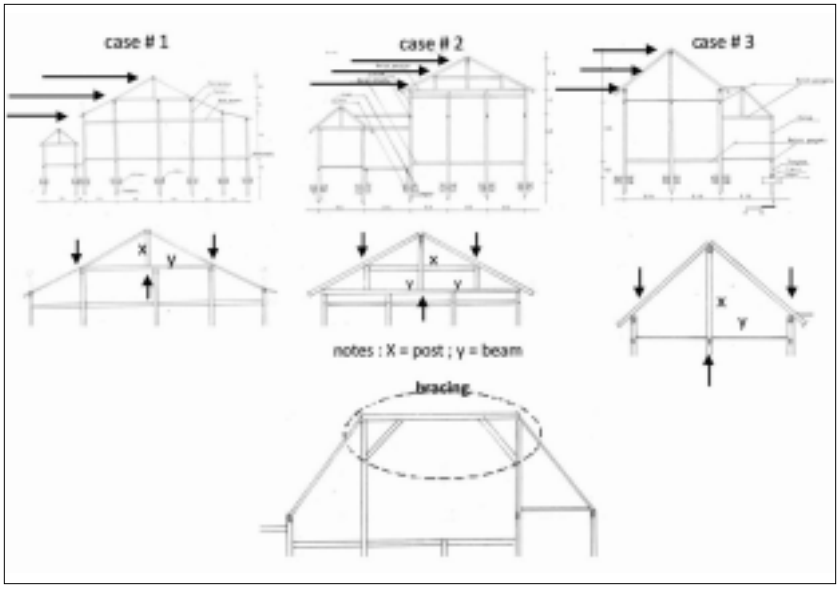

Figure 20. Post and beam on roof structure influence the loads of middle structure

According to A(h)mad et al. (2007: 278), The Malays often constructed their dwellings without any use of metal including nails. Instead they used pre-cut holes and grooves to fit the building elements into one another. The important things in the system of wooden connections between beams and columns on the wall structure were the used of the wooden nails or *pasak* to strengthen the joints (Muhamad Rasdi et al. 2005: 46). In all cases, the use of timber in wall structure increased the

places, the opening frames act as bracing. These bracings serve as an additional stability to the middle structure.

Upper Structure

The upper structure consists of frame and roof surface. In all cases simple structures were used. There are only two main balks, that is the post (vertical) and the beam (horizontal).

The frames for the upper structure are installed in a distance less than 4 metres of each other. In the top, gerber balks are placed to stabilize the structure. In case # 3, bracings are installed to support the gerber balk because the frames are placed in a distance of 5.8 metres (Figure 20). This fact mentioned by Pika (1981) about Indonesian timber characteristic and its use; it is re-emphasized by Frick and Purwanto (1998) who mentioned that compressive strength and tensile strength works in each balk as stabilization. The tensile balk functioned for keeping the compressive balk in its place. So, in all cases the distance between the roof frame constructions was in a range of 2.5 to 4 metres.

CONCLUSIONS

- The unstable soil, the high rainfall, tidal patterns of the rivers, and the high blasts of wind became major factors to consider for creating rigidity on the structures. So then, the structural system choice and design of timber construction in indigenous Malays dwelling were built in unison with the nature.
- The arrangement and the types of structures, such as the pile foundations and the bearing covers, the wall and its connection, and slope of the roofs, were developed in accordance to nature and environment. For example, the connections on joint are an adaptation to unstable soil conditions in most sites of traditional houses; the function of bracing on walls is to avoid torsion caused by wind or other forces; the use of continuous pads provides benefits to a traditional house structure, as it will minimize the shift on a structure that is not simultaneous in one of the grids, due to a weakness in the carrying capacity of the soil at the site; and the roof slope is beneficial in draining the rain water immediately and at once contained it in the water tanks for daily purposes of water need.

- The equilibrium to the local conditions is obtained from the design adjustments. So then, the traditional Malay dwellings did not cause too much bad influences to the surroundings which could damage the environment where the artefact was established.

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