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Assessment of building typology and construction method of traditional longhouse

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Abstract

The longhouse is a well-known traditional dwelling of many natives in Sarawak. A longhouse is a terraced street of separate dwellings covered by one roof. Each family who stay in the longhouse has their separate room. These houses are still in use today and are able to provide the basic shelter needs of the occupants. The use of local materials and the setting that create harmonization with the local environment and climate contribute to the provision of comfort to the occupants. However, the traditional longhouse today is a threatened typology as some of them either have disappeared, are no longer constructed, are tourism attractions or are being maintained as cultural artifacts only. There is a concern that someday the distinct identity of the longhouse might be lost. Therefore, knowledge of construction techniques, assessment of the materials used and typological characteristics of the traditional architecture need to be gathered to preserve the built heritage. A comprehensive document is essential for the preservation and conservation of the traditional longhouse. This paper presents the methodology used and data collected on the typology of the traditional longhouse and its construction method.

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Keywords: Building typology; Conservation; Construction Method; Preservation; Traditional longhouse

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1. Introduction

A Longhouse is the traditional dwellings of many natives in Sarawak such as the Iban, Bidayuh and Orang Ulu. This indigenous architecture is a terraced street of separate dwellings covered by one roof. Every longhouse is headed by headman called *tuai*. Every family stayed in the longhouse has their separate room. Communal activities are carried out on the *ruai* (verandah). These unique features make longhouse part of Sarawak's rich cultural assets with historical and normative value.

A small number of traditional longhouses are still in use until today. Even though some of the longhouses were built before World War II, they can provide the basic shelter needs of the occupants. The use of local materials and the setting that creates harmonization with the local environment and climate conditions contribute to the provision of comfort to the occupants. These practices also give a distinct architectural identity to the building [1]. The uses of local materials reduces energy consumption and lessens the environmental impact of the development on the surrounding area. However, the traditional buildings are now gradually influenced by the development of infrastructures in the surrounding areas [2]. The common traditional materials and traditional construction methods have been replaced by modern building materials and techniques. The traditional longhouse is found to be a threatened typology [3].

Some of the Iban Longhouses in Sarawak have disappeared, are no longer constructed, are being constructed mostly for tourists or are being maintained as cultural artifacts rather than living spaces [3]. There is a concern raised that someday the distinct identity of the longhouses might be lost. Therefore, an appropriate knowledge of construction techniques and typological characteristics of the traditional architecture are required to protect the built heritage in a particularly rural area [4]. Besides the concern for cultural heritage conservation, the environmental integration in the traditional longhouses' design and construction that leads to a good level of comfort can be adopted in the modern housing development. The understanding and application of attributes from ancient vernacular architecture can give value to new buildings [5]. The integration of the principles that characterize the various aspects of traditional architecture to the design of new buildings or the refurbishment of existing ones is a step forward towards sustainable development [1]. Building design with sustainable factors has become more important.

The protection of the built heritage requires an appropriate knowledge of construction techniques and typological characteristics of the traditional architecture. In fact, the assessment of the materials used and construction method are necessary to ensure the longevity of the traditional longhouse. Previous research on longhouse mostly focused on the social and culture of the ethnic group who resided within. Research on the building typology, construction method and environmental performance of traditional longhouse are still lacking. This paper presents the methodology used and its findings on the typology and construction method of traditional longhouse in Sarawak.

2. Overview of preservation and conservation of traditional buildings

For the last 20 years, there has been positive action by many parties in this country to preserve and conserve traditional buildings especially those with heritage significance. Malaysian buildings of heritage and architectural significance are those displaying a particular or an unusual style or construction technique. They present an important work of an architect or craftsman or are particularly rich in details reflective of their time. Buildings of architectural significance can have an important influence on the character of the surrounding environment. Traditional buildings have been designed with respect to nature, incorporating and reflecting the local lifestyle and cultures. Old and historical buildings are a symbol of cultural identity and heritage of a certain community in particular. Historic buildings can give us a sense of wonder and curiosity about the people and culture that produced it [6]. Therefore, people can relate and learn from their predecessors' innovations in the past. These innovations can be seen through the architectural style and design, materials and texture, and buildings technique and construction.

Conservation is about preserving the original, restoring it in a historically accurate manner and using scientific techniques to prolong the building's life without jeopardizing its authenticity. Conservation is not just about physical intervention but also aims to preserve the skills and knowledge of earlier builders and craftsmen. The basic principles and standards of conservation can be summarized into four main principles; documentation and research before intervention, minimum alteration of historic fabrics, preference for original material and workmanship, and

respect for the quality of place. The decision on whether the historic buildings need to be conserved or not must go through the documentation and research process first. Conservation through documentation has always become a compulsory principle at the initial stage on preserving cultural heritage. The documentation, which usually consists of measured drawings, photographs, sketches and written data, provides important information on the cultural significance of historic buildings. The purpose of documentation is to preserve an accurate record of historic buildings that can be used in research and future conservation activities. With referred to Sarawak's traditional longhouse, it is a crucial task to documented these valuable properties. The documentation can become the last means of conservation when one day the building is going to be demolished or damaged by natural disasters.

Full understanding of the structural and material characteristics of traditional buildings comprises elements such as information on the structure, techniques used during construction, the alterations and their effects, its present state and determination of any damage and decay could also contribute to better construction practices in the future. Recent studies on traditional timber buildings indicate that the factors of deterioration and failure of timber houses in Turkey include moisture problems, construction and repair mistakes, neglect, abandonment, earthquakes and metal corrosion. On the other hand, the use of timber structural system also facilitated the longevity of these structures until today without significant damage [7]. Assessment of other types of materials used in the traditional houses should include house elements such as foundation, wall, structure, roof, floor and openings [2].

A comprehensive study of traditional timber buildings is crucial for a better understanding of the performance of building materials in their climatic condition. Old abandoned traditional houses also should be assessed. The reuse of these buildings could preserve a valuable architectural heritage and also prolong the building usage. The assessment should include the usage pattern of curtain walling, roofing materials, and structural systems by geological maps, soil surveys, crop maps and natural resources inventories in the surrounding area. Reusing redundant buildings can give significant positive consequences namely saving in energy and building materials, a creation of jobs and new economic activities, promotion of the cultural tourism, preservation of a valuable document source about countryside culture, recovery of native construction techniques, community encouragement and more pleasant appearance of the village. However, there are chances that reusing of these building could create negative impacts such as loss of building identity, use of foreign materials and construction techniques or destruction of material heritage [4]. The previous research on the longhouse has mostly focused on the social and culture of the ethnic group who resided there [3][8][9]. Therefore, the assessment of the materials used and construction method are important to ensure the longevity existence of the traditional longhouse.

3. Methodology

The methodology used in this study involved quantitative and qualitative analysis of the building typology and construction method of selected traditional longhouses in Sarawak. The assessing and analyzing of the traditional longhouse involved three phases as explained below.

3.1. Phase 1: Selection of traditional longhouse

The traditional longhouse is shaped strongly by culture, weather, and geographic location, so it makes sense to divide the area in Sarawak into distinct regions each with a unique combination of these three traits. However, the division of study area excludes weather since Sarawak received similar weather throughout the state. The preliminary studies on traditional longhouses includes the identification of demography of ownership, type of settlement, historical background, geographic location and topography, landscape features, distance to populated centers and approach roads, pedestrian, and vehicular accessibility, surrounding space and available services. From the inventory, a total of eight numbers of longhouses from Iban, Bidayuh and Orang Ulu ethnic were selected for the case study. Then, a record card template was used for data collection in the second and third phase of the study.

3.2. Phase 2: Analysis of building typology and construction method of traditional longhouse

The analysis of the building typology consists of four parameters namely original and current use, building form, plan and roof configurations and construction techniques and connection details. The analysis of the above parameters was conducted during site visits at the selected longhouses. Observation of the parameters, interviews with residents and measuring of building dimension were recorded in the record card for each longhouse visited. The measurement of the building dimension uses low-cost measurement techniques such as digital laser distance measurer and measuring wheel. The building form, architectural elements, connection details and any possible failures and deteriorations of the longhouse were photographed.

3.3. Phase 3: Organization and Classification of data

Throughout this study, the data on building typology of the traditional longhouses were collated. All the graphical documents such as images, drawings, and plans were organized and compared to identify the similarity, common features and distinctive differences among the traditional longhouse studied. These data is essential for preservation and conservation of the traditional longhouse.

4. Findings

4.1. Original and current use

Longhouses consist of apartment units for every family (*bilek, ramin*), a covered long gallery (*ruai, awah*) and an open veranda (*tanju*). If the longhouse has two to three floors, the upper floors are known as *sadau* in Iban or *rangah* in Bidayuh. All the available spaces in the longhouse provide facilities similar to a village. As an example, the long gallery in the longhouse has the same function as a multi-purpose hall. This area can be used as a meeting place, place to conduct religious activities, wedding reception, and festival celebrations and place to entertain guests.

Each longhouse of different ethnic groups has different features. The original use of the traditional longhouse is for residential as listed in Table 1. All the longhouses studied are remain in residential use except two longhouses (LH004AR and LH013UB) which had been turned into a guesthouse or homestay and become a tourist attraction. Only a few apartment units (*bilek*) were transformed into guesthouses and homestays at these two longhouses. Staying together with the residents allow the visitors to get first hand experience to learn and understand the living culture in a longhouse.

Table 1. Profile of longhouse studied

No	LH ID	Original and current use	Ethnic	Plan (Form & Layout)
1	LH004AR	Residential, homestay, tourist attraction	Bidayuh	Rectangular shape, regular form, straight line house. Overall layout following the geographical condition (oriented along river and stream) Connected to each other. 1-2 storey, variable. 10-16 *'bilek'* (doors) each longhouse.
2	LH009RJ	Residential	Iban	Rectangular shape, regular form, straight line house. Built along river and stream, oriented parallel. 1-2 storey, variable. 29 *'bilek'* (doors).

3	LH010RM	Residential	Iban	Rectangular shape, regular form, straight line house. Built along river and stream, oriented parallel. 1-2 storey, variable. 23 *'bilek'* (doors).
4	LH014RMA	Residential	Iban	Rectangular shape, regular form, straight line house. Built along river and stream, oriented parallel. Single storey. 24 '*bilek'* (doors) each longhouse.
5	LH015RAS	Residential	Iban	Rectangular shape, regular form, straight line house. Built along river and stream, oriented parallel. Single storey. 26 *'bilek'* (doors).
6	LH016RR	Residential	Iban	Rectangular shape, regular form, straight line house. Single storey. 25 *'bilek'* (doors).
7	LH012UK	Residential	Orang Ulu	Rectangular shape, regular form, straight line house. Overall layout following the geographical condition. 1-2 storey, variable. 15 *'bilek'* (doors) each longhouse, 14 blocks longhouse in total.
8	LH013UB	Residential, homestay	Orang Ulu	Rectangular shape, irregular layout according to a geographical condition. The interconnected bridge provided blocks-by-blocks. 1-2 storey, variable. 101*'bilek'* (doors), 7 blocks in total.

4.2. Building form

All the building form for the longhouse has been listed in Table 1 above. The major building form is a straight line as found at six longhouses. The other form are horseshoe and by blocks (interconnected). The illustration of the building form are shown in Fig.1. (a)(b)(c).

The building form of each longhouse is mostly similar except for their architectural style, detailing and materials which is influenced by the surrounding area. All the longhouses studied are situated by a river, since in the past, the river was the residents' main mode of transportation. Normally these longhouses were built facing the river and in harmonisation with the surrounding area. The construction of the longhouse also does not alter the topography of the site. There is no cut and fill of earth applied to the site of the longhouses studied (Fig.2).

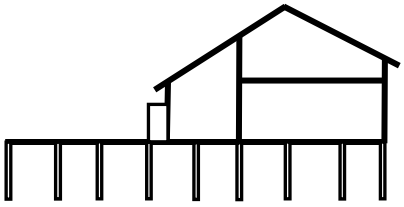
Fig. 1. (a) Straight line, (b) Horse shoe form, (c) Interconnected.

4.3. Plan and roof configurations

The roof design of the longhouse is different among the different ethnic groups. The differences are influenced by their culture and lifestyle. Basic roof configuration of the longhouse and its sectional drawings are shown in Table 2. All the longhouse studied regardless their ethics has similar roof shape i.e., pitch roof. This shape is suitable for tropical climate in Borneo which has heavy rainfall throughout the year. The pitch roof of the longhouses is similar to other traditional house in Malaysia.

The main material used for the roof is sago leaves or palm thatch. However, some of the roofing has been replaced with corrugated zinc sheet as shown in Fig. 2. The modern materials are more favorable due to its readily available in the market as compared to the traditional or indigenous materials. The preparation of traditional materials takes a longer time.

Table 2: The roof configuration details.

No	Ethnic	Roof configuration	Sectional drawing
1	Bidayuh	High pitched roof with timber shingles. Sago or palm thatch as roof coverings.	

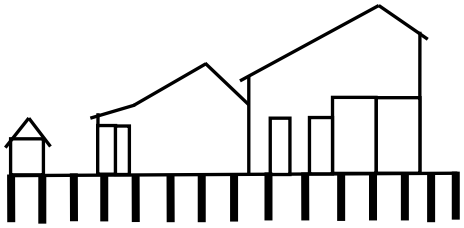
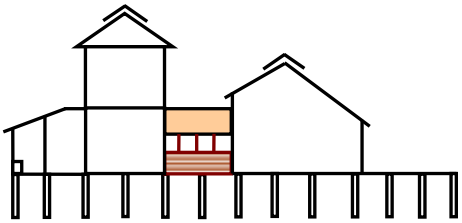
2	Iban	Double-storey, gable-roof style. Palm thatch roof.	
3	Orang Ulu	Double-storey high-pitched gable roof with interconnecting bridge. Palm thatch roof.	

Fig. 2. Side views of the traditional longhouse.

4.4. Construction techniques and connection details

There are two types of structure used in the traditional longhouses construction. They are either using heavy hardwood post and beam structure or combination of hardwood and lightweight bamboo frame structure. The usage of heavy hardwood post and beam structure is common in Iban and Orang Ulu longhouses, while bamboo usage is popular in Bidayuh longhouses. Construction of these houses is normally by using simple timber joinery method. Timber columns and beams are joined using mortise and tenon connection as shown in Fig. 3. Another type of connection of post and beam is mortise and tenon which is strengthened with a steel or timber peg (Fig. 4). These connection techniques ease dismantling and expansion work of the building. The residents are able to add another "bilek" to their longhouse when the family expands or as required by the residents. Therefore, changes to the building layout are easier and faster. The usage of building materials from their surrounding areas also give the opportunity for the residents to source for cheaper materials for the construction of traditional longhouse.

Fig. 3. Mortise and tenon connection of post and beam.

Fig. 4. Mortise and tenon connection of timber post and beam strengthen with steel or timber peg.

In Bidayuh longhouse, the split bamboo for floor construction was tied with rattan as shown in Fig. 5. However, there are new materials used for bamboo connection such as polymer cable as in Fig. 6. The materials used are from their surrounding area. For example, the Bidayuh use bamboo as they live in the area with lots of bamboos. These bamboos are also durable and re-usable. In LH004AR, the bamboos have been in use for 20 years. When the bamboo for the walls and floors have reached their maximum limit of usage or are damaged, they will be crushed to be used as firewood for cooking.

Fig. 5. Split bamboo tied to the bamboo joist (underneath) with rattan for floor construction.

Fig. 6. Bamboo for ridge board, rafters and purlins of a roof structure tied with rattan and polymer cable.

5. Conclusion

This paper deals with the proposed methodology for data collection and subsequent analysis of the typology and construction method of the traditional longhouse. A series of fieldwork at selected traditional longhouse employed a systematic non-destructive physical investigation and recording for the preservation and conservation of the traditional longhouse. In conclusion, this assessment should be able to assist in preparing a comprehensive document that is essential for the preservation and conservation of the traditional longhouse. The document is also beneficial for heritage and culture protection.

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