

## **Historic Building Information Modelling (HBIM): The Application of Digitalization in Conserving Negeri Sembilan Traditional Malay House**

Siti Azira Abd Rahim<sup>1</sup>, Noor Hayati Ismail<sup>2\*</sup>, Nurul Syala Abd Latip<sup>2</sup>, Nurulhuda Ahamad<sup>1</sup>, Mohd Amir Shazwan Hashim<sup>1</sup>, Farhana Mohd. Zaini<sup>1</sup>, Sangeetha Arjinan<sup>1</sup>

<sup>1</sup>Faculty of Engineering and Quantity Surveying, INTI International University, Persiaran Perdana BBN, Putra Nilai, 71800 Nilai, Negeri Sembilan, Malaysia

<sup>2</sup>Faculty of Engineering and Built Environment, University Sains Islam Malaysia, Nilai, Negeri Sembilan, Malaysia

\***Email:** nurulsyala@usim.edu.my

### **Abstract**

Rumah kampung, or Malay house, exemplifies the richness and insight of traditional buildings, sharing a home with people, and living in peace with nature. The typical Malay home is a building elevated on stilts high above the ground, covered with thatch roofs, encased with wooden walls, and pierced with windows and lattices in its most basic form. Due to the increasing interest in cultural heritage as a driving force of socio-economic development, many initiatives involving its preservation, conservation, restoration, and dissemination are undertaken throughout the globe. Conservation entails taking physical steps to preserve the fabric and elements of heritage buildings. It is a method of preventing deterioration from extending the life of buildings. According to the conservation concept, building conservation should maintain as much of the original building structure and fabric as feasible. Heritage buildings are now conserved based on historical and cultural considerations, and the cultural value of the architecture of historic buildings is slowly appreciated. The techniques, methods, and materials used to build and construct the buildings are the primary concern in conservation projects. This paper aims to investigate the current conservation process using the digitalization approach to document Negeri Sembilan Traditional Malay House. Data collection provides a literature review, whereby the current conservation process for cases in Malaysia and various countries will be reviewed. Content analysis was utilized to analyze the results. The findings of this paper provide helpful information regarding the potential development of digitalization based on the conservation process to be used further in the future traditional conservation building.

### **Keywords**

Traditional Malay House, Digitalization, Historic Building Information Modelling, Building Conservation

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## Introduction

According to Noor Hayati Ismail et al., (2014), a traditional Malay house is associated with the word identity and evolution. It is so because of the traces of people of those years who lived on moving around geographically. When people move around, they are bound to leave out the traces of their own culture's identity as well forming an evolution which forms out a new culture and lifestyle to suit the new surroundings. Among the other traces of activity, the evolution of those societies can be clearly seen in the design of the traditional Malay house.

Wahab et al., (2019), states that the Negeri Sembilan Traditional Malay House (NSTMH) is the evolved version of Minangkabau ethnic houses originating from Sumatera. In this study, NSTMH is chosen due to its unique design and characteristic. In Malaysia, the Malay traditional houses are known as the vernacular architecture which portrays a unique design and material which reflects the local people's tradition (Sulaiman, 2017). Therefore, it is significant to preserve and conserve the traditional Malay house as it portrays the creativity and skills of the common villagers in the era prior to availability of modern technologies.

Nationally there are few traditional Malays houses which are listed in heritage list. As far as it concerns the NSTMH, there are not any acts or regulations that specifically govern the heritage environment. In addition, there is also a lack of concern from the house owners themselves who could not appreciate the value of the houses and understand the need for the conservation process. Many NSTMH aging more than 100 years are being abandoned and demolished without proper conservation. At the same time, some individual house does conserve the houses, but they involve changes which could not maintain 100% the original architecture of the house.

However, with the interest of individual researchers, higher education institutes, experts with collaboration with some governing bodies, the conservation of such houses are being taken into consideration. A more organized framework was also studied to enable a proper conservation of these NSTMH. Therefore, it is a need to analyze all the available NSTMH conservation methods so that the current conservation pattern can be identified thus enabling further studies for the overall improvement of the conservation process in digitalization approach.

Building Information Modeling (BIM) and heritage building preservation are combined in Historic Building Information Modeling (HBIM). According to different nations, specialists have varied definitions of HBIM. HBIM is defined as a unique method for automatically developing both visualisation models and document conservation, for example for the documenting of historical buildings and their settings, according to Antonopoulou, 2017; Murphy et al., 2013. HBIM is also characterised as a semantically aware database of historical buildings in which the geometric model is linked to descriptive multi-source data (Murphy, 2012; Long et al., 2011). Furthermore, HBIM is concerned with applying the BIM technique to historic buildings. It is a shared digital representation of any constructed object's physical and functional properties that serves as a dependable basis for decision-making throughout its life cycle (Murphy et al., 2013).

According to Baik, 2017 and Mustafa et al., 2020, the process of HBIM involves 2 stages as shown in Figure 1. First stage involves data collection phase activity called the ‘learning phase’ where data regarding the selected building is gathered using few methods. This stage 1 will gather tangible data such as length, width, height, and other necessary information. All the dimension information will be transferred in digital reconstruction phase, or the modelling based on the data collected. The process of completing this model is called phase 2. In the third phase, an analysis and semantic enrichment will take place based on the completed model and the last stage is the important stage where this stage involves the integration of the HBIM project for the client. In this phase, it might require different delivery requirements depending on the client’s needs.

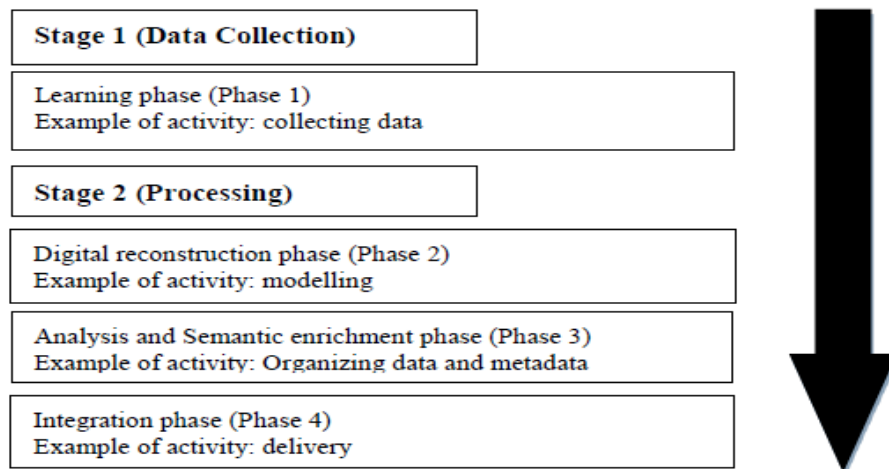


Figure 1. Process of HBIM stages (Baik, 2017, Mustafa et al., 2020)

Other process according to Murphy et al., (2013) and Tang et al., (2010) HBIM process involved three steps. The first step is modelling shapes. The second step is the semantic modelling such as recognition and categorization of objects and the last step is the modelling relationships between the objects. Most of the author said that the first step is the data collection of the existing related the selected building followed by building the model together with improving the existing heritage building.

### Methodology

A thorough analysis of the literature was conducted in order to learn more about the present conservation method for instances in Malaysia and other countries. The literature study entailed a thorough examination of secondary data gathered from a variety of sources, including peer-reviewed academic journal articles, conference proceedings, textbooks, governing organisations, and PhD theses. The data was analysed using content analysis.

## Results and Discussion

Based on Jabatan Warisan Malaysia, 2013, there are approximately 176 cultural heritage buildings that have been designated as national heritage, with some of them having been appropriately preserved. Generally, not many traditional Malay houses are conserved due to a lack of awareness and appreciation. However, based on the information gathered, there are few houses being conserved in Negeri Sembilan. Mustafa et al. (2020), stated that there are three different typologies of historical buildings that exist in Peninsular Malaysia which are Palaces, Aristocrat's house and commoner's house. Each house shows different characters in terms of layout and function. Digitalization based on the HBIM approach consists of using laser scan-to-BIM, the point cloud workflow, the application of BIM's tools (Autodesk AutoCAD, Revit, Cubicost etc.). Because of its distinct characteristics, implementing digital traditional Malay buildings differs from digitalizing other buildings. The table below shows the lists of houses more than 100years old that are conserved and preserved by the owner and authorities.

Table 1. The Conservation of Negeri Sembilan Traditional Malay House

No.	House name	Location	Ages	Method/Process of conservation	Method of Documentation
1	House of Raja Kamaruddin Raja Yaa'kob	Kg Terusan, Kuala Pilah	160 years	Relocation / Reconstruction	Manual and Digital Documentation
2	Rumah Maimunah Yaakub	Kg Penajis Tanjung, Rembau,	101 years	Relocation / Reconstruction	Manual and Digital Documentation
3	Teratak zaaba	Kg. Bukit Kerdas, Batu Kikir Timur, Jempol	>100 years	Preservation	Manual and Digital, 3D modelling
4	Rumah Tukang Kahar	Seri Menanti, Kuala Pilah	140 years	Relocation / Reconstruction	Digital Documentation, 3D Modelling
5	Rumah Hajjah Kundur	Rembau	>100 years	Relocation / Reconstruction	Digital Documentation
6	Rumah Datuk Baginda Tan Mas Mohar	Johol	171 years	Preservation	Manual and Digital
7	Rumah Datuk Klana Sungai Ujong	Rembau	150 years	Preservation	Digital Documentation

In other country such as England and Ireland, HBIM approach has been applied on some country's heritage building for example Imperial War Museum and Woodseat Hall in Staffordshire (Antonoupoulou, 2017). Other than that, In the United Kingdom, an organization called Historic England spearheads many conservations works of the country's heritage building by adopting this approach. In Italy, there are buildings such as the San Cipriano Church and St. Maria Church,

which have been taken as HBIM case study (Contonenza et al. 2018) to move forward with their culturally rich man Roman buildings. In Turkey, there is an increasing of awareness through summits and discussion to preserve Ottoman's empire architectural heritage within the region using the approach. They are using HBIM as they believe that HBIM has many benefits and gives great value in the future (Baik, 2017).

Findings from the research shows conservation process that majority been used to preserved historical building in Malaysia was relocation and reconstruction method. Based on research study also, 3D modelling has also been used to do preservation example of Teratak Za'aba, this 3D modelling method here been used to allow users to view the heritage architecture online, regardless of their location. These 3D modelling works have been carried out all over the world to preserve the historical building.

The implementation of 3D modelling conservation method is to allow the user to see how the original architecture looks alike. The closest detail of this modelling will provide the closest possible to the original house in terms of its shapes in those years. The usage of laser scanning also helps to start the process easier. Additional BIM's tools for examples AutoCAD, Autodesk Revit etc. was used because of the software's interface, which is user-friendly and easy to learn, Mustafa et al. (2020).

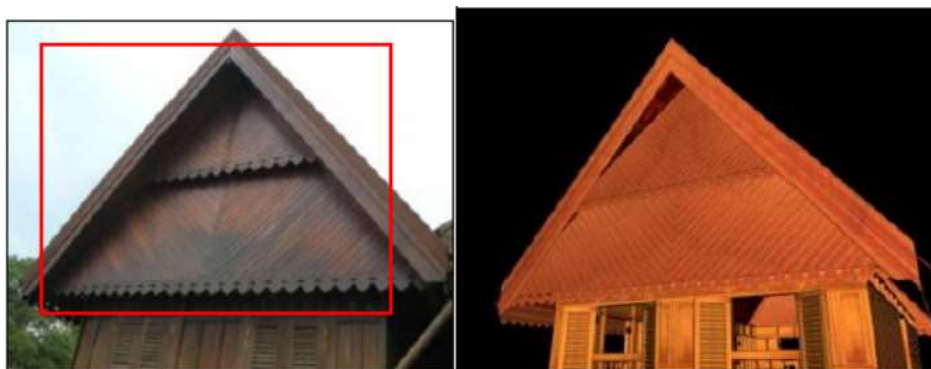


Figure 2. Tebar Layar of the Teratak Zaaba

## Conclusions

The Historic Building Information Modelling (HBIM) has been acknowledged and aware by many research kinds of research to be useful to develop a system for maintaining a historical building efficiently. Looking from the government effort, it is anticipated that HBIM will likely be used for many other types of projects in future.

Based upon the analysis of examples discussed in this paper, it can be said that applying HBIM on heritage buildings is still considered as limited and faces number of challenges. Some of it is lack of proper equipment, lack of professional skills and the most important one is financial-related challenges. In addition, conservation of heritage buildings requires a longer period since gathering the information of the selected buildings is challenging. Those in the conservation field

know that without adequate historic documentation, it is hard to make appropriate decisions on which conservation method to be apply.

The exploration on how HBIM can be beneficial in heritage buildings preservation and offer growth and strengthen the image for that sector in Malaysia. It recommended that upon completion of this information, further exploration on the on this area be performed for a better addition to the content of knowledge for Malaysia's chapter.

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