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MALAYBIM LIBRARY: WEB-BASED PLATFORM DATABASE FOR HISTORICAL MALAY BUILDINGS

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ABSTRACT

This article aims to promote utilising the MalayBIM library as a newly developed web-based platform of digitalised historical Malay buildings. The article focuses on the growing interest in cultural-based BIM libraries and the process and the interface of the developed MalayBIM library. The research has two (2) objectives: to digitalise historical Malay buildings using BIM and design a web-based platform (library) for the digitalised historical Malay buildings. This explorative research has successfully modelled ten (10) historical Malay buildings and 201 components using the BIM approach utilising Autodesk Revit software. The outcome is the MalayBIM library, which is a collection of historical Malay buildings that have been modelled into the BIM environment. The output can be utilised by students, educators and designers. The research would benefit the effort of preserving Malay architecture as a platform of digitalised cultural-historical buildings has been established.

Keyword: BIM library, HBIM, Malay historical buildings, Digitalization
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INTRODUCTION

A Building Information Modelling (BIM) library is a digital database of semantically rich BIM objects that are contributed by open access sources, unified to the specific parameter format, and integrated into a well-defined library structure" (Lu et al., 2017). Afsari and Eastman (2014), Oreni et al. (2014), and Lu et al. (2017) observed that designers would drag various objects from a library and add extra semantics such as materials when practising BIM. Without readily available well-defined objects, designers have to draw all the objects from scratch and form them into a BIM (Lu et al., 2017). The process would be costly and burdensome for them. The abundance of BIM objects in the libraries available worldwide has indicated that lots of data are available for BIM practices. However, most BIM objects in the database focus on contemporary designs instead of historical (cultural) designs. However, regardless of the available data, the management and usage of the data carry more substantial concerns. Previous research (Baik et al., 2013; De Luca, 2013; Murphy, Mcgovern, and Pavia, 2009) have reported that the usage of BIM for historical buildings has many advantages. There were also works on HBIM which focused on ethnic and cultural preservation. Example of HBIM includes Jeddah Historical Building Information (JHBIM) by Ahmed Baik (2014) and Qatar Heritage Building Information Modelling (QHBIM) by Fadli and Al-Saeed (2019). These two examples highlight the importance of utilising HBIM for heritage preservation and conservation purposes. However, these advantages can only be obtained if the model and its database are successfully realised (Murphy, 2012). Oreni, Brumana, Georgopoulos, and Cuca (2014) and other BIM practitioners, such as Autodesk and National Building Specifications (NBS), have suggested the realisation of the model and its database can expatiate through the creation of a BIM library. The action is further enhanced with a straightforward retrieval system that operates smoothly via a suitable platform (Fadli and Al-Saeed, 2019). Therefore, this article aims to promote the MalayBIM library as a newly developed web-based platform of digitalised historical Malay buildings.

METHOD / PROCEDURE

This study has undertaken the following research procedures, as shown in Figure 1.

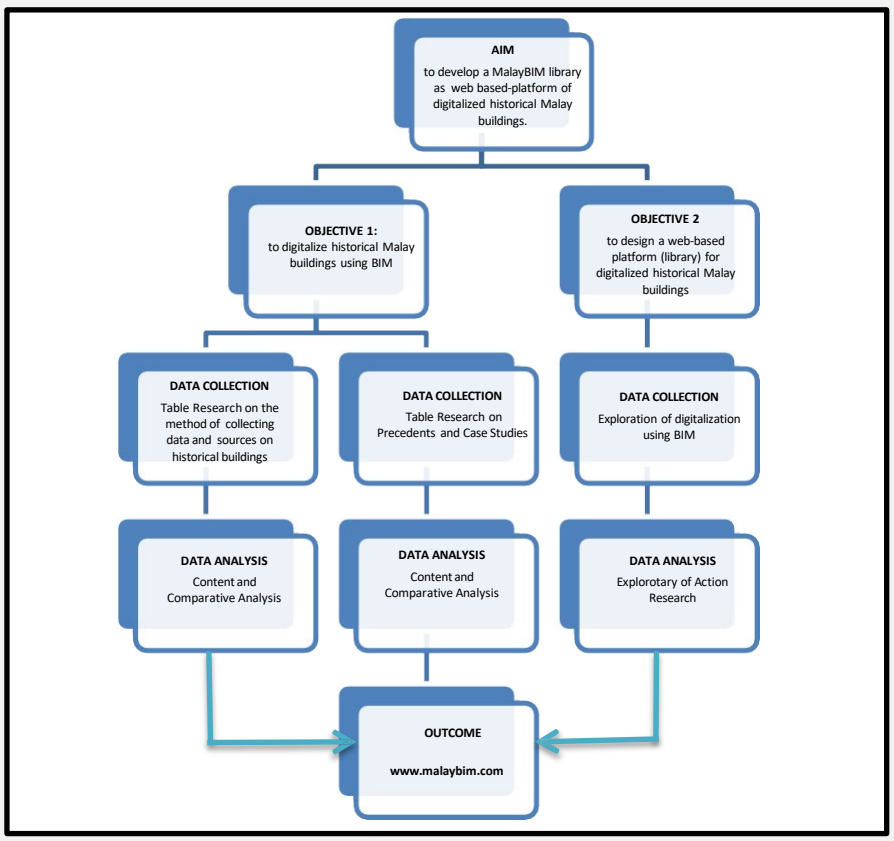


Figure 1: The research Procedures

RESEARCH FINDINGS

Heritage Building Information Modelling (HBIM) is the process of creating and managing a digital representation of a heritage building. The digital representation can collect, organise, manage, display, disseminate, and preserve heritage building information. In the case of historical Malay buildings, this would involve creating a 3D model of the structure using Building Information Modelling (BIM) software. Experts have recognised that work involving cultural heritage buildings differs from other construction work (Ali et al., 2018). In-depth knowledge and expertise on building materials and structures that cause building defects are required. This awareness is vital to ensure that the quality of the building structure and the fabric are both preserved while at the same time maintaining the integrity of the building's heritage values. The knowledge of the condition of the building before any work is executed is considered of utmost critical.

BIM's role as a central database for cultural heritage, supporting comprehensive data input, is forecasted to increase with a systematic method of retrieving its elements. A website was developed as the database to achieve this aim. The website is accessible via the link of www.malaybim.com. The database comprises all the architectural components from historical Malay buildings that have been enriched with BIM-based modelling and further enriched with semantic information. BIM's application in Malay heritage buildings will provide a modelling environment that enhances knowledge management. Knowledge management, such as ensuring complexity, accuracy, alignment, and clarity of all information, is required to understand the system better (Murphy, 2012). The 3-D model of the building on the BIM platform with a robust as-built dataset will ensure that knowledge management is enhanced (Historic England, 2017; Murphy, 2012). Despite the common acceptance of BIM for new buildings, its applications in existing cultural buildings have yet to be thoroughly explored.

From this exercise, there are four (4) stages outlined within the digitalisation framework. The stages are the data collection phase, the digitalisation phase, the semantic enrichment phase and finally, the retrieval phase. The first step of data collection is critical to establish the attributes of each component. The second step of data processing involves textual data analysis and building a physical 3D model for each component. This data will be paired or fused with the complete 3D model of each component from the same building. The semantic enrichment phase enriches the historical components with important information for understanding the historical buildings. Finally, a retrieval system to allow the efficient functions of the MalayBIM database is developed. The stages within the digitalisation framework is shown in Table 2.

There are several reasons why digitalising historical Malay buildings could be beneficial:

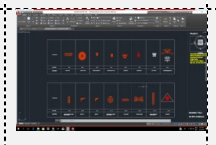
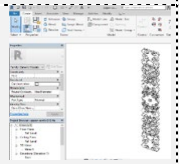
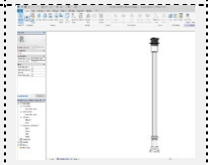
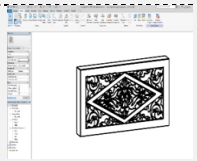
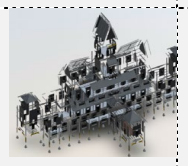
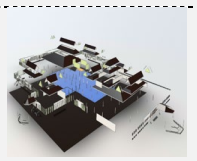
a) It would allow a better understanding of the structure's construction and evolution. This understanding could help improve restoration efforts and ensure that the building remains in good condition for future generations.
b) It could provide valuable information about the location and history of the building.
c) A digital model to create virtual tours of the structure would be beneficial to attract visitors and promote tourism in the area.
d) A digital model could be used to create 3D models of historic buildings that can be advantageous for educational purposes.
e) The digital model could create new building designs inspired by historical Malay architecture.

However, digitalising historical Malay buildings poses several challenges. Among the challenges are:

a) The structure may not withstand the same level of scrutiny as a newly-constructed building.
b) Accurate measurements may not be possible due to damage or wear over time.
c) It may face challenges such as a lack of funds or expertise in BIM software.
d) It may be challenging to find accurate historical photographs of the building.
e) The structure may require significant restoration work before being digitised.
f) A digital model may not represent all aspects of the original design.
g) Privacy concerns may arise if personal information is included in the model.
h) Copyright issues could occur if the model is used commercially without permission from the owner.
i) Errors could occur during the digitalisation process that could lead to inaccuracies in the model.
j) It may be challenging to share or export the model electronically.

Despite these challenges, digitalising historical Malay buildings is an important step that can help preserve and protect the structures and learn more about their history. It will also provide valuable information for tourists who visit the area, as well as researchers who are interested in architectural history. As technology continues to evolve, digitalising historical Malay buildings is the first step that would accrue additional benefits in the future.

Table 2: The stages within the digitalisation framework

	ARCHIVAL REPORT (Istana Seri Menanti)	CAD (Istana Balai Besar Alor Setar)	TERRESTRIAL LASER SCANNER (Istana Balai Besar Kota Bharu)
Sources of Documentation (Stage 1)			
The Digitalization from the sources (Stage 2)			
The Semantic Enrichment for Building Components (Stage 3)			
The Classification of building components for retrieving from HMBIM library (Stage 4)			

MALAYBIM DESIGN DEVELOPMENT

MalayBIM – Currently, the database consists of 10 historical building projects and 201 building components, which have been modelled and semantically enriched. The buildings were selected based on the availability of tangible (dimensions, shape, and form) and intangible information (name and functions) collected from multiple sources such as archival reports, computer-aided architectural drawings, and laser scanning data. The buildings are 1-Baiturrahmah (Perak), 2-Balai Besar Alor Setar (Kedah), 3-Balai Besar Kota Bharu (Kelantan), 4-Istana Besar Seri Menanti (Negeri Sembilan), 5-Istana Gahara (Perak), 6-Istana Leban Tunggal (Pahang), 7-Istana Tengku Long (Terengganu), 8-Rumah Penghulu Haji Akil (Johor), 9-Rumah Menteri Besar Kelantan (Kelantan) and 10- Rumah Penghulu Ghani Abdul Nattar (Malacca). The buildings were modelled using Autodesk Revit software (Version 2018).

OBJECTIVE

The purpose of this research is to investigate the role of working drawings and examine their use in the field of applied arts. The conclusions of this study will create particular knowledge on Art as a subject, which will help raise awareness among artists, designers, and practitioners in academia.

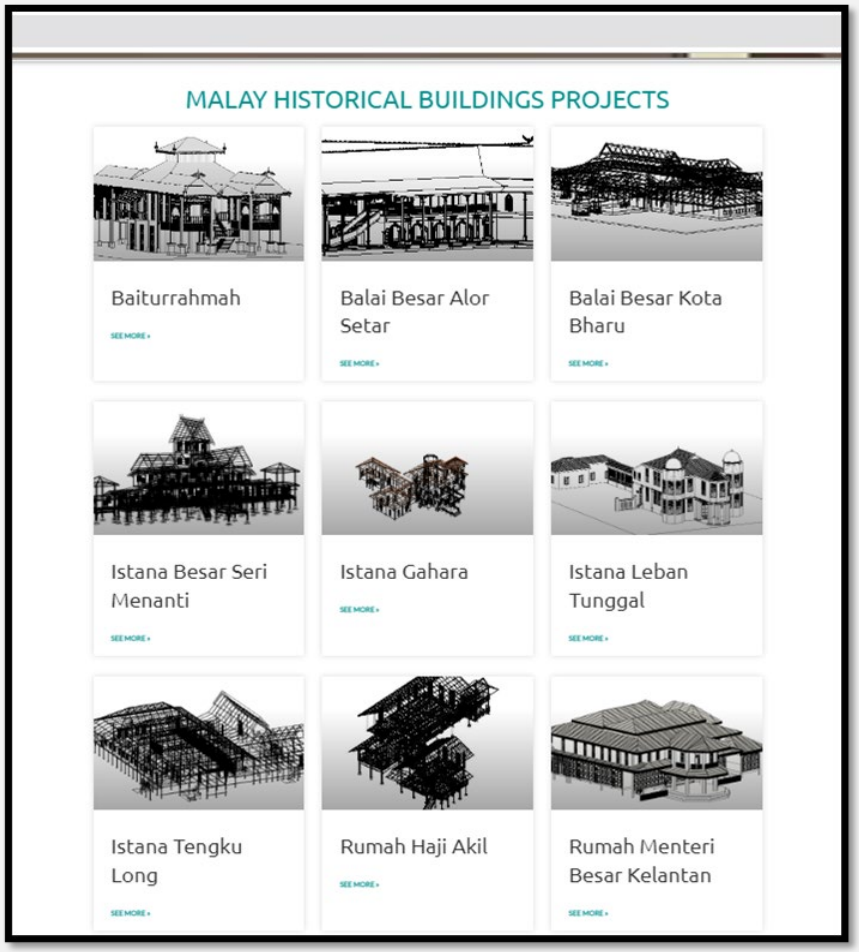


Figure 3: The interface and list of historical building components available in MalayBIM.

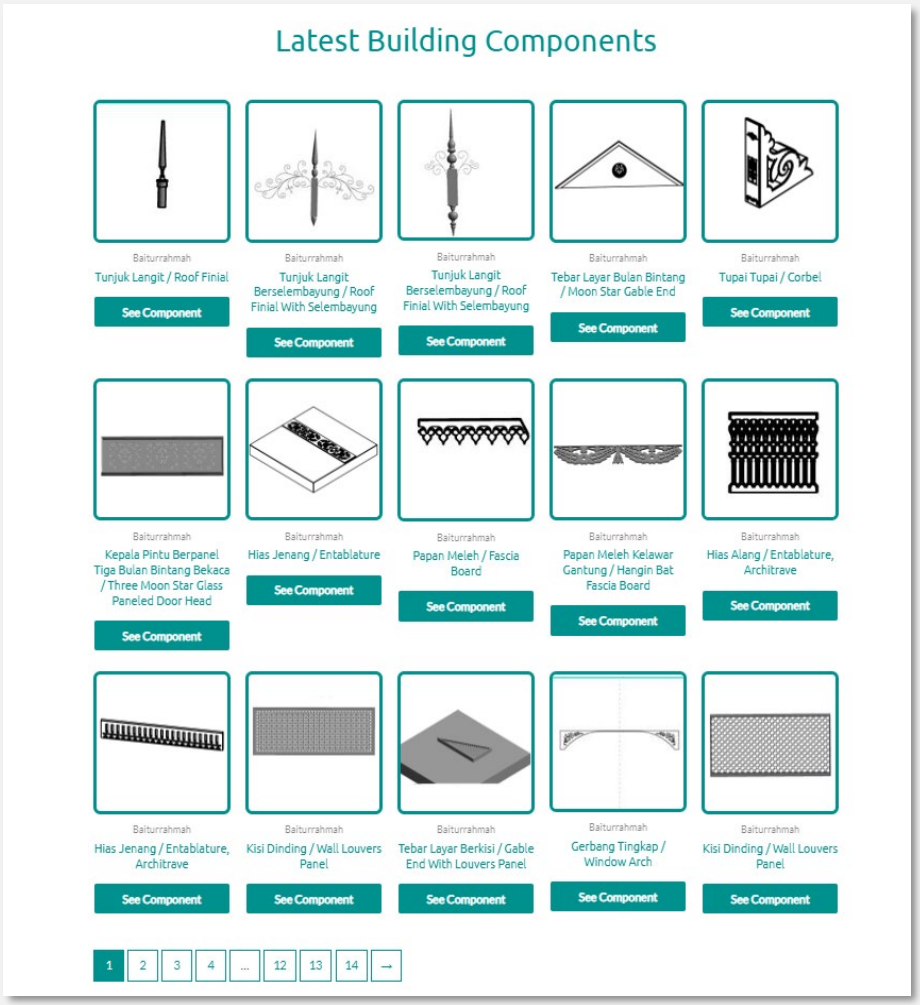


Figure 4: The interface and list of historical building components available in MalayBIM.

FINALISED DESIGN SCHEME

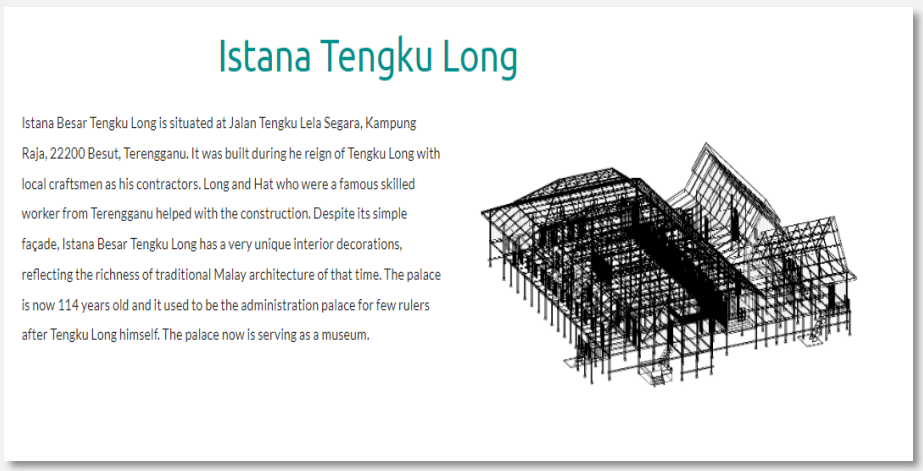


Figure 5: Finalised design development- Istana Tengku Long (Terengganu)

BIM library helps to enhance the collaboration between project stakeholders, with the information embedded inside the BIM objects. It has standardised information, referred to as a one-stop centre for an information resource. Standardised information that is embedded and can be easily accessed would increase working transparency and reduces the risk of ambiguity in executing construction projects (Almainani and Nawari, 2017). With BIM, all parties are encouraged to collaboratively share information, with the library serving as the platform to share information efficiently. The library provides a reliable and sustainable way to transfer data such as measurements, materials, descriptions, and maintenance instructions, as demonstrated in Figure 5.

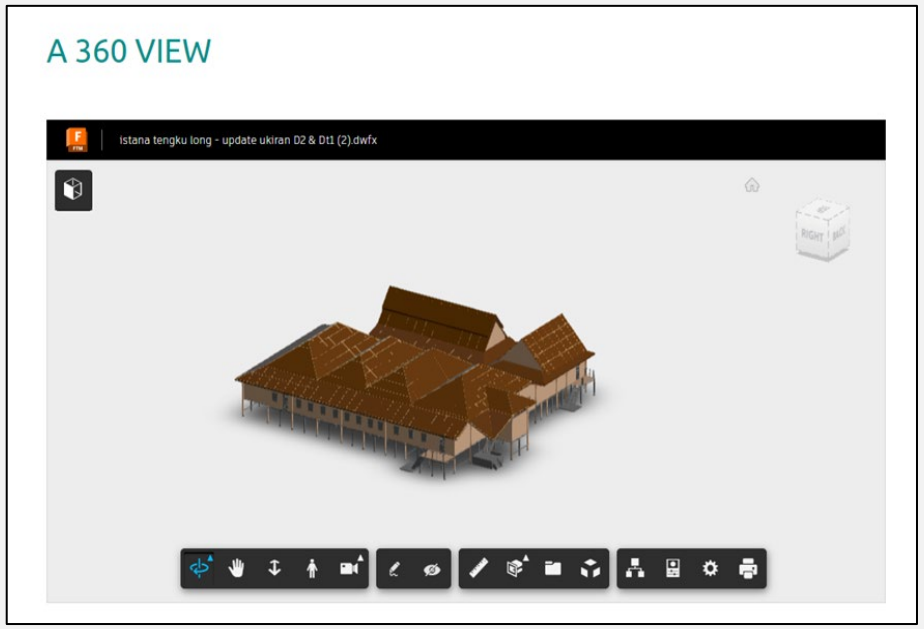


Figure 6: 3D of Istana Tengku Long

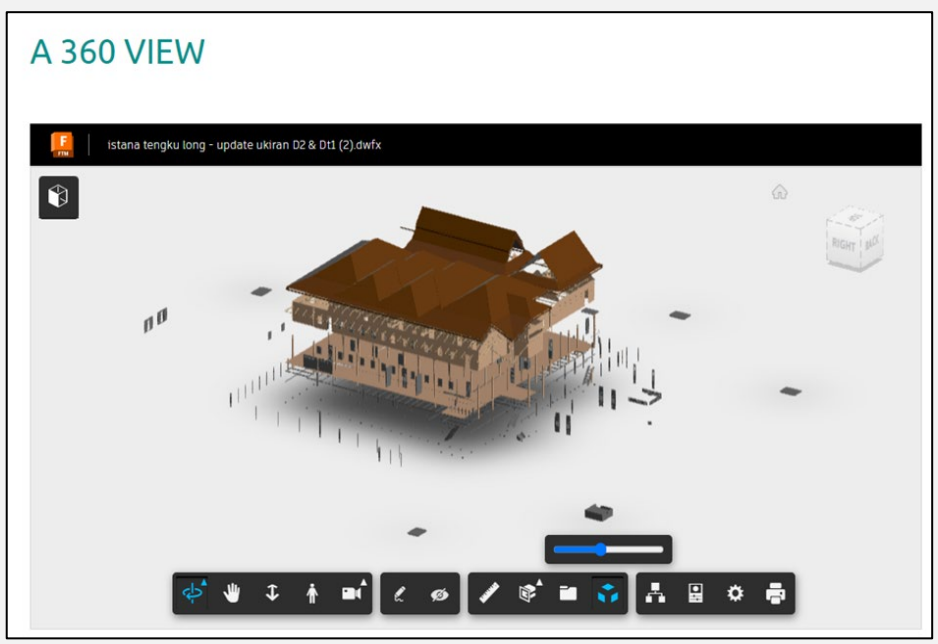


Figure 7: Exploded model of Istana Tengku Long (Terengganu)

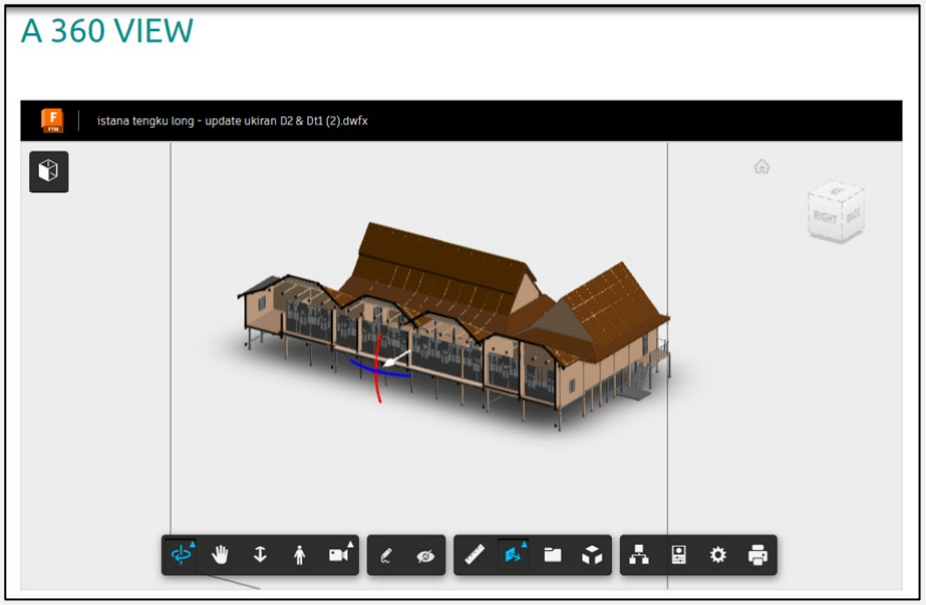


Figure 8: Section of Istana Tengku Long (Terengganu)

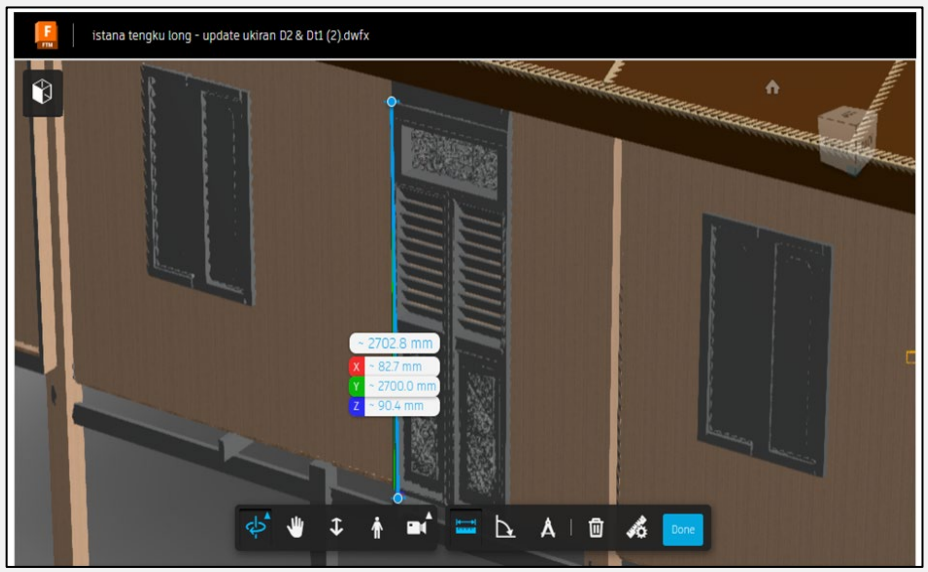


Figure 9: Detailing of Istana Tengku Long (Terengganu)

A BIM library is a database of BIM objects where the contents can be downloaded, edited, and utilised for design. BIM libraries simplify the process of finding appropriate objects for design (Afsari and Eastman, 2014; Almaimani and Nawari, 2017; Baik, Boehm, and Abaikkauedusa, 2017; Ali, Ismail, Suhaimi, Hashim, and Mustafa, 2018).

The aim of creating a BIM library is to capture information that will be beneficial to solving the customers' issues, pains, and goals. Ultimately, the library becomes the foundation for building decision-making tools that measure cost reductions, avoidances, and added value. Building a high-quality value inventory or database takes time and effort, but the payback comes tenfold. The main agenda of having a database is to improve the sharing of information between different professionals within a project, solve the interferences between them, avoid the creation of mistakes, decrease costs, and obtain good results (Ali et al., 2018; Baik et al., 2013).

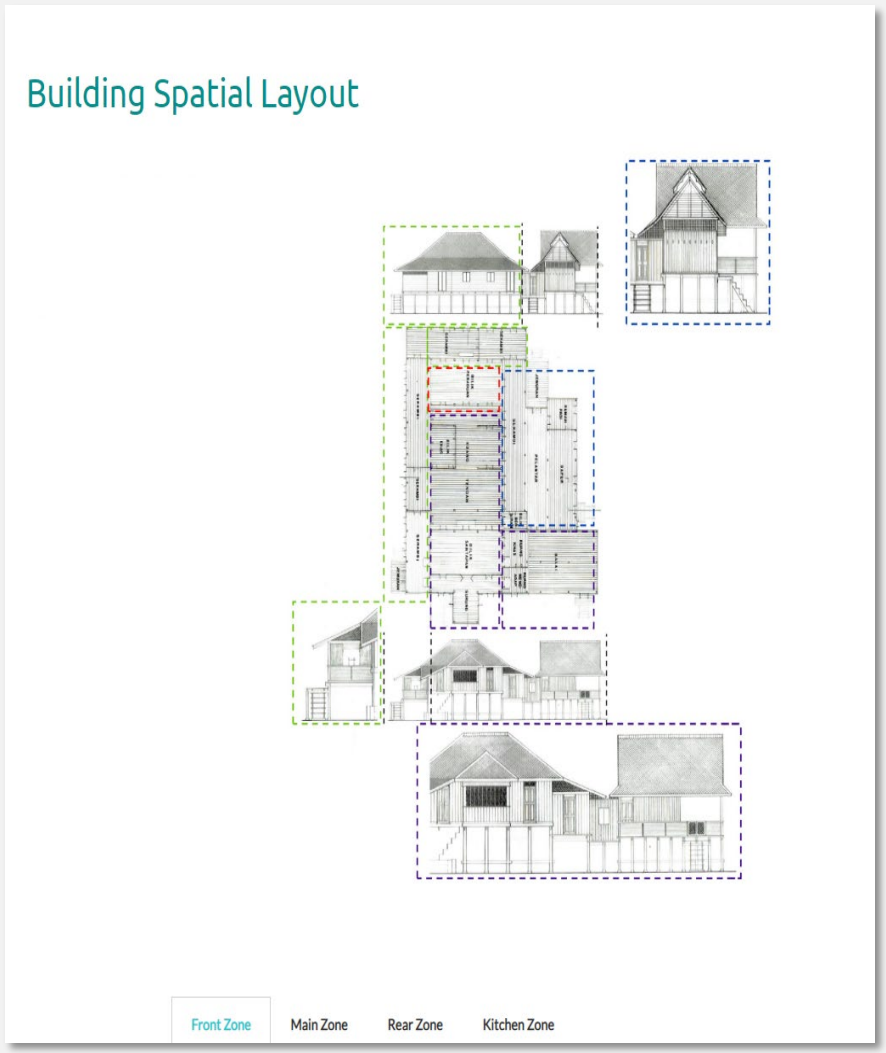


Figure 10: Basic drawings of Istana Tengku Long

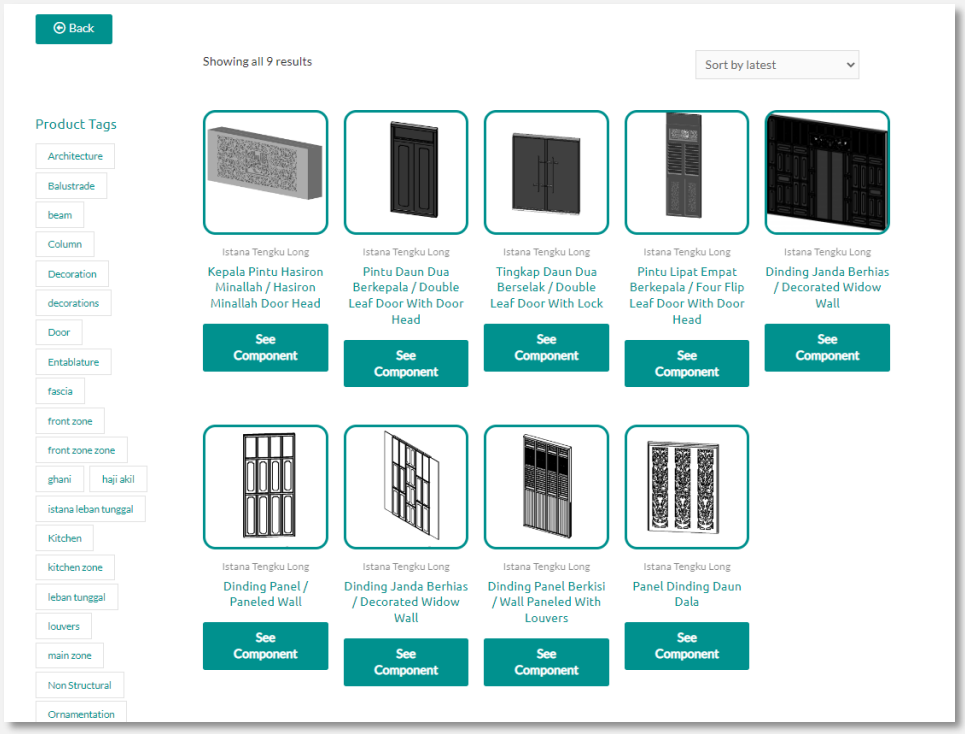


Figure 11: Digitalized components of Istana Tengku Long

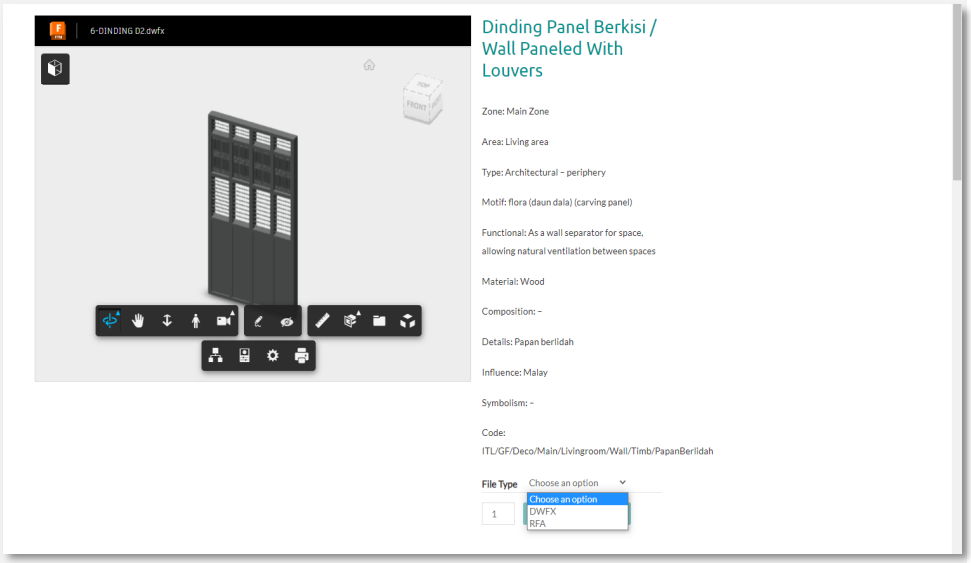


Figure 12: The semantically enriched components and the components are downloadable

This database is unique because it is the first database that models and compiles the components of historical Malay buildings in Malaysia. Furthermore, the philosophy used to develop the database is based on the spatial philosophy of Malay buildings that represent the uniqueness and characters of the Malay culture, as demonstrated in Figure 6. The components in the database are available in.rfa and dwfx formats, as shown in Figure 7 and Figure 8. This step ensures that the components are functional for the designer to use and further develop in the BIM environment. The web-based platform database also provides descriptions of the historical Malay buildings that have been modelled, as shown in Figure 9, Figure10, Figure 11 and Figure 12.

Istana Gahara

Istana Gahara was the home of the last Raja Bendahara of Perak, DYAM Raja Abdul Rashid ibni Almarhum Sultan Idris Murshidul Azzam Shah. It has become derelict when it was abandoned in the 1980's. Istana Gahara is among many unique houses that can be found in Kuala Kangsar, Perak. The interior of the Istana is one of the unique styles that can be found in Malay buildings.

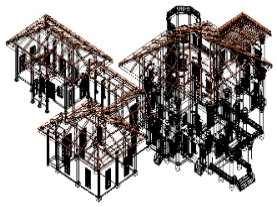


Figure 9: Finalised design development- Istana Gahara (Perak)

Istana Leban Tunggal

Istana Leban Tunggal was built in 1935. The palace is named as Istana Leban Tunggal as it is home to only a single Leban tree (Leban Tunggal). The palace was the home of the Most Honorable Pahang Tengku Sulaiman Ibn Al-Marhum Sultan Ahmad. The palace was occupied by the Tengku Besar of Pahang all his life. The palace is mainly constructed using stone and timber. Among the uniqueness of this building is that it has two domes on its left and right of the entrance. In addition, there is a hall, connecting the main building to a smaller house.

Figure 13: Finalised design development- Istana Leban Tunggal (Pahang)

Rumah Penghulu Ghani

Rumah Penghulu Ghani is situated at Taman Merlimau Jaya, 77300, Malacca . It was built by Demang Abdul Ghani in 1894. The house is decorated with Malay architecture with influence from Chinese arts since Malacca was popular with Chinese traders since the sultanate of Malacca. The house is a beautiful blend of art between cultures. The house is decorated with Malacca and generic Malay architectural identity such as *Bumbung panjang tiang enam belas, kisi-kisi and ornamented door* . The house consist of two components of two famous Malay house which are Rumah Melaka (Rumah Bumbung Panjang Tiang Enam Belas) and Rumah Limas Johor. The house was the residence of Demang (head village) to welcome people during his administration.

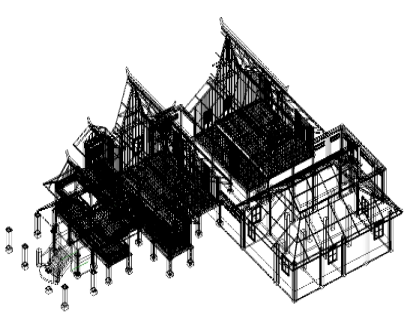


Figure 14: Finalised design development- Rumah Penghulu Ghani (Malacca)

Balai Besar Alor Setar

Istana Balai Besar is a unique hall which was built in 1735 by order of Sultan Muhammad Jiwa Zainal Adilin Muazzam Shah, the 19th Sultan of Kedah (1710 – 1778). Its original function was to act as "Balai Penghadapan" for the king's official activities. The components were initially constructed from timbers, and after some incidents due to attacks from the Siamese (1821) and Bugis (1770), some parts of the components were changed to steel and concrete. The building was constructed displaying the astonishing Malay's woodcarving at that time, and until now, its uniqueness still inspires many architects and tourists. This palace is among the oldest and the finest traditional Malay palaces which remains intact until today.

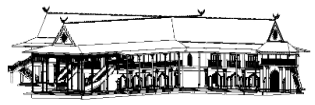


Figure 15: Finalised design development- Istana Balai Besar Alor Setar (Kedah)

CONCLUSION

The digitalisation of Malay heritage using BIM has many benefits and challenges that should be addressed to ensure that this technology is widely available and accessible. In order to promote the digitalisation of Malay heritage, there is an increasing need to train more experts in this field so that users can understand how BIM software programs can benefit the preservation of cultural heritage. Additionally, active outreach activities and communication would ensure that those interested in using this technology know its challenges and benefits.

The digitalisation of historical Malay architecture is vital for several reasons.

a) First, it helps to preserve the unique cultural heritage of Malaysia.
b) Second, it provides a record of the development of Malaysian architecture over the centuries.
c) Third, it assists those involved in understanding the origins of Malaysian architecture and guides future planning.
d) Finally, the historical records serve as an important source of information for understanding Malaysian architecture.

Overall, digitalising Malay heritage can be a powerful way to preserve cultural heritage for future generations.

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DECLARATION OF CONFLICTING INTERESTS

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