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Sketch-Up 3D Modelling as Assessment Tool for Compatibility of New Additions to Heritage Buildings

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Abstract

The article discusses the importance of assessing the compatibility of new additions to heritage buildings in the context of heritage building conservation. It highlights the clash of different values and the need for an effective assessment tool. The study focuses on the suitability of using SketchUp 3D Modelling as a tool for this assessment. Sketch Up is known for its ease of use and intuitive tools. The study uses a qualitative approach and selects experts in heritage building conservation as respondents. The findings indicate that SketchUp is most effective in assessing form compatibility, followed by fabric compatibility, and least effective in assessing functionality. Within the aspect of compatibility, building proportion and scale are the best attributes to evaluate using SketchUp, while building spirituality and comfort are the least effectively assessed.

Keyword: Assessment Tool, Compatible New Additions, Heritage Buildings, Sketch Up 3D Modelling

Introduction

Heritage buildings play a crucial role in preserving our cultural heritage and require careful conservation efforts to maintain their historical and cultural significance (Atalan, 2018). One critical issue in the conservation of heritage buildings is the addition of new structures to these existing structures with significant values (Guzmán-Torres, 2009, 2009; Soosani, 2013). This is because new additions to heritage buildings are considered interventions that have the potential to negatively impact the fabric and cultural significance of the buildings (Guzmán-Torres, 2009). New additions, such as extensions, modifications, and alterations require careful consideration to ensure they are compatible with the character of the heritage building and its historical and cultural significance (Khalaf, 2016; Li, et al., 2021). To ensure that a new addition is suitable, an assessment of the proposed addition is necessary.

In assessing the compatibility of a new addition, the use of a suitable assessment tool is important (Yüceer, et al., 2019; Li, et al., 2021). One tool of interest is the utilisation of 3D modelling technology, which enables evaluators to assess proposed new additions based on visual effects and make necessary changes if required (Agosto, et al., 2017). Therefore, in this article, we will discuss the potential and effectiveness of SketchUp 3D Modelling in evaluating new additions to heritage buildings based on a case study of Tengkera Mosque in Melaka. By gaining a deeper understanding of the potential and limitations of SketchUp 3D Modelling, this article aims to contribute to the field of conservation by providing a comprehensive understanding of the aspects of compatibility that can be effectively assessed using SketchUp 3D Modelling, as well as the aspects less effectively assessed or those that require alternative tools.

Literature Review

Addition to Heritage Building

Preserving heritage buildings is important for many reasons. Historic buildings are witnesses to the aesthetic and cultural history of a city, helping to give people a sense of place and connection to the past (Norwalk Tomorrow, 2019). With the passage of time, heritage buildings also face the need for changes and developments, especially involving new additions. New additions have been recognised as a critical issue in conservation as they may compromise the heritage value of the building (de la Torre, 2014). According to Mahdy (2019), the clash of multiple conflicting values within a building, each held by different stakeholders, is a primary cause of the issue.

The issue of new additions to heritage buildings has gained increased attention as conservation has been recognised to contribute significantly to the concept of sustainable development (Appendino, 2018). This paradigm aligns with the Nara Document on Authenticity (1994), which recognises a diverse range of values associated with heritage buildings, such as social values, cultural diversity, use and function, design and form, as well as emotional significance (Nursaniah et al., 2023). Allowing such new additions is important to prevent heritage buildings from falling into disuse, misuse, and damage (Disli, 2018). However, it is crucial to minimise the negative impact of new additions on the existing value of the building by ensuring that they meet characteristics and criteria of compatibility established by conservation experts, as outlined in international charters and recommendations (Khalaf, 2015).

Criteria of Compatibility

In ensuring the preservation of the values of heritage buildings, any development and changes in the form of new additions need to be compatible. The term 'compatible' has been widely understood as a key principle in integrating new development with heritage buildings (Khalaf, 2016; Soosani, 2013; Guzmán-Torres, 2009). Other terms that carry the same meaning as compatible are harmonious development and contextual development (Khalaf, 2016; Leila Soosani, 2013). To achieve a holistically compatible integration, several approaches and criteria have been outlined by experts as guidelines, including the concept model of cultural heritage introduced by Matero (2006). In this model, there are three main aspects that serve as measurements of the compatibility of new additions: namely form, fabric, and function.

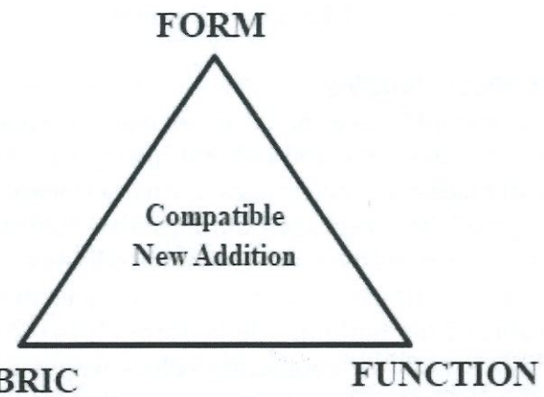

Figure 1: Concept Model of Cultural Heritage
(Source: Authors with adaptation from Frank Matero's Model, 2023)

Compatibility in terms of form essentially refers to the visual impact of the integration of new structures with heritage buildings, taking into consideration that they should not dominate or overshadow the extant structures, but rather complement their original form (ICOMOS, 2010; Disli, 2018). Assessment of compatibility and harmony of form can be carried out based on the following criteria: proportion, scale, height, size, mass, and rhythm. Being compatible in terms of fabric refers to the impact on the original fabric of the heritage building and the compatibility of new materials with the heritage structure. It is important to ensure that new additions do not damage the existing fabric of

the heritage building, such as through demolition and long-term deterioration caused by incompatible construction materials and finishes (ICOMOS, 1964; Amanda, 2017). Function refers to the compatibility of new additions with the current use and user needs. The new additions should provide relevant and useful spaces and facilities without disrupting the original functions of the heritage building (MacCullagh, 2013). This involves understanding and meeting the needs of current users as well as the usability of spaces and the efficiency of building use.

SketchUp 3D Modelling as an Assessment Tool

Designing a building involves careful consideration of factors such as functionality, aesthetics, and environmental impact. When it comes to new additions to heritage buildings, compatibility assessment and appropriate design approaches are crucial considerations (Disli, 2018). Traditional design methods like 2D drawings and physical models have limitations, which is where 3D modelling becomes essential. By utilising 3D modelling, designers can create realistic representations of buildings and evaluate their design and functionality before construction (Perdomo et al., 2005). 3D modelling provides accurate information about a building's structure and materials, making it valuable for heritage building conservation (Norzailawati et al., 2019). New additions to heritage buildings, including extensions and alterations, require careful consideration to ensure compatibility (Letzter, 2023). 3D modelling and visualisation offer detailed information for better decision-making in this process.

SketchUp is a widely used 3D modelling software known for its ease of use and versatility. It is utilised in various fields such as architecture, interior design, and engineering. SketchUp enables users to create 3D models from scratch or import existing models. It offers a range of tools for drawing, extrusion, modelling complex shapes, and editing. Advanced features include rendering tools, plugins, and support for different file formats. Hence, 3D modelling, particularly with software like SketchUp, plays a significant role in assessing compatibility, evaluating design, and preserving heritage buildings. It allows designers to create realistic representations and make informed decisions before construction begins. SketchUp, with its user-friendly interface and versatile tools, is widely adopted in various industries for creating detailed 3D models.

Methodology

This study employed a qualitative approach using purposive sampling. Purposive sampling enables researchers to select experts based on their specific expertise, ensuring that the collected data is highly relevant to the research question. In this study, data was collected through feedback from the selected respondents who are experts in the field of heritage building conservation. There were four respondents involved in this study, consisting of two Registered Conservators and two officers from the heritage authorities, namely officers from the National Heritage Department of Malaysia (NHD). The selection of Registered Conservators was to ensure that the individuals involved are professionals who have been recognised for their expertise in designing new additions to heritage buildings in Malaysia. Meanwhile, the officers from the NHD are officials who have been officially appointed to the Heritage Site Development Committees at the department level.

Using 3D modelling of Masjid Tengkera as a case study of a heritage mosque with new additions, respondents were asked to assess the effectiveness by evaluating the three aspects of compatibility introduced by Frank Matero namely form, fabric, and function. The feedbacks were analysed using thematic analysis to address the research questions. The respondents were further asked to assess the level of effectiveness using a scale based on attributes for each aspect of compatibility. Form has six attributes namely proportion, scale, height, size, mass, and rhythm. Fabric has three attributes namely material, integrity and texture, while function has four attributes: direction, security, spirituality, and comfort.

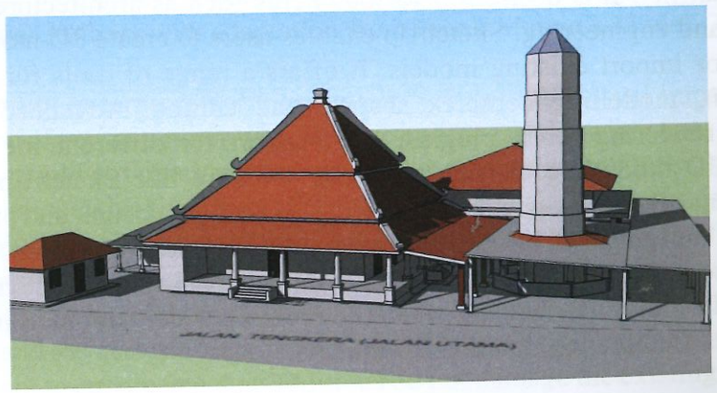

Figure 2: 3D Model of Tengkera Mosque with the new additions generated using SketchUp
(Source: Authors, 2023)

Findings

Based on studies on the effectiveness of using SketchUp 3D Modelling in assessing the compatibility of new additions to heritage buildings, findings have shown variations in effectiveness for each aspect of assessment, namely form, fabric, and function. In this context, the respondents generally shared similar views, considering form as the most effective aspect of compatibility to be assessed using Sketch Up 3D Modelling, followed by the fabric aspect, and finally, they agreed that functionality was the least effective aspect.

Form

The 3D models generated using SketchUp are highly effective in communicating with stakeholders from diverse backgrounds, including non-technical individuals and the general public. The clear and realistic visual representation of the integration between new structural additions and heritage buildings enables easy understanding of the overall building form and resulting changes. Apart from assessing the form compatibility of new additions with heritage buildings, it is also important to consider how the new additions interact with the existing heritage building and its environment.

3D modelling allows stakeholders to visually evaluate how the new additions blend into the existing visual context. They can observe whether the design of the additions respects and enhances the architectural characteristics of the surrounding environment or if it clashes with them. Assessing the compatibility of the form can be guided by six design attributes: proportion, scale, height, size, mass, and rhythm. However, among these attributes, the use of SketchUp 3D Modelling has shown varying effects in assessing form compatibility.

Fabric

In assessing fabric compatibility, it is important to pay attention to the details and characteristics of the existing fabric in heritage buildings. 3D modelling allows stakeholders to clearly visualise details such as texture, colour, patterns, and specific architectural elements of the heritage building's fabric. With a high level of detail, the evaluation of fabric compatibility can be done more accurately. The aspect of structural compatibility can also be effectively assessed using 3D modelling. By generating an accurate 3D model, researchers can investigate how the new additions integrate with the original structure of the heritage building. The effectiveness of this aspect helps ensure the compliance of the new additions with the structure and integrity

of the heritage building. Therefore, in order to enable an assessment of fabric compatibility, the 3D model needs to be created in more detail, including considering construction methods, and ensuring accurate rendering of each building component according to the material type.

Function

The feedbacks from all respondents indicate that assessing functional compatibility based on the visualisations generated from SketchUp 3D modelling is challenging. This is because functional compatibility relies not only on visual aspects but also on user experience within the building. 3D models may not provide a comprehensive understanding of how users will interact with the new additions and to what extent they meet their needs and desires. Additionally, evaluating functional compatibility requires involvement from stakeholders who typically have diverse interests in the heritage building. 3D models cannot directly engage stakeholders in the assessment process. A more holistic approach that involves direct interaction with stakeholders is usually more effective in assessing functional compatibility.

The functionality of heritage buildings is often complex and intertwined with their unique historical and cultural contexts. Assessing functional compatibility involves a deep understanding of the current use of the building as well as the needs and aspirations of the users. 3D models may not fully capture the overall complexity and nuances of the functional aspects of heritage buildings.

Level of Effectiveness

The effectiveness level of using SketchUp 3D Modelling on each attribute for all three aspects of compatibility was further measured using a Likert Scale based on the survey forms provided to the respondents. The assessment results of the effectiveness level for each attribute of the compatible new additions have shown that the form aspect is the most effective, with proportion and scale being the most influential attributes. Meanwhile, the fabric aspect is the second most effective aspect to assess, represented by its three attributes: material, integrity, and texture. On the other hand, the attributes of spirituality and comfort, which are part of the functionality aspect, were found to be the least effective to be measured using SketchUp 3D Modelling as shown in the following diagram:

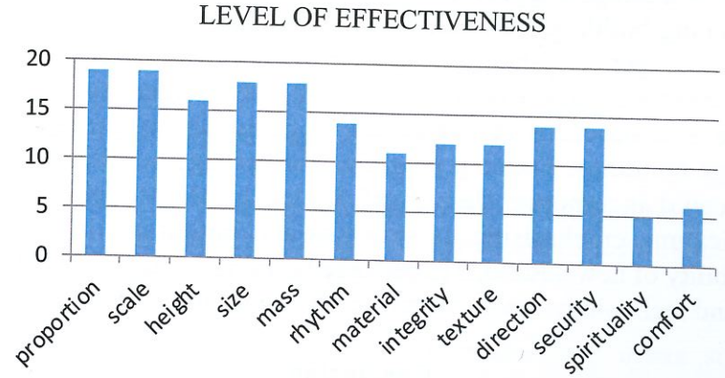

Figure 3: Level of effectiveness for the compatibility attributes (Source: Authors, 2023)

Discussion

Theoretically, this study has contributed to the understanding of compatibility assessment in heritage building conservation by examining the effectiveness of 3D visualisation tools, specifically SketchUp 3D Modelling. It may lead to the development of new theories, or the refinement of existing ones related to the use of technology in architectural conservation and heritage preservation. The study identifies form as the aspect of compatibility that can be most effectively assessed by SketchUp 3D, followed by fabric and function. This finding can inform future research on the importance of different compatibility aspects in heritage building conservation and how to prioritise them using various assessment tools.

Based on the study's findings, policymakers and heritage conservation agencies could consider promoting the use of SketchUp 3D Modelling as a valuable tool for assessing visual compatibility in new additions to heritage buildings. This may help improve the overall assessment process and lead to better decisions regarding heritage building conservation projects. Policymakers may also consider revising guidelines for heritage building conservation to emphasise the importance of building proportion and scale as critical attributes for evaluating design compatibility using 3D modelling tools. This may lead to more effective and targeted preservation efforts.

The study's findings suggest that SketchUp 3D Modelling is less effective for evaluating building spirituality and comfort. Policymakers and heritage conservation agencies should be aware of these limitations and possibly combine SketchUp 3D Modelling with other assessment tools or methods to ensure a comprehensive evaluation of compatibility for new additions to heritage buildings. Training programs for heritage building conservation experts could incorporate the use of SketchUp 3D Modelling as part of the curriculum, emphasising its strengths and limitations in assessing the compatibility of new additions to heritage buildings. This may lead to a more skilled and technology-savvy workforce in the heritage preservation sector.

Conclusion

The addition of new structures to heritage buildings is an important concern in the field of conservation, attracting the attention of scholars striving for compatible and balanced development. Scholars and experts have identified form, fabric, and function as the three essential aspects to take into account in achieving balance and holistic compatibility of new additions to heritage buildings. Evaluating these compatibility aspects requires the use of specific tools, including SketchUp 3D Modelling, as employed in this study. The research findings have indicated that using SketchUp 3D Modelling as an assessment tool offers advantages and limitations. The software's ease of use allows for the involvement of various stakeholders in the assessment process, promoting comfort and participation. Additionally, the development of 3D models using SketchUp greatly assists in evaluating form compatibility aspects. However, assessing fabric and functional compatibility requires more detailed modelling and alternative evaluation approaches. Adopting appropriate tools and evaluation methodologies is crucial to effectively assess new additions to heritage buildings, contributing to the preservation and balanced development of our cultural heritage.

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