

The concept of bridge substructure planning using Revit application for BIM approach

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ABSTRACT

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Bridges are one of the most important infrastructures because they are a link between 2 different points that have an impact on a country's economy. The impact of bridge construction can be controlled with good design and design. In this paper, the author will model the planning of the lower structure of the bridge using Revit Software as a form of Building Information Modeling (BIM) technology. This paper uses references from international and national journals taken from Google Scholar. The references obtained are useful in making a literature review that has a relationship with the topic discussed by the author, namely bridges. It is known that the use of BIM technology is very helpful and makes it easier for engineers in the implementation of a construction project. Therefore, this research enhances the understanding and application of digital tools in civil engineering projects, contributing to innovation in construction practices.

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INTRODUCTION

Transportation and infrastructure are important factors that determine the development and security of every country (Britchenko et al., 2020). Aviation, bridges, dams, drinking water, water, hazardous energy waste, inland waterways, levees, parks, ports, railways, highways, schools, solid waste buildings, transit, and wastewater are the 16 categories of infrastructure (American Society of Civil Engineers, 2017). Bridges are one of the most important infrastructures because they are a link between 2 different points that have an impact on a country's economy. Investment in public infrastructure is a good way for the government to spend money and can boost economic activity in the short and long term (Leduc & Wilson, 2012). In an island nation, bridges are an important element in the transportation network to connect the islands and avoid the bay (Fujino et al., 2019). Therefore, bridge construction has a vital role in a country's development.

A bridge is a facility that connects two parts of a region and supports the economy of the region (Ridwan & Umroniah, 2023). If traffic transportation is smooth, it will facilitate all community activities. Bridge construction also has the importance of shortening travel time for people or goods crossing an area or border so that a smooth transportation traffic system will encourage economic growth in a region. Bridges must be made strong enough so as not to cause interference with the smooth flow of traffic (Anggraini et al., 2021). Therefore, carrying out good calculations and ensuring good workmanship in bridge construction is very important. The materials that can be used in bridge construction are also very diverse, ranging from wood, concrete, steel, and even bamboo. Where each material used has its own advantages and disadvantages in its application.

Bridges are a very important infrastructure in a country. They are facilities that create smoothness in the transportation traffic system in an area. Bridges function as links between two roads that are cut off by a single obstacle, such as valleys, rivers, lakes, and irrigation canals (Yahya, 2022). In addition, bridges also provide an aspect of beauty in an area's traffic. Bridges have been used by humans since ancient times until now. Since the 19th century, advances in materials, optimization methods, and architectural and structural design have contributed to the evolution of bridges in response to the shifting requirements of society (Barker & Puckett, 2013). Various kinds of bridges have been developed by humans until now the technology in bridge

construction has become increasingly modern. This infrastructure has an environmental impact during its construction (Smith et al., 2002). The impact of bridge construction can be controlled with good design and design. Due to their emphasis on territorial relations, bridges are one of the most significant structural typologies designed by civil engineers and have a significant impact on society (Martínez-Munõz et al., 2020).

Bridges are rarely designed compared to highways and other surface structures, being expensive projects that have been built for at least 30 years to, in some cases, hundreds of years (Suchman, 2000). Because the cost of building a bridge is large, careful planning is needed so that mistakes do not occur during its implementation later. Many methods have been used to construct bridges across the country. The most common method of building bridges is the one that uses the forged or cantilever method (Kollegger et al., 2014). To maximize the construction of bridges, the calculation of load strength is also very important followed by the correct design of the structure (Capozzoli et al., 2013). There are many different kinds of bridges that can be built because each structure has its own set of requirements, like span clearance, traffic flow, geometry, and the features of the place where it will be built (Gonzalez et al., 2020).

Steel and reinforced concrete are typically the construction materials of choice for bridges. The accessibility of cutting edge steel and built up substantial innovation gives driving force to the development of scaffolds with longer ranges and taller structures (FUJINO & KAWAI, 2016). However, the design of the bridge must also pay attention to the safety factor for workers in a project. The bridge that is built must have a high level of safety and comfort (Yunus & Syahdinar, 2019). Good design and planning, supported by organized work management, will overcome safety issues in the implementation of a bridge project.

In the fields of architecture, engineering, and construction, the methodology known as building information modeling (BIM) is gaining prominence (Rojas et al., 2019). BIM technology makes it easier to plan, design, and manage work in a construction project, which provides efficiency and effectiveness. BIM also makes it possible to evaluate capacity at any given time (Wu et al., 2017). Technological advances have made a significant contribution to building information modelling (BIM)-based construction project management (Girardet & Botton, 2021). The principal objective of BIM innovation is to have the option to take full advantage of data set data to serve projects, BIM brings about cost reserve funds, quality control, and expanded productivity (Zhou, 2022). However, currently not many people use BIM technology due to limited knowledge.

There are a variety of structures and shapes used in the design and planning process, as well as specialized components with intricate mechanical properties (Hakim et al., 2021). Therefore, construction projects are very appropriate to use BIM technology to achieve efficiency and effectiveness in work. One of the software that implements BIM technology is Revit Autodesk which has been widely used in construction projects in every country. In this paper, modeling of the planning of the bridge understructure including the abutment and foundation of the bridge will be carried out using Revit Software.

In recent years, the rapid development of BIM technology has given new vitality to the world of the entire field of infrastructure construction and has been hailed as a revolutionary force in the transformation of the construction industry (Lv, 2018). Currently, many researchers around the world are studying the use of BIM technology in bridge construction. Dang & Shim (2018) involved BIM innovation in the upkeep of extension watches and fostered a drawing-based span support framework. Ruffels et al. (2020) assessed and checked the scaffold structure utilizing a BIM model. Ye et al. (2021) utilized BIM technology to create an adaptable bridge information model for the purpose of building and engineering bridges.

The construction of the bridge consists of an upper structure and a lower structure. In this paper, the author will model the planning of the bridge understructure using Revit Software as a form of BIM technology. The modelling that will be carried out includes bridge abutments and piles as foundations. The research contribution lies in the application of Building Information Modeling (BIM) technology, specifically using Revit software, to model the bridge's understructure. This contribution is significant because it introduces a modern approach to planning and visualizing essential components of a bridge, such as abutments and piles, in a more precise and efficient way compared to traditional methods. By focusing on the use of BIM technology for infrastructure design, this research enhances the understanding and application of digital tools in civil engineering projects, contributing to innovation in construction practices.

METHOD

The research method used in this paper is planning modeling using BIM technology, namely Revit software. The modelling carried out is the lower structure of the bridge in the form of a bridge abutment and pile foundation. The data used is sample data because this writing is only intended to model learning using Revit Software (BIM). The modelling of the lower structure of the bridge in this paper uses a material that is often found, namely reinforced concrete. This paper also uses references from international and national journals taken from Google Scholar. The references obtained are useful in making a literature review that has a relationship with the topic discussed by the author, namely bridges.

RESULTS AND DISCUSSION

Bridge Abutment Modeling

Bridge abutment modelling begins with using a family template in Revit Software. The purpose is so that the abutment model made can be combined with other elements such as pile foundations. The results of the bridge abutment modeling that has been carried out can be seen in Figure 1 below.

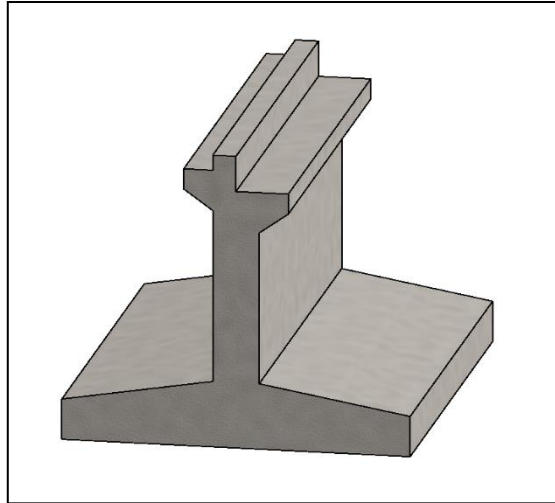


Figure 1. Abutment Modeling

Figure 1 is a 3D view of the bridge abutment. The abutment model made has a length of 7.5 m, and a width and height of 6 m each. Modeling is created using the extrusion feature in Revit Software. After modeling, then the size is determined according to the data we have, then it is only necessary to fill in the material that will be used in planning. The abutment material that the author uses in this modelling is concrete.

Pile Foundation Modeling

The modeling of the pile foundation also starts by using a family template so that later it can be combined with the abutment that has been made. The results of the pile foundation modelling can be seen in Figure 2 below.



Figure 2. Pile Cap Foundation Modeling

Figure 2 above is a modeling of the pile foundation that has been carried out. The piles made have a length of 12 m and a diameter of 40 cm with the material used being concrete. This modelling also uses the extrusion feature in Revit Software.

Bridge Substructure Modeling

Next is the modelling of the lower structure of the bridge in the form of abutments and pillar foundations that have been made. The two pre-built models are stored in the family format combined in the project file as seen in Figure 3.

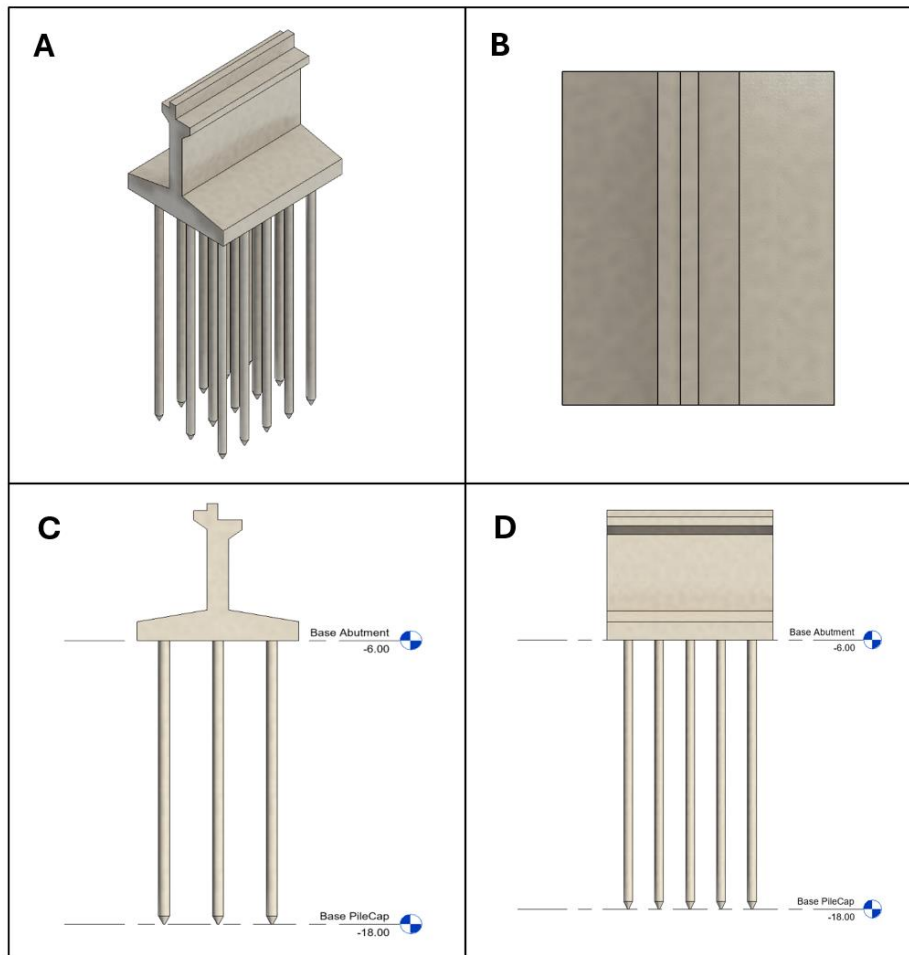


Figure 3. Bridge Substructure Modeling

The modelling of the bridge's lower structure in Figure 3 is a combination of the abutment model and the pile foundation that has been made. The pile foundation is placed right under the abutment, or the base of the abutment, which totals 15 pieces. Image A is a 3D view, image B is the top view, image C is a side view, and image D is the front of the modelling of the bridge's lower structure that has been carried out.

CONCLUSION

This paper presents a model of the lower structure of a bridge using BIM technology and Revit Software. BIM technology significantly accelerates the design modeling of construction projects, allowing for the creation of bridge abutments and pile foundations in a family format. The Revit software features extrusion, which determines the size based on the data. The model includes concrete material, and can be viewed in various views, including 3D and front views. The paper concludes that BIM technology is helpful for engineers in implementing construction projects. Future research should explore the integration of BIM technology in modeling upper and lower bridge structures, compare Revit with other BIM tools, optimize material use, and analyze cost and time efficiency in real-world scenarios. Integrating structural analysis and simulation tools into BIM models would provide a more comprehensive understanding of a bridge's performance under various conditions, enhancing its application in infrastructure development.

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