CHAPTER I
INTRODUCTION

1.1. BACKGROUND OF THE RESEARCH

Bridges are one of the important elements in transportation infrastructure that have a strategic role in supporting the smooth mobility of goods and people and improving connectivity between regions. In Indonesia, with the increasing need for infrastructure that can support economic growth, the construction of bridges with longer spans and larger load capacity is becoming increasingly important. One of the solutions widely applied for bridges with medium to long spans is the use of prestressed concrete, which is known to have higher strength and durability than reinforcement concrete. One of the important elements in this system is the PCI (Prestressed Concrete I-Girder) beam. Characterized by high strength, material efficiency, and the ability to cover long spans, PCI beams are frequently used in modern bridge design. (Naaman, 2004).

The design of prestressed concrete bridges using PCI girders offers a variety of significant advantages, both from a technical and economic perspective. One of the main advantages is the ability of the structure to withstand larger loads with smaller dimensions. The process of prestressing the concrete makes the structure more resistant to tensile forces and able to withstand heavier loads, which is very important in the design of bridges that are in areas with high traffic volumes or less-than-ideal geotechnical conditions. In addition, the use of PCI girders as factory-manufactured precast elements allows for better quality control and reduces the risk of errors during construction, speeds up project execution time, and reduces construction costs.

However, despite having many advantages, the planning of prestressed concrete bridges with PCI girders also faces some technical challenges that need to be considered. The proper planning process requires a deep understanding of the behavior of prestressed concrete structures, load distribution, and other factors such as varying soil conditions and traffic loads. In addition, the process of transporting and installing PCI girders requires special attention so that structural elements are not damaged during delivery and installation at the construction site. Therefore, proper design and analysis are essential to ensure that the bridge structure can function optimally and safely in the long term. T.Y. Lin, a pioneer in prestressed concrete engineering, also underlined the importance of innovative approaches in bridge design to ensure structural efficiency and long-term sustainability.

Along with the development of technology in the field of construction, the concept of Building Information Modeling (BIM) has begun to be applied in the planning and construction of bridges. BIM allows designers, engineers, and contractors to collaborate more effectively in a single digital platform that contains all project-related information, from design, and structural calculations, to construction management. In the context of planning prestressed concrete bridges using PCI girders, BIM allows for more efficient integration between structural calculations, material selection, and scheduling and budget coordination. By using BIM, design changes can be implemented more quickly and coordinated, reducing the risk of errors and improving planning accuracy. According to Eastman et al. (2011), BIM enables the integration of all aspects of design and construction, including in prestressed concrete bridge projects.

As part of efforts to improve the quality of infrastructure in Indonesia, this research aims to explore and analyze the planning of prestressed concrete bridges using PCI girders, especially for medium to long bridge spans. This research will examine various aspects of planning, such as the calculation of load capacity, the selection of optimal girder dimensions, as well as the analysis of stress distribution and safety factors. In addition, this research will also integrate the concept of BIM in the planning process to improve efficiency and accuracy. The application of the BIM concept in bridge planning is expected to be a step forward in realizing more modern, efficient, and sustainable infrastructure development.

1.2. OBJECTIVE AND BENEFITS OF THE RESEARCH

The objectives to be achieved from this research can be described as follows:

1. Planning and designing a prestressed concrete bridge capable of withstanding the loads that may work;
2. Implementing the concept of Building Information Modeling (BIM) to assist calculations and modeling in the planning and design of prestressed concrete bridges;
3. Producing Detailed Engineering Design (DED) from the Planning and design of the Prestressed Concrete Bridge; and
4. Identify and analyze the advantages and disadvantages that can be taken from the application of the Building Information Modeling (BIM) concept in the planning and design of prestressed concrete bridges.

The benefits obtained from this research can be described as follows:

1. This research provides in-depth insight into the use of prestressed concrete in increasing the strength and stability of bridges.
2. Through this Undergraduate thesis, it is hoped that new guidelines and standards can be created in the design of prestressed concrete bridges, which can be used by professionals in the field of civil engineering.
3. By using the Building Information Modeling (BIM) Concept, it is hoped that it can reduce calculation errors from the design of prestressed concrete bridges
4. This Undergraduate Thesis will make a significant contribution to academic and practical knowledge about bridge planning and the application of Building Information Modeling (BIM) in the construction industry, The results of the research can be an important reference for academics, practitioners, and students who are interested in the development of modern construction technology.

1.3. SCOPE AND LIMITATION

Scope and limitation of this research by the following:

1. The bridge that will be designed on the Superstructure uses the main girder in the form of a PCI-Girder with a span of 40 meters;
2. The substructure of the bridge uses 2 abutments without pillars using piles foundations.
3. The BIM-based software used in this research is Midas Civil 2022 and Autodesk Revit 2023;
4. In this study, Building Information Modeling (BIM) is only used as an assistant for calculation and 3D modeling;
5. The BIM-based software used to help analyze the superstructure, substructure, and foundation of the bridge is Midas Civil 2022 with the help of data processing using Excel;
6. The soil data used in analyzing the substructure is fictitious;
7. The 3D modeling that will be made is a prestressed concrete bridge with BIM-based software used, namely Autodesk Revit 2023; and
8. The components modeled are only structural and architectural, while MEP (Mechanical, Electrical, and Plumbing) is not modeled