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STRUCTURAL DESIGN OF THE PILE SLAB BRIDGE IN DAMIT HULU

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ABSTRACT

A bridge is a structure built to connect two areas separated by obstacles such as rivers, ravines, or bodies of water. In Damit Hulu Village, there is an area that frequently becomes flooded during the rainy season, hindering the transportation activities of the local community. To address this issue, a bridge was designed to facilitate the movement of residents in the area. The design process adheres to national standards, namely SNI 1725:2016, SNI 2833:2016, and SNI 2847:2019, and is supported by structural analysis software. The planned bridge is a pile slab type with a length of 40 meters and a width of 6 meters. Based on the design results, the floor slab thickness is 0.3 meters, and the pile cap dimensions are 0.8 meters in width, 6 meters in length, and 0.5 meters in height. All structural components have been verified to meet the technical standards in accordance with applicable regulations.

Keywords: Damit Hulu, Pile Slab, Pile cap, Floor Slab

1. INTRODUCTION

Transportation is the movement of people or goods from one place to another via land, sea, or air routes. Specific tools or vehicles are used to facilitate the transportation process. Transportation plays a vital role in economic development, social life, construction, and politics. In general, there are three main types of transportation: land, sea, and air. In land transportation, there are often obstacles such as rivers, ravines, or other barriers that separate one area from another. Therefore, building bridges becomes an essential solution to connect these divided regions.

To connect two areas separated by an obstacle such as a river, ravine, or other types of barriers, a structure called a bridge is used. Generally, a bridge consists of several main structural elements, including support columns (also known as piers), girders or beams, and a deck surface for vehicles and pedestrians to cross. The construction materials used in bridges vary, ranging from wood, concrete, and steel to high-strength cables. Bridges play a crucial role in facilitating smooth transportation, expanding access and mobility, and contributing to the development of a region.

The Damit Hulu Bridge is located in Damit Hulu Village, Batu Ampar District, Tanah Laut Regency, South Kalimantan Province. The bridge is situated in the lowest area of a highland region, which causes frequent flooding during the rainy season, disrupting transportation activities for the local community. To address this issue, the author has designed the Damit Hulu Bridge using a pile slab structural type as a suitable construction solution.

2. THEORITICAL STUDY

Definition of bridge

A bridge is a supplementary road structure used to connect two roads separated by a river, valley, or body of water. Therefore, the construction of a bridge facilitates smoother transportation access between regions. If a bridge collapses or fails to function properly, it can disrupt the overall operation of the transportation system (Saputra, Priyosulistyo, & Muslikh, 2020).

Preliminary Design

The initial design follows the applicable regulations outlined in SNI 2487:2019. The preliminary structural design includes the initial design of the floor slab and the pile. cap.

Structural Loading

The calculation of structural element loading is conducted in accordance with the applicable standards specified in SNI 1725:2016 and SNI 2833:2016.

Structural Reinforcement

The design of reinforcement for the floor slab, pile cap or beams, and abutment is carried out in accordance with the applicable standards specified in SNI 2847:2019.

***Standart Penetration Test* (SPT)**

The Standard Penetration Test (SPT) is a soil testing method used to determine and obtain the soil's bearing capacity. The advantages of the SPT include the ability to visually identify soil types, obtain qualitative parameters through empirical correlations, its relatively simple and quick process, and its cost-effectiveness. However, the disadvantages of this test are that the resulting soil strength profile is not continuous, and the samples obtained are disturbed (Hardiyatmo,2000).

Allowable Bearing Capacity

The allowable bearing capacity calculation of the piles in this bridge design uses N-SPT data. The calculation is based on Meyerhof's theory. The SPT data require corrections for the groundwater table (N1) and overburden pressure (N2).

3. METHOD

The Damit Hulu Bridge is a pile slab type bridge with a total length of 40 meters and a width of 6 meters, consisting of a 5-meter-wide carriageway and 0.5-meter-wide sidewalks on both the left and right sides of the roadway. This bridge falls under the class C bridge category due to its 6-meter width. The data collected to support the bridge design process include working drawings, soil investigation results in the form of Standard Penetration Test (SPT) data, and preliminary survey data of the bridge area.

4. RESULT AND DISCUSSION

Preliminary Design

The results of the preliminary design calculations carried out based on SNI 2487:2019 are a floor slab with a thickness of 0.3 meters and a pile cap with a width of 0.8 meters, a length of 6 meters, and a height of 0.5 meters.

Structur Loading

The structural load calculations based on SNI 1725:2016 and SNI 2833:2016 to be input into the SAP2000 program are as follows:

Self-weight dead load (MS) = 7.2 kN/m^2

Additional dead load (MA) = 4.6 kN/m^2

Lane load T = 146.25 kN

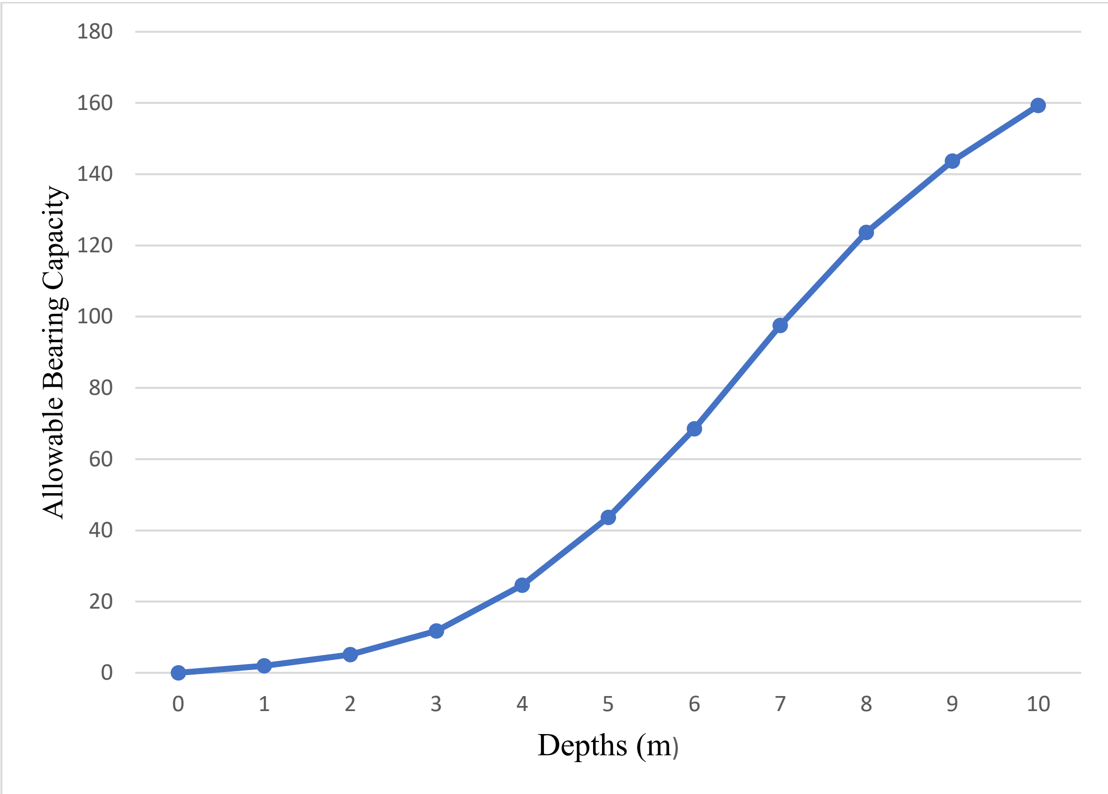
Lane load D = 9 kN/m^2 + 68.6 kN/m

Structural wind load (EWs) = 76.8 kN

Earthquake load = 162.16 kN

Allowable Bearing Capacity Calculation

The results of the allowable bearing capacity calculation based on Meyerhof's theory can be seen in the following graph:



5. CONCLUSION

The structural design of the Damit Hulu Bridge in this final project concludes with the following findings:

1. The most suitable bridge structure with a length of 40 meters and a width of 6 meters is the pile slab type, as this type of bridge is easier to construct and requires lower costs compared to other types of bridges.
2. The structural elements used in the design are:

Original Structural Elements	Structural Elements	Comparison
Floor Slab: • Slab Thickness = 300 mm • Compression Reinforcement: Main Reinforcement = D22-150 Shear Reinforcement = D22-150	Floor Slab: • Slab Thickness = 300 mm • Compression Reinforcement: Main Reinforcement = D19-200 Shear Reinforcement = D16-150	The main tension and compression reinforcements in the designed structural elements are smaller, whereas the shear

Original Structural Elements	**Structural Elements**	**Comparison**
• Tension Reinforcement: Main Reinforcement = D19-150 Shear Reinforcement = D16-150	• Tension Reinforcement: Main Reinforcement = D19-150 Shear Reinforcement = D16-150	reinforcement remains the same.
Pile Cap • Width = 800 mm • Lenght = 6000 mm • Height = 500 mm • Tulangan arah x = D22-125 • Tulangan arah y = D16-150	*Pile Cap* • Width = 800 mm • Lenght = 6000 mm • Height = 500 mm • Tulangan arah x = D22-125 • Tulangan arah y = D16-150	The main and shear reinforcements of the designed structural elements are the same size as those of the original structural elements.
Abutmennt • *Back Wall* X-direction reinforcement = D16-150 Y-direction reinforcement = 10D16 • *Breast Wall* Main Reinforcement = D22-125 Shear Reinforcement = D16-150 • *Pile Cap* Y-direction reinforcement = D22-125 X-direction reinforcement = 40D22	Abutmennt • *Back Wall* X-direction reinforcement = D19-125 Y-direction reinforcement = 7D19 • *Breast Wall* Main Reinforcement = D19-150 Shear Reinforcement = D16-150 • *Pile Cap* Y-direction reinforcement = D22-125 X-direction reinforcement = 31D22	The backwall reinforcement in the designed structural elements is larger, whereas the breastwall and pile cap reinforcements in the designed elements are smaller.

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