



Behavior of precast concrete beam and slab elements under service conditions using LISA FEA

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Article Info	Abstract
<p>Article history: Received 05 September, 2024 Revised 09 October, 2024 Accepted 14 November, 2024</p>	<p>Development has increased massively after the announcement of the IKN area in the area, one of which is the construction of a jetty to accommodate logistics for construction work from infrastructure and facilities to support road, bridge and building construction activities in the IKN area. In this research, we explore how to construct the IKN dock in a timely manner so that it may be utilized appropriately. Researchers perform an examination of the behavior of precast beams and jetty floor slab to acquire stress values and deformations that occur in the process of working methods when installed, casting implementation, and dock service circumstances when using this precast technique. The usage of precast is analyzed utilizing micro software analysis of the finite element technique, namely LISA FEA V.8, to create stress hues behavior that happens. From the results of the modeling simulation above, it can be seen that the largest dominant stress distribution occurs on the side of the beam ear meeting with the deck slab/half slab, the stress occurs according to the working method step between 1.774 MPa in the condition of the slab being installed and increases when the implementation of wet concrete casting becomes 2.567 MPa and when the service condition, the stress again increases to 9,258 MPa.</p> <p>Keyword: Concrete, FEM, Jetty, LISA Precast.</p>
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1. Introduction

The National Capital Region (IKN) of the Nusantara which is located in the administrative area of North Penajam Paser Regency and Kutai Kartanegara Regency is an area that has become the government area of the new state capital of Indonesia, is one of the achievements of equitable development of Indonesian territory, especially the Central and Eastern Indonesia regions. Development has increased massively after the announcement of the IKN area in the area, one of which is the construction of a jetty to accommodate logistics for construction work from infrastructure and facilities to support road, bridge and building construction activities in the IKN area. In this study, we discuss the design of the IKN dock to be carried out in a fast time so that it can be used properly. Precast concrete components (PCC) are being more widely used. This approach has benefits like quicker construction, more productive workers, and less resource waste. Additionally, it has been proposed as an instant reaction to the social demand for housing. The majority of concrete structures are still constructed the

old method in several nations, nevertheless. This study aims to develop a model based on the Technology Acceptance Model (TAM) and the Technology, Organization, and Environment (TOE) framework to quantitatively investigate the influencing factors on adopting PCC from both individual and organizational perspectives, taking into account the significance of publicising its use in building construction [1]. When repairing concrete structures that have been damaged, precast concrete offers various advantages, including speedy construction, high quality, durability, and affordability [2].

Different types of precast beam-column joints have been created and used in line with the modernization of the building industry, and their seismic performance has undergone extensive research. Several precast beam-to-column couplings and frames were evaluated by Blakeley [3], [4]. Their findings demonstrate the acceptable ductility and self-centering capacity of precast joints and frames. Initiated in 1991, the United States Precast Seismic Structural Systems Research Program (PRESSSS) has generated a number of papers [5]. A five-story hybrid prestressed frame with post-tensioned joints, prestressed joints, compression tension/melt gap joints (TYC), and TYC connections underwent pseudo-dynamic tests as part of this research program.

The use of this precast method is carried out to obtain time efficiency in implementation, researchers conduct an analysis of the behavior of precast beams and jetty floor slab to obtain stress values and deformations that occur in the process of working methods when installed, casting implementation and dock service conditions. Analysis of the use of precast is carried out using the help of micro software analysis of the finite element method, namely LISA FEA V.8 to produce stress hues behavior that occurs.

2. Research Method

2.1. Precast Concrete

Precast concrete, also known as precast, is defined as a type of concrete that has been manufactured in a factory using a mold, after which the printed concrete is carried to the construction site and erected. Precast concrete is a reusable building material created by casting concrete in a mold, standard/ordinary concrete, on the other hand, is cast and cured outside. This precast concrete may be made using exact methods under the direct supervision of factory workers because it is produced in a controlled setting / factory (often referred to as a precast plant). When casting concrete in the field, using the precast concrete system offers a lot of opportunity for profit.

2.2. Finite Element Method

The finite element approach is a mathematical technique for tackling challenging examination issues (FEM). The parameters of a linear or nonlinear framework are established using the restricted component approach, which combines a few numerical ideas. Over 20,000 conditions are frequently generated, which is a very large quantity. As a result, this strategy is not very useful unless a decent PC is employed. Tracking down vertex, association, grid, and primary power relocations is a problem that the finite element method uses a component discretization approach to solve. The lattice approach for primary examination is connected to discrete component situations, and the outcomes are the same as those of traditional structural analysis. With one-, two-, or three-layered components (volume/continuum components) or one-, two-, or three-layered components (line components). This method makes use of a continuum component to select a more accurate result [6] [7] [8].

2.3. LISA FEA V.8

The restricted component assessment tool LISA FEA V.8's finite element technique software was used to measure the temperature rise of three different kinds of intensity exchangers. In order of how simple and straightforward they are to design, the three different sorts of models are the line component model, the shell model, and the strong model. The baseplate surface's convection coefficient is not fixed as a percentage of the value used elsewhere for line component models alone since we cannot stop convection from collecting there with the face determination mechanism. It merely requires being aware. We can simply eliminate convection on the mounting surface for the other two models by avoiding that location. [9], [10], [11], [12], [13], [14], [15], [16].

3. RESULTS AND DISCUSSION

In this research, we will analyze using the finite element method with the help of LISA FEA V.8 software by modeling several beam and floor slab elements on the jetty structure and modeling it sustainably according to the step of implementation in the field, the first step is to model the beams and floor slabs of the structure. dock by making a half slab instead of formwork to make time and cost efficiency in this implementation. Previously, a thorough macro analysis of the wharf structure has been carried out to obtain the style and behavior of this structure and obtain a safe and stable condition, taking the maximum force on this structure is applied to the micro structure analysis to provide information on the elements being reviewed, especially the stress values. that happened. The typical piers reviewed are as shown in Figure 1.



Figure 1. Jetty typical

The structural elements on this pier are in accordance with Figure 2. In this study, only the beam and floor slab elements were reviewed.

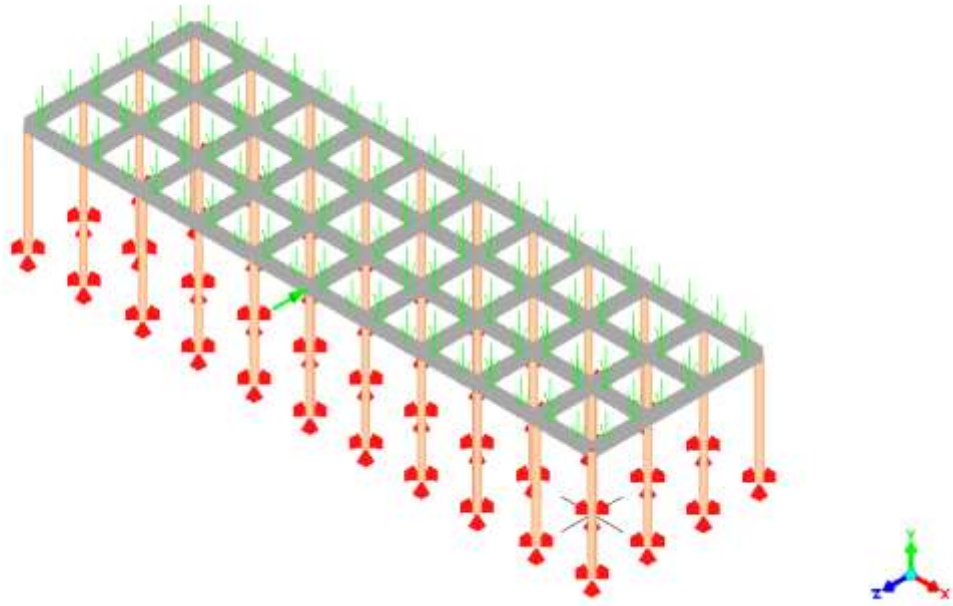


Figure 2. Jetty structure

In the initial modeling the element is the modeling of the floor plate and precast beam system by adjusting the implementation method where the first step is to install half of the slab or deckslab on the precast beam holder which is installed according to the structure module, which is 5000 mm x 5000 mm, where the deck slab is placed in the ear position. beam according to Figure 3, and installed with the size of the deck slab module is 1500 mm x 5000 mm.

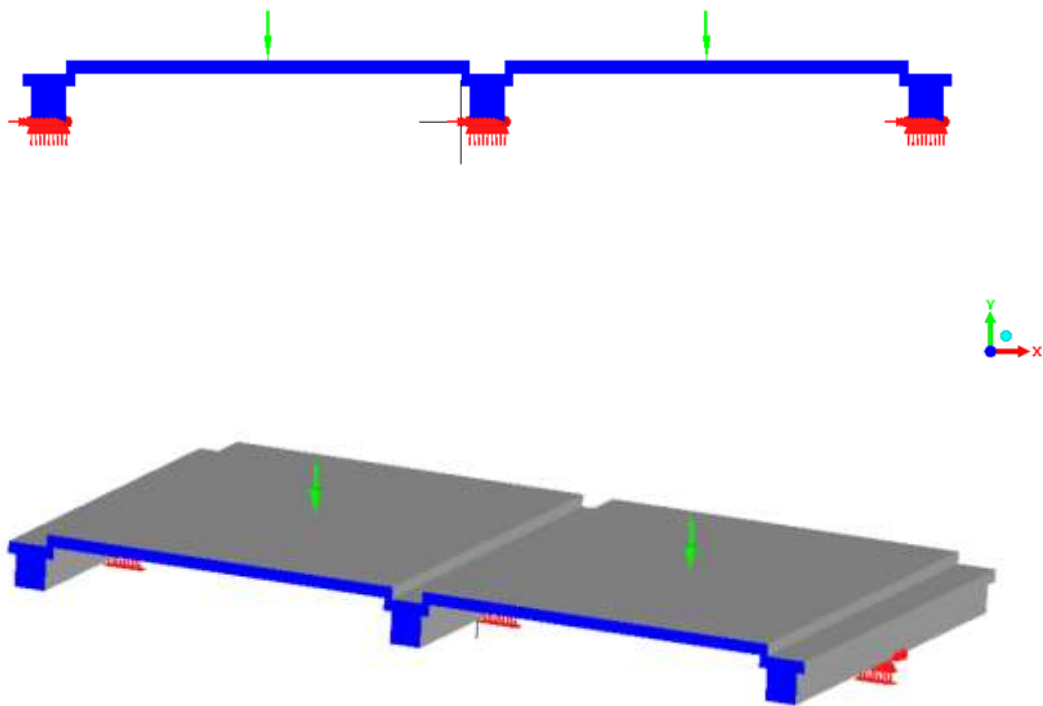


Figure 3. The position of the precast slab deck on the precast beam

In this condition the working load is the dead load from the deck slab and the load from the precast beam itself with the initial beam size being 4000 mm x 5000 mm as shown in Figure 4. And the thickness of the deck slab is 150 mm.

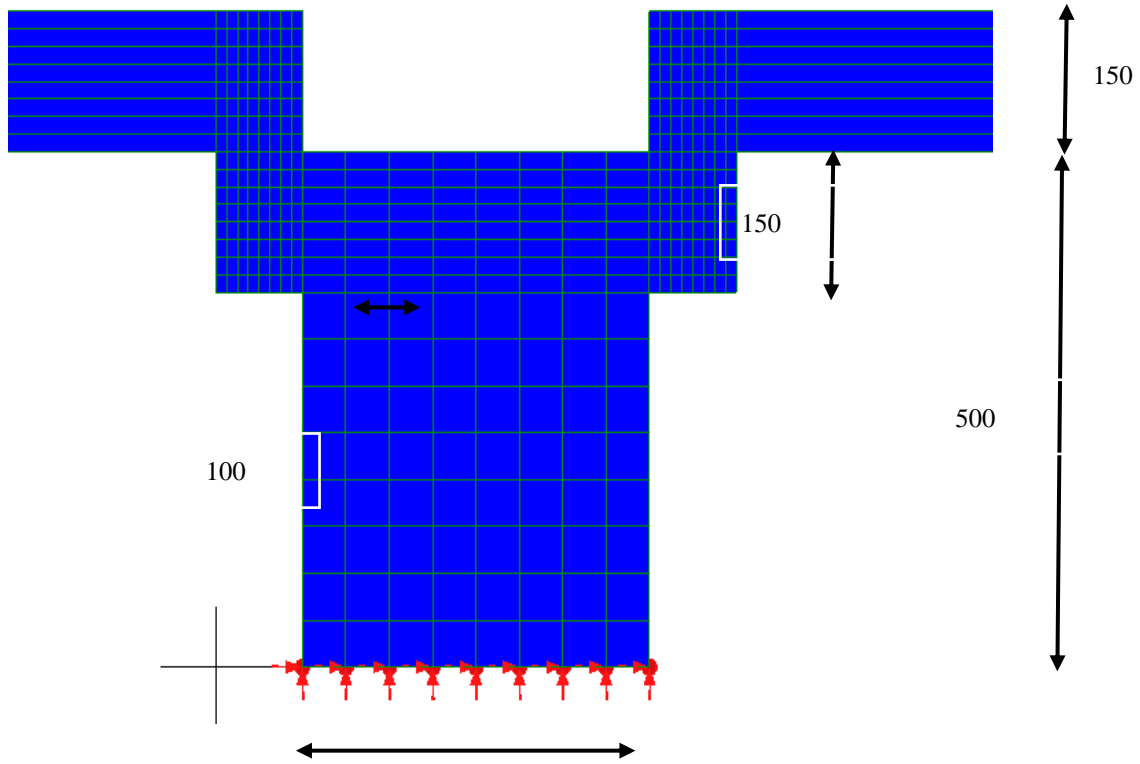
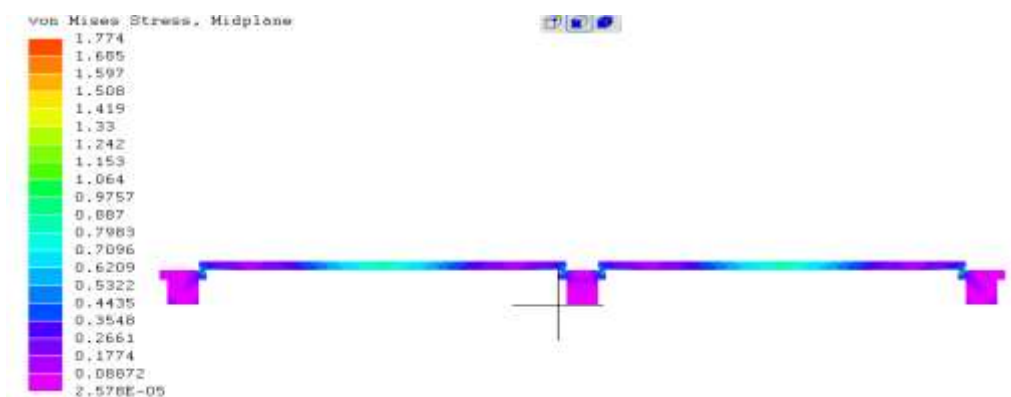


Figure 4. Dimensions of precast slab decks and precast beams

The review of the allowable stress of precast concrete in this study is limited to the allowable compressive stress of concrete in lay conditions, namely $0.45 f_c'$ where the quality of the concrete used is $f_c' = 35 \text{ MPa}$, then the allowable stress limit on this element is only $0.45 f_c'$ ie $0.45 \times 35 \text{ MPa} = 15.75 \text{ MPa}$.

With the condition of the deck slab/half slab installation on the precast beam, the stress that occurs in the precast beam when the half slab is placed is 1.774 MPa , where this stress value is still below the allowable compressive stress of the concrete, and this condition is still categorized as safe, the tone of the stress distribution that occurs is shown in Figure 5.



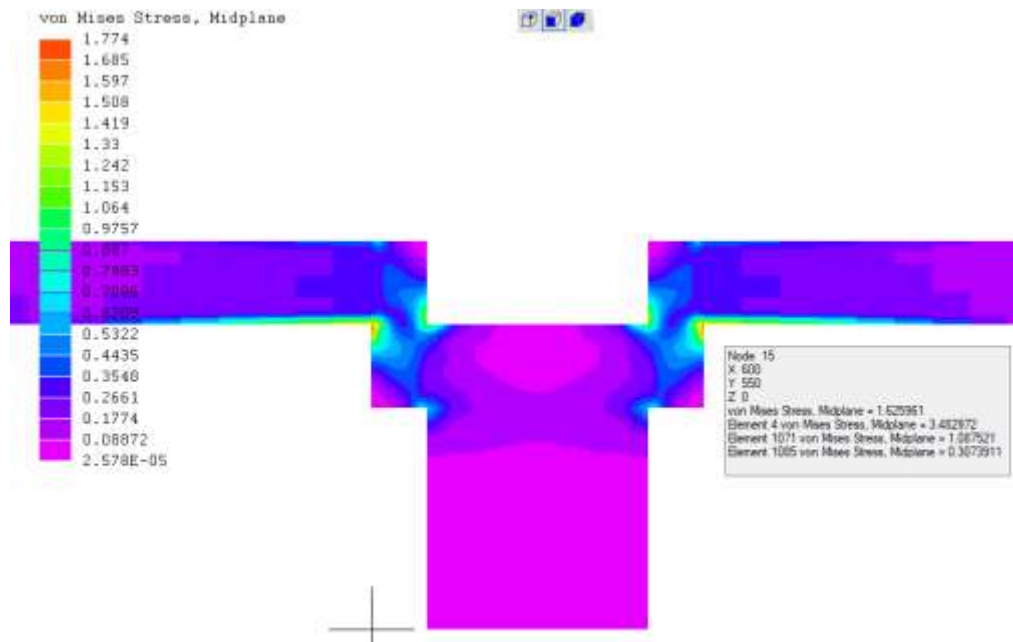


Figure 5. The stress distribution that occurs after receiving the element's self load.

Further modeling the condition of the floor slab and pier element beams according to the plan where the slab is 350 mm thick and the beam height is 900 mm where the beam and slab elements become one unit. In this condition, the load that occurs increases with the volume of wet concrete being cast and the weight of the workers who carry out the concrete casting work. The stress that occurs in the precast beam at the time of placing the concrete is 2.567 MPa < from $0.45f_c' = 0.45 \times 35 = 15.75$ MPa, where this stress value is still below the allowable compressive stress of the concrete, and this condition is still categorized as safe, the tone of the voltage distribution that occurs is shown in Figure 6.

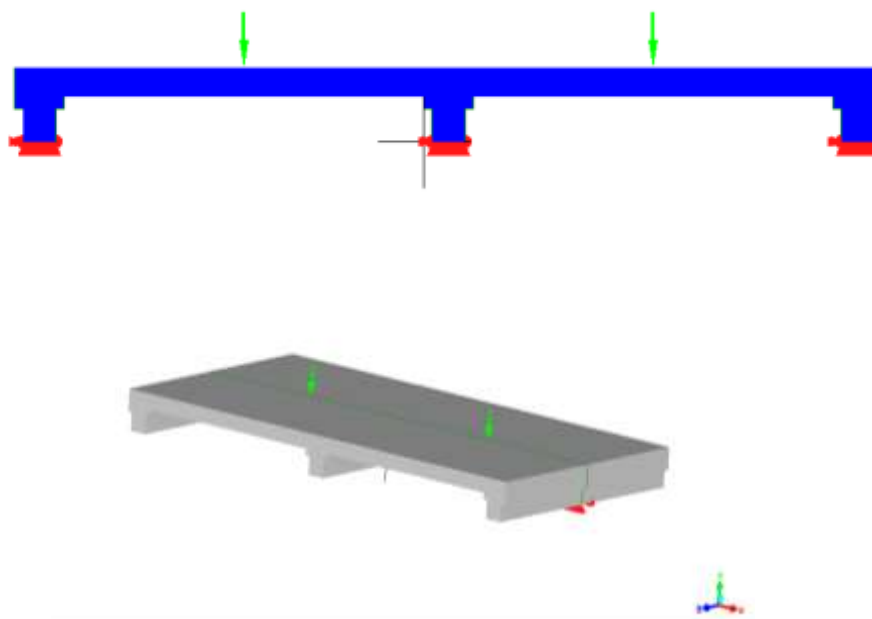


Figure 6. The stress distribution that occurs after receiving the element's with the volume of wet concrete being load.

In the next analysis, modeling is carried out by providing service conditions that have been calculated in the macro-analysis model on the pier structure in the beam and slab elements of the precast floor. The stress that occurs in the precast beam during the service conditions of the beam and column elements is $9.258 \text{ MPa} < \text{from } 0.45f_c' = 0.45 \cdot 35 = 15.75 \text{ MPa}$, where this stress value is still below the allowable compressive stress of the concrete, and this condition is still categorized as safe. , the tone of the voltage distribution that occurs is shown in Figure 7.

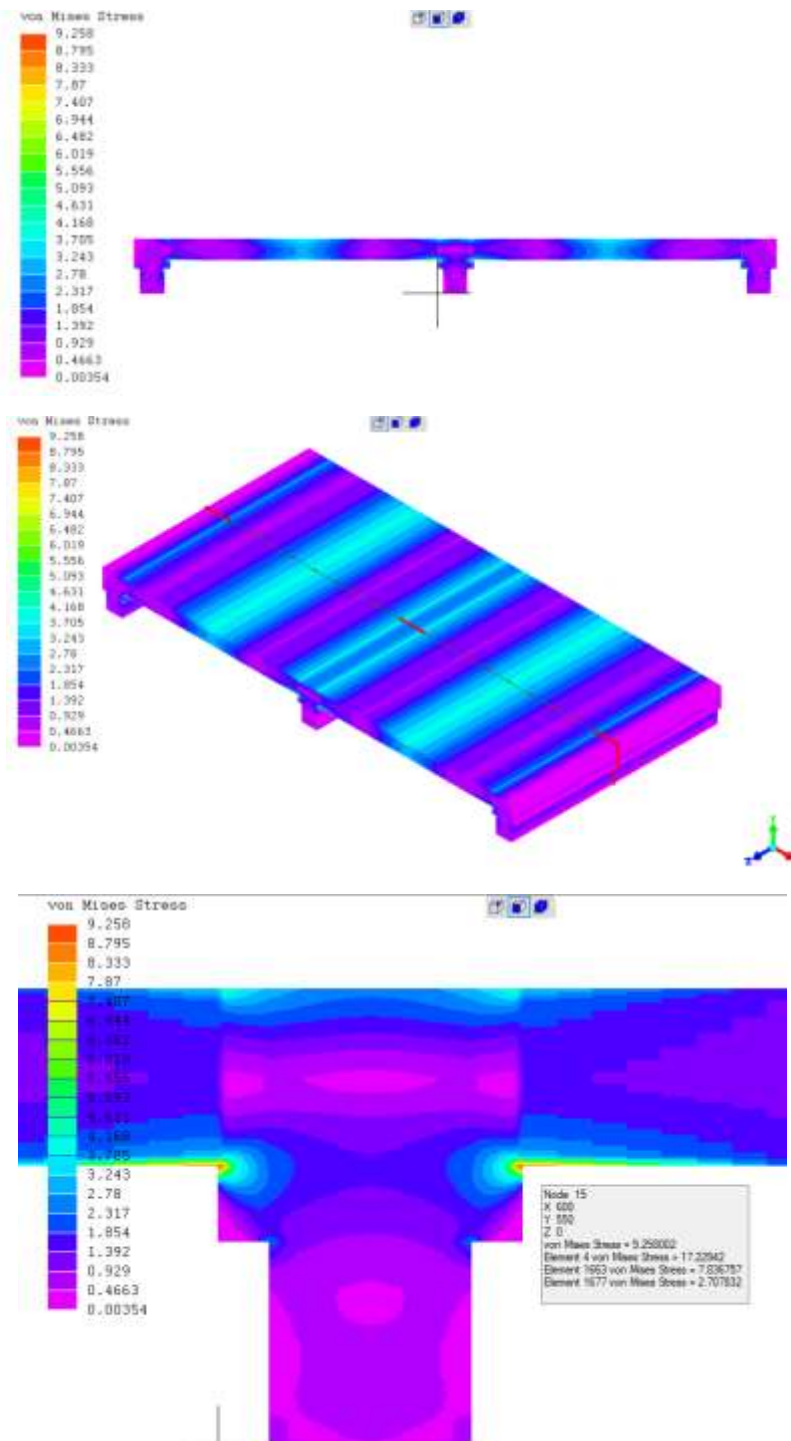


Figure 7. The stress distribution that occurs after receiving the element's with service load

4. CONCLUSION

From the results of the modeling simulation above, it can be seen that the largest dominant stress distribution occurs on the side of the beam end meeting with the deck slab/half slab, the stress occurs according to the working method step between 1.774 MPa in the condition of the slab being installed and increases when the implementation of wet concrete casting becomes 2.567 MPa and when the service condition, the stress again increases to 9,258 MPa, but this condition is still in a safe condition because it is still below the allowable compressive stress of the concrete, which is $0.45 f_c' = 15.75$ MPa. This modeling is only limited to using concrete material, not including the material and steel reinforcement modeling, it is known that this material must make a significant contribution to the tensile stress that occurs. It is hoped that future research will be able to provide modeling and analysis of the reinforcement in the beam and floor slab elements.

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