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Operational Load on Material Handling Process Stockyard Ship to Port Using Field Tests

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Abstract

Since all equipment needs to be handled correctly, the equipment handling procedure is crucial. in order to ensure the equipment's safe arrival at its destination and to preserve its quality and condition. The method used in this research to analyze the calculation using experiment set with sensor data and observation. Finding the optimal operational load process value during material loading and unloading at the Panjang Port is the aim of this study. From analyze results horizontal direction movement speed of 2 km/h has a pressure value of 37 kPa with a distance of 376 mm from the center end of the pipe being unloaded, across the stress value is at 167 kPa with a stretch distance of less than 300 mm, longitudinal direction of 45 kPa.

Keywords: *operational load; loading unloading; stockyard; ship*

1. Introduction

Industry in Indonesia today is experiencing a fairly rapid development. Basically, in an industry there is a production process that requires material handling as a means to support the production process. Ship as a means of transportation is one of the right ones to carry out the material handling process (Ding et al., 2021; Tao et al., 2022). A material that has been obtained from the manufacturer will be transferred from the storage area to the installation site during the production process (Zahraee et al., 2022). To ensure that the transportation process runs smoothly, both financially and in terms of fulfilling deadlines and schedules, as well as in terms of safety and quality, the moving equipment and goods must be handled correctly and efficiently (Nguyen et al., 2021; Nylen & Sheehan, 2021; S. Wang et al., 2022). The process of moving the material is generally referred to as the outline transport process because it uses sea to land or land to sea routes and equipment handling. Equipment Handling is a process that includes basic operations in the movement, protection, storage and control of Equipment and products throughout manufacturing, warehousing and distribution, see Figure 1.

Since all equipment needs to be handled correctly, the equipment handling procedure is crucial. in order for it to safely arrive at its destination and to preserve the state and caliber of the equipment being handled (Kim et al., 2017). As a process, Handling or Handling that combines various manual, semi-automatic or automatic equipment with systems that can support the transportation and installation process of equipment. One of the most populous ports is the Panjang Port of Bandar Lampung Indonesia, which is one of the ports as the main entry point for materials on the island of Sumatra. Therefore, investigation is required before material loading and unloading can be implemented at this port. Prior research on the weight of pipe material on storage racks revealed that the loads increased without making up for the steel frame's strengthening, causing deformation in multiple areas of the structural design (Nylen & Sheehan, 2021; Widiyanto et al., 2022). The location and state of the deviation should be taken into consideration during the material handling procedure (Liu et al., 2022; Nubli et al., 2022). The most stressed area of the construction structure is welded with steel profiles for reinforcement (Balaji Naik et al., 2022; Zhao et al., 2022). This is consistent with studies on loading pipelines and materials aboard ships, where cost-effective and ecologically responsible calculations must also be taken into account when loading and unloading (Robert et al., 2022).

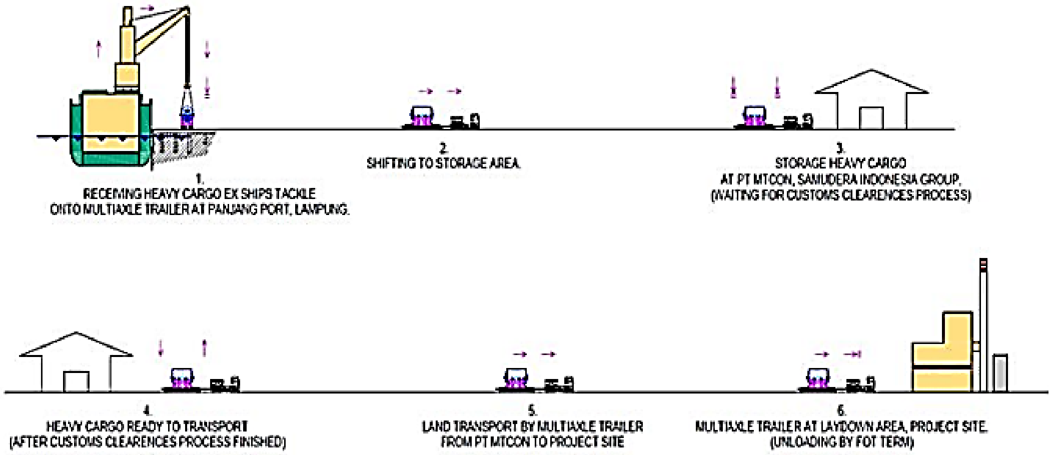

Figure 1. Transport Process

When the process becomes more concise, according to the results of the analysis, it can reduce wasted energy (Gao et al., 2022; Lutomirska & Lutomirski, 2022). However, According to a different study, the ideal circumstances were when the outside temperature did not rise over 40 degrees Celsius and the material handling operational parameters were 80 bars of pressure during the delivery procedure (Vishnuvardhan et al., 2021). Based on studies using simulator software, this can reduce loading and unloading expenses by $132 (d'Amore et al., 2021; He et al., 2022). The lack of specific guidelines for every loading and unloading port necessitates more research. Features that can be adjusted to the storage circumstances must be present in every loading and unloading port situation (N. Wang & Yuen, 2022; Yu et al., 2022).

Finding the optimal operational load process value during material loading and unloading was the aim of this investigation at the Panjang Port of Bandar Lampung Indonesia. The limitations of the problem in this study are the determination of the transportation distance is fixed, ignoring the tidal height of the sea water in the port area at that time, fixed material loads, variations in the speed of transportation equipment and the transportation process from the ship to the truck and vice versa, the pressure sensor is positioned on the loading pad truck, the position of the ship docked at the port site.

2. Materials and Methods

This study's flow can be divided into two primary sections: the process stage and the research findings. Installing the sensor to read the load data in accordance with the requirements of the intended output comes after the experimental setup. In general, a sensor that can withstand the stress load supplied by the contact meeting between the pipe and the truck body's bed is mounted on the body of the vehicle. So that from each data obtained, mathematical simulations can be carried out to obtain ideal analysis results for the loading and unloading process of the shipyard stock material. In general, the flow of the methodology is the experimental set up stage then data collection. The information in question is the load that the pipe receives at a specific transfer time and voltage. Equations 1 and 2 are utilized in the mathematical simulation to determine the maximum force value in each material moving operation. The methodology flow of the research can be seen from Figure 2.

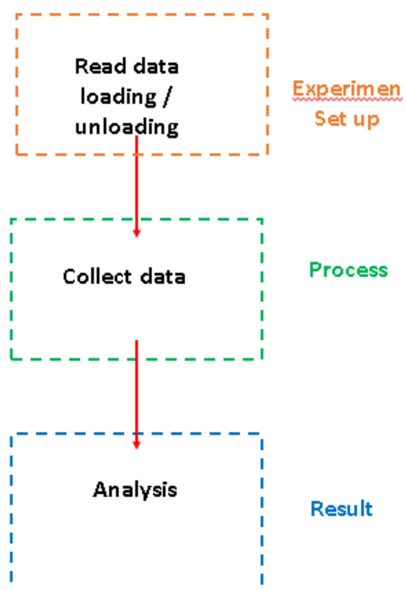

Figure 2. Methodology Flow

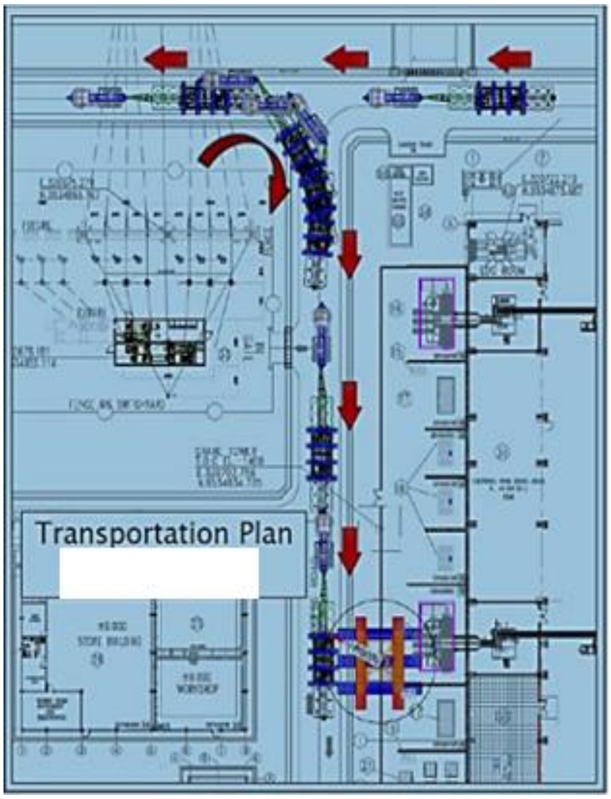

Figure 3. Route of movement of trucks loaded for experiment set up.

The schematic model of the loading unloading process can be seen in Figure 3. From the process of transporting goods from the ship to the truck trailer, a flow scheme is used according to the plan depicted in Figure 3. The description of the data obtained is based on sensor readings on the truck bed module. Each data received shows the stress figures from the process of moving or unloading cargo. Then from this data it can be calculated so that it can be analyzed what the trend is in the shape of the movement of the loading and unloading process carried out for this section.

Figure 4. Shows the position of the grip sensor

It can be seen that the path to be traversed by the truck is forward and then backward to facilitate the maneuvering process (Figure 4). As well as the transportation process above the bed truck (Figure 5), it can be seen that the sensor is installed on the bed truck section, the security position with the rope is also positioned so that the goods actually sit and the load is evenly distributed on each bed truck distribution area.

Figure 5. The sensor module is also placed on the bed of the container

Mathematically in getting the stress that occurs during the loading and unloading process of material, there are several mathematical approaches that combine the level of capacity utilization with the contact process that occurs, as in Equation (1).

$$U_{PN} = \frac{N_{1,2,..max}}{\beta . A . k_1} \tag{1}$$

where $N_{1,2,..max}$ is the highest axial force in the compression member, β is the buckling coefficient for the steel, A is the cross-sectional area, k_1 is the allowable compressive stress in the steel. On the other hand, to get the stress value for the axial force Equation (2) is used:

$$M_{ED} = \frac{N_{ED} . e_0}{1 - \frac{N_{ED}}{N_{CR}} - \frac{N_{ED}}{S_v}} \tag{2}$$

where N_{ED} is the design value of the axial force, e_0 is the value if the initial imperfection, M_{ED} is the design value of the bending moment, h0 is the distance between the center of gravity of the bow string, S_v is the cross-sectional area of the bar, N_{ED} is the second moment of the profile compound area. After the calculation values are obtained, they are grouped to be analyzed and compared.

3. Results and Discussion

Based on the results of the calculation analysis, it is found that the stress value that occurs when the loading and unloading process from the truck leads to the deviation. With variations in speed in the loading and unloading process, it can be seen the load characteristics that occur in each process. Based on sensory comparison data on static materials, each type of pressure that occurs has a varying load.

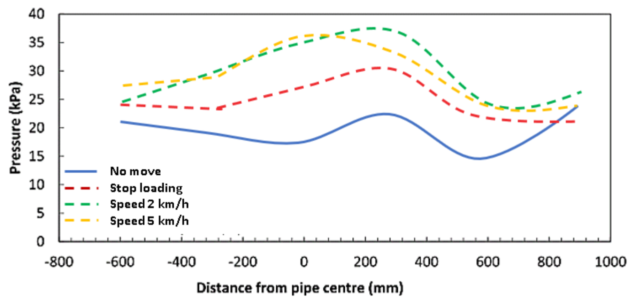

Figure 6. Stress variation across horizontal direction

Figure 6 shows the influence of the laying distance on the main axis of the pipe where the movement speed of 2 km/h has a pressure value of 37 kPa with a distance of 376 mm from the center end of the pipe being unloaded. This value has similarities with the others in the area of 0 to 270 mm. The middle position toward the back of the bed truck is a very dangerous position for absorbing the moment of movement of the pipe load deflection, which is why there is a trend of growing stress. The average increase when the load is not shifted is 56% of the initial value.

In terms of the depth of the stretch in sending the cargo, when viewed from the speed of movement, it is obtained at a medium speed or 2 km/h. The highest stress value is at 167 kPa with a stretch distance of less than 300 mm, while at loading without movement the maximum value is at 30 kPa, Figure 7. This makes a comparison of 5 times that of the no-moving condition.

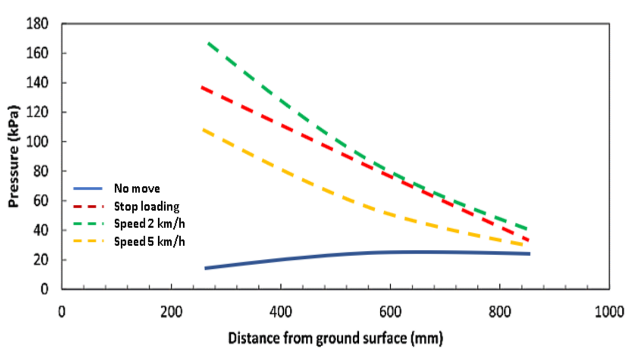

Figure 7. Stress variation across the depth

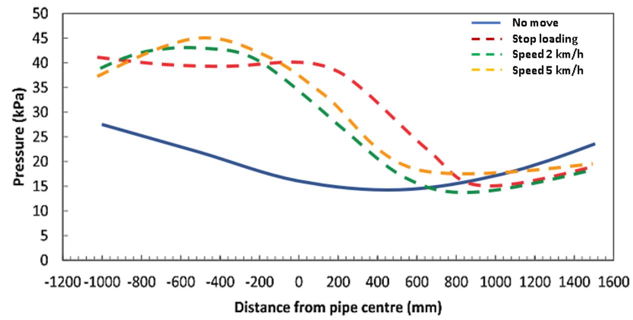

Figure 8. Stress variation in longitudinal direction

So, if we compare the stress longitudinally to the center of the load, the average pipe has a peak in the area close to the crane arm or 44.6 kPa, in Figure 8. For this reason, after experiencing the lifting movement by the crane and sitting in the trailer truck load area, the stress decreases along with the contact and is supported by the chassis part of the truck. Even when the condition stops, stress will occur because of the combination of the load on the material by the gravitational force that occurs. It can be illustrated that in the loading and unloading process, from the results of the analysis, the longer the process, the higher the stress that occurs along with changes in the characteristics of the way cargo is transported from the loading and unloading process. Meanwhile, this analysis process is a comparison with numerical methods obtained to obtain ideal conditions for the loading and unloading process.

4. Conclusion

Based on the results of observations and analysis, it can be concluded that the movement of the pipe loading and unloading process requires proper planning for a review of the location and coverage area of the fastener access. The material clamping means and the movement of the loading and unloading process show the stress characteristics that occur at the pedestal and with the contact between the pipe and the bed truck. The binding setting conditions also show an influence on the response ability of the material. The stronger the locking, the higher the stress that occurs so that it has a characteristic tensile distribution curve from which conclusions can be drawn. The greatest stress occurs in the horizontal direction of 37 kPa and in the pipe direction of 167 kPa and then the longitudinal direction of 45 kPa. This is still entering the safety factor level of the material, so it remains safe when loading and unloading is carried out.

5. Acknowledgement

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