Engineering and Technology Journal e-ISSN: 2456-3358
Volume 08 Issue 08 August -2023, Page No.- 2536-2539
DOI: 10.47191/etj/v8i8.07, I.F. – 7.136

Bouyancy Calculation on Barge Ship in Process Loading Unloading Material Stockyard Ship to Port

Sunarso Sugeng[1], Samuel Febriary Khristyson[2]
[1,2] Department of Industrial Technology, Vocational School, Diponegoro University,
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang, Indonesia 50275

ABSTRACT: Equipment Handling Process or Equipment handling is very important because all equipment must be handled properly. so that it can reach its destination safely and also to maintain the condition and quality of the equipment being handled. The method used in this research to analyze the calculation using load and unloading data. Purpose of this study was to determine the ideal value in the buoyancy after and before load process at the time of loading and unloading material at Port. The result analysis based on hydrostatic reviews and ship stability in terms of ship buoyancy capatibilty is stated to be suitable and stable according to IMO standards. Value of the ability of the barge to accept the load when the laden condition is fully loaded is +-6000 tons, thus to achieve a full load condition with a total load. 6000 tons) of 1.035 meters (still meets the minimum standard of 0.2 meters).

KEYWORDS: Equipment Handling Process, Bouyancy, Loading, Unloading, Barge.

1.0 INTRODUCTION

In the production process, a material received from the manufacture or manufacturer will be moved from the storage area to the Installation site (Zahraee et al. 2022). The moving equipment and materials must be handled properly and efficiently so that the transportation process can run well, both in terms of costs and costs, meeting the schedule or schedule targets as well as in terms of safety and quality aspects (Nguyen et al. 2021; Nylen and Sheehan 2021; S. Wang, Qi, and Laporte 2022). Equipment Handling Process or Equipment handling is very important because all equipment must be handled properly. so that it can reach its destination safely and also to maintain the condition and quality 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.So the need for research for the implementation of loading and unloading of materials at this port.

The purpose of this study was to determine the ideal value in the buoyancy after and before load process at the time of loading and unloading material at Port. 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, the position of the ship docked at the port site.

2.0 REVIEW OF PAST WORK.

Previous studies on the load of pipe material on storage racks showed an increase in loading without compensating for the reinforcement of the steel frame, it caused deformation in several places of the structural construction **(Nylen and Sheehan 2021; Widiyanto et al. 2022)**. This can save costs for the loading and unloading process by 132 dollars, based on research samples on simulators software **(d'Amore, Romano, and Bezzo 2021; He, Wan, and Meng 2022)**. The absence of detailed standards for each port of loading and unloading makes the need for a further study. Each loading and unloading port condition must have characteristics that can be adapted to the storage conditions**(N. Wang and Yuen 2022; Yu et al. 2022)**. However, another study said that if the best conditions were when the ambient temperature did not reach 40 o C, during the delivery process it received a pressure of 80 bar in its material handling operational conditions (**Vishnuvardhan et al. 2021)**. The material handling process should pay attention to the position and condition of the deviation**(Liu et al. 2022; Nubli, Sohn, and Prabowo 2022)**. Reinforcement in the form of steel profiles is carried out by welding to the most stressed part of the construction structure **(Balaji Naik, Prabhu, and Allen Jeffrey 2022; Zhao et al. 2022)**. This is in line with research on loading pipes and materials on ships where economical and environmentally friendly calculations also need to be considered during the loading and unloading process **(Robert et al. 2022)**.

3.0 MATERIALS AND METHODS

The flow of this research is classified into 2 main parts, namely at the stage of the process and the analysis of the research. Starting from the set up, then calculate the load and unload from the barge ship cargo. Data from the calculation collect into make some grapic. 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. The methodology flow of the research can be seen from Figure 2.

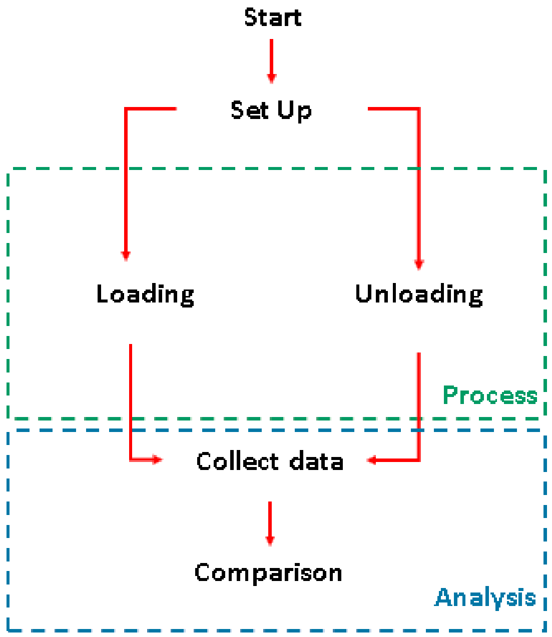

Figure 2. Methodology Flow

The schematic model of the calculation buoyancy for loading and unloading process can be seen in Figure 3. From the process of transporting goods from the ship to yard, a flow scheme is used according to the plan depicted in Figure 3. It can been seen the buoyancy draught can use to calculate ship stability, also the buoyancy point and gravitation longitudinal and transversal mode .

Figure 3. Proses loading unloading at ship

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.

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

Where $N_{1,2,..max}$ is the highest axial force in the compression member, β is the buckling coefficient for the steel as calculated , 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, the following equation is used:

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

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.

Based on the results of the calculation analysis, it is found that the stress value that occurs when the loading and unloading process. But before after calculate the cross curve of ship, that can know the maximum of righting arm moment of ship when the loading maximum. On the figure 4 , that show the maximum load of displacement of ship in the righting arm of many degree.

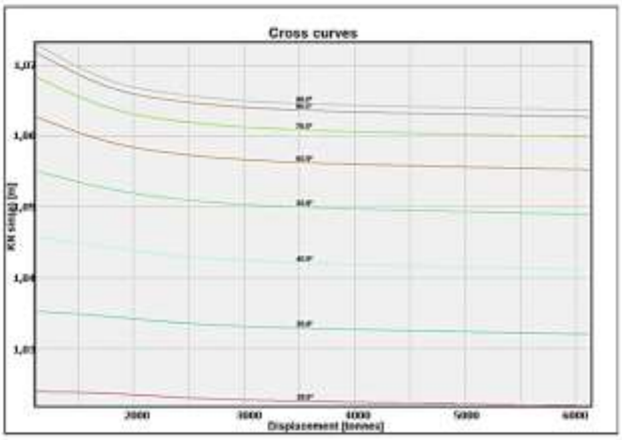

Figure 4. Cross Curve of ship

In Figure 4, shows the value of the ability of the barge to accept the load when the laden condition is fully loaded is +-6000 tons, thus to achieve a full load condition with a total load of TP being carried is +-4000 tons still fulfilling the ship's ability to carry cargo. Based on these conditions, in full load (up to full draft) the distance from the Bouyancy point (upward pressure) in the transverse position shows the figure of 1.7 meters.

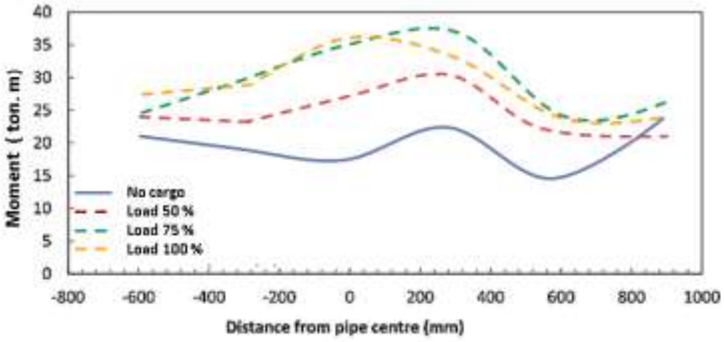

Figure 5. Moment of ship loading condition

There is a trend of increasing stress that occurs this is because the middle position towards the back of deck is a position that is quite risky in accepting the moment of movement of the pipe load deflection, figure 5 . The average increase when the load is not shifted is 56% of the initial value.

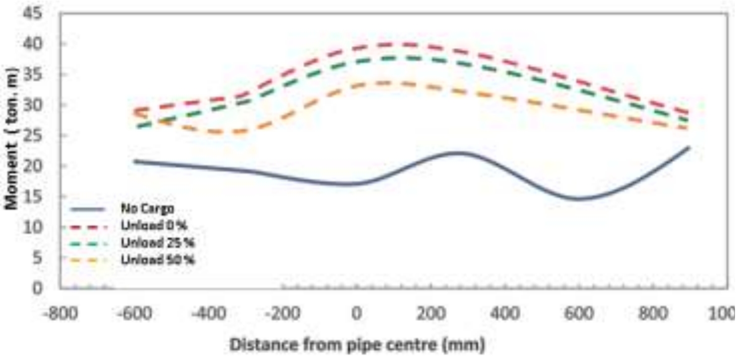

Figure 6. Moment of ship unloading condition

Figure 6, show the initial condition of unloading the ship , that show the compatibility of ship buoyancy is same like load condition.

CONCLUSIONS

If look at the stability criteria according to IMO (International Maritime Organization) standards, they are: **GZ value (KN sin Ø) at 30 deg.** Shows the value of the displacement condition of the ship's draft full load (6000 tons) of 1.035 meters (still meets the minimum standard of 0.2 meters). **Likewise for all GZ values (KN sin Ø)** at each rollout angle, this shows a value that is > 0.2 meters. Analysis based on hydrostatic reviews and ship stability in terms of ship buoyancy capatibilty is stated to be suitable and stable according to IMO standards, in calm and full ship conditions can carry + - 5000 tons of displacement for its cargo, so that if you look at the cargo carried it is sufficient to maintain the stability of the ship.

REFERENCES

1. Balaji Naik, K, M Prabhu, and J Allen Jeffrey. 2022. "A Review on Vibration Analysis of Glass/Carbon/Basalt Composite Pipe Material for Petroleum Industry." Materials Today: Proceedings 51: 1042–45. https://www.sciencedirect.com/science/article/pii/S2214785321049385.
2. d'Amore, Federico, Matteo Carmelo Romano, and Fabrizio Bezzo. 2021. "Optimal Design of European Supply Chains for Carbon Capture and Storage from Industrial Emission Sources Including Pipe and Ship Transport." International Journal of Greenhouse Gas Control 109: 103372. https://www.sciencedirect.com/science/article/pii/S1750583621001249.
3. Ding, Long, Faisal Khan, Xiaoxue Guo, and Jie Ji. 2021. "A Novel Approach to Reduce Fire-Induced Domino Effect Risk by Leveraging Loading/Unloading Demands in Chemical Industrial Parks." Process Safety and Environmental Protection 146: 610–619. https://www.sciencedirect.com/science/article/pii/S0957582020319169.
4. Gao, Xudong et al. 2022. "Experimental and Numerical Investigation on Transverse Impact Resistance Behaviour of Pipe-in-Pipe Submarine Pipelines after Service Time." Ocean Engineering 248: 110868. https://www.sciencedirect.com/science/article/pii/S0029801822003080.
5. He, Weilin, Min Wan, and Bao Meng. 2022. "Size Effect on Nonlinear Unloading Behavior and Bauschinger Effect of Ni-Based Superalloy Ultrathin Sheet." International Journal of Mechanical Sciences 231: 107563. https://www.sciencedirect.com/science/article/pii/S0020740322004568.
6. Kim, Juneyoung et al. 2017. "New MEG Injection System with a Seabed Storage Tank Assisted by Ship Transportation." Ocean Engineering 140: 50–56. https://www.sciencedirect.com/science/article/pii/S0029801817302640.
7. Liu, Jun et al. 2022. "Multi-Field Coupling Nonlinear Vibration Characteristics of Hydraulic Lifting Pipe in Deep-Ocean Mining." Applied Ocean Research 120: 103074. https://www.sciencedirect.com/science/article/pii/S0141118722000281.
8. Lutomirska, Marta, and Tomasz Lutomirski. 2022. "A Practical Case Study on Assessment and Rehabilitation of a Pipe Rack." Engineering Failure Analysis 141: 106654. https://www.sciencedirect.com/science/article/pii/S1350630722006264.
9. Nguyen, Dinh Duc, F A Atiku, Vahid Pirouzfar, and Chia-Hung Su. 2021. "Technical, Economic and Thermodynamic Analysis for Loading, Storing,

Unloading and Transporting of Ethane Fluid." Journal of the Taiwan Institute of Chemical Engineers 120: 218–28. https://www.sciencedirect.com/science/article/pii/S1876107021001401.

10. Nubli, Haris, Jung Min Sohn, and Aditya Rio Prabowo. 2022. "Layout Optimization for Safety Evaluation on LNG-Fueled Ship under an Accidental Fuel Release Using Mixed-Integer Nonlinear Programming." International Journal of Naval Architecture and Ocean Engineering 14: 100443. https://www.sciencedirect.com/science/article/pii/S2092678222000097.
11. Nylen, Julian, and Madoc Sheehan. 2021. "The Impact of Moisture on Lead Concentrate Powder Dust Emissions in Ship-Loading Operations." Powder Technology 394: 353–62. https://www.sciencedirect.com/science/article/pii/S0032591021007567.
12. Robert, D J, D Chan, P Rajeev, and J Kodikara. 2022. "Effects of Operational Loads on Buried Water Pipes Using Field Tests." Tunnelling and Underground Space Technology 124: 104463. https://www.sciencedirect.com/science/article/pii/S0886779822001031.
13. Tao, Longlong et al. 2022. "An Integrated Probabilistic Risk Assessment Methodology for Maritime Transportation of Spent Nuclear Fuel Based on Event Tree and Hydrodynamic Model." Reliability Engineering & System Safety: 108726. https://www.sciencedirect.com/science/article/pii/S0951832022003507.
14. Vishnuvardhan, S et al. 2021. "Fracture Studies on Bi-Metallic Pipe Weld Joints under Monotonic and Cyclic Loading." International Journal of Pressure Vessels and Piping 192: 104351. https://www.sciencedirect.com/science/article/pii/S0308016121000508.
15. Wang, Nanxi, and Kum Fai Yuen. 2022. "Resilience Assessment of Waterway Transportation Systems: Combining System Performance and Recovery Cost." Reliability Engineering & System Safety 226: 108673. https://www.sciencedirect.com/science/article/pii/S0951832022003076.
16. Wang, Shuaian, Jingwen Qi, and Gilbert Laporte. 2022. "Governmental Subsidy Plan Modeling and Optimization for Liquefied Natural Gas as Fuel for Maritime Transportation." Transportation Research Part B: Methodological 155: 304–21. https://www.sciencedirect.com/science/article/pii/S019126152100206X.
17. Widiyanto, Ilham et al. 2022. "Numerical Analysis of Stiffened Offshore Pipe Subjected to Environmental Loading: A Study Case Using External Pressure." Procedia Structural Integrity 41: 274–81. https://www.sciencedirect.com/science/article/pii/S2452321622004905.
18. Yu, Zhiming et al. 2022. "The Failure Patterns and Analysis Process of Drill Pipes in Oil and Gas Well: A Case Study of Fracture S135 Drill Pipe." Engineering Failure Analysis 138: 106171. https://www.sciencedirect.com/science/article/pii/S1350630722001455.
19. Zahraee, Seyed Mojib, Saeed Rahimpour Golroudbary, Nirajan Shiwakoti, and Peter Stasinopoulos. 2022. "Palm Oil Biomass Global Supply Chain: Environmental Emissions vs. Technology Development of Maritime Transportation." Procedia CIRP 105: 817–22. https://www.sciencedirect.com/science/article/pii/S2212827122001366.
20. Zhao, Ruijie, You Zhou, Desheng Zhang, and Xiongfa Gao. 2022. "Numerical Investigation of the Hydraulic Transport of Coarse Particles in a Vertical Pipe Based on a Fully-Coupled Numerical Model." International Journal of Multiphase Flow 155: 104094. https://www.sciencedirect.com/science/article/pii/S0301932222000970.

.