Indonesian Naval Technology College
Postgraduate International Conference, Vol. 8, No. 1, pp. 155-166
June, 27th 2024

LOADING AND UNLOADING ON THE RORO FERRY DURING EXTREME WEATHER AT MERAK-BAKAUHENI PORT

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ABSTRACT

Indonesia, an archipelagic country with 31 million km² of water and an exclusive economic zone of 27 million km², plays an essential role in the global economy. Public transportation, including land, air, and sea, dramatically affects the region's economic performance. With their roll-on-roll-off design, Roro Ferry's passenger ships are becoming an efficient and effective mode of transportation. However, they still face shortcomings in terms of safety and convenience. The research used is qualitative with a descriptive approach. The study's location is the Merak-Bakauheni Ferry Terminal, the main link between Java and Sumatra. Data was collected through interviews, observations, and case studies and analyzed using Miles and Huberman's interactive data analysis techniques. The study results show that implementing appropriate safety procedures can minimize the risk of accidents and cargo damage. Using ramp doors makes the loading and unloading easier but requires special adjustments during extreme weather. In addition, strict checks on mooring ropes, ramp doors, ventilation, and the cleanliness of the loading room, as well as the readiness of the crew, are crucial. In adverse weather conditions, additional procedures are required to handle heavy loads, such as fuso and Ironton trucks. This study provides recommendations for infrastructure improvement, revision of standard operating procedures (SOP), safety training, and collaboration with BMKG to improve safety and operational efficiency.

KEYWORDS: Sea Transportation, Roro Ferry Ship, Loading and Unloading Safety, Merak-Bakauheni Terminal

1. INTRODUCTION.

As an archipelagic country in accordance with the 1982 United Nations Convention on the Law of the Sea, Indonesia has a vast maritime territory with waters covering an area of 3.1 million km2 and an Exclusive Economic Zone of 2.7 million km2. This study aims to identify and analyze issues in the loading and unloading process on the Roro Ferry during extreme weather at the Merak-Bakauheni port. The research focuses on finding practical solutions to improve the efficiency and safety of the loading and unloading process, especially in adverse weather conditions.

The background of this research is based on the frequent occurrence of cargo damage and accidents on ships caused by extreme weather and suboptimal handling of loading and unloading on the car deck. Some key issues identified include the suboptimal installation of lashing fixtures, a limited number of crew members, lack of cleanliness on the car deck, and lack of time available for loading and unloading. Maintenance of lashing equipment is rarely performed, which can be fatal due to the lack of quick handling of problems if they occur in the short term.

However, ferry operations face obstacles, especially those caused by extreme weather. Extreme weather conditions, such as those recorded at level 6 on the Beaufort Scale, can pose a risk of serious accidents, with strong winds of up to 27 knots and waves as high as 4 meters. In one instance, bad weather reportedly caused two trucks to overturn while loading at Motor Vessel Nusa Darma due to negligence in implementing cargo safety procedures.

The main goal of this study is to achieve maximum efficiency in transporting vehicles from the delivery site to the receiving location safely in any situation. Therefore, optimizing loading and unloading handling is very important, especially during dangerous weather conditions for crew and passengers.

This research seeks to provide practical guidance for better handling of loading and unloading on Roro ferries, reducing the risk of accidents and cargo damage. The approach includes direct observation, interviews with crew members, and data analysis collected during sea practice on the Motor Vessel Jagantara.As an archipelagic country in accordance with the 1982 United Nations Convention on the Law of the Sea, Indonesia has a vast maritime territory with waters covering an area of 3.1 million km2 and an Exclusive Economic Zone of 2.7 million km2. This study aims to identify and analyze issues in the loading and unloading process on the Roro Ferry during extreme weather at the Merak-Bakauheni port. The research focuses on finding practical solutions to improve the efficiency and safety of the loading and unloading process, especially in adverse weather conditions.

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2. MATERIALS AND METHODS

2.1. Procedure

by (Moekijat, 2001), a procedure is "a set of interconnected tasks that represent a specific sequence of time and steps to perform the work that needs to be completed." Procedures are an essential part of any company". Procedures are well-defined actions that must be performed in the same manner or technique as specified in a written procedure to achieve the same outcome. A procedure can also consist of a series of activities or steps that must be taken to produce something desired (Fani and Wibowo, 2021).

2.2. Understanding Loading and Unloading

Based on the book (Indonesian Central Bureau of Statistics, 1996), unloading is the unloading of goods from ships, both goods departing from the port of origin in Indonesia and from abroad. Loading is the act of loading, which means moving goods from the dock/warehouse to the cargo deck for safe transportation to the intended destination.

According to Chapter 1 Act 14 of Government Regulation No. 20 of 2010, loading and unloading activities are service activities that carry out loading and unloading activities inside and outside the ship, including loading and unloading activities and receiving or shipping.

In loading and unloading, RORO ships use methods that are different from those of other commercial ships, such as PT. Jemla Ferry Indonesia has standard operating procedures that must be complied with in the Safety Management Work Instruction Manual book. According to the description, the explanation of handling vehicle cargo is as follows::

a. After the ship is appropriately berthed, the engineer on duty turns off the engines when they are no longer used, such as:
   1) Main Engine
   2) Bow Thruster
   3) Steering Engine
   4) Compressor, etc.

   The engineer on duty rechecked the hydraulic system support engine:
   1) Bow Visor
   2) Ramp door
   3) Lower Cover

   The engineer on duty re-checked the cargo room ventilation system. The deck crew on watch duty opens and serves the bow visor, ramp door, and lower cover, which the Officer supervises on duty or the Officer in charge.
b. Before loading begins, the Officer on duty is responsible for checking whether all the means related to loading are ready. The officer on duty coordinates readiness with the Engineer on Watch. Things that an Officer must consider on duty are:
   1) The mooring ropes must be fast as well.
   2) Ramp door, stand on Moveable Bridge.
   3) The wire rope on the ramp door is loose.
   4) The Moveable Bridge position forms the smallest possible angle with the ramp door.

5) Ventilation should be in good working order.
6) The loading room must be clean and free of obstacles.
7) The deck and engine crew are ready in their respective places.
8) The Means of Communication worked as well.

c. Ensuring the ship is ready to receive the ship's cargo by the requirements.
d. If not, complete the things that have not been achieved.
e. When the ship is ready, report to the ground officer, communicate, and confirm the vehicle number, type, and tonnage to be loaded to facilitate planning.
f. After confirmation between the ship and the ground officer, officers from the land immediately send the vehicle cargo according to an officer on duty request. It will be subsequently received and arranged according to its size and type. Things that must be considered in the preparation of vehicles include:
   1) The side distance between vehicles is approximately 60 cm, and the front and rear distance is approximately 30 cm.
   2) Place heavier vehicles in the stern.
   3) Place the animal close to the ventilation.
   4) Place hazardous loads in a separate place that is easily accessible and supervised.
   5) small vehicles should not be placed separately and in the middle of a truck or similar vehicle for the safety of small vehicles.
   6) Avoid ample "broken stowage."
   7) Warn vehicle owners about the dangers of crime on board.
   8) Warn vehicle owners to use the handbrake, not start the engine, and not smoke during the voyage.
   9) Installing wheel shanks and vehicle lashing standards properly, according to the "Cargo Securing Manual."
g. After completing the loading, the ramp door and bow visor are closed by the crew on the deck, then prepare for sailing by the "Operation Preparation Procedure."
h. On the voyage, carry out the "Watchkeeping Procedure on the bridge."
i. Before arriving at the port, prepare such as the "Berthing Preparation Procedure."
j. After the ship is well berthing, the bow visor and ramp door are reopened, and preparations for loading and unloading are carried out as the first step. Whether the vehicle shank or lashing has been opened and secured must be considered.
k. After the ship is ready for loading and unloading, report to the ground officer and confirm the type and number of vehicles so that the ground officer can prepare all facilities according to the "Procedure for receiving and unloading vehicles."
l. After the ship and ground have been confirmed, the vehicle can be dismantled.

2.3. Extreme Weather

According to (Hamid and Dayana, 2022) in a book entitled Meteorology, extreme weather refers to weather conditions that are different from normal. Extreme weather events only occur in seconds, hours, or days. Extreme weather can also last up to 3 days.

Extreme weather greatly affects the sea transportation sector, especially inter-island ships, which are an important sector in transportation in Indonesia. The Beaufort Scale, invented by Francis Beaufort in 1805, was used to measure wind speed and its impact on ships and ocean waves.

According to the UK Meteorological Office, the Beaufort scale is an empirical measure to describe wind intensity based on observed sea conditions. The Beaufort scale starts from 0 for the calmest gusts of wind to 12 for gusts of wind that can cause destruction. The following Beaufort scale can be described in Table 1 below:

Table 1. Beaufort Wind Scale

Beaufort Number	MPH		Terminology	Description
	Range	Average		
0	0	0	Calm	Calm. Smoke rises vertically.
1	1-3	2	Light air	Wind motion visible in smoke.
2	4-7	6	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	11	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	15	Moderatebreeze	Dust and loose paper is raised. Small branchesbegin to move.
5	19-24	22	Fresh breeze	Smaller trees sway.
6	25-31	27	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	35	Near gale	Whole trees in motion. Some difficulty whenwalking into the wind.
8	39-46	42	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	50	**Severegale**	**Light structure damage.**
10	55-63	60	**Storm**	**Trees uprooted. Considerable structuraldamage.**
11	64-73	70	**Violentstorm**	**Widespread structural damage.**
12	74-95	90	**Hurricane**	**Considerable and widespread damage tostructures.**

2.4. Security Implementation

According to (Murdjito, 2022), ship safety can be defined as the state of the ship that meets the requirements of material, construction, building, machinery and electricity, stability, layout and equipment, auxiliary equipment and radio, ship electronics, as evidenced by a certificate after inspection and testing.

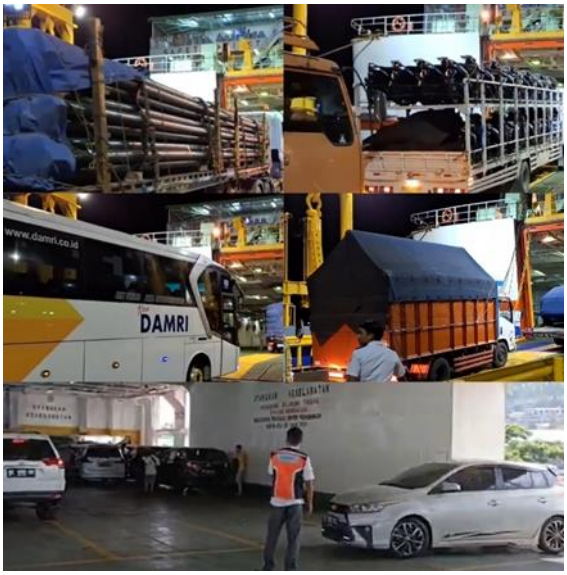
Safety on board is, therefore, a set of measures and procedures implemented to ensure the safety and well-being of everyone on board. It encompasses many aspects, including ship construction, safety equipment, crew training, and compliance with maritime safety regulations.

According to (Iwan Weda, 2022), ship security is defined as a state of fulfilment of safety and security requirements concerning water transportation and protection against all identified risks. The application of ship security has a broad and complex meaning. Ship security focuses not only on protecting the ship itself but also on protecting passengers, cargo, and associated port facilities. Ship security includes various aspects, such as surveillance, security, and escort, as well as various strategies to anticipate and deal with various threats that can occur at sea, such as crime, sabotage, and other disturbances.

2.5. Roro Ferry

According to (Rubiyanto and Wahyuni, 2022), ships are all types of conveyances on the water with all types of propulsion and function as a means of transportation in water. In the Big Indonesian Dictionary (KBBI), a ferry is a ship that functions as a means of crossing between islands permanently, commonly called a ferry. Meanwhile, RORO ships in the Big Indonesian Dictionary are ferries designed to carry vehicles (cars, buses, trucks, trailers, etc).

Figure 1. Example of Roro Ship's Cargo



From some of the above definitions, it can be concluded that the RORO ferry is a ship that can carry vehicles into the ship with its propulsion engine and exit the ship itself, so it is called a roll on - roll off ship, abbreviated as roro. Therefore, this ship has a ramp door connected to a moveable bridger (MB) or a floating dock connecting to a concrete pier.

2.6. Research Methods

This research uses a qualitative approach. Qualitative research is one of the systematic activities to explore theory, not to test theories or hypotheses. According to David Williams (1995) in Ratnaningtyas et al. (2022), qualitative research is a researcher's attempt to collect data based on natural circumstances. Of course, since it is done naturally, the results of this research are also scientific and can be researched and accounted for. Here are the detailed methodologies used:

a. Data Collection Techniques

1) Interview Method

Interviews were conducted to gather direct information from sources. This verbal process involves a series of questions and answers between the interviewer and interviewee, who interact face-to-face to exchange information. In this study, interviews were held with the third officer or Mualim III, who is responsible for safety equipment, to explain how to support cargo's smooth handling and unloading using safety equipment on the KMP. Jagantara ferry.

2) Observation Method

According to (Ridwan, 2003), observation involves direct monitoring of the research subject to gain insights into their activities. This method was used to gather data on the windlass operations, ramp door, and moveable bridges during the sea practice. The researcher participated directly in these operations to ensure that incidents were accurately recorded.

3) Documentation Technique

Documentation involves collecting data through written records such as documents, archives, and books. This method supplements written research by examining all documents related to the research problem, including cargo records and ship data.

b. Data Analysis Techniques

Data analysis involves systematically searching and organizing data from interviews, field notes, and documents. According to (Sugiyono, 2019), this process consists of categorizing, breaking down into units, synthesizing, organizing data into patterns, selecting what is important, and drawing conclusions that are understandable to oneself and others. According to (Miles & Huberman, 1992), data analysis involves three concurrent activities:

1) Data Reduction: This process includes selecting, simplifying, abstracting, and transforming raw data from field notes. Data reduction is continuous and can involve summarizing, coding, and grouping data into broader patterns.
2) Data Display: This involves organizing and compressing information into diagrams, charts, or matrices to facilitate understanding and drawing conclusions.
3) Conclusion Drawing and Verification: This involves interpreting the data and verifying the conclusions drawn to ensure they are valid

3. RESULT AND DISCUSSION.

The following is data analysis according to the Miles and Huberman model which includes data reduction, data display, and conclusions/verification.

a. Data ReductionThe loading and unloading process of roro ferries during extreme weather

1) Obstacles faced:

a) High waves that interfere with the stability of the ship when docked.

b) Strong winds that can cause shifts in the position of the ship.

c) Rainfall that reduces visibility for the driver and crew.

2) Procedures performed:

a) Use of loading and unloading aids to ensure the cargo position remains stable.

b) Improved coordination between the ship's crew, port authority and captain.

c) Use of radar and GPS systems to assist navigation in low visibility conditions.

3) Impact of extreme weather:

a) Longer loading and unloading times.

b) Increased risk of damage to cargo and equipment.

c) Decrease in port operational efficiency.

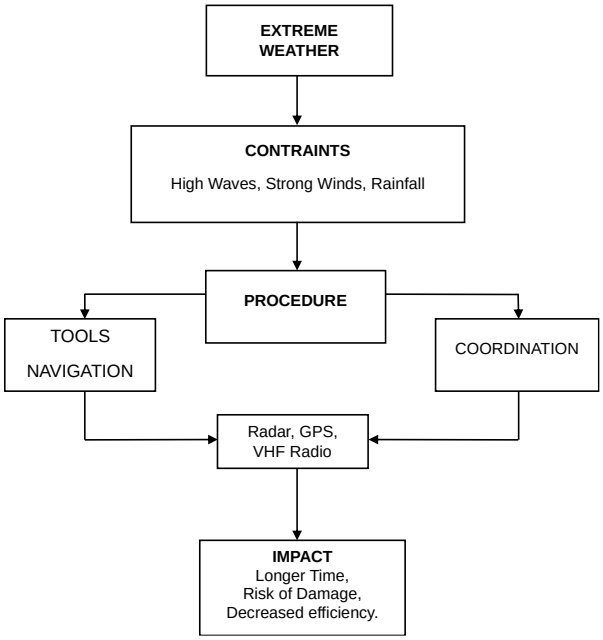
b. Data Presentation

Constraints and solutions matrix along with the loading and unloading process diagram of the data that has been reduced by the researcher.

Table. 2 Matrix of constraints and solutions

Constraints	Solution	Impact
High waves	Use of navigation aids	Longer loading and unloading time
Strong winds	Improved coordination between ship crew, authorities and captain	Risk of shifting ship position, unstable ship when loading and unloading.
Rainfall	Use of radar and GPS	Low visibility, rampdoor becomes slippery.

Fig. 2 Diagram of Unloading Process



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The loading and unloading of roro (Roll-On/Roll-Off) vessels at this port plays a vital role in mobilising goods and passengers. However, this process often faces major challenges, especially during extreme weather. Severe weather can cause high waves, strong winds and heavy rainfall, disrupting the smooth and safe loading and unloading process.

a. Problem Identification.

Some of the main problems faced in loading and unloading roro ships during extreme weather at Merak-Bakauheni Port include:

1) Cargo and Vehicle Safety:
   Extreme weather conditions increase the risk of cargo and vehicle damage during the loading and unloading process. Vehicles such as large trucks and buses are prone to shifting or falling if improperly handled. Existing tie-downs and securing systems often need to be improved to deal with the dynamic forces caused by high waves and strong winds.
2) Worker Safety and Health:
   Workers involved in the loading and unloading process face a higher risk of occupational accidents during inclement weather. Wet and slippery conditions can lead to slips and falls, and exposure to strong winds can compromise stability while working on the docks and vessels.
3) Operational Efficiency:
   Extreme weather often causes delays in loading and unloading schedules, leading to delays in vessel departures. This impacts operational efficiency and customer satisfaction. Longer and more careful adjustments to loading and unloading procedures are required, which can reduce productivity and increase operating costs.

b. Problem Cause Analysis.

1) Lack of Infrastructure and Adequate Equipment:
   The roro ferries need adequate equipment to deal with extreme weather, such as stronger vehicle tie-down systems.
2) Suboptimal Procedures and SOP:
   Existing Standard Operating Procedures (SOP) may need to be more detailed or well-implemented to deal with extreme weather situations. This includes worker training and safety equipment readiness.
3) Lack of Safety Training and Awareness:
   Port workers and crew members may need more specialized training to handle loading and unloading in adverse weather conditions. Awareness of the importance of safety and emergency procedures may also be suboptimal.

The data collected during the study covered various aspects such as vessel condition, weather, and cargo type. Data analysis was conducted using the Miles and Huberman interactive data analysis model, which involved data reduction, data presentation, and conclusion drawing or verification. The analysis results show that properly implementing safety and security procedures can minimize the risk of accidents and cargo damage during extreme weather. The following table summarizes the research data:

Table 3. Summary of Research Result Data

No	Aspects Studied	Key findings
1	Loading and Unloading Procedure	The use of Ramp Door facilitates the process of entering and exiting vehicles, requiring adjustments during extreme weather.
2	Safety and Security Implementation	Strict inspection of mooring ropes, ramp doors, wire ropes, ventilation, cleanliness of the loading room, and crew readiness.
3	Weather Conditions	Extreme weather affects the stability of the ship and cargo, requiring additional procedures for safety.
4	Load Type	Special handling is required for heavy loads such as fuso trucks, trontons, and other heavy vehicles.

4. CONCLUSION.

Based on the results of the research that has been conducted, some of the main conclusions that can be drawn are as follows:

a. Loading and Unloading Procedures:
   Rowing ramp doors on Roro vessels facilitate entering and exiting vehicles, but special adjustments are required during extreme weather to ensure safety and operational efficiency.
b. Safety and Security Implementation:
   Strict implementation of safety procedures, including inspection of mooring ropes, ramp doors, wire ropes, ventilation, loading bay cleanliness, and crew readiness, is essential to minimize the risk of accidents during extreme weather.
c. Weather Conditions:
   Extreme weather significantly affects the stability of the vessel and cargo. Therefore, additional procedures are required to ensure the safety of cargo and passengers during adverse weather conditions.
d. Type of Cargo:
   Special handling is required for heavy cargo such as fuso trucks, tronton and other heavy vehicles. Proper procedures must be implemented to prevent damage and accidents during the loading and unloading.

This research shows that implementing proper safety and security procedures can reduce the risk of accidents and cargo damage during extreme weather at Merak-Bakauheni port.

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