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12 Meter Pilot Boat Restoration

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Abstract

Pilot boat (guide ship) is a ship used to deliver or pick up boat guides, in the Lumpur area, Kab. Gresik has a 12 meter long pilot boat which has sunk and is about to be restarted. This study aims to determine the process and time of restoration of a 12 meter pilot boat where this ship has not been functioning for approximately 6 years, which coincides with the Mud Jetty of Kab. Gresik. The method used in this research is to use quantitative methods.
The results of this pilot boat restoration research are that the ship does not become waste and can be re-functioned as it should be. So the total estimated time needed to restore the 12 meter pilot boat is 427 hours 54 minutes or about 62 days 1 hour 20 minutes.

Keywords:pilot boats; restoration

1. Introduction

A pilot boat is a ship that is used to deliver or pick up ship guides, which is usually done by a maritime pilot, who is a sailor who directs the ship through dangerous or congested waters, such as a harbor or river mouth.

In the Mud area, Kab. Gresik has a pilot boat with a length of 12m which has sunk and is about to be refurbished. The cause of the sinking is because the accommodation space has been open for several years and the sealant on the seacost and stern tube is worn out so that rainwater or seawater can get inside and without there is maintenance, because water has filled the ship's space causing the ship to sink, not only the ship sinks but there are several parts of the ship that may experience damage, namely the system parts, hull parts, and parts of the fittings

Picture1Initial condition of the ship

The inside of the ship before being lifted, that the inside of the ship, especially in the engine system part, had been filled with water, and also mixed with mud on the inside of the ship with a thickness of approximately 70 cm.

Picture2Ship Condition in Dock

The condition of the ship is already in the dock, with the superstructure and also the condition of the hull which has been cleaned of barnacles or shells which aims to see the condition of the hull, whether there are cracks or leaks.

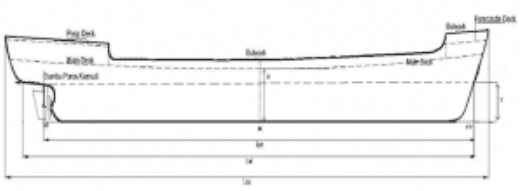
Picture3Ship Condition

Damage occurred in the steering system, engine system, electrical system, ship navigator system, ship equipment, room space, engine room and storage area, such as the absence of ropes or damage to other parts of the ship.
The purpose of this research is to find out how the ship can be used according to its function, and the ship does not become waste at sea or docks, to know the restoration process, to find out how long it takes in the restoration process.

Ship Building Theory 1

Ship building theory 1 itself is a theory that explains the main size of the ship, the shape of the body
Ships are generally defined by:

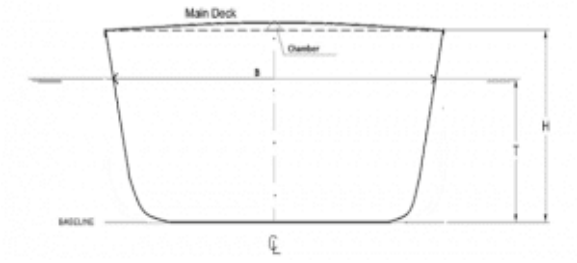
1. The main size of the ship
2. Ship size comparison
3. The coefficients of hull shapes



Picture4Ship Length

1. Ship Length
   The definition of ship length in making line plan drawings is known to have several terms which include:

1) LBP : Length Between Perpendiculars or LPP is the length of the ship as measured from the vertical line drawn from the axis of the steering shaft (Ap) to the vertical line drawn from the intersection of the fully laden waterline with the ship's bow height (Fp).
2) LWL : Length of Water Line, namely the length of the ship measured from the vertical line drawn from the intersection of the fully laden water line and the stern height of the ship to the vertical line drawn from the intersection of the fully laden water line and the ship's bow height (Fp) or is the length of the waterline at full load.
3) LOA : Length Over All, namely the length of the ship as measured from the vertical line drawn from the rear of the hull to the foremost of the hull or the entire length of the hull.



Picture5Ship Width

2. Ship Width (B)
   The definition of the width of the ship in the manufacture of line plans is known as the molded breadth, namely width ship measured on the inside of the plate amidships (Amidship).
3. Ship Height (H)
   The definition of ship height in making line plan drawings is known as the depth molded (height molded), namely the height of the ship measured from the base line to the side of the ship's deck at the middle of the ship.
4. Vessel Draft (T)
   The definition of a ship's draft in drawing a line plan is a vertical line measured from the base line line) up to the waterline height. For maximum draft means the vertical distance from the base line up to full load of water amidships.

Ship Building Theory 2

Ship building theory 2 itself is a theory that explains ship structures, namely:

1. Embossed hull (freeboard)
   Rising hull regulations are made as part of an effort to improve the seaworthiness of ships as a whole, namely:
   1) Structurally/construction is strong enough for the voyage in question
   2) Have sufficient stability for the intended service
   3) Has a hull substantially watertight from keel to freeboard and weathertight above this deck
   4) Have sufficient volume and reserve lift above the waterline so that the ship is not in danger of sinking (founding or plunging) in very large waves

   All of the above is related to the size of the freeboard, a small freeboard will result in more dangerous conditions for the ship, crew and cargo. A watertight hull is a requirement for the issuance of an embossed hull certificate.
2. DeckLine
   1) The deck line is a horizontal line that is 300mm long and 25mm wide.
   2) This line must be installed in the adminship on both sides of the ship.
   3) The overhang is usually through the intersection of the outward extension of the top surface of the freeboard deck and the outer surface of the ship's skin.
   4) The deckline may be placed in reference to any other point, as long as the freeboard is corrected for that.
   5) The location of this reference point and the identification of the freeboard deck must be recorded in the International Overboard Certificate.
3. Embossed Stomach
   1) The Summer Load Line is measured from the top of the line that passes through the center of the circle and is also marked with the letter S.
   2) Winter Load Line is marked with the letter W.
   3) The Winter North Atlantic Load Line is marked with the letters WNA.
   4) Tropical Hull (Tropical Load Line) is marked with the letter T.
   5) Fresh Water Rising Hull (Fresh Water Load Line) is marked with the letter F.
   6) The Tropical Fresh Water Load Line is marked with the letters TF.

ISO - 47080 – Smallcarft

ISO (International Organization for Standardization) is the largest international standard development organization in the world. ISO was founded in 1947, and has issued International Standards covering almost all aspects of technology and business. ISO members are national standard bodies representing their respective countries. Full members have the right to sell ISO International Standards, and adopt ISO International Standards to become national standards. ISO related to ships, both from the method and product requirements will be explained in the table.

table1ISO - 47080 – Smallcarft

NO	ISO Standard Number	ISO Standard Title
1	ISO 12215-1 : 2000	Small crafts - Hull construction and scan - Part 1 : Materials : Thermosetting resin, Glass fiber reinforcement, Reference laminates
2	ISO 12216 : 2020	Small aircraft - Windows, Spotlights, Hatches, Lights off and Doors - Strength and water tightness requirements
3	ISO 13297 : 2020	Small boats - Electrical systems - Alternating and direct current installations
4	ISO 13929 : 2001	Small plane - Steering wheel - A directional link system
5	ISO 15083 : 2020	Small boats - Kaqpal bilge pump system
6	ISO 15084 : 2001	Small ship - Gasoline engine on board - fuel and electrical components installed in the engine
7	ISO 23411 : 2020	Small steering wheel crafts
8	ISO 25197 : 2020	Small aircraft - Electronic or electronic control systems for Steering, Gearshift and Throttle

EURO CERTIFICATE

1. EN ISO 12215-1 : 2018 – Small crafts – Hull construction and scanning - Part 1 : Materials : Thermosetting resins, glass fiber reinforcement, reference laminates (ISO 12215-1 : 2000)
2. EN ISO 12216 : 2018 – Small aircraft – Windows, searchlights, hatches, blackout lights and doors – Requirements for strength and watertightness (ISO 12216 : 2002)
3. EN ISO 13297 : 2018 – Small vessels – Electrical systems – Alternating current installations (ISO 13297 : 2018)
4. EN ISO 25197 : 2018 – Small aircraft – Electrical or electronic control systems for rudder, shift and throttle (ISO 25197 : 2012, including Amd 1 : 2014)

BKI (VOL III) 2021 Rules for High Speed Craft, 2021

1. Referring to the rules of BKI Part 3. Special Ship (Vol III) regarding standards and methods in selecting materials or manufacturing processes.
    1) General

        This section includes the hull and superstructure elements which provide the longitudinal and other primary and local strengths of the ship as a whole as well as important components such as foil and skirt which are in direct contact with the hull and superstructure.
    2) Documents for Approval

        The following documents must be submitted. To facilitate a smooth and efficient approval process, they must be submitted electronically to the BKI HO. In certain cases and following prior agreement with BKI, they may also be submitted in paper form in triplicate1.
    3) Midship

The cross-sectional plan (midships, other typical sections) shall contain all necessary data on the scantling of the longitudinal and transverse hull structures and details of the anchorage and mooring equipment.

4) Elongated section

The longitudinal section plans shall contain all necessary details regarding the dimensions of the longitudinal hull structures and on the locations of the watertight bulkheads and deck support structures, superstructures and deckhouses.

2. Deck

A deck plan showing the dimensions of the deck structure, the length and width of the cargo hold, openings above the engine and boiler rooms, and other deck openings. On each deck, the deck load due to the load shall be determined as assumed in determining the size of the deck and its supports.

3. Engine and boiler seats

Drawings of engine seats and boilers, under-seat structures and transverse structures in the engine room, with details of the attachment of the engine base plates to the seats, and engine type and output.

4. Complementary

Drawings of rudder, axle brackets, stabilizers including struts, bearing materials and propeller details

5. Ingredient

The drawings mentioned should contain details about the hull material (e.g. hull structural steel grades, standards, material numbers). Where high tensile steel or materials other than hull structural steel are commonly used, drawings for possible repairs shall be placed on board.

6. Definitions and symbols

The following definitions of terms and symbols apply throughout this Section and its Appendices and, as a rule, are not repeated in different paragraphs. Definitions that apply only to certain paragraphs are specified therein. "Formed base line": A line parallel to the summer load waterline, crossing the top side of the keel plate or top of the skeg at the center of length L.

BKI (VOL V) 2021 Rules for Fiberglass Reinforced Plastics Ships, 2021

1. General equality

Equivalence Alternative hull construction, equipment, arrangement and scantling will be accepted by BKI, provided that BKI is satisfied that the construction, equipment, arrangement and scantling are equivalent to those required in this regulation.

2. Definition

1) Scope of application

The definitions of terms appearing in these Rules must be as defined in this Section, unless otherwise specified.

2) Ship Length

Ship length L is the horizontal distance in meters on the load line from the fore side of the stem to the aft side of the rudder in the case of ships with rudders or to the axis of the rudder in the case of ships without rudders. However, in the case of a ship with a cruiser stern, the length of the vessel is specified at the top or 96% of the total length at the maximum designed payload line, whichever is greater.

3) Ship Size

The ship's width (B) is the horizontal distance in meters between the outside of the side shell laminations measured on the top surface of the top deck laminations on the sides in the widest part of the hull.

4) Ship Depth

Depth of ship (H) is the vertical distance in meters from the bottom surface of the bottom laminate or from the intersection of the line of extension of the bottom surface of the bottom laminate and the center line of the ship (hereinafter referred to as "start point H") to the top surface of the top deck laminate on the side measured at center (L).

5) Midship Amendment A amidship section is that part for 0.4L amidships specified otherwise.

6) Ship's End Section The ship's end section is the portion for 0.1L of each end of the vessel.

7) Freeboard deck

The freeboard deck is usually the topmost continuous deck. However, in cases where openings without means of permanently closing exits in the uppermost part of the continuous deck or where openings without means of permanently closing watertight exist in a ship below that deck, the freeboard deck is the continuous deck below that deck.

8) Power Deck

The strength deck at any one point of the ship's length is the top deck at that part where the shell layers extend. However, for superstructures, except for sunken superstructures, which are considered ineffective against longitudinal forces, the strong deck is the deck immediately below the superstructure deck.

3. Raw materials for primary structures

   Glass fiber reinforcement, resins for laminates and core materials for sandwich construction and structural adhesives to be used for: FRP ships shall be tested and inspected in the presence of the Surveyor and accepted, except as approved by BKI according to the requirements in.

4. Raw material approval

   At the request of raw material producers, BKI will check the materials used, manufacturing methods, inspection standards in workshops, quality control systems, etc. for the raw materials listed below and carry out the tests and inspections specified in this section on test samples designated by BKI. If the test sample has passed these tests and inspections, it is treated as an approved material:
   1) Glass fiber reinforcement
   2) Resin for lamination
   3) Core material for construction
   4) Structural adhesive.

5. Continued approval

   Raw material manufacturers wishing to obtain follow-up approval are subject to periodic surveys, as a rule, at intervals of not more than one year, in accordance with the following requirements:
   1) Inspection of materials used manufacturing methods, inspection standards in workshops, quality control systems, etc.
   2) Testing and inspection appointed by BKI.

6. Classification Survey During Construction
   1) Stomach
   2) List and data of raw materials
   3) General settings
   4) Amidst the ship (indicating the parts of the ship in the hold and engine rooms, and in the way of wing tanks, if provided, as well as indicating the intended character of the classification and the draft of the cargo)
   5) Construction details fore and aft, and truss and truss
   6) Propeller and rudder post (indicates the material and speed of the ship)
   7) Construction profile (showing arrangement of watertight bulkheads, payload, bracket sizes and parts on board at 0.1L and 0.2L from the end of the ship)
   8) Deck plan (showing arrangement and construction of the hatch, hatch beams, etc.)
   9) Single bottom and double bottom
   10) Watertight and oiltight bulkheads (indicating the position of the highest tank and the top position of the overflow pipe)
   11) Bulkheads at the ends of superstructures (showing door construction)
   12) Main engine seating, thrust block, plummer block, generator and other important auxiliary engines (shows output, height and weight of main engine and arrangement of retaining bolts)
   13) Steering gear (shows detailed structural and material arrangements)
   14) Laminating procedure and details of joints.

7. Machine room
   1) Mounting bolts for main engines shall have sufficient shank length to reduce their stiffness and an effective means of avoiding looseness.
   2) Where engines subjected to large excitation forces due to piston side thrust are installed, the joints of the girder to the frame and brackets shall be made rigid, and resonance shall be avoided against vibrations in the horizontal direction.
   3) Tie girder joints with undershell laminates, frames and brackets, and their reciprocal joints shall be T-type splices using sufficient backing fabric and the splice width shall be sufficient. In this case, the direction of the circumferential fabric fibers is usually not oblique to the connecting line.

8. transoms

1) Choose a location where the water flows the smoothest and has minimum turbulence and bubbles will be present, especially at high speeds. The transducer must be immersed in water continuously and the sound beam not obstructed by the keel or propeller shaft. Ensure that there is adequate headroom and that there is a minimum dead rise angle.
2) Never install a transducer near water intakes, openings, or behind strakes, struts, fittings, or hull irregularities. Also, water near the keel can be highly turbulent which will negatively affect performance.

9. Minimum Thickness of Laminate Deck
    1) The thickness of the Laminate Deck of Single Skin Construction shall not be less than that obtained from the following formula: The thickness of the top deck laminate amidships if framed longitudinally, is
    tD = 4.8 - a - √(p [mm])
    a = Spacing of longitudinal beams [m]. Such that
    p = specified in 3.[kN/m2].
    2) The top deck laminate thickness for the amidships when framed transversely shall not be less than that obtained from the following formula:
    tD = 5.8 - a - √(p [mm])
    a = Spacing of longitudinal beams [m]. like
    P = specified3.[kN/m2].
    3) The thickness of the top deck laminate except for amidships and other deck laminates shall not be less than that obtained from the following formula:
    tD = 4.2 - a - √(p [mm])
    a = Spacing of longitudinal beams [m]. like
    P = specified3.[kN/m2].

2. Method

The data collection method in this Final Project is the direct (primary) data collection method. Data collection is done by taking data related to the problems in this Final Project. . The data needed include:

1. Ship data
    Ship data is urgently needed and used for reference or for the restoration process of ships. From this data, it can be determined which parts need to be restored. Includes namely:
        1) The main size of the ship
        2) Lines Plan
        3) RU

2. Data processing
    After the data from the ship has been collected, the next step is data processing.

3. Data analysis
    After the necessary data has been collected and supported by a literature review related to the data, it is then processed so that the final results are in accordance with the objectives of the research. The analysis carried out is to determine:
        1) The data analysis carried out determines the part of the pilot boat that will be restored.

3. Discussion

In this case, explaining the stages and estimated time for this restoration process, the stages and time of restoration is important in order to know what are the stages and how long it takes for this restoration process, the stages and estimated time calculations are divided into several process part namely:

1) Ship docking process
2) Ship restoration process
3) Ship finishing process

Ship Docking Process

This docking process is intended to facilitate the repair and maintenance of the ship, for the processing process includes:

1) Water drain
2) Docking preparation

3) Mud cleaning

Picture6Vessel Before Docking (Draining)

Picture7The Ship Is Docked

Picture8Ship Condition After Drainage

Some estimates of the time needed for the ship cleaning process are:

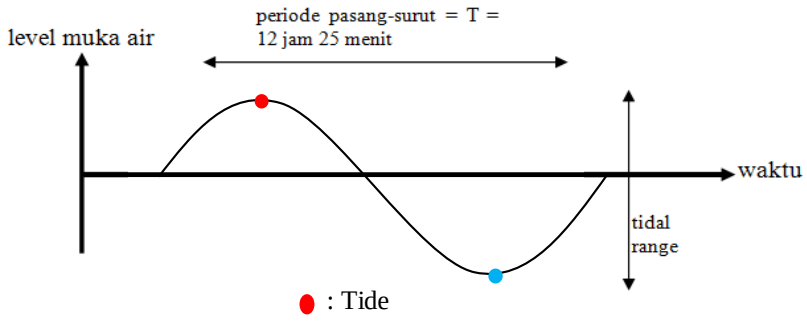
table2The Time Required During Docking Preparation

NO	PROCESSING	SIZE	VOLUME	DEBIT	TOTAL	RESULTS
1	Water drain	per 1 M3	75.24 M3	1100L/Min	82,764 L/minute	1 hour 12 minutes
2	sludge drain	per 1 M3	112.86 M3	1100L/Min	124.146 L/minute	1 hour 48 minutes

3	Ship docking	-	-	-	-	51 hours
4	Preparation before docking	-	-	-	-	120 minutes
		TOTAL				56 hours

DataThis was taken from the survey results in the field so the total time needed is 56 hours to carry out the cleaning processper 1 M3itself, but before the docking process is carried out, the first thing to do is to prepare for docking, which takes approximately 30-60 minutes.

In this case the docking process itself cannot be just done, the docking process is carried out when the sea water is at maximum tide, in one day the tides occur twice but with different heights, not only that the docking place is also one of the considerations also whether the ship can be brought to the dock/shore or not, the following below is the tide table:



Picture9Water Tides Diagram

Ship Restoration Process

In this next stage after the ship has succeeded in docking is the restoration process, the ship restoration process includes several stages, namely:

1. Ship cleaning process
2. Restoration process

Picture10Before the Cleaning Process

Picture11After Cleaning Process

The estimated time and several stages in the ship restoration process will be explained in the table below:

table3Ship Cleaning Process Time Estimation

NO	PART	SIZE	ESTIMATED TIME	AREA	TOTAL	RESULTS
1	Hull (outer)	per 1 M2	± 60 minutes	39.5 meters	2,370m2/min	39 hours 5 minutes
2	Stomach (in)	per 1 M2	± 80 minutes	10.5 meters	840m2/min	14 hours
3	Decks (above)	per 1 M2	± 60 minutes	20.6 meters	1,236m2/min	20 hours 6 minutes
4	Decks (bottom)	per 1 M2	± 80 minutes	7.30 meters	584m2/min	9 hours 7 minutes
5	Upper building (outside)	per 1 M2	± 60 minutes	11.12 meters	667.2m2/min	11 hours 12 minutes
6	superstructure (in)	per 1 M2	± 70 minutes	11.18 meters	782.6m2/min	13 hours
7	Accommodation Room	per 1 M2	± 50 minutes	10.15 meters	507.5m2/min	8 hours 45 minutes
8	Preparation before cleaning per section	-	-	-	-	210 minutes
			TOTAL			117 hours 45 minutes

DataThis was taken from the results of a survey in the field so the total time needed in the cleaning process for this ship is 117 hours 45 minutes or if it is made in days around 16 days 49 minutes, but from that time there is a preparation process before carrying out the cleaning process which is estimated takes about 30 - 40 minutes, in this cleaning process it cannot be cleaned only once there are also several factors that affect the estimated time, namely:

1. Hours of work of workers/handymen
2. Availability of materials/tools
3. Weather factor
4. And several factors beyond that

For the process of cleaning the ship itself, it is assisted with the help of a sanding machine which facilitates and speeds up work, if it is done manually without the help of a machine it will take even longer.

table4Estimation of Restoration Process Time

NO	PROCESSING	ESTIMATED TIME	AREA	TOTAL	RESULTS
1	Replacement or patch	± 30 minutes	55,175 meters	1,655m2/min	28 hours 15 minutes
2	Roof cutting	± 30 minutes	4.14 meters	124.2m2/min	2 hours 7 minutes
3	Transom cutting	± 20 minutes	24 meters	48m2/min	1 hour 20 minutes
4	Meth coating and fiberglass composite	± 20 minutes	55,175 meters	1.103m2/min	18 hours 39 minutes
5	Preparation before restoration per section	-	-	-	160 minutes
		TOTAL			171 hours 1 minute

DataThis was taken from the results of a survey in the field where the process was carried out manually or with the help of a machine, the total time required for this restoration process was 51 hours 1 minute or about 2 days 3 hours 1 minute.

Processpreparation of each part prior to restoration also requires a significant amount of time, around 40 minutes. If everything is done manually, the estimated time could be even longer and several factors affect the estimated time, namely:

1. Hours of work of workers/handymen
2. Availability of materials/tools
3. Weather factor
4. And several factors beyond that

The above factors become one of the considerations in the long or fast processing process.

Ship Finishing Process

Finishing processis the final process that is carried out after all processes are completed, this finishing process also requires several stages and takes quite a long time, namely:

1. Caulking
2. Coatings
3. Painting

Picture12Caulking Process

The following below is the time calculation of the caulking process with a size of 1 M2:

table5Estimation of Collection Time

NO	PROCESSING	SIZE	ESTIMATED TIME	AREA	TOTAL	RESULTS
1	Caulking	per 1 M2	± 60 minutes	110.35 meters	6,621 m2/min	110 hours 35 minutes

In this case the patching or caulking process takes 110 hours 35 minutes or about 4 days 14 hours 35 minutes. Because there are many stages that have to be repeated, not just done once, but done repeatedly in order to get the right and maximum results, here are some of the processes needed during the finishing caulking process:

1. Sanding or roughing the surface of the part with the aim that the putty can stick to the surface of the part to be patched/puttyed, the estimated time required for this sanding is around 15 minutesper 1 meter M2.
2. Mixing the putty mixture which consists of gelcoat, resin and catalyst, takes 5-10 minutes.
3. The application of putty on the surface of the part to be putty takes 5-10 minutes per 1 M2.
4. After applying the putty results, let it sit/dry for about 15 minutes.
5. After the putty is dry, the next step is sanding the putty which aims to make it even with the initial surface, sanding the dry putty takes 5-10 minutes per 1 M2.

ProcessThis is done repeatedly in order to get the appropriate and maximum results. The above process is done manually, working hours factor, weather factor, material availability factor, the number of damaged or repaired parts is also one of the long and fast process considerations.

Unfinished process

The stage that has not been carried out is the coating process. The coating process itself is a process of adding a special layer to the paint surface which in the finishing process, this ship has not yet reached the paint or coating stage. The following is the estimated processing time that has not been done

table6Estimated Processing Time that has not been carried out

NO	PROCESSING	SIZE	ESTIMATED TIME	AREA	TOTAL	RESULTS
1	Coatings	per 1 M2	30 minutes	110.35 meters	3,310m2/min	55 hours 16 minutes
2	Painting process	per 1 M2	20 minutes	110.35 meters	2,207 m2/min	37 hours 17 minutes
TOTAL						92 hours 33 minutes

Estimated time estimates are taken from the stories of workers or builders, which takes ± 92 hours 33 minutes or 3 days 20 hours 33 minutes. The work process is carried out as follows:

1. Sanding or smoothing the rough surface, so that the paint can stick perfectly.
2. Manufacture of jealcoat paint mixture for coating, consisting of talc, coloring pigments, resins and catalysts.
3. Surface washing or cleaning aims to clean the surface from dust or dirt adhering to the wall surface.
4. Detailing, this stage is the stage before the coating process is carried out which aims to clean the existing gaps from dirt or dust so that during the coating process the results are maximized.
5. After the next step is the coating paint coating.

ProcessThe above also requires some preparation with an estimated time that each process takes approximately 30-60 minutes at each stage.

Total Estimation of Working Time

Afterthe calculation of the estimation of each part is found, the total construction time for this 12 meter pilot boat is:

table7Overall Total Time Calculation

NO	PROCESSING	TOTAL AREA	TOTAL TIME
1	Docking Process	206,910 Meters	4 hours
2	Restoration Process	9,927.5 meters	206 Hours 46 Minutes
3	Finishing Process	12,138 Meters	203 Hours 8 Minutes
	TOTAL	228,975.5 meters	413 Hours 54 Minutes

So the total estimated time required for the restoration of the 12 meter pilot boat is 413 hours 54 minutes or if it is made into days, it is around 17 days 20 hours 54 minutes.

Table of Estimated Working Hours

table8Total Estimated Time Required in the Process

NO	PROCESSING	WORKING HOURS	TOTAL TIME	DAY
1	Ship docking	-	56 Hours	2 Days 8 Hours
2	Ship Cleaning	7 Hours Per Day	117 Hours 45 Minutes	16 Days 52 Minutes
3	Restoration Process	7 Hours Per Day	51 Hours 1 Minute	7 Days 3 Minutes
4	Finishing Process (Collection)	7 Hours Per Day	110 Hours 35 Minutes	15 Days 1 Hour 6 Minutes
5	Finishing Process (not done yet)	7 Hours Per Day	92 Hours 33 Minutes	13 Days 19 Minutes
	Total		**427 Hours 54 Minutes**	**62 Days 1 Hour 20 Minutes**

FromThe table above explains how long it takes to work on each process with the working hours of the workers in the field. However, there were delays in the process of restoring the 12 meter pilot boat due to several factors. So the total calculation of the estimated completion of the 12-meter Pilot Boat restoration following the working hours of the masons as a whole takes 427 Hours 54 Minutes or 62 Days 1 Hour 20 Minutes.

4. Conclusion

Based on the results of the research "Pilot Boat Restoration 12 Meters" above, the authors draw several conclusions:

1. Restoration is one way to return or restore an object to its original state, by carrying out the restoration process on the ship, the ship will not become waste at sea or at the wharf, the ship can also be used again as its original function and condition, namely as a pilot ship.
2. The restoration process is carried out in several stages, namely:
   1) Ship docking process, which aims to facilitate work by bringing the ship to the dock or the shore.
   2) Ship restoration process, in this stage where the ship has started the repair process.
   3) The process of finishing the ship, where this stage is the final stage after the ship is restored.

3. The time required for this restoration process as a whole takes about 492 hours 15 minutes or about 20 days 12 hours 15 minutes, but there are several obstacles so that the ship is not finished according to the estimated schedule. Factors that influence the restoration process are:
   1) Internal factors
      a. Working hours factor
      b. Material/equipment availability factor
      c. Funding factor

   2) external factor
      a. Work factor double masonry
      b. Weather factor

5. References

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