



Aceh Traditional Boat Modification Using Fiberglass Material

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ABSTRACT

Shipbuilding must be completed with careful planning, such as general arrangements, lines plans, and construction plans. However, a different reality is found in the shipbuilding process in traditional shipyards. Traditional shipyards rely on hereditary experience in the ship-building process, so it is suspected that there are discrepancies in certain aspects of the ships being built, one of which is the size of the ship's construction. Ships with fiberglass materials have been made in Indonesia because they have good strength and are cheaper than wooden ships. Fiberglass, often known as fiberglass reinforcement plastic (FRP), is a composite material made of two elements that, despite their different physical qualities, work well together. Fiberglass material can be a good consideration for people who want to build ships. The purpose of this research is to develop traditional boats from wood raw materials into fiberglass raw materials. Finding a redesign for a traditional Acehnese boat that matches the characteristics of the fiberglass material. Based on the research that has been done, it can be interpreted as follows: Boats with fiberglass material have the advantage of being light in construction, and the production process does not take long and uses molds. Boats made of fiberglass have more advantages than boats made of wood, there is not too much maintenance for boats compared to wooden ships, and fiberglass materials are resistant to sea worms or sea trifles/sea shells that stick to the body of the boat or ship.

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1. Introduction.

Fishing vessels include ships, boats, or other floating equipment used to carry out fishing operations, assist fishing operations, fish cultivation, transport fish, process fish, provide training, and conduct fishery research and exploration [1]. Careful planning, such as general arrangements, line plans, and construction plans, is required in shipbuilding [2]. Besides that, shipbuilding planning is needed to improve the quality of ship products produced in shipyards [3];[4]. Without this technical

planning, traditional shipyards rely on hereditary experience in the shipbuilding process [5];[6], so it is suspected that there are incompatibilities with certain aspects of the shipbuilding process. Ships built, one of which is the size of the ship's construction.

Ships with fiberglass materials have been made in Indonesia because they have good strength and are cheaper than wooden ships [7]. The advantages of fiberglass-based composites are lightweight, corrosion resistant, easy to form, and affordable prices. However, fiberglass also has the undesirable property of being hygroscopic because of its chemical content [8]. Fiberglass boats are also more profitable than wood-based boats in terms of shrinkage, maintenance, and investment value. In addition, the availability of wood as a raw material for shipbuilding is decreasing, so alternative materials are needed [9]. The Indonesian marine sector is currently experiencing an increase in market demand. Given that the majority of Indonesia's land is in the sea, there is a significant need for ships that can be used as working tools. Indonesian beaches have different forms of ship designs according to the customs and culture of each

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region [10].

Based on KKP statistical data for 2022, the city of Banda Aceh has a fishing fleet in 2019-2020 with a total of 1088 vessels. The types and ships observed varied with the types of motor boats, outboard motor boats, and boats without motors. Of the total number above, the most dominant number is motor ships, in 2019 it reached 430 units and in 2020 experienced an increase of 459 fleet units. There was no increase or decrease in outboard motor boats, the number of outboard motor boats in 2019 was 79 units, and in 2020 the number of fleets. Outboard motor ships are the same as in 2019, namely 79 units. And for ships without motors in 2019 with a total fleet of 7 units, in 2020 there will be a significant increase, namely 34 fleet units. With this, the total number of motorized, outboard motorized, and non-motorized vessels in 2019 is 516 units and the total number of vessels in 2020 is 572. That way, in 2020 there will be an increase of up to 10%. The data collection for ships taken in 2019 and 2020 are ships with a size of 0-5 GT.

In general, wooden vessels are the most widely produced type of fishing vessel compared to other types of vessels. Such as fiberglass and steel. This is supported by The Pasaribu code (1985) [11] that wood is one of the main building materials for fishing boats in Indonesia. The ease of procuring raw materials and economic balance are the reasons why wood is chosen as the material for making fishing boats [12].

According to WALHI Aceh (2006) [13], every year Aceh loses forest areas of 20,796 ha due to illegal logging, one of which is the rate of damage being triggered by ongoing illegal logging activities. As a result of forest destruction, there are many floods, landslides, and wildlife disturbances. Therefore, the Governor of Aceh implemented a moratorium on logging through the instruction of the Governor of Nanggroe Aceh Darussalam Number 05/INSTR/2007 concerning Moratorium Logging in Nanggroe Aceh Darussalam to restore forest functions and to re-arrange Aceh's forest development strategy.

Fiberglass reinforcement plastic (FRP) or better known as fiberglass is a combination of two components that have different physical characteristics, but both have complementary properties [2]. According to Oh et al. [14] Fiber-Reinforced Polymers (FRPs) have excellent strength-to-weight ratio, corrosion resistance, and workability, leading to a wide range of applications, including in the aviation and automotive industries, ships, and offshore platforms. be a good consideration for people who want to build ships. Many factors are considered when choosing a fiberglass material, including the fact that it is accessible at most chemical stores and is tougher, and lasts longer than wood. which rot easily, and the maintenance of fiberglass boats is easier than wooden boats [15].

The majority of boats in Aceh are made of wood, with the Governor's regulation regarding the Logging Moratorium, fishermen or wooden ship craftsmen will find it difficult to repair ships or build ships, so many of these ships are abandoned. Due to difficulties in making traditional wooden boats, research is needed on the Development of Traditional Aceh Fiberglass Boats. So that with this research, traditions in the environment, especially wood, can be preserved and small fishermen can carry out their activities. This study aims to develop tra-

ditional boats from wood raw materials to fiberglass raw materials and find a redesign (shape) of traditional Acehnese boats that are by the characteristics of fiberglass materials.

2. Research Methods.

2.1. Method of collecting data.

Collection of sources and information based on books, papers, and other sources related to this research. it aims to be used as a theory in solving the problem to be solved. In addition, the authors also extract information about fishing vessels by visiting them physically to check their design and readiness for fishing operations.

2.2. Design analysis.

1. Design.

According to Ardhy et al. [16], the design process of a ship requires variations in total length (length overall/LOA), length of water line (length water line/LWL), maximum width (beam maximum/Bmax), width of waterline (beam water line), depth hull (Depth/D), water draft (draft/d), displacement, maximum speed (max speed), type/function of ship, and type of material.

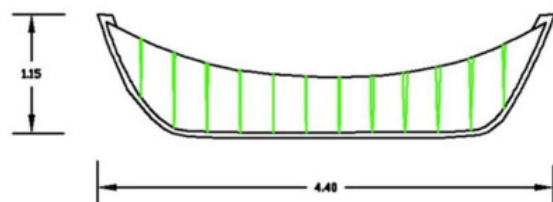
2. Construction Stage (Drawing).

Includes line plans and offset tables, calculations for hydrostatic curves, weight and center of gravity calculations, trim and stability calculations, profile construction drawings, center section drawings, installation drawings (electrical, piping, steering, engine, navigation, communications), interior drawings, and other detailed drawings. Based on these drawings, the production process can begin. The initial stage, making the mold. Molds come in two types: semi-permanent molds and permanent molds. removable molds are usually made for relatively small orders. Permanent prints, on the other hand, are made for relatively large orders. Originally had to be produced to make this eternal print. prototype ship to be built. Semi-permanent and permanent molds consist of the female mold method, namely a mold whose inside side is smooth and the outside side is rough [16].

2.3. Research result.

The first step is to make a plan drawing of the shape of the ship to be made or it is called the ship lines plan. the determination of the shape of the ship in question from the outline drawing is carried out based on the results of the author's observations. The results of the lines plan can be seen in Figure 1 below:

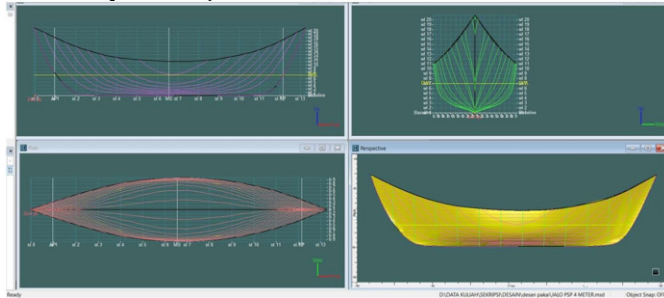
Figure 1: Boat Design.



Source:Authors.

In addition to the line plans in this section, drawings are also carried out whose purpose is to find out the shape of the hull, namely the characteristics of the hull, especially those below the waterline, where the waterline that has been drawn serves as the basis for this drawing. The drawing of the line plan (ship lines plan) is made in two dimensions (see Fig. 2), so the drawing is divided into three parts, namely:

Figure 2: Lines Plan.



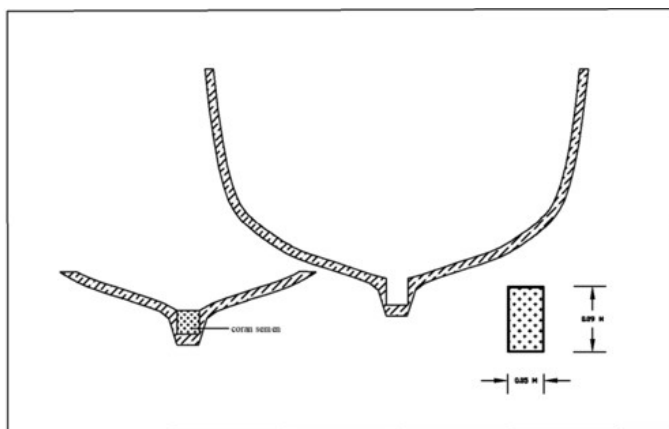
Source: Authors.

1. Sheer plan: If a vertical incision is made along the hull, the shape of the ship is called a sheer plan. This design shows the shape of the fore and stern of the ship. The vertical line that cuts the ship can be known whether the planned waterline is sufficient or not. Can be seen in the picture with 6 purple lines.

2. Half-breadth plan: If the ship is sliced horizontally down the hull, a half-width plan, or a half-width plan of the visible part of the ship, is produced. This illustration shows a line shape. water for each increase from the bottom (especially the increase in each fiber) Figure 6 which is the red line

3. Body plans: The body plan is part of the line plan that shows the shape of the ship if the ship is cut vertically cross-wise. From the drawing, you can see the curvature of the ivory frames (stations). You can see the picture of 6 green lines.

Figure 3: Modification in the keel and casting keel.



Source: Authors.

Fiberglass-based traditional Aceh boat modifications are focused on the hull of the boat, more precisely on the keel of the boat. Modifications to the hull basically do not change the tra-

ditional model, this modification of the traditional boat on the keel has a different keel compared to a wooden boat, wooden boats have keels that tend to be small and do not protrude on the body or hull of the boat. Whereas the modifications made to the keel of the fiberglass boat tend to emerge on the hull as shown in Figure 3 above.

The size specifications planned for the design or model that is bolted can be seen in Table 1.

Table 1: Size specifications.

BOAT SIZE DATA	VALUE	UNIT
LONG	4.40	Meters
WIDE	0.90	Meters
TALL	0.60	Meters
BOW HEIGHT	1.15	Meters
KELL LENGTH	2.48	Meters
KEEL WIDTH	0,05	Meters
KEEL HEIGHT	0.09	Meters
HULL SIZE	0.10	Meters
GALLEY SIZE	0.10	Meters

Source: Authors.

2.4. Discussion.

The design of this boat makes modifications to the hull of a traditional Aceh boat. The modification of the hull that is carried out is that the keel is enlarged and intended as ballast, the modified keel will be filled with cement material (cement casting) as the main ballast function on fiberglass boats. It is hoped that the presence of ballast on the keel can reduce the shock to fiberglass boats.

2.5. Shipbuilding.

Building or constructing a new ship made from fiberglass is inseparable from the design drawings and considering how much material will be used in the manufacture of the new ship. When going to make a boat or ship, it requires preparation, namely the design of a ship or boat that accompanies size specifications, in the process of making a boat it must also be seen from what materials will be used and needed during the manufacturing process.

2.6. Mold-Making Process (Mall).

Mold manufacture (Mall) must first prepare mold-making materials, namely as shown in Table 5, and work equipment. Mold (Mall) which functions as a printing tool or mold that has been adjusted by a pre-planned model or design. The process of building a mall varies depending on the size of the boat, in the construction of a mall boat carried out in this research, it takes 1 to 2 weeks more or less.

The construction of the boat foundation is the first step before installing the boat frame. The initial foundation of this boat was formed from the keel and hull, the keel and hull were the strength of the boat to be worked on. To make it easier when making fiberglass boats, the mold or mall made must be the same shape and size as the working drawings. After the mold frame is finished, the shape of the boat to be built will be seen.

In the next stage, the mold frame will be covered with plywood so that you can see the shape of a boat.

2.7. Fiberglass Boat Lamination Process.

The process of lamination of fiberglass boats is carried out, namely when the process of making the boat mold (Mall) is complete, then after the mold is complete, the next stage will be the process of forming the boat body using Fiberglass material. Before carrying out lamination work at the mall using Matt 300 and Woven Roving 600, several processes will be carried out first, namely:

1. The process of polishing mirror glass.
2. Resin mixing process.
3. Process of mixing flour (talk powder haichen).
4. The process of mixing color pigments.
5. Chop strand mat (matt) and woven roving processes. The process of installing Mat 300 and woven roving 600 on the boat hull.

Fiberglass boat laminate has 6 layers, namely four layers of matt 300, and two layers of woven roving 600, with an alternating process of working like the first layer of matt 300 pasting and the second layer of woven roving 600 onwards, on the last second layer, only using matt 300. After the fiber coating is complete. Before entering the painting stage, the caulking process is carried out first using haichen talk powder on all the outer parts of the boat, the talk powder has previously been mixed first with color pigments before being attached to the boat body, this is used to cover the parts of the fiber that are experiencing deficiencies and also serves to rejuvenate during the painting process.

2.8. Painting Process.

The painting process is carried out after the caulking process, but before entering the painting process, then the putty is tidied up by rubbing the uneven parts of the putty. after tidying up, enter the painting process which is done by mixing resin, talc powder, and color pigment, in the process of making this liquid is the same as making putty, only the difference is when mixing less talk powder is used to get a liquid texture compared to putty which is has a thick texture. After the process of making liquid paint is complete, then the new painting process is done with 2 repetitions to get good results. This process is done on the outside of the boat first, for painting on the inside of the boat it is done after dismantling the mall. This painting is done to give better results than the previous one.

2.9. Opening or Removing Fiberglass boat from Mold or Mall.

Opening or removing the fiberglass boat from the finished mold or mall is done when the painting process has dried completely to minimize the risk of damage to the paint and putty that has been done. To release the results from the mold must be done carefully so that the results of the previous work are not damaged. If during the process of releasing the fiberglass boat there is damage experienced during the process of removing the fiberglass boat from the mold, then repairs must be carried out before the next stage of work is carried out, then checking

the condition of the damage to the boat must be carried out. If damage occurs during removal, what will be done is repair the damage, depending on how severe the damage is. After the repair work was completed, the casting process was carried out.

2.10. Finishing process.

This finishing process is carried out when there is damage to the outer hull and the inner hull resulting from the release of the boat from the mold, which must be repaired. this finishing also gives a better hull finish. This finishing stage aims to maximize the parts that are lacking during lamination and painting. The finishing process includes the installation of dragons and ivory on the inside of the boat. after the work on installing the galley and hull, the next stage is the fireplace on the edge of the boat which was caused during lamination, after the work on the fireplace on the edge of the boat, the next stage is the stage where the painting of the inside of the boat that has been installed with galley and hull to beautify the appearance of the inside looks good.

2.11. Casting Process.

The casting process is the final stage in the process of making this boat. the casting stage is carried out on the inner keel, before casting the inner keel, it must first be ensured that the paint on the inside of the boat has dried completely. After making sure that the inside of the boat is completely dry, then the keel of the boat can be cast. At the casting stage the keel uses a mixture of sand and cement, after mixing the two elements, the sand and cement elements can be evenly incorporated into the keel of the boat. At this final stage, the modification stage is carried out, namely on the keel of the boat to minimize the shock when the boat is operated.

Conclusions.

Boats made of fiberglass have the advantage of being light in construction and the production process does not take long and the production process is easy. Boats or boats made of fiberglass have more advantages than boats or ships made of wood, maintenance of fiberglass boats is not too much compared to wooden ships, and the durability of fiberglass material is that it is resistant to sea worms or sea trifles/sea shells that stick to the body of the boat or ship.

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