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Estimation of Capacity and Center of Weight of Traditional Ship, Bagan Siapiapi

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ABSTRACT

On traditional manufactures fishing boats in Indonesia, especially in the shipyard at Bagan Siapiapi, on Riau province usually made by rely on the ability of inherited tradition and hereditary not based on function and their designation. Example that way still used when determine capacity and center of gravity. This research aims to study capacity and center gravity of ship nets at Bagan Siapiapi using computer simulations. On this method some of data about capacity, center of gravity, drawing design and construction of ships would to be studied systematic and accurate base on practical condition. That case would be studied and validate on the one shipyard industry at Bagan Siapiapi. Some result from this study are (1) Capacity of ship nets 7093 kg and the weight is 13401.04 kg on the full condition. (2) Center weight of ship nets at X = 0.7mm; Y = 888.5mm; and Z = -162.5 mm. (3) Stability of ship nets on the without load has a smaller tilt angle compare than the full load condition.

KEY WORDS: *Ship nets, capacity, center of weight*

1.0 INTRODUCTION

Indonesia is maritime country which two-thirds territory is ocean. Amount area of the sea shown that Indonesian is state which potential resources of fish. This resources can bring benefits in utilization if would be supported in good condition on facilitate and infrastructure. If we want increasing in the utilization of ocean that will be required attempt and efforts to increase amount of fishing ship. Fishing ships are vessels that be used in fishing business which involves utilize or caught of or collecting water resources, processing in aquaculture or in anything else like research, training and inspection of ocean resources [1].

Some of fishing ships consist of many different size and shape. The small ones from wooden driving by oar or sail and the big vessel made by steel. Capacity of the ship that would be built on the shipyard have different characteristic from one shipyard to another. It can depend on fisheries business, usually restricted by capital. Generally there are two ways of making fishing ships in Indonesia :

1) traditional,
2) modern.

On traditional manufactures fishing boats in Indonesia, especially in the shipyard at Bagan Siapiapi, on Riau province usually made by rely on the ability of inherited tradition and hereditary didn't based on function and their designation. Instance of capacity and center of weight those are defined using traditional method.

On the traditional shipyard at Bagan Siapiapi, after the built the ship will be launched into the ocean to estimate capacity and check center of weight. Some people on that area usually using high sinking of ship hull as a reference to define weight of ship, and center of weight define from stability of ship net. This way doesn't accurate so they change a shape and dimension of ship while doing testing.

The habit of community to build a vessel without make a good plan, without a drawing design would be need a long duration to construct of vessel. The center of weight is something important that can be benefits for safety crew and any passenger who boarding it. In the early step designer must be define a point of load at a ship for good stability in shipping [2]. Generally fleets of fishing vessel at Bagan Siapiapi on the operate using a gill net .

Many shipyard in Indonesia still used traditional method on ship manufacture until this day. In fact vessel made by traditional manner can be operate for fishing as well as modern vessel.

However it need some attempt to develop and carry out some modernization on design and manufacture process for traditional shipyard.

This research aims to study capacity and define center of weight of ship net at Bagan Siapiapi.

2.0 LITERATURE REVIEW

2.1 Fishing Vessel

Fishing vessels are vessels that are directly used in fishing operations to pick up fish, animal, or anything plant water [6].Ships in Indonesia are generally made traditionally. Tradition is a hereditary customs (of ancestors) are still running in the community. Generally ship in Indonesia made by traditional method in thinking and acting. This tradition is inherited from ancestors in society until this time.

2.2 Ship Capacity

The capacity of the ship is designed to be sufficient to accommodate fish, fuel, water, engine, accommodation spaces and others room [5]. Thus, the internal capacity of fishing vessels, among other things: the fish hold, engine room, fresh water tank, fuel tank, the accommodation space, and others. Gross ton (GT) is a ship capacity associated with capability of vessel to be loaded.

2.3 Center of Weight

Center of weight is the center of gravity. It's point of working force in down direction. Position of G in the empty vessel define by result from stability experiment, depend on divisions of room on the ship. So as long there are no action to remove, add or reduce a load point of G will not be changed even the ship maneuvering. Figure of 1 explained of specify center gravity.

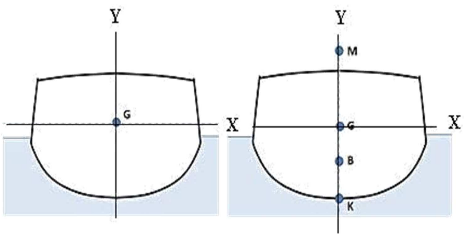

Figure 1: Center of gravity of ship

Notice:

M = point of meta center
K = *Lunas*
B = point of floating

2.4 Stability of Ship

On the fishing process, stability and safety on vessel is main required term to ensure on ship because dangerous environment in many area operation of ship. This is related to characteristic ship operating of crew [4]. Some of requirements on condition to obtain stability in balance are:

1) Floating Force (Fa) = weight force or gravity force (W),
2) Center of floating point and weight point within on the same line,
3) Point of weight of ship define below of meta center line. Figure 2 shows the balance on stable condition of traditional ship model.

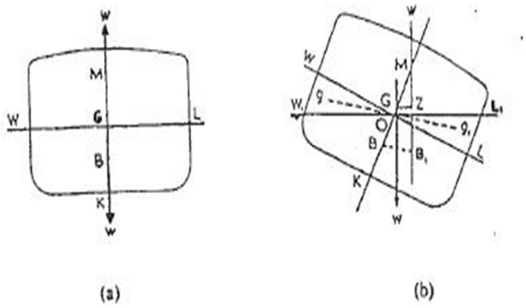

Figure 2: (a) Balance (b) Balance on stable condition

Notice:

B = Floating point
G = Weight point
K = Lunas
M = Point of meta center
W= Weight of ship

3.0 METHODOLOGY

3.1 Density Testing

The density of a substance is ratio between mass with volume of substance. Some mechanical properties of wood is related to specific of weight to describe mass per unit volume. On Figure 3 was shown a flowchart to check out density a substance.

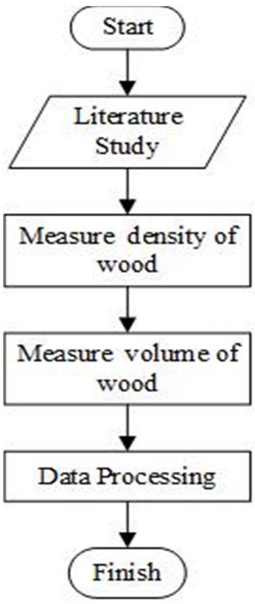

Figure 3: Flowchart testing a density

Table 1: Mass of part of ship net

No	Ship Construction	Quantity	Volume total wood specify	Woods Name	Mass
			(m^3)		(kg)
1	Lunas	1	0.600	Keruwing	540.00
2	Linggi	2	0.380	Resak	340.60
3	Gading-gading	36	0.650	Laban	592.63
4	Balok dek	18	0.380	Keruwing	300.70
5	Badan kapal	1	3.330	Laban	3029.40
6	Landasan mesin	2	0.092	Resak	83.40
7	Putaran Sauh	2	0.040	Laban	37.70
8	Rumah Kapal	1	1.140	Meranti	881.48
9	Box Ikan	1	0.170	Meranti	132.13
10	Mesin	1	-		370.00
			Total		6308.04

Some data would be collected appropriate and systematic such as capacity, point of weight and lay out design about construction of ship. The mass of part of ship net is shown in Table 1. This research was used study case to compare data directly on field or shipyard.

This method was applied to assigning on shipyard at Bagan Siapiapi. Figure 4 was shown flowchart diagram to do it.

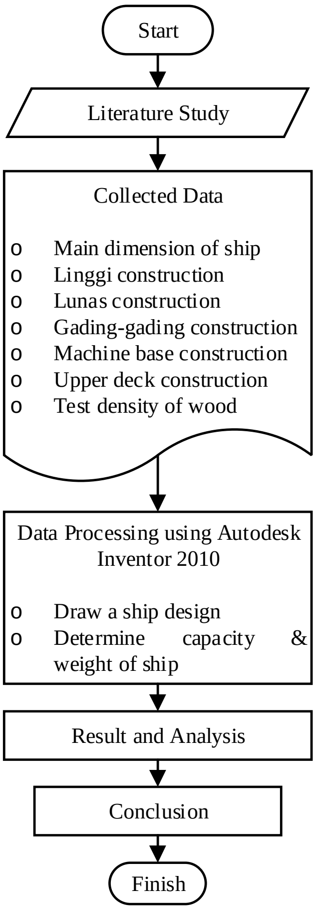

Figure 4: Flowchart of research

4.0 RESULT and DISCUSSION

4.1 Ship Capacity

Mass of the ship net at Bagan Siapiapi shipyard are indicated in Table 1. The ship mass are amount of structure mass construction of ship net

$$W = (\rho_{air\ laut})\ x\ (V_{terendam\ teoritis})\ x\ g$$

$$V_{terendam\ teoritis} = \frac{m_{kapal}}{\rho_{air\ laut}} = \frac{6308.04\ kg}{1025\ {kg}/{m^3}} = 6.15\ m^3$$

$$\begin{aligned} W &= (\rho_{air\ laut})\ x\ \Delta V\ x\ g \\ &= (\rho_{air\ laut})\ x\ (V_{muatan\ penuh}\ x\ V_{muatan\ kosong\ teoritis})\ x\ g \\ &= 1025\ kg/m^3\ x (13.07\ m^3 - 6.15\ m^3) x\ 9.81\ m/s^2 \\ &= 69582.33\ N = 7093\ kg \end{aligned}$$

$$\begin{aligned} W_{max} &= W_{min}\ x\ W_{muat} \\ &= 6308{,}04\ kg\ x\ 7093\ kg \\ &= 13401.04\ kg \end{aligned}$$

The sinking of ship hull is 870 mm. This data obtained from observed on field at shipyard in Bagan Siapiapi. Actually ship capacity can determine through;

$$\begin{aligned} W_{teoritis} &= (\rho_{air\ laut})\ x\ (V_{muatan\ penuh}\ x\ V_{muatan\ kosong\ teoritis})\ x\ g \\ &= 1025\ kg/m^3\ x (13.07\ m^3 - 6.17\ m^3) x\ 9.81\ m/s^2 \\ &= 69381.23\ N = 7072\ kg \end{aligned}$$

$$\begin{aligned} W_{max} &= W_{min}\ x\ W_{muat} \\ &= 6308.04\ kg\ x\ 7072\ kg \\ &= 13380.04\ kg \end{aligned}$$

4.2 Center of Weight and Point Stability of Ship

Position center of weight of ship was determined using commercial software Autodesk Inventor 2010. Figure 5 shows that the center of weight of ship net. The roll angle related to deep sinking a hull of ship is shown in Table 2.

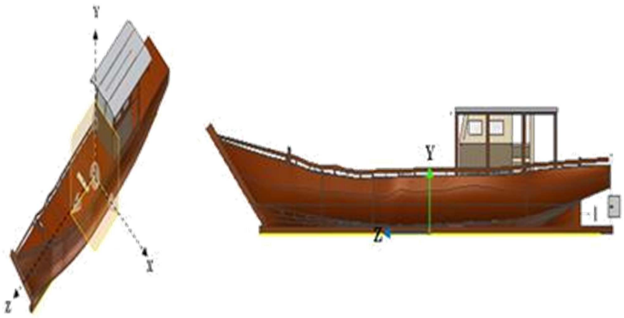

Figure 5: Center of weight of ship net

Empty condition
X = 0.9 mm, Y = 888.5mm, Z = -162.5mm

Full load condition
X = 0.7 mm, Y = 976.7 mm, Z = -600.4 mm

Tabel 2 : Roll angle related to deep sinking a hull of ship.

No	Deep sinking (mm)	Roll angle Front view (^{o})	Roll angle Side view (^{o})
1	823,00	89,24	-84,00
2	860,70	89,38	-81,20
3	898,40	89,50	-81,00
4	936,10	-89,68	-81,90
5	973,80	-89,69	89,00
6	1011,50	-89,74	85,00
7	1049,20	-89,62	80,50
8	1086,90	-89,58	80,30
9	1124,60	-89,63	80,25
10	1162,30	-89,61	80,08
11	1200,00	-89,80	80,03

4.3 Discussion

1.) The depth sinking hull of ship from water level is 870 mm on the condition without load. Autodesk Inventor software shows that condition would be happen if 6.11 m^3 volume of ship submerged. On the other side community on the shipyard at Bagan Siapiapi estimate deep sinking of hull 1200 mm from water level at the full load while on Autodesk Inventor software shown 13.01 m^3 volume ship submerged.

Weight of ship is 13216.6 kg be obtained from calculation whereas real condition maximum weight of ship 13195.6 kg.

There is a difference result between software and real fact amount of 21 kg. Therefore a deep sinking of hull from water level was affected to capacity of load. Capacity of ship net manufactures by shipyard in Bagan Siapiapi is 7.093 kg.

2.) Position center weight of ship net from Autodesk Inventor software 2010 are;

Without load
X = 0.9 mm, Y = 888.5mm, Z = -162.5mm

On full load;
X = 0.7 mm, Y = 976.7mm, Z = -600.4 mm

The result indicates center weight of ship net is affected by working load. In this case the load evenly distributed.

3.) The deep sinking of hull of ship net without load is 823 mm. Roll angle is 89.24 ^{O} and pitch angle is 84^o. The ship would rolling to left and rear. Otherwise deep sinking of hull 1200 mm on the full load and -89,8^o roll angle and 80.03 O at pitch angle while the ship rolling to left and rear.

5.0 CONCLUSION

Capacity ship net at Bagan Siapiapi is 7093 kg and weight at the full load is 13401.04 kg. Position center weight of ship net at Bagan Siapiapi are; X = 0.7 mm, Y = 888.5mm and Z = -162.5 mm. Angle of roll and angle of pitch on the empty load less than full load condition.

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