General Arrangement of Ship Firefighting

By Bambang Antoko

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GENERAL ARRANGEMENT OF SHIP FIREFIGHTING USING DOUBLE HULLS WITH ASYMMETRIC TYPE

Bambang Antoko

Marine Engineering Department, Shipbuilding Institute of Polytechnic Surabaya, INDONESIA.

bambangantoko@gmail.com

ABSTRACT

In dealing with accidents, the ship that fixes it makes a fire engine using double hulls or called catamarans. By using a special asymmetric type of double hulls can increase from a fire fighting boat so that it is more accurate in extinguishing hotspots that appear on ships and in ports that repair fires. Inside the fire engine system is equipped with an air pump (hydrant) and chemical firefighters with a standard of approval. Fire can be dealt with quickly if the extinguishing material matches the type of fire. Fire engines are specially designed units in the ship's general arrangement to extinguish fires that occur in port and ship areas so that fires in the area around the port and ships will be quickly resolved. Therefore, this fire extinguisher system is made with a high-pressure air pump and chemical extinguishing and asymmetric double hull design so that it can be used in accordance with the function of the fire extinguisher.

Keywords: ship, hull, asymmetric, fire engine, fire.

INTRODUCTION

Water transportation is an important requirement in Indonesia. Ships are transportation built to transport people or goods to carry out an operation. However, many factors make the journey using ship transportation to be dangerous, namely the occurrence of ship accidents in the form of burning ships, collisions and others. The accident of this ship is almost 85% caused by human negligence.

In designing a ship, especially for large ships, fire system has been equipped in accordance with needs. However, it did not rule out the possibility of a fire extinguisher on the ship failing. This is certainly dangerous for the crew and passengers. Accidents that cause fires can be overcome quickly if carried out in accordance with the type of extinguishers and the type of fire that occurs. Thus we need a unit that functions as a special ship to overcome the danger of fire that occurs.

Fire engines are specially designed units in the general plan of the ship to extinguish fires that occur in the port area and on the ship so that if there is a fire around the port area and the ship will be quickly easily overcome. Therefore, a fire extinguisher system is made with a high pressure water pump and chemical extinguisher and a double hull design using asymmetric type so that it can be used in accordance with the fire.

BASIC THEORY

Fire Boat Review

A firefighting Ship is a ship that functions as a fire hazard control vessel on the beach, river, dock or sea. In addition, this ship can also function as a Quick Response (SAR) ship in the event of a ship accident at sea. [1]

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Various Types of Hull

Here are shown various forms of the hull as follows: [2]

1. ***Ship with Flat Hull***
   This flat hull ship is a ship that can be used in calm waters. Usually used for ships with low speed. Widely used for tankers, Draft barges are usually smaller vessels. To increase stability, the center of gravity is usually lowered.

Figure 1. Flat Hull

2. ***Ship with Double Hulls***
   This ship with several hulls has a high stability, but the waves generated are smaller so that it is a suitable ship to be operated on the river, but the undulating waters have a high impact on rocking.

Figure 2. Double Hull

3. ***Ship V Hull***
   A ship with a sharp hull like the letter V which it's has a small obstacle so it is more efficient in using fuel. Such vessels are usually used for high speed vessels.

Figure 3. V Hull

4. ***Ship With Tunnel Hull***
   Hulls like this are intended to reduce friction, in contrast to catamarans because of the inner angle of the taper, making it easier to maneuver the ship.

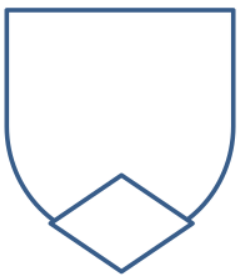

Figure 4. Tunnel Hull

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5. *Ship With Pontoon Hull*

Ships built on pontoons, such vessels are very stable, and can be run easily using outboard engines or being pulled by cables for river crossings. Not efficient when used for long distance shipping.

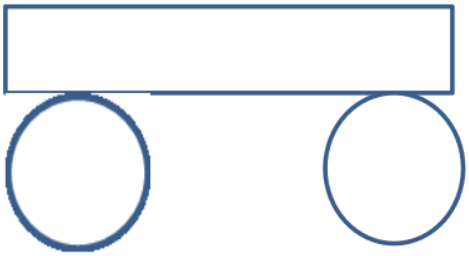

Figure 5. Pontoon Hull

Concept of Model Double Hulls

The ship which will be planned as a firefighting ship is expected to have good movement and high comfort and safety. For an analysis of the flow contained or formed by the catamaran hull model can be seen in the following figure. [3]

Model A Model B Model C Model D

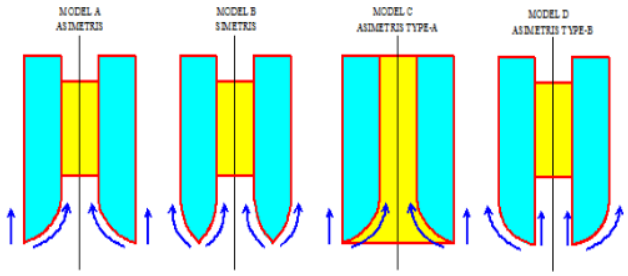

Figure 6. Fluid Flow Shape

1. Twin hull ship model with both sides symmetrical stream line (Model B)

   It is assumed that as two monohull vessels whose two hulls are connected to a certain distance, they will have the same wave system as a stream line. Around the ship immersed in water will develop and produce movement. This system can be seen schematically in the picture. And maybe it will be divided into two kinds of waves, namely divergent waves and transverse waves and both are generally found near the bow and stern of the ship and move forward with the hull.

2. The double hull ship model is asymmetrical on both sides, the hull on the outside of the stream line and the inside is straight. (Model D)

   The front end is the point where the fluid flow will spread sideways (following the stream line) almost the same as the picture above, it's just that the inside is straight so that the flow follows the shape of the ship body straight to the ship's ugliness. So that when it applied to this form it will still cause a fairly large lateral wave.

3. The double-hull ship model is asymmetrical on both sides, the hull is streamlined inside and the outside is straight. (Models A and C)

   Fluid flow formed from the bow of the ship is concentrated into the middle of the ship (between two hulls) moving to the ship's wreckage, while to the side the direction of the

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straight flow follows the shape of the hull's outer body to the stern as shown in the picture. This model is suitable for ships operating in the river or nearby areas where there are many people, because this catamaran model does not cause a larger lateral wave compared to the catamaran model which is streamlined outside. What distinguishes model A and model C is only the extent of the decks that exist on each of these ships, the model ship C has a deck area that is larger than the model ship A.

After finding the desired model has been determined we get a general description of the shape of the catamaran designed. So that the waves formed by the catamaran are not large, do not disturb the surrounding area and the deck is wider then in this design use a catamaran model with symmetrical sides both in the streamline and it's a straight outside (Model C) which we then determine the main size of the ship catamaran.

Classification of Types of Causes of Fire

A fire is a flame, whether small or large in a place that we don't want it to be, harm in general is difficult to control [4].
A fire can occur if there are 3 things as follows:

1. There are combustible materials in the form of solid liquid or gas (wood, paper, textile, gasoline, oil, etc.)
2. There are high temperatures caused by heat sources such as Sunlight, Electricity (shortcut relation, heat mechanical energy (friction), Chemical Reactions, Air Compression
3. There is enough oxygen (02) in the womb. The greater the oxygen content in the air, the greater the flame will be. If the oxygen content is less than 12% there will be no fire. Under normal circumstances the oxygen content in the air is 21%, effective enough for a fire. If the three elements are sufficiently available then the fire occurs. If one of the 3 elements is not available in sufficient quantities then a fire cannot occur.

So the fire can be put out in three ways, namely:

By lowering the temperature below the fire temperature

a. Eliminating acidic substances
b. Keep flammable items away

Fire Grouping

The classification of fires according to the regulation of the Minister of Manpower and Transmigration Number 04 MEN / 1980 Chapter I Article 2, paragraph 1 categorizes fires into 4 namely categories A, B, C, D. Whereas the National Fire Protection Association (NFPA) establishes 5 categories of causes of fire, namely classes A, B, C, D and K. [5]

Lines plan

The outer side of the hull is curved in some cases where there is bending, the depiction of the hull on a piece of drawing paper is called a line plan (lines plan / ship's lines / lines), the shape of the hull in general must follow the needs of buoyancy, stability, speed, engine strength, if the motion and the important thing is the ship can be built. [6]

General Arrangement

The general plan of a ship can be defined as the design in the determination or marking of all the required space, the intended space such as cargo space and engine room and accommodation, in this case called superstructure (upper building). Besides that, it is also planned to place equipment and the location of roads and some other systems and equipment.

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METHODOLOGY

Problem Research

Fire extinguisher catamaran design as a solution to overcome ship fire and uncontrolled ship port fires.

Variable Research

1. CSA
2. Body Plan
3. Lines Plan
4. General Arrangement

Data Collection Technique

Basic data on various types of catamarans, fire engines and supporting data obtained from literature and interviews.

Data Processing Techniques

With numerical computing with the help of software in the form of AutoCAD, Maxsurft and Solidwork as well as MS Excel with the minimum hardware specifications used as follows:

1. Laptops with a minimum of Core i5 processor and 4GB RAM.
2. Hard disk 750 GB.

Output Data

Pictures, graphs and analysis tables about:

1. Ship's Main Size
2. Lines plan.
3. General Plan
4. 3-dimensional design drawing.

RESULT

Requirement

The planned catamaran ship is a firefighting ship which is more laid out for its level of stability and the fire extinguishing system used so that the ship must be equipped with supporting equipment as a function of the ship. Loaded ship is 0.5 meters with a maximum speed of 20 knots.

Table 1. Parameter design

Hull Form	Double Hull Asymmetric
Draft	0,5 m
Vmax	20 knots
Crew	5 person
Engine	Out board
Material	Fiber glass
Equipment	Safety equipment
Pax	28 persons

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Principle dimension

1. ***Comparative Vessels***

   The data for comparative vessels and their main size comparisons can be seen in Table 3. This vessel data is used as a basis and reference in determining the main size of new ships.

2. ***Optimization Parameters***

   Optimization of the comparison of the main size of the comparative ship is used as a reference in determining the main size of the ship in the pre-design if previously the ship laden value (T) of 0.5 meter has been determined. From the comparative prices in table 3, we can find out the minimum and maximum price comparisons of the comparator's main sizes. In the design process is taken as a parameter to determine the main size of the ship only the ratio of Lwl / B and B / T. comparison ship. By optimizing the comparison of the main ship sizes, the main ship sizes are obtained:

   L = 13.12 m Bl = 1, m Bwl = 4 m T = 0.5 m H = 1.4 m

Lines plan with Maxsurf and Autocad

After determining the main size of the ship, the hull is designed by entering the main size of the ship into the Maxsurf software. The type of catamaran has 2 hull designs so the maxsurf software is designed only 1 hull. Then the hull is divided into 2 each 1 m wide and detailed images in the AutoCAD software.

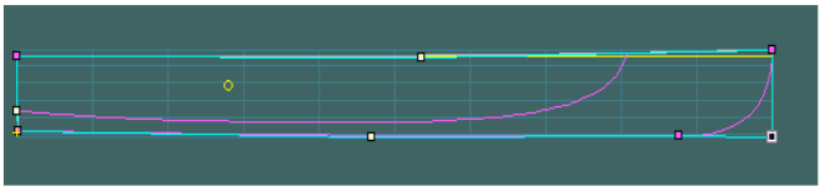

Figure 7. Basic Design Lines

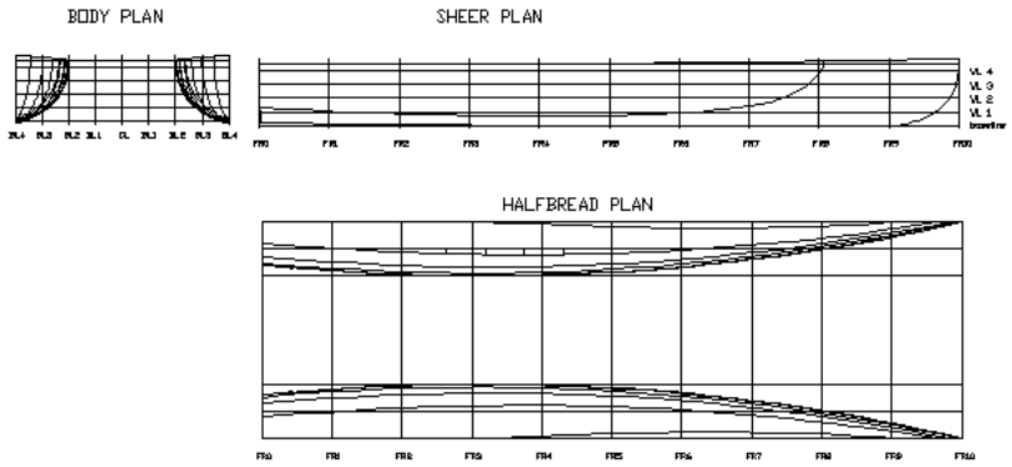

Figure 8. Lines Plan

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Ship General Arrangement

In this discussion, it will be explained about the large volume of fuel tanks, lubricants and fresh water for engine coolers while the ship is operating. For general plans, see details in the appendix.

$$Wfo = \frac{a \times (EHPMe) \times Cf}{V \times 1000}$$

Where:

a = distance sailing
= 3,000 km x 2
= 6,000 km
= 3,52 sea-miles

V = velocity
= 20 knots

EHP ME = 98% x BHP ME
= 98% x 20
= 19.6 HP

Cf = coefficients fuel oil

Wfo = 0.18 kg/BHP/Jam (0,17 – 0.18)
= 3.12 x 19.6 x 0.18/(10 x 10000)
= 11,01 x 10^{-4} ton

For extra of fuel oil include with addition 10% capacity :

Wfo = 110 % x 11,01 x 10^{-4}
= 12,21 x 10^{-4} ton for 1 trip

1. ***Oil lubrication tank (Wsc)***

If know with specific oil consumption at100 % load (with tolerance 13.5 is 1.3 gr/kwh). So weight of lubrication oil Wsc is :

Cl = coefficient lubrication oil
= 0.0025 Kg/HP jam (0.002 ~ 0.0025)

Wsc = 3.12 x 19.6 x 0.002 /10000
= 15.2 x 10^{-6} Ton

2. ***Fresh water tank (Wfw)***

Determination of the volume of fresh water tank is planned to accommodate the supply of fresh water for the needs of the main engine (Wfw) engine coolant. The need for fresh water for cooling the main motor as follows:

Wfw = 2 x 10-4 Ton

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General arrangement of firefighting ship. as shown

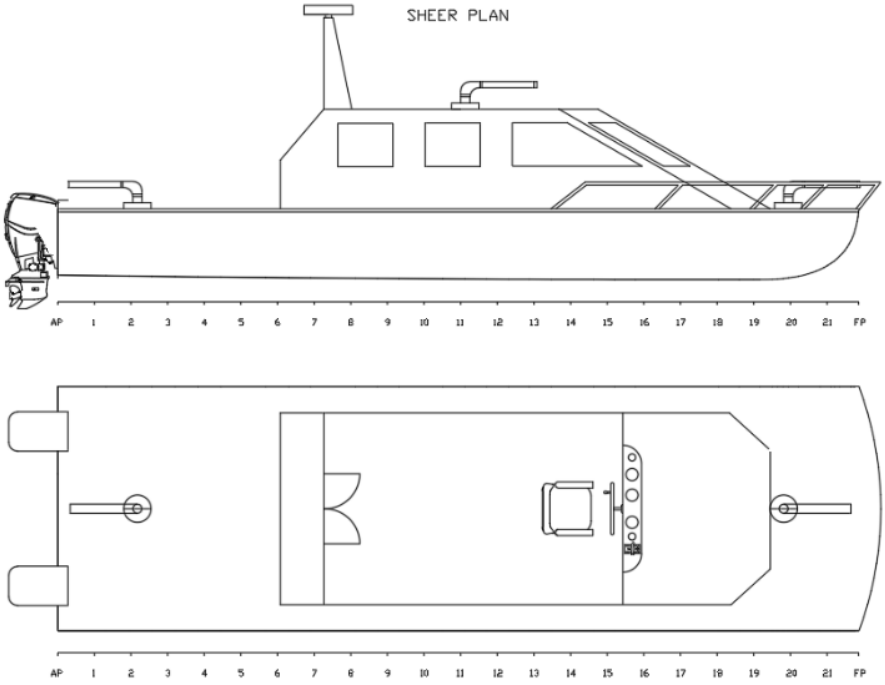

Figure 9. General Arrangement

List of equipment

1. Navigation and communication
    a. System control 1 set
    b. System steering 1 set
    c. Switch Panel 12– DC
    d. Marine radio 1 set
    e. Handy talkie 2 set
    f. Side light 2 unit
    g. Search light 1 unit
    h. Warning light 2 unit
2. Equipment of safety
    a. Life buoy
    b. Life Jacket
    c. P3K
    d. Bed Portable
    e. Oxygen Tube
    f. Diving
3. Equipment fire fighting
    a. CO 2
    b. Foam

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c. Water jet pump

4. Machinery deck

a. Bolder 2 set

DISCUSSION

Based on the results of research that has been done by the author, namely Fire Boat Design, which functions as a fire boat in the port area and as a SAR or patrol in order to improve the rapid fire fighting system, it can be concluded some technical information as follows:

1. By using the optimization comparison design method of the comparator ship, the main size of the multifunctional catamaran is L = 13.12 m B1 = 1, m Bwl = 4 m T = 0.5 m H = 1.4 m

2. General Arrangement Results (general plan) of the ship are designed according to the needs, namely for firefighters at the port and ship.

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