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Analysis Of The Placement And Needs Of General Cargo Ship Tanks With DWT 3650 Tons

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Abstract

A general cargo ship is a ship that carries various kinds of cargo in the form of goods. The goods transported are usually in the form of goods that have been packaged and do not require special care, are not easily damaged, or die. The tank is a closed part of the ship's structure and is usually found under the ship, which functions to store either ballast water or fresh water on the ship. General cargo ships are also equipped with various types of tanks, including fuel oil tanks, diesel oil tanks, lubricant oil tanks, fresh water tanks, and ballast tanks. Method of calculating tank volume requirements using the Sipson method. From the calculation results obtained a fuel oil tank volume of 80.610 m^3, a diesel oil tank of 17.083 m^3, a lubricating oil tank of 19.359 m^3, a freshwater tank of 78.835 m^3, and a ballast water tank is 619.091 m^3. The location of the placement of each tank is sections number 33-43, 44-46, 47-49, 50-58 and 59-125.

Keywords: Tank, Ship Construction, Sipson, Regulation

1. Introduction

A general cargo ship is a ship that carries goods, both in large and small volumes. The goods transported are usually goods that have been appropriately packaged. This cargo ship is designed in such a way to facilitate maximum transportation. And the place can be reasonably comprehensive and quiet. On board the vessel, the equipment must be complete for a system to run smoothly. The ship's tank is a tool that must exist to support the existing system.

Fig. 1. General cargo in operation [1]

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There are tanks used on ships, for example, fuel oil tanks, diesel oil tanks, lubricating oil tanks, fresh water tanks, and ballast tanks. Each of these tanks is usually still subdivided by name according to its function. For example, fuel tanks are divided into three types: storage, setting, and daily. For the tanks on board, the ship must meet the requirements of the classification bureau, namely the agency authorized to conduct inspections and issue approvals so the ship can be allowed to sail or operate. The conditions must be met usually related to the number, location, technical provisions, safety, and tank volume [2][3].

According to regulations from the Indonesian Classification Bureau, the placement of tanks is also regulated by applicable rules, such as Daily tanks (service tanks) are placed at least 2.5 m above the central motor crankshaft axis, for storage tanks or bunkers from the fuel system placed on a deck that bottom or double bottom and must be isolated from other rooms. From the abovementioned regulations, it is essential to understand the planning of the existing tanks on the ship. Even though it looks simple, or you can say it's just a tank, there are many rules. The number of regulations related to the tank is because the tank is a vital thing. After all, a problem with the tank will affect the operation and safety of the ship and passengers, so the tank must be planned correctly in terms of the number [3][2], location, equipment, and volume provided. Determination of unsymmetrical tank volume requires several methods. The method can be by manually using formulas, software, or computer applications to speed up calculations. The use of CAD or Maksurf software is commonly used.

1.1. Section Tank structure

The ship's tank is a closed part of the ship's structure and is usually found under the ship, which functions to store water, either ballast water or fresh water on the ship. General cargo ships are also equipped with various types of tanks, including fuel oil tanks, diesel oil tanks, lubricants oil tanks, fresh water tanks, and ballast tanks.

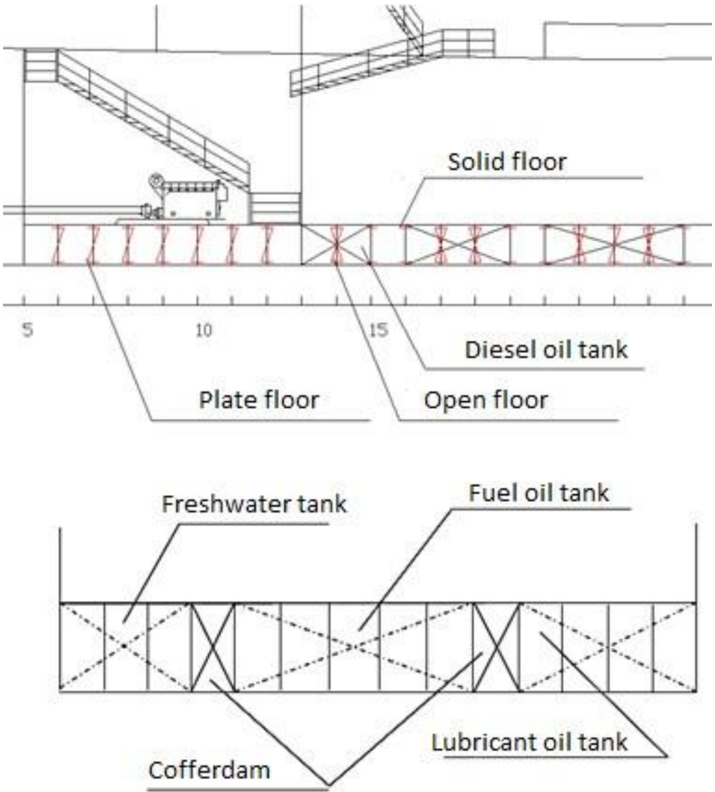

Fig. 2. tank ship overview [5]

Fuel Oil Tank and Diesel Oil Tank is the fuel on board is generally MFO (marine fuel oil) and MDO (marine diesel oil). Both types of fuel have their own or separate tanks. FO oil is commonly used when ships are sailing, from BOSV to EOSV. It is thicker, heavier, but cheaper. Before use, the boiler preheats this oil to make it more dilute. DO oil is used during exercise, arriving, or departing. It is more watery, lighter, and does not require a heating process like FO oil. However, the price is

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higher. Due to specific considerations, some ships only use MDO. Bunker tanks are usually located outside the engine room area, typically double-bottom tanks or tanks on either side. This tank is used to receive supply bunkers, MFO, or MDO. The capacity is the largest among other fuel tanks. Settling tank is several settling tanks on the ship. It can be more than two tanks. MDO settling tank and MFO settling tank. The fuel from the bunker tank is transferred to the settling tank before going to the service tank. Service tank is usage tanks, the number can be one or more. The fuel in this tank has been treated and is ready for use by the aircraft: main engine, auxiliary engine, or boiler. To calculate the need for fuel oil using and diesel oil weight calculation the following equation [6][7].

$$Wfo=(Pbme \times bme + Pae \times bae) \times (S/V_{Serv}) \times 10^{-6} \times 1{,}3 \quad (1)$$

$$Wdo = (0{,}1 \sim 0{,}2) \times Wfo \quad (2)$$

Where, Pbme is the total power of the main engine in Kw, Bme is the primary engine-specific fuel consumption, and Pae is the total power of the auxiliary engine in Kw. Bae is the fuel consumption for diesel engines, Vs is ship speed, and S is sea trial.

Lubricating oil (LO) or lubricating oil is significant in maintaining that engine components work optimally and achieve an appropriate service life. LO Sump Tank This is the system oil reservoir tank on the main engine (ME). The pump circulates the oil in the sump tank, lubricates certain parts of the engine, exits to the charter, and then returns to the sump tank. LO Carter AE In the auxiliary engine, the LO Carter acts like a sump tank. The pump circulates the LO, exits, and returns to the charter. Calculation of the weight of lubricating oil using the following equation.

$$W\ lub = ((Pbme \times bme) + (Pae \times bae)) \times S/V_{serv} \times 10^{-6} + add \quad (3)$$

Where, add an addition of 10% as a consideration of the safety factor. Pbme is the total power of the main engine in Kw. Bme is 1.2 ~ 1.6 gr/Kw (for four-stroke engine). Pae is the total power of the auxiliary engine in Kw. Bae is the specific fuel consumption for diesel engines. Vs is the ship's speed, and S is the sea trial [8].

Fresh Water Tank, ships need much fresh water. Ships with 20 crews can spend at least 8-12 tons daily. Fresh water is used for accommodation and engine cooling systems (freshwater cooling). Fresh water tanks are located in the front (Fore Peak Tank) and behind (After Peak Tank). Fresh water is filled at the port via land installations, tanker cars, or water barges. Calculation of Fresh Water is Tank Freshwater weight, MCK water weight, and Cooling water weight using the following equation.

$$W_{fwd} = \frac{drinking\ water\ needs\ x\ number\ of\ crew\ x\ total\ sailing\ days}{1000} \quad (4)$$

$$W_{mck} = \frac{drinking\ water\ needs\ x\ number\ of\ crew\ x\ total\ sailing\ days}{1000} \quad (5)$$

$$W_{fwo} = 0{,}14 \times Pbme \times S/V \times 10^{-3} + add \quad (6)$$

Where Add is 10% Wfwo. Pbme is total power of main engine in Kw, Vs is ship speed and S is sea trial. Therefore, the total weight of fresh water is as follows.

$$W_{fw} = W_{fwd} + W_{mck} + W_{fwo} \quad (10)$$

A ballast tank is used for the ship's stability, which is very important for safety and comfort. It is double bottom tanks on either side of the ship. These tanks are filled with seawater. Ballast water is filled (ballasting) or discharged (deballasting) for some reason. Corrects tilt, adjusts trim when the ship is unloading.

2. Materials and Methods

The method used in this research is to model the shape of the ship's tank in the double bottom. Modeling is intended as a comparison or calibration material from volume calculations carried out with the empirical formula of the Simpson method. The research was carried out in stages, using CAD

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software to make a tank model from the ship. In this study, the general cargo ship model will be used, with ship data as follows.

Table 1. Ship dimension

Type Kapal	General Cargo
Length Between Perpendicular (LBP)	92,15 m
Length Water Line (LWL)	94,45 m
Breath (B)	16,5 m
Defth (H)	7,8 m
Draught (T)	5,4 m
Speed (Vs)	12 knot
Route (Makassar – Tarakan)	517 seamiles

3. Result

3.1. Weight And Volume Calculation

The calculation of the volume of the tanks on the ship must be carried out in the planning before the ship is built. The planning is based on the needs of the crew and the needs of machinery and the classification rules used. The calculations are based on the line plan drawing, the general arrangement, the tank planning drawing, or the tank arrangement drawing. After the ship is finished, the tanks whose volume has been calculated can be filled with fluid, and only then can they be compared or compared with the calculation results. Calculation results can be seen in the following table.

Table 2. Modulus and profile

Ship Tanks	Weight of Fliuda	Volume of Fluida
fuel oil	64,936 ton	68,354 m^3
Diesel Oil	12.987 ton	14.758 m^3
lubrican oil	15,810 ton	17,566 m3
Fresh water	74,056 ton	74,056 m3
Ballast water	620,500 ton	605,366 m3

3.2. Calculation Of Tank Volume

The tank's volume calculation is done using Simpson's equation. Then the results of the calculation of the volume requirement are compared with the volume of fluid needed by the ship during operation. As shown in the table, analysis and calculations are carried out by trial and error until it reaches the required tank volume.

Table 3. Tank Volume of fuel oil calculation

Section (1HDB)	Ordinat	FS	O.FS	Section (0.5HDB)	Ordinat	FS	O.FS
33	6,16	1	6,16	33	5,82	1	5,82
34	6,33	4	25,32	34	5,99	4	23,98
35	6,49	2	12,98	35	6,16	2	12,32
36	6,64	4	26,57	36	6,32	4	25,28
37	6,79	2	13,58	37	6,47	2	12,95
38	6,93	4	27,73	38	6,62	4	26,49
39	7,07	2	14,14	39	6,77	2	13,53
40	7,21	4	28,83	40	6,77	4	27,06
41	7,34	2	14,67	41	6,90	2	13,81
42	7,46	4	29,83	42	7,04	4	28,14
43	7,57	1	7,57	43	7,16	1	7,16
Section (0HDB)	Ordinat	FS	O.FS	Area Section	Ordinat	FS	O.FS
33	4,06	1	4,06	1HDB	80,783	1	80,783

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Section (1HDB)	Ordinat	FS	O.FS	Section (0.5HDB)	Ordinat	FS	O.FS
34	4,24	4	16,94	0.5HDB	76,560	4	306,238
5	4,41	2	8,83	OHDB	57,520	1	57,520
36	4,59	4	18,35			∑	444,541
37	4,76	2	9,52				
38	4,93	4	19,73				
39	5,10	2	10,20				
40	5,27	4	21,07				
41	5,43	2	10,86				
42	5,59	4	22,35				
43	5,74	1	5,74				

V Total = $\frac{1}{3 \, x \, 0.544 \, x \, \sum m^3}$

=80,610 > 68,3 54

The Fuel tank is located between sections number 33-43.

Table 4. Tank Volume of diesel oil calculation

Section (1HDB)	Ordinat	FS	O.FS	Section (0.5 HDB	Ordinat	FS	O.FS
44	7,6753057	1	7,675	44	7,276778	1	7,276778439
45	776,963	4	31,079	45	7,383749	4	29,5349958
46	7,8527285	1	7,853	46	7,480399	1	7,480399122
Section (OHDB)	Ordinat	FS	O.FS	Area Section	Ordinat	FS	0.FS
44	4,81	1	5,887537441	1HDB	18,155	1	18,15480648
45	4,92	4	6,026595149	0.5HDB	17,253278	4	69,01311172
46	5,03	1	6,157610944	OHDB	7,0395465	1	7,039546498
44	4,81	1	5,887537441			∑	94,2074647

V Total $\frac{1}{3 \, x \, 0.544 \, x \, \sum m^3}$ = 17,082 > 14,758

The diesel tank is located between sections number 44- 46.

Table 5. Tank Volume of lubrican oil calculation

Section (1HDB)	Ordinat	FS	O.FS	Section (0.5 HDB	Ordinat	FS	O.FS
47	8,0356833	1	8,036	47	7,701947	1	7,701947437
48	8,0795099	4	32,318	48	7,755565	4	31,02225866
49	8,1174477	1	8,117	49	7,801706	1	7,801705953
Section (OHDB)	Ordinat	FS	O.FS	Area Section	Ordinat	FS	0.FS
47	6,494019	1	6,494019394	1HDB	18,155	1	18,15480648
48	6,584526	4	26,33810243	0.5HDB	17,253278	4	69,01311172
49	6,662863	1	6,662863234	OHDB	7,0395465	1	7,039546498
						∑	94,2074647

V Total = $\frac{1}{3 \, x \, 0.544 \, x \, \sum m^3}$

= 19,359 > 17,566

The lubrican tank is located between sections number 47-49.

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Table 6. Tank Volume of freshwater calculation

Section (1HDB)	Ordinat	FS	O.FS	Section (0.5HDB)	Ordinat	FS	O.FS
50	8,0795099	1	8,080	50	7,755565	1	7,755564665
51	8,1174477	4	32,470	51	7,801706	4	31,20682381
52	8,1510798	2	16,302	52	7,841971	2	15,68394119
53	8,181976	4	32,728	53	7,877939	4	31,51175558
54	8,2044656	2	16,409	54	7,911177	2	15,8223547
55	8,2046696	4	32,819	55	7,935421	4	31,74168575
56	8,2048736	2	16,409	56	7,935569	2	15,87113816
57	8,2050776	4	32,820	57	7,935717	4	31,74286689
58	8,2052816	1	8,205	58	7,935864	1	7,935864365

Section (0HDB)	Ordinat	FS	O.FS	Area Section	Ordinat	FS	O.FS
50	6,584526	1	6,584525608	1HDB	76,443	1	76,44292215
51	6,662863	4	26,65145293	0.5HDB	73,728	4	294,9110046
52	6,728232	2	13,4564646	0HDB	63,401	1	63,40061556
53	6,779841	4	27,11936205			∑	434,7545423
54	6,816911	2	13,63382255				
55	6,839722	4	27,35888674				
56	6,85059	2	13,70118074				
57	6,852042	4	27,4081681				
58	6,846574	1	6,846574				

$$V\ Total = \frac{1}{3\ x\ 0.544\ x\ \sum m^3}$$

= 78,835 > 74,056

The Freshwater tank is located between section number 50-58.

The rest is used for ballast water storage. The results of calculations using the Simpson equation yielded a volume of 619,090. The ballast water tank is located between sections number 59-125. The placement of the tank can be seen in the following figure.

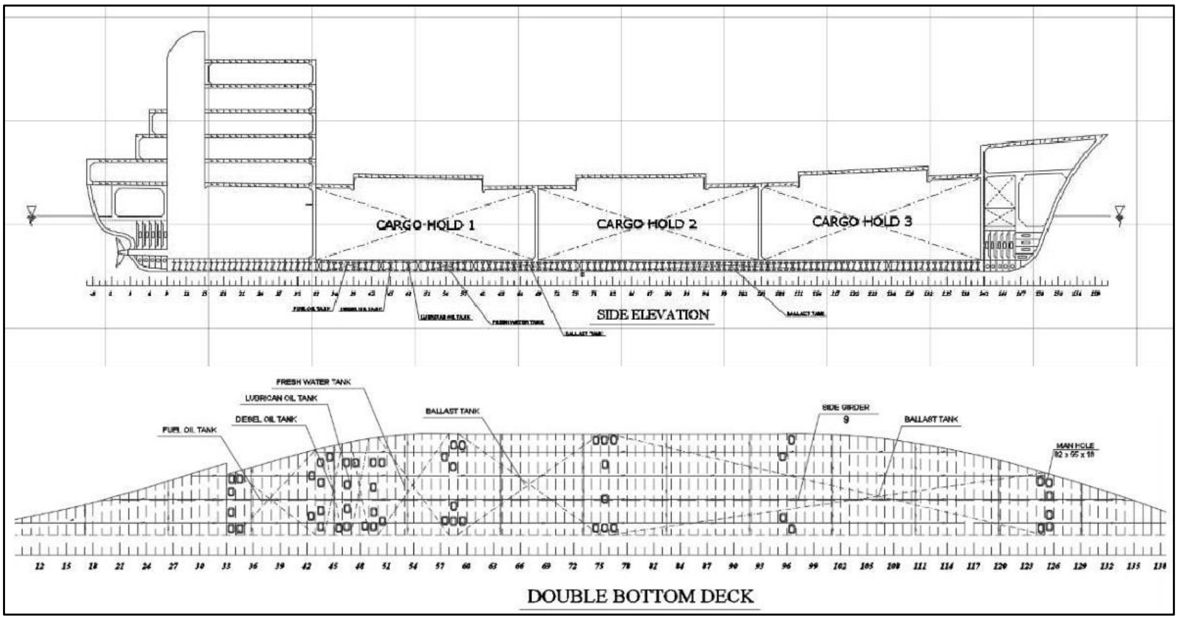

Fig. 4. Placement of the ship tank

4. Conclusions

Based on the tank calculation using the Simpson equation, the laying of the tank is obtained. The fuel tank is located between sections number 33-43. The diesel tank is located between sections number 44-46. The lubrican tank is located between sections number 47-49. The freshwater tank is located between sections number 50-58. The ballast water tank is located between sections number 59-125.

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