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Redesigning a 300 ft Barge as a Floating Hotel to Support Tourism in the Thousand Islands

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Abstract– The Thousand Islands is a marine tourism area located around Jakarta, which has several beautiful and charming islands. Many cargo barge decks are not operating because natural resources are starting to decline. One of the innovations to increase tourist attraction is by designing a floating hotel using a 300 ft barge as a supporting facility in the Thousand Islands. Determination of the main size of the ship using the method of comparison of several barge sizes of 300 ft and stability calculations using the A.N-Krylov method with maxsurf software. Obtained ship size LOA = 91.5 m, B = 27.5 m, H = 5.5 m, T = 4.3 m. The superstructure modification has three decks, each deck being 3 m high with a different length. The results of the floating hotel design have a total of 52 rooms that can accommodate 116 visitors. There are superior room types, deluxe rooms and suite rooms and are equipped with other facilities. The floating hotel's safety equipment includes 8 lifebuoys, 188 lifejackets, 4 lifeboats and 8 liferafts. The stability of the floating hotel meets the intact stability criteria of the IMO standard A.749(18) Ch3 - Design criteria applicable to all ships.

Keywords– Barge 300 ft, Floating Hotel, Marine Tourism, Thousand Islands.

I. INTRODUCTION

Indonesia is a country that has natural beauty and ethnic diversity and cultural uniqueness [1]. Named the most beautiful country in the world which has more than 17,000 islands with a coastline of more than 50,000 kilometers [2]. Since ancient times, Indonesia has been the center of attention for the attractiveness of foreign and domestic tourists in the tourism sector. According to the World Tourism Organization, tourism is a phenomenon that affects the social, cultural, and economic sectors and requires the movement of people from their usual environment to countries or places outside the environment, for professional, personal or business purposes [3].

One of the places that has become a tourism destination is the Thousand Islands, where the expanse of sea and the breadth of the island are very charming. The island which is a group of islands is located north of Jakarta [4], so it is very easy to reach from the city. Even though it's called the Thousand Islands, that doesn't mean there are a thousand islands [5]. This island consists of hundreds of small islands inhabited by local natives. There are two districts in the Thousand Islands, namely the North Thousand Islands District and the Thousand Straits Islands District. Has 110 islands that have great potential to be used as marine tourism development.

Marine tourism activities that can be carried out in the Thousand Islands include diving, snorkeling, water sports, mangrove forests, staycations, mackerel hunting, shark viewing, and turtle breeding [6]. There are several islands in the Thousand Islands which are leading tourist attractions. The islands include Ayer Island, Bidadari Island, Kotok Tengah Island, Sepa Island, Putri Island, Untung Jawa Island, Pramuka Island, Tidung Island, Payung Island, Harapan Island, Sebira Island, Kelapa Island, Pari Island, Lancang Island, Macan Island., Pelangi Island, Pantara Island, and Matahari Island. From 2018 to 2021 the total number of tourists visiting the Thousand Islands will reach 1,863,058 [7]. The number of tourists each year has decreased, this figure indicates that the Thousand Islands need to increase the potential of tourist areas as an attraction for tourists who will visit. Minister of Tourism and Economy Sandiaga Uno said "The Thousand Islands have tourism potential that can be developed to be beautiful and attractive, but we have not yet built quality and sustainable destinations" [8].

A potential tourist area is not called a destination if there is no 6A component namely attraction (actions; natural, artificial, purpose built, heritage and special events), accessibility (access; the entire transportation system consisting of routes, terminals and vehicles), amenities (accommodation facilities, catering, rituals and other tourist services), available packages (pre-arranged packages by intermediaries and principals), activities (all activities available at the destination and what consumers will do during their visit at the destination) and ancillary services (additional services used by tourists; banks, telecommunication, postal, newspapers , hospitals and others) [9].

One of the innovations that support the area's potential to attract tourists in the Thousand Islands is the design of a floating hotel using barges as a tourism support. A floating hotel is a luxury ship with facilities as befits a five star [10]. Here tourists can enjoy the facilities that are owned by floating hotels made ofbarge.

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Barge Or a barge is a type of ship with a flat hull or a large box that floats, which functions to transport goods or cargo such as coal, sand, wood and others [11]. In general, barges do not have a propulsion system, so tugboats are needed to tow them. However, currently, many barges are traded or leased in Indonesia [12]. This is because natural resources are starting to run low so that many barges are not put to good use. As a result of this phenomenon, many ship owners produce barges for other purposes such as ship block transport, floating fish ports, floating power plants, floating hospitals, floating restaurants, and supporting tourism activities [13].

The barge used is a 300 feet barge type as a reference for determining the main size of the floating hotel hull. We collected some data for a 300 feet barge comparison ship and selected a barge that has the most ideal main size for designing a floating hotel. The stability calculation method used is the A.N-Krylov method and for drawing design using Autocad software, Maxsurf software and SketchUp software.

II. METHOD

A. Method of collecting data

The method used in collecting data related to this study uses indirect (secondary) data collection methods. The data needed are comparison ship data, tourist data, location data and other supporting data.

B. Comparison Ship Method

Determination of the main size of the floating hotel using the comparison ship method. The comparison ship method here is to analyze some data of a comparison ship with a barge size of 300 ft and choose the barge that has the most ideal main size for designing a floating hotel.

C. Hull Redrawing

Redrawing or redrawing the barge hull using the maxsurf modeler software. In this method, major size corrections are made to the actual hull design. In table 1, the data for a 300 ft comparison vessel is not known for the block coefficient (cb), midship coefficient (cm), prismatic coefficient (cp), waterline area coefficient (cw), ship displacement (Δ), and ship displacement volume (∇). The following is the formula used in the calculation:

- Block Coefficient (Cb)
  $Cb = 1.115 - ((0.276 \times Vs_{(knot)} / (Lbp_{(m)}{}^{0,5}))$ (1)
- Midship Coefficient (Cm)
  $Cm = 0.977 + 0.085 \times (Cb - 0.60)$ (2)
- Prismatic Coefficient (Cp)
  $Cp = \frac{Cb}{Cm}$ (3)
- Water Plan Area Coefficient (Cwp)
  $Cw = Cb / (0.471 + 0.551\ Cb)$ (4)
- Displasment (Δ)
  $\Delta = LOA \times B \times T \times Cb \times c$ (5)
- Volume Displasment (∇)
  $\nabla = LOA \times B \times T \times Cb$ (6)

D. Stability Calculation Method

To calculate the stability of the ship designed using the A.N-Krylov method to obtain results that are in accordance with the IMO A.749(18) Ch3 standard - Design criteria applicable to all ships. The results of stability calculations use the maxsurf stability software.

III. RESULTS AND DISCUSSION

A. Ship Main Size Determination Analysis

The following is the data of a 300 ft barge ship which is used as a reference for determining floating hotel hulls:

TABLE 1.
COMPARISON VESSEL DATA OF 300 FT BARGE

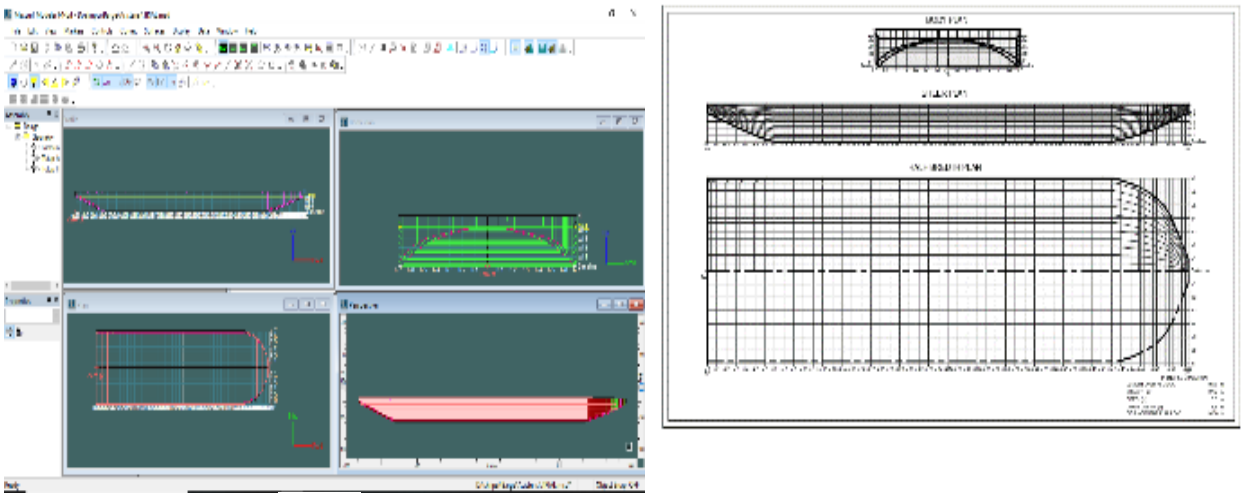
No	Vessel Name	LOA (m)	B (m)	H (m)	T (m)	DWT (ton)	Source
1	300 ft Deck Cargo Barge 3 Sister	91.5	24.4	5.5	4.3	7000	vlmaritime.com
2	Start Marine 3037	91.5	24.3	5.5	3.6	7476	kapalaku.com
3	18 Deck Cargo Barge	91.5	24.4	5.5	4.2	7498	allship.net
4	300 ft Unmanned Deck Cargo Barge	91.5	24.4	5.5	4.2	7800	dynamarinegroup.com
5	300 ft Citra 3001 deck Cargo Barge	91.5	24.4	5.5	4.2	-	citrashipyard.com
6	300 ft Deck Cargo Barge 2 Sister	91.5	27.5	5.5	4.3	8154	vlmaritime.com

In table 1. the data for the comparison ship is 300 ft barge, determined using a ship with the name 300 ft Deck Cargo Barge (2 Sisters). This ship has the widest breadth (B) dimension, allowing for more efficient placement of compartments than other comparison ships.

B. Redrawing Floating Hotel Hull

The calculation results obtained as redrawing corrections for floating hotels are as follows:

- Block Coefficient (Cb) = 0.855
- Midship Coefficient (Cm) = 0.998
- Prismatic Coefficient (Cp) = 0.857
- Water Plan Area Coefficient (Cwp) = 0.871
- Displasment (Δ) = 9482.268 ton.
- Volume Displasment (∇) = 9250.993 ton.



(a) (b)

Figure 1 (a) Hull Modeling Using Software Maxsurf Modeler (b) Lines Plan For Floating Hotel Hul

These values are used as comparison corrections when modeling floating hotel hulls with the maxsurf modeler software. The limit for the difference in correction tolerance is set at a maximum of 5% [14].

TABLE 2.
CORRECTION OF THE DESIGN COEFFICIENT BY CALCULATION

No	Measurement	Maxsurf	Calculation	Unit	Ratio
1	Block coefficient (Cb)	0.855	0.855	-	0.000%
2	Max sect. area coefficient (Cm)	0.998	0.998	-	0.000%
3	Prismatic coefficient (Cm)	0.857	0.857	-	0.000%
4	Displasment	9486.000	9482.268	**t**	-0.040%
5	Volume displasment	9254.194	9259.993	m^3	-0.030%

C. Floating Hotel Safety Gear

This equipment is used to ensure the safety and welfare of passengers and crew in dealing with various emergency situations [15]. The determination of the number of safety equipment refers to the Safety of Life At Sea (SOLAS) regulations [16]. The floating hotel safety equipment includes: 8 units of lifebuoys, 188 units of lifejacket, 4 units of lifeboats with a capacity of 39 people/unit lifeboat and 8 units of liferafts with a capacity of 25 people/unit liferaft.

D. Estimation of Calculation of Electricity Needs

From the results of the calculation of the floating hotel's electricity needs include:

TABLE 3.
AMOUNT OF FLOATING HOTEL ELECTRICITY NEEDS

No	Need	Total Power (Watts)
1	Description	17012.61
2	Hotel Room Equipment	65352.80
3	Kitchen equipment	65352.80
4	Laundry equipment	4200.00
5	Office supplies	4842.90
6	Pump	74000.00
7	Winchlass	5000.00
8	AC Central	257000.00
9	Kompresor & Blower	1500.00
10	Lift	2400.00
	Total	496661.11
	Total (KW)	496.66

In table 3. The total electricity demand for floating hotels is 496.66 Kw. Then it was determined that the electric generator for the floating hotel would use the Yanmar 6EY18LW brand with a power of 660 Kw for 2 units.

E. Floating Hotel Tank Calculation

From the results of tank calculations for floating hotels, the need for a fresh water tank is 477.60 m^3, sewage tank 102.03 ton/m^3, and fuel oil tanks 98.84 tons.

F. Calculation of Additional Buildings on Floating Hotels

The results of the calculation of the addition of buildings to the floating hotel are 1823.25 tons.

G. Floating Hotel Mooring System

In selecting a mooring system configuration for a floating hotel, use a spread mooring system with a combination of buoy moorings connected to 8 mooring lines [17].

H. Planning Number of Floating Hotel Employees

The number of floating hotel employees is adjusted to the following needs:

TABLE 4.
NUMBER OF FLOATING HOTEL EMPLOYEES

No	Department	Crew List	Crew
1	Front Office	Manager	1
		Recceptionist	4
		Accountig	2
		Cashier	1
		Security	3
2	Restaurant	Chief	1
		Cooker	4
		Waiter	8
		Cashier	1
3	Housekeeping	Executive Housekeeper	1
		Roomboy	9
		Bellboy	6
		Laundry	3
4	Engineering	Engineer Supervisor	1
		Electrical	3
		Oiler	3
5	Additional Facilities	Billiards Room	2
		Gym room	1
		Shop	2
		Bar	4
6	Clinic	Doctor	1
		Nurse	2
	Total Crew		63

From table 4, it is known that the number of floating hotel employees is 63 people.

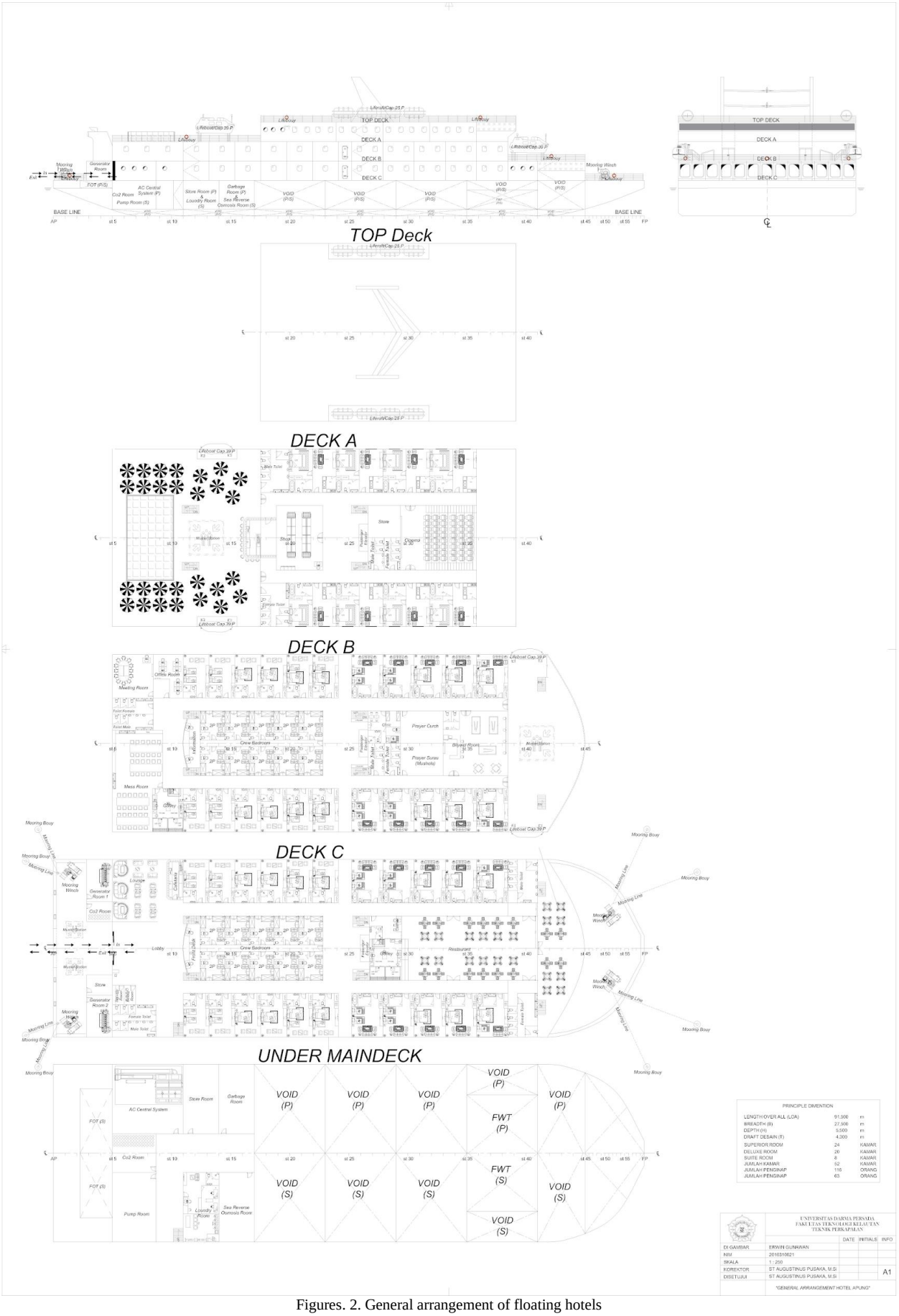
I. Floating Hotel General Arrangement

The addition of the upper building has a height of 3 meters from each deck. This building is used to design the rooms needed for a floating hotel according to some rules and books. The regulations and books that become the reference are as follows:

1. Tourism Office Decree No. 14/U/II/88 concerning Implementation of Business Provisions and Hotel Management [18]. (SKDP)
2. Copy of Regulation of the Minister of Tourism and Creative Economy of the Republic of Indonesia Number PM.53/HM.001/MPEK/2013 Concerning Hotel Business Standards [19]. (PMPAREKRAF)
3. Personal Design (DP)
4. Maritime Labour 2006 [20]. (MLC)
5. Practical Ship Design Volume 1 Chapter 5 [21]. (PSD)
6. Hotel And Resort, Fred Lawson [22]. (FL)

TABLE 5.
PLANNING OF FLOATING HOTEL FACILITIES

No	Floating Hotel Facilities	Standard Size	Design Results			Source
			Capacity	Dimensions LxW (m)	Area (m^2)	
1	Standard Room	Minimal 24 m^2				PMPAREKRAF
	a. Superior Room	According to the needs	2-3 P	4 x 6.75	27	DP
	b. Deluxe Room	According to the needs	2-3 P	4.84 x 6.75	32.67	DP
2	Suite Room	2 x Standard Room (48 m2)	2-3 P	7.26 x 6.75	49.005	PMPAREKRAF
3	Crew Room	14,5 m2/4 P	4 P/room	3.8 x 4.5	17.1	MLC 2013
	Lobby	Minimal 100 m^2	1 Unit	10.98 x 27.5	301.95	SKDP
	a. Front Desk	1.4 m 2/100 Room	1 Unit	2.62 x 7.60	19.912	FL
	b Cafeteria	According to the needs	1 Unit	2.48 x 6.24	15.6	DP
	c. Lounge	According to the needs	1 Unit	7.31 x 9.63	70.395	DP
4	c Toilet					
	(-) Male	Uninoir 4, WC 2	1 Unit	6.75 x 2.5	16.875	SKDP
	(-) Female	WC 3, Makeup Place	1 Unit	6.75 x 2.5	16.875	SKDP
	d. Security Room	According to the needs	1 Unit	1.8 x 3	5.4	DP
	e. Belboy	According to the needs	1 Unit	1.8 x 3	5.4	DP
5	Restaurant	2,8 m2 x Total room	1 Unit		260.68	FL
	a. Galley	According to the needs	1 Unit	5 x 6.5	32.5	DP
	b. Public toilet					DP
	(-) Men's Toilet	Uninoir 4, WC 2	1 Unit	4.84 x 6.75	32.67	SKDP
	(-) Women's Toilet	WC 3, Makeup Place	1 Unit	4.84 x 6.75	32.67	SKDP
6	Bar and Pool	According to the needs	1 Unit	19.6 x 18	537.082	DP
7	Laundry	50 m2 + 0.07 m^2 x Passenger	1 unit	10,98 x 10,75	118.035	PSD
8	Shop	20 m^2	1 Unit	8.92 x 10	89.2	PSD
9	Cinema	20 m^2	1 Unit	11.45 x 10	114.5	PSD
10	Clinic	According to the needs	1 Unit	5 x 5	25	DP
11	Bilyard Room	According to the needs	1 Unit	10.5 x 10	105	DP
12	Prayer Chruch	According to the needs	1 Unit	4 x 5	33.15	DP
13	Prayer Surau	According to the needs	1 Unit	5 x 5	33.15	DP
14	AC Central System	According to the needs	1 Unit	10.98 x 10.75	118.035	DP
15	Control Room	According to the needs	1 Unit	9.48 x 10.75	101.91	DP
16	Storeroom	According to the needs	1 Unit	5.52 x 10.75	59.34	DP
17	Mess Room, Galley	According to the needs	1 Unit		144.54	DP
18	Office, Meeting Room	According to the needs	1 Unit	10.98 x 6.75	74.115	DP



Figures. 2. General arrangement of floating hotels

J. Floating Hotel Stability

Stability calculations for floating hotels use maxsurf stability software with reference to the Intact Stability (IS) Code criteria. Ch.III/3.5 [23]. For calculations only in loadcase I conditions or in 100% passenger and 100% tank conditions. Meanwhile, loadcase II for passengers is 50%, consumables are 50% and ballast is 100%. The results are as follows:

TABLE 6.
LOADCASE I INTACT HOTEL APUNG

Item Name	Quantity	Unit Mass tonne	Total Mass tonne	Unit Volume m³	Total Volume m³	Long. Arm m	Trans. Arm m	Vert. Arm m
Lightship	1	1500	1500			45	0	0
Deck A	1	200	200			51	0	11.5
Deck B	1	100	100			43	0	8.5
Deck C	1	100	100			45	0	5.5
Top Deck	1	30	30			60	0	14.5
Total Loadcase			1930			45.751	0	2.142
FOT (P)	100%	62.171	62.171	65.838	65.838	78.688	-1.5	2.501
FOT (S)	100%	62.171	62.171	65.838	65.838	78.688	1,5	2.501
Total Loadcase		124.342	124.342	131.676	131.676	78.688	0	2.501
FWT (P)	100%	238.8	238.8	238.8	238.8	69.025	-4	2.5
FWT (S)	100%	238.8	238.8	238.8	238.8	69.025	4	2.5
Total Loadcase		477.6	477.6	477.6	477.6	69.025	0	2.5
SEWAGE TANK	100%	4	4	4	4	62	0	1.5
No.1 Ballast (P)	100%	606.031	606.031	591.25	591.25	56	-6.875	3.15
No.1 Ballast (S)	100%	325.053	606.031	317.125	317.125	57.441	4.606	3.15
No.2 Ballast (P)	100%	606.031	606.031	591.25	591.25	46	-6.875	3.15
No.2 Ballast (S)	100%	606.031	606.031	591.25	591.25	46	-6.875	3.15
No.3 Ballast (P)	100%	606.031	606.031	591.25	591.25	36	-6.875	3.15
No.3 Ballast (S)	100%	606.031	606.031	591.25	591.25	36	-6.875	3.15
Total Loadcase	100%	3359.209	3359.209	3277.375	3277.375	45.322	-795	3.148
Total Loadcase			5891.151	3886.651	3886.651	48.089	-453	2.752
FS correction								0
VCG fluid								2,752

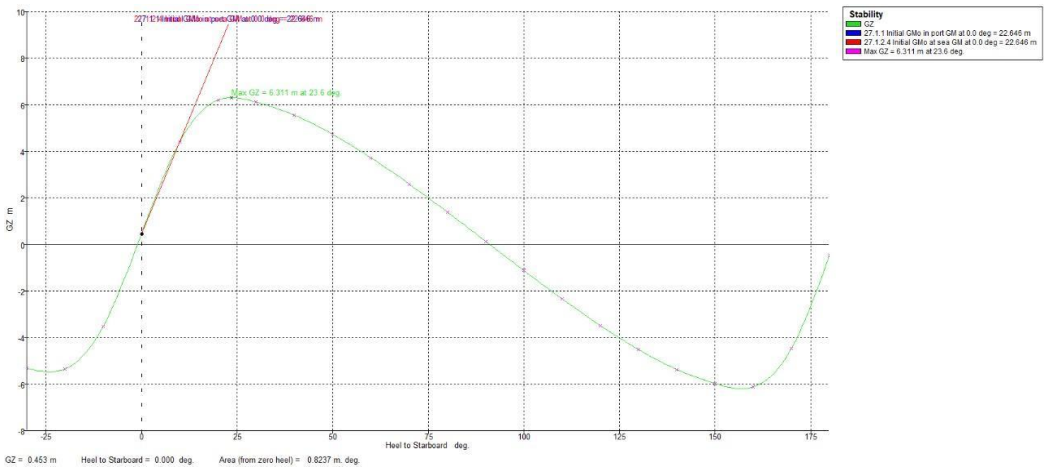


Figure 3. Graph of GZ Loadcase I Floating Hotel

TABLE 7.
LOADCASE II INTACT FLOATING HOTELS

Item Name	Quantity	Unit Mass tonne	Total Mass tonne	Unit Volume m^3	Total Volume m^3	Long. Arm m	Trans. Arm m	Vert. Arm m
Lightship	1	1500	1500			45	0	0
Deck A	0,5	100	100			51	0	11.5
Deck B	0,5	50	50			43	0	8.5
Deck C	0,5	50	50			45	0	5.5
Top Deck	0,5	15	15			60	0	14.5
Total Loadcase			1715.000			45.751	0	2.142
FOT (P)	50%	31.086	31.086	32.919	32.919	78.688	-1.5	2.501
FOT (S)	50%	31.086	31.086	32.919	32.919	78.688	1.5	2.501
Total Loadcase		62.171	62.171	65.838	65.838	78.688	0	2.501
FWT (P)	50%	119.400	119.400	119.400	119.400	69.025	-4	2.5
FWT (S)	50%	119.400	119.400	119.400	119.400	69.025	4	2.5
Total Loadcase		238.800	238.800	238.800	238.800	69.025	0	2.5
SEWAGE TANK	50%	2	2	2	2	62.000	0	1.5
No.1 Ballast (P)	100%	606.031	606.031	591.25	591.25	56.000	-6.875	3.15
No.1 Ballast (S)	100%	325.053	606.031	317.125	317.125	57.441	4.606	3.15
No.2 Ballast (P)	100%	606.031	606.031	591.25	591.25	46.000	-6.875	3.15
No.2 Ballast (S)	100%	606.031	606.031	591.25	591.25	46.000	-6.875	3.15
No.3 Ballast (P)	100%	606.031	606.031	591.25	591.25	36.000	-6.875	3.15
No.3 Ballast (S)	100%	606.031	606.031	591.25	591.25	36.000	-6.875	3.15
Total Loadcase		3359.209	3359.209	3277.375	3277.375	45.322	-795	3.148
Total Loadcase			5377.180	3.584.013	3.584.013	48.089	-453	2.541
FS correction								0
VCG fluid								2.541

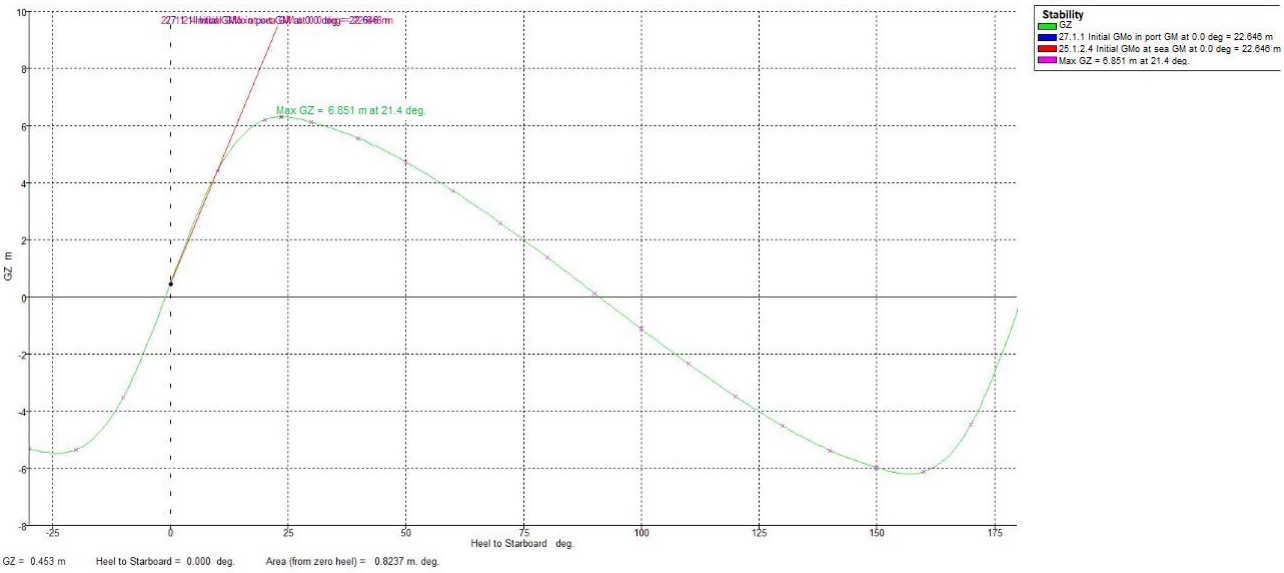


Figure 4. Graph of GZ Loadcase II Floating Hotel

Table 8.
KRITERIA INTACT STABILITY

Code	Criteria	Value	Units	Actual		Status	Margin %	
				Loadcase I	Loadcase II		Loadcase I	Loadcase II
Regulation 27 - Intact stability	2b i: Area 0 to 30	0.15	m	22.646	25.162	Pass	14997.3	16663.667
Regulation 27 - Intact stability	2b i: Area 0 to 40	3.151	m.deg	142.957	158.841	Pass	4436.45	4929.389
Regulation 27 - Intact stability	2b i: Area 30 to 40	1.719	m.deg	58.480	64.978	Pass	3302.19	3669.100
Regulation 27 - Intact stability	2b ii: Max GZ at 30 or greater	0.2	m	6.115	6.794	Pass	2957.5	3286.111
Regulation 27 - Intact stability	2b iii: Angle of maximum GZ	25	deg	26.3	29.222	Pass	-5.46	-6.067
Regulation 27 - Intact stability	2b iv: Initial GMo	0.15	m	22.646	25.162	Pass	14997.3	16663.667

From figure 3 of the floating hotel GZ loadcase I graph, it is known that the results of the analysis using maxsurf stability software for a max GZ value of 6.311 m at 23.6 deg and from figure 4 of the GZ loadcase II graph for a max GZ value of 6.851 m at 21.4 deg.

In table 8, it is known that the intact stability criteria for the stability analysis of the floating hotel meet the intact stability criteria of the IMO standard A.749(18) Ch3 - Design criteria applicable to all ships. So that the ship is stable when operating both in loadcase I and loadcase II conditions.

K. Floating Hotel 3D Drawing

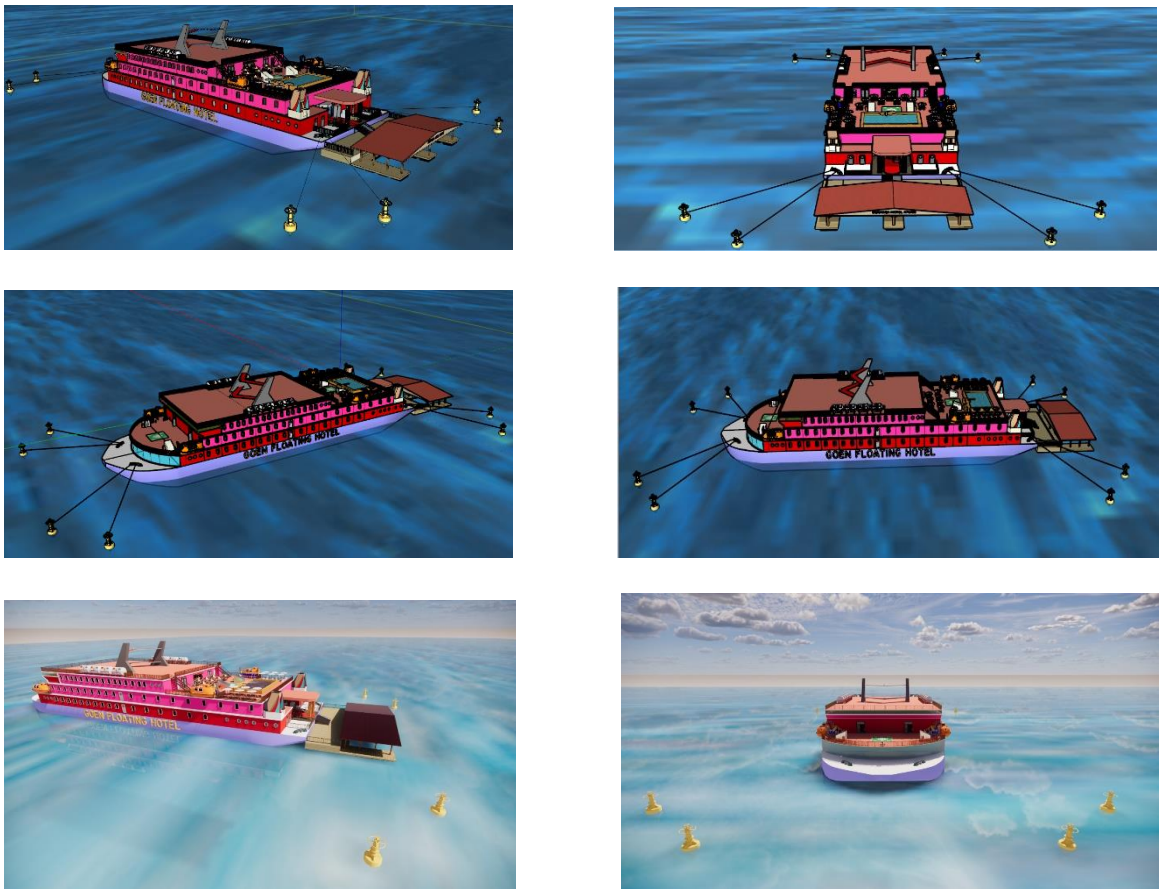


Figure 5. 3D Hotel

IV. CONCLUSION

Conclusion From the results of the floating hotel design planning, the number of rooms is 52 rooms that can accommodate 116 visitors. The details of the types of rooms and beds in the floating hotel include, 8 superior twin rooms, 8 superior double rooms, 8 triple superior rooms, 8 deluxe twin rooms, 8 deluxe double rooms, deluxe triple rooms totaling 4 rooms, suite double rooms totaling 8 rooms. There are facilities such as, restaurant, bar, cafeteria, cinema, billiard room, clinic, prayer surau, prayer church, laundry. Floating hotel safety equipment 8 units of lifebuoys, 188 units of lifejacket, 4 units of lifeboats with a capacity of 39 people/unit lifeboat and 8 units of liferafts with a capacity of 25 people/unit liferaft. The total electricity demand for floating hotels is 496.66 Kw. The results of the calculation of the addition of buildings to the floating hotel are 1823.25 tons. The stability of this floating hotel meets the conditions of loadcase I (100% passenger, 100% consumable and 100% ballast) and loadcase II (50% passenger, 50% consumable and 100% ballast) condition.

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