

RESEARCH ARTICLE

MODEL OF REPAIRING SHIPYARD IN THE NAVAL BASE AREA, SURABAYA.

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Abstract

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*Key words:*machine, Naval, repair, shipyard, workshop. To support the preparedness of the duty of Indonesian warships in securing the marine territory of Indonesia requires maintenance, repair and improvement in terms of ship bodies, machinery, weapons, and other components. The maintenance and repair of the ship requires a special place with special and up-to-date technology, the place is called a shipyard which containing ship's docking and other supporting units. The existence of areas and infrastructure precisely in the Naval Base Area of Surabaya, it very supports for the sustainability of shipyards. Proper and correct layout planning in designing a shipyard is technically indispensable for its sustainability. The aim of this study is to plan a model of repair shipyard in Naval Base Area in Surabaya. This study was started from literature study followed by survey in the planned location to collect some data. Collected data then descriptively analyzed and technically calculated to make a model of repair shipyard. The result showed that the suitable model of repair shipyard in there was graving dock. It completed with suporting facilities such as plate warehouse, prepration and fabrication workshop, machine and electrical workshop, pipe workshops, wood workshops, outfitting workshop and other supporting buildings. The graving dock and all facilities which complete it were planned based on economics, social, components needed and environmental aspects.

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Introduction:-

Indonesia is the largest archipelagic country in the world that has borders with many countries, both land (continent) and sea matirim). The sea border is generally the outer islands of 92 islands, including small islands that still need more intensive management. This is because the natural resources that exist within it, tend to cause problems with neighboring countries, illegal fishing, sand theft, smuggling, wood theft, etc. (Peraturan Presiden No. 78 Tahun 2005).

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In connection with this, the Navy plays an important role in relation to safeguarding the security of the territorial waters of Indonesia against all kinds of potential threats that arise (Ministry of Defence, 2016). One of the strategies undertaken by the Indonesian Navy in maintaining the security of Indonesia's linkage area is by using Defense

Strategy of National Sea which consists of three components: Detterence Strategy, Layered Defense Strategy, and Sea Control (Markas Besar TNI AL (2004) *in* Putra and Sholeh, 2017).

In addition to its role in safeguarding the territorial waters of Indonesia, the Navy also plays an important role in implementing state defense policy, maintaining the sovereignty and integrity of the state, protecting the nation's honor and safety, implementing War Military Operations and Non-War Military Operations, also actively participate in the maintenance of regional and international peace (Marsetio, 2013).

The important role of the Navy is certainly influenced by supporting military facilities, including the availability of adequate Indonesian warships. In fact, the number of warships owned by Indonesian Navy is not comparable with the area of Indonesian marine waters. In quantity, the number of Indonesia warships is still minimal and the quality of each ship is less good. This is because the average age of the warship is too old. In addition, maintenance and repair of Navy ships is still being done in private national shipyards and state-owned enterprises, so there are bring up some problems including: waiting time before and after docking process relatively long time, difficulty maintaining the secrecy of armaments and weapons systems, etc.

Therefore, it is necessary to have a special shipyard complete with the latest technology with best docking facilities and other supporting units. Hopefully, maintenance process, ship body maintenance, machine, weaponry and other components can be conducted well. Thus, it will increase support for the readiness and smoothness of Navy ships in the operational tasks of marine security.

Efforts to build the shipyard, requires a special strategy related to the environmental conditions both natural and social around. Hopefully the results of this study, can provide information about reparing shipyard model which consider the technical aspects, functions of the environment, especially in the area of Surabaya Navy Region.

Methods:-

This study was conducted in the Naval Base Area, Surabaya (Fig. 1 a,b). Repair shipyard was planned accodance with the master plan of Indonesian national navy 2005-2020, for development of eastern fleet area.

This study was started from literature study followed by survey on the planned location to collect some datas, maps, and navy policies which concerned with development plan of repair shipyard. Collected data then analyzed descriptively and technically calculated to build a model of repairing shipyard.



Figure 1:- a) Overall development sites and b) Research sites of graving dock development plan.

As reference for calculating the time required by the worker and the plating machine and workshop machine, the overall steel weight of war ship owned by Indonesian national navy, were estimated by formula which stated by Watson (*in* Rina, 1997). The estimation results showed that steel weight of the whole vessels was 1631.1 ton and the average of plate and profil work for the whole too was about 31.63 ton. If assumed time for plate and profile

repairing for each vessel was 30 days, so the distribution of plate and profile repair was about 1054 ton.day⁻¹. For reparation supplies and ensuring the availability of materials, so work distribution was rounded to 1.5 ton.day⁻¹ or 450 ton.year⁻¹.

Result and Discussions:-

In this study planning of the basic and supporting facilities needed to create a new repair shipyard was carried out. Planning of the basic mains began with dock planning in accordance with environmental conditions. Docks were closed area from a marine structure which for berthing of the ships. It kept its afloat and facilitate loading and unloading cargo and passengers. Generally, docks were classified into wet and dry docks. Wet docks were required for berthing the ships and facilitate the loading and unloading cargos and passengers. It was also called as harbor docks. While dry docks were used to repairs the ships (Wadho, 2014).

Celik (2009) said that as main facility in docking, the existence of a building berth or repair shipyard should be properly planned for ship planners and well designed to meet expectations such as service quality, capacity constraints, and geographic benefits. Based on Indonesia National Army needed, environment conditions, economics cost and the benefit of dock, dry dock was appropriate to used in naval base area in Surabaya. One of five kind of dry dock which shared by Wadho (2014) (i.e. graving dock, floating dry dock, marine railway dock, ship lift dry docks and slip ways), graving dock was suitable to used there. Wadho (2014), said that graving dock or usually called as dry dock had long excavated chamber, having side walls, a semi circular end wall and a floor. It also had the open end of the chamber which provided with a gate and act as the entrance to the dock.

Beside that, graving dock had a prime advantage i.e. it is capable of dry docking vessels. Their function well as newbuilding facilities for large vessels when used in conjunction with large cranes, which permit rapid constructions by using large subassemblies (Salzer, 1986).

In this study, graving dock was planned to have a length of 130 m, a width of 30 m, with a working draft of 6 m and had a capacity of 13000 tons. Hopefully, it was able to accommodate and raise two boats with a total length of less than 130 m or one ship with a maximum length of 130 m (Fig. 2). Not only had sufficient area for ship berths, hopefully this graving dock was also equipped by some supporting facilities such as two unit mobile cranes @ 30 ton, one unit Tug boat, power flow such as genset, clean water which get from local freshwater company, one unit graving dock pump, some important equipments such as welding machine, hand grinder, sand blast equipment, painting equipment and mechanical hoppers. It was also equipped by the other facilities such as telephone connection, fire bridge and bathroom facilities.



Figure 2:- Cross section (a) and longitudinal section (b) of graving dock.

Related with this facilities, International Labour Office (ILO) (1977), had been shared that facility such as ventilation and lighting were also important in graving dock. In each compartment where reparation worked, effective and suitable fresh air circulation should be provided for securing and maintaining of each compartment. Efficiently lighting also important in there because it could support work efficiency and minimized the errors. In addition, the medical aid also became the facility that need to considered.

In the way to plan graving dock in this study, not only based on the conditions of refference ship owned by Indonesian National Army such as War Ship dr. Soeharso (990) but also considered the depth of the dock and wave height. War Ship dr. Soeharso (990) had Lo Loa = 122.00 m; B = 22.00 m; T = 4.90 m; H = 6.70 m; Vd = 12.00 knot; Netto Gross = 2480.00 ton and GT Deep Weight = 11300.00 ton. The dock depth ranged from 3 to 5 m with wave height between 0.3 to 3.3 m.

After planning the basic facilities required in the ship repair shipyard, the next step was to plan the supporting facilities. Determination of supporting facilities was conducted by comparing with existing shipyard, which also use graving dock as its basic means. In general, the supporting facilities consist of production workshops, warehouses and other material handling facilities.

One of supporting facilities that planned in this study was plate warehouse which planned in area 15x11 m, with carrying capacity of soil up to 10 ton.m⁻². Distribution and number of plates required (Table 1) in this workshop were assumed based on the distribution of plate and profile repair which estimated before. If plates ordering were done as much as six times a year, then the requirement of plate for one month was about 75 tons.

Plate thickness (mm)	Long (mm)	Wide (mm)	Unit weight (ton)	Number (sheets)	Total (ton)
8	6000	1500	0,576	25	14,400
10	6000	1500	0,720	30	21,600
12	6000	1500	0,864	30	25,920
14	6000	1500	1,008	15	15,120
				Total	77,040

Table 1:- Distribution and number of plates required in plate warehouse.

This plate warehouse was required with material handling which used overhead crane with capacity five tons. Hopefully, it has lift ability up to 80 %, so it able to lift 8 sheets of 6 mm plate simultaneously and can fulfill the production capacity.

Near the plate warehouse were planned preparation and fabrication workshop. The distance among these three workshop allowed the transport of plate sheets became more effective and efficient. Preparation and fabrication workshop were required by some facilities such as roll plate machine which will put in area 8 x 3 m. It could straighten the plate with a maximum thickness of 16 mm with a width of 2000 mm.

Bending machine plate also needed in preparation and fabrication workshop. This machine (planned in area 7x3 m) had capacity two ton with 90 minute distruction for one plate sheet. The next machine which needed in this workshop were two cutting plate machine (planned in area 4x3 m) which able to cut plates with a thickness up to 14 mm, maximum width about 3000 mm and cutting speeds up to 60 minutes per plate sheet. It would put close to plate warehouse, roll machine and plate press machine. It might use to make cut forms of hull, sheer, top-side and transom. Usually, the result of plasma cutting was not good (smooth) and uneven, so it needed finishing process by using grinding.

The last machine that must available in preparation and fabrication workshop was welding machine. Based on observation result of existing reparation shipyard, this machine had electric current about 400 Ampere with the welding electrodes which had various diameters (3.2, 4, 5, and 6 mm). Each welding electrodes that commonly used for plates had thickness 8, 10, 12 and 14 mm.

In this study, machine and electrical workshop were planned to be in an area of 11 x 5 m. The functions of these two workshops for all ship repaired machine performance, propeller shafts, steering wheel, propeller and also damaged electrical network. In this study, the workshop had the following facilities (Table 2).

No	Kind of	Supporting facilities	Capacity	Number	of
	wokshop			equipment	
1.	Machine	Large lathe machine	Put in room 10x3 able to repair the shaft with	1	
	workshop Drill sits machine		length reach 7000 mm and diameter 500 mm		
			Ability of drill up to 900 mm with a diameter	1	
			of 80 mm		
		Skrap machine	Maximum workpiece 900 mm	1	
		Grinding machine	Ability to work up to disc with diameter 14	1	
		Hand grinder Disc diameter up to 125 mm, w		4	
			speed about 660 rpm. It can be carried in all		
			directions		
		Overhead crane	5 ton	1	
		Iron racks	-	-	
2. Electrical workshop	Electrical	Electrical tool	-	2	
	Electrical accessories	-	-		
		Coil roller	-	1	
		Dynamo	-	-	-
		Dynamo equipments	-	-	-
		Cable roller	-	-	
		Warehouse	-	-	
		Employees locker	-	-	

Table 2:- Plan of complementary facilities at the machine and electrical workshop in the ship repair shipyard of naval base area, Surabaya

In this study, repair shipyard was also planned to had pipe, wood and outfitting workshops which located in one location and close together. Hopefully, it would increase the efficiency of working time and work simplification. The pipe workshop design was based on the number and dimensions of the pipe base material, the type of work (cut, curved, pipe tip preparation) as well as the final shape of the desired pipe. This workshop was supported by several facilities such as two pieces of pipe cutting machine capable of cutting pipes to diameter 1, one pipe bending machine capable of SMAW and MIG/MAG welding machines.

The wooden workshop (planned in an area of 11x5 m) was designed to work on cutting wooden blocks for boats while riding the graving dock. In addition, the workshop was also used to repaired ship parts which made of wood such as steering wheel in wheel house, wardrobe, table, chair and other wooden tool box. While the outfitting workshop (planned in an area of 11x7 m), was designed for the assembly of pipes and other equipment as part of the complete component before being installed on the vessel. Outfitting workshop might be supported by some facilities (Table 3).

Repair shipyard which planned in this study, also needed to be equipped with a ship's weapons workshop. This workshop was one of the supporting facilities that distinguished it from other graving dock. It played an important role to ensured that the weapons which installed on all war ships of the Navy were ready for use at all times. Some supporting buildings such as the boardroom and administration, meeting room, security post, parking lot, cafeteria, generator room, bathroom, etc. were also necessary in this repair shipyard model.

No	Equipments	Capacity	Number of equipment
1	Pipe Bending Machine 3 "	It can bend pipe Ø 3 "	2
2	Air Compressor 7-30 kg/sqcm	-	1
3	Sand Blasting Machine	Nozzle Diameter 4/2/1	2
4	Airless Spray Machine	-	1
5	Vacum Cleaner Machine	-	1
6	Water Jet Cleaner	200 Bar	1

 Table 3:- Some facilities in outfitting workshop.

Related with all facilities which planned in this study, Matulja *et al.* (2009) said that layout design based ship building technology was based on the close relationship between the production point in the production area. The model of repair shipyard in The Naval Base Area of Surabaya can show in Fig 3.

Conclussions:-

Based on the results, it could be concluded that shipyard build planning in Naval Base Area of Surabaya completed with main facility such as graving dock and supporting facilities such as plate warehouse, preparation and fabrication workshop, machine and electrical workshop, pipe workshops, wood workshops, outfitting workshop and other supporting buildings such as the boardroom and administration, meeting room, security post, parking lot, cafeteria, generator room, bathroom, etc. This build planning was carried out by considering the correct pattern of development in terms of technical, economic aspect, natural resources, human resources, environment, state policy and organizational policy etc.



Figure 3:- Model of Repair Shipyard of Naval Base Area Surabaya.

Refferences:-

- 1. Celik, M. 2009. Fuzzy axiomatic design-based performance evaluation model for docking facilities in shipbuilding industry: The case of Turkish shipyards. Expert Systems with Application, 36: 599-615.
- 2. International Labour Office (ILO). 1977. Safety and health in dock work. An ILO code practice. Second edition. Geneva: 6.
- 3. Marsetio. 2013. Strategi TNI Angkatan Laut Dalam Pengamanan Batas Maritim NKRI: Kajian Historis-Strategis. Jurnal Sejarah CITRA LEKHA, XVII (1): 1-18.
- 4. Matulja T., Niksa F and A. Zamarin. 2009. Methodology for Shipyard Production Areas Optimal Layout Design. BrodoGradnja, 60 (4): 369-377.
- 5. Ministry of Defence. 2016. Pengembangan postur pertahanan militer guna mendukung terwujudnya poros maritim dunia. Puskom Publik Kemhan: Jakarta: 16.
- 6. Peraturan Presiden No. 78 Tahun 2005. Tentang Pengelolaan Pulau-Pulau Kecil Terluar.
- Putra, I. N. and Sholeh H. P. 2017. Konsepsi pembangunan kekuatan dan kemampuan sistem informasi operasi TNI AL dalam mendukung penyelenggaraan Strategi Pertahanan Laut Nusantara. http://sttal.ac.id/wpcontent/uploads/2017/05/JURNAL_11_wadan.compressed.pdf. Accessed on October 19th 2017.
- 8. Rina. 1997. Ship design and ship theory. Herald Poehl: 70.
- Salzer, J. R. 1986. Factors in the selection of drydocking systems for shipyards. Journal of Ship Production, 2 (2): 110-119.
- Wadho, L. H. 2014. Docks and their classification. Mehran University of Engineering and Technology. https://www.slideshare.net/LATIFHYDERWadho/docks-and-their-classification. Accessed on October 10th 2017.