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Plan for the Power Requirements of The Lights in the Fishing Boat Room Using LED Lights

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ABSTRACT – In the process of building a ship, electrical and lighting installation is one of the important components in the construction of a ship that concerns every room on the ship. This study conducted tests on the study of LED lights in the room above the ship. The method used is the zonal cavity method with division in one room into three parts, namely the height ceiling cavity (hcc), height room cavity (hrc), and height floor cavity (hfc) as well as determining the illumination value according to the standards set for each room. And the results obtained for the lamp power at TASA 22 by using the type of lighting with the LED type obtained a lighting electric load of 1.483 Kw. The results of this study provide for the fact that from various other research sources, it is concluded that LED lamps are better than TL lamps.

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INTRODUCTION

The shipbuilding process is divided into two stages: the design stage and the physical construction stage. The design stage involves the owner's desires, which are derived from existing data. The physical construction includes the construction of the hull and superstructure, installation of machinery, electrical systems, pumps, and other equipment [1]. In shipbuilding, electrical and lighting installations are essential components in designing a vessel to facilitate the activities of the ship's crew. Additionally, proper lighting standards are necessary for each section of the ship, especially in sensitive areas such as the engine room and navigation room [2].

The ship's lighting system should follow technological advancements. Currently, most ships still use fluorescent lights for main illumination instead of energy-efficient LED (Light Emitting Diode) lights. LEDs provide low-power radiation, cost savings, and longer lifespan [3]. Energy efficiency is a crucial concept in planning the lighting installation process on a ship as it affects the size of the generator set to be installed. Many studies on engine performance indicate that higher engine power leads to increased fuel consumption [4][5]. This, in turn, impacts the operational costs of the ship, considering the rising fuel prices, particularly for diesel, in Indonesia [6]. Therefore, it is necessary to consider replacing fluorescent lights with LED lights in the ship's lighting system, as LED lights offer even better performance compared to fluorescent lights, especially when applied to a vessel [7][8].

Electrical and lighting systems must meet specific standards in every room on the ship, as defined by classification societies such as the Indonesian Classification Bureau (BKI) and the American Bureau of Shipping (ABS). These classification societies have regulations concerning ship electrical standards and lighting criteria for each accommodation space on board. The primary goal is to regulate the electrical and lighting systems on board, ensuring they meet minimum standards and facilitate the crew's work while providing ease of movement for crew members and passengers, as well as ensuring safety on board. The zonal cavity method is commonly used to determine the required lighting levels in each room [9][10]. By employing this method, the lighting requirements for each space on the ship can be determined.

METHOD

Methode zonal cavity, also known as the Lumen method, is a technique used to determine the lighting level in a specific area inside a room. This method is considered accurate for application in various spaces, including those on a ship, as it takes into account the effects of reflections on the lighting level. The fundamental principle of this method relies on the availability of cavities within a room. In Figure 1, the division of cavity dimensions in a room can be observed, including ceiling cavity, floor cavity, and room cavity [9].

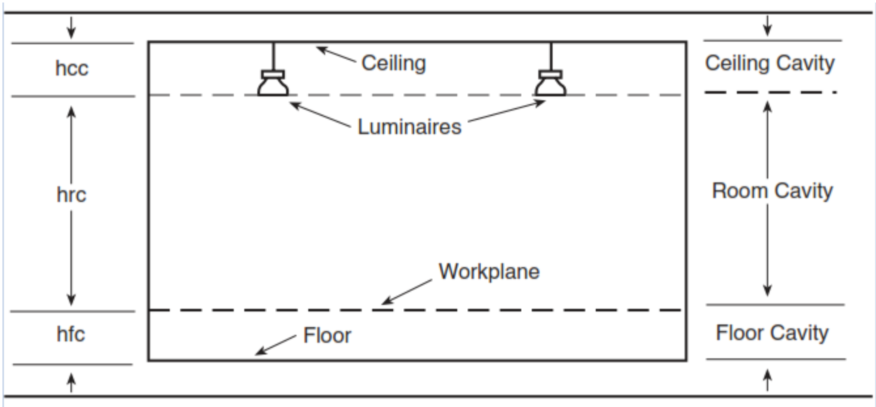

Figure 1. Cavity dimensions of the room [9]

1) Height Ceiling Cavity (HCC)

   Height Ceiling Cavity (HCC) refers to the vertical distance between the room's floor and the surface of the ceiling. It affects how natural light is reflected and distributed within the space. The appropriate HCC can optimize natural lighting by allowing better reflection of natural light from the ceiling into the room [11].

2) Height Room Cavity (HRC)

   Height Room Cavity (HRC) refers to the vertical distance between the working surface (such as a desk) in a room and the surface of the ceiling. HRC affects the distribution of natural light in the workspace. An optimal HRC can help reduce shadow contrast and ensure a uniform level of lighting throughout the working area [12].

3) Height Floor Cavity (HFC)

   Height Floor Cavity (HFC) refers to the vertical distance between the room's floor and the area outside the building. HFC plays a role in controlling the amount of natural light entering the room through windows or gaps in the walls. The appropriate HFC can optimize natural lighting by allowing sufficient light to enter the room without causing glare [13].

The calculation stages in finding the lighting level are the first to determine the Cavity Ratio, then determine the reflectance factor, then determine the coefficient of utilization, and finally the Compute average illuminance level. To get the value of the Room Cavity Ratio (RCR) ratio, it can be obtained by using the following formula:

Room Cavity Ratio (RCR) = 5 hrc (L + W) / (L x W) (1)

Where :

hrc = distance from the lighting to the working area.
L = length of room (meters).
W = room width (meters).

The amount of light flux required in a room is calculated by the following formula.

Φ Room = (E Room x A) / (CU x LLF) (2)

Dimana :

Φ Room = Flux of light produced in a room (Lumen)
E Room = Nominal illumination required in a room (Lux)
A = Area of a room (m2)
CU = Coefficient of Utilization/coefficient of luminaire utilization
LLF = Total light loss factor

Meanwhile, to calculate the number of lights needed in a room can be calculated using the following formula.

$$N\ Room = \Phi\ Room / \Phi\ Lamp \quad (3)$$

Where:

N ruang = Number of lights needed in a room
Φ Room = Flux of light produced in a room (Lumen)
Φ lamp = Flux of light in the lamp to be selected (Lumen).

Subchapters

A. Description of the Ship (TASA 22)

This ship is classified as a Fishing Vessel type, with its electrical power source coming from a 3-phase generator with a capacity of 775 HP and operating at 1200 RPM. The ship was constructed in 1992. It has a Total Gross Tonnage (GT) of 271 tons. The main specifications of the ship can be seen in Table 1.

Table 1. Main Specifications of the Ship TASA 22

TASA 22 Specification	
Length over all (LOA)	41,496 meters
Moulded breadth (BMLD)	8,00 meters
Designed draught (TMLD)	3,423 meters
Molded depth (HMLD)	3,810 meters
Speed Service (Vs)	Knot

The complete image of the ship can be seen in figure 2.

Figure 2. Fishing Vessel TASA 22

B. Electrical Installation

Electrical installation is a system used to distribute electrical power to fulfill human needs. In the planning of an electrical installation system in a building, it is divided into two parts: artificial lighting installation and power installation. Artificial lighting installation is the effort to provide electrical power to lights, making them a source of light when lighting is limited by time and environment. On the other hand, power installation is the installation used to operate electrical machinery within a building and supply power to all equipment that requires electricity. In electrical planning, there are applicable standards and laws [10].

Similar to buildings on land, offshore structures such as ships also require a power supply to support activities on board. The main source of power for ships comes from the main generators, which supply power to meet the entire vessel's energy needs. In the case of the research subject, the TASA 22 Fishing Vessel, the electrical power is generated by two main generators. Additionally, there is one harbor generator and an emergency generator. These generators function to provide electrical power to the lighting installations in the engine room (JL 1), main deck (JL2), navigation deck (JL3), power systems requiring 380 volts (JP), Junction Monitoring (JM), Junction Communication (JC), and Junction Emergency (JE). Figure 3 shows the wiring diagram installation on the TASA 22 vessel.

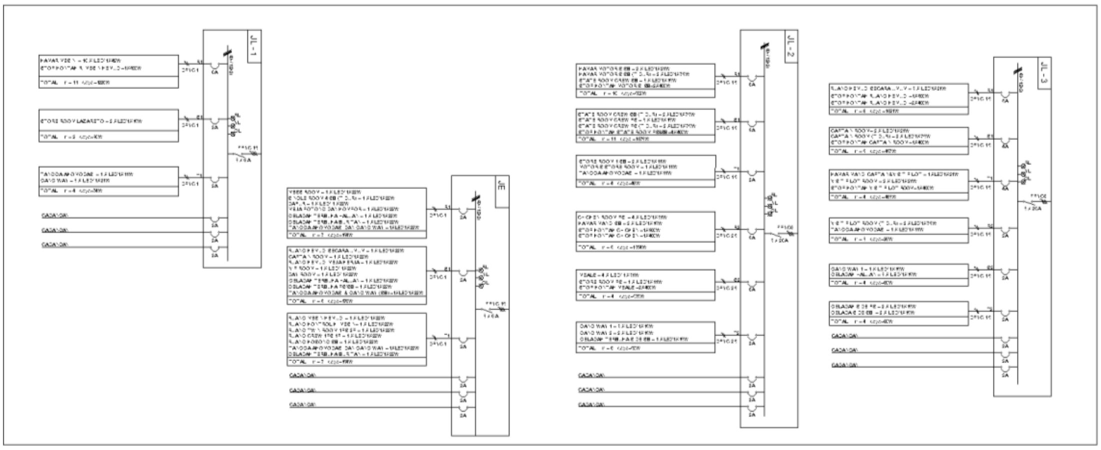

Figure 3. Wiring Diagram Junction Lightning TASA 22

C. Lighting Installation Planning

Illumination refers to the density of light emitted from a light source. Illumination intensity is the light flux falling on 1 square meter of a surface, measured in lux (lx) and represented by the letter E. By analogy, if we imagine a lamp as a faucet that sprays water, the water being sprayed is lumens, and the amount of water discharged per unit of time per square meter is the illumination intensity [10]. The systematic formulation is as follows:

$$N = \frac{E \ x \ A}{\emptyset \ x \ LLF \ x \ Cu \ x \ n}$$

Where :

N = Number of Lights
E = Lighting Intensity (Lux)
A = Working Area (m^2)
Q = Total Illumination Value of Lights in lumen units
LLF = Light Loss Factor (0,7 - 0,8)
Cu = Coeffisien of Utilization
n = Number of Lights at 1 point

In the lighting section, there are regulations specified in the American Bureau of Shipping (ABS) class standard. Since there are no regulations regarding lighting systems from the Indonesian Classification Bureau (BKI), the standards based on ABS are used. The criteria for crew accommodation lighting can be seen in Table 2.

Table 2. Lighting Criteria for Crew Accommodation Spaces

Space	Illuminance Level in Lux	Space	Illuminance Level in Lux
Cabins and Sanitary Spaces			
General Lighting Reading	150		
Reading and Writing		Sanitary Spaces	
Desk	500	Lavatory/Toilet	200
Bunk Light	200	Bath/shower Area	150
Changing Room	200	Light During Sleep Period	<30

Dining Space			
Mess Room and Cafetaria	300	Snack or Coffee Area	150
Recreation Space			
Lounges	200	Gymnasiums	300
Library			
General Lighting	150	Bulletin Board	150
Reading Area	500		
Multimedia/Computer Room	300	Game Rooms	200
TV room/Movie Theater	150	Reception Areas	300

D. Lamp LED

LED (Light Emitting Diode), also known as LED lights, is a type of lighting that has higher efficiency and is environmentally friendly compared to other types of lamps. LED lights have a light intensity of approximately 70 - 100 lumens/watt. Due to their lower operating temperature, they have a longer lifespan, reaching up to 50,000 hours of usage. Furthermore, with an efficiency level of up to 50% of electrical energy converted into light energy, LED lights have the advantage of long-term use [10].

RESULTS AND DISCUSSION

The measurement of lighting intensity in each room of the ship is done by determining a reference point based on the room's conditions, such as the length, width, height, and area of the room, as well as determining the illumination value adjusted to the standards set for each room. As explained earlier, the generator on the ship supplies power for all electrical needs on board, including lighting, power for pump installations, and power for navigation purposes. This analysis focuses on the lighting requirements with the aim of determining the amount of electrical power needed for lighting on the TASA 22 ship using LED lights based on the lighting regulations issued by ABS.

The power requirement for lighting on TASA 22 using LED lights on each deck.

Table 3. The burden of lighting on LED lamps.

No.	**Deck**	**Power (KW)**
1	Bottom Deck	0.524 Kw
2	Main Deck	0.600 Kw
3	Navigation Deck	0.359 Kw
	Quantity	1,483 Kw

For the total power requirement of the TASA 22 generator, adjusted for 4 conditions namely Sailing Condition, Port Entry and Exit, Docked, and Emergency, as summarized in table 4 for LED lights.

CONCLUSION

The results of the analysis for the lamp power on TASA 22 using the type of LED lighting show that the electric load for lighting is 1.483 kW. Thus the overall power requirement for the ship's electrical system using LED-type lights is 7.1 Kw in sailing conditions, 5.7 Kw in and out of port, 6.8 Kw in anchored conditions, and 0.4 Kw in emergency conditions.

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