CALCULATION OF LIGHTING INSTALLATIONS AND BUDGET COSTS ON ROAD PROTOCOLS (CASE STUDY JALAN MERDEKA – SUTOMO PEMANG SIANTAR)

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Abstract

Based on the results of the discussion in data processing according to field data, the results of the discussion are as follows: The number of street light poles is 100 rods per trip and one hundred street lights. The distance between the poles is 50 meters and the height of the pole is 7 meters and the LED lights are 90 watts so they don't match the standard of street light lighting. The installation must comply with the provisions for installing aerial cables in PUIL 2000 TC (Twisset cable), the designation for aerial cables that are familiar in the field. (in PUIL various aerial cables NFY, NFAY, NF2X, NFA2X, etc.) On TC cables for identification: On TC cables there is a line / strip one is used to mark phase = N, On TC cables there is no line / strip used to mark neutral = N Nominal current on each panel is 12, 37 amperes and the total use of lighting on the Sutomo-Merdeka road is 18,000 watts. The total budget costs are; total material price + tax + profit = IDR 1,515,164,000.- + IDR 174,243,860.- + IDR 303,032,000.-, = IDR 1,992,440,660.-

Keywords:: calculation of intensity and cost budget on protocol roads.

INTRODUCTION

Until now it has been proven that lighting plays an important role both indoors and outdoors to support activities especially at night. For this reason, it is necessary to create a comfortable atmosphere, and optimal results are obtained.

In lighting, it really needs personnel who are really experts who also understand the types of lights so that the conditions of the lights that we use on the road. For that required lighting calculations

On highways, good lighting can reduce the risk of motorized vehicle accidents occurring, in addition to getting a more comfortable atmosphere, and better safety for road users, and the risk of crime can be reduced.

Budget is a tool for management in planning and controlling the company. The budget is the organization's work plan in the future which is embodied in a quantitative, formal and systematic form. In general, all functions within an organization can be grouped into four main functions, namely planning, organizing, actuating, controlling. Budgeting is usually done during the planning stage. At the activity stage it is grouped into several types, namely the basis of preparation, method of preparation, period of time, field, ability to compose, function and method of determining the cost of products.

Rudianto (2009)

Based on the opinion above, the author raised the research title "CALCULATING LIGHTING INSTALLATIONS AND BUDGETING COSTS ON PROTOCOL ROADS. (CASE STUDY OF JALANMERDEKA-SUTOMO PEMATANG SIANTAR)"

Objective.

1. To determine the intensity on the highway
2. To find out how to do the steps in carrying out a highway electrical installation
3. To find out how much budget costs are needed for highway lighting planning.

LITERATURE REVIEWS

Unit of Definition in Information

The term lighting technique is understood and deepened into a technique that includes everything related to the production and lighting of light

According to Cristian Huigen in (1678) put forward an opinion that light is a wave event. Where based on this theory light consists of free movements carried out by electromagnetic waves

In free space electromagnetic waves have a late speed V=3.〖10〗^5 km/sec with frequency F (H_Z) in accordance with this condition, the wavelength is obtained

$$\lambda = \text{..... } 21\frac{V}{f}$$

Where:

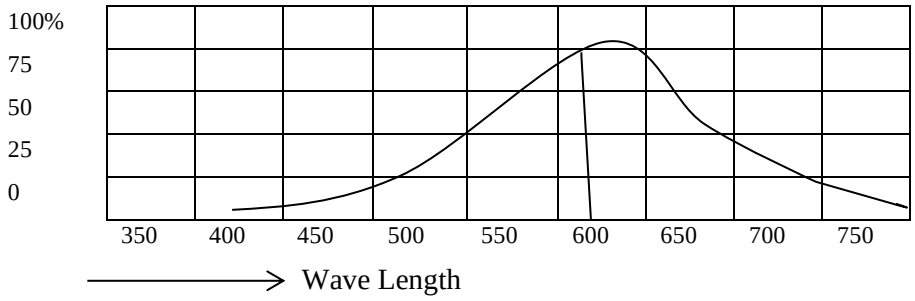
λ = Wavelength (m)

f = frequency (H_Z)

V = Speed(m/s)

The wavelength of visible light ranges from 380 – 780 µm. This is because the sensitivity of our eyesight is different, so a standard size is made.

Visual Sensitivity Table



Basic Lighting

Light current/light flux (Φ) According to Abdul Kadir (1995) light flux is the total light emitted every second by a light source. Where, = light flux (lm) Q = light energy (lm.sec) t = time (s)

Terms of Good Information

Good lighting is closely related to a success because it can increase work effectiveness. To get good lighting there are several conditions that must be met, including:

1. Strong lighting.
2. Strong uniformity of illumination.
3. Room index.

Glare Effect

Glare is any bright light within eye reach that causes discomfort, fatigue or irritation to the eyes. Glare occurs when a person receives direct light from a very bright light source. This blinding is called direct blinding.

Glare occurs because there is a difference in contrasting light between the light source and its surroundings is called contrast glare. We can feel the glare itself if we look at the car's headlights at night. Because of the difference in contrast between the lights and the dark surroundings. But during the day the same light does not cause glare because the surroundings are also daytime.

Glare occurs due to the reflection of light that falls on a shiny surface or is reflected into the eye, it is called reflected glare.

General

The equipment used in electrical installations varies depending on the nature of the room or location and the environmental conditions in which the installation is used where the installation will be installed. Of the many types of installations that exist, only a small portion will be discussed by the author.

Installation of PJU by way of cable air

Usable carrier

1. Installation must follow the provisions for aerial cable installation in PUIL 2000
2. TC (Twisset cable) designation of aerial cables that are familiar in the field. (in PUIL various aerial cables NFY, NFAY, NF2X, NFA2X, etc.)
3. On the TC cable for identification.
4. On the TC cable there is a line / strip one used to mark phase = R
5. In TC cables there is no line / strip used to mark neutral = N

Insulator

Insulation or insulators are used to support electrical conductivity where insulators are needed. Insulators must be made of porcelain or other materials and must have corners and curves that are smooth and not sharp. To avoid damage to the conductor during installation.

The installation of the insulator must be strong and such that there is no excessive mechanical force on the supports to be supported. For installation in highway lamps, roller insulators are often used. Above the street lamp cables, the installation of roller isolators must be such that the clearance between the leads of different phases or different polarities

is not less than 3 cm. For 1.5 mm and 2.5 mm type (NYM) street light cables, the distance between their fulcrum points shall not exceed 1 m (Puil 1987 clause 742A5).

A switch is defined as a device for connecting and disconnecting current circuits, both in current and non-current conditions.

A socket is a device for connecting electric current to a movable point of use. So the socket needs to be installed in an electrical installation to increase usage.

Definition of Budget

Budget is a tool for management in planning and controlling the company. Budget according to Rudianto (2009). is an organizational work plan in the future embodied in a quantitative, formal and systematic form.

Budget Function

According to Rudianto Pada Tahun (2009), in general all functions within an organization can be grouped into four main functions, namely functions: Planning (Planning), Organizing (Organizing), Actuating and (Moving), Controlling (Controlling).

Budget Type

According to Nafarin in (2009), budgets can be grouped into several types, as follows: Aspects of the basis of preparation, Aspects of the method of preparation, Aspects of the time period, Aspects of fields, Ability to compose, Aspects of functions, and Aspects of the method of determining the cost of products.

Operational Cost Budget

The operational budget is all expenditure plans related to the distribution and sale of the company's products and expenses to run the organization. Rudianto (2009). According to Munandar (2007). the preparation of the operational cost budget that is common in a company includes the following budget; Fixed Cost Budgeting, Variable Cost Budgeting, Semi-Variable Cost Budgeting.

METHODS

Time and Location of Research

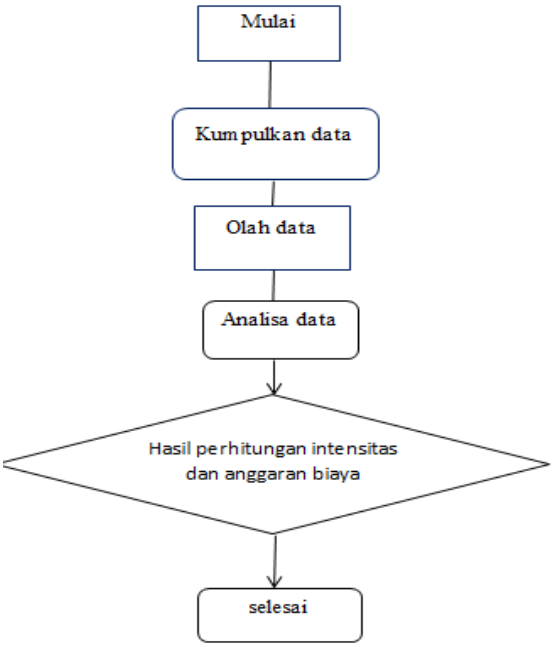
1. Field study.
   It was carried out on Jalan Merdeka-Sutomo in the Siantar Simalungun area, namely surveying the existing street lights and checking for deficiencies that occurred in the lighting for Jalan Merdeka – Sutomo.
2. Retrieval of Climatology data for Research Locations.
   These data were obtained from the Tarukim Office for Public Street Light Lighting in the South Siantar Siantar area.

Research methods

1. To obtain the calculation results for the lighting installation and the budget for the Sutomo-Merdeka road, the author must collect data from KPR
2. In the process of collecting data the writer also conducts interviews in order to obtain complete data

Data processing

1. After the data is collected, the data is processed based on the theories and information obtained from existing sources, including:
2. The author conducted a field survey to calculate the number of poles that have been installed.
3. The author conducted a field survey to calculate the installed power.
4. The author conducted a field survey to calculate the cross-sectional area of the existing cables.
5. The author conducted a field survey to calculate costs at the time of installation.
6. The author conducted a field survey for cost analysis



Research flow picture

Data Analysis Theory

Technical analysis is carried out to obtain a lighting system that is good, safe, reliable, durable, and in accordance with the manufacturer's specifications and especially in accordance with SNI. The technical analysis is carried out on the components which include lighting, poles, and others.

In analyzing lighting installations, there are several things that need to be considered in order to get good lighting, which fulfills its function so that the eye can see clearly and comfortably.

Light intensity

Light intensity is the light flux per unit angle of space emitted in a certain direction, which can be written in Equation 3.1 below:

I =∅/w

Where : I = luminous intensity (candela)
∅= luminous flux in lumens (lm)
w = space angle in steradian (sr)

Table of Graph of Light Intensity Statements

Distance (m)	r^2	I (cd)	E'= I/r^2 (lux)	E = E'Cos$a$ (lux)
0	49	800	16,3	16,3
1	50	750	15.0	14,8
2	53	700	13,2	12,7
3	58	600	10,3	9,5
4	65	500	7,7	6,7
5	74	420	5,7	4,6
6	85	350	4,1	3,1
7	98	200	2,1	1,4
8	113	0	0	0

1. Graph of illumination intensity of a single light source can illuminate the graph depicts the intensity of illumination in a flat area, expressed in units of lux
2. The following figure shows how to obtain a graph of the lighting intensity of a hanging street lamp and a polar intensity diagram
3. The calculations are given in the table above

Lumination

Luminance is a measure of the brightness of an object, or the intensity of light from a surface per unit area projected from a given direction. Too much luminance will dazzle the eyes. Equation 3.2 is to show the magnitude of the luminance of light in an area:

L = l/As

Where : L = luminance (cd/cm2)
I = Luminous intensity (cd)
As = apparent surface area (cm2)

Illumination Intensity (Illumination).

The intensity of illumination or illuminance is the density of the light flux that hits a surface, mathematically formulated in Equation 3.3:

E =∅/A

Where : E = Illuminance or light intensity (lux or lm/m2)

∅= luminous flux (lm)

A = Field area (m2)

The intensity of illumination at a point is generally not the same for every point on that plane. Illumination intensity of an area due to a light source with intensity (I), decreases with the square of the distance between the light source and the area (square law)

Lighting Efficiency.

Lighting efficiency is the ratio between the light flux emitted by the armature or it can also be interpreted as the light flux reaching the object with the light flux emitted by the light source or the initial light flux, mathematically formulated in

$$\eta=\frac{\emptyset_g}{\emptyset_0}$$

And :

$$= E \times A\emptyset_g$$

In carrying out a planning the required light flux can be calculated by

$$\emptyset_0=\frac{E\ x\ A}{\eta}$$

The number of armatures needed to get good lighting quality can be calculated by

$$n=\frac{E\ x\ A}{\emptyset_{amatur} x\ \eta\ x\ d}$$

Where : η= lighting efficiency

$\emptyset_g$= light flux emitted by the armature (lm)

$\emptyset_0$= luminous flux emitted by the light source (lm)

d= depreciation factor

Lighting efficiency can also be calculated by calculating the spatial index or shape index, which is expressed in the form of Eq

$$k=\frac{p\ x\ l}{h(p\ x\ l)}$$

Where:k = index of space or shape

p = road surface length (m)

l = road surface width (m)

Data Processing Stage

The next stage after obtaining the data and information is processing the data by determining the pattern of the budget when installing street lighting. The data needed in processing the data is as follows:

1. Cost budget data for the unit price of materials.
2. Budget data for implementation/installation of street lights.
3. Overall budget data related to the budget for installing the Merdeka – Sutomo street lights.

VAT rates

For the calculation of the budget for the installation of public street lights, VAT must be imposed. Determination of the VAT rate is regulated in Law Number 42 of 2009 concerning Value Added Tax on Goods and Services and Sales Tax on Luxury Goods.
The following is a list of VAT rates:

1. The 0% VAT rate applies to exports of Tangible Taxable Goods, Intangible Taxable Goods and exports of Taxable Services.
2. The 11% VAT rate applies to all products circulating within the country, including in the Exclusive Economic Zone and continental shelf where laws governing customs apply.
3. The VAT rate on luxury goods is set at a minimum of 10% and a maximum of 200%.
4. Specifically for goods and services subject to the 10% VAT rate, the rate can still be changed to a minimum of 5% to a maximum of 20% following applicable government regulations.

The VAT rate charged to the buyer will be clearly written on each proof of sale and purchase transaction. That is, the price that will be paid will be added to the amount of VAT. However, if we don't find VAT information on the receipt, it means that the total price listed includes VAT

RESULTS AND DISCUSSION

General

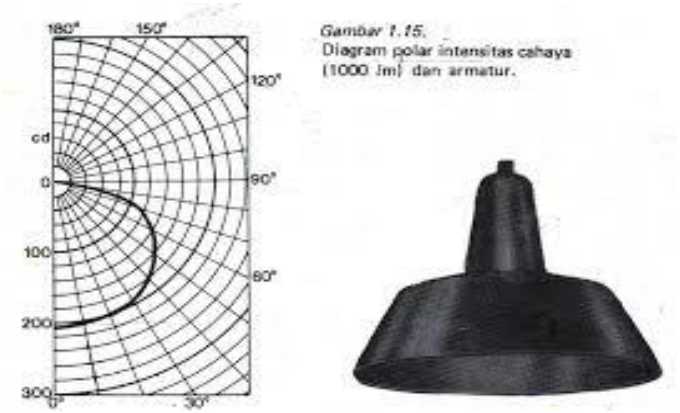
To calculate lighting projects several diagrams and charts of light sources are used. The characteristics of these lights and armatures can be found in catalog books.

Light Intensity Polar Diagram

The figure shows a polar diagram of light intensity of a lamp armature. The light intensity of an incandescent lamp has spatial symmetry with respect to a vertical line through the center of the lamp. Therefore the distribution of light intensity is given in a flat plane through the axis of symmetry. The diagram does not need to be drawn entirely, just half

Measurements are made at a relatively far. Therefore the light source can be thought of as a point light source. In figure 4.1 the length of the radius from 0 to a point on the graph

represents the light intensity in that direction in candela. Generally these diagrams are given for lamps giving 1000 lumens. The luminous intensity of a lamp is proportional to the other luminous flux; the values given in the diagram still have to be multiplied by the number of thousands of lumens of the lamp.



Illumination Intensity Graphic Image

Calculation of Foundations and Pillars

a. Calculation of the cost of making poles
   1. Reinforced concrete ;1 m^3 = IDR 800,000.-
   2. 4 pieces 3/4" diameter anchor bolts @ IDR 23,000.- = IDR 92,000.-

   So the total cost of foundation per pillar = IDR 892,000.-

b. Calculation of the cost of making each pole

   1.pole round 1 stem = IDR 2,700,000.-
   2.led light (1 complete set) = IDR 4,500,000.-
   So the total cost for each pole. = IDR 7,200,000.-

(the above calculation is based on information data from the Pematang Siantar PRKP office

So it can be seen that the cost of making the entire foundation and making piles is:
= (foundation cost + pile cost) x total number of piles
= (Rp 892,000.- + Rp. 7,200,000.-) x 200 poles
= IDR 8,092,000.- x poles
= IDR 1,618,400,000.-

Overall Cost Budget Calculation

Taxes (PPh and VAT) = 11.5% x total price of materials
= 11.5% x IDR 1,515,164,000
= IDR 174,243,860

Profit = 20% x (total material price + tax)
= 20% x IDR 1,515,164,000.-
= IDR 303,032,800.-

Then the total budget overall costs, is

= total material price + tax + profit

= IDR 1,515,164,000.- + IDR 174,243,860.- + IDR 303,032,800.-

= IDR 1,992,440,660.-

CLOSING

Conclusion

Based on the results of the discussion in data processing according to field data, there are several conclusions, as follows:

1. The number of street light poles is 100 rods per way and one hundred street lights. The distance between the poles is 50 meters and the height of the pole is 7 meters and the LED lights are 90 watts so they don't match the standard of street light lighting.
2. The nominal current on each panel is 12.37 amperes and the total use of lighting on the Sutomo-Merdeka road is 18,000 watts
3. The total budget costs are; total material price + tax + profit = IDR 1,515,164,000.- + IDR 174,243,860.- + IDR 303,032,000.-

= IDR 1,992,440,660.-

Suggestions and Acknowledgments

1. Therefore, for PRKP to carry out restoration on street lights that are no longer functioning (damaged)
2. In planning a lighting to be taken into account according to the needs of highway users

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