Environment Lighting System Evaluation: Lancang Kuning University Context

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Abstract: Street lighting lighting becomes a necessity for road users, including road users within the University of Lancang Kuning. The teaching and learning process at night makes the street lighting system as a must for the campus. Evaluation of the existing lighting system to obtain solutions and recommendations later. From the results of data collection and lighting density simulation, it is found that the commonly used lamps are a 500W white heart / bulb lamp that is directly proportional to the area of the 250W yellow Son-T light bulb. The difference is that the 500W white bulb has a very bright spot of lighting under the lamp, while the 250W yellow Son-T is almost uniformly illuminated even under the lamp itself. Lamp height does not significantly affect the expanse of the lighting, as evidenced by comparing the height of 8 meters and 4 meters from the road surface there is a difference of area + 12.5%. The maintenance and planning of the street lights in Unilak is also not very good where at point A lights self-supporting lighting area has been entered in the enrichment area of the parabolla single street lights so as not to affect the expanse of lighting, then light bulbs and the non-functioning of street lights at other locations.

Keywords: Illumination, Lux, Lamp, Bulb, SON-T

1. Introduction

The campus of a university is a place for higher education activities in Indonesia, the campus is equipped with facilities to support Tridharma Perguruan Tinggi (Teaching, Research and Service), therefore the campus without infrastructure such as lecturers without teaching equipment (such as books, pens, laptops and others). One of the supporting facilities for teaching and learning activities is the street lighting system, streetlight lighting system is not just a light for road users such as pedestrians and riders, but also can improve the security system, comfort and beauty of the campus at night. The University of Lancang Kuning already has street lighting system, although it is not yet considered optimal, this infrastructure needs to be a concern for the leaders and the academic community of Lancang Kuning University, especially after the night class due to the prohibition of prohibiting lectures on Sundays. As a result, the traffic of street users at night is almost the same as during the day at the time of the night schedule.
From the writer's observation, there are some points and there is even a road that is not touched at all by the lighting system of both the street lights and the light from the light of the building like the road from the front of the Faculty to the PKM until the Faculty of Law and some other point. There are also excessive street lighting systems such as the entrance from Umban Sari Street to the intersection of the Unilak library building. In addition to the uneven distribution of the lighting system, the maintenance of these facilities is still very minimal, it is seen from some broken lamps that never replaced, physically not damaged but cannot live until no automatic system installed so that some lights stay on until noon day.

As part of the academic community which is also the user of this road lamp facility, it is still not optimal the governance and maintenance of streetlight lighting system in the University of Lancang Kuning, so that the evaluation of the streetlight lighting system in Lancang Kuning University is needed to optimize the use of lamp roads and recommendations on the use of energy-saving lamps.

2. Research Methods

2.1. Determination of location and retrieval of research data

The research location is done along the main road at Lancang Kuning University, to facilitate the research, the main road in the University of Lancang Kuning is divided into 4 sections based on the road map based on google maps.

Based on Figure 1.1 the location is divided into 4 parts include: Location A: Along the driveway from Jalan Patin / Umbansari to the intersection of Pusaka Unilak building. Location B: Beginning entrance from Jl. Yos Sudarso to the left and right of Rectorate and Pustaka Unilak Location C: Beginning Entrance Road from Jl. Yos Sudarso went to PKM Unilak to the intersection of three Gedung Pustaka Unilak Location D: starting from Simpang PKM Unilak to the intersection of the entrance to Unilak Rectorate.
2.2. Data collection

The data collection is done by measuring the light intensity using LUX Meter, the measurement distance measurement method with matrix is chosen in order to map the light intensity distribution, the distance between one measurement point with the other measurement point is 1 meter. Measurements are done at night where the learning process is carried out by involving students in taking data. Here's the data based on the measurement location.

2.2.1 Location Data A

At this location, there are 20 single parabolic street lamps, 2 single angel tampel lamps to power poles and 11 self-help lights. Based on the data, of 33 street lamps installed only 8 live lights (see below shaded image) with the same type of single parabolic type, following the location of the street lights attached at location A. Measurements made to live light, from the measurement results obtained lighting intensity data in units of lux equal.

2.2.2 Location Data B

At this location, there are 16 self-contained street lights, 4 spotlights, 3 single angle stick outlet lights and 1 self-supporting lamp near the road (installed in water rower next to Unilak generator). Of the 19 existing street lamps, only 7 street lamps are live incoming post from yos sudarso, three rectorate intersections, three intersections to Unilak mosque continuously 2 points until the intersection / front stage open FIB and intersection of three canteen / faculty of engineering.

The height of self-supporting lights is 8 meters on average except for swaya street lights installed at the entrance of jl. Yos Sudarso with a height of 4 meters.

![Figure 2 Light spot location at location B](image)

There are 3 types of light bulbs used on location B that is a heart ball / bulb with 250 W power and 500W power and one 150W yellow 150W Son-T light bulb. From the measurement results of the three types of lights, a 500 W blue heart / white bulb is located at three points, namely the three intersections of the rectorate, the intersection of three mosques and the intersection of three FIB.

While the same powerless light / bulb (250W) is attached to the Post entrance to Unilak with a height of 4 meters or half of the lights with the same power.

And the last illumination of the yellow SON-T bulb type which is at the 150W engineering intersection, the data are obtained as follows.
2.2.3 Location Data C

At this location there are 7 self-supporting lights installed sequentially from technical intersection to the entrance to Fasilkom building and 5 single parabolla street lights in PKM Unilak Building area. This type of self-supporting lamp consists of 2 types of lights that all use the heart light / bulb is powered 500W and 250W. The 500W power is located at the entrance of the FKIP building to the entrance of the Fasilkom building and the other uses 250W power.

The average light height is the same but the two lampposts in front of the Faculty of Forestry Building and the lower entrance of Faculty of Computer Science are + 4.5 meters. While 2 street lamps right in front of engineering building in broken / not good condition. At location C only 3 lamps that live is 1 headlamp of Faculty of Engineering building and 2 headlamps Faculty of Forestry Building and Faculty of Computer Science entrance.

![Figure 3 Slope System on Location C](image)

Based on the measurement result, the distance of light to the measurement value between the lighting system in front of the engineering faculty and the rector is the same, but the measured value is more or less the same. While the distance of light and measurement results of two lights in front of the Faculty of Forestry and lights into the Faculty of Computer Science is almost the same, the following measurement values.

Location Data D

At this location there are 7 parabolla double lamps near PKM Unilak building, but no one light is on. In addition, the self-supporting street lights are installed and almost all are on, the location of the self-supporting lights around the Faculty of Law building until the entrance to Unilak (Yos Sudarso street direction). Self-supporting lights are installed on power poles, buildings and trees with 2 types of altitudes of 8 meters for mounted lights on buildings and power poles and 4 meters taped to trees.

![Figure 4 Light spot location at D](image)

The following sample data obtained, namely the height of 8 meters and 4 meters.

2.3 Data Processing Method

From the primary data above, the area of lighting can be divided into 4 categories namely:

1) Lighting system with a height of 8 500W with a type of light bulb white heart bulb.
Figure 5 Area of Illumination of White Bulb Lamp 500 W, height 8 meters.

From the picture it can be seen that the area of illumination is the same on both images that is the farthest distance that can be measured by lux meter is 8 meters from the lamp or 16 meter diameter of the wide circle of lighting.

2) Lighting system with a height of 8 meters 250W power with a type of heart bulb Merkuri ML Philip lamp

Figure 6 Area of Illumination of White Bulb Lamp 250W, height 8 meters.

From the picture it can be seen that the area of illumination is the same on both images, ie the farthest distance that can be measured by lux meter is 4 meters from the lamp or 8 meters wide diameter of the lighting.

3) Lighting system with a height of 8 meters 250W power with type SON-T Yellow light bulb located at the street corner Faculty of Engineering.
From the picture it can be seen that the area of illumination is the same as a 500W white light bulb, where the illumination distance measured by a lux meter is 8 meters from a lamp or 16 meters in diameter of the exposed circle of light, but the lighting system spreads in the absence of the brightest part of the parts.

4) Lighting system with a height of 4 meters with a 500 W White bulb bulb type contained in front of the Faculty of Forestry and the entrance of the Faculty of Computer Science.

From the figure shows that the area of the lighting is wider than the 8 meter height described in number 1, the distance of the meter that can be measured by the lux meter is 9 meters from the lamp or 18 meters in the diameter of the wide circle of lighting, but a very bright lighting system is on point close to the lights.

5) Lighting system with a height of 4 meters with 250W White bulb bulb type contained along the road to the Faculty of Law and Unilak Postal Entry
From the picture shows that the area of light bulb light bulb lighting 250 watts is almost equal to the expanse of lighting area at an altitude of 8 meter where the distance of illumination that can be measured by lux meter is 4 meters from the lamp or 8 meters wide diameter of the lighting.

3. **Data analysis**

From the data processing method above can be analyzed that the height of the lamp to the area of the lighting will affect the area of the lighting itself. White bulb type lamps will be lighter and wider area of illumination when installed low but not too / approximately 12.5% between the lights at an altitude of 8 meters and 4 meters. The Yellow 250W SON-T type lamp is capable of spreading light with the same distance to the 500W white bulb lamp, the difference is not the very bright point data emitted by Merkuri ML Philip lamp the 500W white bulb has a very bright spot ie the nearest point on the lamp itself, for streetlight size, SON-T is more efficient than the 500W Merkuri ML Philip lamp.

Besides analysis of the lighting system, dark areas can still be found in several major road points in the Lancang Kuning University neighborhood, including:

- **Dark area in Location A**
  
  \[
  \text{Dark area} = \frac{\text{The number of lights that are off}}{\text{total lights installed}} \times 100\% \\
  = \frac{9}{17} \times 100\% = 53\% 
  \]

- **Dark area in Location B**
  
  \[
  \text{Dark area} = \frac{\text{The number of lights that are off}}{\text{total lights installed}} \times 100\% \\
  = \frac{8}{15} \times 100\% = 53\% 
  \]

- **Dark area in Location C**
  
  \[
  \text{Dark area} = \frac{\text{The number of lights that are off}}{\text{total lights installed}} \times 100\% \\
  = \frac{3}{7} \times 100\% = 43\% 
  \]

- **Dark area in Location D**
  
  \[
  \text{Dark area} = \frac{\text{The number of lights that are off}}{\text{total lights installed}} \times 100\% \\
  = \frac{8}{18} \times 100\% = 44\% 
  \]

The above value is still based on the number of lights installed or available where 48.25% of the main road area in the Lancang Kuning University environment does not get light from the street lighting system already installed.

4. **Result and Discussion**

From the description of the data and analysis in the previous chapter, the following results can be formulated by
5.1 Comparison of the 500W White Bulb with SON-T 250W

Light distribution

- Merkuri ML Philip lamp 500W = ± 8 meters
- Philip SON-T lamp 250W = ± 8 meters

Energy consumption

- Merkuri ML Philip 500W = 500 W/h
  
  Electricity cost = Powtricity princes x elect
  
  = 500 W x Rp. 1.4
  
  = Rp. 700/hour

  1 month electricity cost = 8 h/day x 30 days/month x Rp. 700
  
  = 168,000/ lamp

- Philip SON-T lamp 250W = 250 W/h
  
  Electricity cost = Powtricity princes x elect
  
  = 250 W x Rp. 1.4
  
  = Rp. 350/hour

  1 month electricity cost = 8 h/day x 30 days/month x Rp. 350
  
  = 84,000/ lamp

(Assumed electricity price of Rp. 1400 / kwh). So the use of Philip SON-T lamps is more efficient than the Merkuri ML Philip

5.2 Calculation of Electricity Costs

In the existing conditions, namely

= Total live lights (500W x life) + (250W x life) + (SON-T power 250 x live)

= (500 W x 5 ) + (250W x 16) + (SON-T 250W x 1) = 6,750 W

Then the cost of electricity per day

= 6,750 x 8 h x Rp. 1.4

= Rp. 75,600 / day

5.3 In maximum lighting conditions

All lights are installed = (500W x life) + (250W x life) + (SON-T power 250 x live)

= (500 W x 13) + (250W x 33) + (SON-T 250W x 1)

= 15000W

Then the cost of electricity per day = 15000 x 8 hours x Rp. 1.4 = Rp. 168,000 / day

From the above calculation, turn on all self-supporting lights installed 2x the cost of electricity to the lights that are on. And if we replace the white light bulb into SON-T. Then = 250W x 47 lights x Rp. 1.4 = Rp. 131,600. Savings occur with a minimum lighting distance of 16 meters, especially the dominant 250W bulb lights.

5.4 Lighting Area

The following is a comparison between street lights in existing conditions with maximum conditions where all lights are on
In maximum lighting conditions are turned on, almost all areas of lighting lamps are included in the area of single-lamp street lighting in Yogyakarta so that it is not efficient and useful. Dark conditions in the existing conditions can be done in two ways, namely turning on the lights on the dark spot or making repairs to a single parabolla lamp (maybe it will involve other parties because this type of lamp is the help of the local government and maintenance under the PU service).

In the maximum condition, it appears that the dark area has been illuminated even though it has not been maximized so that some points such as the front of the rector, the front of the library and guard posts need to be given a lighting system. The red dot is an electric pole that can be used to move the self-help lamp at location A to location B because the use is not optimal and damaged by time. Self-help lamps in the entrance corner of the Master of Management are not very effective because most of the lighting area is in the parabolla single street lighting area across the street.
In the maximum condition, the installed lights are turned on, there is still a dark area after the intersection enters the Faculty of Computer Science to the Minister of Unilak. Self-help lamps that are not effective at location A can be moved at this location.

At location D, there are still dark areas, especially in front of Building 3, the canteen and the corner of building 2, the use of lighting at location A which is not optimal to be a solution for lighting systems in this location can be optimized.

5. Conclusion
Based on the results of the above measurements and discussion it can be concluded that. The main road lighting system in Lancang Kuning University is not optimal yet, the percentage of dark areas is still above 48%. At the maximum position, where all installed lights are repaired or reactivated, the dark area is less than 30% and the self-installed lights installed on the location can be used / reinstalled in the dark location. Low-light lamps can affect the lighting area even though a little, but the use of yellow heart lamps such as SON-T is far wider in the lighting area, from a comparison of data obtained that the lamp area of a 500W bulb is comparable to SON-T 250W

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