Analysis of electrical energy efficiency using LED in the bank building (Study case in Bank X)

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Abstract. This study aims to analyse the efficiency of electrical energy by utilizing LED lights in the bank building in replacing fluorescent type lamps which can later be used as a basis for consideration of energy efficiency. This research was conducted using a qualitative description method by observing and measuring initial conditions, then conducting an analysis to calculate efficiency. To carry out energy efficiency analysis begins with an ideal plan for the need for lighting intensity according to the standard using LED lamp. Research activities began by collecting data covering the location and specifications of the building, detailed drawings in the form of ass built drawings related to electricity, lighting, and lighting equipment’s throughout the building. Then measure lighting intensity and illumination power. Measurement data were analysed against SNI 6197-2011 standard and carried out a plan to replace existing lamps using LED type lamps as energy efficiency. Then draw conclusions about energy efficiency by replacing LED lights. Based on data analysis of lighting intensity that there is 104 rooms or 55.32 % of 188 rooms measured that have not been accord to standard SNI 6197-2011. And analysis of illumination power that there is 55 rooms or 29.26 % of 188 rooms measured that have not been accord to standard SNI 6197-2011. If all of TL fluorescent lamps are replaced by LED lamps, and some rooms that less illumination power are improved the with LED lamps, so the total efficiency of electrical energy in the Bank Building is approximately 18 (eighteen) percent.

1. Introduction

To reduce energy use, energy efficiency activities need to be done [1]. Energy efficiency activities are carried out without reducing comfort [2,3]. This is because comfort is related to worker productivity [4]. Energy efficiency activities indicate that building savings reach 15% with management of building operations [5]. Through setting the switch off the load outside working hours, setting the thermostat temperature control, and adjusting the lighting level can save energy up to 45% [6]. In addition, 19 government offices in Hong Kong showed that improving energy management practices could save electricity financing [7]. Other activities are through the installation of occupational sensors able to save electricity by 20-50%, the replacement of magnetic ballasts to electronics can save electricity by 25-35%, and the installation of dimmers is able to save electricity by 10-60% [8]. Furthermore, by increasing the efficiency of operations in buildings, offices and institutions can save energy by 20% [9]. Even an institutional building can save up to 42% [10].

The lamp is an electrical device that was created to provide artificial lighting. The working principle of the lamp is to convert electrical energy into light energy. The magnitude of the light flux...
to determine the magnitude of the total light visible from the lamp seen from the number of lumens on the lamp. The greater the lumens in the lamp, the lighting effect produced by the lamp will be brighter. Conversely the smaller the lumens of the lamp, the lighting effect produced by the lamp will be dimmer. Based on its working principle, it is generally necessary to obtain greater light fluxes with greater electrical power. The ratio between the light flux (lumen) and the electrical power of the light source is called efficacy in units of lumen / watt. Along with the development of semiconductor technology in the use of electric lighting installations.

LED technology was introduced 1962. LED sources are solid state semiconductor components that convert electrical energy directly into different light. Electrical power (watts) input sources for LEDs to produce a smaller flux of light than other types of lights. As stated in SNI 6197: 2011 concerning Energy Conversion in Lighting Systems that LED has an efficacy of 70 lumens / watt [11]. This value is much higher than the type of fluorescent lamp, mercury, halogen and incandescent (incandescent). In bank buildings based on information obtained from building managers, generally lighting types use fluorescent lamps. When viewed from the side of its efficacy, these types of fluorescent lamps are lower than LED lamp. Based on the above problems, the researchers are interested in analysing the efficiency of electrical energy by using LED lamp in the Bank Building.

2. Methods
This research was conducted using a qualitative description method by observing and measuring initial conditions, then conducting an analysis to calculate efficiency. To carry out energy efficiency analysis begins with an ideal plan for the need for lighting intensity according to the standard using LED lamp.

![Research flow diagram](image)

Based on the research flow diagram above, the flow diagram phasing can be explained. Research activities began by collecting data covering the location and specifications of the building, detailed drawings in the form of ass-built drawings related to electricity, lighting, and lighting equipment’s throughout the building. Then measure lighting intensity and illumination power. Measurement data were analysed against SNI 6197-2011 standard and carried out a plan to replace existing lamps using LED type lamps as energy efficiency. Then draw conclusions about energy efficiency by replacing LED lights.
3. Results and discussion

3.1. Results

There was 188 rooms/area that measured in building Bank. The analysis that used to lighting intensity and illumination power is SNI 6197-2011 standard. The results of the lighting intensity analysis found 104 rooms were not according to SNI 6197-2011 standard and only 74 rooms were according to SNI 6197-2011 standard of 188 rooms measured. The results of lighting intensity is shown in Figure 2.

Figure 2. Analysis of lighting intensity in the rooms against SNI 6197-2011.

Figure 2 show analysis of lighting intensity that there is 55.32 % of rooms that have not been accord to standard SNI 6197-2011. Meanwhile only 46.68 % of rooms that have been accord to standard SNI 6197-2011.

The results of the illumination power analysis found 55 rooms were not according to SNI 6197-2011 standard and 133 rooms were according to SNI 6197-2011 standard of 188 rooms measured. The results of illumination power is shown in Figure 3.

Figure 3. Analysis of illumination power in the rooms against SNI 6197-2011.

Figure 3 show analysis of illumination power that there is 29.26 % of rooms that have not been accord to standard SNI 6197-2011. Meanwhile 70.74 % of rooms that have been accord to standard SNI 6197-2011.
3.2. Discussion
Based on data analysis of lighting intensity that there is 55.32 % of rooms that have not been accord to standard SNI 6197-2011. Meanwhile only 46.68 % of rooms that have been accord to standard SNI 6197-2011. And analysis of illumination power that there is 29.26 % of rooms that have not been accord to standard SNI 6197-2011. Meanwhile 70.74 % of rooms that have been accord to standard SNI 6197-2011. Those show that lighting intensity aspect is worse than illumination power. It means lighting intensity in bank building must to improve. Alternative to improve the lighting intensity but efficient is replacing TL fluorescent lamps to be TL LED lamps.

Totally there is more than 3600 unit of TL fluorescent lamps in bank building. If all of TL fluorescent lamps are replaced by LED lamps, and some rooms are improved the illumination power with LED lamps, so the total efficiency of electrical energy in the Bank Building is approximately 18 (eighteen) percent.

4. Conclusion
Based on data analysis of lighting intensity that there is 104 rooms or 55.32 % of 188 rooms measured that have not been accord to standard SNI 6197-2011. And analysis of illumination power that there is 55 rooms or 29.26 % of 188 rooms measured that have not been accord to standard SNI 6197-2011. If all of TL fluorescent lamps are replaced by LED lamps, and some rooms that less illumination power are improved with LED lamps, so the total efficiency of electrical energy in the Bank Building is approximately 18 (eighteen) percent.

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