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Study of Electrical and Lighting Installations in Water Engineering Laboratory Buildings

(Case Study: Laboratory of Water Engineering, University of Muhammadiyah Jember)

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ABSTRACT

Abstract - Electrical installation of buildings is an assembly of electrical equipment in buildings that are related to each other, to meet certain goals or purposes and have coordinated characteristics. The design and installation of this electrical installation covers all aspects of the building, one of which is for the Water Engineering laboratory building. Electrical power in this laboratory building is used for room lighting, pumps, heating, cooling and so on. Based on the above, to obtain a water engineering laboratory building with optimal lighting, the use of durable pumps, the use of environmentally friendly cooling and heating devices and the selection of efficient and efficient tools for related purposes as well as the use of electricity that is efficient and safe. So it is necessary to study the Electrical and Lighting Installation in the Water Engineering Laboratory Building. From the results of this study, it can be concluded that for this laboratory lighting is used 20 TL lamps with each lamp 18 watts and uses lamps of 1350 lumens, laboratory operations use 2 pumps each with a power of 450 watts and heating and cooling equipment and tools the other has a power of 600 and for the distribution of electricity, 2 MCB panels are used, each of which is 6 amperes. It is recommended that each pump be made an individual panel so that safety in the experiment is not compromised when used together and there is a need for routine maintenance and control.

Keywords: Electrical installation, lighting, Laboratory

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1. INTRODUCTION

The development of the population in our country, Indonesia, is very rapid, so it is directly proportional to the increase in housing. And this also increases the use of electric power and is not proportional to the addition of electric power in general. Thus, the use of electric current is appropriate and efficient [1]. This includes the installation of good and correct electrical installations. Electrical installation is a way of placing and distributing electric power for all equipment that requires electricity. For its operation, in this case, it is directly in the area of consumer activity. Building electrical installation is an assembly of electrical equipment in buildings that are related to each other, to fulfill certain goals or purposes and have coordinated characteristics [2]. The design and installation of this electrical installation covers everything from buildings, one of which is for laboratory buildings.

Between the design and installation of electrical installations in laboratory buildings must be appropriate. Lighting electrical installations installed in laboratories that are not in accordance with standards, as evidenced by existing drawing documents that do not match the reality, insufficient lighting intensity [3]. No less important in the use of electricity in the laboratory is the maintenance of the electrical installations, so a reliable maintenance technician is needed. It is necessary to procure equipment maintenance technicians for routine, periodic, preventive and emergency maintenance [4]. Electrical power in laboratory buildings is usually used for room lighting, pumps, heating, cooling and so on.

In the working environment in the laboratory, productivity and efficiency are the top priority goals, including lighting. And lighting design troubleshooting is expected to support this. The interior lighting design of the house, which is the key to the success of the design of an interior space [5]. Specifically lighting must provide comfort and convenience for activities that occur in the room. To carry out normal activities, one must know that ideally the measurement of the degree of comfort to the visual comfort of a building or space is determined by the intensity of the light in the room [6]. The growing trend in most workspaces is to increase worker satisfaction, and lighting should contribute to visual, health and psychological environmental satisfaction. The factor that must be considered and is a form of compliance

with K3 cultural habits in printing production is illumination [7] . Based on this, it is necessary to plan a good laboratory lighting. Planning lighting in a laboratory room is one of the factors for designing to produce good and energy efficient lighting [8].

The basic equipment in the water engineering laboratory is pumps, heaters, coolers and other stone tools. For pumps, special tests are needed. Modification of equipment testing equipment for accurate performance test equipment in determining the performance of the pump, getting a better installation [9]. Thus the pump test will get maximum and efficient results from pump work. Meanwhile, the cooling device must be chosen carefully, because in its use it can continue for several days or even months. In the cooler it is also possible to use dangerous chemicals that must be placed carefully. Therefore, we need a storage that is portable, has aesthetics, light weight, but still saves energy and has the same cooling capability as conventional coolers [10]. Experimental and research activities in the laboratory cannot be separated from the use of tools and materials with heating devices as one of the main tools that are always used. What heating media can be used to be more effective and efficient both in terms of cost and in equipment maintenance so that the autoclave is cleaner, more efficient and durable [11]. The heating device used is expected to be effective, cheap and clean and the efficient use of electric power is expected.

Based on the foregoing, to obtain a water engineering laboratory building with optimal lighting, the use of durable pumps, the use of environmentally friendly cooling and heating devices and the selection of tools for related purposes that are efficient and use electricity that is efficient and safe. So a study is needed regarding electrical and lighting installations in water engineering laboratory buildings.

2. Literature Review

2.1. Water Engineering Laboratory Building

A building is a large wall building and so on as a place for activities, such as offices, meetings, commerce, performances, sports, and so on. One of the laboratory buildings. According to the KBBI, a laboratory is a certain place or room and so on which is equipped with equipment for conducting experiments (investigations and so on) [12]. The use of laboratories must be based on certain scientific methods. This makes all experiments, research, testing activities, calibrations, learning practices, to certain material products run well and according to purpose. It cannot be denied that the laboratory's image seems serious and exclusive. Even though there are many laboratories scattered in various places. Starting from pharmacies, polyclinics, factories, educational institutions, to hospitals. Different laboratory locations also provide different functions and tasks. The Water Laboratory Room is a form of building that functions as a laboratory in the field of water science education which is a place for research, testing, experimentation, calibration which is also related to learning in the field of water science.

2.2. Electrical installation components

Electricity is something that is common in our daily life. Good buildings for residential homes, offices, schools, laboratories equipped with electrical supporting facilities in building so that they can function and be inhabited properly, comfortably and meet safety require careful planning of electrical installation drawings with reference to the rules set out in the world of electrical engineering. Electrical installation drawings play a very vital and decisive role in an installation plan, because only with the help of drawings an installation work can be carried out. In terms of electricity, the important thing to know is the type and function of the cable. From its function, the cable is divided into several types, namely:

a. NYA Cable - Building wire, type NYA- 100 V, with PVC insulation has a size of 1-500mm.
b. BBC Cable - BCC or AAAC type bare conductors, with sizes 1-500mm, widely used for above ground transmission (SUTM) and grounding conductors.
c. NYY Cable - Low voltage cable, type NYY or NYFGbY with PVC insulation and sheath. Used for internal use, can also be used for ground cables but requires a little extra security cable.

To get the number of lights in a room can be calculated using the room illumination factor method, the formula is as follows:

$$N = \frac{E \; x \; L \; x \; W}{\emptyset \; x \; LLF \; x \; Cu \; x \; n} \quad (1)$$

Ø lamp = I x P

Where,

N = Number of light points

E = Illumination Intensity (Lux)

L = Room Length (meters)

W = Room Length (meters) = Luminous Flux (Lumen)
LLF = 0.8 P = power (watts).
I = 75 lumens Cu = Coefficient of Utility
n = Number of lights in one point

Powerful Light (E)
Offices = 200 - 500 Lux
Apartment / House = 100 - 250 Lux Hotels = 200 - 400 Lux
Hospital / School = 200 - 800 Lux
Basement / Toilet / Corridor / Hall / Warehouse / Lobby = 100 - 200
Lux Restaurant / Store / Shop = 200 - 500 Lux

3. METHODOLOGY

3.1 Research Place

For an overview of the research location at the Water Engineering Laboratory of the Muhammadiyah University of Jember, which is located at Jalan Karimata number 49, which is located in the hamlet of Gumuk Kerang, Karangrejo Village, Sumbersarii District, Jember Regency, the location data is presented in Figure 1 below.

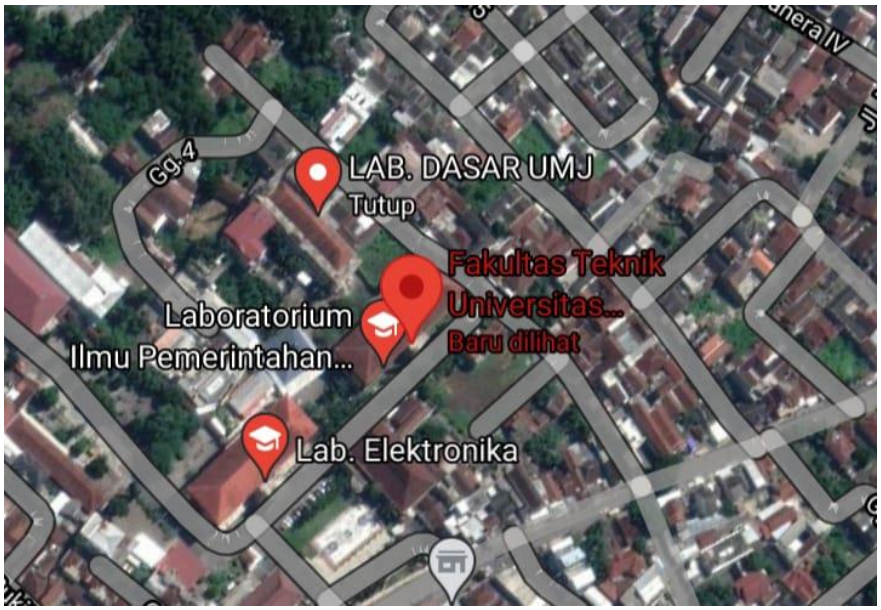

Figure 1. Research Location

3.2 Research Tools And Materials

In this study the authors use equipment and materials that are tailored to the needs. more specifically the equipment and materials used.

3.3 Research Flowchart

The flow chart in this study which describes the study of Electrical and Lighting Installations in Water Engineering Laboratory Buildings is presented in Figure 2 below.

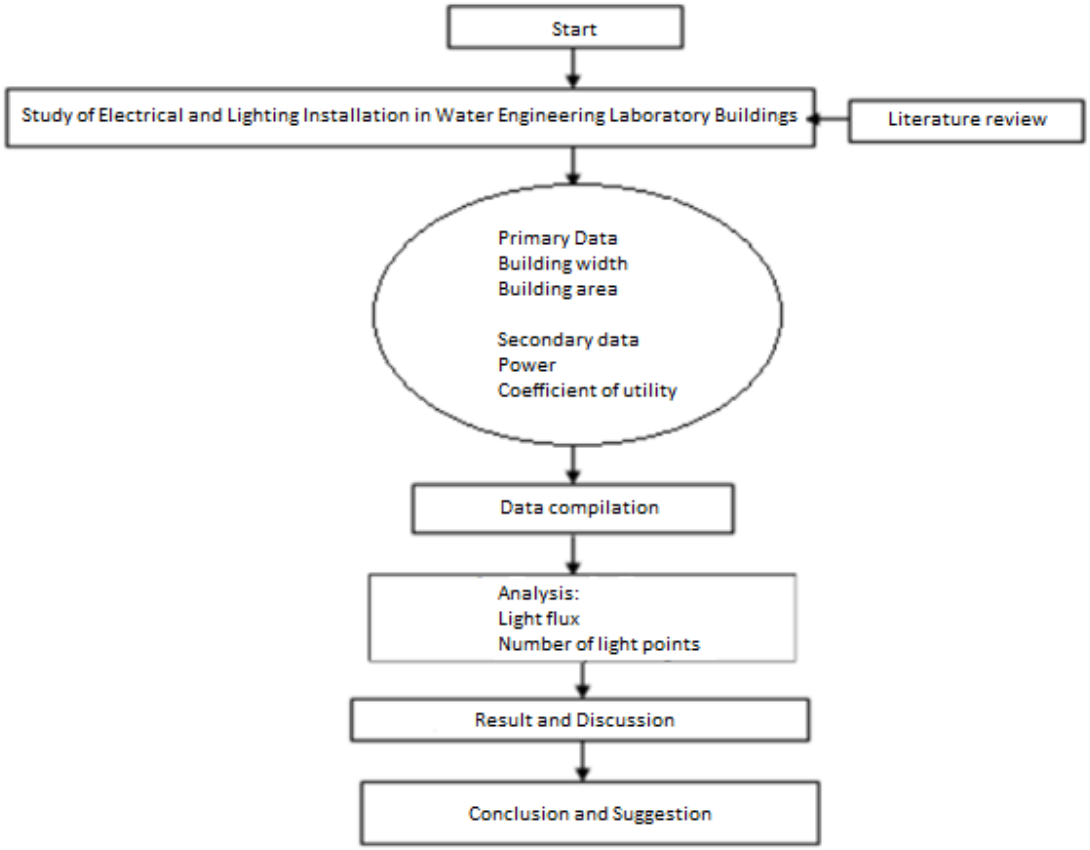

Figure 2. Research Flowchart

4. Results and Discussion

4.1 Overall electrical energy consumption

The use of electricity is used for lighting, pumps for water laboratories, other laboratory equipment such as coolers, heaters, scales and so on. For lighting or for lamp placement it is very important because lamps have a very important role, the use of lamps that will be used is divided into 2 parts: TL lamps and ordinary lamps (downlights) Placement of light points is very influential on lighting. overall light point placement. And for the purposes of electricity for lighting and aids made in a separate panel. Meanwhile, the placement of points for the purposes of pumps and other water laboratory equipment required a separate panel as well.

4.2. Use of electrical energy for lighting

The water engineering laboratory building requires a bright room so that the process of research, testing, experimentation can be seen so as to reduce the risk of misreading sizes, height differences, distinguishing colors and so on. One of them is the lighting system in the building. In this study, the design of lighting installations in laboratory buildings and lighting calculations were carried out. In this section we will create a lighting standard and calculate the lighting using formula (1).

Known:
Building length: 8 meters
Building width: 6 meters
18 watt TL lamp plan
E (for laboratory) = 500 lux
LLF = 0.8
Cu = 0.6 (60%)

Calculation:
Ø = I x P
= 75 x 18
= 1350 lumen

For 2 TL lamps
= 1350 x 2
= 2700 lumen
Then the number of lights that will be used is:

$$N = \frac{E\ x\ L\ x\ W}{\emptyset\ x\ LLF\ x\ Cu\ x\ n} = \frac{500\ x\ 8\ x\ 6}{1350\ x\ 0.8\ x\ 0.6\ x\ 2} = 18.5$$

Can be rounded into 20 lights. The lights are placed in 5 rows by 4 lanes.

4.3 Use of electrical energy for pumps and other laboratory equipment

In this study, 2 pumps, each with a power of 250 watts, were used, heating, cooling and other equipment with a total of approximately 600 watts.

4.4 Power Distribution And Control Panel

Analysis of laboratory building electrical equipment, namely:

a. MCB 1 phase 6 Amp - 220 Volt
So P = V x I x Cosphi = 220 volts x 1 ampere x 0.85 = 187 watts
Then P = V x I = 220 volts x 6 amperes = 1122 watts
Used to supply on:
Pumps of 2 units of 250 watts = 500 watts
Heating and cooling devices and others 600 watts
So the total requirement is 1100 watts, then the MCB 1 phase 6 Amp - 220 Volt can be used.

b. MCB 2 phase 6 Amp - 220 Volt
So P = V x I x Cosphi = 220 volts x 1 ampere x 0.85 = 187 watts
Then P = V x I = 220 volts x 6 amperes = 1122 watts
Used to supply on:
20 units of TL lamp of 18 watts = 360 watts
Other tools approximately 700 watts
So the total requirement is 1060 watts, then the MCB 1 phase 6 Amp - 220 Volt can be used.

5. Conclusion

Based on the results of the study on Electrical and Lighting Installations in Water Engineering Laboratory Buildings, it can be concluded as follows:

a. For this laboratory lighting, 20 TL lamps with 18 watts of each lamp are used and lamps of 1350 lumens are used.
b. For laboratory operations, 2 pumps each with a power of 450 watts and heating and cooling devices and other equipment with a power of 600.
c. For the distribution of electricity, 2 MCB panels are used, each of which is 6 Ampere.
d. It is recommended that each pump be made its own panel so that the safety in the experiment is not compromised when used together.
e. There is a need for regular maintenance and control so that the durability of goods can be guaranteed.

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