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Utilization of Electrical Energy in Lecture Building at Universitas Bangka Belitung

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Abstract. Electrical energy has become necessary in supporting human life activities, one of which is in higher education institutions. Universitas Bangka Belitung, as one of the public universities in the Province of Bangka Belitung Islands, currently has 12 lecture buildings to provide the best academic services in the 20 available undergraduate programs. Through measurements carried out during lecture activity hours in a few weeks at the main panel in 12 lecture buildings, also obtained the average current, average voltage, and average real power in the R phase, S phase, and T phase. Lecture building with sampling data every 15 minutes. Based on measurements, the entire lecture building's electrical energy consumption is in the range 2-5 kWh with electronic equipment used, including air conditioning, LCD computer projectors, and room lighting.

1. Introduction

Electrical energy has become a vital necessity for the Indonesian people. Data shows that the amount of electrical energy distributed to customers always increases every year. In 2018, the amount of electrical energy distributed to customers amounted to 239012.04 GWh, an increase from the previous year, which was only 226014.06 GWh [1]. One of the electrical energy customers is higher education institutions, universities, institutes, polytechnics, academies and other higher education institutions.

Universitas Bangka Belitung is one of the higher education institutions in the Bangka Belitung Islands Province, with 20 undergraduate study programs at five faculties. With the increasing need for electrical energy and the development of the University, it is necessary to plan and evaluate periodically related to the use of electrical energy. Several policies have been planned and will be implemented, including a hybrid energy source with Solar Power Generation [2].

Several studies related to the utilization of electrical energy in buildings on campus overseas [3]-[7] include audits and conservation of electrical energy at the University of Muhammadiyah Semarang by showing the energy consumption index value of 117.4 kWh / m² [8] in building B, Bengkalis State Polytechnic [9] in Brawijaya University [10] at the Faculty of Engineering, University of Serambi Mekkah [11] in the FPMIPA building of JICA, the University of Education of Indonesia [12] and at the University of Teuku Umar [13]. Other research is related to the analysis of power requirements in the West Halmahera Regent office building which also considers the energy consumption index value [14], audit analysis for achieving energy efficiency in the AB building in Tangerang Regency [15]. Therefore, monitoring of electrical energy utilization in all buildings will be carried out. Lectures at the

Universitas Bangka Belitung by paying attention to current, voltage, power and electrical energy within a certain measurement time

2. Methodology

Measuring currents, voltages and power for the R, S and T phases on 12 main panels of the lecture building at the University of Bangka Belitung. Current, voltage and power measurement data for each building is taken every 15 minutes. The profile of the use of electrical energy in several buildings at the University of Bangka Belitung is obtained every 15 minutes.

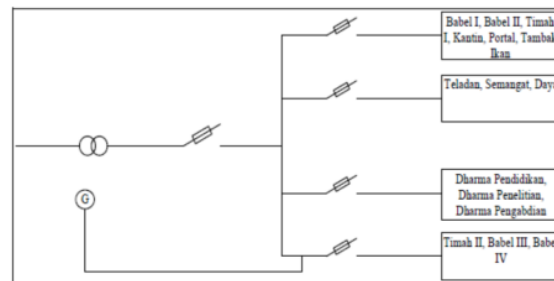


Figure 1. Electrical in-line diagram of the lecture building at Universitas Bangka Belitung [16]

In Figure 1 is an in-line electrical diagram of a building at Universitas Bangka Belitung. The source of electrical energy comes from PLN with a power of 690 kVA. Figure 2 is a plan of the lecture building at Universitas Bangka Belitung, all identical, consisting of 2 floors with the same area and the same space division.

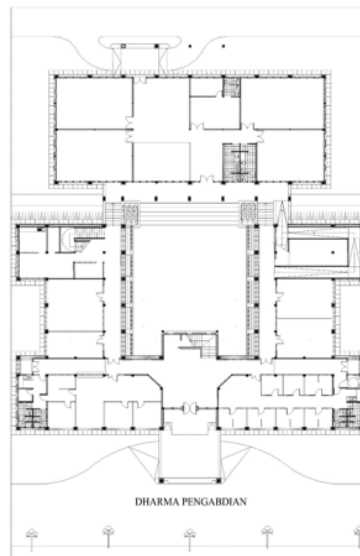


Figure 2. Electrical in-line diagram of the lecture building at Universitas Bangka Belitung [16]

3. Results and discussion

Measurements were carried out in a span of 2 weeks in 12 buildings at Universitas Bangka Belitung, namely Babel I , Babel II , Timah I, Timah II, Babel III, Babel IV , Semangat, Teladan, Daya , Dharma Pendidikan, Dharma Penelitian and Dharma Pengabdian.

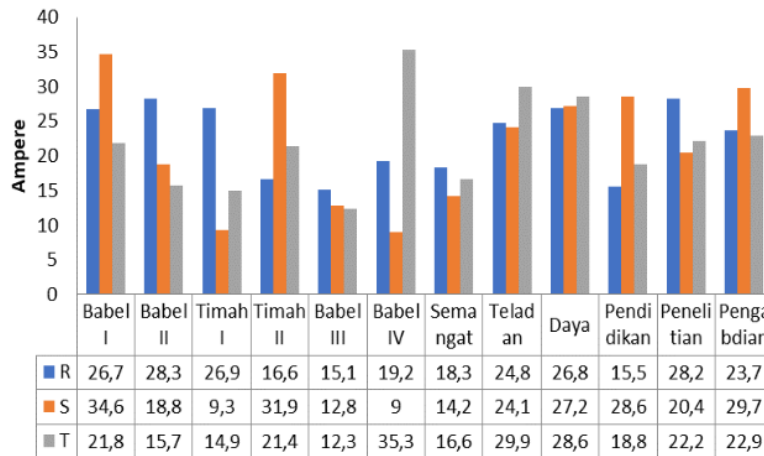


Figure 3. Graph of average current

Figure 3 shows the average current use of all lecture buildings at Universitas Bangka Belitung. From Figure 3 can also see the use of 3 phase currents R, S and T. The highest average use of phase R in Babel II building, for the highest S phase currents in Babel I Building and the highest T phase currents in Babel IV. Meanwhile, the lowest average use of phase R is in the Babel III building, the S phase currents in the Babel IV building and the T phase in the Babel III building.

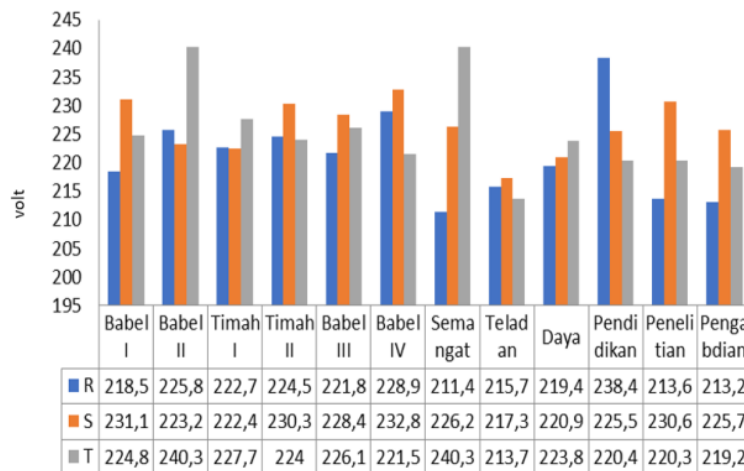


Figure 4. Graph of average voltage

From Figure 4 is a graph of the average voltage usage of the Universitas Bangka Belitung lecture building. It can be seen that the use of the highest and lowest average voltage is in the R, S and T phases. In the R phase the highest average voltage is in the Dharma Pendidikan building, Babel IV and Timah I, the S phase is in the Babel IV building, phase T is in the Babel building II and the spirit building. In phase R the lowest voltage is the Semangat building, in the S phase is the Teladan building and in the T phase is the Teladan building.

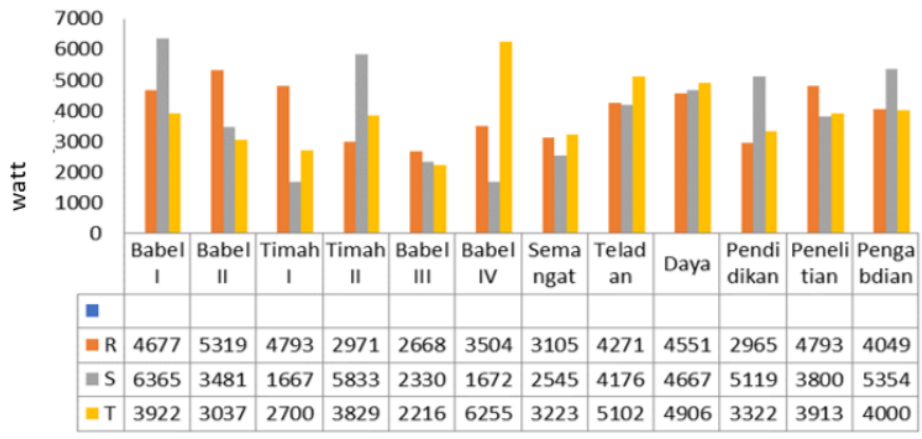


Figure 5. Graph of average real power

In Figure 5 is a graph of the average power usage of each building. It can be seen that the highest average power in phase R at the Babel II building, while the highest average power in phase S at the Babel I building and the highest average power in phase T at the Babel IV building. Furthermore, the lowest average power in phase R is in the Babel III building, the S phase in the Timah I building and the lowest average power use of phase T in the Babel III building.

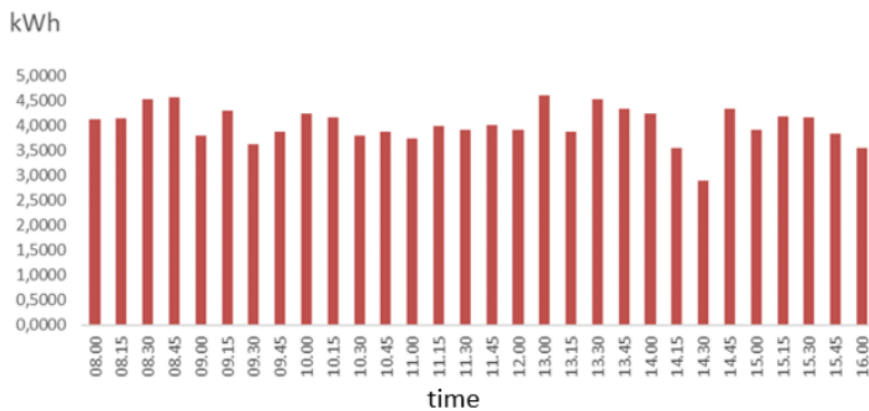


Figure 6. Graph of electrical energy consumption in Babel I building

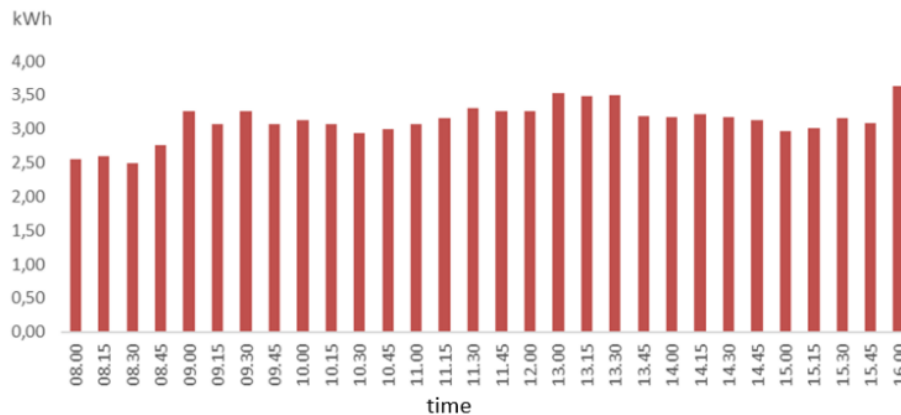


Figure 7. Graph of electrical energy consumption in Babel II building

Figure 6 and Figure 7 are the electrical energy profile in one of the 12 lecture buildings at the Universitas Bangka Belitung. This energy profile provides information on power consumption every 15 minutes. Data was collected from 08.00 a.m to 04.00 p.m following lecture activities held at Universitas Bangka Belitung. The use of electrical energy in 12 existing buildings with data collection every 15 minutes shows that the electrical energy consumption ranges from 2 - 5 kWh. The electronic equipment on 12 buildings at Universitas Bangka Belitung is dominated by lecture and office support equipment including air conditioning, LCD projectors, computers and room lighting.

4. Conclusion

The utilization of electrical energy in 12 lecture buildings at the Universitas Bangka Belitung can be seen from the average current in each phase, the average voltage in each phase, the average power in each phase and the use of electrical energy which is collected every 15 minutes. Measurements made during lecture activity hours can display the need for and use of electrical energy in all available lecture buildings.

1 Acknowledgment

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