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The Reduction of Electric Energy usage in Lighting Air-conditioning and Lift System in the Science Building Dhonburi Rajabhat University

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Abstract: The purposes of this research were (1) to study the use of energy in lighting, air-conditioning and lift systems, 2) to analyze the energy consumption. 3) to reduce the energy consumption in the Building 1, Dhonburi Rajabhat University. In this research, electric energy data were obtained by measuring and analyzing energy usage in lighting air-conditioning and lift systems to modify and reduce the energy consumption. The results showed the electrical energy of the building 1, in lighting, air-conditioning and lift systems. The energy consumption for lighting, air-conditioning and lift systems were 78,326 W which was 9 %, 669,710 W which was 88 % and 89,520 W which was 11% of total energy consumption in the building 1, respectively. The save electric energy in lighting system was 36,344 W which could save the electrical energy of 282,087.59 THB per year. The air - conditioner used in the building were 263 split type with the total of 650,800 Btu/hour and total electric power of 669,710 W. When the operating temperature was set at 25 ^{o}C. The University could save electrical energy up to 1,801,971.86 THB per year. The lift systems were 282,087.59 W per year. There were air conditioners, which used induction motor of 30 hp two lifts supported passengers for 14 floors and the rest of two lifts supports for 15 floors. The total energy was 89,520 W. When the lift operated in every the other floor. The university would save energy from the lift system for 347,400 THB per year from the total lost energy of 107,892 kW. Accordingly, the University save electrical energy up to 2,431,459.454 THB per year.

Keywords: Energy, lighting, air conditioning, passenger transport system.

1. Introduction

Current demand for energy, it is very important to everyday life at home or at work. Thus, it can be said that energy is vital to the survival of mankind. High-rise buildings cannot avoid the used of electricity. The refrigeration and air conditioning systems, lighting, passenger transport. Dhonburi Rajabhat University as a state higher education institution. It is responsible for the management of education, from the diploma, bachelor, master's degree and social service. Its main mission is to produce qualified graduates, knowledge, morality and complete with intelligence. Dhonburi Rajabhat University also provides academic services to the community. Therefore, there are a number of students. And personnel, including people who use services in the University there. It has a high rate of electricity consumption. Combined with the environment and hot air and Thailand is located in the tropics. Latitude 5 degrees north and 20 degrees 37 minutes 27 seconds over the hot zone. The weather is so hot all year round. The average temperature is almost 33-38 degrees Celsius. As a result, the demand for the installation of air conditioning more. This results in increased power consumption. Dhonburi Rajabhat University has to install the air conditioner in

every classroom. So that all students become comfortable. Problem is that the university has higher electricity costs. Dhonburi Rajabhat University there are 7 buildings. It is a 15 storey building with 2 buildings. Electrical power load mainly consist of 75% air-conditioning, 20% lighting and 5% lift. The cost of electricity consumption is not less than 500,000 baht per month per 15-storey building. In response to the Energy Promotion and Conservation Act 1992, Section 2, Section 27. Energy conservation in buildings is one of the following: 1) Reducing solar heat that enters the building. 2) The temperature inside the building to a reasonable level. 3) The use of building materials to help conserve energy. 4) The use of lighting in buildings more effectively. 5) Utilization and installation of machinery, equipment, and materials that generate energy conservation in buildings. 6) The system controls the operation of machinery and equipment. 7) Energy conservation by other means as prescribed in the Ministerial Regulations

To promote economic use of electricity and know the value of energy. Therefore, this research is focused on education. The electricity consumption analysis, lighting system, air conditioning and lift of Science and Technology building. The information is used as a guideline for improvement and management system. To be appropriate and the most effective.

2. Research Methodology

Study and analyze the use of electrical energy. There are three parts.

1. Explore electricity consumption. In the light system. Air conditioning and elevators by walking trails. And map building schedule of load circuits, each sub-layer.

2. Measurement of electrical energy with energy analysis blue (Power Analyzer Meter) and analyze energy usage. For lighting systems, air conditioning and lift.

3. Install the capacitor bank into the building's power supply system.**3. Data analysis**

The analysis process is as follows.

1. Calculate the area of illumination from the equation.

$$ChP = \frac{LW + BW}{TON} \quad (1)$$

2. Calculate the electrical energy used for the lighting system from the equation.

$$\frac{kWh}{Y} = \frac{P \times (Day/Y) \times (hr/Day) \times Diversity}{1000}\% \quad (2)$$

When kWh / Y : the electrical energy used (kWh/Y)
P : the power used (W)
Day / Year : the time of system usage (day per year)
Hours per day : the time of system task (hr/Day)
Diversity : the percentage of activation (%).
1,000 : the constant to change the unit from watts to kilowatts.

3. Measure and analyze brightness, the brightness of the space available in the building.

$$\text{The appropriate brightness of the area} = \frac{A_1}{A_T} \times 100 \quad (3)$$

4. The use of low loss ballast analysis.

The researcher will perform the analysis by using. Low watt loss ballast instead of core loss ballast. The power loss is about 5.5 watts, so the power saving is about 5.5 watts, analyzer before and after the update.

5. The air conditioning systems analysis.

Calculate the enthalpy difference (DH) from the equation.

$$DH = Hr - Hs(btu/lb) \tag{4}$$

Calculate the amount of air (Cubic Foot per Minute: CFM) from equation.

$$CFM = \frac{A \times V \times 60 \times 100}{(30.48)^3} \tag{5}$$

Calculate kW/Ton from equation.

$$\frac{kW}{Ton} = \frac{P \times 12{,}000}{btu/h} \tag{6}$$

A kilowatt of cooling kWR of the equation.

$$kWR = \frac{(btu/h) \times 3.52}{12{,}000} \tag{7}$$

6. Analyze the use of electronic thermostats.

kWh / Y = P x hour / year x average working percent x percent activation x percent activation hours

7. Analysis of power consumption for lighting systems, air conditioning systems for buildings and elevators.

8. Analyze the power consumption using a power analyzer meter before and after the research.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{8}$$

4. Experiment result

4.1 Lighting systems

Table1. Indoor lighting system 1

Items	code	Bulb type	Ballast type	Power loss (W)	Power (W)	number of bulbs	Total power (W)
1	A	Fluorescent	Core	35,784	36	1988	71,568
2	B	Fluorescent	Core	560	18	56	1,008
3	C	Complex fluorescent	Electronic		11	252	2,750
4	D	Incandescent	-		150	20	3,000
Total				36,344		2,316	78,326

4.2 Air conditioning system

Table 2. Air-conditioning systems in buildings 1.

Items	Air condition type	number	Air (Btu/h)	Power (W)	Total air (Btu/h)	Total power (W)
1	Split type	252	25,000	2,530	6,300,000	637,560
2	Split type	5	36,000	3,850	100,000	19,250
3	Split type	6	18,000	2,150	108,000	12,900
Total		263			6,508,000	669,710

Table 3. system (elevators)

Items	Number of floors	Motor rated (Hp)	Power)W(
1	14	30	22,380
2	14	30	22,380
3	15	30	22,380
4	15	30	22,380
Total			89,520

Table 4. Electrical Energy from Lighting Systems Air conditioning and lift

Items	Type	Power loss)kW(	Total power)kW(	Energy losses. (bath/year)
1	Lighting	36.344	78.326	282,087.59
2	Air conditioning	26.788	669.710	1,801,971.864
3	Lift	44.760	89.520	347,400
Total		107.892	837.556	2,431,459.454

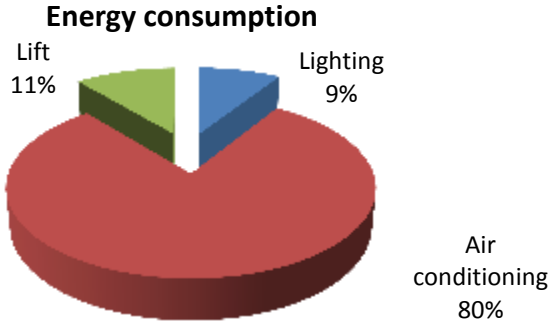

Figure 1. Compare the proportion of electrical energy, lighting Air conditioning and an elevator

Table 5. compares power (P) and power factor (pf) before and after installing the capacitor.

	Pre test		Post test		Reduced electrical power (%)	t
	$\overline{X}$	SD	$\overline{X}$	SD		
Power (kW)	403.29	27.29	357.70	10.95	12.74	.004*
Power factor (pf)	0.82	0.01	0.97	0.005		.000**

5. Conclusion

The power consumption of the lighting system is 78,326 watts or 9 %. The air conditioning system uses 669,710 watts of electricity, 88 percent and 89,520 watts, or 11 % of total electricity. The electrical energy of the lighting system is 78,326 watts. The electricity saving can be 36,344 watts, saving 282,087.59 baht per year. The air conditioner used in the building is a total of 263 air conditioners with a total capacity of 6,508,000 Btu / h and a total capacity of 669,710 watts. When the temperature of the air conditioner was set at 25 degrees Celsius, Dhonburi Rajabhat University can save energy. THB 1,801,971,864 per year. The transport system (elevator) uses four 30HP electric motors, consisting of two 14-storey freeways, and two 15-storey passenger terminals, each with a total capacity of 89,520 watts. Or odd numbered layer electricity will be reduced and the Dhonburi Rajabhat University. The electric energy saving in the elevator is 347,400 baht per year. Total electricity loss 107,892 kW will make Dhonburi Rajabhat University. Energy saving in the elevator is equal to 2,431,459,454 Baht per year.

Reference

1. Department of Energy Development and Promotion. Building Energy Conservation Guide. Bangkok: Thammasat University. 1995).
2. Chansak A. Lighting Design Techniques. Bangkok: Association for the Promotion of Technology (Thailand-Japan). (2002).
3. Chomnan H. Lighting technique Bangkok: Kasetsart University. (1997).
4. Boonmee U. and Duangjan T. Tariyarat. Brightness study in the classroom. Laboratory Building 5 and Building 10 Rajabhat Mahasarakham Institute. Mahasarakham: Rajabhat Mahasarakham Institute. (2002).
5. Piboon D. Design of an open sash system. Bangkok: SE-EDUCATION. (1997).
6. Wachara W. Processes and techniques. Reduction of energy costs. Bangkok: SE-EDUCATION. (2001).
7. Wattana T. Lighting. Bangkok: Asia Press. (1980).
8. Witaya Y. Refrigeration and Air Conditioning (Theory).Bangkok: The Technology Promotion Association (Thai-Japan). (1994).
9. Climate Center. Thailand Weather Conditions. Meteorological Development Office Meteorological Department. Bangkok. (2009).
10. Energy Research Institute. Energy Saving. Bangkok: Chulalongkorn University. (1993).
11. Somdech P. Theory of illumination. Bangkok: Phitsanulok Printing. (1982).

12. Somsak S. Principles and techniques of repairing refrigeration and air conditioning. Bangkok: SE-EDUCATION. (1990).
13. Soonthorn B. Bangkok: First Offset. (2002).