ENERGY STUDIES ON COMMERCIAL BUILDING IN FKE, UTeM

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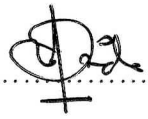
Signature : 

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To my beloved mother and father

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ABSTRACT

An energy audit is an inspection, survey and analysis of energy flows in building, process or system with the objective of understanding the energy dynamics of the system under study. In this project, an energy audit will be done at Fakulti Kejuruteraan Elektrik,FKE, Universiti Teknikal Malaysia Melaka. Energy audit is conducted to seek opportunities to reduce the amount of energy input into the system without negatively affecting the output. There are several types of energy audit which are walk through audit, standard energy audit and detailed energy audit. The main purpose of this study is to identify and detect where, when and how to conserve the energy usage among FKE's resident. Among the device that contributes to this study are lighting system, office equipments, motors, Heating, Ventilating and Air-Conditioning System, HVAC, and etc. Some issues that affect the energy use are building factor, people factor and occupied period. While completing this FYP, some methods had been identified. Firstly, survey will be conducted for all FKE's staff on 'Energy Efficiency Awareness'. By this survey, we can determine the level of energy awareness among staffs in FKE. With all the data, an energy audit seeks to prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings. As a solution, this project will come out with some recommendation to overcome the energy management problem.

ABSTRAK

Audit tenaga adalah pemeriksaan, bancian dan analisis terhadap aliran tenaga di dalam bangunan, proses ataupun sistem dengan objektif untuk memahami dinamik tenaga dalam sesebuah sistem yang dikaji. Dalam projek ini, audit tenaga akan dijalankan di Fakulti Kejuruteraan Elektrik, FKE, Universiti Teknikal Malaysia Melaka. Audit tenaga dilakukan untuk mencari peluang untuk mengurangkan jumlah tenaga masukan kedalam sistem tanpa mempengaruhi keluarannya. Ada beberapa jenis audit tenaga iaitu audit tenaga biasa dan audit tenaga terperinci. Tujuan utama kajian ini adalah untuk mengenal pasti dan mengesan dimanakah, bilakah, dan bagaimanakah untuk memelihara tenaga yang digunakan dikalangan pengguna di FKE. Antara alat yang menyumbang kepada kajian ini adalah sistem pencahayaan, alatan pejabat, motor, sistem penyejukan, pemanasan dan aliran udara, dan sebagainya. Beberapa isu yang mempengaruhi penggunaan tenaga adalah faktor bangunan, faktor manusia, dan waktu penggunaan. Ketika melengkapkan kajian ini, beberpa kaedah telah dikenalpasti. Pertamanya, bancian akan dijalankan kepada staf FKE yang bertajuk "Kesedaran Kecekapan Tenaga". Hasil daripada bancian ini dapat ditentukan tahap kesedaran dikalangan staf FKE terhadap kepentingan memelihara tenaga. Dengan semua data tadi, audit tenaga mampu untuk mengutamakan penggunaan tenaga dari yang lebih penting kepada kurang penting. Sebagai penyelesaian, projek ini akan disertakan beberapa cadangan untuk mengatasi masalah pengurusan tenaga.

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IT	-	Information Technology
FKE	-	Fakulti Kejuruteraan Elektrik
UTeM	-	Universiti Teknikal Malaysia Melaka
OPP	-	Outline Perspective Plan
RM	-	Ringgit Malaysia
kWh	-	Kilowatt hour

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CHAPTER I

INTRODUCTION

1.1 Energy Audit in FKE, UTeM

An energy audit is an inspection, survey and analysis of energy flows in a building, system or process with the objective of understanding energy dynamics of the system under study. Typically, an energy audit is conducted to seek opportunities to reduce the amount of energy input into the system without negatively affecting the outputs [1]. The object under study is commercial building of Fakulti Kejuruteraan Elektrik, Universiti Teknikal Malaysia Melaka. The purpose of the study is to reduce energy consumption in FKE commercial building while maintaining or improving human comfort, health and safety. Beyond simply identifying the sources of energy use, an energy audit seeks to prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings [1].

The energy audit is the first step in control the energy consumption. There are three types of energy audit which is walk-through audit, standard energy audit and detailed energy audit. Energy auditing of commercial buildings can range from a short walk-through of the facility to a detailed analysis with hourly computer simulation [2].

There are some common energy conservation parameters that will be discussed later in this study. The common parameters are:

- Building envelope
- Electrical systems
- Lighting
- Office equipment
- Electric motors

1.3 Scope of the Project

Base on the main objective of this project study, this project only involves for commercial building in FKE, UTEM. An energy audit will be done based on detailed energy audit. This audit is most comprehensive but also time-consuming energy audit type. Specifically, the detailed energy audit includes the use of instrument to measure energy use for the whole commercial building and some energy systems within the building. For example, this study will focus on lighting systems only.

Survey will be done to all FKE's staff including lecturer, teaching engineer, and technicians. The survey title is 'Energy Efficiency Awareness'. The main purpose of the survey is to study the level of energy awareness among FKE's staff.

Then, all the lighting parameters around FKE consist of administration and academic block and Block D and E will be calculated. From there, the chances to reduce the energy will be detect by some method such as reducing light bulb, reduce usage time and others.

After that, by the analysis on lighting, recommendation will come out. That recommendation is purposely to optimize energy usage in FKE.

1.4 Problems Statement

Misconduct electrical energy usage leads to waste energy. The effect of the wastage is not only involves cost, but also affecting nature. Because of insufficient in natural resources which is main source in generate electricity, consumer need to be more effective in using and handling energy. Besides that, generate electricity using fossil fuel will effect on nature by creating green house gas which emit sulfur and nitro gas that can cause acidic rain. Then, least energy awareness among FKE's staff and student leads to wastage energy and increase the utility cost. This energy audit will lead to reduce energy cost at the minimum level with optimum usage.

CHAPTER II

LITERATURE REVIEW

2.1 Energy Audit

Energy auditing is a proven effective energy management tool and has been practiced by energy professionals in Malaysia since the 1980s. However, many sectors are not aware of the benefits of energy audits. Those who do conduct energy audits for the building often do not priorities energy efficiency for financial and technical reasons.

Energy audits are a systematic study or survey to identify how energy is being used in a building or a plant. It is also a useful procedure to find out the best options for energy conservation. Energy audits provide an analysis of the amount of energy consumed during a given period in the form of electricity, gas, fuel, oil or steam. Using that information, it is also possible to list how the energy was used according to the various processes in a plant or at the various outlets in a building. The next step in an energy audit then is to identify the potential for energy savings accurately [6].

The main part of the energy audit report is energy savings proposals comprising of technical and economic analysis of projects. Base on the final output, an energy audit can also be defined as a systematic search for energy conservation opportunities [6].

The term 'energy audit' is widely used and may have different meaning depending on the energy service companies. Energy auditing of buildings can range from a short walk-through of the facility to a detailed analysis with hourly computer simulation. Generally, four (4) types or stages of energy audits can be distinguished.

There are as follows:

- Walk-through audit
- Utility cost analysis
- Standard energy audit
- Detailed energy audit

2.1.1 Walk through Energy Audit

Walk-through or preliminary audit comprises one day or half-day visit to a site and the output is a simple report based on observation and historical data provided during the visit. The findings will be a general comment base on energy best practices or the manufacturer's data.

2.1.2 Detailed Energy Audit

This audit is most comprehensive but also time-consuming energy audit type. Specifically, the detailed energy audit includes the use of instrument such as data logger or Fluke Meter to measure energy use for the whole building and some energy systems within the building [5]. Detail audit is carried out for the energy savings proposal recommended in walk-through or preliminary audit. It will provide technical solution options and economic analysis for the factory management to decide project implementation or priority. A feasibility study will be required to determine the viability of each option. For example, the parameters are:

- Lighting systems
- Office equipments
- Fans
- Chiller
- Air-conditioning systems

2.1.3 Benefits of Energy Audit

There are several benefits of energy audit. Some of that are:

- Clearly identified energy savings
- Proposed payback periods
- Conserve our nature by reducing the release of Carbon Dioxide gas from fluorescent bulb

2.2 Energy Efficiency

In the Eight Malaysia Plan and the Ten Year Outline Perspective Plan 3 (OPP 3), energy efficiency has been recognized as important measure in order to increase the competitiveness of the country's goods and service [4]. Energy efficiency in buildings means use less energy for heating, cooling and lighting. It also means buying energy-saving appliances and equipment for use in a building [3]. The important concept for energy efficiency in building is the building envelope, which is everything that separates the interior of the building from the outdoor environment [3]. Today, most common appliances and electronic devices are available in energy-efficient models such as air-conditioner, fans, copiers and computers. Several energy efficiency lighting options such as compact fluorescent light bulbs are also available.

2.3 Common Energy Conservation Measure

Some issues that affect energy use in certain building are building factor. Buildings characteristics can play an important part in focusing attention on possible energy-saving measure. For some buildings, the envelope such as walls, roofs, floors, windows, and doors, can have important impact on the energy used to condition the facility. Some of the commonly recommended energy conservation measures to improve the thermal performance of the building envelope are:

- Addition of thermal insulation
- Replacements of the windows

- Reduction of air leakage
- Improve indoor comfort level

The second issue is people factor. How the site operatives use the building may have a significant impact on energy consumption. The local operation of space heating controls, air conditioning units, office lighting, computers, printers, and duration or nature of occupancy periods can all affect energy consumption.

The others issue is occupied period. The longer the site space is occupied, especially office, the greater the potential for energy use and waste.

2.3.1 Electrical Systems

For commercial building, the electrical energy cost constitutes the dominant part of utility bill. Major part for electrical systems is such as lighting systems, office equipment, air-conditioning systems, and electrical motors.

2.3.1.1 Daylight optimization

The building layout should be designed in such a way as to maximize the penetration of daylight into the inner space (working area). It has been proven that natural daylight is the preferred light source for human beings. It gives better environment and improves productivity of the personnel.

The challenge in daylight design of buildings is to design windows and shading which let daylight in, prevent heat from entering the building, and reduce glare to the occupants. The building layout should be designed such that as many of the occupant as possible can access to daylight thus reduce operating time of lamp.

Apart from their role in natural daylight optimization, the light colored interior and glazed partitions play important roles in making the environment at the workplace to be more lively and pleasing.

2.3.1.2 Energy Efficiency Lighting and Controls

In order to fully utilize daylight, artificial lighting has to be controlled so that it is automatically shut off when daylight is sufficient to satisfy the lighting needs. Lighting represent 40% of total electrical used. For example, a daylight responsive control system and the lighting system can be combined with motion detector, which automatically shuts off lighting and reduce cooling once if area is unoccupied.

Today, several energy efficient lighting option such as compact fluorescent bulbs also available in market. Besides that, we can use reflective device and delamping whenever the luminance levels are above the level recommended by the standards. The Luminance level that suggested in every space in building is shown in table 2.1.

Table 2.1: Suggestions of Luminance level in some space

Suggestions illuminance	
Entrance	200 – 500 Lux
Dining hall	200 – 500 Lux
Kitchen	300 – 750 Lux
Guest hall	75 – 150 Lux
Corridor and stairways	100 – 200 Lux
Lift space	75 – 150 Lux
Administration counter	300 – 750 Lux
Office	300 – 750 Lux

2.3.1.3 User Comfort –Air Conditioned Area temperature / RH Settings

Air conditioning consumes largest share of energy. For office, the suitable temperature range is 23°C and 26°C, which Relative Humidity about 60% to 70%. Changing an office air-conditioner from 20C to 24C will save about 33% of energy. The addition of efficient controls, programmable thermostats can significantly reduce energy use. Lowering office thermostats by 1 degree can frequently reduce heating costs by 10%.

2.3.1.4 Energy Efficiency Office Equipment

Office equipment such as computers, printers, and photocopier machine consume electricity and also need air-conditioning to dissipate the heat they generate. Much electrical equipment nowadays comes with 'Energy Star' label. People are encouraged to switch off appliances instead of putting them in the stand-by mode when appropriate.

2.3.1.5 Electrical Motors

Energy cost to operate electric motor can be significant part of operating budget. It constitutes 40% of total consumed by commercial buildings. To reduce the energy cost by operating motor, we are encouraged to:

- Reduce operating time
- Optimizing motor systems
- Using control to match output with demand
- Use energy-efficient motor

CHAPTER III

METHODOLOGY

3.1 Methodology of the Project

Project methodology is a process or steps that have been used while running and completing this project. While running this Final Year Project (FYP), there are several steps that must be completed. For FYP 1, only one step involved, which is running the survey among FKE academic's staff; FKE technical's staff and FKE's student. The survey is conducted purposely to study the awareness among all of them about "Energy Efficiency Awareness".

3.2 Survey

For this FYP, first step that has been taken is runs the survey. The survey was conducted among lecturer and technician it FKE. These questionnaires purposely to study the awareness level among users in FKE. The questionnaire is titled "Energy Efficiency Awareness". 11 questions for technician and 12 questions for lecturer had been set up.

From that questionnaire, the energy consumption in staff's office can be predicted. Besides, the awareness among them can be traced. Consequently, the flow of energy waste can be trace. The last question for every set of questionnaire is about respondent's opinion on how to control the energy usage in FKE. This survey had been done from 6th August 2008 and finish on 20th October 2008.

3.3 Observation and Measurement

For the next step, an observation of the trend energy usage and consumption in FKE Commercial Building will be calculated. All the data of electrical parameters around FKE building will be collect. The electrical parameter constitutes lighting, air-conditioner, computers, photocopiers, projector and all electrical equipments in FKE's laboratory and workshop. This step will take the longest time to complete it. To collect all the data, an observation and interview with the technician will be done. Because of some constraint, unfortunately, only some place or room will be measured their parameter. This parameter only involved lighting and IT (Information Technology) components.

After that step, the maximum demand of the class will be calculated base on the timetable that provided by FKE's office. From there, we can predict the usage energy pattern and some recommendation have been proposed in order to optimize the usage of energy.

Only some place is involved in this audit. The places are all lecturer room, lecture room at administration block and lecture room at block E. However, the audit only prioritizes about lighting and Information Technology (IT) only. The audit will calculate whether the entire lighting connected load is sufficient enough or insufficient. To calculate the total lamp, the equation 3.1 will be use.

$$Total\ Lamp = \frac{Brightness\ Requirement}{Lumen\ Output} \tag{3.1}$$

To calculate the, the Lumen method can be use. By using this method, overall brightness that generates by lamp can me calculate whether it is sufficient or not. The calculation for this method as follows:

$$N = \frac{E \times A}{F} \tag{3.2}$$

Where,

N = Number of lamp

E = Requirement lighting level