Academic Journal of Science,
CD-ROM. ISSN: 2165-6282 :: 1(2):429–433 (2012)

STUDY OF BUILDING ENERGY INDEX IN UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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Towards year 2020 energy requirement will become more intensive in Malaysia. Building sector is the major energy consumers where is consume 48% of the total electricity energy. According to MS1525 standard, recommended building energy index in Malaysia is 135kWh/m²/yr. However, almost of the building do not meet this standard. Building owners or building user are not aware whether their building achieved or not this requirement. Malaysia presently only three building achieved this standard. The question is do University Tun Hussien Onn achieve this recommended standard? This study is to calculate and identify the building energy index in university. In this project, the case study will focus on the building energy index for major buildings in main campus. The objective of the study can be achieved by sequence of method such as collect energy consume data from energy utility provider, collect gross floor area of the building, calculating building index by excel software and analysis trend of building energy index. It is expected to getting building energy index for year 2010 and 2011 and both of the result will be compared either the trend increasing or decreasing. It estimated the result will not satisfied the MS 1525 Malaysian Standard, but this result will able to build up awareness of building energy index among building owner and users.

Keywords: University building and Energy Index.

Introduction

Increasing number of world population causes huge demands of building and electric energy. The increasing demand of electric energy leads to the sharp depletion of energy resources of the non-renewable type. Therefore, efficient usage of energy is one approach that is being studied and implemented to reduce the electric energy demand. However, energy is use widely in human daily life neither at home, shopping mall nor during working hours. Almost human daily activity related to building such as house, mall, office, factory and others needs electric energy. This phenomena causes building sector is the major responsible for electric energy utilization. Building sector is accounted consumed more half of total usage globally. There are same phenomena happen whether in develop country or developing country. In the United Kingdom, more than 60% of energy used is to condition the building indoor environment. While in Malaysia, approximately 48% of all available electrical energy used in commercial and office buildings [1].

Building Energy Index

As Malaysia moves towards the status of a developed nation in 2020, our energy requirements become more intensive. The building sector is among the major energy consumers in the country. This happen too UTHM, where rapid growth of UTHM leads increase of electrical energy usage. It expected that UTHM soon expand six times greater. It is crucial to study its building energy index. Figure 1.1 shown present building energy index (BEI) in Malaysia. Energy index is the amount of electric energy consume per year per meter square, where electric energy in kWh unit. Unit of building energy index is kWh/m²/yr. According to MS1525 standard, recommended building energy index, BEI is 135 kWh/ m²/ yr[2]. However, majority buildings in Malaysia do not meet this standard. Figure 1 shown only three buildings achieved BEI recommended standard. Do UTHM buildings achieve this recommended standard [1]?

Figure 1. Building Energy Index for Malaysian building.

Methodology

The objective of the studies was sucess by the sequence of method. The first step of this case study is the identification of the problem statement. Next step is defining the aims and objectives of the project for future accomplishment. The aims and objectives, this study will be focusing on the study of building energy index in UTHM with the expectation of suggesting approaches or measure that can be taken to reduce the energy consumption. It expected that, this study provide estimation of potential cost saving based on suggested measure. Result of UTHM building energy index will be calculated and discussed. Figure 2 shown detail of the methodology flow.

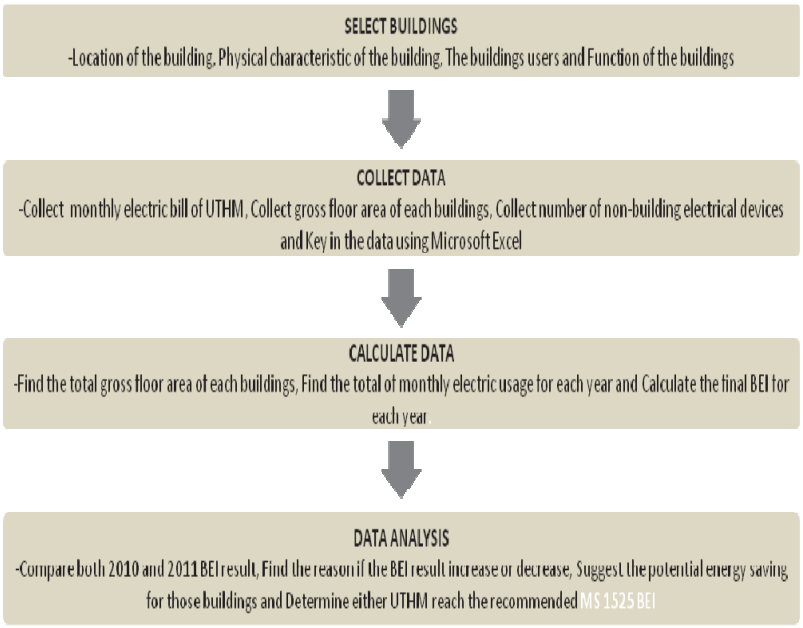

Figure 2. Building energy index research flowchart.

University's Building

In this study, the building located in University Tun Hussein Onn Malaysia (UTHM) main campus was selected as a case study. The building was located at Parit Raja, Batu Pahat, Johor, Malaysia, where positioning at 2° toward North and 103° toward Eas. UTHM main campus layout was show in Figure 3. The main campus compound were categorized to several zone for identify and management control. All the buildings in the main campus University Tun Hussein Onn Malaysia categorized into nine zones. There are zone 1, zone 2, zone 3, zone 4, zone 5, zone 6, zone 7, zone 8, and lastly zone 9. Each zone contain several building between two to twenty-five building or block, Each building or block have their own function and building user trend. Table shown the detail of building listed according to zone.

The UTHM total gross floor area is 219828.734 meter square. This main campus is capable to cater up to 12000 students and 3000 staff. UTHM main campus has a lot of facilities. Mostly, majority of the buildings are operating in office hour which is starts at 8.00 am until ends at 5.00 pm, total sum is about eight working hours. While that was different with laboratories, workshops, computer laboratories and studios, because their usage are depends on the student's class schedule. There are many types of building usage in UTHM and each building has their own function and operation. The purpose of P&P building is for teaching and learning activities. University allocated lecture halls, examination halls, classrooms and seminar rooms for teaching and learning activity. It was fully air-conditional and equipped with high tech teaching aid facilities. Cafeteria and Canteen, there are many cafeterias and canteens within the university vicinity for staff and students to have their meals from time to time.

Sports facilities provided by the University are stadium with track and field facilities, football field, rugby field, hockey field, netball court, handball court, volleyball court, badminton hall, basket ball court, squash court and many more. While University Medical Centre is

provides health and medical services to the students and staff especially for emergency cases and outpatient treatment. There are doctors and medical assistants work hand in hand with paramedic staff. The centre also provides ambulance service for emergency cases. Laboratories are set up which are fully equipped with machines and latest equipments to enhance students' understanding, competency and potential in the course of their study in technology and engineering fields. The library collection consists of monographs, journals/magazines and audio visual topics, journals and magazine, theses, CD_ROM and microfilms. In addition, the also library provides electronic searching information services through CD-ROMS database. In additional there are hostels available in the main campus. The hostels can accommodate up to 2,600 students, and also provide facilities such as mosque, cafeteria, rest room, study room, magazines, cyber cafe, photocopy kiosk and others. Bank, ATM and Mini Post Office was set up to serve staffs and students in the main campus. This facility provides one stop payment centre, postal order, registered letter and parcel services.

Building Energy Index Result and Discussion

The analysis of electric consumption was based on monthly summary report for year 2010 and 2011. Table 2 is a summary of the electric bill record kept from January until December. According to the summary, UTHM total annual electric bill was 21378875 kWh for 2010 and 25477599 kWh for 2011. However, the monthly electric consumption was not consistent. The difference was attributing to the intensity of electric consumption during the semester term, semester break, holidays, convocation and others. The highest electrical consumption was in October for both years, where the amount was 2115004 and 2761560 accordingly. The least was the February, where the amount was as low as 1573611 kWh and 1680617 kWh.

Table 2. Electric energy usage in 2010 and 2011.

YEAR 2010												
MONTH	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
ENERGY USAGE (kwh)	1800342	1573611	1994828	1855462	1646968	1561344	1974983	1964267	1560454	2115004	1656001	1675611

YEAR 2011												
MONTH	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
ENERGY USAGE (kwh)	1757133	1680617	2187953	2071238	1829331	1831845	2123014	1876535	2410113	2761560	2448260	2500000

The index selected would depend on the intended application of the index and the normalizing factor. Among architects, the normalizing factor for comparing buildings is the gross floor area. The most commonly used index for comparing energy use in buildings is therefore the Building Energy Use Index (BEI). This is usually expressed as kWh/m2/year which measure the total energy used in a building for one year in kilowatts hours divided by the gross floor area of the building in square meters[3].

There are technical report presenting energy audits carried out by Pusat Tenaga Malaysia, the office buildings in Malaysia revealed that the majority of Malaysian Office building had BEI in the range of 200 to 250kWh/m2/year [4].

Calculation of Building Energy Index:

Total Energy usage for 2010 = 25477599 kWh

Total UTHM Gross Floor Area = 219828.734 m²

$$\text{UTHM Building Energy Index} = \frac{\text{Total Energy usage for 2010}}{\text{Total UTHM Gross Floor Area}}$$

$$= \frac{25477599 \text{ kWh}}{219828.734 \text{ m}^2}$$

$$= 116 \text{ kWh/m}^2\text{/year.}$$

Building Occupancy ratio is 0.493, therefore ,

$$\text{BEI by considering occupancy ratio} = \frac{116 \text{ kWh/m2/year}}{0.493}$$

$$= 235 \text{ kWh/m2/year}$$

Conclusion and Recommedation

Currently, from calculation the Building Energy Index of UTHM building is 116kWh/m2/year. The best BEI practice and recommended by Malaysian Standard is 135kWh/m²/year. Therefore, UTHM building energy index lower compared to recommended value. The result is not really show the actual building performance index because building university is not fully utilizes in whole year. Estimated the result might double from current result because university campus were fully utilizes during first semester and second semester only.

The result of this study need to refining by considering the number of day where the building was not utilizes. There building are not fully utilize during semester break where student are not in the university campus. University building operation are not practice like shopping mall building, general office building or factory building where there are operation almost whole year. In additional several factors need to be considered to improve building energy index in university campus such educate users; create awareness, monitoring and others

Acknowledgements

The author gratefully acknowledges the support of this work by Faculty of Mechanical and Manufacturing Engineering, (FKMP), Office for Research, Innovation, Commercialization and Consultancy Management (ORICC) and Universiti Tun Huseein Onn Malaysia (UTHM) under Short Grant vote number 0630 and Fundamental Research Grant Scheme vote number 0721.

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