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ORIGINAL ARTICLES

Energy Management Practice: Office Building In Malaysia

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ABSTRACT

The energy management has been developed in escalates as its concept and idea are being discussed by many various parties from building owners, tenants or potential tenants, facilities managers and etc. In addition, more and more people are now concerned about energy management as the cost of energy is utilize increasingly. The concept of facilities management is originated in the US and it is spread widely during the 1980s in Europe and the US. The main duty of a facilities manager is to minimize the building operating cost without compromising comfort and pleasant to the building tenants. Currently, the concept of energy management services is being provided as part of facilities management services in most developed countries. However, the practice of energy management concept in Malaysia is vaguely acknowledged as it is not fully applied by the relevant parties. This paper aims to identify the energy management techniques, methods and systems of office buildings and to recommend ways to improve efficient energy management practices in Malaysia.

Key words: Energy Management, Office Building, Malaysia.

Introduction

According to Encarta (2006) energy is power supply or source: a supply or source of electrical, mechanical, or other form of power. In the context of economics, the word "energy" is synonymous to energy resources which refer to substances like fuels, petroleum products and electric power installations.

Energy is very important in our daily life from preparing a cup of tea in the morning to brushing our teeth before we sleep. However due to the scarcity and limitation of energy, the cost of consuming energy is escalating but ironically our dependability towards energy is growing by the minutes. According to research done by Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP), Malaysia's energy consumption per unit of Gross Domestic Product (GDP) is high in comparison to most developed countries and several advanced developing countries (MIEEIP, 2006).

Most energy management investment decisions are governed by dollars saved versus dollars spent and considers the length of payback (Bomi Institute, 2005). Offices which operates within large or numerous buildings or complexes may experience high energy consumption. According to Bomi Institute (2005) in office building, approximately 40 percent of energy is used for mechanical equipment (HVAC, elevators, etc.), and 20 percent is used for miscellaneous purposes such as personal computers, photocopiers, fax machines, and the like. By reducing energy use and managing energy efficiently, overhead costs can be minimised and subsequently help to reduce energy wastage.

Based on the definition, the major target of energy management is simply to maximise profits or to minimise cost which is basically in line with most of businesses objective. At present, many businesses and industries are adopting Total Quality Management (TQM) strategy or even ISO procedures for improving their operations and adopt energy management as part of their strategy to save cost. Other desirable sub-objectives of energy management programs according to Capehart et al (2003) include:

1. Improving energy efficiency and reducing energy use, thereby reducing costs
2. Cultivating good communications on energy matters
3. Developing and maintaining effective monitoring, reporting, and management strategies for wise energy usage
4. Finding new and better ways to increase returns from energy investment through research and development
5. Developing interest in and dedication to energy management program from all employees
6. Reducing the impacts of curtailments or any interruption in energy supplies

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In recent years, the idea of energy management is being discussed by many various parties from building owners, tenants or potential tenants, facilities managers and etc. More and more people are now concerned about energy management as the cost of energy use escalates. According to Bomi Institute (2005) in office building, approximately 40 percent of energy is used for mechanical equipment (HVAC, elevators, etc.), and 20 percent is used for miscellaneous purposes such as personal computers, photocopiers, fax machines, and the like. By reducing energy use and managing energy efficiently, overhead costs can be minimised and subsequently help to reduce energy wastage.

Overview on Energy Usage in Various Sectors in Malaysia:

Different industries have different equipment for their purpose. An office building for examples has different equipment compare to car manufacturer's equipments and therefore, different energy. For the purpose of comparisons or benchmarking, it is appropriate to compare energy use with other users in the same type of operation. This research identified two sectors which are commercial business sector and industry sector. The industrial sector are the major electricity usage with 53% compare to other sectors. MIEEIP (2006) reported that the energy consumption in the industrial sector in Malaysia is the highest with 36.4% and only rivalled by that in the transport sector, which accounted for 35.3% of the overall energy utilisation (MIEEIP, 2006). At present, efficient energy consciousness is slowly being push by Malaysian government under the implementation of the ongoing energy efficiency programmed under the MIEEIP. It is primarily guided by the utilisation objective of the National Energy Policy (MIEEIP, 2006). While energy prices are not expected to increase dramatically, the Government of Malaysia has already put in place measures to promote energy efficiency and energy conservation that will include the industrial sector, as long-term efforts. The commercial sector consumed the second largest electricity in Malaysia. Most of the electrical usage for commercial sector is in the form of air conditioning, lighting, mechanical systems such as lift and escalators and also ventilation.

Methodology and Analysis:

For this purpose of study, three organisations have been selected as case studies due to their diversity of building. Information pertaining to efficient energy management and the relevant aspects covered under this research will be gathered as to obtain information of current practice of energy management in Malaysia.

The first case study is the Faber Towers which mainly contain offices in the higher level mixed with retail outlets in the lower level of the building. The building was built in early 1980s without consideration of energy efficient design implemented.

The second case study is the Telekom Tower, a modern building which uses building automation system to manage its facilities. The management also has implemented various energy management approaches to enhance energy efficiency including energy audit, energy performance contracting, energy monitoring and an energy management policy.

The third case study is the Ministry of Energy, Water and Communication (MEWC) Low Energy Office (LEO). The building was intentionally developed to enhance energy efficiency design throughout the building. The energy in the building is being managed by an energy management department who monitored energy consumption. The building although not being managed by designated facilities managers is included in this study to highlight the government awareness towards energy management.

These case studies focus on the current practice of energy management undertaken by facilities managers to these organisations and the information is obtained via interviews.

2.1 Energy Management Practice:

In general, the findings can be summarized as follow:

1. The fact that Faber Towers was built in early 1980s explains limited energy consumption approaches that can be undertaken as the building was built without any consideration on energy efficiency design.
2. The facilities management of the Menara Telekom has implemented 4 approaches in order to ensure effective energy management can be practiced and this includes energy audit, energy performance contracting, energy monitoring and an energy management policy.
3. The new MECM LEO building demonstrates the feasibility of the energy efficiency measures according to the new Malaysian Standard MS 1525:2001 "*Code of Practice on Energy Efficiency and use of Renewable Energy for Non-residential Buildings*". The building was intentionally developed to enhance energy efficiency design throughout the building through the implementation of:

a. Energy Savings through Design
b. Energy Savings through M&E Services and Equipment
c. Energy Management System

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2.2 Facility Manager approaches for energy management planning:

Table 1 illustrates the approach that can be undertaken specifically for energy management planning. The implementation of energy management can either be undertaken by in-house facilities management or by outsourcing through energy performance contracting (EPC). Both have their own pros and cons and it is up to the facilities managers to decide which method to choose.

Table 1: Approach taken for energy management planning for Case studies.

	Building	**Energy Management Practice**
1.	Faber Towers	• Reducing lighting fixtures in lift lobbies
		• Reducing the operating time of lifts and escalators
		• Reducing the operating time of chillers
2.	Menara Telekom	• Conducting energy audit to identify current energy consumption and proposed energy saving opportunity
		• Engaged energy performance contractor to study and implement guaranteed energy savings
		• Monitoring of energy consumption but lack of comparison to similar buildings
		• Possess energy efficient policy but poorly publicized within the FM department
3.	MEWC LEO Building	• Implementing energy savings through design of the building in: - Building orientation - Building envelope - Natural air ventilation - Maximize daylighting - Interior space layout
		• Implementing energy savings through M&E services and equipment in: - Efficient air-conditioning system - Innovative lighting system - Energy efficient office equipments - Renewable energy application
		• Application of Energy Management System to optimise various energy systems in the building.

2.3 Energy Audit:

Energy audit is done to examine the ways energy is currently used in that facility and identifies alternatives for reducing energy cost (Capehart et al, 2003). Implementing energy audit enables facilities managers to identify which facilities consume most of the energy. According to Capehart et al (2003), the goals of energy audit are:

1. To clearly identify the types and cost of energy use.
2. To understand how the energy is being used – and possibly wasted.
3. To identify and analyze alternatives such as improved operational techniques and/or new equipment that could substantially reduce energy cost.
4. To perform an economic analysis on those alternatives and determine which one are cost-effective for the business or industry involved.

The process of energy audit can be divided into 3 phases which are:

1. Preparation for an energy audit visit
2. Performing facility survey
3. Implementing audit recommendations.

Energy Consumption Approaches:

Energy Savings:

Generally, saving energy equals saving money. The term energy savings are commonly used nowadays reflecting to the escalating cost of today's energy price. Most manufacturers in the market today try to adapt the term *"Energy Efficiency"* to their products ranging from light bulbs to automobiles to attract cost conscious buyers. Local governments are encouraging people to use energy efficiently by promoting on the internet, televisions and newspapers. As described by American Public Power Association (APPA, 2003). The application of energy saving methods and techniques that can be undertaken by the facilities managers are as follows:

1. Retrofitting
2. Proper Maintenance
3. Reduce Usage and Resetting Equipments
4. Installation of Sub-meters
5. Financial Incentives

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Energy Management Control System (EMCS):

The development of IT has tremendously changed the way we live and the dependency of human race towards IT has never been so immense. The development of EMCS varies in cost, complexity and effectiveness. The large EMCS system often includes fire-safety functions, equipment maintenance, status monitoring, report generation as well as energy management. The EMCS technology is changing rapidly and there are many vendors in the field, and each has introduced new equipment (Capehart, 2003).

Facilities managers who intend to use EMCS in their building should consult several vendors and be well prepared to discuss the facility's needs. What usually happened is that most of the decisions made are not towards what the company really needs. The computer is just a tool to do what the users tell them to do. According to BOMI (2005), general applications of EMCS are as follows:

1. Time of day (start/stop) – controls of such as mechanical equipment as lighting, chillers, air handlers etc.
2. Optimisation – free cooling by using outside air, chilled water reset, condenser water reset or supply air reset.

Energy Benchmarking:

The purpose of energy benchmarking is to act as a yardstick by facilities managers to measure the effectiveness of energy management plan which they developed. Facility Managers can have significant impacts on their operating costs by understanding how they are performing relative to others and what opportunities exist to reduce or control utility costs (Facility Issues, 2006).

Energy Performance Contracting:

According to Energy Efficiency and Conservation Authority (EECA), New Zealand defines Energy Performance Contracting (EPC) as:

"A contractual way of delivering improved energy services to an organisation with a guarantee of energy performance, external financing for asset investment, and management of the energy improvement by an external service provider."

Energy Performance Contracting (EPC) is an outsourcing method in energy management practices. Outsourcing of work or tasks is generally preferred nowadays around the world and also in Malaysia (Chan, 2005). Jones (1996) has identified the following reasons that lead to outsourcing which is as follows:

1. Private Sector – Competitive pressure force awareness on overheads
2. Public Sector – Inconsistent public expenditure profiles from year to year
3. Skill Shortages – Some work required many professional support
4. Manpower Shortages – Decline in the availability and number of quality graduates lead to this problem
5. Flexibility – Unpredictable markets which require both base costs and fixed overhead to be low
6. Specialist Knowledge – Modern technologically advance buildings need expert to monitor and maintain it.
7. EPC is different from conventional contracts. Killick (2003) has identified 3 core features that separate EPC from usual contracts which are:
8. Contracts are based on Guaranteed Performance
9. Finance and implementation can be arranged by the EPC contractor
10. Technical improvements produce operational savings/ avoided costs.

The EPC is preferred by facilities managers as there is no upfront expense involved to the facility, and payments usually start only when the project is complete and energy savings should already be accruing. Basically the facilities managers are facing 0% failures when embarking into EPC.

Energy Management Planning:

Basically energy management planning is done either by in-house facilities management or by outsourcing through energy performance contracting (EPC). Both have their own pros and cons and it is up to the facilities managers to decide which method to choose.

Energy audit is one method done before any energy management practise take place. Energy audit is done to examine the ways energy is currently used in that facility and identifies alternatives for reducing energy cost (Capehart, 2003). Implementing energy audit enables facilities managers to identify which facilities consume most of the energy. Theoretically, facilities that used the most energy have the greatest potential savings. After the energy audit takes place, then the implementation of energy management should follow.

According to BOMI (2005), there are 2 major areas of energy management which are:

1. Energy Savings
2. Energy Management Control System (EMCS)

Energy savings is basically methods and techniques used by facilities managers to reduce their energy consumption whilst EMCS is the application of electronic control system in managing energy. Finally, energy benchmarking and energy rating is made to measure the building performance in term of energy usage within similar buildings.

Energy Audit:

An energy audit (also called energy survey, energy analysis or energy evaluation) examines the current situations of building energy consumption. According to Capehart et al (2003), the goals of energy audit are:

1. To clearly identify the types and cost of energy use
2. To understand how the energy is being used – and possibly wasted
3. To identify and analyze alternatives such as improved operational techniques and/or new equipment that could substantially reduce energy cost
4. To perform an economic analysis on those alternatives and determine which one are cost-effective for the business or industry involved.

Energy Savings:

Generally, saving energy equals saving money. The term energy savings are commonly used nowadays reflecting to the escalating cost of today's energy price. Most manufacturers in the market today try to adapt the term *"Energy Efficiency"* to their products ranging from light bulbs to automobiles to attract cost conscious buyers. Local governments are encouraging people to use energy efficiently by promoting on the internet, televisions and newspapers. US government for examples under the American Public Power Association has produced free guidebook to promote energy savings practise (APPA, 2003).

The application of energy saving methods and techniques by the facilities managers are as follows:

1. Retrofitting
2. Proper Maintenance
3. Reduce Usage and Resetting Equipments
4. Installation of Sub-meters
5. Financial Incentives

Case Study No. 1: Faber Towers:

Building Background:

Faber Towers located in Taman Desa, which is located approximately 12km from the city of Kuala Lumpur. Faber Towers were developed by Faber Union Sdn. Bhd. (FUSB), a subsidiary of Faber Group Berhad (FGB). The construction of the building started in 1985 and it finally completed in 1990. On 3rd August, the property was issued with a Certificate of Fitness for Occupation by the Kuala Lumpur City Hall and the building became occupied in the same year.

Energy Management Approach:

As mentioned above, the building was designed in early 1980s when energy savings and energy efficiency was not a main issue. The building is also not being monitored by building automation system which is why the management of Faber Towers is currently adopting manual energy saving strategy.

According to Respondent A1, the services that consume most of the energy in the building are the one which involves motorized systems. That includes air-conditioning and mechanical system i.e. lifts and escalators. Therefore, management focus on energy savings are towards the reduction in lighting, control of lift and escalators and adjustment of air-conditioning. The following is the comprehensive detail on energy saving methods applied in Faber Towers.

Lighting:

FFSB has made an approach to energy saving by reducing the electrical usage in lighting with focus on the lift lobby area. There are two lift systems in the building to serve the two towers. Generally lift lobby is the area of least time spent in the building which is maybe why FFSB has decided to adopt this method to this area.

The lighting case in the lift lobby is being reduced from 3 lamps to 1 lamp which is still adequate and comfortable. Mathematically, 1 lift lobby has 8 numbers of lighting cases, so the management manages to save up to 16 lightings cases per floor which total to 336 lightings cases. However there is a crucial consideration of

safety needs of the building user. It is a normal practise to install closed circuit television (CCTV) to lift lobby in commercial buildings is in lacking in this building. FFSB should consider installing CCTV as a proactive crime prevention rather waiting for a misfortune to happen.

Lifts and Escalators:

Lift and escalators are one of the major contributes in energy consumption in the building due to the motorized mechanical movement in the system and the frequency of the usage in the building. The escalators serve 2 floors which are from ground floor to 2nd floor which running non-stop throughout the day. Lifts on the other hand operate as required with total of 6 numbers of lift per tower excluding 1 number of Bomba lift per tower.

The escalators basically serve the lower level of the building which is a mix of mainly of retail outlet and a few offices. The standard office hour is usually started from 8.00 a.m. to 5.00 p.m. but allowances should be made to people working overtime. The retail outlets in the building are open up to 9.00 p.m. but a few of them closed before 8.00 p.m.

FFSB has studied the usage pattern of these systems and has implemented energy savings to these systems by reduction of usage. The escalators are switched off at 8.30 p.m., which is half an hour earlier than the actual closing time. The lifts are switch off at 8.30 p.m. excluding lift 'Bomba' which being the only designated lift for each tower. From the interview, FFSB has not received any complaint from the tenants of the building since implementation of the system.

Air-conditioning System:

The air-conditioning system in the building is basically consuming most of the energy in the building. However due to the warm climate factors in Malaysia, the usage of air-conditioning especially in the commercial buildings is essential.

The air-conditioning systems in the building are divided into centralised and packaged unit. The centralised system is control by FFSB for podium level (ground floor to 2nd floor) whiles the package unit is control separately by the building tenants from 3rd floor above. FFSB has adopted energy savings by reducing the total time of chillers usage. The chillers is switch off at 7.30 p.m., which is one and half hours earlier than scheduled. Rationally, the temperature is still cold in the chillers along with circulation of existing cold air in the building and this can maintain the low temperature in the building

Although the method implemented are not significant, the awareness of energy savings particularly to Faber Towers has shown that the facilities managers in Malaysia are working towards the right direction. FFSB has also proposed to convert the manual control system to an automatic system by installing a building automation system (BAS) to enhance energy management control. The proposal however has been postponed by the management due to the high initial cost of installation which is estimated at RM 1.2 millions.

Case Study No. 2: Telekom Tower:

Building Background:

Menara Telekom is the icon of Telekom Malaysia Berhad (TMB) which is located at Jalan Pantai, Kuala Lumpur. The 55-storey tall with estimated building gross area of 241,600 m^2. At the moment, the building is occupied by mainly by Telekom Malaysia Berhad plus a few other private tenants.

The air-conditioning system in Menara Telekom is using chilled water system which is supplied by TNB district cooling under contract for 20 years. At the moment, the heat load in the building is lower than the minimum heat load expected with resulting excess payment to the supplier (Ali, 2005). Although the reduction in building heat load is uneconomical, the high consumption of electricity to the operation of air-conditioning system should be monitored and reduced wherever possible.

Menara Telekom is installed with building automation system (BAS) namely Integrated Building Management System (IBMS) which provides a productive, cost-effective environment by optimising security, systems, services and management and their inter-relationship. The system allows monitoring of building and online control of building air-conditioning system, lighting and alarm system but the system is not being used to the maximum capability.

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Energy Management Approach:

The facilities management practise in Telekom Malaysia Berhad (TM Berhad) is quite impressive compare to other organisation in Malaysia. TM Berhad has acknowledged the significant of facilities management as part of its non-core activities to support the core activities of the organisation.

The approach of TM Berhad towards energy management under its FMID Division is going towards right direction. Menara Telekom Operation and Maintenance (MTOM) have initiated an energy audit to measure the current energy consumption of the facilities in the building and to proposed recommendation. MTOM in addition has engaged an energy performance contractor to provide an energy efficient solution to the building. MTOM also monitored and make comparison of energy consumption of the building. The implementation of energy efficiency policy also shows the awareness towards energy management. The following are details on the energy management methods applied in Menara Telekom.

Energy Audit:

Energy audit is important to actually measure what is the existing condition of the building overall. Energy audit can be done internally or by outsourcing it to energy consultant; for Menara Telekom, MTOM has decided to outsource the audit to professional consultant. MTOM has hired ECO Energy, an established local energy management consultant to perform an energy audit of Menara Telekom.

The audit was carried out to identify current energy situation concerning the consumption of electricity, water and also indoor comfort level. The audit covers many areas from the mechanical and electrical systems, air-conditioning system, BAS, building designs, maintenance and its impact on water and electricity usage, opportunities for cost savings and also recommendation for better operating procedure and environmental aspects.

From the energy audit done, ECO Energy has outline opportunities for savings in usage of electricity and water in Menara Telekom which is as follows:

1. Optimisation of chilled water and tower water pumping system operations and controls
2. Optimisation of air system operation and controls
3. Optimising of office area lighting system
4. Enhancing the operations of the current BAS
5. Training the facilities management staff on efficient building management

Energy Performance Contracting:

Energy Performance Contracting (EPC) is a contract bound between the organisation and the contractor where the contractor guaranteed to improved energy consumption of the building. MTOM has adopted EPC by engaging Factor Four Technology Sdn. Bhd. to propose energy efficiency system based on EPC. The result from the proposal shall reduce the operating cost of chilled water pumps without compromising on required flow rates and pressures.

After thorough analysis, Factor Four Sdn. Bhd proposed to optimised pumping system and to optimised heat exchanger to reduce the required pumping energy and to improve heat transfer rate. The measurement of before and after the retrofit were done to measure the effectiveness of the proposal. MOTM also involved in the process by joint monitoring to make sure that the proposed design can achieve lower energy consumption without compromising comfort level.

From the proposal, Menara Telekom has managed to reduce approximately 50% of its pumping operating cost by retrofitting the existing pumping system which offer lower overall operating cost, better volume pumping control and more reliable system.

Energy Monitoring:

Usually to identify if there is something wrong with our car, the monitoring of fuel consumption is basically the easiest method to implement. Monitoring is actually an essential phase in any management process which in this case, energy management process. Monitoring can ensure the calibre of the system implemented in the building is in perfect condition and working in the highest precision as possible.

In MTOM, the importance of data collection for monitoring purposes is being done by the engineer. The engineer will monitor the building energy bill and compare it to the previous recorded data. However the data collected were not used comprehensively. The efficiency of energy management in Menara Telekom cannot be determine as there is no comparison made to other building with similar characteristic (Ali, 2005).

Energy Efficient Policy:

The policy of energy efficient for FMID is prepared to create awareness of energy conservation and implementation of energy management programme in the organisation. The policy is support by written Energy Conservation Guidelines which has 2 main objectives:

1. Cost saving through energy management program in TM and further enhance the corporate growth and remain competitive
2. Promote energy management plan to reduce energy consumption through efficient use of energy and minimise wastage.
3. According to research done by Ali (2005), although FMID have an energy policy, the employees of MTOM are not aware of it; making the policy unsolvable. The finding shows that the policy is not fully publicized and standardized among the employees. However, the understanding of energy saving is acceptable as energy efficient is included in all specifications for buying new plant and equipments.

Case Study No. 3: Mewc Leo Building:

Building Background:

The Ministry of Energy, Water and Communication (MEWC) Low Energy Building (LEO) is the first government own building which integrates a comprehensive energy efficient features. It was constructed by Putrajaya Holdings Sdn. Bhd. for the MEWC. The building is located at Parcel E, Federal Government Administrative Centre in Putrajaya. The building is being monitored and managed by in-house building Energy Manager En. Abdul Rahim Mahmood. He is responsible for the day to day energy management, handling visitors from Malaysia and abroad.

The main objective of this building is to demonstrate energy efficient building is possible to achieve without compromising comfort to the occupants. The building also shows the commitment of government towards energy efficient through “Leadership by Example”. Government also want the building to enhance awareness on energy efficient building design through integrated approach to building design and to demonstrate local capacity in energy efficient building design.

The building design was supported by Danish Agency for Development Assistance (DANIDA) programme. Since January, 2001, Danish experts in cooperation with Malaysian architects and engineers optimised the overall design of the building and its energy systems for minimum energy consumption. A computerized design tool was introduced as a key instrument in the optimization of the building design and the design of the energy systems.

The new MECM LEO building demonstrates the feasibility of the energy efficiency measures according to the new Malaysian Standard MS 1525:2001 "*Code of Practice on Energy Efficiency and use of Renewable Energy for Non-residential Buildings*". Following this code, the LEO building must have an energy consumption less than 135 kWh/m^2year. The predictions are that the LEO building will have an energy index close to 100 kWh/m^2year. This is a very good performance compared to typical new office buildings in Malaysia and the ASEAN region, having an Energy Index of 200 – 300 kWh/m^2year (MEWC, 2006).

The energy management of this building can be divided into the following:

1. Energy Savings through Design
2. Energy Savings through M&E Services and Equipment
3. Energy Management System

Energy Management Approach:

Energy Savings through Design:

LEO building is carefully designed to achieve efficient energy criteria starting from the beginning where the following design factors were taken into account:

1. Building Orientation
2. Building Envelope
3. Natural Air Ventilation
4. Maximise Daylighting
5. Interior Space Layout

- *Building Orientation:*

The objective of orientation of the building is to prevent direct sun lighting into the building. Direct sun lighting can influence the temperature in the building thus increasing the usage of air-conditioning. The windows for this building are orientated to the north and the south which receive less sunlight.

- *Building Envelope:*

The LEO walls consist of 200mm thick lightweight aerated concrete which has insulation value up to 2.5 times better than traditional brick wall. The external surfaces are light coloured which help reduce solar heating to the walls. The 100 mm roof insulation of the building is thicker than the standard 25mm insulation. The roof surface is protected by a second layer of canopy roof to prevent direct solar penetration. Green landscaping is added to the roof top for additional shading and for aesthetical purposes.

- *Natural Air Ventilation:*

The 4-storey height atrium is the centre of the building where the visitors and the occupant pass by. The atrium is an enclosed area roofed by transparent material which allows daylight through. This atrium provides daylight deep into the building, which would otherwise need an artificial lighting.

At the top of the atrium is a solar wall, or "thermal flue". The two-storey black wall with vertical glass glazing in front acts as a ventilation system driven by natural forces. Solar radiation heats up the black wall, which in turn heats up the air in 800mm gap between the wall and the glass.

The hot air rises as in a chimney and escapes through vents and resulting vacuum which suck outside air into the ground level of the atrium through sliding doors. When this air passes through the sliding doors, a spray mist system emits water particles, thereby cooling the air by a couple of degrees.

- *Maximise Day lighting:*

The atrium provides day lighting to penetrate into the building which reduces the artificial lighting usage in the building. The building is also equipped with lighting sensors where it automatically shut off the artificial lights if the day lighting is sufficient (illumination level 300 – 400 lx). The punch hole windows design and glazing maximise day lighting into the building but reduce the heat of sunlight and glare in the building.

Analysis of Case Studies:

Table 2: Energy Management Practise.

Item	Building	Energy Management Practise
1.	Faber Towers	Adopt energy savings practise by: • Reducing lighting fixtures in lift lobbies • Reducing the operating time of lifts and escalators • Reducing the operating time of chillers
2.	Menara Telekom	Adopt energy management practise by: • Conducting energy audit to identify current energy consumption and proposed energy saving opportunity • Engaged energy performance contractor to study and implement guaranteed energy savings • Monitoring of energy consumption but lack of comparison to similar buildings • Possess energy efficient policy but poorly publicised within the FM department
3.	MEWC LEO Building	Adopt energy management practise by: • Implementing energy savings through design of the building in: o Building orientation o Building envelope o Natural air ventilation o Maximise day lighting o Interior space layout • Implementing energy savings through M&E services and equipment in: o Efficient air-conditioning system o Innovative lighting system o Energy efficient office equipments o Renewable energy application • Application of Energy Management System (EMS) to optimise various energy systems in the building.

The case studies have shown that in the practise of energy management in Malaysia is acknowledged, although the complexity varies between buildings in the Klang Valley. The implementation of energy

management is also varied. Basically new buildings such as MEWC and Menara Telekom have implemented extensive energy management practise compared to older building such as Faber Towers which now focus on energy saving practise.

The case studies also revealed various types of energy management approach by facilities managers.

Conclusions:

It was found that that by employing facilities managers, the organisations can help to support their core business thus by providing energy management practice as well as can increase profit to the organisations. The case studies revealed that facilities managers in Malaysia were aware of the importance of energy management to increase profits and reducing overhead. The Malaysian government for example has taken lead in building and energy efficient building complete with energy management system. In the future, energy management system should be part and parcel of every building in Malaysia.

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