

Potential Retrofit of Universiti Tun Hussein Onn Malaysia Existing Building Towards Green Building

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Abstract: Most of the existing buildings in Malaysia are not sustainable. Improper design led to negative environmental impact and minimizes the economic value a building. At the same time, local community and society could not enjoy the facilities that they supposed to get. They are numbers of potential strategies to improve the performance of existing building by retrofitting it with green building elements. This study is investigating and proposing potential retrofitting of existing buildings at Universiti Tun Hussein Onn Malaysia (UTHM). The strategies that can be implemented in the old buildings were investigates in order to improve its performance. The Green Building Index (GBI) was used as the benchmark in analyzing the old buildings. Questionnaire survey was adopted as the main tool for data collection. Results showed that all 28 identified criteria for green had an average index value higher than 3.5 which means that there is a significant need to retrofit the existing buildings towards green building. It is possible to implement green concept for all buildings investigate. The performance of buildings can be improved by understanding the criteria of GBI and integrating it into the study buildings.

Key words: Malaysia Green Building Confederation (MGBC), green, building, retrofit, GBI, UTHM

INTRODUCTION

Green building concepts were designed to reduce the overall impact of the built environment. From previous research, it was shown that green buildings bring a lot of benefits including potential environmental benefits, economic and social. Thus, the concept of green building is recommended in planning, design and construction of buildings (Ang, 2008). One of the buildings in the UTHM that the concept of sustainable development is the Faculty of Civil Engineering and the Environment (FKAAS) where this building consisted of, classrooms, laboratories and rooms meeting. This building is one of the new developments by UTHM, completed by 2010. FKAAS is not excluded in the Green Project. Recent years, UTHM has taken a big step in the green campus initiatives towards policy of sustainable campus. The policy draws out a line in academics, campus planning, administration, outreach, implementation and also operations. Most of the buildings, either new construction or the existing building are focused to be classified as green building which will maximizes the efficiency and operation and minimizing its waste and footprint (Castleton *et al.*, 2010). The building of FKAAS is taken into main consideration for this study. The operations and maintenance is now to be evaluating to

determine either this building implemented with the concept of green building based on green building. Therefore, it came out with questions about what level of awareness for green building in the community of UTHM? Can the existing building in UTHM retrofit to green building? What are the potential of retrofitting the UTHM existing building to green building?

Problem statement: In Malaysia the design of green buildings in the hot climate, humid and wet already been taken into account and the use of green building may raise issues of maintenance which is ensure indoor air quality is better, encourage regular maintenance and testing of equipment and reduce building operating costs of the building such as lighting and air conditioning (Mat *et al.*, 2009). In order to broaden the green building applications in Malaysia the Ministry of Energy, Green Technology and Water (KeTTHA) the industry faces difficulty as follows:

- A very low demand and the high cost of green products and services
- Difficult and challenging cooperation between players in the implementation of the construction industry and green technology criteria

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Fig. 1: Map of UTHM

- The lack of local expertise in green technology
- Lack of R and D activities, knowledge and technology transfer in green technology
- A lack of understanding, acceptance and awareness of green technology among the players of construction industry and citizen as the whole

Ministry Of Education (MOE) has adopted the movement towards sustainability. The public and community in universities giving concerns on the pollution and degradation of the environmental caused by the consumptions of materials and energy in universities campus. Therefore, there were efforts in managing the ecosystems and this can be done by adopting the systems based on design and integrated approach towards sustainable campus. In addition to the physical environment of the university as a green landscape that supports and enhances the academic excellence of the program, buildings must also participate to play its role. Operation and maintenance costs of utility are high and keep increased in UTHM shows that unsustainable living conditions practiced by the University. This situation shows that there is a need to propose a redesign or retrofit the existing buildings of UTHM based on requirements of green building assessment, in order to reduce the operation and maintenance cost and also zero negative impact to the environment. But, this situation seems hard to implement due to lack of expertise in this area since a lot of building in Malaysia already established with element of green building. Green building concept planned and designed to minimize the overall impact of environment and nature. From previous research, it was shown that green buildings bring a lot of benefits including potential environmental benefits, economic and social. Thus, the concept of green building is recommended in the planning and designing in building construction. One of the buildings in the UTHM that applied the concept of sustainable development is the

Faculty of Civil Engineering and the Environment (FKAAS) where this building consisted of, classrooms, laboratories and rooms meeting. This building is one of the new developments by UTHM, completed by 2010.

FKAAS is not excluded in the Green Project. Recent years, UTHM has taken a big step in green by comprehensive initiatives towards sustainable campus policy. The policy draws out a line in academics, campus planning, administration, outreach, implementation and also operations. Most of the buildings, either new construction or the existing building are focused to be classified as green building which will maximizes the efficiency and operation and minimizing its waste and footprint. The building of FKAAS is taken into main consideration for this study. The operations and maintenance is now to be evaluating to determine either this building implemented with the concept of green building based on green building. Thus it comes out with question on what is the awareness level for green building among UTHM communities? Can the existing building in UTHM retrofit to green building? What are the potential of retrofitting the UTHM existing building to green building? The researchers also want to determine the level of green building index, identify the advantages of using green technologies, and identify the elements that are used in green technologies. In order to solve this problem, researchers conduct research to identify elements in building a sustainable development concept. In order to ease the development of green building and to have a better life for human and environment, this study need to investigate the potential element of retrofit the UTHM existing building according to Green Building Index.

Establishment history of UTHM: The official portal of Universiti Tun Hussein Onn Malaysia, the history of UTHM began on 16th September 1993 (Fig. 1). The university was formerly known as Pusat Latihan Staf

Politeknik (PLSP). PLSP the core business is to train and produce polytechnic academic staff to be knowledgeable and skilled in various fields of engineering. The training institute was jointly administered between Universiti Teknologi Malaysia (UTM) and the Ministry Of Education (MOE). Then PLSP was upgraded to Institut Teknologi Tun Hussein Onn (ITTHO) in 1996. This promotion is recognition to institutions that excel in the development of human resources to technical education. The institute achieved another milestone when the Malaysian government agreed to awarding this institute a university-college status on 27th September 2000. This is to recognize the contribution in the development of science and technology and also help the country reach its aspirations. Thus, these institutions have been recognized as Kolej Universiti Teknologi Tun Hussein Onn (KUiTTHO) and the official announcement was officiated by The Minister of Education at that time. KUiTTHO continue to grow and give progress, producing graduates who are knowledgeable, skilled and competitive to accommodate industrial needs of the country. Therefore, in accordance with achievement of the progress, Malaysian government agreed to award KUiTTHO full university status to Universiti Tun Hussein Onn Malaysia (UTHM) on 20th September 2006. Subsequently on 1st February 2007, The Minister of Higher Education officially announced the change of status and finally on 2nd March 2007, Dato' Seri Hishammuddin Tun Hussein Onn made the official declaration of the changing. On 1st May 2004 Faculty of Civil and Environmental Engineering (FKAAS) was set up after the restructuring of all the faculties in Universiti Tun Hussein Onn Malaysia (UTHM).

Definition of green building: Green building focuses on improving the efficiency of resource use of energy, water and materials while reducing impacts on health and the environment during the life cycle of buildings through design, construction, operation and maintenance (GBI, 2013). Green buildings should be designed and operated to reduce the overall environmental impact of the building and surrounding area. In Malaysia, buildings with green technology is considered new but efforts to build the buildings with green technologies including residential areas to ensure better quality, comfortable and affordable for all groups of society. Therefore, the government has realized that green technology approach can be a good alternative for residential buildings. Green building Concept is designed to reduce the overall impact on the building and its overall surroundings. From past studies, it was found that green buildings bring many benefits and advantages including the potential benefits to economic, social and environmental. Thus,

the concept of green buildings is recommended to be implemented in the construction industry in our country.

Green Building Index: Green Building Index (GBI) is an environmental rating system for buildings that are developed with the Malaysian Institute of Architects (PAM) and the Association of Consulting Engineers Malaysia (ACEM). It is designed to evaluate the environmental design and building performance of the building or house in conditions of Malaysia's tropical weather. It is also the first comprehensive system in Malaysia encompasses six (6) main elements, Energy Efficiency (EE), Indoor Environmental Quality (EQ), Management and Sustainable Planning Area (SM), materials Resources (MR), Water Efficiency (WE) and Innovation (IN).

Benefits of green building: Green building throughout its life cycle designed to save resources and energy through recycling of materials, reducing emissions of toxic substances and also align its design to suit the climate, tradition and culture and the environment. Green building can sustain and improve the quality of human life and at the same time maintain the capacity of ecosystems both locally and globally. Green building has many benefits including better utilization of resources; improve productivity and huge savings in operation.

Potential green building in Malaysia: As a developing country, the government of Malaysia took a serious approach to green building development as stated in the government agendas since 2010 (Mat *et al.*, 2009). Putrajaya and Cyberjaya will be a pilot development project of the Green Municipal and will be directly as a model to other cities in Malaysia. The Malaysian government has built three units of energy-efficient buildings as demonstration office to the authorities and the public within 10 years. The Government of Malaysia is also very supportive in the development of green buildings in this country. In Europe and the United States they are ahead in studying and applying the criteria of green technologies to enable the retrofitting of existing buildings towards green building. The development of green technologies in existing buildings has become common and it has the full support of the government and non-government. In fact, recently the government has decided that all new buildings to the government's need to combine green technology features (Bruce *et al.*, 2015; Wilkinson, 2012). Moreover, in the 2010 Budget recently, the Prime Minister announced tax exemption for building owners who managed to get a green certificate (GBI). In



Fig. 2: FKAAS building (UTHM, 2009)

addition, the buyer of the building with green certificates (GBI) is also exempt from stamp duty with effect date from 24th October 2009 until 31st December 2014 for a good period of 5 years. Apart from that, RM1.5 billion funds will be established to provide assistance and support to companies that are interested to get involved or have been involved in green technology. In the development of this green building and with political stability, Malaysia is ready to move better than ever. This is for the better country by building more green buildings and also to implement and develop green technology. Most of the existing buildings in Malaysia were built without taking into consideration of green technology, it is timely GBI has to be considered in the construction industry as well as to help building owners to retrofit their building towards green building.

Retrofitting building: Retrofit is the process of modifying or mounts something after it has been completed. For buildings, it means making changes to internal systems or building element itself after it was completed and occupied. The development of new technologies mean that building retrofits can allow for significant reductions in energy and water usage. The existence of guidelines for green technology in the country has led to the awareness on the importance of green building, but there is a need to thoroughly consider the awareness on UTHM community . a good awareness to the UTHM community in green technologies will be able to give confidence to the university management to consider the potential of retrofit to existing buildings towards green building. In addition, the university has taken a big step in the implementation of green technologies for the realization of initiatives geared towards the development of a sustainable campus with FKAAS building which is built (Fig. 2).

MATERIALS AND METHODS

The chosen building for this study is FKAAS building in UTHM. The questionnaire survey in this

study to investigate an insight of respondent who involved in development of the campus and maintaining old buildings in UTHM. Before that pilot survey and expert pilot was done to validate the questionnaire. Interviews with selected industry professionals were used as the pilot survey and expert pilot. Users also invited as respondents in this research to exploring applicable strategies to improve the building performance. A total of 100 respondents were participated in this study. The results were analyzed and discussed to achieve the research aims. The analysis was done by using Likert Scale to find up the mean index.

RESULTS AND DISCUSSION

The important criteria in the retrofit of existing buildings towards green buildings: Figure 1 shown the important criteria have to retrofit the existing building in UTHM towards green building. There were 80 respondents (79.02%) agree and strongly agree that using solar thermal technology, for example, the most important criteria in green building by using solar panels to generate renewable energy can be considered as sustainable. The average index for solar thermal energy is 4.09; it is a kind of renewable energy that has been used for green buildings. This technology can be used for heating water or air for residential and commercial use, also can heat the pool and the important one is to produce electricity. Then, it was followed by second important criteria, namely the installation or use of renewable energy other than solar energy. The average index for this is 4.07 with 77 respondents are strongly agree or agree that responses to sustainable green building which is the renewable energy is important in the aspect and element of retrofit. Renewable energy other than solar energy comes from natural sources such as rain, wind, tides and geothermal heat which are renewable (naturally added).The average index for installation of CO₂ monitoring and control system is 3.64 which also important in improving the performance of a building. GBI NREB had state that by provide response monitoring of carbon dioxide levels at the existing building can ensure the delivery of minimum outside air requirements.

The criteria can be retrofitted by installing a carbon dioxide monitoring and control systems with a minimum of (1) sensor CO₂ at all main entrances for each floor of the building. To facilitate the continuous monitoring and adjustment of outside air ventilation rates and to ensure independent control, the ventilation rate is maintained to the level $\leq 1,000$ ppm. This is because from the analysis, the average indexes values of all this

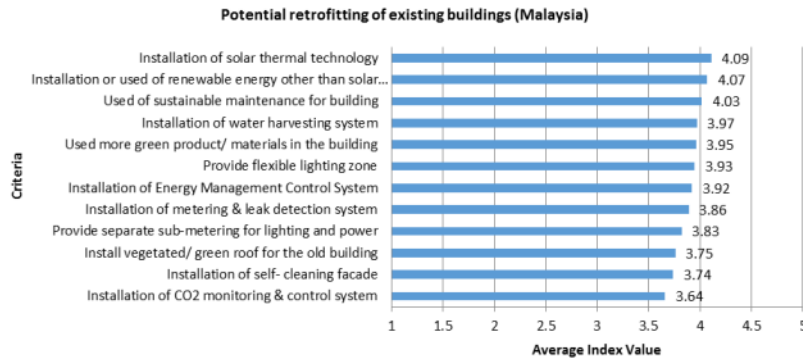


Fig. 3: The important criteria in the retrofit of existing buildings towards green buildings

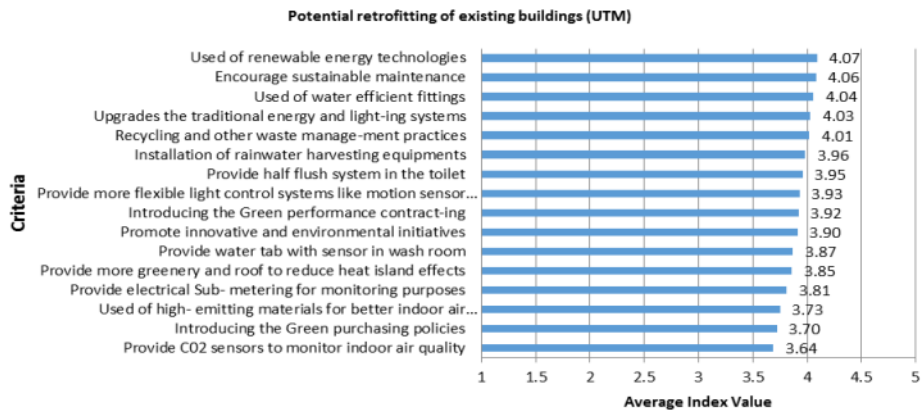


Fig. 4: The criteria that significant for retrofit existing building at UTHM

benefits are exceed 3.5 which mean that it is significant and acceptable results for our study (Fig. 3).

This study also seeks for the respondents' opinion on the criteria that significant for retrofit existing building at UTHM. The criteria identified are very important since it is already directly related to the application of significant criteria of green building in UTHM campus building in the future. Figure 4 shows that all the criteria identified is very important. From the analysis, the average index value for all of these criteria is >3.5 which means that it is significant and acceptable for our study. In 17 questions that have been provided in this objective, there are six main criteria to be taken into account in the assessment to get the score namely; Energy Efficiency (EE); Indoor Environment Quality (EQ); Management and Sustainable Planning Area (SM); Material Resources (MR); Water Efficiency (WE); and Innovation (IN). The first criteria is energy efficiency in the GBI NREB assessment. The questions that relevant are encourage sustainable maintenance; upgrades the traditional energy and lighting systems; providing light control system more

flexible as motion sensors and auto sensor and provide electricity sub-meters for monitoring. The second important criteria to be used in retrofit the existing buildings of UTHM is encourage the sustainable maintenance. This criterion has an average index of 4.07 as shown in Fig. 4. There are 80 respondents who are strongly agree and agree that the application of sustainable maintenance policies important in the retrofit of existing building towards green building. In GBI assessment, there is maximum 3 points in the rating evaluation. Sustainable maintenance can help to monitor and control/save the operation cost of the building because the building designated to have maintenance office and inventory storage that is fully equipped with facilities such as tools, instrumentation and etc. In addition, the maintenance team will also need to have documented plan for at least 3 year maintenance management including preventive and corrective maintenance budget. While the other significant criteria in item energy efficiency also important since it is significant in the study. It has been proven in the GBI NREB because there are the major portions in the points of rating. The

used of high-emitting materials for better indoor air ventilation (the third last significant) and providing CO₂ sensors to monitor indoor air quality was the least significant and were in Indoor environmental quality which is the second criteria. The average index is 3.64 and 35 respondents strongly disagree or disagree or moderate that the significant of provide CO₂ sensors in the aspect of monitor indoor air quality in green building. Although, it is important to ensure the health of occupant but it is consider not too important if compare to other criteria. While the used of high-emitting materials for better indoor air ventilation is to used building material that can reduce the adverse health effects to the occupants from finishes that emit indoor air pollution. Then the third criteria is sustainable site planning and management, there is provide more greenery and roof to reduce heat island effects. The sustainable building can react to reduce thermal gradient differences between urban (developed) and rural (undeveloped) that can minimize the impact on microclimate of human and wildlife habitat. The building must have Hardscape and Greenery Application Provide (HGAP) which is any combination of shade or paving materials with Solar Reflectance Index (SRI) at least open grid pavement system for 50% of the site hardscape and roof application with a vegetated for at least 50% of the roof in order to get the maximum points in the GBI rating.

In the criteria of material and resources, provide recycle bin can be consider under reused and recycling materials or waste management. This is also the way to collect and analyze information on the types and amounts of waste generated by facility and figure it out the ways to reduce waste. Green purchasing policies is policies that evaluate and identify the material to be purchased for the building. The material must be an environmentally friendly and less impact to occupant health. Green performance contracting is useful to turn the existing building high-performance green buildings. It is the projects which include energy efficiency issues, water efficiency, renewable energy, green housekeeping, green purchasing policies and waste management. Green performance contract saves money through lower operating cost and reducing energy used of the facility. In addition, building owners should have cost forecast for the life of the contract. Meanwhile, the use of water efficient fittings, provide water tap with sensor in wash room, provide half flush system in the toilet, recycle and other waste management practice and installation of rainwater harvest equipment which are the criteria of water efficiency. To maximize the water efficiency within buildings and reducing the burden on municipal water supply it can be

install the external devices at existing building. After install all these devices, we can reuse the used water for non-drinking purpose, or there is different pipe with drinking water and non-drinking water. Thus we can save the consumption of drinking water because the water is used in the right purpose. Then finally in the criteria of Innovation, there are used of renewable energy technologies and promote innovative and environmental initiatives. The average index value is 4.07 and 80 respondents are strongly agree or agree the use of renewable technologies. Therefore, the renewable energy is important for retrofit at UTHM.

CONCLUSION

The potential of retrofitting that towards green building for non-residential buildings in UTHM was explored and significant elements were identified which guide to buildings retrofits. The installation of solar technology is the most priority step among others in the operation green building retrofitting. In Malaysia to heat water in the toilet for bath we need to installed solar technology in a building especially in residential areas. As a result, this will minimize the energy consumption. This study also finding that the most significant criteria in the potential of UTHM building toward green building initiative is the use of renewable energy technologies. This shows that the important of renewable energy in UTHM existing building. A part from that the technologies can be applied were solar thermal energy plate and solar plate. As for water management, rainwater harvesting technology can be used for recycling and re-use of rainwater.

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