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The Application of Green Building Index on Mosques

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Abstract: Green building refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition. The Green Building Index is industry's recognized green rating tool for buildings to promote sustainability in the built environment and raise awareness of these issues among relevant stakeholders. Generally, the assessment of commercial and residential properties under the GBI rating tool is based on six main criteria: energy efficiency, indoor environment quality, sustainable site planning and management, materials and resources, water efficiency and innovation. This article discusses to what extent mosques in two municipalities in Johor Baharu, Malaysia and Tanjung Pinang, Indonesia have adopted sustainable principles, focusing mainly on energy and water efficiency and innovation. The objective is also to test the model of Green Mosque Index, which has not been empirically established. A qualitative approach was employed using field observation on twenty mosques, which was conducted in May 2016 in Johor Baharu and April 2017 in Tanjung Pinang. The study found a number of practices was adopted by the mosques leading to water and electrical conservation, such as the usage of energy saving lighting, rain water conservation and waste management. It can be contested there are various green approaches being implemented and they have the potential to deliver significant cuts in consumption and cost.

Key words: Green practices · Mosque index · Sustainability

INTRODUCTION

The concept of building sustainability is particularly focusing on improving effectiveness in resource consumption such as water and electricity during its operation by reducing detrimental implication from buildings on human health and environment. A better settlement effort, building design, operation, conservation and waste disposal system are some of efforts that should be achieved to obtain a better sustainable building environment [1]. The research work on which this article is referring to is an attempt to evaluate the green principles leading to sustainable practices applied by mosques in Tanjung Pinang, Indonesia and Johor Baharu, Malaysia. To measure sustainable principles practiced by mosques in both municipalities, the researchers refer the concept of Green Mosque Index (GMI) as proposed by [2].

Literature Review: In Malaysia, the establishment of Ministry of Energy, Green Technology and Water (KeTTHA) in 2009, is the determination of the Federal Government to spearhead initiatives on power, green technology and water industries and the formation of the Green Building Index Malaysia (GBI Malaysia). It can be seen as a clear sign of increasing commitment to energy sustainability. In related research, some works of sustainable principles applied in buildings include private and government buildings [3; 4; 5; 6], universities [7; 8], higher education institutions [9], and school buildings [10;11]. [2] in his study in three states in Peninsular Malaysia suggest six potential concepts to be used to establish Green Mosque Index (GMI) namely Energy Efficiency, Indoor Environmental Quality, Sustainable Site Planning and Management, Material and Resources, Innovation and Design and Water Efficiency. This is elaborated in Table 1 below.

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Table 1: Sustainable Index for Mosque According to the Suggested Green Concept.

Value Sustainable	Green Mosque Index (GMI)
Energy Efficiency (EE)	-Availability of written reminders (eg. Sticker reminder)
	-The use of sustainable lamp (eg. LED/CFL)
	-Building design that allows more daylight into the building
	-Building design that allows more natural ventilation into the building
	-Availability of alternative power sources (eg. Solar cell)
	-Availability of automatic sensing to control the use of lighting
Indoor Environmental Quality (EQ)	-Availability of spaces which allow natural air flow
	-Availability of air penetrable wall
	-The use of materials which generate less heat (eg. Timber)
Water Efficiency (WE)	-Availability of Rain Water Harvesting System
	-Availability of pond
	-Availability of well and reserve water source
	-Availability of economical water cistern in toilet (eg. Double flushing water cistern)
	-Availability of water tap with automatic control
	-Availability of water taps with infra-red
	-Regular maintenance
Sustainable Site Planning & Management (SM)	-Recycle-able ablution water
	(Recycle wudhu water can be used for various purposes such as for plant watering, for use in toilets)
	-Using water from RWHS for various purposes (eg. Washing kitchen utensils, for plants watering, for toilet use, etc)
	-Using water from well for various purposes (eg. Plants watering, for toilet use)
Material &Resources (MR)	-Using transparent or translucent roof at suitable areas.
	-Using easy cleaned materials for walls and floors
Innovation & Design	-Innovative design for controlling mechanical lights (eg. Automatic switches)
	-Renewable energy (eg Solar cell)
	-Passive design to facilitate natural light and ventilation into the building.

In previous resource consumption research, several conservation behaviors highlighted green practices that include examples by [12] in his investigation on behaviors in homes and offices such as using only full loads of washing, installing water saving devices alternatively and turning off taps. There were water conservation practices, public attitudes and sustainable consumption awareness toward the use of clean water [13-15]. In energy consumption, most of behaviour related energy research extensively occurred in houses where the link between energy consumption and households' socio-demographic characteristics and proifles existed [16-18]. There is a lack of research clearly de?ning sustainability with regard to mosque and lack of systematic research on how energy consumption to save energy in mosque compounds, whish this study attempts to address.

Methodology and Data Treatment: The researchers employed nonparticipant observation on ten mosques in Johor Baharu in May 2016 and the remaining ten mosques in Tanjung Pinang in the following year. Observational research is particularly prevalent in social sciences, and it is a social research technique that involves the direct observation of phenomena in their natural setting. This differentiates it from experimental research in which a quasi-artificial environment is created to control for spurious factors, and where at least one of the variables is manipulated as part of the experiment. The observation was further scrutinised based on Green Building Index Malaysia checklist, which was modified to suit the different geographical settings of the case study areas.

RESULT AND DISCUSSION

The study found obvious green practices that were applied by the mosques in the study areas as shown in Table 2. All mosques in Johor Baharu obtained water supply from state's agency, so-called Syarikat Air Johor (SAJ), while about twenty per cent was derived from rain water harvesting system (RWHS). In contrast, the mosques in Indonesia utilized water sources primarily from bored -wells or from underground water called 'sumur'. As the distribution and delivery of state government' water service is poor, local people obtained water from underground sources. According to The National Economic Recovery Plan in 1998 [19], underground water is a viable alternative ware source to be developed in future to overcome water shortages. It is estimated that Malaysia has plenty full of underground water reserve, consists of around 5,000 billion cubic meter.

Pic 1: Bored well 'sumur' as a main water source in the Tanjung Pinang Mosque

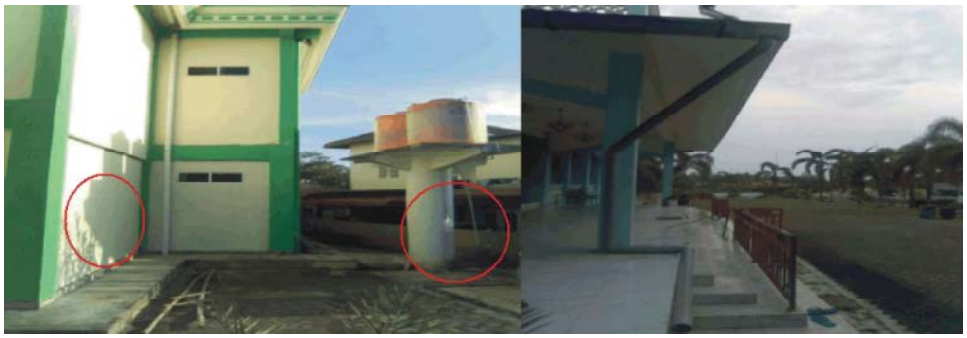
Table 2: Comparison of sustainable practices between mosques in JohorBaharu and Tanjungpinang

Green principles Practices	Johor Baharu	Tanjungpinang
Source of Water:		
- SAJ / PDAM/Water agency	80%	0
- SAJ/PDAM and RWHS	20%	0
- Sumur / bored well	0	100%
Rain Water Harvesting System (RWHS)		
- Available	20%	0
- Not available	80%	100
- Potential for RWHS	90%	100
Stickers for conservation reminder		
- Ablution area	40%	30%
- Bath room and toilet	10%	0
- Electrical device controlled area	50%	0
Facilities in toilet areas:		
- WC & Single flushing cistern	100%	0
- WC & pail only	0	80%
- WC & tub	0	20
Facilities in bath rooms:		
- Shower only	0%	0
- Shower and water tap	100%	0
- Room with water tap and pail	0%	10%
- Room with tub	0	20%
- No bathroom	0	70%
Recycle bins	40%	10%
Energy sustainability		
Sustainable Design		
- Air Flow		
- Good	50%	40%
- Medium	50%	60%
- Bad	0	0
- Natural Light		
- Good	60%	70%
- Medium	20%	20%
- Bad	20%	10%
- Air conditioner attached		
- CFL bulb	50%	20%
	40%	100

Source: Field work March 2016

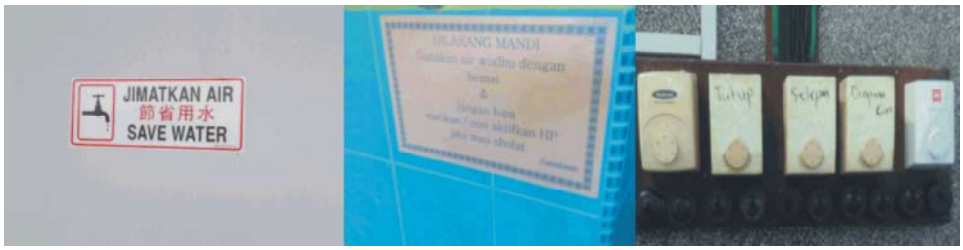
Rain Water Harvesting System (RWHS): Rainwater as an alternative source of water in buildings has been used for many years throughout the world. It can be used both as drinking water and non-potable water [20]. RWH among other option may play a significant role in widening water security and reducing impacts on environment [21]. The rainwater harvesting system (RWHS) has the multi task for various purposes in the building including the collection, storage, distribution and use of water [22]. RWHSs are mainly used in the US and many European countries as supplementary schemes to conventional source of water for non-potable use, especially for flushing toilets, cleanup work, washing as well car wash [23-29], irrigation of green areas [30] and the irrigation of crops [31, 32]. A possibility to implement RWHS depends on many factors, the most important of these are: climatic conditions (rainfall amount, frequency of rainfall) and the demand for non-potable water (type of building, number of users and individual water usage for the given purpose) [33]. In the mosque compounds of the study areas, the study found a great potential to introduce the system due to heavy rainfall annually, but not aggressively implemented due to financial restriction and low awareness among the communities.

Pic. 2: Simple Rain Water Harvesting System in Sri Pulai mosque. Skudai, Johor Baharu. Harvested Water Used Especially for Uttensil Cleaning



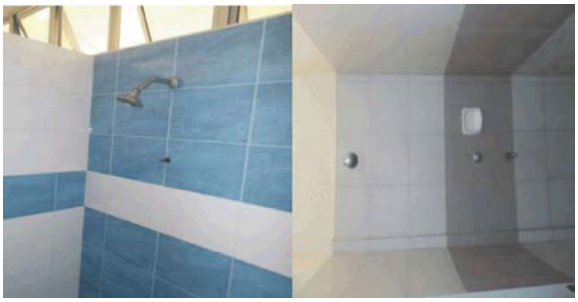
Pic. 3: Unutilized facilities of possible RWHS in in Tanjung Pinang and Johor Baharu mosques, respectively

Reminder Stickers: Other effort to conserve water is reflected by the availability of reminder stickers. The mosque's management staff also put friendly reminders on the easily-seen areas such as ablution areas, bath rooms and toilets to enable users to constantly bear in mind, and thus behave appropriately in water use. In Johor Baharu, the most common areas with patched stickers can be found in ablution areas (40%), bathrooms and toilets (10%), and the remaining are in electrical socket areas (50). In Tanjung Pinang, the stickers were only found in ablution areas (30%).



Pic. 4: Reminder stickers to save comsumption

In bathroom areas, one way of saving water is the use of shower, and this can be observed in all mosques in Johor Baharu, while only 30 per cent of mosques in Tanjung Pinang provide but with no shower facilities. They used a bath tub or commonly called a 'bak' with pail. It is often contested that the use of shower is proven to be more economical when compared to other means in bathing [2].

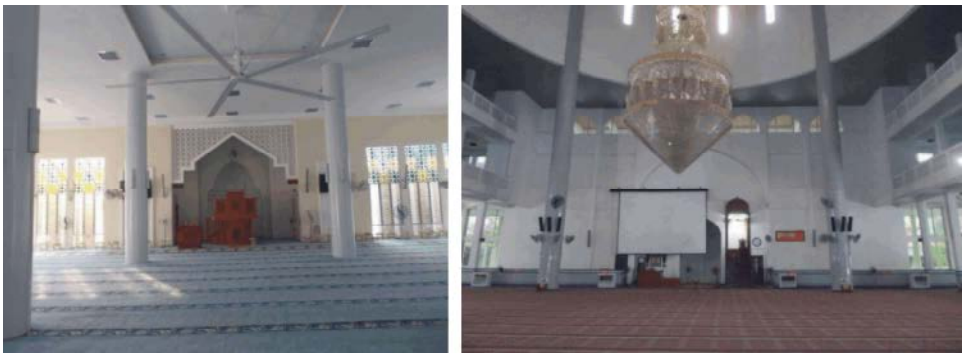


Pic. 5: The usage of shower head in mosques in Johor Bharu

Waste Recycling: Mosque is an ideal platform to engage in 3R (reuse, recycle, reduce) activities, galvanizing such an educational and awareness campaign about environmental practices in Islamic teaching, hence the institutional organization and community's belief (both physical and spiritual) can be strengthened. Facilitating recycle bins at mosques is a best strategy in a pipeline to encourage people to dispose wastes in an appropriate manner. 3R practices have been considered an alternative way of promoting ecological balance through conscious behavior among communities. This kind of effort will lead to savings in materials and energy to benefit to environment. 3R approach is innovates people to enable them understand how to segregate their waste wisely.

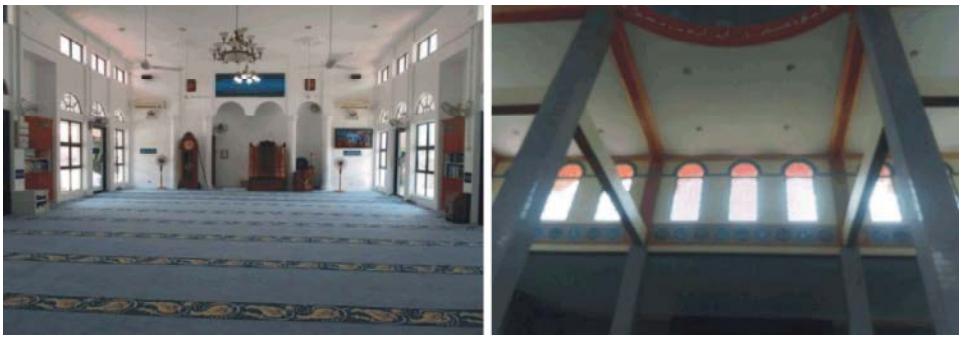
Pic 6: Recycle bins in the Tanjung Pinang and Johor Baharu's mosques

Less Energy Consumption: Building design could also influence energy consumption, and a good design will facilitate natural air and light ventilation into buildings and thus minimize energy uses from fans, air conditioners and lightings.



Pic. 7: Good design that enables natural air flow and lighting

Most mosques in Johor Baharu has a good air flow due to huge size of primary prayer halls (50%) that allow natural ventilation. They also demonstrated a good natural lighting (60%) and supported it with an air conditioning system. The demand for air-conditioned prayer halls is high in Malaysia due to hot and humid weather. Only twenty per cent of mosques in Tanjung Pinang installed air-conditioned system, as it demands high electrical consumption. It was observed that seventy per cent of the mosques used natural lighting.



Pic. 8: The use of CFL bulb for energy saving

CONCLUSION

The concept of sustainable management in mosques can affect the welfare of mankind in the social, economic and environmental aspects. The paper found that different locations tend to apply different practices. The paper concludes that the principles of sustainable resources in water and energy management as well other sustainable

principles have existed both in Tanjung Pinang and Johor Baharu's mosques, at varying degrees. The mosque authorities should place greater emphasis should be on efforts to publicize the importance of energy and resource conservations. Local governments should urgently implement sustainable practice policies which rationalise the demand of usage to ensure more efficient use.

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