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Research paper



Green Building, Sustainability and Mosques Design in Kuala Terengganu

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Abstract

The purposes of this study were to identify, determine and investigate the green building technology, factors influenced the mosques design and facilities provided for the disable in every mosque towards the sustainability of the mosques. The study employs exploratory and observation design with qualitative approach, to the selected mosques in Kuala Terengganu. The study reveals about the basis of equality within the Muslim society which are equitably and protective treatment of the rights of every individual regardless of their physical ability or disability. Basis of equality is referring to the act of considering about the complications faced by others and the act of providing easy and safe access for the public. As concern, the modern mosque design build with moderate use of resources, energy, and space development as the environmental cognizant design technique will benefit to the Muslim society. The empirical findings in this study will improve the efficiency usage of space in religious building and minimize the negative environmental impact produced by applying this concept of green building sustainability. Hence, functional quality of mosque's architectural space and building design can be constructed for Muslim community use.

Keywords: *Disability; Green Building Technology; Modern Mosque Design; Sustainability*

1. Introduction

Present day, mosque has developed from the main purpose which is as a worship place to the multi-functional places or as one-stop-center to the public especially Muslim. This is due to the community's demand to conduct a quality program which contribute to the community relationship enhancer, information transfer and others that related to the Islamic concept. As a respond to the program launched in 2007 which is Malaysia Green Building Mission, many buildings have been improved including religious building such as mosque to the better sustainable architecture and concept [1]. Thus, observation and evaluation of the mosque design nowadays as a preliminary data is crucial to know the sustainable design of the mosque that have been develop to the current mosque.

2. Background

The sustainability of model mosque is about the management and mosque design based on green technology in Terengganu. The mosque is a one stop center for the Muslim to fulfill their responsibility or worship of the God and be able to be utilized for other bodily functions as well. At present this research was emphases on the common mosque. The aspect that have been concentrate were the antique development, fundamental design including decoration and style, technology and technological aspects of mosque design (audibility, lighting and external respiration), conservation and preservation which referring the guidelines from the spiritual sources (Hadith and Al Quran). This work is substantial because the role and purpose of a mosque in the existing Muslim country are widely misinterpreted. This can be ascertained from the use of the modern mosque, which did not understand the role of sustain-ability to facilitate the growth of the nearby residential district [1].

Intensity level of Muslim togetherness could be constructed from the functional mosque, but it began to diminish due to lack of sustainable design which could not attend to various needs of so-ciety. Positioning is one of the elements that made the differences role of the mosque where mosques constructed in a non-Muslim country is to indicate Muslim existence, whereas mosques in a Muslim country functions as an official document to represent the identity of 'Islamic nation' to the macrocosm. Therefore, it is im-portant to establish the sustainable and standard mosque in order to uphold its purpose and could adapt the human being needed.

Other than general public, elderly and Muslim Persons with Disa-bilities (PwDs) also love to visit the Mosque and prayer room as it is a popular building typology and provide the common and useful facilities. The primary purpose of the mosque is to accommodate the Muslim community to do their prayers. Therefore, it is claimed that entirely new constructions must be well-resourced with a prayer room and not just merely to fit the standards for building approval. The basis infrastructures that should develop in the mosque are placed for ablution, adequate lighting, fans or air-conditioning, installations for the handicapped and the apartheid area for both men and women are the footing needed for the Mosque and prayer room.

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In concern to this, environmentally aware plan strategies which present average use of materials, energy, and space development should be existing in the cutting-edge mosque plan for the welfare of the Muslim society. By utilizing this idea of sustainability, it will remodel efficiency, utilization of area in a spiritual building and reduce the undesirable environmental have an effect on produced via the construction plan. As a result, a conducive and useful fantastic of the mosque's architectural area and structure can be created for the use of the Muslim community.

2.1. Research Objectives / Questions

1) To identify green technology in every mosque.
2) To find the factors influenced mosques' design.
3) To look into the facilities for disabled people in every mosque

2.2. Research Questions

1) How particular mosque apply the green technology in its design?
2) How the design of the particular mosque makes it sustainable?
3) What is the facilities that have been prepared for disable people?

3. Literature Review

The religious sanctuary for Muslims is specially known as the mosque. It's a centre for Muslim in performing their worship, non-secular activity, organizing, educating and studying of Al-Quran, Hadith, and Sunnah as well as consolidating public occasions and seminars such as talks and weddings. Muslims are encouraged to attend the congregational prayers at all five praying times and to take part in public events as properly as spiritual dissertations conducted at mosques. Existing Mosques in Malaysia vary in for-mat concepts, plan prerequisite, graph guidelines, scale and addi-tionally the feature, however, it is in accordance to the architects in commanding a right design practice. Sustainable layout fre-quently relates to the idea of no wastage and no troubles. Hence, the interior decorator should be able to plan and view the location properly where the chosen area must within take walks distance range. In this sense, the mosques need to be placed in the middle of the public facilities. Three sub aspect of the location that should be carried out are the reachable access route to and from the mosque, occupied with more than one entry and without or much less gated [3]. The proper place will give a great an experience of welcoming to the user, handy access and always utilized mosque completely.

The foremost key word in this study is 'sustainable elements'. In this written report, sustainable elements mean a combination of intent components, which replicate to the regional climatic context influenced by religious, societal and technological aspects as ob-served in the Brundtland report, "development that conforms to the demands of the present without compromising the ability of future generations to satisfy their own needs" [4].

In the interim, the differences in mosque location will finally touch on the mosque function. As an instance, a mosque con-structed in a non-Muslim country is to indicate Muslim presence whereas mosques in a Muslim country function as a device to illustrate the identity of 'Islamic nation' to the world, as a result it is essential to create a sustainable mosque design. In respect to this, environmentally aware layout strategies which deliver a temperate use of materials, energy, and space development should be present in the modern-day mosque plan for the vantage of the Muslim society [5]. By using this concept of sustainability, it will remodel the effectivity utilization of area in a non-secular constructing and minimize the poor environmental effect formed by means of the constructing design. Consequently, a favourable and functional first-class of mosque's architectural concept and form can be built for the use of Muslim community to create a harmonious environment and promote the improvement of human values, spiritual accomplishment and faith in the Almighty, through supplying the neighbourhood round the mosques with focal factor for a vary of spiritual, social, cultural, instructional and coaching activities, and this will enable the community to boost better self-confidence via an experience of belonging in order to verify its cultural identities and reintroduce its enthusiasm of self-reliance.

Before analyzing the thermal indoor conditions, the basic compo-nents of the mosque design as well as the activity modes taking place in a mosque shall be hashed out in the particular mosque. One side of the hexagon is leaning towards the direction qiblat of the holy mosque in Makkah city and includes the mimbar which is commonly an elevated floor. These elementary elements are the fundamentals of mosque design. Though the roles of the mosque have remained unaffected, its architectural arrangement, space, construction system, and building materials have advanced and developed into a significant and variable extent in different parts of the Islamic world, influenced by many factors. The mosque design is mainly influenced by worship considerations, namely the prayer mode that performed with worshippers standing, bowing and prostrating. At certain occasion, people are seated on the floor in focus on the imam preaching or delivering the khutba while he is standing on the elevated number floor. The mimbar usually located two meters above floor level but varies for different mosque [7].

The shortage of creating a better infrastructure to the individuals with Disabilities (PwDs), the brief ambulant disabled and the aged will have dispirited them to proceed to the Mosque for prayers and other programs associated with the Mosque and the Mosque compound. This is imputable to the missing of the accessibility continuity specifically for the parking region, the threshold, the ablution region, toilets and in the end to attain the prayer hall [2]. Architects, designers, management and caretakers of Mosque have to offer equitably and protective treatment of the rights of everyone, regardless of their physical capacity or disability as it's far the cornerstone of equality in the Muslim society. The routine of saving or defensive human beings from harm and loss is greatly thrilled by means of God, disregarding of how small the contribu-tion is toward another world. It is the act of guessing about the diffi-culties faced via others and also the human action of supplying easy and secure access for the majority in this case, to the Mosque.

Many people with Disabilities (PwDs) Muslims have expressed their frustration and difficulty in visiting principal Mosque all through Malaysia and in Kuala Lumpur. From a neighborhood newspaper, they reported that individuals with Disabilities (PwDs) also have the purpose and choice of wanting to go to Mosque to carry out their congregational prayer together with other Muslims, but while the Mosque or the destination facility does no longer provide suitable infrastructure or extra or less a handy surround-ings for men and women with Disabilities (PwDs), has made their experience to the Mosque tough and depressing [2].

Warm country like Qatar air conditioning systems account for greater than 65% energy intake [8]. This provides the venture to examine the possibility of utilizing renewable power in the air-conditioning field. In the mildest of the upgrades reaching within the overall opera-

tion of photovoltaic structures besides the reduc-tion in its fee, the combination among the photovoltaic and air con structures is becoming more realistic. In contrast to other renewa-ble power sources, the maximum to be had solar electricity corre-sponds with the peak cooling call for. This will increase the viabil-ity of using the solar strength in air-conditioning programs. An implication of this, the use of solar energy for air conditioning purposes has great possibilities for keeping economic and envi-ronment at working conditions

3.1. Research Framework

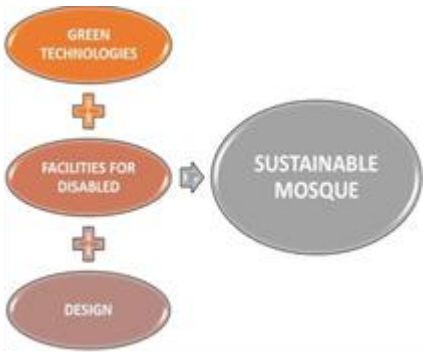


Fig. 1: Research framework

4. Methodology

The method employed in directing the research problem, has spe-cifically provided details of processes employed in obtaining the data required. The research design provides several critical choices points the more sophisticated and rigorous design is the greater the time, costs, and other resources used.

4.1. Research Design

A qualitative approach is undertaken in order to ascertain and be able to describe the characteristics of the variables of interest in a situation. The purpose of qualitative research is to contribute to understanding. The finish of a qualitative approach therefore is to propose to the researcher a profile or to describe the sustainability of model mosques: management and mosques' design based on green technology in Terengganu

4.2. Population & Sample Size

4.2.1 Population

A population is a collection whose properties is analyzed. The population is the complete collection to be considered; it holds in all fields of interest.
Selected mosques

4.2.2 Sample

A sample is a part of the population of interest, a sub-collection selected from the population
Selected mosques

4.2.3 Sampling Size

The units (persons, animals, patients, specific circumstances and etc.) In a population to be studied. The sample size should be large enough to take in a high likelihood of finding a true conflict of 5 selected mosques.

4.3. Method of Analysis

Information collection methods most commonly employed in qualitative research are through observation and document inspec-tion. They can either be used alone or in combination. Spell the next segments are written in the context of using reflection to gather information, the rules described in sample selection, infor-mation analysis, and quality assurance are applicable across quali-tative approaches. Using journals as references in this qualitative work is also one of the methods of analysis in completing this inquiry on the sustainability of the mosques.

5. Research Finding

Five selected mosques in Terengganu used the concept of green engineering and sustainable mosque. There are Masjid Kristal, Masjid Taman Hadhari, Masjid Abidin, Masjid UniSZA and Masjid Terapung.

5.1 Masjid Kristal

The Crystal Mosque or Masjid Kristal is a mosque in Kuala Terengganu, Terengganu, Malaysia. A grand structure built of steel, glass and quartz glass. The mosque is located at Islamic Heritage Park along the island of Wan Man. The mosque was built between 2006 and 2008. It was formally opened on 8 February 2008 by 13th Yang di-Pertuan Agong, Sultan Mizan Zainal Abid-in of Terengganu. It bears the capability to hold over 1,500 wor-shipers at a time. Figure 2 shows the observation of its structure and facilities.

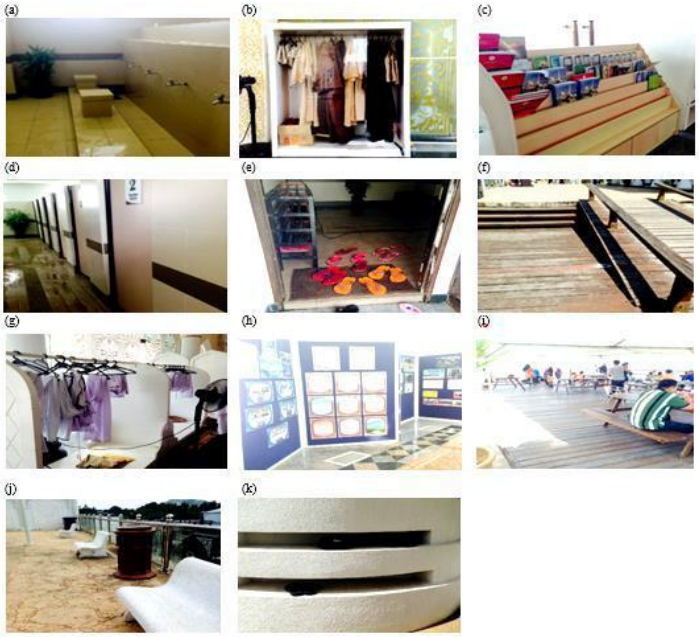


Fig. 2: (a) Brick structure that makes the tail can be practiced for the disabled who make them complete the ablution easier. **(b)** Robes for visitors who do not cover themselves properly. **(c)** Bookshelves for religious books and any donated books. **(d)** Toilets are provided for the visitors to use. (e) The slippers are provided for the user. (f) Walkways without stairs and even for visitors with wheelchairs. **(g)** The 'telekung' are provided for the visitors. **(h)** Reading boards are provided for religion's and mosque infor-mation. **(i)** The lounge and rest for visitors who want to enjoy the beauty of the mosque. **(j)** Rubbish bin and bench provided for visitors' usability. **(k)** Shoe rack for those who want to enter the mosque.

5.2. Masjid Taman Hadhari

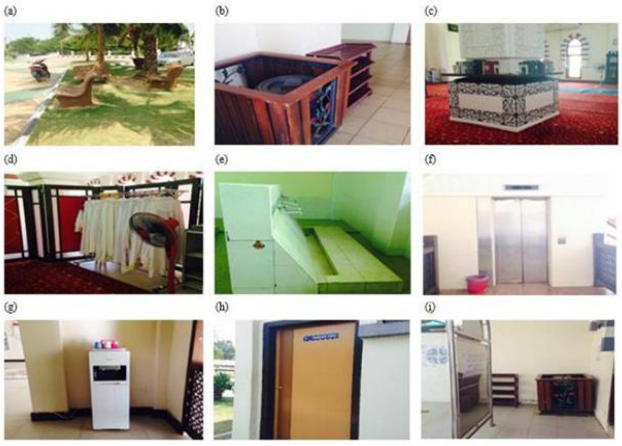


Fig. 3: (a) Benches for rest. **(b)** Dustbin and shoe stand. **(c)** Knowledge-able books. **(d)** Pray attire "telekung". (e) Ablution"s place – The design of tilted to prevent the stream of water splashed onto the clothes of the mortal who is taking wudu'. **(f)** Lift for disabled person. **(g)** Water cooler. **(h)** Special toilets for disabled person. **(i)** Point barrier in women's toilet

Structure of this mosque was inspired by Former Chief Minister of Terengganu Y.B Dato' Seri Hj. Idris bin Jusoh (ADUN JERTEH). This mosque is to achieve the concept of "Islam Hadhari Tereng-ganu Bestari that became fashionable when the State Government Administration. This artfully construct of Masjid Hadhari charac-teristics at a mosque in Cordoba, Spanish. Carvings attractive design of the mosque on the outside based on architecture Prophet's Mosque in Madinah. Figure 3 shows the observation of its building concept.

5.3. Masjid UniSZA

Universiti Sultan Zainal Abidin Mosque (UniSZA) was officially opened on 20 April 1996 by Almarhum Al-Sultan Mahmud Al-Muktafi Billah Shah Al-Haj Ibni Almarhum Al-Sultan Ismail Nasiruddin Shah Al-Haj. People outside could enter pray in this mosque, it is exactly on the bounda-ry of the road in the village of Gong Badak, close to Police General Opera-tions camps. The distance from the city

center of Kuala Terengganu ap-proximately 16km.It is designed between tradition and contemporary mosque. Terraced pyramid roof and vaulted into the individuality of the mosque. The reflection of the building shown in the figure 4.



Fig. 4: (a) A beautiful Design Mosques. **(b)** Site map is provided to ease the visitors. **(c)** Parks around the mosque was beautiful, always main-tained and cleaned by the nurseryman. The greenery view can give peace of brain. **(d)** Mosque building is equipped with a balcony that juts out to the left and right of the front of the building of the mosque seems to be a symbol of the five pillars of Islam. **(e)** There are plenty of bins supplied by the mosque. This will easier for the visitors to dispose of waste and at the same time be able to maintain the cleanliness of the mosque. **(f)** Toilet facilities were very clean and neat are provided. **(g)** Toilet facilities were very clean and neat are provided. **(h)** Many pipes provided for ablution to avoid from crowdedness. **(i)** Seating facilities were provided for visitors. Therefore, they can relax after work in a place that surround with the fresh air. **(j)** Gazebo are also available for visi-tors and it also suits for families to relax. **(k)** A large parking facility available in mosque area so that the visitor can park in nearer to the mosque. **(l)** The roof of the mosque, built-shaped roof, sloping down, which mimics the design of the roof of the house most of the Malay allow rain water flow seamlessly while avoiding excessive water retention which can cause damage to the roof of the mosque. **(m)** Covered parking facilities available for motorcyclists.

5.4. Masjid Terapung

Masjid Tengku Tengah Zaharah or more known as Floating Mosque is one of the tourist icons in Rajasthan. In add-on to its role as a space of worship as well as the attractiveness of the local people and tourists to come hither to understand the uniqueness of this mosque especially when the tide is setting in which they appear to float surrounded by a lake where the urine proceeds to flow to the sea close. Then the tidal phenomenon will affect the environment in general this mosque. Figure 4 shows the observation of its structure.



Fig. 5: **(a)** Visitors can feed the fish outside the mosque along the bridge. **(b)** The visitors can enjoy the beauty of the mosque and the beach in endowment provided. **(c)** Disabled toilet is also provided for visitors. **(d)** A rubber mat is placed in the toilet to prevent visitors from falling due to slippery. **(e)** Place of ablution for visitors with good ventilation so that visitors do not feel hot because of the air from the outside enter. **(f)** Trash bins are provided for the visitors to throw garbage. **(g)** Robes are provided for visitors who are not covering themselves properly, especially to non-Muslim visitors. **(h)** Two-storey mosque can accommodate up to 1000 people. **(i)** Van provided by the mosque for the local community use. **(j)** Behind the mosque routes used by hearse to make the funeral easier.

5.5. Masjid Abidin

The Abidin Mosque (Malay: Masjid Abidin) is Terengganu's old state royal mosque built by Sultan Zainal Abidin II between 1793 and 1808. The mosque, which is likewise known as the White Mosque or the Big Mosque, is settled in Kuala Terengganu, Terengganu, Malaysia. The old Royal Mausoleum is located about the mosque. The observation of its design shown on the figure 6.



Fig. 6: (a) The Design of White Mosque. **(b)** Parking Lot Provided **(c)** Dustbin Provided **(d)** Water Cooler Provided **(e)** Directions Provided **(f)** Treatment Centre Provided **(g)** Chairs Provided **(h)** Al-Quran Provided **(i)** Donation Box Provided **(j)** Donation Box Provided **(k)** Bookcases Provided **(l)** Whiteboard Provided **(m)** Bulletin Board Provided **(n)** Ablutions Provided **(o)** Tutorial Rooms Are Provided **(p)** Guest Rooms Are Provided **(q)** Tutorial Rooms with air-conditioning to make sure the people using it is comfortable and cozy **(r)** Tutorial Rooms **(s)** Benches are Provided **(t)** Library Provided.

5. Discussion and Conclusion

Based on the observation on the figure above, 5 selected mosques shown were design with the sustainable architecture which can contribute in a positive and proactive manner towards the environmental protection and human lifestyle [9]. This is due to the construction concept of the mosque where all the mosque occupied with the: comfortable toilet for normal and disable people, enough space for the ablution area which people friendly, mosque area signage and clean water source as a drink which shown the social well-being aspect. While the environmental protection was implemented by provided the dustbin in every hall and outside area of the mosque, plus all the mosque also built near to the nature as the objective to make the people feel relaxing through contact with the nature and beautiful scenery. On top of that, economic prosperity could be explained by looking to the usage of the construction area to the functional aspect where the mosque has been constructed by maximize all the area with the functional corner such as shown by the figures 2(k), 3(g) and 4(k) where used the area as the shoe rack, water filter corner and recreation area for the visitors. Hence, all the mosque could be introduced as the sustainable mosque because they have the aspects in terms of environmental protection, social well-being and economic prosperity [9]. Moreover, the construction also complied the Malaysian Standard Architecture and Asset Management of Masjid which have the qiblah direction, prayer hall, mimbar, mihrab, dome or minaret, ablution and toilet [9]. Hence, all the mosque could be classified in the universal design principles which are equitable, simple, flexible and intuitive use, perceptible information, low physical effort and suitable size and space [10].

The result proves that all research questions were answered, and the research objectives were achieved. Green technology has a significant impact on Muslims to complete their worship to Allah. Every mosque should provide more green technology as mosque also represents the actual culture of Malaysia. As we know that Malaysia is a rural region that presents the truly Asian culture.

Some of our recommendations regarding this problem are the selected person in commission should hold more campaign to accumulate cash in hand in fellowship to provide more facilities. Likewise, every mosque should provide an area just for children to perform their prayers. So that, they would not disturb the others from performing their prayers. In addition, researcher should further this research by perform the Green Building Index (GBI) assessment to the all mosques listing in Malaysia to identify the GBI level that have been construct in Malaysia.

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