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Health Factors in Islamic Perspectives and its Relation to Sustainability with Case Study at Traditional and Modern Mosque

R. Das[1], T. S. Qureshi[2], M. S. J. Chowdhury[1] and M. J. B. Alam[3]
[1]Department of Architecture, Leading University, Sylhet
[2]Department of Civil Engineering, Leading University, Sylhet
[3]Department of Civil and Environmental Engineering, Shahjalal University of Science and Technology, Sylhet

Abstract
The study elucidates how health consideration integrated to the traditional, conventional and modern mosque design in Bangladesh. A literature survey is conducted to understandard the definition of health based on Islamic perspective. The purpose is to compare its sustainability and relationship with traditional and present design pattern of mosque. The literature study identifies four primary factors on health in the mosque design associated with natural lighting, ventilator, location of toilets and rainwater discharge. Analysis comprises design on natural lighting related to sun shading and indirect lighting, rainwater discharge related to rainwater deflection and leakages and wall openings related to natural cross air ventilation. In this study, Kalitikor Central Mosque, Bandar based on traditional pattern, Noyashorok Jamia Mosque and Amborkhana Jamia Mosque were chosen as modern type mosque. The analysis however shows the weakness that Kalitikor Central Mosque and Amborkhana Jamia Mosque design does not apply enough windows in the construction for opening furthermore Amborkhana Jamia Mosque design includes toilet facilities within the mosque. Noyashorok Jamia Mosque have sufficient opening in Back and left side however Amborkhana and Nayashork both of the mosque have no open windows facilities in it's right hand side. The traditional toilet system is also a threat to health and safety factor.

Key wards: Health, Mosque, Sustainability

Introduction

The study discusses issues of health factors related with culture and Islamic perspectives and application of these factors in modern mosque design and plan. The scope of this study is limited to qualitative study on the physical analysis of design factors of health. The literature review covers Islamic perspectives on health, traditional ideology in design of mosque and modernity in plan and design in Bangladesh. The aim of the study is to identify the related factors which can be used as the indicators for healthy environmental suitable design and plan of mosque in Bangladesh. Kalitikor Central Mosque, Bandar based on traditional pattern and Amborkhana Jamia Mosque were chosen as modern type mosque for the study.

Mosques are important built institutes in Islamic societies because they accommodate spiritual, social and educational activities. Mosques' positive impact in advancing the concept of sustainability in society is indisputable. Throughout history, mosques have played an important role in resolving many problems, such as environmental problems, through different activities which, as a result, have lead to the enhancement of masses' behavior. This paper argues that mosques have the potential to provide technical solutions towards sustainability as well as their behavioral counterparts without losing their traditional identity. Nowadays, mosques face physical challenges to satisfy its functions. Mosques' activities have become widely intensive and well organized and attract people more than mosques' capacity.

Health is one of the most important factors in Islam. Based on Surah Al-Baqarah (Verse 22) and Hadis, islam encourage the keeping good health. According to Syrakoy and Athena (2007) that pre-modern Islamic world had skilled doctors, hospitals, and scientists. Moreover there are five Islamic laws are termed Ahkam Khamash, among them, laws related with health, whatsoever act done by the Muslim in this world which could bring harm and cause illness to human being is considered as haram. Therefore, planning and design based on Islamic laws plays a critical role in architecture. The architect and engineer must acquire the knowledge associated with the health factors when designing the buildings so that they can design a healthy environment within the building.

Heath Factors in Building Design

Health is commonly associated with comfort level. In architecture, comfort level can be achieved by application of passive and active design elements. In contrast to active design, passive design is sustainable to the social, cultural and environmental prospective, which offers healthy conditions (Eben Saleh, 1999). The climate varies from location to location. So, sustainable planning and design should consider the

sunlight's intensity, humidity, rainfall, radiation, geography, air-temperature, etc.

The design can improve indoor air temperature and humidity, day lighting fixtures and air quality and hinder the presence of polluted substances like germs, bacteria and funguses. In case with the tropical region, the passive design elements focuses on natural lighting, rainwater discharge and wall openings. These details have been recently studied by Ahmad Sanusi Hassan *et al*, 2010. Brief of their findings studies has been correlated in our research theory.

Natural lighting

The purpose of design on natural lighting is to tackle the problem of solar heating and glare to the interior building from direct sunlight. Sun shading and indirect sunlight are two primary factors under natural lighting category. Design with excellent natural lighting or day lighting is important to gain the comfort level for healthy environment. The design with appropriate building orientation avoids problems of solar heating and direct sunlight (Moujalled *et al*., 2008). To gain comfort means to have efficient use of natural energy resources specifically for developing countries like Bangladesh.

Sun shading

Providing shade from sunlight is necessary in design. The purpose as noted by Binggeli (2003) is to avoid heats from sunlight to the building's interior, and poor design will increase the indoor temperature. Direct sunlight penetrates sun's (solar) heat with it, creating poor thermal comfort. The overheating indoor temperature causes uncomfortable to the occupants; as a result, this condition creates unhealthy indoor air environment Direct sunlight exposure should be avoided in a warm and humid climate in a tropic; the design should integrate shading devices (Binggeli, 2003) to gain passive cooling. Primary factors to achieve excellent sun shading are building orientation, roof shade, attached roof shade, screen louver and window louver. Without this roof shade, the building materials will expose to direct sunlight, which gain the sun's heat. These building materials will reradiate the heats to the indoor area, and consequently this radiation increases the indoor temperature.

Indirect sunlight

Design a building in a tropical country which uses indirect sunlight is necessary for efficient use of light energy. The concept of day lighting reduces the use of electric energy (Edwards and Torcellini, 2002). The most unique way is to furnish diffused daylight into the building. This can be achieved by integrating sun shading devices as a part of the building design (Chella *et al*., 2007). These devices diffuse the direct sunlight to indirect sunlight into the building. Therefore this method limits the problem of luminosity. Building orientation, roof shade, attached roof shade, screen louver and window louver are primary factors to gain for indirect sunlight.

Rainwater discharge

Discharging rainwater becomes a crucial factor because the rain is frequent. Peninsular Malaysia is one of the regions, which has the highest rainfalls in the world from the two annual monsoons, northeast and southwest monsoons (Robequain 1954). This region receives high annual rainfall at an average of 2500mm. Excellent building design will hinder problem of rainwater deflections and leakages to ensure the design for healthy environment.

With frequent rain, the probability of rainwater deflection's occurrences is high especially during torrential rains and when wind velocity is high. The roof works like a large umbrella as argued by the local architect Jimmy Lim (Powell, 1993), and plays crucial role to ensure the rainwater discharged in efficient way to hinder the rainwater deflection from happening. Poor design will lead to rainwater penetration into the building and roof perimeters, which lead to fungous growth. Roof overhang, attached roof overhang, fascia board, screen louver and roof ridge board are the important elements to block rainwater deflection from penetrating inside the building.

Roof should have simplest design as possible that creates smooth rainwater flow from the roof discharged to the ground level. Design with roof form with complex roof ridges has high tendency of roof leakages. The rainwater will penetrated into the roof structures and then inside the building. The leakages cause dampness to the roof and building floor, which leads fungus growth, with germs and bacteria. The roof should work like a large single umbrella to hinder the building materials used in a construction of the building interiors from rainwater leakages and deflection. Simple pyramid roof form, roof overhangs and roof ridge board design are necessary for efficient rainwater discharged.

Wall openings

Wall openings are crucial in tropical building design. These openings are doors, windows and their upper

window openings, and roof window openings. The openings are for cross ventilation and stack effect for passive cooling of air temperature and humidity. In tropical region, high annual rainfall accelerates evaporation, which causes humidity. The vapour content has only a slight difference between day and night as well as throughout the year. The water vapour is normally from 19 to 24 grams per cubic metre which is twice that of England during the summer (Fisher, 1964). Efficient indoor air ventilation creates 'cross air movement and induced air flow' reducing the air temperature and humidity level. This creates comfortable and healthy environment from sun's heat and high humidity as well as removing funguses, bacteria and germs from the indoor building.

Cross air ventilation

Efficient natural ventilation is necessary for excellent indoor air quality by inducing outside fresh air into the indoor building. Maximum wall openings will maximise cross air ventilation. The openings allow an increase of indoor air speed (Moujalled *et al*., 2008). Wall openings like doors, windows and upper windows at the ground level, and windows at the roof levels are important factors for cross air ventilation. The purpose is to dilute the existing polluted indoor air. Poor air ventilation causes indoor air pollution in the building rated as sick building, unhealthy for occupancy. Brown and Deekay (2001) argued that large wall openings with wind direction perpendicular to the openings (at its windward and leeward sides) has excellent cross air ventilation, creating high pressure at the inlet zone and low pressure at outlet zone. This air movement gives cooling effect to the indoor air temperature and humidity. With excellent design of cross air ventilation, it reduces the use of ceiling and wall fans.

Stack effect

Stack effect is upward and outward air flow due to induction of air pressure in the building. This condition occurs because the warm air is lighter than the cool air. The air pressure induces warm and polluted air to flow out through roof openings. As the warm air flow out, its absence is replaced by outdoor fresh cool air coming from the ground floor's window and door openings. This air circulation ensures that the building has comfortable and healthy indoor environment. According to Klote (1991), this excellent upward and outward air pressure occurs as the air intake outside the building is as minimised as possible while the indoor space has a height as great as possible. Similar to cross air ventilation, doors, windows and upper windows at the ground level, and windows at the roof levels are important wall openings to induce the stack effect.

Methodology

A qualitative approach of an architectural survey is used. It is necessary to personally explore the sites by conducting an inventory of architectural features obtaining photography and interviewing people.

The analysis is to measure the level of influence of health factors to the traditional mosque design with the case study at two Mosques of Sylhet City. An evaluation by the researcher using working drawings and site observations was conducted. This survey uses 3 different measurable scales of the Likert Model (Wikipedia, 2010) as the followings:

a) poor (means poor level related to the health factor)
b) moderate (means moderate level of the health factor)
c) excellent (means moderate level of the health factor)

Case Study on Mosques

Islam is one of the fastest growing major religions in the developed countries. Mosque is the prayer ground for Muslim. Bur the culture, social structure and tradition are different from place to place among the Muslim. Their culture and local socio-economic picture is presented through design and plan of mosque.

It is clear from the observation that there is no doubt that the mosque has an excellent roof shade design . Three tiered roof concept makes a design of attached roofs become important parts of the roof structures. There is attached roof system. These attached roofs have roof overhangs, which provide excellent sun shades in Bander Mosque (Fig. 2). The roofs block high angle sunlight from penetrating into the building. In addition, the design of open verandah area makes possible for a construction of recessed walls 3 m further inside the building. The reason is to avoid the walls from exposure to direct sunlight, which causes solar radiation. In addition, the design of open verandah area makes possible for a construction of recessed walls 3 m further inside the building. The reason is to avoid the walls from exposure to direct sunlight, which causes solar radiation. The attached roof overhangs work well blocking high angle (45-75^{o}) sunlight. Although the Amberkhan and Noyashorok mosque has attached roof system, but proper sunlight protection is absent.

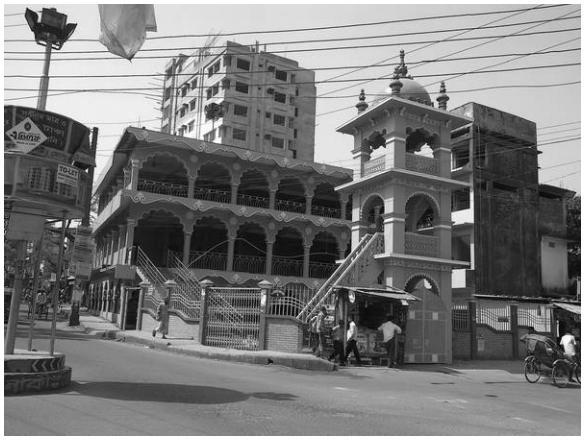

Fig. 1. Noyashorok Jamia Mosque.

Fig. 2. Bander Mosque.

Fig. 3. Toilet in Bandar Mosque.

Fig. 4. Ozu facility and toilet in Amborkhana Mosque.

Fig. 5. Ozu facilities in Bandar Mosque.

Fig. 6. Ozu facility in Noyashorok Mosque.

The ozu and toilet system in the Bandar Mosque is separate from main building and there is sufficient ventilation system however the entire is not hygiene. The ozu facilities and the toilet system of Amborkhana Mosque are very congested and entire facilities are attached with the main building. This negatively impact entire air circulation system, furthermore entire facilities have no natural lighting facilities. Noyashorok Mosque ozu and toilet facilities

are considerably similar to Bandar Mosque which is typical in many mosques in Sylhet City.

Building orientation in a tropical region has efficient design by applying rectangular plan with wide wall at north and south facade compared to narrow wall at east and west façade. The mosques does not apply screen louver in the design. Without the louvered fittings, the northwest and southeast façades are exposed to low angle (0-45^{o}) sunlight. Simple roof is the best roof form for smooth rainwater flow from the roof to the ground level with piped system. There are three ground doors at east recessed wall. No ground door is at the northwest wall. The level of stack effect is moderate in Bander mosque because the prayer hall has large ground floor window, upper windows and door openings. This means the air intakes from the ground floor windows are high and as a result, it only induces low air pressure into the prayer hall. On the other hand, the level of stack effect is poor in Amberkhana mosque because the prayer hall has no ground floor window in three sides but only has door openings in north-west side.

Table 1. Analysis in direct sunlight

Health factors	Mosque	Director	Level of Health		
			Poor	Moderate	Excellent
Roof shade	Ban-Mosque	Northwest facade		X	
		Northeast facade		X	
		Southeast facade		X	
		Southwest facade		x	
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
Building orientation	Ban-Mosque	Northwest facade		X	
		Northeast facade		X	
		Southeast facade		X	
		Southwest facade		X	
	AM-Mosque	Northwest facade	X		
		Northeast facade		x	
		Southeast facade	x		
		Southwest facade	x		
Screen louver	Ban-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
Window louver	Ban-Mosque	Northwest facade	X		
		Northeast facade		x	
		Southeast facade	X		
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		

Table 2. Analysis on indirect sun-lights

Health factors	Mosque	Director	Level of Health		
			Poor	Moderate	Excellent
Roof shade	Ban-Mosque	Northwest facade	X		
		Northeast facade		X	
		Southeast facade	X		
		Southwest facade	x		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
Building orientation	Ban-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	x		
		Southeast facade	x		
		Southwest facade	x		
Screen louver	Ban-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
Window louver	Ban-Mosque	Northwest facade	X		
		Northeast facade		x	
		Southeast facade	X		
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
Attached roof shade	Ban-Mosque	Northwest facade	X		
		Northeast facade			X
		Southeast facade			X
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		

Table 3. Analysis on rainwater leakages

Health factors	Mosque	Director	Level of Health		
			Poor	Moderate	Excellent
Roof form	Ban-Mosque	Northwest facade			X
		Northeast facade			X
		Southeast facade			X
		Southwest facade			X
	AM-Mosque	Northwest facade			X
		Northeast facade			X
		Southeast facade			X
		Southwest facade			X
Roof overhang	Ban-Mosque	Northwest facade			X
		Northeast facade			X
		Southeast facade			X
		Southwest façade			X
	AM-Mosque	Northwest facade			X
		Northeast facade			X
		Southeast facade	X		
		Southwest facade			X
Attached roof shade	Ban-Mosque	Northwest facade			X
		Northeast facade			X
		Southeast facade			X
		Southwest facade			X
	AM-Mosque	Northwest facade			X
		Northeast facade	X		
		Southeast facade		x	
		Southwest facade			X

Table 4. Analysis on air ventilation

Health factors	Mosque	Director	Level of Health		
			Poor	Moderate	Excellent
Ground door	Ban-Mosque	Northwest facade		X	
		Northeast facade		X	
		Southeast facade	X		
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade		x	
		Southeast facade	X		
		Southwest facade	X		
Ground windows	Ban-Mosque	Northwest facade		X	
		Northeast facade		X	
		Southeast facade		X	
		Southwest facade	X		
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		
Ground upper windows	Ban-Mosque	Northwest facade		X	
		Northeast facade		X	
		Southeast facade		X	
		Southwest facade		X	
	AM-Mosque	Northwest facade	X		
		Northeast facade	X		
		Southeast facade	X		
		Southwest facade	X		

Conclusions

These mosques set an example that simple materials and techniques coupled with good vision and engineering are capable of producing good and sustainable architecture with respect to their heritage identity. In addition, these techniques provide both environmental and energy efficient aspects. These buildings type also provides a higher margin of quality of life to occupants. Although, these techniques positively contribute to sustainability of local environment, they, definitely, need further research to enhance and develop them to be more efficient, practical and economical. However the analysis finds that the traditional mosque design does not apply screen and window louvers as the design elements for health factors. The traditional mosque design are only relying on the roof overhang concept with open serambi area and the recessed walls to tackle the problem of solar radiation, luminosity and rainwater deflection. In case with the problem of solar radiation and luminosity, this concept only works well to block high angle sunlight but not to low angle sunlight. The presence of window and screen louvers is important because it can block the low angle sunlight's penetration into the building. Besides, the study explains that the emphasis is more to cross air ventilation compared to stack effect. The design has large window and door openings on the ground floor level. To upgrade the development of traditional mosque design, the study recommends the uses on screen and window louvers as the important design elements. This integration will certainly improve the health level and its sustainability.

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