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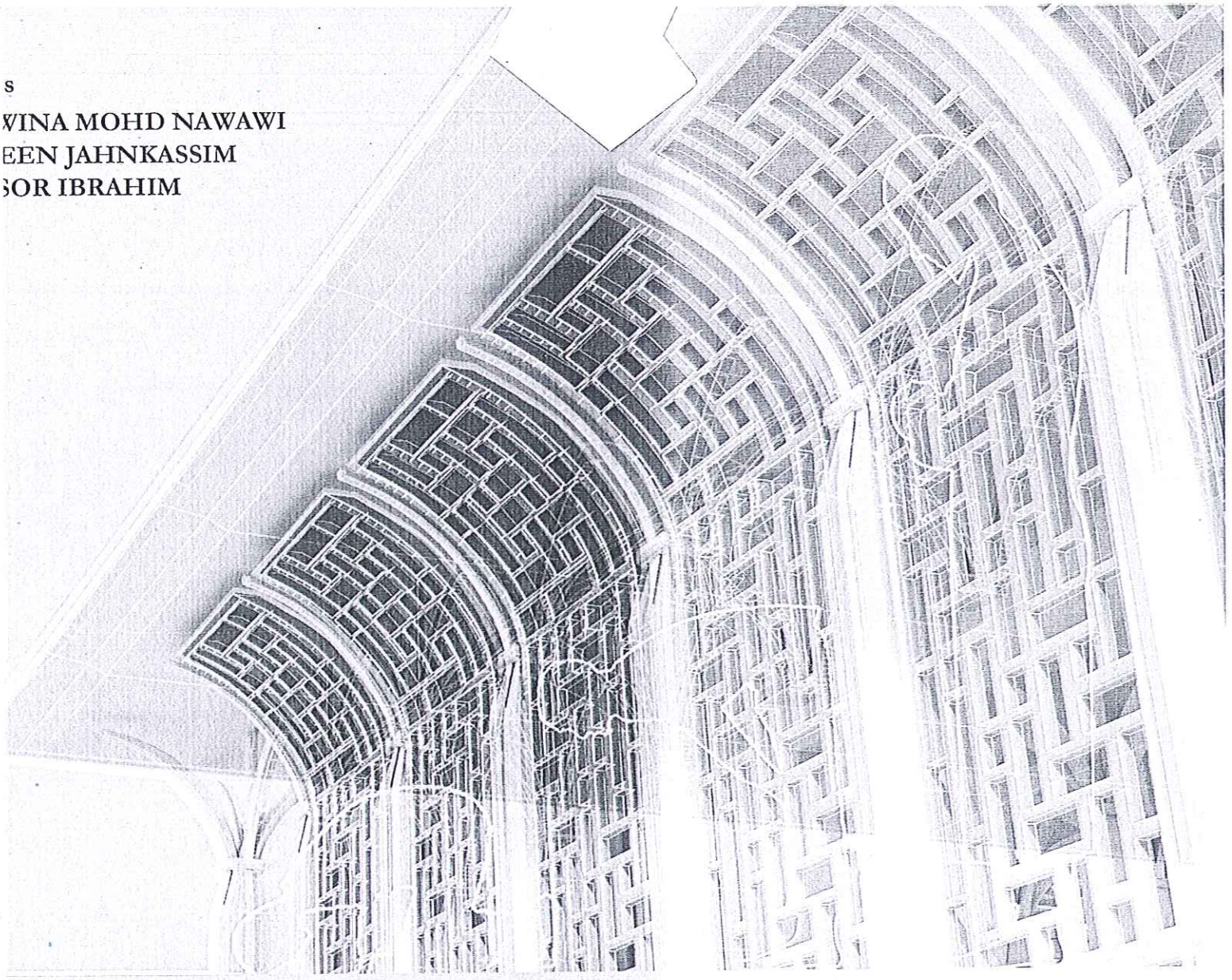
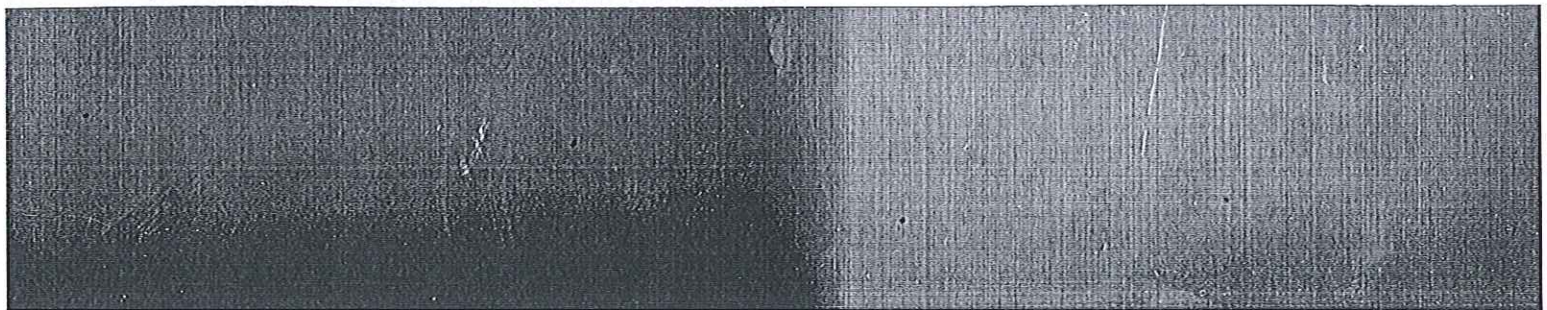


DIMENSIONS OF MASJID ARCHITECTURE

Perspectives and Writings in Theory and Design

Kulliyyah of Architecture and Environmental Design
International Islamic University Malaysia

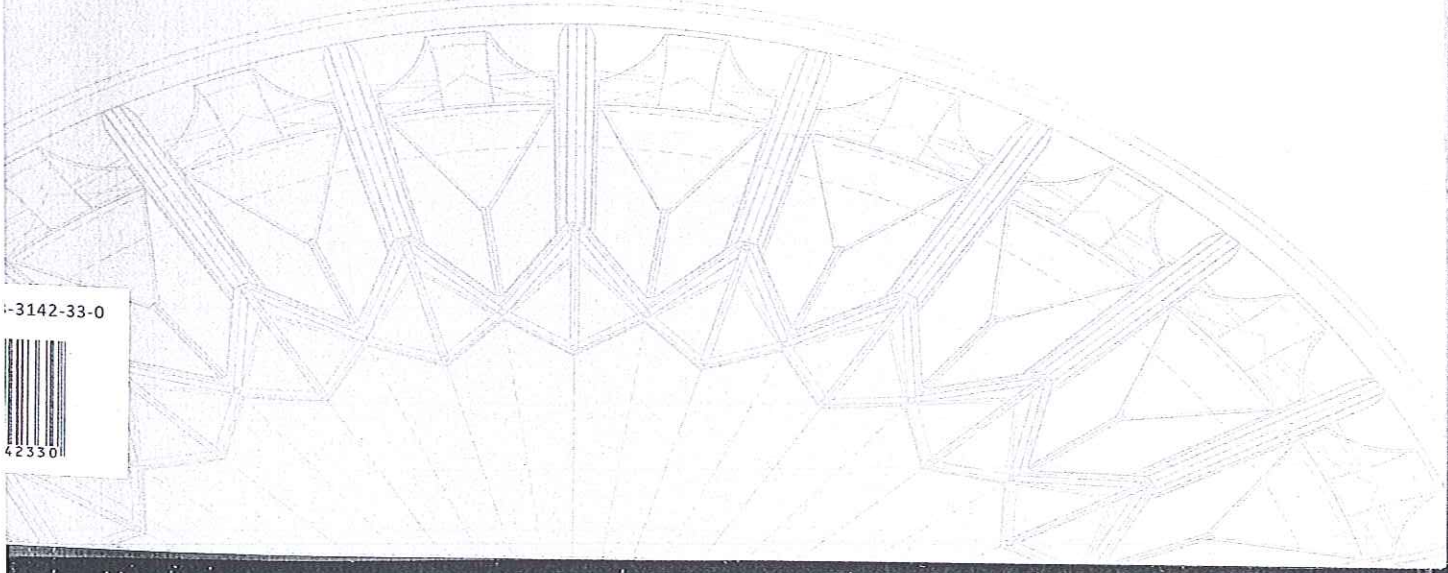
Al-Bukhary Foundation



DIMENSIONS OF MASJID ARCHITECTURE

Perspectives and Writings in Theory and Design

Mosque or masjid architecture has been the subject of a continuous flow of writings, theoretical discourses, design statements and formal interpretations in the past. Its evolution in terms of form has ranged from simple beginnings to emotive structures throughout history; and in recent times, from faithful reconstructions of the 'traditional' to the heroic gestures of the 'avant-garde'. Rather than a continued focus on history, aesthetics and form, this book attempts to bridge the world of theory and practice by converging past writings and thoughts, with built work. In a compilation of transliterated lectures, writings and discourses of case studies on the subject, the multidisciplinary fields on 'masjid' architecture are explored; not only in terms of design and language but amongst others, in terms of links to theory, the ideals of multiculturalism, the agenda of sustainability, the necessity of heritage and the importance of asset management. This interweaving of discourses and design practices including perspectives on the arts, heritage, planning, sustainability and philosophy is but a neccessary step towards building a framework of theory on the masjid through a dynamic oscillation and fusion between the world of 'ideas and values' of Islam and the realities of the built environment and its practices in the modern world.



CHAPTER 16
Passive Design of Two Modern Masjids in Malaysia

Maisarah Ali
Tengku Anis Qarihah

16.1 INTRODUCTION

The masjid represent a building typology in which the act of prayer in Islam or "solah" is contained, housed and celebrated. For centuries, the masjid has developed from its origins and humble beginnings and was formerly steeped in vernacular typology and construction which was derived from its locality into man-made grandeurs and marvels in engineering ingenuity. From the humble scale of the wooden masjid of South- East Asia to the grandeur of multiple dome-like architecture of the past Ottoman Empire, the masjid is an important building type in the Islamic world and has evolved technologically, structurally and aesthetically. However, throughout its entire evolution and development, the masjid has always been a practical example of some of the best practices in environmental and climatic-conscious design due to its function as a public building which is always open to the public. Hence, for centuries, the design and construction of the masjid has had a focus on passive design and climatic conscious strategies. These strategies have, throughout

recent centuries, developed into a range of features which have responded to the trends in modern stylistic expression , yet they have also been implemented various advancements in building technology and engineering.

The Tuanku Mizan Zainal Abidin Masjid in Putrajaya is an example that exemplifies the pinnacle of such efforts. The masjid, otherwise popularly called as The Steel or "Iron Masjid" was designed and constructed with an emphasis on the expressive use of steel. The entire building can oblige more than 20,000 individuals for congregational prayer at one time. The Putra Masjid in Putrajaya, on the other hand, is an earlier example of large concrete structure with massive engineering in a large scale and which can accommodate up to 15,000 worshippers inside and many thousands more in the external patio.

As the masjid typology modernises, the emphasis of modern methods and new materials such as steel and glass has grown. These have had a significant impact on the range and effectiveness of passive strategies in order to create comfort conditions. Passive strategies such as thermal mass and thick walls have typically arisen from traditional techniques and methods of construction during medieval eras. As the masjid modernises and nations and communities attempt its construction with modern materials, some of the passive impact to control climate without excessive use of energy may have been compromised. The masjid must be able to accommodate thousands of people and yet, still fulfil expectations and requirements in providing sufficient thermal comfort conditions according to the local climate. A good passive strategy must be able to offer a framework and mechanism of cooling without excessive energy use. Thermal comfort is an extremely vital part of a public facility such as the masjid. This is such that in order for prayers to be performed in peace and comfort. Optimum thermal design and operation is thus, a crucial factor to accomplish the thermal comfort for the duration of the entire day. Masjids contain a capacity and operating schedules that differentiate them from other types of buildings.

Masjids usually have domes surmounting praying hall which add to the space and volume of the building and to emphasise the main area of the prayer hall architecturally. Incidentally, this can be used to increase the thermal comfort of the user. Because of the symbolic and iconic role of masjid features such as the dome and minaret, such features can be adopted with passive design strategies which help to provide thermal comfort and reduce energy consumption. This is particularly important as masjids are public buildings which are not commercially-based and rely on government and community funding for their operation.

Recently, as Malaysia becomes increasingly urbanised, active air-conditioning has been seen as conventional practice and increasingly used necessary in operating masjids. Hence, it is increasingly observed how most masjids are furnished with a central, split air

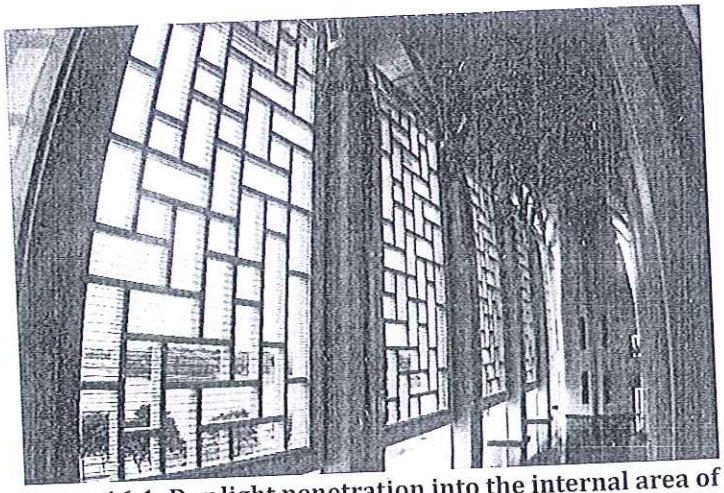


Figure 16.1: Day light penetration into the internal area of the main prayer hall, Tuanku Mizan Zainal Abidin Masjid, through the woven stainless steel mesh (mashrabiya)
Sources: Kumpulan Senireka Sdn. Bhd.

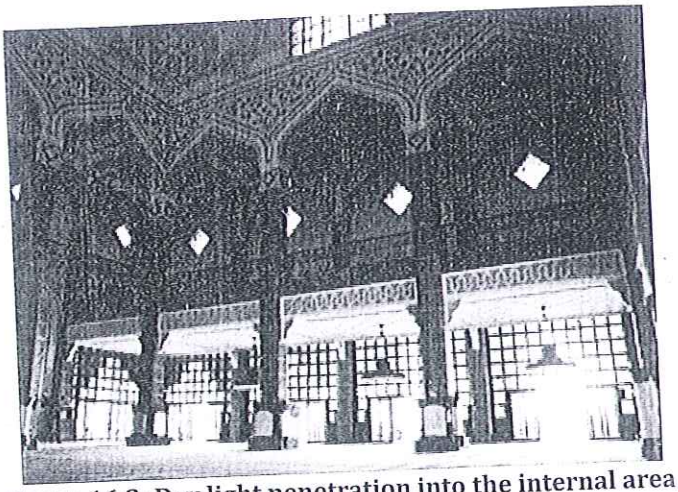


Figure 16.2: Day light penetration into the internal area of the main prayer hall, Putra Masjid, through the glass wall and doors (Ground Floor Level) and through stain glasses at the First Floor Level, upper floor level and dome neck windows.
Sources: Kumpulan Senireka Sdn. Bhd.

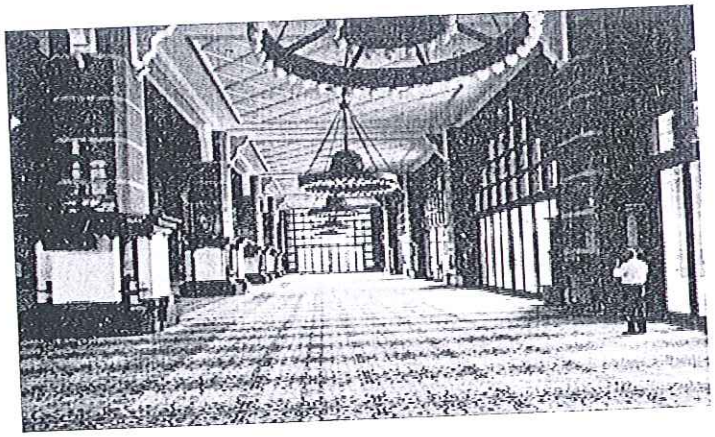


Figure 16.3: Hallway of Putra Masjid

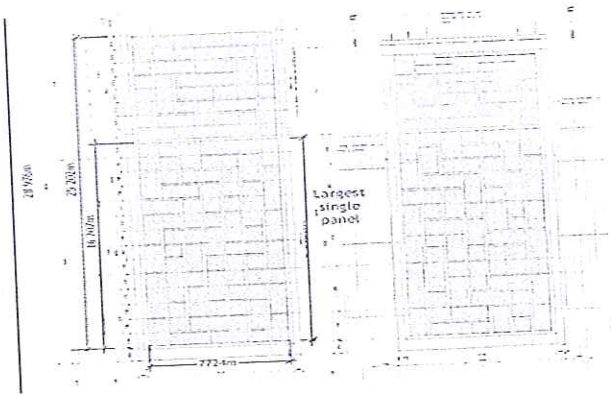


Figure 16.4: Shape and Size of Glazing of Putra Masjid

conditioning systems, window or combination type unit of air-conditioning system, in conjunction with ceiling fans. The aim of this chapter is to discuss and highlight how two masjids– in the Putra Masjid and Tuanku Mizan Zainal Abidin Masjid–which utilise modern materials and construction had integrated passive strategies which their architectural form and design itself. Both were designed by Kumpulan Seni Reka and are located in Putrajaya.

16.2 DESIGN CONCEPT

Ar. Dato' (Dr.) Nik Mohamed Mahmood, the principal architect recalls how he had aimed from the early start of the design process, to ensure that masjid environment is aligned with the acts of worship or ibadah. In Putra Masjid, the architect himself gave some input on the actual siting of the masjid being next to the water element, i.e. the Putrajaya Lake and nature. Since the site is huge, the idea of having landscape with water features in a 'sahn' at the frontage of the masjid and having the masjid surrounded with green planter box and vegetation was immediately seized upon. The architect believed that the landscape and vegetation is crucial in achieving a degree of cooling of the surrounding environment while at the same time, it exudes a tranquil ambience and welcoming feeling to the users.

In order to enhance the breezy air movement, the ceiling height of the masjid was raised up to 5 times the volume of a typical masjid design. Large overhangs were incorporated around the building notably for protection from solar heat gains; they also serve to protect from wi driven rain including by reducing the incidences of rain splashing into the praying hall. The space underneath th overhangs had been utilized as an overflow space to allc jemaah do their prayers especially during Friday prayer.

For Tuanku Mizan Zainal Abidin Masjid, there w new challenges as the material itself was the result of ar emphasis on Modern architecture, millennium looks anc technologies. While the emphasis was on steel, the idea to "balance" out such "modern" emphasis in constructio with "traditional" concepts, hence, the idea of a Steel Ma with big openings and being integrated with "modern mashrabiya" concepts. It was crucial that the masjid mus be surrounded with water elements, has an airy and bre praying hall, have a tranquil space and is highlighted wit exquisite detailing.

The "open concept" with a minimal focus on the amount of vertical walls was followed where possible. The emphasis on using Mashrabiyah Screens allowed for maximum cross ventilation through the masjid. In order to emphasise passive design, the openness of the masjid crucial; such an open concept would also encourage "nig ventilative" cooling where the drop in temperature durir night-time would be harnessed to cool both the interior the structural elements of the masjid at the same time–b

which ultimately, work in tandem to create a comfortable environment within the main prayer hall. (Refer to figure 5.1)

a. Site context

The site is located at the end of the Qibla Axis, and this merits a signature building that acts as a termination point.

b. Loftiness

The main prayer hall, architecturally and symbolically, was intended to be a high multi-volume space to instil the feeling of humility. Hence, the very high and lofty ceiling was meant to create a feeling of awe towards Allah and to make the Jemaah feel humble, modest and small in front of the Creator. Indirectly, it creates a tranquil & silent space. However, a climatic objective was also achieved. A multivolume space encourages the stack effect and thermal stratification with cooler air accumulating at the ground level where users and visitors can maximise its positive effects.

c. Water

In traditional Islamic Architecture, water is enticed into gardens, masjid, and houses because water is the reflection of Heaven. Water is also a temperature regulator, and man has always had an insatiable need to see and hear water.

16.3 PASSIVE DESIGN STRATEGIES IMPLEMENTED

16.3.1 Site Planning and Building Orientation

For Putra Masjid and Tuanku Mizan Zainal Abidin Masjid, both buildings face the Qibla. The buildings' facades have equal area of surfaces which face the north–south and east–west. Because of this issue, the designers implemente the idea of shading devices (mashrabiya) made by Glass Reinforced Concrete (GRC) with intricate pattern casted on the surfaces of the Putra Masjid and woven stainless steel wire mesh at the Tuanku Mizan Zainal Abidin Masjid.

The shading devices not only act to avoid direct sunlight wind-driven rain but also to beautify the facade treatment to the fullest. The set back of the prayer hall wal to avoid direct sun light penetrating into the prayer hall. Ai conditioning is used at selected spaces but at the same tim this reduces the usage of air-conditioning system at Putra Masjid.

For both masjids, there are transition spaces that visitors may move through before reaching the main area. From the main entrance, visitors will reach to sahn (the lar open space concept of '*Ruang Limpahan*'); they then will move 8-12metres deep through the corridors before reach to the doors of the main prayer halls. This concept continu towards both sides of the masjid, with the same of concept a transitional space.

16.3.2 Day Lighting

The combination glazing, wire mesh and mashrabiya not only allowed the admission of daylighting but at the same time, they controlled glare. In the tropics, there is an abundance of solar radiation and daylight. The harvesting of daylight is at times, unsuccessful as with it, comes the admission of heat and glare. While heat has a magnitude, glare has a directional component. Glare depends on which direction the viewer or visitor is looking from. This, often, is unable to be controlled, unlike an office space in which the occupants are seated in almost the same position throughout the working day. Hence, in a masjid, it is important that glare is controlled in both direction of the grilles. Additionally, shading and solar control represent large surfaces or panels in the view of users and visitors within the space.

Day lighting penetrates through the glass wall panels, glass door panels and stain glasses at the wall and the dome area. However, the glazing at the lower level (glass wall panels) have shading devices and for stain glasses, the transmitted light is less than 40%; some is reflected and some is absorbed by the tinted/ stained glass.

In the Tuanku Mizan Zainal Abidin Masjid, glazing is only used at the commercial area which is at the lower part of the building and the quantity of glazing is only 4.8% from the overall fenestration.

16.3.3 Internal Ceiling, Partition and Floor Surfaces Properties

Moveable partitions are placed at the female prayer area (ground floor level) and permanent partitions are placed at the upper level of the female prayer area. They are made from "craft cengal woods". The floor surfaces at the outside area are made of stone granite while that of the inside are made of tiles. However, the inside areas are fully covered with 10mm imported carpet. For the Tuanku Mizan Zainal Abidin Masjid, the ceiling is plastered and installed with lighting features. Moveable partitions are placed at the female prayer area (upper level). They are made of "stainless steel wire mesh". The floor surfaces at the outside area are made of stone granite while the inside is tiles. However, the inside areas are fully covered with 10mm imported carpet.

16.3.4 Optical, Solar and Thermal Properties of Windows

For both masjids, the size, location, shape and orientation of the glazed areas in the buildings will have critical effects on heat gains and solar gains because glazed areas have the highest heat gain per unit area and the major proportion of solar gains are also through windows.

Table 1: Daylight distribution of the Main Prayer Hall at Putra Masjid and Tuanku Mizan Zainal Abidin Masjid

No.	Masjid	Date	Time	Lux	DF (%)	Day lighting Factor	Distribution
				External	Internal		
1	Putra Masjid	9th June 2012	9.00 am	5500	150	3	Fair
		Thursday	1.00 pm	8500	280	3	Good
		Clowdy & Overcast	5.00 pm	6500	220	3	Good
		11th June 2012	9.00 am	7500	200	3	Fair
		Saturday	1.00 pm	25000	480	2	Fair
		Bright & Sunny	5.00 pm	12000	220	2	Fair
		17th June 2012	9.00 am	10000	250	3	Fair
		Friday	1.00 pm	28000	520	2	Fair
		Bright & Sunny	5.00 pm	15000	350	2	Fair
2	Tuanku Mizan Zainal Abidin Masjid	9th June 2012	9.00 am	7500	180	2	Fair
		Thursday	1.00 pm	10500	280	3	Good
		Clowdy & Overcast	5.00 pm	6500	220	3	Good
		11th June 2012	9.00 am	8500	220	3	Good
		Saturday	1.00 pm	26500	750	3	Good
		Bright & Sunny	5.00 pm	12000	320	3	Good
		17th June 2012	9.00 am	10000	300	3	Fair
		Friday	1.00 pm	28000	550	2	Fair
		Bright & Sunny	5.00 pm	15000	250	2	Fair

16.3.5 External and Internal Shading Devices

The external shading devices are in the form of mashrabiya and the roof overhangs while the internal shading devices are the roof ledge at the transition space/ corridor. Users found the mashrabiya and the screening reasonably effective in fulfilling human comfort requirements to the occupants. Most of the users commented that they feel the tranquillity of the space overall.

16.3.6 Day lighting Distribution

The distribution and levels of natural lighting is analysed in Table 1. On the whole, the high volume of openings and fenestrations has given ample light to the prayer hall. The shading devices help to control the glare and only allow in the necessary amount of natural lighting.

16.3.7 Facade Design

Overall the facade concept has combined both cultural and climatic features which are the mashrabiya, roof overhang, openings, wall system and cladding systems in order to minimize solar heat gain yet still achieve architectural expression. Figures on page 155,156 and 159 shows the comparative studies between the two masjids which are the Putra Masjid and the Tuanku Mizan Zainal Abdin Masjid.

16.3.8 Natural Ventilation

In the Steel Masjid, natural ventilation was integrated by emphasising full height mashrabiya panels that represent a fixed system of woven wire mesh aimed at allowing natural wind flow and natural ventilation directly at body height to the main prayer hall. The design of the Putra Masjid is more enclosed with only the selected areas for natural ventilation and it is hardly felt. Its thermal attenuation is achieved more from the control of solar gains and the control of heat gain through the conduction of massive walls. There were not still and stagnant areas found in the main prayer hall, and natural ventilation can be felt well circulated in the space.

16.3.9 Strategic Landscaping

Both masjids are located next to a lake or are surrounded by the water bodies but in terms of landscape design, a more well thought out scheme can be found in Tuanku Mizan Zainal Abidin Masjid. In this case, the masjid strategically utilizes the concept of water element which is located all around the main prayer hall. The Qibla walk which emphasizes on the roof top gardens also shows the importance of greeneries and trees in the surrounding area. The architect probably learns from the earlier experience of designing the Putra masjid in which the courtyard or the sahn concept did not work as well as intended. The water element and canals were found not to

function as ideally as intended since the width are too small, and they work like a drain to collect surface water instead of as canals or sahn like the middle east masjids.

The *souq* area which is next to the Putra masjid is paves with man-made tiles and stone. Trees are planted in planter boxes but the impact of the greenery is less felt when walking in that area. In contrast to the Qibla Walk, the tranquillity and the feeling are different. The anodized coating and finishes for the steel mashrabiya helps to reflect the heat from coming into the space or absorbed by the building material itself.

16.4 TRENDS IN ENERGY CONSUMPTION

16.4.1 Electrical Energy Consumption for Putra Masjid

Data of electrical consumption for one month in the Putra masjid was obtained from data logger which were clamped on incoming supply cables. Trends highlight how the usage is reduced on Mondays. This was due to the increased activities from Thursday until the weekend. Thursday is known as "Friday night", and it is the first day of the week in the Muslim calendar. On this day, many activities are held in the masjid. During Friday prayers, the masjid is full due to the congregation being compulsory for Muslim men. During the weekend, many activities are held such as classes, lectures, workshop, etc. The usage of electricity in the masjid comes mainly come from the air conditioning system, lighting, electrical equipment, elevator, motor pump system, etc. The estimated annual electricity consumption for the masjid in 2010 was 1,085,402 kWh.

It can be seen that there is a big gap between October 2009 and November 2009 because in November 2009, JAIM appointed a facility maintenance company to maintain the masjid. After the appointment, the bills reduced by about 60%. This shows that proper maintenance of the system is crucial in order to reduce the energy consumption. The responsibility of maintaining the building should be carried out by competent and skilled personnel. There was also a higher usage of electricity in the month of August due to the fasting months of Ramadhan in which extra activities were held other than the 5 daily prayers.

Other factors that helped to reduce energy are scheduled maintenance and servicing of equipment. The facilities maintenance company came out with energy saving strategies and the personnel were assigned to control and monitor the usage of electricity in certain areas to avoid wastage. The centralized systems of curtained area were modified to split unit systems to make sure the systems were only utilized when there was a need for it. end users.

Both the Putra Masjid and the Tuanku Mizan Masjid in Putra Jaya were designed to incorporate passive strategies at different emphasis and extents. Some of the strategies implemented are site planning and building orientation, effective room depth, high floor to ceiling height, internal and external shading devices, building envelope and building facade, selection of colours, opening, window and fenestration, selection of suitable building materials and landscape and water element. It was found that the electricity bill for the Tuanku Mizan Zainal Abidin Masjid is lower (27%) than the Putra Masjid although the praying capacity for the Tuanku Mizan Zainal Abidin Masjid is double than that of the Putra Masjid.

This shows that the concept of passive design strategies, energy saving and sustainable building can go along with a masjid of extra ordinary design. Overall, both masjids are embodiments and examples of the fusion and synthesis between the need to incorporate passive elements and climatic strategies with an emphasis and concern for aesthetic features and advancing architectural expression of modern Islamic design.

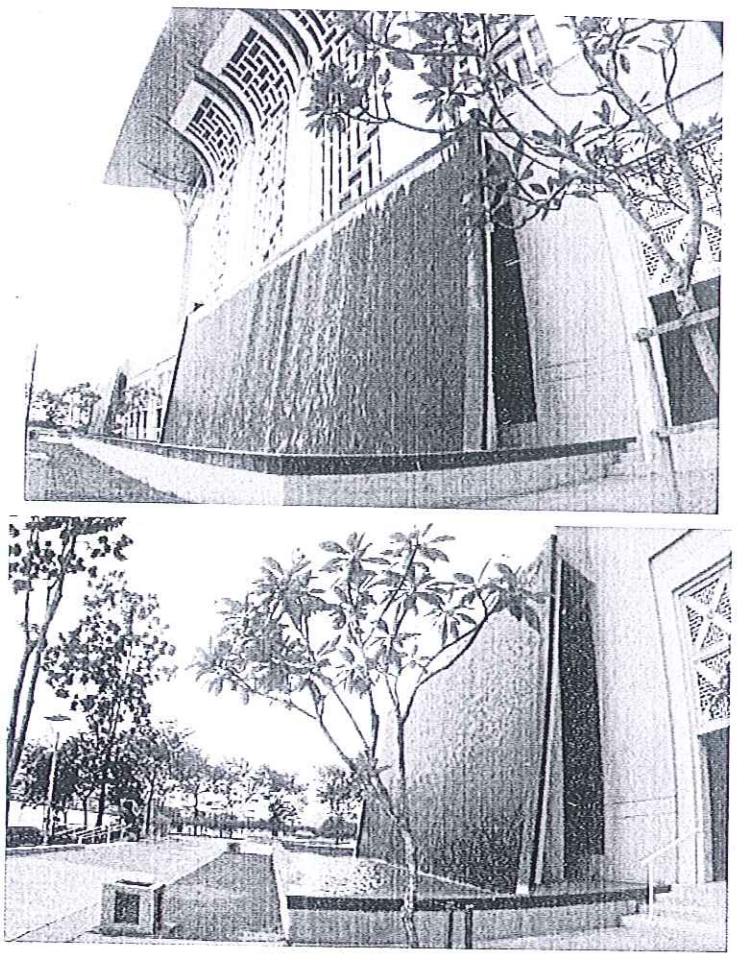
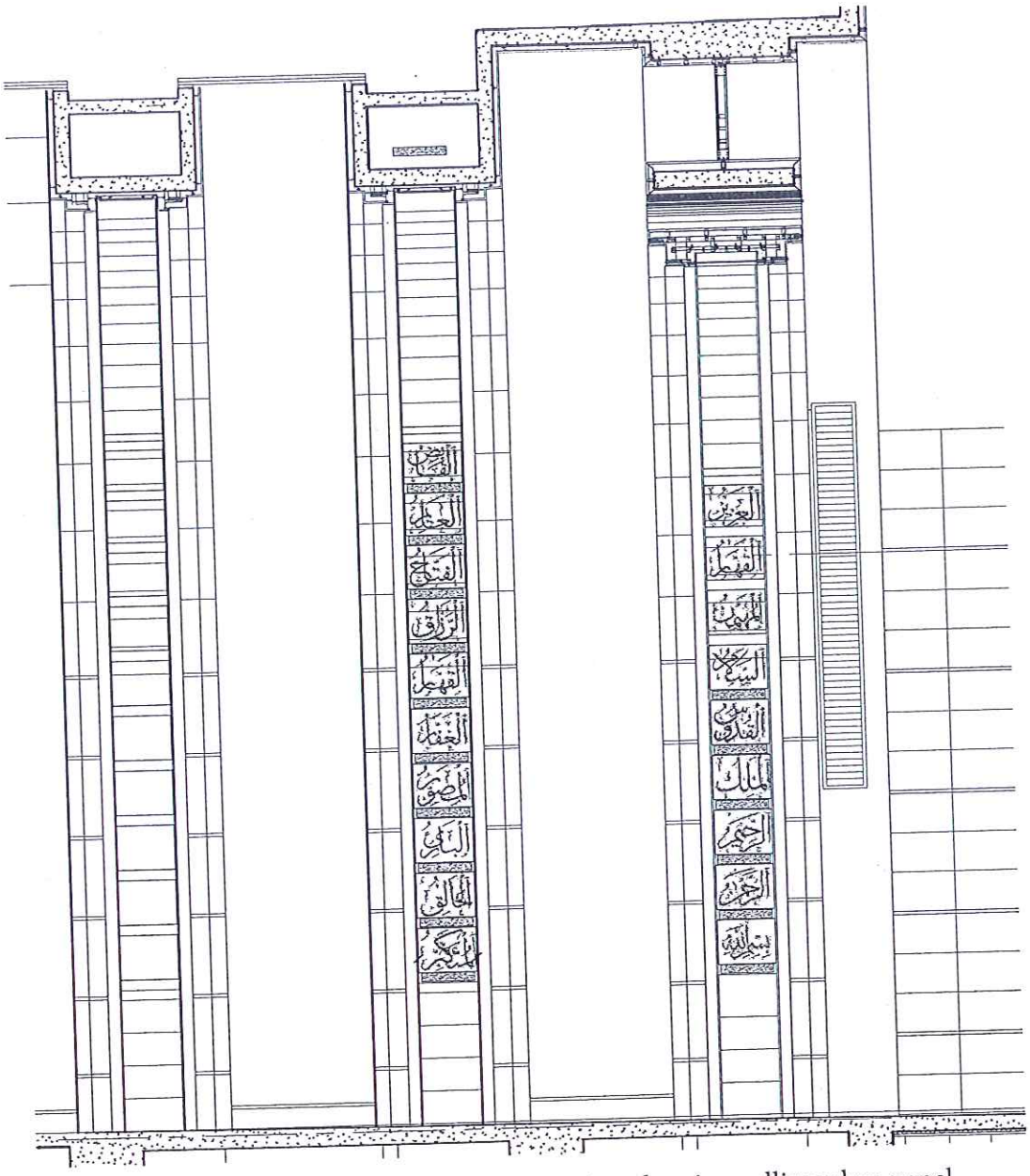


Figure 16.4 : Masjid Tuanku Mizan - view of external area



Masjid Mizan : Section showing calligraphyc panel
(Source: Courtesy of (Kumpulan Senireka Sdn Bhd)