



MOSQUE ARCHITECTURE

PRESENT ISSUES AND FUTURE IDEAS

عمارة المسجد:

قضايا الحاضر و أفكار المستقبل

Editors

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جائزة عبد اللطيف الفوزان
Abdullatif Al Fozan Award

for Mosque Architecture

عمارة المساجد



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A photograph of a mosque courtyard. On the left is a long, high wall made of reddish-brown mud-brick with a decorative zigzag pattern near the top and several small, dark, rectangular windows. The roofline is topped with a series of white, conical structures. In the center-right, a tall, slender minaret rises against a blue sky with scattered white clouds. The courtyard floor is paved with light-colored stone tiles. In the foreground, a wooden railing with thick, dark, textured posts and a horizontal rail runs across the frame. A large, green palm tree stands in the middle ground. A few people are visible sitting on the wall. The overall scene is bright and clear.

INNOVATIVE TECHNOLOGIES IN SPIRITUAL CONTEMPLATION

MIZWALAH TAHA: TOWARD THE REVITALIZATION OF TRADITIONAL MOSQUES ARTEFACTS

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INTRODUCTION

THE importance of time and timekeeping in Islam cannot be overstated. Out of the five main principles of Islam, four of them can only be properly executed within specific times. The Medieval Islamic civilization, with its great emphasis on time measurement and timekeeping, especially in the regulation of prayer times, adopted and utilised sundials, among other scientific instruments, towards these ends.

Time has traditionally been measured by the apparent movement of the Sun and Moon in the sky. The diurnal motion of the Sun is used to measure periods of 24 hours and longer periods of time can be measured by the phases of the Moon.

Sundials have been used, as a primary instrument, since time immemorial, by various civilisations, to measure time. The apogee of sundial development was during the medieval Islamic civilization, with the design and production of various types of sundials that were well documented via treatises. These sundials were built for mosques and madrasahs, either architecturally incorporated in the mosque designs or as standalone instruments.

Nowadays, sundials can still be found in gardens, parks and recreational areas in Western countries, not so much as timekeepers but as cultural and scientific artefacts. However currently, sundials are not being built in the Muslim world and have been relegated as museums exhibits. An initial effort has been made to reintroduce sundials in an Islamic setting in Malaysia by the construction of a sundial, Mizwalah TaHa, in the new Lembaga Tabung Haji complex.

This paper presents the importance of time and astronomy in Islam and the historical and traditional designs and usage of sundials in mosques. Detailed design criteria for the construction of Mizwah TaHa are given, taking into account the features of traditional mosque sundials. A proposition is made that modern Islamic sundials, be built for new mosques, where they can showcase Islamic science and art and that these sundials can be used as pedagogical tools for the study of astronomy and also used as spiritual contemplation aids.

ASTRONOMY AND ISLAM

The eighth to the fifteenth Common Era (CE) centuries, were known as the Golden Age of Islamic science when there was a flourishing of sciences from astronomy to zoology. Astronomy is a science that is especially important for Muslims. The Islamic world was the center of scientific breakthroughs, innovations, and inventions. Great astronomers and scientists such as Al-Khwarizmi, Al-Battani, Al-Biruni, Ibn Yunus till Ulugh Beg produced monumental works that set the foundations for modern science generally and astronomy specifically.

Among the key objectives for the development of Islamic astronomy from the earliest periods of Islamic history were the practical needs to determine direction and times for the execution of Shari'ah mandated activities. There are many verses of Qur'an and Hadith of the Prophet Muhammad (PBUH) that provide encouragement and guidance for the determination of qiblah, time measurement and calendar structure. For example:

"It is He Who made the sun to be a shining glory and the moon to be a light (of beauty), and measured out stages for her; that ye might know the number of years and the count (of time). Nowise did Allah create this but in truth and righteousness. (Thus) doth He explain His Signs in detail, for those who understand."

[Surah Yunus (10): 5]

"They ask thee concerning the New Moons. Say: They are but signs to mark fixed periods of time in (the affairs of) men, and for Pilgrimage. It is no virtue if ye enter your houses from the back: It is virtue if ye fear Allah. Enter houses through the proper doors: And fear Allah: That ye may prosper"

[Surah al-Baqarah (2): 189]

The other main objective for the study of astronomy was to know and glorify Allah as the Creator of the heavens and the Earth.

“Verily in the heavens and the earth, are Signs for those who believe. And in the creation of yourselves and the fact that animals are scattered (through the earth), are Signs for those of assured Faith. And in the alternation of Night and Day, and the fact that Allah sends down Sustenance from the sky, and revives therewith the earth after its death, and in the change of the winds, – are Signs for those that are wise.”

[Surah Jathiyah (45):3–5]

“Behold! In the creation of the heavens and the earth, and the alternation of Night and Day – there are indeed Signs for men of understanding. Men who celebrate the praises of Allah standing, sitting, and lying down on their sides, and contemplate the (wonders of) creation in the heavens and the earth, (with the thought): “Our Lord! not for naught hast Thou created (all) this! Glory to Thee! Give us salvation from the penalty of the Fire.”

[Surah Ali ‘Imran (3):190–191]

Allah SWT has enjoined mankind to study, contemplate, and reflect on the signs of nature in order to know Him.

The sundial can meet the above-mentioned objectives, thus being an instrument for time measurement as well as an aid to contemplate the wonders of the heavens.

SUNDIALS IN TIME

Introduction to Sundials

A sundial is a scientific instrument for telling the time and date from the position of the Sun in the sky. In its most basic form, a sundial consists of two main parts viz, the gnomon and plate. The Sun shines on the gnomon and the shadow of the gnomon falls on the sundial plate that has lines inscribed on it to indicate time and dates. The daily apparent motion of the Sun in the sky rising from the east and setting in the west makes the shadow of the gnomon move from west to east.

Figures 1 and 2 illustrate the working of an armillary equatorial sundial.

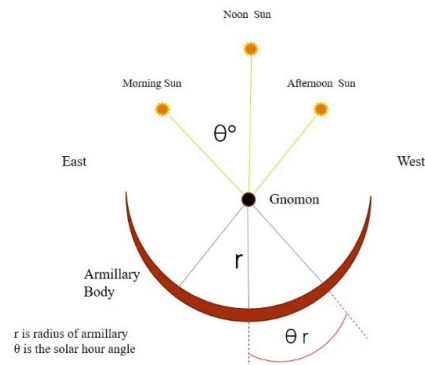


FIGURE 1

The daily apparent motion of the Sun from east to west casts the shadow of gnomon on the armillary body surface to indicate hours.

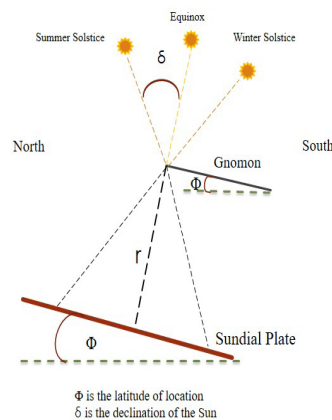


FIGURE 2

The apparent position of the sun (solar declination) in the sky over a period of a year changes in the north south direction to give dates.

Characteristics of Sundials of Islam

There were several types of sundials that were invented and used throughout the medieval Muslim world. Prominent astronomers such as Al-Khwarizmi, Al-Biruni, Al-Battani, Thabit ibn Qurra, and others designed, built and wrote treatises on sundials. Ibn al-Shatir (1371 CE) the resident astronomer and timekeeper, the muwaqqit, at the Umayyad mosque in Damascus had designed a polar pointing gnomon for a horizontal sundial. This was the first sundial in history to measure equal hours and was the most sophisticated sundial known before the European Renaissance¹. Prior

to this, sundials would indicate unequal or temporal hours, the hours in summer being longer than the hours of winter.

According to Prof David King², mizwala was an ancient Arabic generic term for sundials and rukhama and munharifa are respectively terms for horizontal and vertical type sundials. Many sundials found in medieval mosques and madrasahs tended to be of the horizontal and vertical types. However, there were special types of sundials such as the vertical declined, and cylinder types that were built in the mosques in Damascus, Algeria and Cairo³. The earliest and existing sundial, in Islamic history, is the gnomon ('asa) of Mu'adth ibn Jabal (RA), in the mosque of Janad in Yemen⁴. Mu'adth ibn Jabal (RA) was sent by the Prophet (PBUH) as governor to Yemen.



FIGURE 3

'Asa Mu'adth ibn Jabal (RA), in the courtyard of Janad mosque.

Islamic sundials tended not to have any artistic ornamentation on them. This is in stark contrast to other Islamic scientific instruments, such as astrolabes, celestial globes, quadrants and many others that have very rich ornamentation. The reason could be that sundials are placed in the open and as such are exposed to the elements. Sundials, with metal gnomons, tended to be made of marble with the timelines engraved on them. However, other instruments mentioned earlier tended to be made of brass and are portable and only taken out of their casings when used.

One of the main uses of the sundials in the medieval Islamic period was to indicate the times of prayers apart from counting the passing of hours. The indicated prayer times depended on the type of sundial, place used, and the local requirements. It is possible to indicate on most types of sundials all the prayers times, i.e. Fajr, sunrise, Zhuhr, 'Asr, sunset (Maghrib) and 'Isha start times.

The most common prayer time to be indicated on the Islamic sundials are the Zhuhr and 'Asr prayer times. There are some differences in the definitions of the start of the Zhuhr and 'Asr prayer times depending on the localities and school of thought (mazhab) practiced there.

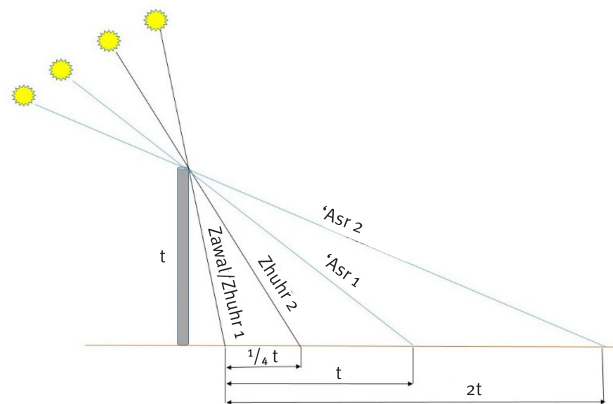


FIGURE 4

The position of the Sun and the shadow length of a vertical gnomon for the different start times of Zhuhr and 'Asr.

Conventionally, the start of Zhuhr prayer time is when the Sun has transited the local meridian and the length of the gnomon's shadow is the shortest (Zhuhr 1 in Figure 4). However, according to King², in medieval Andalusia and Morocco, the start of Zhuhr time was when the shadow length was at Zhuhr 2, i.e. when the gnomon shadow has extended more than its shadow at meridian transit by a quarter.

For the start of 'Asr prayer time, there are two main practices. The majority practice of the mazhab is that 'Asr ('Asr Awal) starts when the gnomon shadow length is equal to its height plus its shadow length at solar transit (zawal), shown as 'Asr 1 in the Figure 4. The second practice, by the Hanafiyah mazhab, is that the time of 'Asr prayers is when the gnomon shadow length is equal to twice its height plus its shadow length at solar transit, shown as 'Asr 2 in Figure 4. 'Asr 2 is also known as 'Asr Thani.

Three representative types of sundials, viz. the muharifah, rukhamah and khatulistiwa (Equatorial) shall be discussed to illustrate their designs. The Ottoman munharifah or vertical declined sundial can still be found on walls of mosques in Turkey³. They tend to be placed on south west walls of the mosque buildings, whereas the qiblah is towards south east. The sundials have two gnomons, one for measuring the hours and the other specifically for 'Asr Awal and 'Asr Thani. The hour lines are marked for every 20 minutes and the hours are based on ezani (Ottoman denotation) or ghurubi hours. The ezani or ghurubi hours were used to mark time since sunset, as the day started at sunset and was denoted 12 hours in the time system used. The following information was also given on the sundial:

1. Zhuhr time;
2. hours to sunset (Maghrib prayer time);
3. Time to 'Asr;
4. 'Asr Awal and 'Asr Thani start times;
5. line to denote 4 hours before start of 'Isha times;
6. lines to indicate 14 hours before start of Fajr.



FIGURE 5

Dr Ibnor Azli beside the *munharifah* of the Fatih Mosque
(built in 1717 CE) in Istanbul.

(Source: Ibnor Azli)

A sophisticated design of a rukhamah is the sundial at the Sidi Okba mosque (built in 688 CE) in Khairouan in Tunisia. An interesting feature of this sundial is that it has 4 gnomons as shown in Figure 6.



FIGURE 6

Four gnomon *Rukhamah* of Sidi Okba mosque in courtyard of mosque.

(Source: Gianni Ferrari)

According to Gianni Ferrari, the information provided by this sundial are as follows:

1. the solar hour angle and local apparent time;
2. Babylonian hours, i.e. hours after sunrise;
3. Italian or Ghurubi time, hours after sunset;
4. Zhuhr time;
5. Fajr, 'Asr Awal, 'Asr Thani and 'Isha start times;
6. direction of qiblah.

The method to obtain the times of Fajr and 'Isha is interesting as its determination is made whilst the Sun is shining, and the time is noted using an astrolabe. The determination of the beginning of Fajr is made when the western most gnomon's (left in figure) shadow falls on one of 2 lines. One of the lines indicates Fajr beginning 20 hours later and another line indicating 21 hours from that instance. The muwaqqit would note the time from the sundial and then determine a reference star which would be above the horizon at the beginning of Fajr the next morning. The next morning, before Fajr, the muwaqqit shall observe the rising of the reference star using his astrolabe. Once the reference star is seen, it signifies the start of Fajr.

Determination of the start of 'Isha times is similar to that of Fajr. However, in this case, the eastern most gnomon's shadow would indicate the number of hours to 'Isha.

There are not many old mosques in Malaysia and of these very few have sundials. The Serkam Pantai mosque, built in 1883 CE, in Melaka state

Malaysia has two simple sundials in its compound. The first is an equatorial (khatulistiwa) sundial for measuring local apparent time and the other a vertical gnomon sundial to indicate Zhuhr and 'Asr times⁵. It does not have the sophistication of the sundials of the Middle East and does not indicate the other prayer times.



FIGURE 7

Serkam Pantai mosque in Melaka state with two sundials.

(Source: Syed Kamarulzaman)

MIZWALAH TAHA

The Malaysian Islamic Astronomy Society had been given the responsibility to design and build a sundial at the new Tabung Haji Hotel and Conference Centre Complex in Sepang, near to the Kuala Lumpur International Airport. This sundial serves as a unique landmark for the complex. Several sundial designs, including the horizontal and armillary types, were submitted to Tabung Haji to make the choice. Finally, the agreed design was the equatorial armillary sundial.

The sundial resembles the logo of Tabung Haji which is made up of the Arabic letters "Ta" and "Ha". It consists of two main parts namely, the armillary body shaped like "Ta" and the gnomon in the form of the letter "Ha". The time and date are indicated where the gnomon shadow or "Ha" shadow falls over the semi-circular surface of "Ta".



FIGURE 8

Panoramic view of Tabung Haji Complex with the Mizwalah TaHa.

(Source: Syed Kamarulzaman)

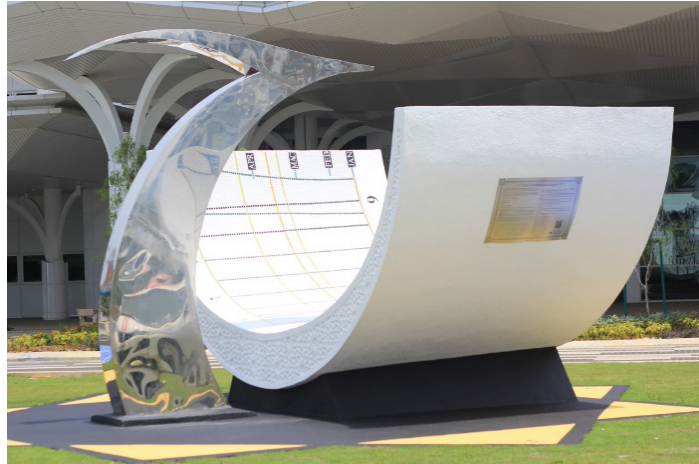


FIGURE 9

Mizwalah TaHa where the “Ta” armillary body and “Ha” gnomon face true north.

(Source: Syed Kamarulzaman)

The technical parameters of Mizwalah TaHa are as follows:

TABLE 1

Technical parameters of Mizwalah TaHa.

Type of Sundial	Equatorial Armillary with axial style
Latitude	2° 47' 19" North
Longitude	101° 40' 39" East
Time zone	UT + 8h
Longitude correction	1hr 13 min 17 s
Height of Gnomon (Ha)	3,500mm
Arc Length of armillary Body (Ta)	6,850mm
Width of armillary body (Ta)	2,500mm
Inclination of Axis of armillary body (Ta)	2.78
Year of construction	2018

The main design objectives for Mizwalah TaHa are as follows:

1. a functional sculpture that showcases Islamic science and art. This sculpture, not only has aesthetic and artistic value, but will also be able to demonstrate the range of measurements of time and dates;

2. it should be easy and practical to read and use;
3. as a teaching tool of astronomy. Hours, prayer times and the position of the Sun above the sky every day are marked. Information is provided in three languages, namely bahasa Malaysia, English, and Arabic. If users need more information, they can browse the related website for more information;
4. as a tool for contemplation and realization of Allah's wisdom and power in ordering the intricate movements of the Sun and Earth. "Do you not see the power of your Lord? How he lengthened the shadows! If He desires, He will make it fixed (unmoving and unchanging), Then We made the Sun as the guide of the shadow" [Surah Al-Furqan (25):45]. This verse was made into a motto for this sundial. Contemplation on the flow of time and reflections on shadows can be made whilst watching the shadow of the gnomon slowly move.

A Functional Sculpture of Islamic Science and Art

In order to meet the stated objective of a functional sculpture to showcase Islamic science, the sundial was designed to measure time as accurately as possible. The Sun makes a revolution of 360 degrees in 24 hours across the local meridian. The meridian line being the imaginary line of longitude connecting the north and south poles, through the location. The Sun's hour angle increases by 15 degrees every hour of time with respect to the meridian line of the sundial. With the height of the gnomon at the centre point of the circular arc being 2,500mm, the gnomon's shadow would move an arc length of 11mm for 1 minute of time and its movement is quite easily discernible. The shadow would move against a background of white mosaic tiles. Tiles of 25mm square are used to indicate lines and the background. Different colours are used to differentiate the various times and dates. It is possible to read the time from the gnomon shadow to an accuracy of 1 minute.

The time shown on the Mizwalah TaHa must be as accurate as possible as any observer would instinctively check his watch or smart phone to compare the time shown on the sundial with that of his device. The displayed sundial time is not meant to compete with the other devices' accuracy as their highly accurate digital time is synchronised with the vibration of caesium crystals, since the adoption of atomic time standards in 1967, and time is no longer from the Sun's apparent movement⁶. In contrast, the sundial time is synchronous with the Sun's movement in the heavens.

Three dimensional decorative embellishments in the form of Islamic geometrical patterns, made of Glass fibre reinforced concrete, were attached to the front and back of the armillary body of the sundial. As the sun moves, the protuberances of the geometrical patterns throw their own shadows on the patterns that make them seem animated rather than static.

The information displayed on the curved surface of the sundial is shaped and sized in such a way that a user can easily read off the surface comfortably while standing.



FIGURE 10

Islamic Geometric patterns on front and back of crescent body of Mizwalah TaHa.

(Source: Syed Kamarulzaman)

Practical and Ease of Use

Islamic sundials in the past were meant to be used by the expert muwaqqits and muadzin and generally not for use by non-experts. The lines engraved on them tended to be numerous and overlapping, with sometimes several gnomons on a single instrument. Thus, reading time from them needed some expert knowledge.

In Mizwalah TaHa, only needed lines are marked so there are not too many lines that can confuse the user. A colour coded system is used to differentiate the line type. The curve's surface is white so that the colour of the information lines can be clearly discerned. This allows a layman to be able to read the time and date. The medieval Islamic sundials did not have any colour coding of the lines making them more difficult to read.

The time given is from 9:00am to 5:00pm Malaysian time (UT + 8) and the time in Mecca, from 4:00am to 12:00am, as the facility is for pilgrims going for Haj pilgrimage. This also allows the observer to see the time difference (5 hours) between the countries clearly and is also a demonstration of the Earth being a globe, where the Sun has risen in Malaysia, whilst it is still night in Mecca.

Astronomy Teaching Tool

An innovative feature that has been set up with the sundial is a website (www.th.mizwalah.org) that contains information, explanations and even animations on the astronomy of the Earth's motion around the Sun. The website is easily accessible via a Quick Response (QR) Code that can be scanned using a smart mobile phone. This is the first of its kind for a sundial.

Contemplations on Time

"It is He who made the sun a shining light and the moon a derived light and determined for it phases – that you may know the number of years and account [of time]. Allah has not created this except in truth. He details the signs for a people who know" [Surah Yunus (10):5]. Man is exhorted to reflect, think and contemplate on the signs (ayat) of Allah in the Universe in order to understand Him and the truth. Approximately 750 verses or one-eighth of the Qur'an exhorts Man to undertake contemplation and thinking. Time is one of the most important of Allah's sign, so much so that several oaths and adjurations in the Qur'an are about time.

There is a Hadith Qudsi in Sahih al-Bukhari (No. 4549) and Sahih Muslim (No. 2246) that Abu Huraira reported: The Messenger of Allah, peace and blessings be upon him, said, "Allah Almighty said: 'The son of Adam abuses me. He curses time and I am time, for in my hand are the night and day'"

The Economist magazine had an interesting study on the social problems in modern cultures that result from a "time-is-money" mindset in people⁷. Once time is financially quantified, people worry more about wasting, saving or using it profitably. Psychologists⁸ have discovered that there exists a correlation between time, money and anxiety. "Busy" is that frenetic, always alert multitasking that propels people through overburdened lives. It involves being always "on", glancing regularly at their phones and jumping from task to task. It is the juggling, cramming and rushing that make up so much of their daily existence. It is urgency, distraction and exhaustion.

In this era of ubiquitous communication technologies where computing power and internet connection speeds are increasing exponentially along with sheer quantity of information and entertainment such as instant messaging and social media, people have developed a greater urge to satisfy their needs instantly. Any delays in their ability to satisfy desires instantly also breed impatience and anxiety. The 2014 Economist article quotes research from Google that people visit websites less often if they are more than 250 milliseconds slower than a close competitor. Newer research in 2016, by Google⁹ has found that 53% of mobile website visitors will leave if a webpage does not load within three seconds. When experiences can be calculated according to the utility of a millisecond, it can create impatient and harried individuals.

Albert Einstein noted: "An hour sitting with a pretty girl on a park bench passes like a minute, but a minute sitting on a hot stove seems like an hour". Thus, when one is engrossed and busy with someone or something that is the objective and love of one's life, time seems to pass very fast and there is not enough time to do things.

From an Islamic spiritual perspective, this phenomenon is prevalent because modern man has secularised time. Sheikh Imran Hosein¹⁰ explains that all through history, time has remained as Allah created it, except in this age. Professor Syed Muhammad Naquib al-Attas had analysed secularisation and its danger to Islam in his landmark study on "Islam and Secularisation"¹¹. He states that secularisation is a loosening of the world from religious and the breaking of all supernatural myths and sacred symbols. It is the turning of Man's attention away from the worlds beyond and towards this world and this time.

S. Imran Hosein goes on to refer to the Prophetic tradition of the secularization of time as one of the early signs of the Last Age. The Prophet (PBUH) said that time would move faster and faster until a year would pass like a month, a month like a week, a week like a day, a day like an hour and an hour like the time it takes to kindle a fire. The secularization of time has brought this about and time no longer leads the heart towards Allah but makes it busy and preoccupied with the present world (dunya).

Unfortunately, the Ummah is not immune to this disease that the Prophet (PBUH) called al-Wahn, that the Prophet defined as "Love of the dunya, and hatred of death". We have fallen in love with dunya. Anytime one is enamored with someone or something, it becomes next to impossible to get over that love or be separate from it.

In the Mizwalah TaHa, it is believed that the analogue nature of the information, and the way the information is derived from nature, will contribute considerably toward a perception of time that is less intertwined with human needs and desires.

Reflections on Shadows

Shadows, in Arabic al-dzil, are the opposite of brightness. Allah has described Heaven where, "Food and shade are perpetual" giving a meaning that Heaven is always shaded. Al-Abbas bin Abdul Mutalib and al-Nabighah al-Ja'diy characterised Heaven as covered by shadows that make it shady¹².

Allah also describes the condition of the inhabitants of Heaven where they "shall find therein neither the severe heat of the sun nor intense cold". This can mean that Heaven is shady due to shadows of the trees that encompasses its inhabitants¹³.

Surah Ar-Ra'ad (13):15 illustrates Allah's power over every created thing, including their shadows; "And to Allah prostrates whoever is within the heavens and the earth, willingly or by compulsion, and their shadows [as well] in the mornings and the afternoons". In another ayat, in Surah An-Nahl (16):48, "Have they not considered what things Allah has created? Their shadows incline to the right and to the left, prostrating to Allah, while they are humble".

In above verses, shadows are described as prostrating, due to their natural movement from west to east and lengthening and shortening in the duration of a day.

Allah has created several kinds of shadows, that have their own meanings and functions. Hence, the word shadows in the verses is always in the plural tense. There are beneficial as well as harmful shadows. The beneficial shadows are found in Heaven and the harmful ones in Hell.

Shadows have also been used as metaphor for the ephemeral and transient by Muslim scholars and mystics. Ibn al-Qayyim (14 century CE) a prominent ulama is reported to have said that "This worldly life is like a shadow. If you try to catch it, you will never be able to do so. If you turn your back towards it, it has no choice but to follow you"¹⁴.

Observing the movement of the shadows on a sundial can bring one to a contemplative state and brings one to be in synchrony with the motions

of the heavens. This can bring about a slowing down of modern man's life that is dictated by ever smaller divisions of digital time, to the primordial slower tempo of life, especially in the environs of prayer and meditation. The Mizwalah TaHa can hopefully also be used as an aid to such spiritual contemplation.

Information Given by Mizwalah TaHa

The information given by Mizwalah TaHa mirrors the information given by medieval Islamic sundials, such as prayer times and hours whilst adding modern time and date information as follows:

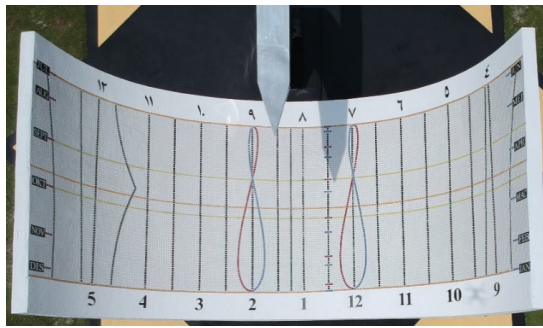


FIGURE 11

The shadow of the gnomon casted on the body of the Mizwalah TaHa indicating 12:20 hrs. on 8th April.

(Source: Syed Kamarulzaman)

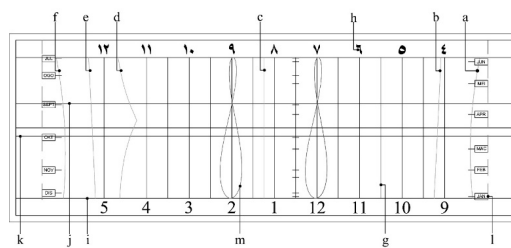


FIGURE 12

Lines and marking on crescent shaped body.

(Source: Syed Kamarulzaman)

The following information can be obtained from the sundial. The following numbers refer to the parts of the sundial body in the figure above (prayer times lines are coloured green):

1. 2.5 hours after Fajr;
2. 2 hours after sunrise;
3. start of Zhuhr;
4. start of 'Asr;
5. 2 hours before sunset and Maghrib;
6. 2.5 hours before start of 'Isha;
7. local apparent times, that have longitude correction built in for 120 degrees time zone, are indicated with black lines. Times are from 9:00 a.m. till 5:00 p.m. with half hour lines;
8. Mecca times are shown in Arabic numerals from 4:00 a.m. till 12:00 noon;
9. sun declination in orange colour; summer solstice (22 Jun.), winter solstice (22 Dec.), equinoxes (22 Mar./22 Sept.). It indicates the position of the sun in the sky during the course of a year;
10. anniversary date for Malaysian Independence Day on 31st Aug. 1957 is indicated by a horizontal yellow line;
11. anniversary date of incorporation of Lembaga Tabung Haji on 30 September 1963 is indicated by a horizontal yellow line;
12. the first of the months are indicated by short lines and coloured blue for January to June and red for July till December;
13. analemma, shaped like the number eight, consists of two colours; blue from January till end of June and red for dates between early July till the end of December.

CONCLUSION

Mizwalah TaHa was designed in the tradition of Muslim scientists, as an effort to revive and revitalise an important architectural, cultural and scientific artefact associated with medieval mosques.

It is recommended that efforts be made to build Islamic sundials as landmarks of mosques, parks, schools or institutional buildings serving as functional sculptures showcasing a combination of Islamic art and science.

With the use of modern materials and construction methods, an innovative and creative designer can turn a purely functional scientific instrument into a versatile conduit for the expression of his creativity and imagination, that can be a work of art as well as a fascinating utility for the general public.

In the present age of heightened environmental consciousness, sundials are the ultimate eco-friendly, solar powered device, which does not produce any pollution and almost requires no maintenance. Sundials can continue to function as long as the Sun continues to shine in the sky.

Sundials can also be used as a means to contemplate and reflect on the continuously unending, systematic and precise movements of the Heavens and the Earth. These are indications and evidences that this universe has a Creator and a God that holds it together by the laws that He decreed.

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