

POETRY OF DAYLIGHT IN ISLAMIC ARCHITECTURE

IN IRAN

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ABSTRACT

The present research attempts to study the effect of daylight on the creation of a spiritual atmosphere in historical mosques. Considering the great biological crisis, shortage of fossil fuels and tremendous expenses, the public decided to revert to sustainability which formed a great part of our history prior to the introduction of electricity into our lives.

In the basic model of traditional architecture in Iran, light has been regarded as the most important trait of Iranian architecture. Light, despite its Immaterial and operational nature, may be the symbol of aesthetic perception and the architect can use light to create a special atmosphere and to inspire specific emotions. Considering the two types of mosques in Islamic architecture, one with a yard and the other without one, the Imam and Sheikh Lotfollah Mosque were selected for the research; both belonging to the Saffavied period (early 17th century) and the zenith of Iranian architectural heights, and both situated in the Naghshe Jahan square in the city of Isfahan in Iran. The selection was made for the purpose of discovering an appropriate solution for contemporary mosques.

The method of research in this study has been measurement, High Dynamic Range (HDR) photography, observation which specifies the model of light distribution in both mosques. Subsequently results together with the results obtained from interviews with visitors to the mosque, the methods for creating a spiritual

atmosphere using light was examined and the following results were obtained. In order to the time limitations, to predict the daylighting performance through the year we use the Radiance software. With attendance to the site and had observation and doing the measurement as well as the effects of openings for balancing light for better perception this hypotheses is discussed "how much the western; the eastern and southern openings influence the increasing light control from the big openings of northern wall? ". In this case we decided to use the Radiance software for predicting the light effects of openings by do some changes in the modelling of mosques in software. The precise conditions of light in space, similarities in the hierarchy of design in the Sheikh Lotfollah and Imam mosques and their relationship with daylight, the difference between spaces designed for group or individual activities in both mosques and their relationship with light design, the difference between the form openings in creating a spiritual feeling in space and the method of generalizing the alternatives of natural light control are various other uses in contemporary architecture.

Keywords : Daylight, Poetry of light, Islamic worldview, Islamic Architecture, Mosque, HDR photos

1. INTRODUCTION

The attractive and amazing reputation of the historical architecture of Iran has found worldwide proponents in various parts of the world, such that we can observe interested tourists from all parts of the world in these sites. A study of the architecture reveals various reasons for the attraction. Researching historic architectural structures has led to the discovery and introduction of the approach of ancient architects to the appearance of new ideas; the study of the techniques used in the structures can be a solution for contemporary design. In the original model used for traditional Iranian architecture, light has been considered the most important trait of Iranian architecture. Each group has attempted to describe and interpret the secrets that lie within the works of architecture, based on their own knowledge and expertise. Despite the significance of the study of light and its various approaches, scientific research reveals that no comprehensive research exists in the context of natural lighting in historical mosques.

The point of the present research is in the measurement tools used, information analysis software and the establishment of a relationship between quantitative and qualitative approaches. Then results were discussed for future applications.

2. METHODS

2.1 Proses

In the method of research, have been collected form field data of HDR images, Luminance meter, the Eluminance meter and interview the Imam and Sheikh Lotfollah Mosques. The researcher has also attempted to interview the observers in various age levels and with different religions in order to better understand

the spiritual feeling created by light in the atmosphere.

The information received from HDR pictures were also analyzed using the photosphere software, and then analyzed with the Luminance Meter with regard to architecture spaces and human perceptions.

Subsequently the radiance software used to simulate the transformation of light in 21 of Jun (summer revolution) and 21 December (winter revolution).

The simulation software was used in the approval or rejection of research hypotheses. The hypotheses raised after observations was that the openings should have effect on the balance of the light in the space for better perception.

The comparison of the output and the discovery of its relationship with the qualitative aspects of light (the creation of spiritual light) can reveal the techniques used for the transformation of natural daylight into a spiritual light.

In the present research, the dates 27 and 28 June were used for extracting .The field research in the two mosques covered a study of the corridor and the dome of both mosques.

2.2 Research Location: the Sheikh Lotfollah and Imam Mosques, Isfahan, Iran

Both mosques were built in the Saffavied period in the Naghshe Jahan square in Isfahan, in the early 17th century AD. The Sheikh Lotfollah Mosque has been studied as a sample of a mosque without a yard. The courtyard of the mosque is located in the eastern part of the square. The frontal section includes a dark hole which comprises the entrance to the mosque. The turning point of the entrance, arcs and the 90 degree curve of the corridor have together led

the light to dim more and more toward darkness and to lead less light to the depth of the space. The darkness of the corridor prepares the observer for the light within the dome area. According to Arthur Pope: “no person of deep perception and thought can be left unimpressed with the feeling of being in the presence, when entering the conflicting atmosphere. The structure lacks any weakness due to its significance and perfection” (Pope A, 1969).



Figure 1 Sheikh lotfollah mosque

The Imam mosque has been studied as a sample of the mosque with a yard. The building of the mosque can be considered as one of the masterpieces of the beginning of the 17th century of the hegira because of its architecture, tile work, stone graving, the bigness of the dome and the length of the minarets (Mirmiran, 1998). Like most traditional Islamic Iranian buildings the imam mosque is an introvert building. Its most important character is that viewers do not feel the axis of the place turns towards Mecca through the octagonal vestibule and its side corridors while entering the mosque towards the beautiful court (Taghizadeh M., 2007).

This character is seen in the sheikh Lotfollah mosque corridor as well. Given the colours used

in the building the architecture of the Imam mosque has tried to make an ideal spiritual atmosphere (Navai K., 1999).



Figure 2 Imam mosque

Both mosques are valuable examples of Iranian mosques in the most prosperous period of the Iranian architecture history (the Safavide period). Objectives of the study are to learn the techniques used and the role of daylighting performance in spiritual places. The study assesses the dome space and the corridor of both mosques.

HDR images and luminance level have been collected at the 8 locations in the dome and the entrance corridor of the both mosques as indicated in figures 3 and 4. From the author's observations these 8 locations in were the most hesitation and endurance of the viewer happen. The measurement has been done three times ;9 am, 12 pm and 3 pm.

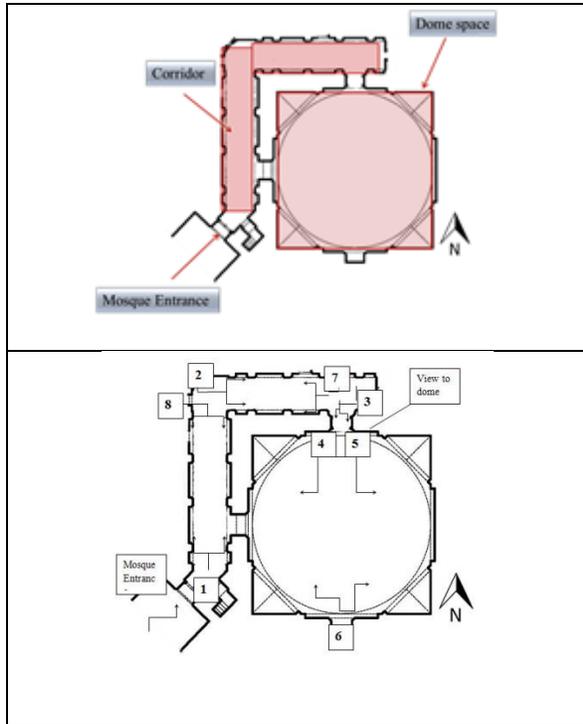


Figure 3 Sheikh lotfollah mosque plan & measurements pints

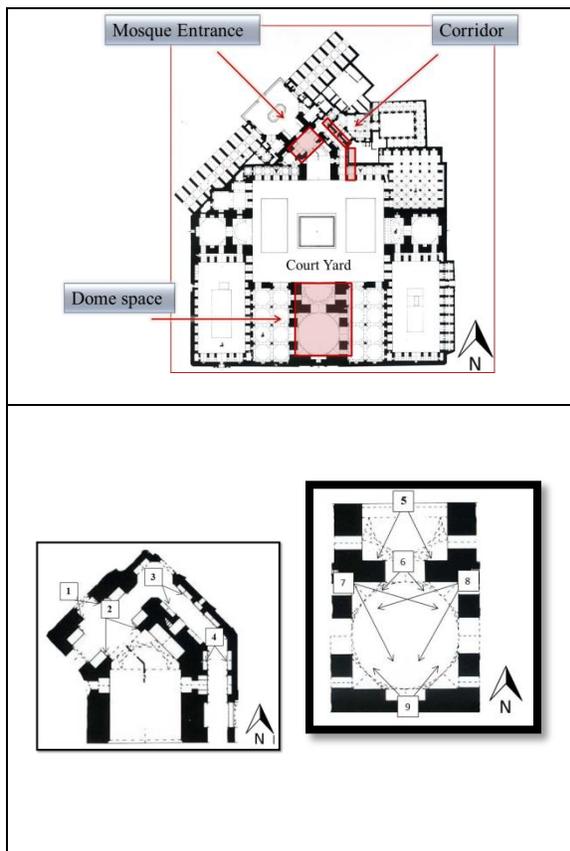


Figure 4 Imam mosque plan & measurements pints

2.3 Measurement Tools

Advancements in the digital industry have enabled the collection of a large amount of data through light and efficient tools such as the Luminance meter model LS-100 and LS-110 for the measurement of the luminance light in space, and the measurement of the luminance of the source of light or the reflective surface. The Luminance meter measures light information reflected from the atmosphere for the user's observation. The information received from this tool is indicated in candela/ square meters.

HDR Photography (High dynamic range imaging) is a set of methods used in imaging and photography to allow a greater dynamic range between the lightest and darkest areas of an image than current standard digital imaging methods or photographic methods. HDR images can represent more accurately the range of intensity levels found in real scenes, from direct sunlight to faint starlight, and is often captured by way of a plurality of differently exposed pictures of the same subject matter. The information has been examined along with those obtained from the luminance meter. This information assists in the study of the amount of light from a visual approach.

The lux meter model DT-1301 is a precise tool and quite user friendly for the measurement of light lustre in internal spaces.

RGB-1002 is a portable color analyzer equipped with an external sensor probe having a 45°/0° color measuring geometry. The modem uses accurate microprocessor technology and spectral analysis method to determine the color of the sample.

It benefits from excellent repeatability due to spectroscopic analysis technique used.

The information collected from this tool in the Radiance software can lead to actual renders of space.

2.4.1 Observation Sheykh lotfollah Mosque

As seen in the figure 2 this mosque has no court and contains just a dome space and a corridor. This mosque has been designed for individual worshipping activities and the designer has prepared the environment for thinking and contemplating through particular usage of little light and delicate atmosphere. Given the concept of Islamic mosques for entering the dome space in the direction of the Mecca the architect of the building has used a corridor of 24 meters with a turn of 45 degrees in the design. Besides guiding the worshipper in the direction of Mecca to the main space of the dome space also prepares the atmosphere for the individual to separate oneself thoroughly from the exterior and understand the interior space. The entrance of the mosque has a turn relative to the corridor that makes it so the light does not directly enter the corridor (figure 6). There are two windows in the corridor that guide people in the way (figure 7). According to the effects of opening's light The dome, they are categories in three groups, first the openings around the dome which reflect the light in two ways, first the beams that bright the dome (Figure 8) and second the beams that pass through the interlaced design of the opening and made beautiful patterns of light in the space and move like clouds in the sky of the space of the dome (figure 9) the second openings is the opening above the entrance door that provide the main light of the dome space. This is the light of the north that directly shines onto the altar (figure 10). The third category would be small openings of the western, southern and eastern walls part that play an important role in balancing the light entering from the northern part (figure 11). The effects of these small openings have been studied further in Radiance simulations.



Figure 6 Entrance of Sheikh Lotfollah mosque

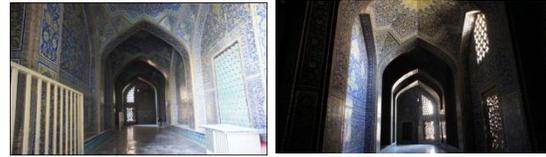


Figure 7 The two windows of Sheikh Lotfollah corridor

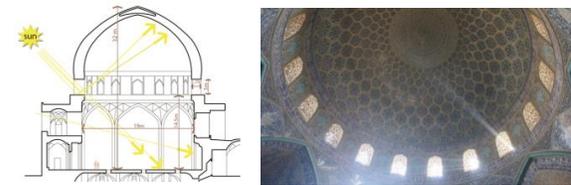


Figure 8 The openings of dome area present dome of Sheikh Lotfollah mosque



Figure 9 The beautiful patterns of light in the dome of Sheikh Lotfollah mosque



Figure 10 The opening above the entrance of sheikh Lotfollah mosque

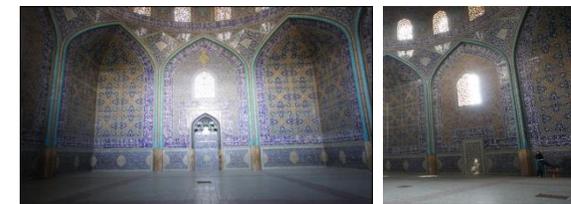


Figure 11 The small openings of the western, southern and eastern walls of sheikh Lotfollah mosque

2.4.2 Imam mosque

As seen in the figure 3 this mosque is one of those that have a court of which the concept is doing collective worshipping activities. After entering the mosque one enters a hesitation place. From this place, the dome of the mosque is visible but is not reachable. To get to that place we have to pass through a corridor that the architect has put in place using natural light, and the ceilings along the corridor full of contrast, beauty and diversity.

As indicated in figure 12 and 13 the mosque as well as the mentioned mosque has the openings with the same positions.

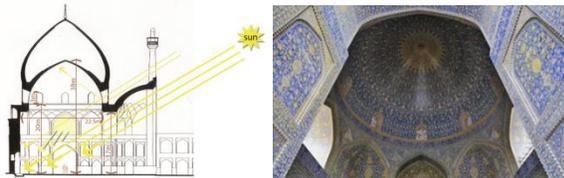


Figure 12 The openings of dome area present dome of Imam mosque



Figure 13 The openings of dome area indicated of under dome of Imam mosque

3. RESULTS AND DISCUSSION

3.1 Eyes adaptation during the corridor according to the time, the movement and the passing

In both the cases the corridors are dark. The Sheikh Lotfollah mosque corridor contains a deeper darkness for the better visual reception of the dome space; though bigger, the Imam mosque corridor but enjoys the same architectural design for getting into the

main court. The beautiful idea seen in both mosques is the spiritual and psychological preparation of the visitor for getting into the atmosphere of the mosque. The Sheikh Lotfollah corridor is dark and the time the visitor passes when walking through it to get to the dome space adapts his eyes to the darkness to perceive the dome space with little light and it also liberate him from mundane properties to relate to god with his mind.

This process has been defined in the Imam mosque with two corridors. The darkest of the Imam mosque corridor is much less in comparison to that of the Sheikh Lotfollah mosque, the difference in reason of making the venues accounting for the difference in lighting. Because of its vastness and the state of being a place for gathering, the Imam mosque hosts a large crowd of people at collective prayer times and also the two schools contained in it make a lot of people move through the space. So the light reduction will not have to be as much as in the Sheikh mosque but the same contrast has been used in both the places.

Also the length of the corridors and the time needed for passing through them prepares the visitor for getting into the mosque. In Sheikh Lotfollah mosque this corridor leads directly to the dome space but in Imam Mosque, given the different usages the mosque has and also the reasons mentioned above, the corridor leads to the division point that the viewer facing the dome space and the Mecca. The architect shows thus the main reason of making the mosque (worshipping and collective prayers). One may conclude that for a better

comprehension of the spiritual atmosphere of the mosque factors like light, movement and time have helped the architect prepare the mind and the view of the visitor for the space.

The corridor speaks the beautiful idea of the architect in the best way possible. The viewer needs some time to get to the dome space and its little light will open a spiritual sphere for him. The time the viewer spends while walking through the corridor prepares for entering and understanding the atmosphere of dome space. The time is the fourth dimension for understanding the space used by the architect for the corridor that passing through it prepares the viewer for understanding the space. Considering the time, the movement and the passing the architect has really made a kind of architecture which is understandable for the viewer. This way of designing in which the light organizes the architecture has reached its paroxysm in using the concept of the time.

3.2 Similarity of the Design Hierarchy in the Two Mosques and its Relationship with the Architecture of Light

Given the researches done so far one may conclude that designing hierarchy in the two mosque types of with and without court both follow a constant concept that shows up in mosques differing according to the performance of the mosque. The main concept while entering the worshipping place of the mosque is seeing the main part of the mosque which is the dome space in the first look without there being direct access. This happens in Sheikh Lotfollah mosque through the interlaced window and in Imam Mosque through the biggest opening of the entrance. The next concept is the hierarchy

of moving towards the dome space and preparing people for a better understanding of the interior space of the mosque. (figure 14).



Figure 14 View to the dome from entrance

3.3 The different between the places designed for collective activities and individual ones and its relation with light

Studying the difference of light in the two mosques of Sheikh Lotfollah and Imam one may form this theory that knowing about the of the natural light in the atmosphere and the lighting method of the dome space through the ceiling the Sheikh Lotfollah mosque has been able to make a somehow dark place that is actually out of contact with the external world.

This way of designing the place prepares the space for worshipping and contemplation and emphasizes on individual isolation in relation with god. Making individual isolation can emphasize on individuality and introversion. The space is well prepared for the presence of spiritual light in this building because the natural light retracts and the space plunges into the darkness. On the other hand the Imam mosque prepares the space for collective activities and the space emphasizes thus on extroversion and collective activities. The relation method that enters light into the space and makes it possible to make views from all sides, lead the place and those who are in it to collective activities. This way of lighting the space is one of the three also proposed by the prominent architect (Grutter J., 1996).

On the other hands about this relation H. Onz has: “the view of the horizon leads to balance and internal comfort. This way man feels equilibrium. The view of the earth puts man in relation with the external world and gives information about the exterior.” (H. evans, Benjamin, 1981) All these elements prepare the dome space for collective activities and reduces spaces which are persona realms.

So one may conclude that spaces intended for collective activities have a method of lighting which is different from that of the places which are good for personal isolation. This theory is easily visible in the two mosques of Sheikh Lotfollah and Imam. In the former the place is lit from above and the reduction of the relation between the user of the space and the exterior place prepares them for worshipping and personal contemplation while in the latter the lighting is from the sides and from above and direct relation with the adjacent places prepares mutual relation and face to face interchanges (figure 15).



Figure 15 Dome spaces of sheikh lotfollah and Imam mosque

3.4 The difference of the opening’s size of the Imam and Sheikh Lotfollah mosque

The dome space of the Sheikh Lotfollah mosque is higher in comparison than that of the Imam mosque, equipped with big entrance openings and two eastern western openers. Besides, the big entrance opener creates the dominant light of the space. The windows of the dome hillock are

eight which are much fewer than those of the Sheikh Lotfollah being sixteen. The opening design and the light distribution pattern have been chosen differently because they are based on the aim of designing the space and the usages needed.

Field studies and simulation results for the whole year shows that dome hillock windows light yield illuminates a small part of the surface under the dome and the beams touching the floor. The beams that make up the light stains on the floor and on the walls of the Sheikh Lotfollah mosque dome space are actually absent in the mosque, except for some instances on the higher part of the wall, also the wall thickness acts like light shelves do and reflects the light to the place under the dome.

Theory holds that maybe the imam mosque dome space internal height difference (38 meters) in comparison with the Sheikh Lotfollah mosque with an internal height of about 30 meters affect the internal luminance of the dome space. About this point Olgy says: “The form and the reelection of the surface and the characteristics of the places lit

from above are very important. The higher the ceiling the more light distribution in the space and the fewer windows needed (Olgy V. and Egan.M D., 2001). Te difference in number of windows in comparison with the Sheikh Lotfollah mosque reflects the height difference and the existence of longitudinal northern, stare and western openers of the Imam mosque that speaks a different light distribution.

Comparing the architecture of the openers in the two mosques shows that theoretically speaking one may conclude something. The number of dome hillock openers in the Sheikh Lotfollah mosque is twice that of the Imam mosque we said above that the openers are few because the ceiling is high.

Also the dimensions of the openers are somehow alike with a height of three and width of 2.5 meters. The light beams seen in the Sheikh Lotfollah mosque is seen in the Imam mosque with the same openers dimensions but just at some times and only on the upper part of the wall which is due to more height and the way the window is installed in the dome. The opener of the Sheikh Lotfollah is precisely on the hillock of the dome and along the z vector. But in Imam Mosque, it is in the beginning curve of the dome with the opener installed along the z vector. Also in the Imam mosque the outer dimensions of the opener surpass that of the interior in the dome. Its full scientific explanation is beyond the scope of this research and needs another study in which precise simulation software should be used to see if the above theory holds.

3.6 Generalizing natural light control methods for other purposes in contemporary architecture

The valuable points found in this study while assessing the concepts of light and controlling it for making a special spiritual sphere in the two studied historical monuments can be the beginning of a new way for other researches. It needs to be mentioned that studying the light and the way it is utilized does not depend only on religious buildings; the light usage methods utilized in the Islamic architecture may be the idea of other building to meet the needs envisaged there. For example the concepts of architecture, light, movement and time which are stronger in the Sheikh Lotfollah mosque entrance corridor (due to its usage) can by itself be a creative idea in many

buildings to prepare people for entering a new place and comprehend it better. This idea is not attached to a particular time or place and could be generalized to every time or place.

Ways of controlling the light and its influences used in two buildings built four hundred years ago, that have made the building so splendid using of the time, can be an example to be followed by lighting engineers and architects to light a place with natural light using the contemporary technologies and meet the needs the usage of the building demands. Developing study fields in different periods can give comprehensive information about the light distribution pattern (quantities and qualitative) and issue new strategic messages to contemporary architects to use their timely method and their experience a historically rich monument to develop architecture and progress in it.

4. Conclusion

Later in this study, one can develop successful research examples in different historic periods based on different usages regardless of the mosque and the religious building. In this study the relation between the light and spirituality in the space of historical mosques has been assessed but the above study method can be generalized and appropriated in different usages based on the need.

This scientific process that started from thus study can, beside religious buildings of the Islamic architecture, be used in different fields and usages like museums, houses etc.

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