

turnitin for london mosque

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DESIGNING DAYLIGHTING FRAMEWORK FOR NORTHERN HEMISPHERE CLIMATE: STUDY OF ANALYSIS & RECOMMENDATIONS FOR ADAPTIVE EXPANSION APPROACH FOR LONDON CENTRAL MOSQUE, UNITED KINGDOM

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ABSTRACT (CENTURY GOTHIC 8 CAPITAL BOLD)

Any religious building's holistic and ceremonial performance is profoundly and dramatically impacted by lighting research. In this study, the current situation is examined via the lens of analysis, and a performance - based preamble design proposal analysis for the study of adaptive expansion approach for London Central Mosque. Numerous studies have been done on significance of the ornamentation of mosques and its acoustics impacts on the congregational activities. However, few exceptions given on the importance of daylighting effect in the mosques. Looking at the massive and widely compacted end-users in London Central Mosques especially during peak season given that numbers of devotees is increasing each year, the objective is to understand the analysis and recommendations needed for the adaptive expansion approach in designing daylighting framework for northern hemisphere climate. The performance of the lighting design for London Central Mosque was the subject to few case studies referred that focused on the evolution and morphology of daylighting in religious and historical areas. Thus, this research will then conduct an observation and analysis studies as the method to materialize the findings. This study will also anticipating recommendations that suggest both passive and active design implications towards the idea of adaptive expansion. As a result, the outcome discussions demonstrate numerous implementation criteria ranging from design stages of site analysis, climate aspects till the electrical fittings and external shading devices well recommended for the best proposal assisting and improving the mosque's current circumstances. The study's findings also indicate that minimal glare and efficient lighting distribution help to reduce energy consumption, enhance reading quality, and properly illuminate public and private religion events and other activities carried out in the situation of optimum brightness of London Central Mosque.

KEYWORDS:

Daylighting; Adaptive; Expansion; Mosque; Architecture; Assessment

INTRODUCTION

Such a luminance relationship inside the typical visual field should be regulated where visually work is involved to allow the retina to adjust to the ambient brightness in line with the task's own brightness[1]. By doing so, it is possible to lessen the requirement for constant readoption and the "shock" of extreme contrast when doing a task. Learning that lighting is important in daily life activities including spiritual aspect, daylight is widely used in any primary spiritual

or congregational area[2]. Those buildings or structures that representing religion also typically well-equipped with conference and discussion spaces where we need optimum lighting to prompt our visual assistance in carrying out congregational routine.[3]

To avoid uncomfortable visual situations caused by high contrast, this research demonstrated the need for suitable daylighting for both the interior and exterior of structures. Additionally, the rhythm of lighting in religious buildings denotes a unique function and

highlights the hierarchy of space layout and its importance in religious activities[4]. Usage of light not only has symbolic and spiritual significance, but also contributes to the enhancement of the adornment and beauty of mosque interiors. Muslims use several techniques to bring light into the inside of mosques to highlight simplicity, clarity, and purity. The mosque's lighting structure and illumination within are seen as designs, mystical and spiritual representations.[5]

BACKGROUND OF RESEARCH PROBLEM STATEMENT AND ISSUE

The development of the London Central Mosque (also known as the Regent's Park Mosque) has widely



Figure 1 Entrance lawn to lobby area of London Central Mosques in London, United Kingdom (Source: Authors)

known for its representation of worldly and spiritual integrations of people and culture. Situated along the Park Road in Regent's Park, London principal prayer hall and a conference room are located on the ground floor whilst female worshiping area located on the first floor of the London Central Mosque as per Figure 1, 2 and 3. It was built in 1977, with a noticeable golden dome, and was designed by Sir Frederick Gibberd. Over 5,000 male worshipers may fit in the main hall and women can pray on the balcony above the hall. The mosque has only a large carpet and a chandelier as furniture. Islamic sacred geometry is used to design the interior of the dome, which also features small stained-glass windows around the base that feature turquoise 16-pointed stars as indicated in Figure 11 where it's adorned with chandelier at the center of the main prayer hall highlighting decorated fragment-shaped dome with symbolizing Islamic geometry.



Figure 2 Site plan location of London Central Mosque in 146 Park Rd, London NW8 7RG, UK (Source: Google Maps)

The mosque holds on-site amenities include a small bookstore and halal café as per floor plan indicated in Figure 3 below. The Islamic Cultural Center, which was formally inaugurated by King George VI in 1944, is connected to the mosque[6]. George VI gave the

property to the Muslim community in Britain in exchange for King Farouk of Egyptian and the Sudan giving land in Cairo for the construction of an Anglican cathedral. Mosques in United Kingdom predominantly serve as one initiation of renewed interfaith deliberation among locals. A strong, cohesive society depends on the contributions made by mosques and Islamic institutions around the nation[7]. For instance, the mosque continues to organize an open-to-all COVID-19 immunization clinic. They also operate a food bank to assist the most vulnerable members of our communities, particularly during these trying times. [1]

COMPACT LIVING ON PEAK CONGREGATIONAL

The second-largest religious community in the UK now is British Muslims. According to the 2021 census, there are now approximately 4 million Muslims living in England and Wales, making up about 6.5 percent of the country's total population and a growth of 1.2 million ever since 2011 count. This has significantly altered Britain's demographics and subsequently escalates the occupancy capacity in the central mosque during peak seasons [2] [3] [4]. The mosque serves as a gathering space for Muslims to engage in religious observances and group prayers. Given its diversity and multiculturalism, London has a sizable Muslim community, and the city is home to many mosques[8]. It could be used to describe the process of constructing a new mosque or enlarging an existing one when referring to mosque construction or expansion. To meet the expanding demands of the Muslim community, many mosques worldwide either undergo repairs or are built from scratch [4][6].



Figure 3 Ground floor plan of London Central Mosque

LACK OPTIMIZATION OF MOSQUE DAYLIGHTING IN VARIOUS SEASONS FOR THE CLIMATE

Additionally, lighting enhances Islamic ornamentation and decorating in mosque in both active and passive design ways, giving them life and spirit. However, this were seen to be direct reference to the middle eastern without full inculcate the cultural characteristic of the actual region [5]. Following several factors may prevent mosque daylighting from being optimized for diverse climates and seasons:

1. Traditional Architecture: Traditional architectural designs are used to construct many mosques, giving aesthetic appeal and cultural significance precedence above scientific optimization. Its specific requirements for natural lighting optimization in various seasons and climates may not be considered in these designs.

2. Insufficient Data and Study References: On mosques natural lighting optimization in various climates, there may be little research and data accessible. This can be because there's not enough funding or research being done on this area of mosque architecture.

3. Value Added Concerning to Culture and Religion: Mosques have significant cultural and religious value; thus, any alterations or design changes should be done cautiously. The investigation of optimization methods could be constrained by a preference for keeping conventional architectural characteristics and design components.

4. Cost Constraints: Implementing daylighting 4. Budgetary Restraints: Putting daylighting optimization ideas into practice may require additional funding for things like the installation of high-tech glass systems, shading equipment, or automatic monitoring systems. Mosques with limited funding may give other building or maintenance needs priority over daylighting optimization.

5. Insufficient Knowledge and Experts' Skills: Mosque architects and designers could not be sufficiently knowledgeable or skilled in maximizing daylighting for periods and regions [6]. This may lead to a lack of awareness or comprehension of the possible advantages and approaches for maximizing mosque daylighting.

Due to inadequate daylighting performance for an acceptable level of comfort in overall and intermediate zones, the mosque's inconsistent behaviors throughout daylight hours have been significantly different in every season in the country [7]. Hence, this research will then focus on the daylighting analysis distribution in the main area of the London Central Mosque for each season and suggesting the best possible mitigation plan for the mosque as role of daylighting in preserving its postcritical context with deliberate consideration of daylighting based on climate setting [8].

METHODOLOGY

The methodologies used to accomplish this recommendation study are site observation and pre assessment software. According to the preliminary site survey, the main prayer hall area was too dark for night worshipping activity in autumn & winter as indicated in Figures 4. The following research suggest the expansion detailing preamble thoughts on the design criteria that needed to be inculcated to cater the upgrowing Muslim community in London [10]. Predesign software was used to test proposals based on all the data and graphic evidence gathered to determine the practical design options for the mosque. The study that was undertaken was quantitative research, and the data that were obtained were the primary type of data. To provide a workable plan for repurposing religious structures, the proposed proposal layout will be injected and imparted into the architecture of the mosque.

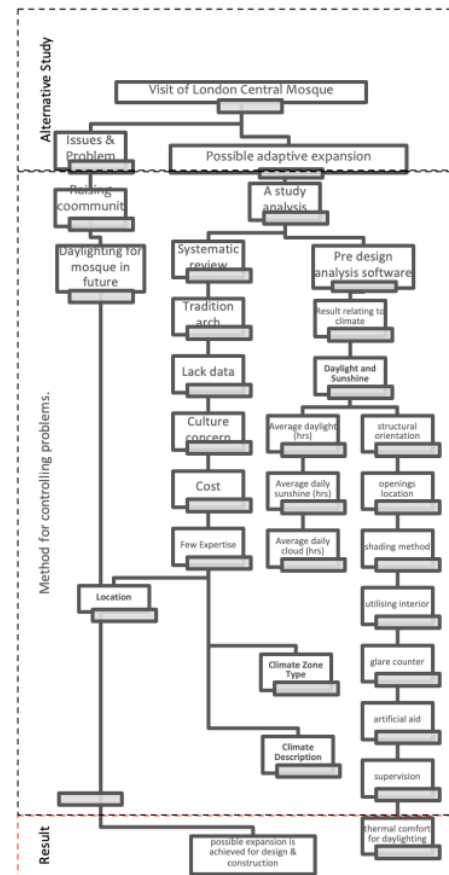


Figure 4 Methodology for daylighting analysis and recommendation for the study of adaptive expansion in London Central Mosque

RECOMMENDATION FOR A CLIMATIC BASED PRE-ASSESSMENT INCULCATION FOR LONDON CENTRAL MOSQUE ADAPTIVE EXPANSION

A. REACCESSING SITE ANALYSIS

Start by performing a comprehensive site analysis to comprehend the mosque's location, orientations, nearby structures, and any relevant limitations that might have an impact on daylighting[9]. Surrounding structures or trees elements will have to be taken into considerations. Based on climate-based daylight simulation shown in Figure 5 and 6, the main entrance shall be given priority to assess and allow visible way findings to the visitor since it is adjacent to the main road and facing the location of frequent beneficial sun, slightly south which is opposite to countries like Australia in the Southern Hemisphere[10].



Figure 5 (Top) Main entrance of the mosque from the Park Rd (Bottom) View from internal courtyard area (Source: Authors)

The analysis portrays the finding on the daylight percentage are most during summer with the 15hours daylight hours as per Figure 6. Thus, the best time for maximizing work activity for the mosque is during this time of the year where Muslim may experience longer prayer time for Asar to Isya' in most favorable time as compared to winter seasons which we have shorter daylight hours. In Muslim religious practice and according to Islamic Hijr calendar, Ramadhan is one of the holiest months where lots of religious activities such as fasting, congregational tarawih prayer, massive gathering for breaking fast and sahor are being performed. Muslims across the world commemorate Ramadhan, which is the ninth month of said Islamic lunisolar calendar, as a time for fasting, prayer, introspection, and community. The months of the Islamic calendar, which is based on the moon, advance by 10–12 days annually in comparison to the

Gregorian calendar, which would be based on the sun. Within the Gregorian calendar, Ramadan's start and end dates change every year. As a contrary, it can happen at any time of year, even in the cold. Ramadan in the wintertime affects the architectural space planning activities and how Muslims religiously celebrate this holy month in different ways than when it falls in other seasons[10].

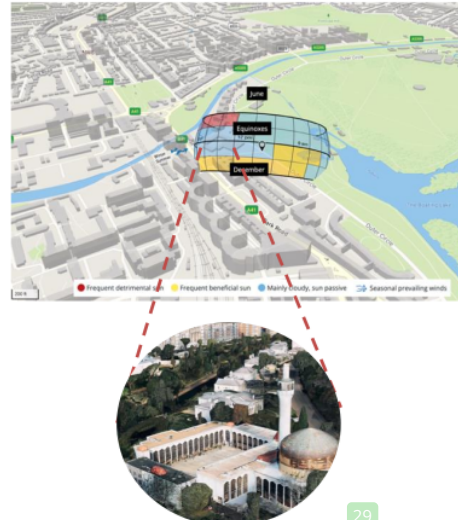


Figure 6 A site analysis study for the location on how the sun and wind affecting the site at different times of the year.



Figure 7 Daylight hours analysis based on the location of the London Central Mosque according to seasons.

The findings displays that the impact on wind on the comfort level for the site which indicates that London Central Mosque do have very low exposure to daily sunshine in winter and fall which the end user in the mosque is likely to be around the plaza area close to the courtyard where full openings of the windows can be found there. This plaza is normally used for breaking fast during Ramadhan. Thus, this area will need a slight treatment for heating purpose if the Ramadhan fall during those seasons[4]. From the analysis in Figure 7 as well, it is shown that the radial distribution mapping shown biggest circumference ($C=2\pi r$) facing the south-west in summer which is close to 40%.

The greatest approach to avoid the sweltering evening sun at the London Central Mosque during summer would be to have a sunbreak around the internal plaza area of the mosque as shown in figure below. Establishing through vertical or horizontal hooked sunbreak will include suggestions of verandas, projecting eaves, and other fixed horizontal architectural elements that offer shade for the walls and windows as per Figure 11 previously [14], [15]. Fixed vertical sunbreak should typically not exceed 150 percent V due to their impact on daylight and structural considerations. Additionally, certain laws could restrict how far they can project onto street frontages [14]. Using inclined blades like fixed blind should ideally not be turned more than 30 degrees from normal to reduce the amount of daylight lost. The sunbreak that is added should allow windows to open all the way, and the window must be constructed to make it simple to clean the outside of the glass. Additionally, the blade gap during production should be adequate for cleaning or painting the mosque future adaptive expansion.

D. INCORPORATE METHODS FOR SHADING

Create efficient shading plans can be adapted to this London Central Mosque adaptive expansion project's environment and strike a compromise between reducing solar heat gain and maintaining easy access to sunlight inside the mosque rooms [18]. This can entail the use of external shading tools like overhang, hood, fins, louvres, or movable blinds suggested by the predesign assessment software in Figure 12 below that will let inhabitants regulate incoming sunlight. The building's daylighting design most suitable for the mosque, which reduces the mosque's dramatic contrast between internal and outdoor luminance, is predominantly introduces double overhang. With the indication of rating implementing it in project exemplify the highest percentage of beneficial sunlight absorption and lowest detrimental solar impact among others in the pre assessment software done for the site. Among the five automated design result in the pre assessment test, the least option listed is external blinds or offset panels are also quite effective and appropriate in many instances, while not being as long-lasting as sunbreak in Figure 11. Part types of curtains and internal blinds or panels can reduce glare especially during hot summertime, and if their exterior surfaces are light-colored and placed close to the glass, some of the solar energy that reaches them is reflected outwards through the glass [9].

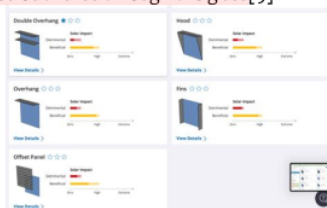


Figure 12 Shies the different options result of shading design for the area with the indication of the degree effect in beneficial and detrimental.

E. WINDOW LOCATION AND SIZING

Evaluation done based on the pre assessment design expansion project shown Figure 13 below where the mosque's openings should be situated to maximize sunshine while minimizing glare and heating gain or loss using data about solar angles year-round. Glazing assembly insulation and shading are both needed for better performance as suggested by the predesign analysis. Where more natural light is required, the future expansion project should consider installing larger windows or skylights with guidance as per assessment done further in next Table 1.

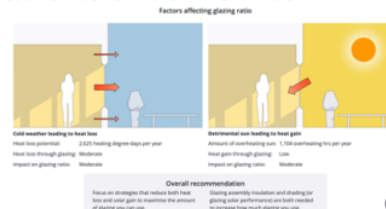
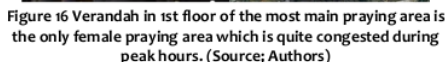


Figure 13 The pre-assessment result for design solutions showed suggestions for maximum glazing ratio for this London Central Mosque site.

Insertion of special window glazing in the mosque can be used to partially regulate the amount of sunlight that enters [19]. However, there is still a noticeable disparity between areas in the sun and those in the shadow. Consequently, curtain spaces are also necessary. Hectic lighting environment of the future praying room for women, meeting room and plaza or assembly point should be avoided with correct distribution lighting. The amount of light in the room should be adequate for the task or activities that will be carried out there [19]. The current general lighting with a high luminance was used to distribute an equal amount of intensity around a room. However, a lot of the light was not used effectively. In achieving optimum thermal comfort, the quantity and quality of mosque's task lighting needed to complete each duty varies from one activity to another, such as reading the Quran, delivering lectures to people, and holding meetings among Muslims [9].

F. REFLECTIVE SURFACES FOR EXTRA LUMINATION

In conjunction to window sizing and location, designing interior spaces of the mosques, extra care usage in reflective surfaces like bright walls, panels, ceilings, or flooring does give significant impact inculcating focus and mood in religious activity [11]. Based on the assessment done through the predesign software, it gives optimal and typical strategies in handling the glazing specifications. There are various the adaptable style and provisions of windows suggested, and matrix of window, glazing and glass options are tabulated in the Table 1 below with its detailing characteristics and impact percentages.



Impact of the frequency of sun on toplighting strategies

Identify toplighting that finds the right balance between occupant's and maximizing light

Sunny spots	Variable spots	Cloudy spots	Low daylight
			
Frequency (Occupied hrs) 20%	Frequency (Occupied hrs) 30%	Frequency (Occupied hrs) 25%	Frequency (Occupied hrs) 1%
At these times: <ul style="list-style-type: none"> • Direct glazing may be enough • or diffuse direct sun to control glare and spread light • warmer daylight colors 	At these times: <ul style="list-style-type: none"> • 10% net glazing may be needed for good light • Bounce or diffuse direct sun to control glare and spread light evenly • Neutral systems may be less effective 	At these times: <ul style="list-style-type: none"> • 20% net glazing may be needed for good light • Elements bouncing or offusing light may reduce light as well • Expect cooler daylight colors 	At these times: <ul style="list-style-type: none"> • Other sources of light are needed for illumination • Interior glazing will act as a mirror • Heavy through glazing will be poor when it rains

This can be used to inform the strategies below

Integrate artificial lighting solutions that can be dynamically adjusted to ensure consistent illuminance while consuming the least amount of energy[20]. Artificial light is typically created by turning electrical energy into light energy and using lamps. The design of the light fixture (luminaries) housing the lamp and the reflectivity of the walls and ceiling are additional variables that affect the quality of artificial light on the work area[21]. Fixtures should be made to provide as much useful light to a work surface as possible. They ought to be positioned to reduce shadows and glare. Reflective walls and ceilings can reduce the amount of lighting needed in a place[9]. Based on the predesign analysis done for the London Central Mosque and the suggested implementation of skylight in women praying area's expansion, the simulation result indicates various percentage frequency of occupied hours under different daylight ambience as per Figure 17. 26% frequency reached under sunny spells which suggest 5% roof glazing may be enough for good light where it bounces or diffuse direct sun to control glare and spread light evenly. However, this is totally different scenario experienced under low daylight ambient. During this situation, other sources of light are needed for illumination and the interior glazing will act like a mirror[1]. In fact, the privacy of human occupants will be slightly poor without usage of blind in the mosque area. Thus, this low daylighting situation for the mosque were further explore onto another assessment analysis for the possibilities of different skylight design as per Figure 18 below. The listed solutions to counter the low daylighting problem are implementation of the sawtooth-clerestory window facing north of the mosque and cushions lighting. Both solutions limit glare by diffusing direct sun heating the mosque and warming the lighting condition during sunny and making it bit cooler when cloudy apart from providing partial view

Suitability of different toplighting in this climate

<p>Sawtooth facing north</p> <ul style="list-style-type: none"> ◦ rooms gain by facing away from direct sun ◦ cooler daylight from northern sky ◦ almost none of northern sky at any time ◦ almost none of time passing <p>☆☆☆☆</p>	<p>Cushions</p> <ul style="list-style-type: none"> ◦ rooms gain by allowing direct sun to enter when light and sunny, cooler light when cloudy ◦ almost none of the sky when cloudy ◦ almost none of time passing <p>☆☆☆☆</p>
<p>Baffle</p> <ul style="list-style-type: none"> ◦ angle sun low may cause glare ◦ warmer daylight from different angles ◦ almost none of sky at any time ◦ almost none of time passing <p>☆☆☆☆</p>	<p>Reflector</p> <ul style="list-style-type: none"> ◦ angle sun low may cause glare ◦ warmer daylight from lower angles ◦ almost none of sky at any time ◦ almost none of time passing <p>☆☆☆☆</p>
<p>Light Pipe</p> <ul style="list-style-type: none"> ◦ rooms gain by receiving direct sun ◦ return daylight mixed with cooler, cooler light ◦ almost none of sky at any time ◦ light levels change gradually with time of day <p>☆☆☆☆</p>	<p>Sky Light</p> <ul style="list-style-type: none"> ◦ reflecting material may be hard to see right ◦ cooler daylight mixed with bright, warmer light ◦ almost none of sky at any time ◦ light levels change with time of day <p>☆☆☆☆</p>
<p>Sawtooth facing south</p> <ul style="list-style-type: none"> ◦ rooms gain sun likely to cause glare ◦ warmer daylight due to direct sun ◦ almost none of southern sky ◦ almost none of time passing <p>☆☆☆☆</p>	<p>Certeratory</p> <ul style="list-style-type: none"> ◦ rooms direct sun likely to cause glare ◦ warmer daylight when warmer direct sun ◦ almost none of sky of 100% not in use ◦ almost none of time passing <p>☆☆☆☆</p>
<p>Baffle</p> <ul style="list-style-type: none"> ◦ angle sun low may cause glare ◦ warmer daylight from different angles ◦ almost none of sky at any time ◦ almost none of time passing <p>☆☆☆☆</p>	<p>Reflector</p> <ul style="list-style-type: none"> ◦ angle sun low may cause glare ◦ warmer daylight from lower angles ◦ almost none of sky at any time ◦ almost none of time passing <p>☆☆☆☆</p>
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<p>Roof Light</p> <ul style="list-style-type: none"> ◦ angle-risk of glare from direct sun ◦ warmer light sunny or very common ◦ almost none of sky of the sky and clouds ◦ almost none of time passing during cloudy days <p>☆☆☆☆</p>	<p>Sky Light</p> <ul style="list-style-type: none"> ◦ reflecting material may be hard to see right ◦ cooler daylight mixed with bright, warmer light ◦ almost none of sky at any time ◦ light levels change with time of day <p>☆☆☆☆</p>

H. LAYOUT UTILIZATION

How often outside space is available

An outside space in this location without intervention will have limited use for several periods of 20 minutes or more.

Always available 12%¹
Stable with intervention 85%¹
Never available 3%

¹ Annual occupied hrs

Maximum intervention viability

Lighting 100%²
Sun shade 16%²
Rain cover 13%²
Wind breaks 85%²³
Air replacement 6%²
Heating 55%²

Overall breakdown

² Combine wind (reduces) with heating and lighting = 94%² hrs¹

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Unlike the indoor areas which occupies the highest place in a religion's hierarchy, the main praying area need to be aided with vertically sufficient brightness. The efficiency of the general lighting system in providing light to the work surface increases with the Woor area for a certain ceiling height[16]. In the London Centra Mosque main prayer hall's high ceiling and relatively compacted during peak hour seasons, more light must enter the inner spaces and surfaces. As per dialoged in the predesign software based on the mosque climate as per Figure 20 below, result illustrated and clarified the best ways for architectural response is providing shelter from the cold that include well-insulated glazing envelope for the indoor, good control of infiltration, layout massing with limited articulation, efficient and comfortable heating system for the central mosque's expansion project[18].

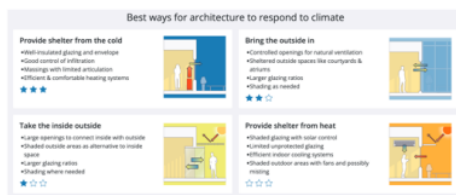


Figure 20 Suggests the best architectural layout for London Central Mosque



Figure 21 Interior lighting for the main prayer hall of London Central Mosque

By introducing the intensity and homogeneity of the room perimeter, the suggested type of lighting may enhance the atmosphere of the prayer hall and even give the feeling of space [22]. The difference in the amount of horizontal brightness from the proposed overhead system has very little of an impact on feelings of comfort. The suggested new lighting scenario condition fosters new potential visual contact and unifies individuals in places of worship[13]. Because facial emotions and movements are more easily discernible in the mosque, increasing the intensities can lessen anonymity and bring people together[18]. Thus, choosing multidirectional

distributional concentrating lighting for the main praying hall as per Figure 21 allowing extreme contrasts in the space to be mitigated to a sufficient extent by the upward component as per Figure 21. It produced efficient operation, which led to an evaluation of the lighting, and built a new framework to make the activities in the prayer room more convenient (Figure 19-21). Sound and visual attention for end-user activities [23]. A modern architect should use modern building technology to reflect the essence of these principles[10]. Relationship between integral lighting system and architectural form allow reflex control of brightness function and light management like the dome of the mosque. Visually subordinate lighting used for both indirect and concentrated direct lighting systems established the relative importance of various mosque space planning[18]. For instance, the primary prayer hall, which houses the congregational prayers located on the highest point of the London Central Mosque's space planning whilst the kiosk, class, meeting rooms encircling the semi-private spaces and some insertion of dim lighting in the visual landscape for the outdoor plaza area for the mosque[10].

CONCLUSION



Figure 22 Intervention of mosque project improvement in terms of saving hours

The result answer the methodology and objective drafted for the study. Creating a schedule for monitoring time limit and frequency for data collecting through this predesign assessment software, observation studies and literature reviews done prepare developers with then set of frameworks in daylighting needed. Thus, considering changes in the length of the day throughout the year, monitoring could take place continuously, irregularly (like once per hour), or seasonally like the predesign assessment done based on the climate change for the next expansion project for the mosque[24]. Hence, it is known that the illumination levels as well as any additional pertinent information, such as the weather, the placement of the shading devices, the direction of the building, and all key points rendered in suggestion analysis and the intervention strategies drafted will produce about 88% hours in terms of improvements as per Figure 22, are excellent move for the adaptive future expansion project for the London Central Mosque.

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