

# Implementation of Green Architecture Concept in Mosque Design : A Face And Islamic Da'wah

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**ABSTRACT** : Mosque as a means of worship is very important for Indonesian people who are Muslim majority. Mosques in Indonesia have been numerous and will continue to grow. Environmental issues due to the many building developments have become a global concern today, from the limited natural resources, global warming, climate change, Urban Heat Island (UHI) to its impact on the comfort and health of people. The concept of green architecture has been used to minimize environmental damage from buildings. This design-based research will implement green architecture approach in the mosque design in the context of a particular location to identify problems, possible applications and potential development. The designated location is in the eastern area of Bandung, city gates that has fairly dense place of settlement and transportation. The results showed that green architecture approach with neighborhood perspective criteria can be applied, especially with large scale mosque such as the case. The approach is more holistic and relates to the type of communal building. Criterias such as (1)land ecological enchancement; (2)circulation, movement and connectivity; (3)water management and conservation (4)solid waste and material; (5)community wellbeing strategy; and (6)building and energy, can be applied by combining with various design ideas and responses of site problems.

**Keywords** : Mosque, green architecture, research-based design

## INTRODUCTION

Mosque is a means of worship that is very important for people in cities in Indonesia, it is caused by a majority of the Muslim population. The importance of this mosque not only as a means of worship but also as a means of coaching creed, morality, worship, social and community, as well as the economy of the people (Ministry of Religious Affairs, 2008). Mosques must be needed facilities that can support spiritual activities not only for the fulfillment of prayer needs only, but also a place of learning, socializing, and channeling creativity accompanied a comfortable and solemn environment. The development of mosques in the dominant Islamic country such as Indonesia will continue to increase from small to medium to large scale, in line with the needs of religious people

Environmental issues due to the many building developments have become global attention today, from global scale such as natural resources limitation, global warming, climate change, to a more micro scale such as Urban Heat Island (UHI) and its impact on comfort and human health (Gou & Xie, 2017). It is also mentioned in the Quran of Islam in the past, "*there has been damage on land and in the sea because of the deeds of human hands, so that God feels to them part of the (consequences) of their deeds, that they may Return (to the right path)*" (QS. Ar Rum: 41). The verse explains that natural damage is largely happening because of human deeds.

Construction and building become one of the causes of natural damage if designed not consider the importance of environmental preservation. In line with that, the building of mosques should be built with environmental considerations to minimize environmental damage referring to the verses "Quraniyah" (derived from the Qur'an) and "Kauniyah" (the form of natural law) which has no nature Damage to nature and must match what is needed. As the word of God has been established in the Surah (QS. 7:56), "*and do not make any damage on the face of the Earth, after (God) fix it and pray to him with fear and hope. Indeed, Allah is very close to those who do good*". This development consideration is in line with the concept of environmentally friendly architecture or green architecture that basically leads to sustainability. The concept of green architecture pays attention to the physical condition of natural resources, greenery, efficiency of energy and water use and minimizes harmful effects on human health and the environment (Ragheb, El-Shimy, & Ragheb, 2016). In line with that, the green architecture

features mentioned by Vale & Vale (1996) are there are six green building aspects that are environmentally friendly, such as energy saving, working with climate, respect for site, respect for user, limiting new resources, holistic. Environment-friendly architecture or green architecture is not only related to the building but also very dependent on the user, climate and setting the building, so that in some conditions the difference in location selection greatly affects the design of the building. This research-based design is going to try to apply the green architecture approach in the exploration of mosque building design in context of certain location to identify problems, possible application and potential development.

## METHODS

The focus of this research-based design is to identify problems and potential features on the site and propose green architectural concept. This study attempted to conduct experimental studies in applying the concept of green architecture in the design of mosques with a location setting at the entrance of a fairly dense city. The selected location is on the east side of Bandung city and the entrance of the city (the outer region of the east).

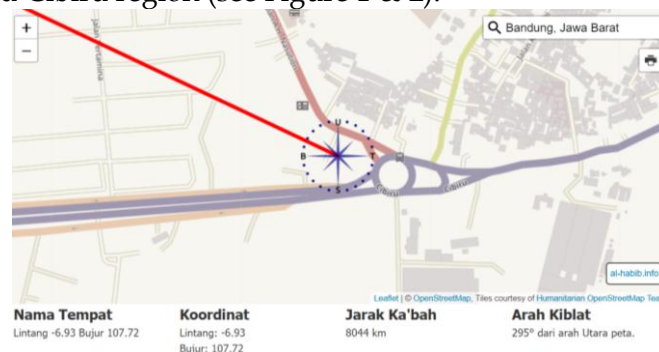
The research was initiated by conducting literary studies from several secondary sources related to the concepts of green architecture. The concept of architecture used as green indicator is an indicator that not only focus on building but also in the area with reference from Greenship Neighborhood. (Green Building Council Indonesia, 2015). The next stage, the research was conducted by exploring the design modeling by using previously collected data from literature study and comparative study by adjusting local context needs in the locations taken.

## Location Of Study

This study used factual location in experimental implementation of the concept of green architecture in mosque design. The use of factual location is backed by experiments in the concept of green architecture is very dependent on the condition of the location or building site. The location that is taken is in Bandung city on the east side. Bandung City is one of the cities with a Muslim majority, of course, also has an impact on the increasing number of building mosques in this city.

Based on RTRW Bandung, the development of large-scale mosques still gathered in areas of the city center, but not even evenly in other areas, especially in East Bandung (Pemerintah Kota Bandung, 2012). Judging from the potential destination and aesthetics of the city's face, the construction of mosques in East Bandung area is also very important considering its strategic location in the city and provincial scale.

Cibiru District is a region that is located in the outer line of the eastern part of Bandung, as well as the main entrance for the Regency/city of West Java surrounding it to the city of Bandung, such as Regency/Town Cileunyi, Garut, Sumedang, and others. By location, Cibiru Sub-district became one of the leading faces representing the city of Bandung for migrants. It is one of the potential for the existence of this grand Mosque to become a landmark that can appeal to migrants and form a good image for the city of Bandung. Making the mosque a landmark through green architecture approach will also affect the interest of the community to prosper the mosque in accordance with the aesthetic aspect mentioned by the Ministry of Religious Affairs (2008). Location selected at the front area of Bandung in the east of 2 ha, located in strategic area, dense transportation, with the axis of interest between Panyileukan and Cibiru region (see Figure 1 & 2).



**Figure 1.** Location and direction of Qibla.

sumber: [www.googlemaps.com](http://www.googlemaps.com)



**Figure 2.** Boundaries of site and building density conditions around the site  
*sumber: www.googlemaps.com*

Seeing the development of Bandung itself, the world of architecture in the city of Bandung also experienced continuous development from time to time. Bandung has been regarded as the most complete architectural laboratory because it has so much architectural richness to date the inspiration of excavations in the concept of design to research (Putra, 2004). Bandung continues to grow with new architecture in the present with the use of new and increasingly advanced technologies. Correspondingly, the application of environmentally friendly technologies can be applied to buildings in the city of Bandung, as well as mosques even though the design process is not the main concept.

## RESULTS AND DISCUSSION

### 1.1 Mosque

In Shrestha & Shrestha (2014), the mosque is defined literally as a ' place of prostration '. With the understanding that any place that is quite neat and clean and has an orientation towards Mecca can be regarded as a mosque and used for prayer. Prayer is a way of dealing with the people of faith in his lord and as a symbol of submission full (Ardhiati, 2013). In addition to being used for prayers, mosques are also used in many Muslim activities such as information centers, education, and deliberations (Ardhiati, 2013). In line with the recommendation of the religious department in Indonesia that the mosque is not only as a prayer place but more strategic than that, namely as shaping the person and society in a broader sense such as social, educational and of the people. From some of the above, it can be concluded that the mosque is a place to carry out all forms of Islamic activity that reflects the worship of Allah SWT, whether it is prayer, education and other activities.

### 1.2 Environmentally friendly architecture-Green Architecture

The concept of environmentally friendly architecture is a design concept that pays attention to the physical condition of natural resources, greenery, efficiency of energy and water use and minimizes harmful effects on human health and the environment, better known as Green architecture (Ragheb et al., 2016). In line with that, the green architecture features mentioned by Vale & Vale (1996) are there are six green building aspects, such as energy saving, working with climate, respect for site, respect for user, limiting new resources, and also holistic. Environment-friendly architecture is not only related to the building but also very dependent on the user, climate and setting the building, so that in some conditions the difference in location selection greatly affects the design of the building. Some of the initial approaches in the design were formulated in table 1.

**Table 1.** Ide Desain

No.	Character	Design Idea
1.	Islamic architecture based on Qur'aniyah (Qur'an) and Kauniyah (Alam) or The Law of God and The Law of Nature	Utilization of waste, rainwater and used ablution water using rain water harvesting and wetland system
		Efficient in waste management
		Provides green open space, adequate ventilation, and pool water retention as a microclimate engineering
2	Contextual	Response to local environmental needs

4.	"Kekhusyuan" or sacrality	Thermal, Visual and Audial comfort
3.	Environmentally friendly technology	Environmentally friendly and energy-efficient use of materials
4.	Functional	Formulation of spaces that can provide da'wah activities as well as active and professional
		There is an ablution facility and bathroom for accessibility and accessibility, the layout of ablution place to pray place must be easily reached

In the case of a large scale mosque building, it would be better to use not only the green architecture approach that focuses on the building, but also combined with an approach that focuses on the surrounding area. This is due to the extensive condition of the site and requires the response of the building due to various problems such as transportation pollution, street vendors, congestion, as well as minimal public activities. It is also in line with the benefits of the green architectural approach described by GBCI (Green Building Council Indonesia, 2015), among others, maintaining the harmony and balance of environmental ecosystems, and improving the environment quality, minimizing the impact of development on the environment, improving micro climate quality, implementing the principle of connectedness, ease of achievement, safety, and comfort on the pedestrian path, as well as maintaining balance between the needs and availability of resources in the future.

### 4.3 Green Architecture and Neighborhood

Green Architecture in six dimensions of criteria Greenship Neighborhood developed by GBCI (Green Building Council Indonesia, 2015), namely (1) land ecological enhancement; (2) circulation, movement and connectivity; (3) water management and conservation (4) solid waste and material; (5) community wellbeing strategy; and (6) building and energy. In each of these criteria there is the purpose of application, the purpose of which is used as an indicator of the application of green architecture in the design of mosques.

#### 4.3.1 Land ecological enhancement

In designing this mosque, environmental ecosystem maximized with the provision of green open space is very wide, it is necessary in the condition of very dense transportation site and the impact of its pollutions. In addition to maintaining the harmony and balance of environmental ecosystems and improving the environmental quality of healthy areas, the provision of green open space also as a buffer for air pollution and sound This green open space will also add to the value of the sacrality of the mosque in terms of visual and meaning, in addition to the existence of vegetation as an ecological part of the green open space and the presence of aesthetic functions/architectural as supporting facilities become Complement of the city's community activities as a social (Wibowo, Rukayah, & Suprapti, 2016).

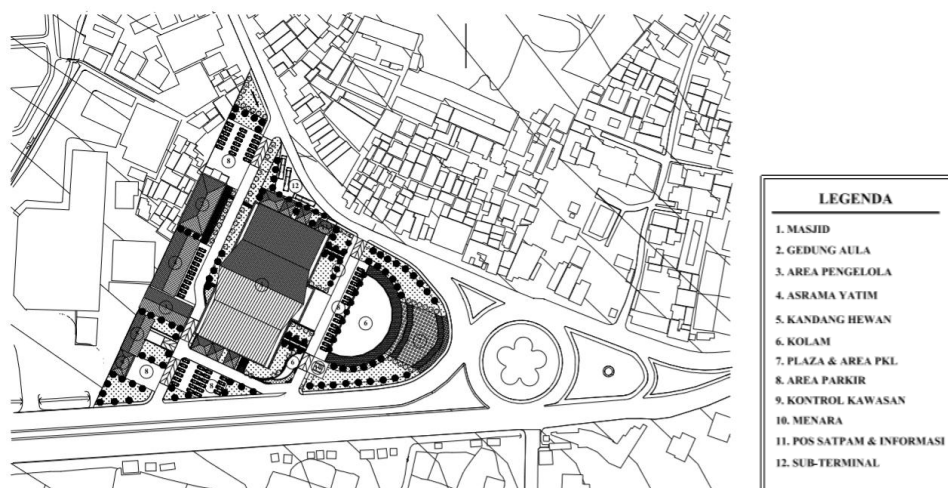


Figure 3. Mosque block plan

In improving the quality of the environment, public health and encouraging interactions by providing green open spaces are crucial and at once to minimize the development impact of natural biodiversity balance and diversity. The use of plant species is used in the design of this mosque. In addition, to encourage the production of local food and reduce the carbon footprint derived from the emission of food transportation, the green area is also planted local productive plants that can be utilized in providing food in local activities mosques and community activities (see Figure 3 and 4). Vegetation layering techniques can be explored further in areas such as the fence lining of crops, fruitful layers of plants, and layers of hydroponic vegetables (Reiza & Wibowo, 2017).



**Figure 4.** On site greenery

In an effort to improve the quality of micro-climate around areas that are very much polluting and reduce Urban Heat Island then the provision of large ponds in the mosque front area can be done to soak up the heat of the area is excessive, although consequently to lack of the overflow area for the users of the mosque to use the front of the mosque in some major activities (see figure 5). Nevertheless, with a large capacity of the mosque and still can accommodate the activities then the provision of this large pond can still be applied. This pond is also used as a shelter Rain Water Harvesting.



**Figure 5.** Pond as a climate response and rainwater harvesting shelter.

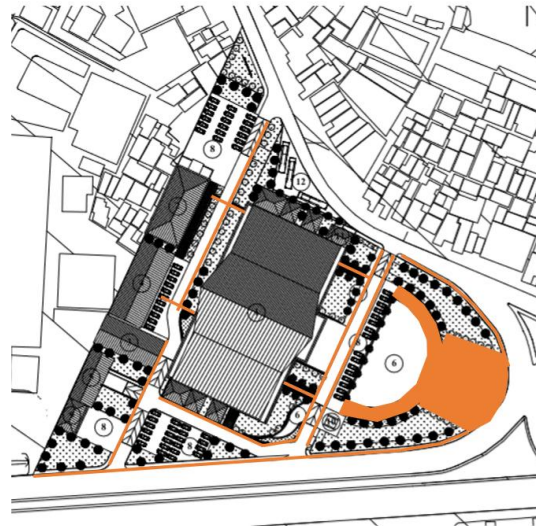
#### 4.3.2 Circulation, movement and connectivity

The concept of circulation used in the mosque in the exterior of the site is linear pattern. Divided into three access from the tread and from three different paths (see figure 6). The main roads are located in the southern and northern parts of the site specifically for cars, motorcycles, bicycles to be parked land and drop off. On the eastern part of the site is a pedestrian circulation that is very close to nature and surrounded by diverse vegetation divided into two lanes for women and men to avoid "sakhwat". The third circulation is in addition to the main western part of the site, namely the circulation of services intended for bus circulation, the circulation of the side lines, the fire extinguisher or garbage transport vehicles to be separated with the main access and The service has its own access with different paths to facilitate achievement. The accessibility planning is for the movement of people, goods and vehicles.



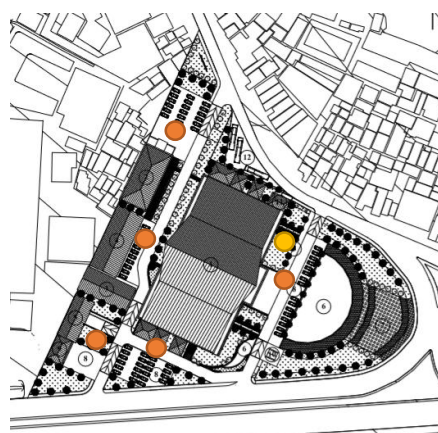
**Figure 6.** Analysis and entrance solutions for vehicles and pedestrians

In the planning of mosques, pedestrians are prioritized within the region. Designing applies the principle of connectivity, ease of achievement, safety, comfort and attractive to pedestrian pathways (see figure 7). Ensure the implementation of life and livelihood in activities. Provide the ease of achievement provided to everyone including pedestrians with special needs and young children, in realizing the similarity of the opportunity. For vertical circulation using stairs located on the right and left side of the building is separated between the circulation of women and men. There is also a main staircase that can be accessed by the users of the mosque, the side ladder of men-women and also there is a ramp for the disability that is available next to the access of the stairs.



**Figure 7.** Pedestrian connectivity

By providing several separate parking points to divide the density of each entrance of the road, parking facilities can be more optimal, because the mosque is large scale so that the arrival of many areas use the vehicle in a time very likely to happen. Optimization of parking facilities serves to avoid parking on the road and increase the congestion burden of the area. The area of the mosque also facilitates the use of bicycles within the area (yellow circles are also for bicycle parking) so as to reduce the use of motor vehicles (see Figure 8).



**Figure 8.** Parking points of vehicles and bicycles

In addition, the site is also provided with a sub-center terminal area for public transport and buses (see figure 9). This is in response to the congestion problem that is also caused by buses and transportation that take the road to take passengers. Design strategies that respond or give a space for public transport also encourage people to use public transportation to travel, thereby reducing emissions and the use of private motor vehicles.



**Figure 2.** Sub center terminal for buses dan public transportation

The role of connectivity and integration of space from road network in the region will also increase the potential of attraction and destination in the activities of the surrounding community (Ramadhan et al, 2018). It will have a positive impact on the mosque's prosperity and for the community itself.

#### 4.3.3 Water management and conservation

The mosque has a high need for clean water at certain times. Water needs are filled with water sourced from the PDAM, and then channeled to ground reservoir, then pumped up to the roof water tank in the tower. Furthermore, water is distributed throughout the building in need of water. For the water used for the need of additional ablution water, fish pond water and the watering garden using rainwater harvesting that is processed using the rainwater harvesting system (RWH). Dirty water comes from three types namely rainwater, place of ablution and waste. There is a pond that is used for water retention/wetland with rainwater harvesting process. Rainwater is channeled through the gutters and passed the infiltration and to be utilized again for watering crops. This is done to support the use of alternative water (in addition to groundwater and water from PDAM) independently.

Raindrops flows into rainwater harvesting in the form of a pond that is then converted water that has been in the treatment for clean water. To create an environmentally friendly building, it is necessary to use alternative water sources, such as to accommodate rainwater to be used as a source of clean water to flush plants with the first processing (such as recycle in water ablution). Used water ablution will be accommodated on a tank then the water is inserted into the filtration tank. In the filtration tank the ablution water and its cohand will be separated by filtering. Then from the water filtration tank of ablution flowed into the chlorinated tub. This is done so that ablution is free from harmful microorganisms, namely disinfection process. Water that has been disinfected will be accommodated on the tank then channeled through the faucets ablution water.

The ablution room is placed behind the building where the prayer process becomes directed and will not interfere with the main circulation. In regulating and supervising the water system, there is a control room of the building and the area (separate) which includes water control technology and mechanical electrical (see Figure 10).

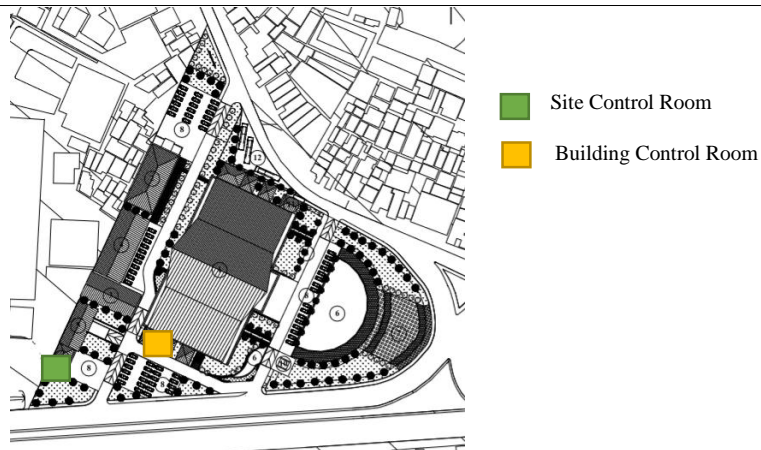


Figure 10. Control room of the building and the area

#### 4.3.4 Solid waste and material

In reducing the negative impact on the environment through the management of solid waste (garbage) Some efforts are carried out in management. Handling waste by using the application of the reduce-reuse-recycle principle, such as organic waste-inorganic used again and not wasted (see figure 11).

##### Bottles, glasses, cans, paper



##### Trash stinks



##### Other garbage

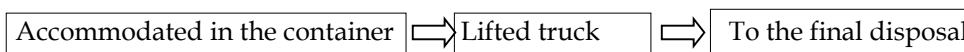


Figure 11. Waste processing cycles

The use of materials for the infrastructure of the area is also chosen from domestic sources, such as paving that absorbs water and asphalt and cement which is also mixed with the materials of the former building while taking into account the strength and durability. In accordance with the research of Ramadhan, et al (2018) related material infrastructure from local sources, environmentally friendly and absorb water and can reduce UHI become one of the efforts to achieve sustainability in streetscape or infrastructure area.

#### 4.3.5 Community wellbeing strategy

In facilitating that people can interact and activities and become part of the area, the mosque planning should also provide community interaction rooms. In the context of the mosque then its function not only as a means of worship but also as a means of coaching creed, morality, worship, social and society, and the economy of the people, then the design strategy applied one of them by providing activities for both the organizer and the community (see figure 12). These spaces are aimed at the establishment of activities that will be the potential for the development of faith, morality, worship, social and community, and the economy of the people. Orphaned dormitories, temporary living spaces, multi-purpose halls and sacrificial cages become some examples of space provided to achieve that goal. The planning of mosques also prepares gatherings and activities with the intent to share insights to improve awareness, knowledge, and community participation on the concept of sustainability in the region and impact to secure, comfortable, and fast-paced areas of threat of crime and natural disasters. The provision of a merchant area while on the site is also a solution for street vendors using sidewalks around the tread and reviving the socio-economic conditions surrounding the tread. Another impact of these spaces is to create a compact area, for the development of the effectiveness of activities between

the residential and commercial sectors and create an area with respect to the preservation and development of local cultures.

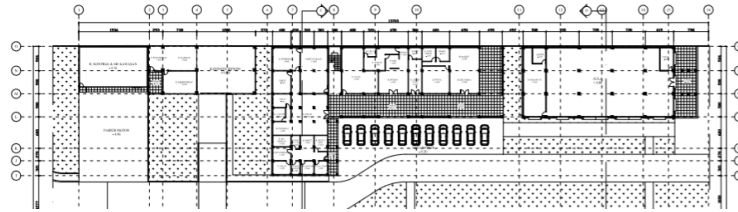


Figure 12. Community activities management and activity spaces.

#### 4.3.6 Building and energy

In the building, the application of green architecture one of them applied to renewable materials by using bamboo material (layers and processed) on the façade, the use of the GRC roster as sun shading. The use of shading is also beneficial as a radiation filter so that the entrance is the light of the sky, but because there are insects, noise and dirt factors that can enter the building, it also used the sliding window so that at times can be closed. Alloy glass window and shading as a secondary layer is quite effective in maintaining comfort in related space, thermal, visual (light) and audial (noise pollution through the glass window so that it is closed) as well as other disorders such as insects and related to maintenance.

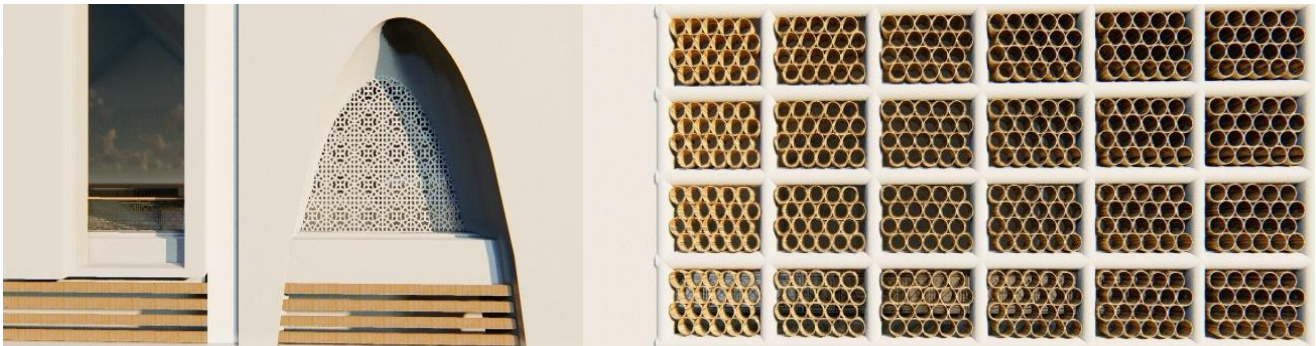


Figure 13. GRC and Bamboo processed on the façade

Building also make energy savings inside buildings by optimizing natural light during the day. From design simulation also found interesting light bias from facade form and window opening composition (see figure 14). This can add value to the use of interior space itself.



Figure 14. Simulation of morning to afternoon light and resulting bias

The design has not yet accommodated the use of alternative energy sources such as solar panels to reduce the state's electrical burden and reduce environmental impacts related to fossil-fired power plants. Nevertheless, it has been provided room for the use of solar panels on the west side of the building that can be placed solar panels and can be connected to the control room for placement of batteries and other devices.

In terms of building shape, cultural and historical contextual elements that tend to be contemporary can be applied and combined to the concept of green architecture, also to be more friendly to the local culture. The design of the mosque is made by adaptation of the distinctive sundanese roof "Julang Ngapak" with a gigantis scale that can reach the view of the pedestrians and the new vehicle users enter the city of Bandung as a new landmark that can be accepted by the community (see figure 15). The shape of buildings and facades can be explored very freely despite using the green architecture approach.

The green architecture approach does not limit exploration, but it can find new development potential for design such as shape, pattern, light and others. In large-scale mosques representing a particular region and history, the form and technology should still consider the local cultural context with the development of a more aligned meaning. The implementation of green architecture in this mosque not only covers its function as a place of preaching but also as an Islamic face for the city of Bandung.



**Figure 15.** Building façade and tower during the afternoon

In addition to the application of neighborhood approaches, similar approaches to six green building aspects, such as energy saving, working with climate, respect for site, respect for user, limiting new resources, and also holistic developed by Robert Vale in its definition related to green architecture can also be applied well on design experiments.

## CONCLUSION

The green architecture approach with criteria from the area perspective can be applied to the mosque building on a large scale than the perspective of the single building. The approach is more thorough and very related to the function of a communal building. Criteria such as (1) land ecological enhancement; (2) circulation, movement and connectivity; (3) water management and conservation (4) solid waste and material; (5) community wellbeing strategy; and also (6) building and energy can be applied by combining with various design ideas and adjustments of existing locations in the case of the mosque building. The location context also greatly affects the application of the green architecture concept that is not only related to the building but the response to environmental problems around the site.

Some of the main concepts in the design include providing spaces to host activities that will be the potential of coaching, morality, worship, social and community, and the economy of the people. . The green architecture approach does not limit exploration, but it can find new development potential for design such as shape, pattern, light and others. In realizing the design of mosques with environmentally friendly insight, the concept of environmentally friendly is applied to the context of local environment such as congestion, pollution, street vendors (PKL), density, through the solution of providing subterminal space for Public transportation, tree vegetation to absorb pollution in areas (as well as sound buffers into buildings) also to lower the temperature of the micro climate by creating a large pool in the center of the site and provision of street vendors on the site. In the building, can apply the use of bamboo materials (layered and processed) on the façade, the use of the GRC roster as sun shading and other environmentally friendly technologies such as the provision of RWH, waste management, and a differentiated area control system with the building.

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