ZAZZAU EMIRATE COUNCIL

Mal Abdul Kareem Central Mosque

Zaria - Kaduna State, Nigeria
November 2023

CONCEPT DESIGN REPORT

dar

بسم الله الرحمن الرحيم

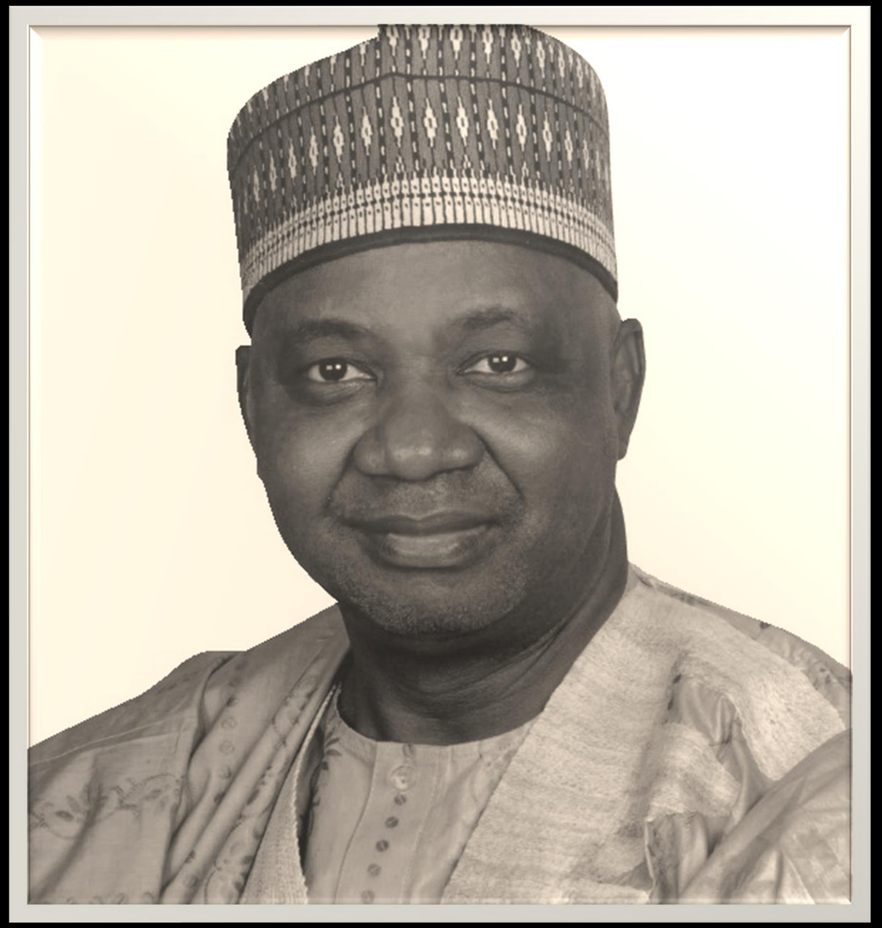
The Zaria Central Mosque was Initially built during the reign of Emir Abdulkarimu of Zazzau and Sultan Muhammadu Bello around 1836. The Mosque was maintained and preserved by all successive Emirs of Zazzau up to the present day.

However, on Friday 10th of August 2023, the Mosque collapsed which as a result killed some worshippers during asr prayers. We Immediately Invited experts which included, Faculty of Architecture ABU ZARIA, Nigerian Institute of Architects, Nigerian Institute of Builders, Kaduna State Ministry of works to assess and advise us on the cause of the accident and the way forward.

In this regard, we appointed a team of Highly respected Professionals Under the Leadership of former Nigerian Vice president Arc Mohammed Namadi Sambo GCON, to review the findings and recommend the way forward. It's in this light that they accepted after extensive review of the findings of above-mentioned Institutions and proposals submitted of which finally Dar Al Handasa was chosen as the best to design the new Mosque. Alhamdulillah, I'm grateful to Allah for making it possible to upgrade the mosque in my time as the 19th Emir of Zazzau and also during the reign of Sultan Mohammed Saad Abubakar CFR. Let me seize this opportunity to thank the entire members of the technical team as well as the fund-raising committee under the former governor of kaduna state Mal Nasir el Rufai CON.

Permit me to express my appreciation and delight to the Chief Launcher Alh Abdulsamad Isyaka Rabiu for the huge contribution he made as well as commitment to this project. Finally, let me Specially thank the governor of kaduna state Mal uba Sani for the Leadership role he has been playing towards the reconstruction of the Mosque as well as supporting the victims' families.

Mal Ahmed Nuhu Bamalli CFR, LLD
19th Emir of Zazzau
20th November 2023

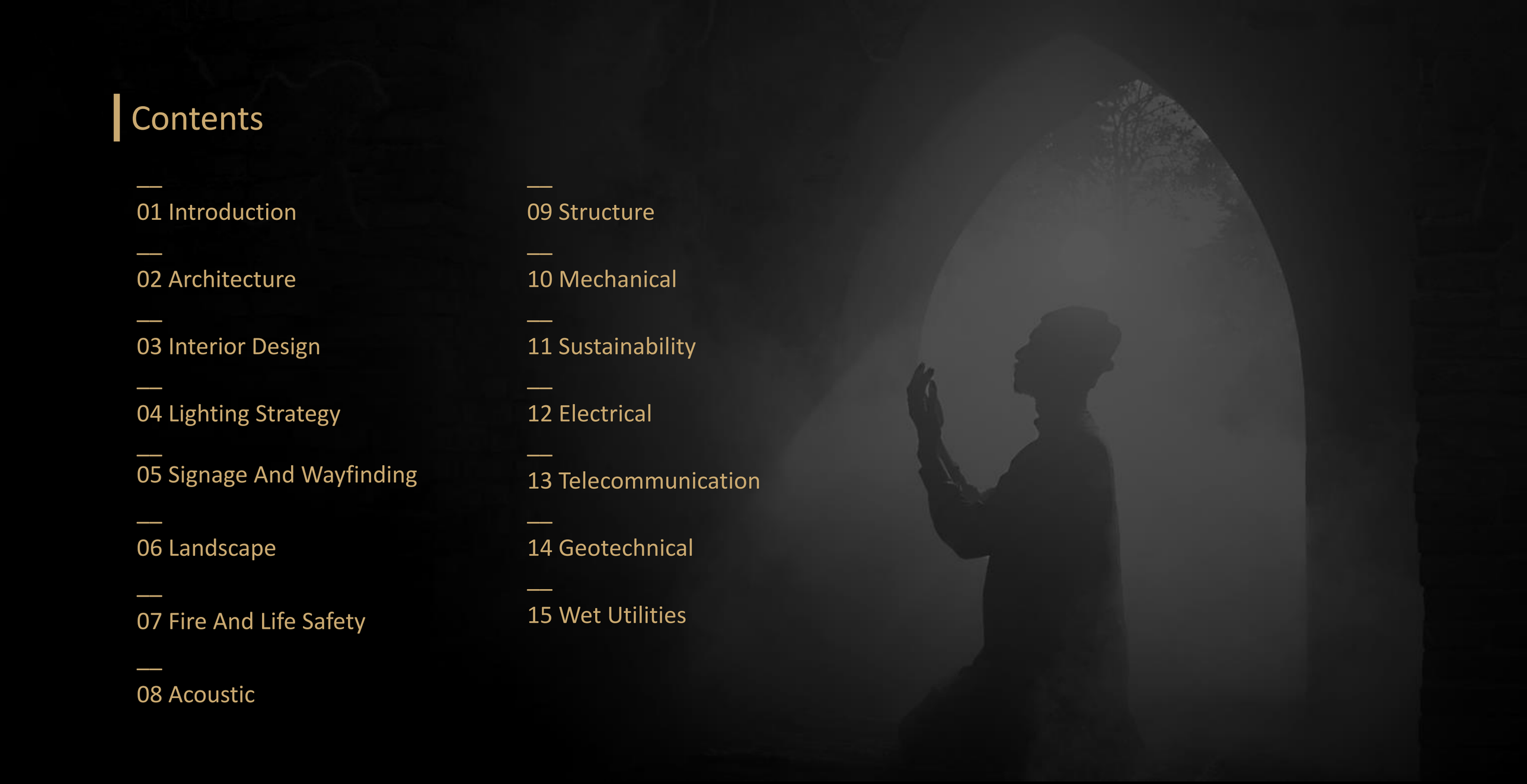


On behalf of the Technical Committee for the Reconstruction of the Zaria Jumma'at Mosque, we deeply appreciate the gracious and favorable consideration of His Royal Highness, the Emir of Zazzau Mallam Ahmed Nuhu Bamalli, CFR, LLD, to technically advise on the investigations reports on the causes of the collapse of the old historic Mosque built in the 1830's and make recommendations and proposals for the reconstruction and development of a new mosque.

We are seriously working towards achieving this noble objectives with deep appreciation to His Royal Highness and the Zazzau Emirate Council.

Arc: Mohammed Namadi Sambo, GCON, FNIA
Former Vice President (2010 to 2015)
Chairman Technical Committee for the Reconstruction of the Zaria Jumma'at Mosque, Zaria, Kaduna State.

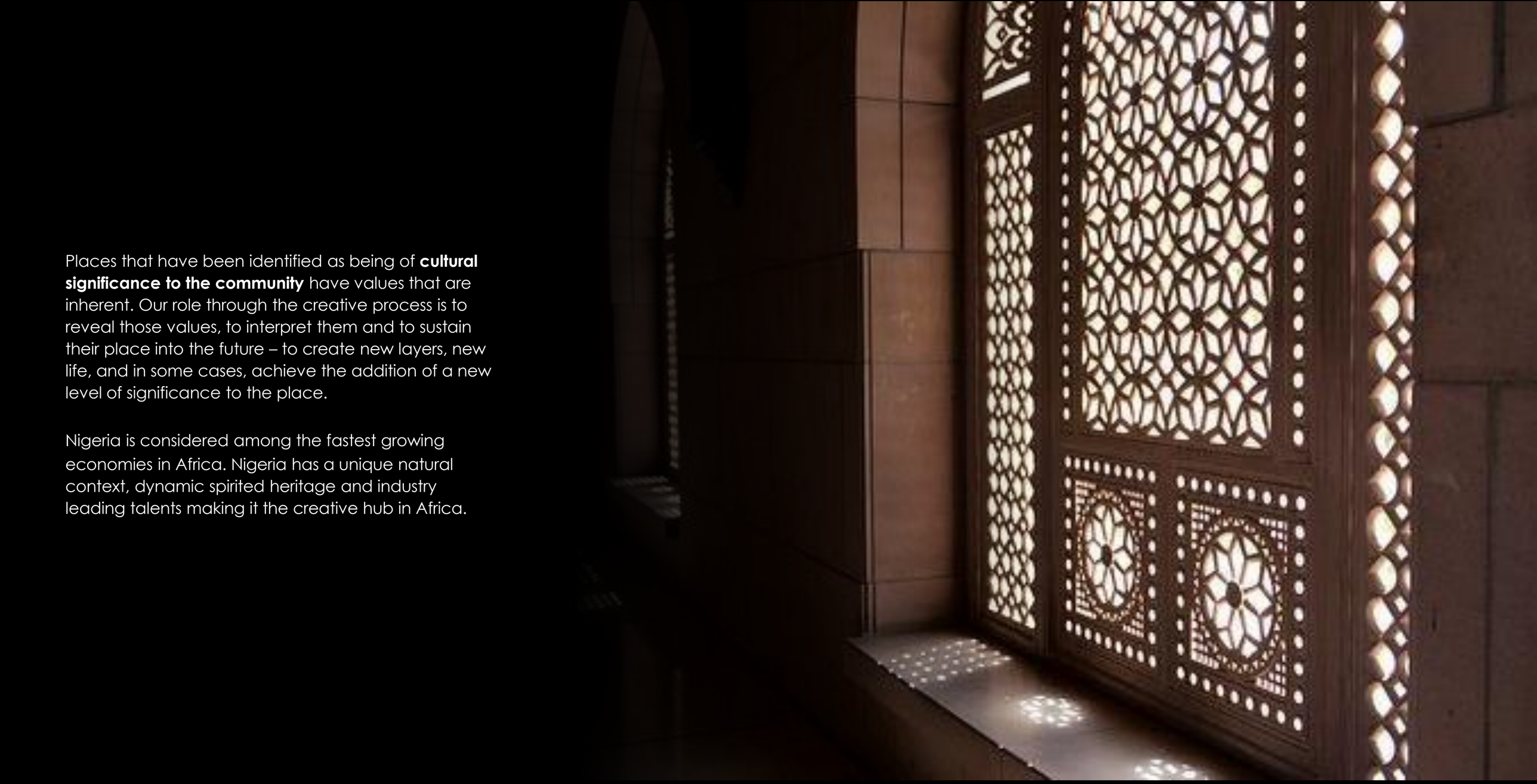
Contents



01 Introduction

Places that have been identified as being of **cultural significance to the community** have values that are inherent. Our role through the creative process is to reveal those values, to interpret them and to sustain their place into the future – to create new layers, new life, and in some cases, achieve the addition of a new level of significance to the place.

Nigeria is considered among the fastest growing economies in Africa. Nigeria has a unique natural context, dynamic spirited heritage and industry leading talents making it the creative hub in Africa.



Understanding the Context

Nigeria is a vibrant and diverse nation that captivates the senses with its rich cultural tapestry, natural beauty, and dynamic population.

The country showcases a blend of bustling cities, serene rural landscapes, and a fascinating history that dates back centuries.

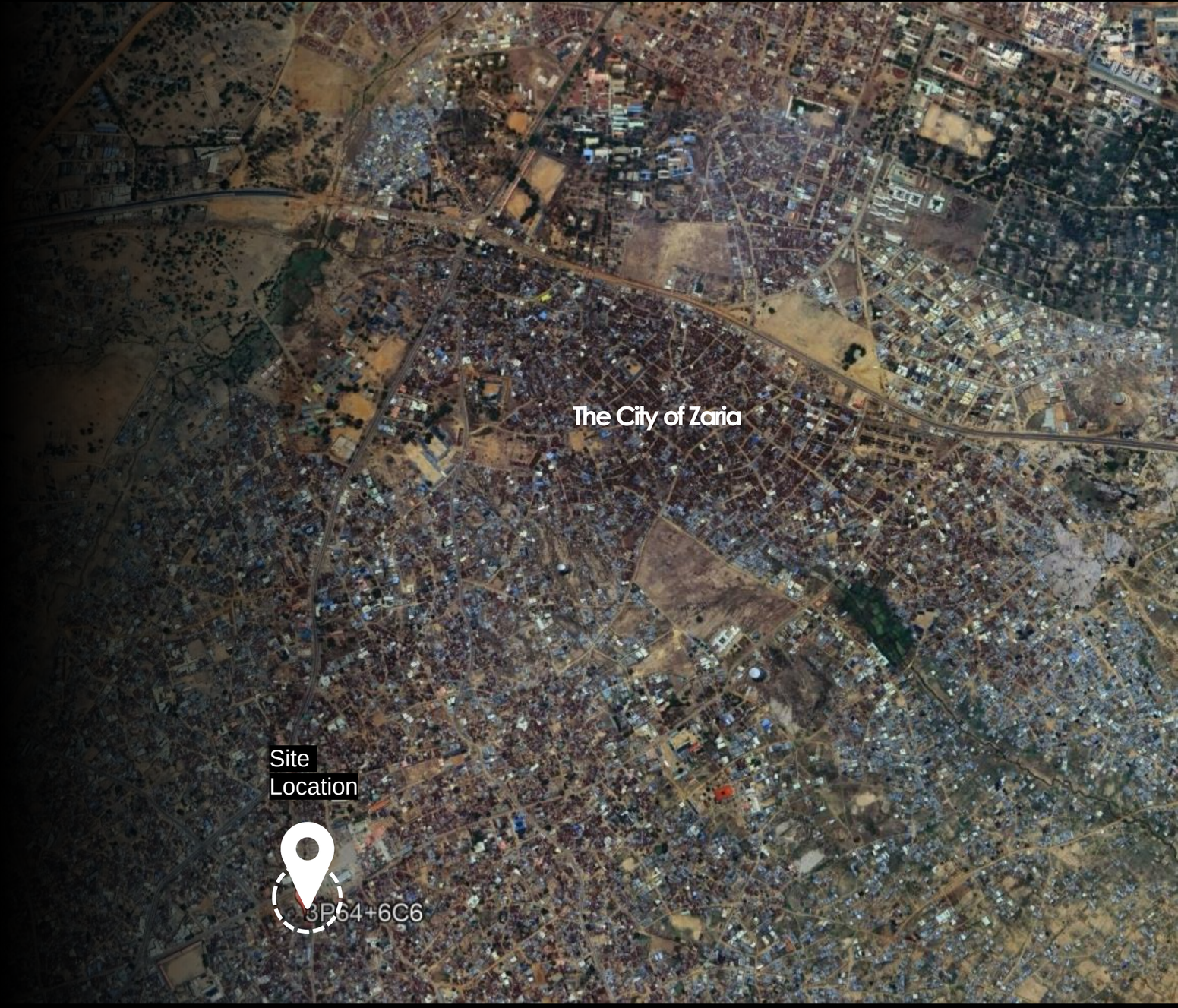
This allows us to embrace diverse cultural influences, architectural traditions, and local contexts.

Surrounding Context

Zaria located in northern Nigeria, is a city rich in history, culture, and academic prominence. Steeped in the legacy of the ancient Hausa Kingdom, Zaria exudes an enchanting blend of tradition and modernity. The city is approximately 300km away from the country's capital Abuja.

Surrounding Context

Zaria is renowned for its esteemed educational institutions, including the renowned Ahmadu Bello University, which attracts students from across Africa. The vibrant markets, bustling streets, and warm hospitality of the Zarian people create an immersive experience that unveils the essence of Nigeria's diverse cultural tapestry**. From its historical landmarks to its cultural festivities**, Zaria is a captivating city that captivates visitors with its **vibrant spirit and timeless charm**.



Surrounding Context

Zaria's architectural traditions are a testament to a beautiful blend of Islamic, Hausa, and local influences.

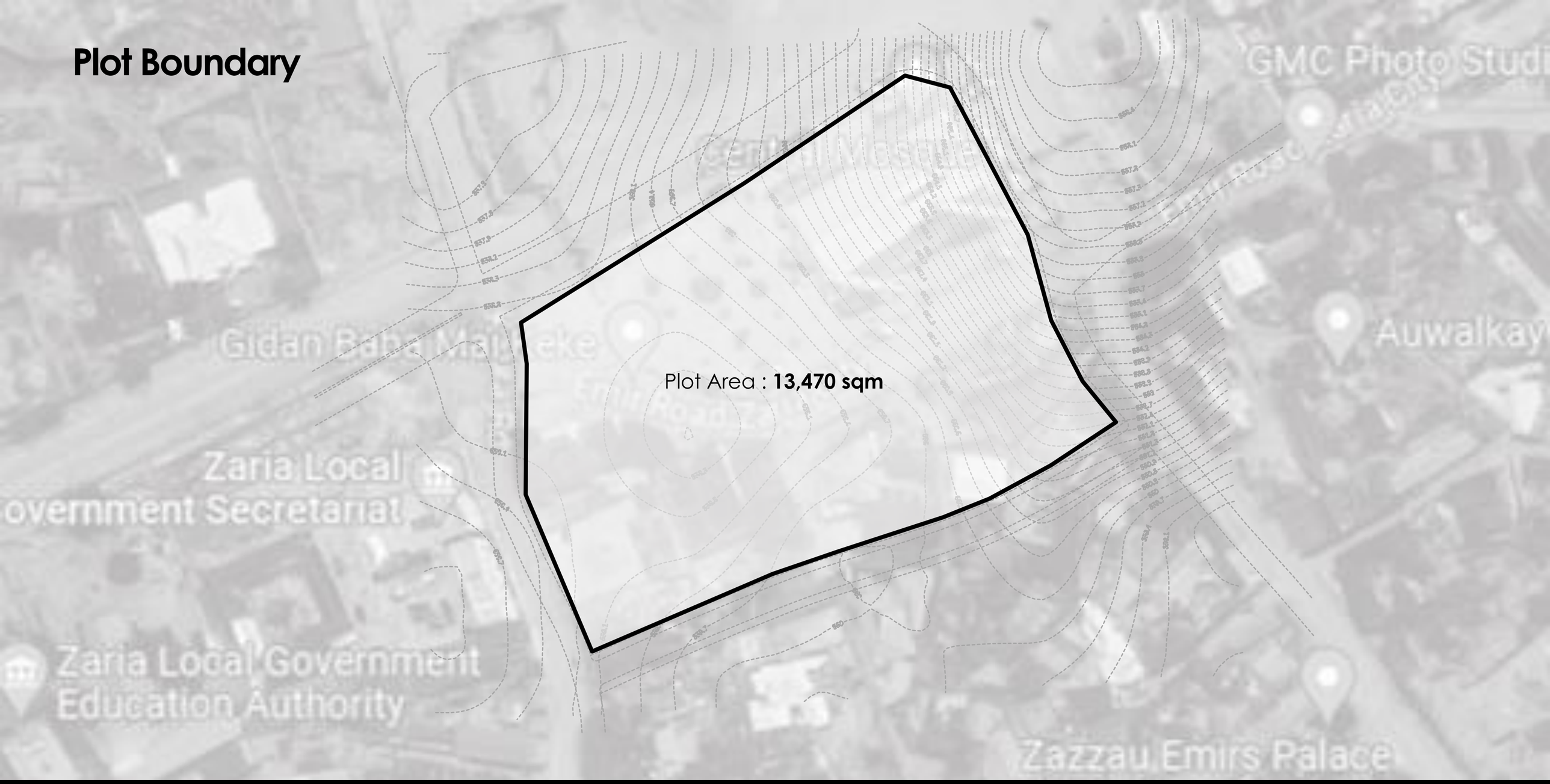
Surrounding Context

Its architectural marvels, such as the iconic **Zazzau Emirate Palace** and the old Great Mosque of Zaria, showcase the city's grandeur and its deep-rooted Islamic heritage.

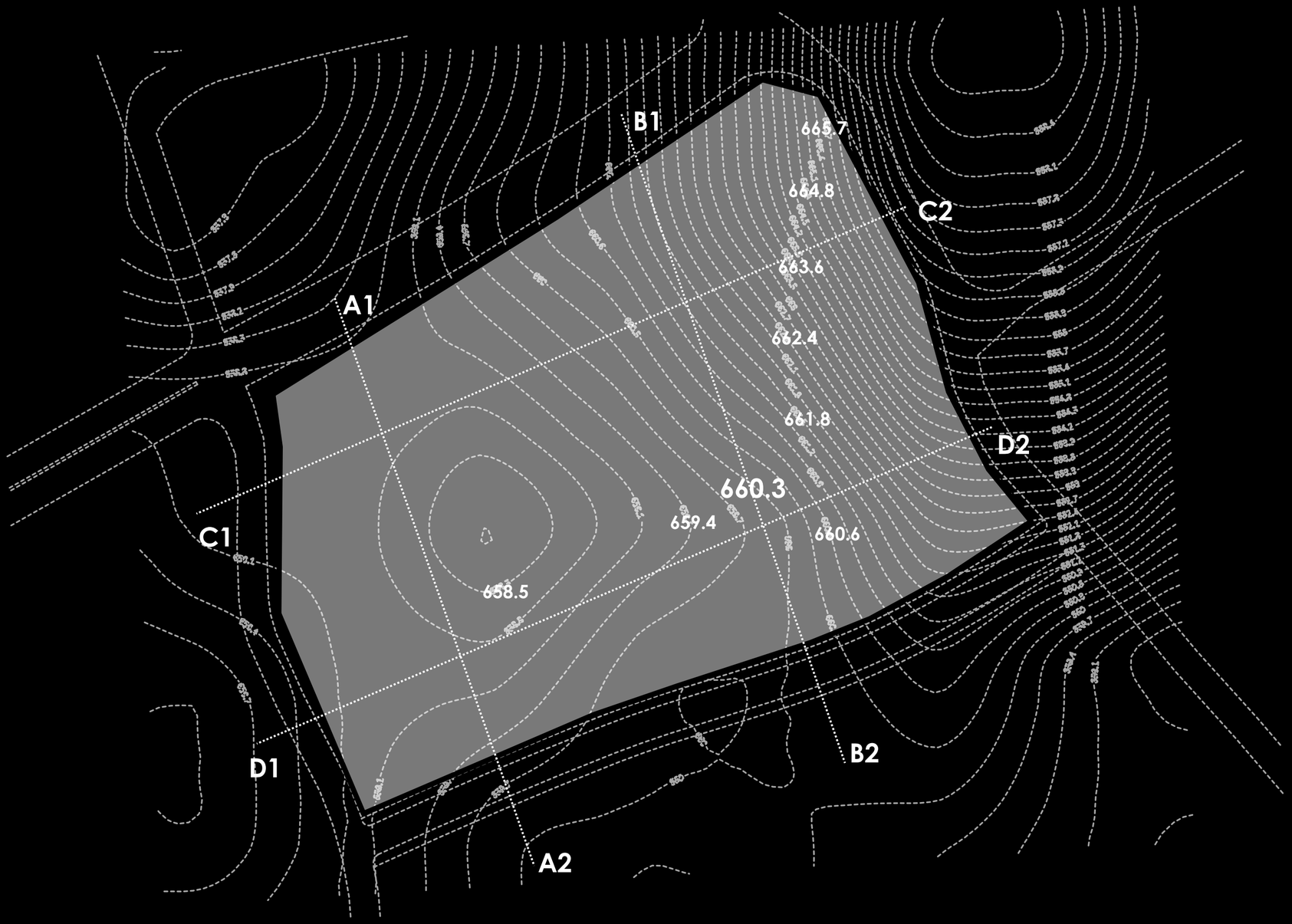
Surrounding Context

Surrounding Context

Plot Boundary



Site Levels


B1
665.7
664.8
C2
663.6
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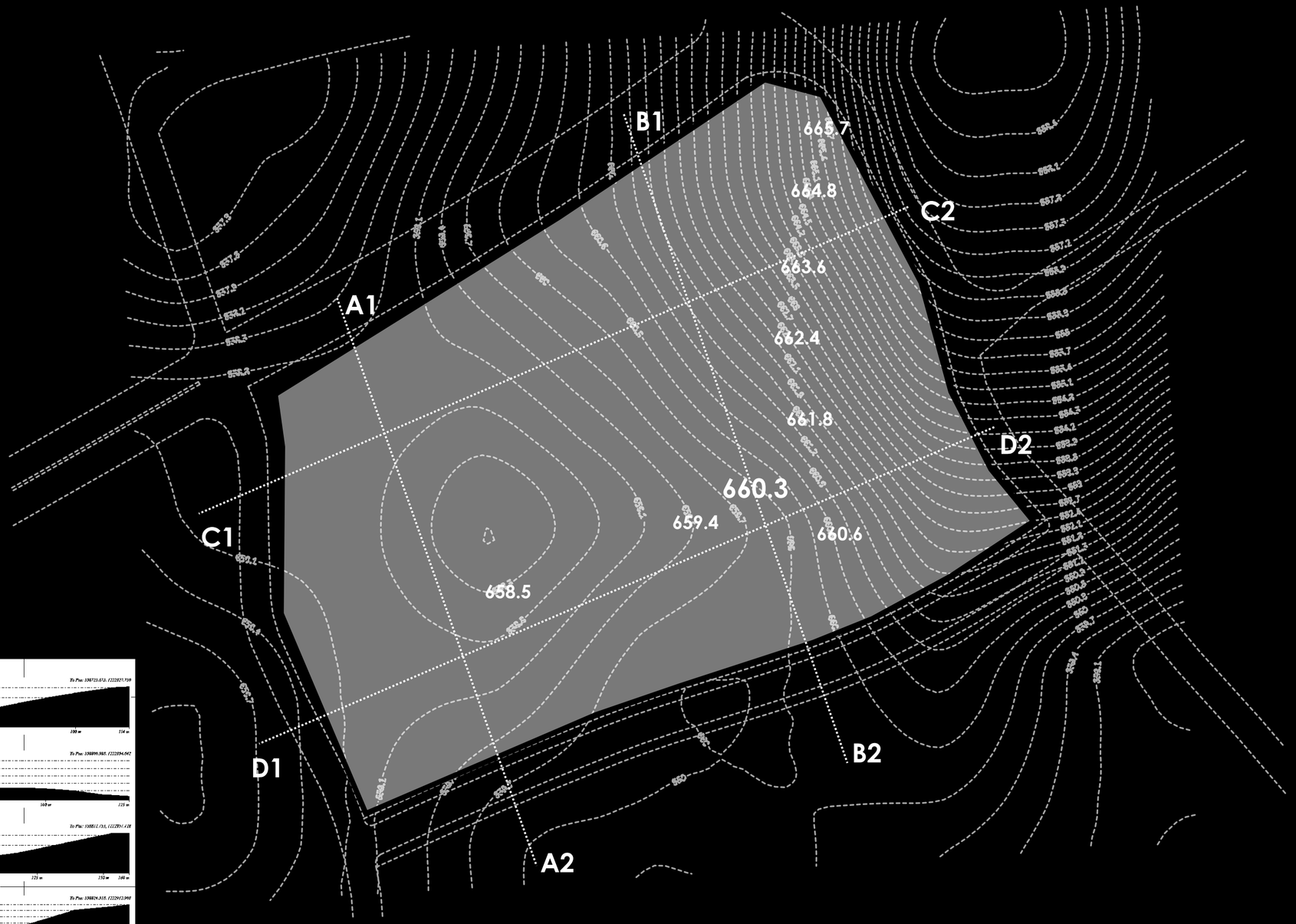
A2

Site Levels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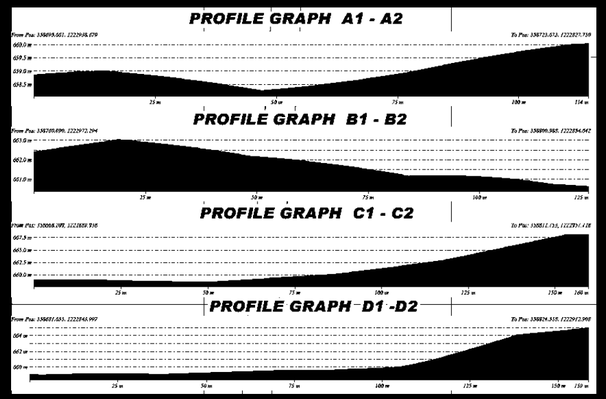

PROFILE GRAPH A1 - A2
PROFILE GRAPH B1 - B2
PROFILE GRAPH C1 - C2
PROFILE GRAPH D1 -D2

DESIGN VISION

The envisioned redesign of the **Central Mosque in Zaria** aims to honour the city's past while **embracing its future**, creating a sacred space that harmoniously blends **tradition and modernity**.

DESIGN VISION

The envisioned redesign of the **Central Mosque in Zaria** aims to honour the city's past while **embracing its future**, creating a sacred space that harmoniously blends **tradition and modernity**.

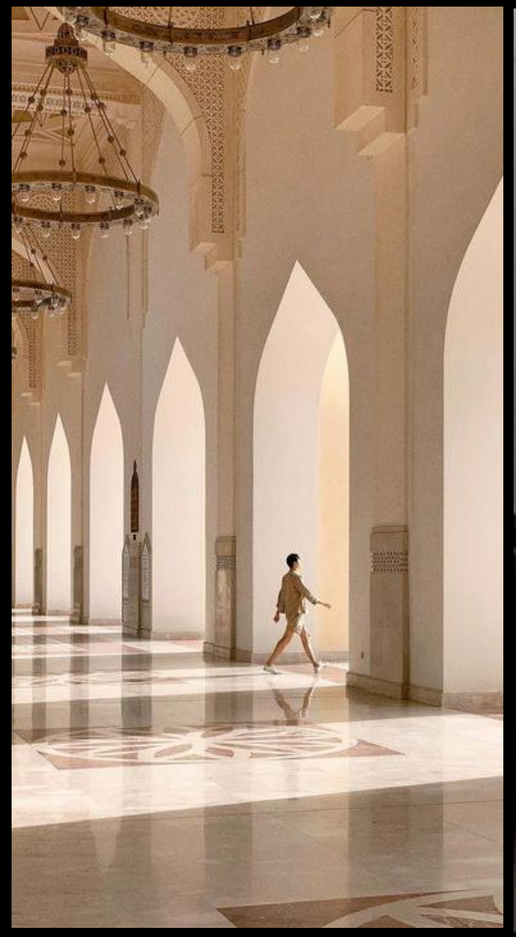
Design Considerations

Contextual Integration

Visualize the mosque blending harmoniously with the natural surroundings, reflecting the diverse landscapes and vibrant colors found in Nigeria.

Cultural Significance

Explore the cultural and historical influences that shape the design.



Architectural Features

Envision the mosque's architectural features that set it apart as a symbol of grandeur and spiritual sanctity

Community Gathering

Envision the mosque as a vibrant hub for community interaction and social cohesion.

History

The history of the Mosque in Zaria

History

The history of the Mosque in Zaria

Figure 2.12 The Friday Mosque, Zaria: plan and sections

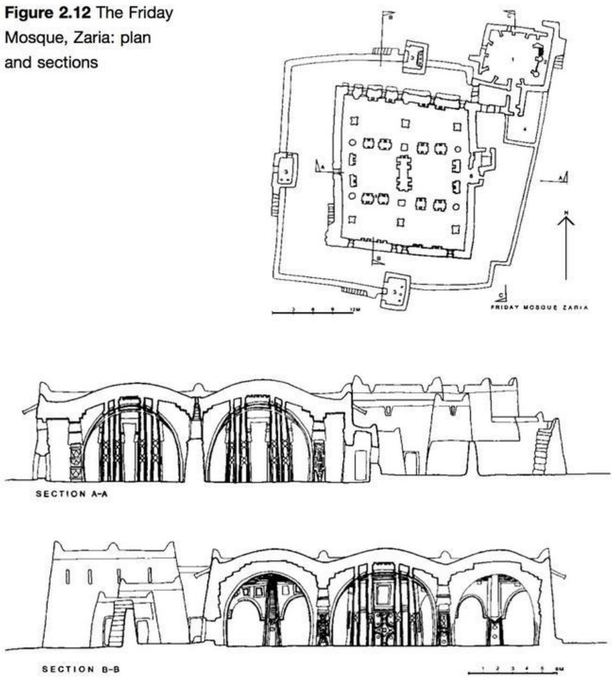
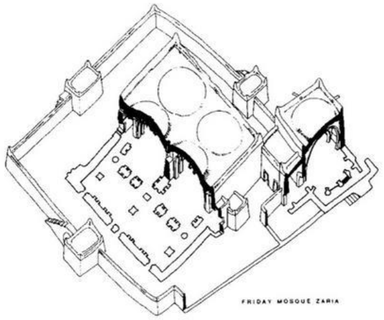
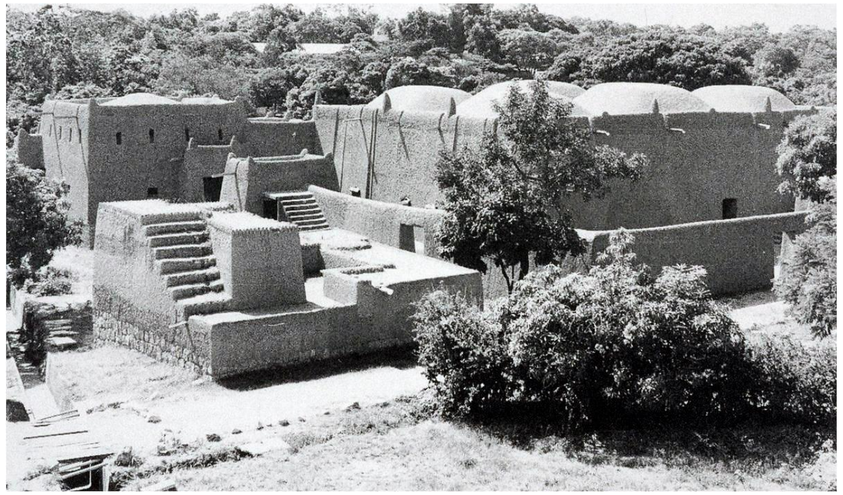
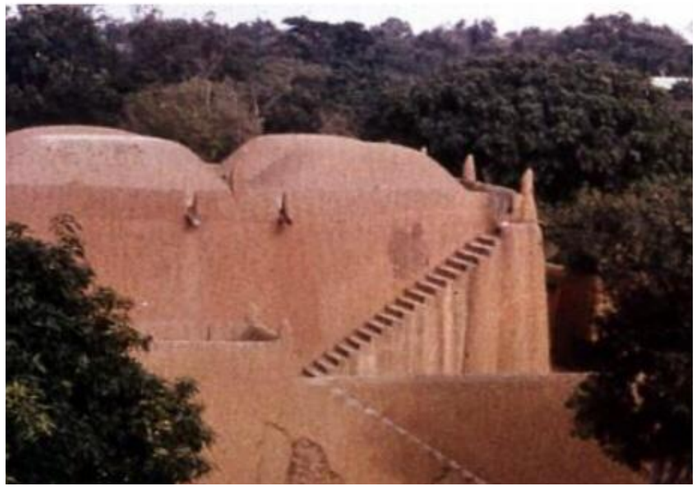


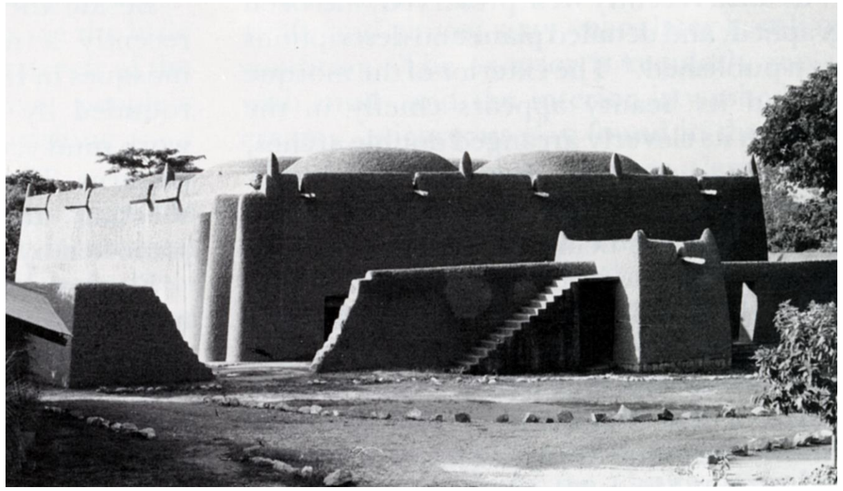
Figure 2.13 The Friday Mosque, Zaria: axonometric

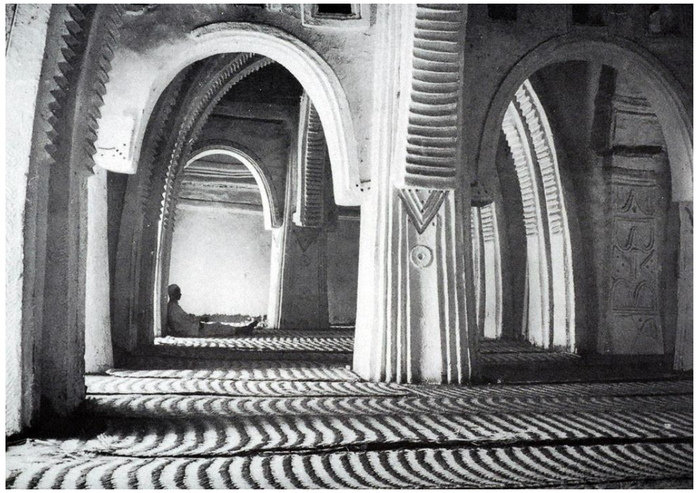






Zaria's Masallaci Juma'a, or Friday Mosque, was built in the later 1830s or early 1840s. Showcasing traditional Hausa Architecture.



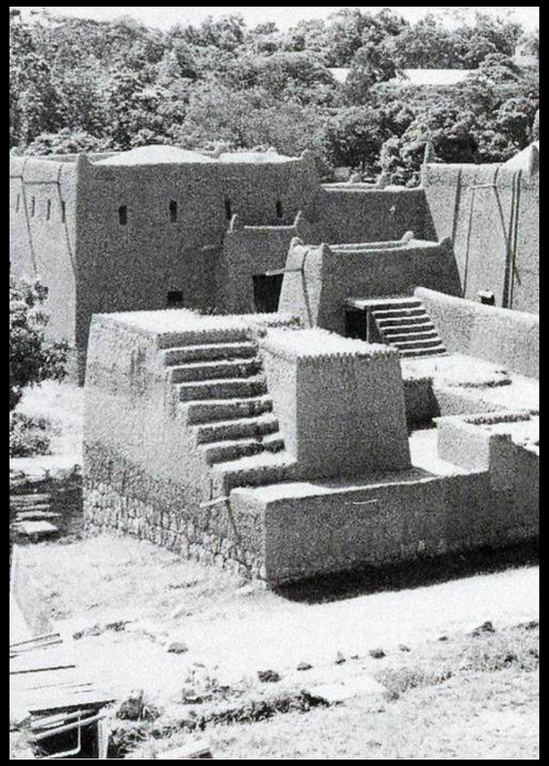


Site Photos

With the growing population and increasing demand for larger worship spaces, the expansions aimed to accommodate the needs of the community while preserving the mosque's historical and cultural significance.

Design Concept

Architectural Approach
Design Drivers

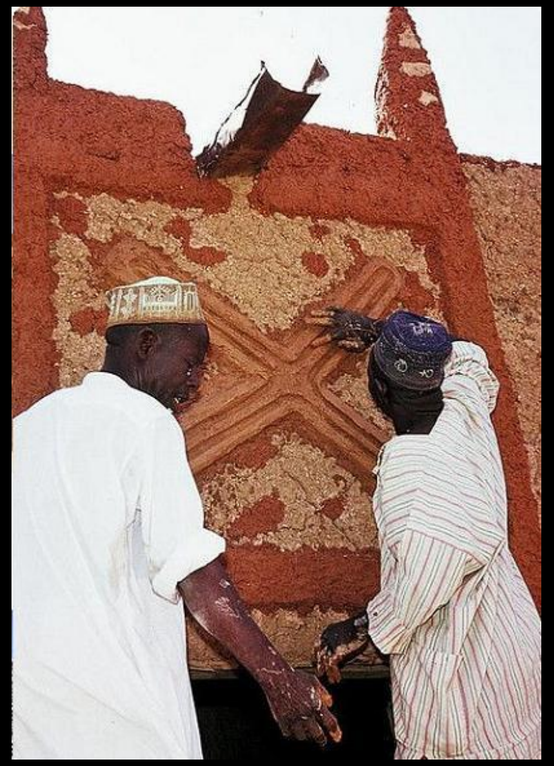


Authenticity

Using modern design to create new architecture inspired by the cultural architectural values .

Identity

Using the surrounding landmarks to create new architecture connected to the past.



Sense of Community

Capitalizing on the strong community ties rooted in the culture.

Environment

Respecting the environment by producing a responsive design.

A Courtyard that Connects people

A Community Hub

Architectural Approach
Design Drivers


The Ilorin Central Juma'at Mosque


The Ilorin Central Juma'at Mosque , Nigeria


Ghana National Mosque


Ghana National Mosque

DESIGN ELEMENTS
PRAYER HALLS

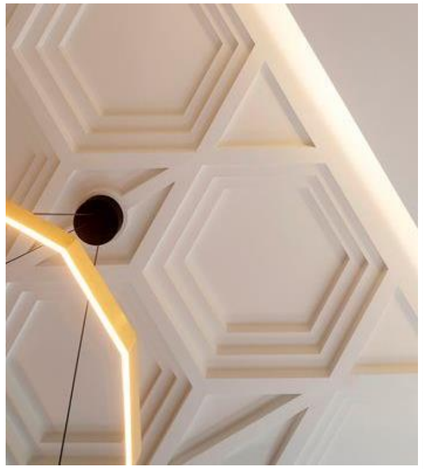
In the bustling city of Zaria, Nigeria, stands a hidden oasis of tranquility: the **Prayer Hall.** This sacred space is designed to encourage contemplation and connection with the divine.

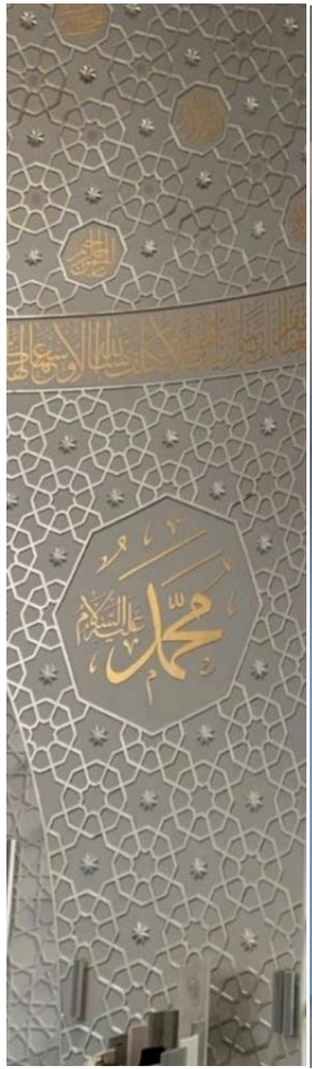
The walls, **adorned in pristine white**, exude purity and simplicity, symbolizing a sense of purity and clarity in worship. The hall is spacious, allowing for a congregation of worshippers to gather comfortably.

Natural light floods the hall through its many windows, casting a soft glow the walls of the interior.

The prayer hall is often adorned with **soft carpets**, providing a cushioned surface for worshippers during prayer.

At the far end of the hall is **the Qiblah wall**, a uniquely designed niche in the wall that indicates the direction of Mecca. Worshippers align themselves with the qiblah when offering their prayers.





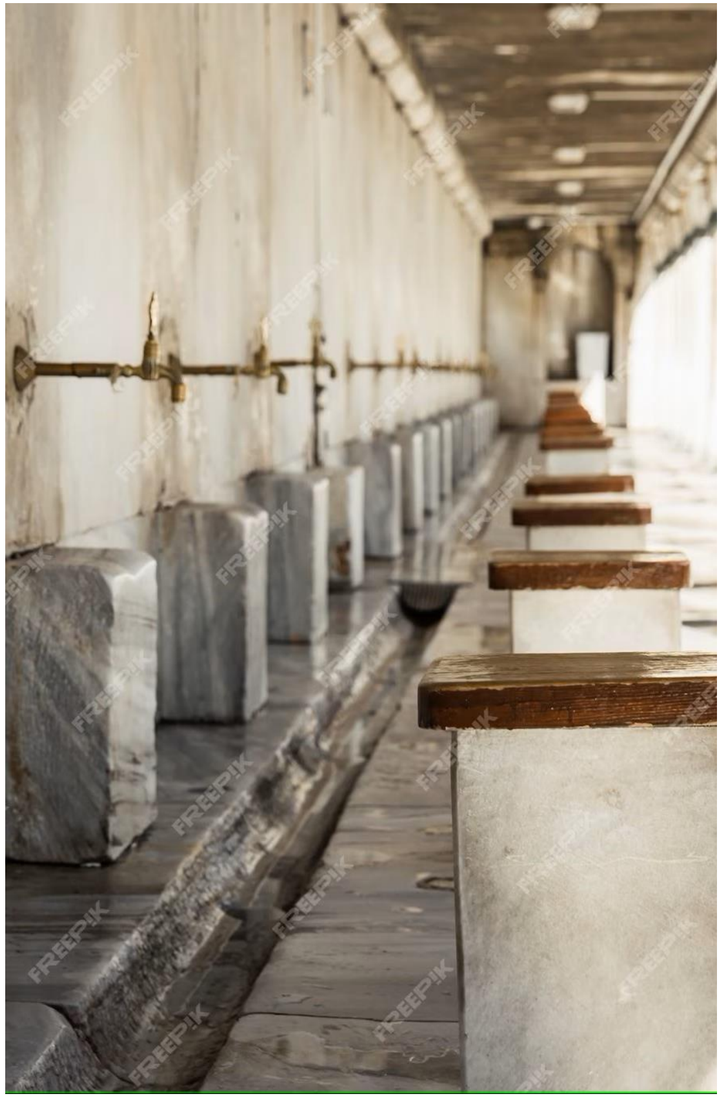
DESIGN ELEMENTS
Prayer Amenities

The ablution area special place where worshippers can come to cleanse themselves physically and spiritually. The **natural light** and **peaceful atmosphere** create a space that is conducive to contemplation and connection with the divine.

The **sound of the running water** is soothing and calming, and the gentle scent of incense fills the air.

Worshippers approach the ablution area with reverence, their faces filled with peace and tranquility. They take their time to perform their ablutions, taking care to cleanse themselves thoroughly. As they wash, they recite verses from the Quran, seeking Allah's blessings and guidance.

After completing their ablutions, worshippers' step away, feeling refreshed and invigorated. They are now ready to enter the prayer hall and offer their prayers to Allah.

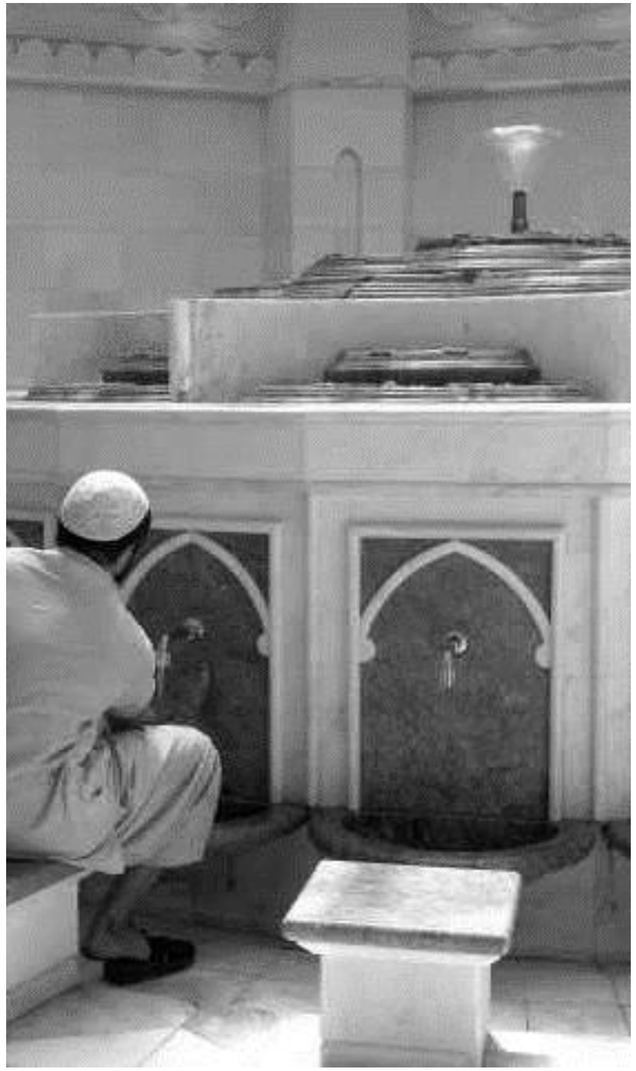


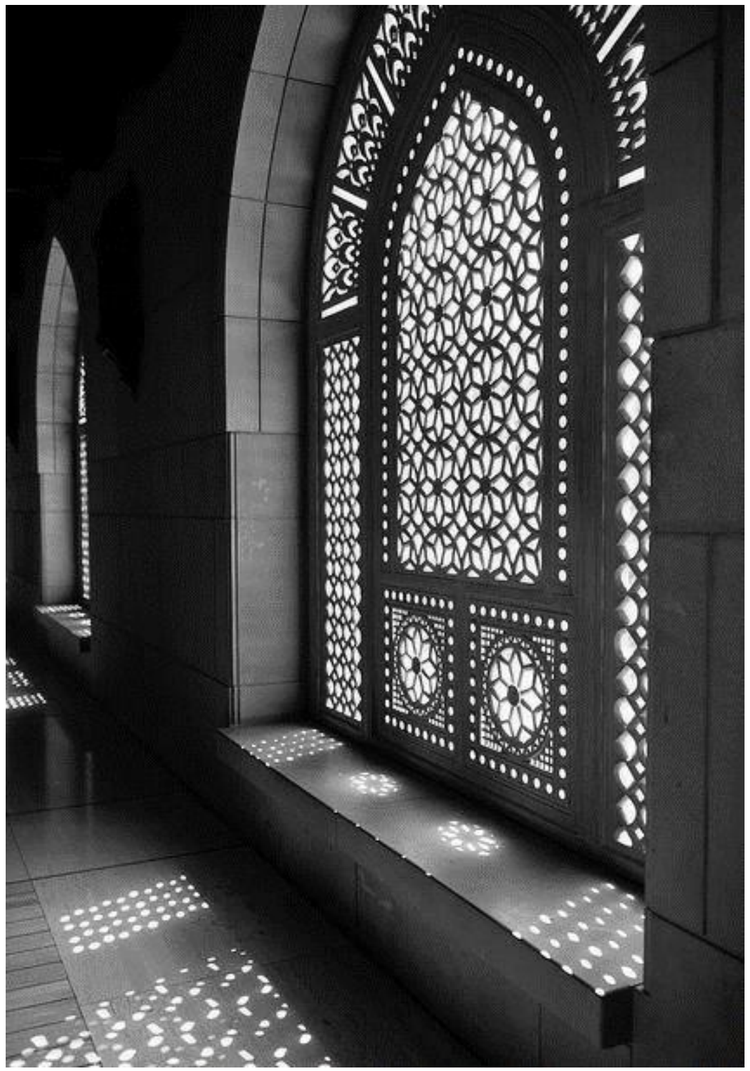
DESIGN ELEMENTS
Prayer Amenities

The public toilets are a model of cleanliness and efficiency. They are designed to be both functional and inviting, with a focus on natural light.

The toilets are **located in a separate building** from the mosque itself, but they are easily accessible to worshippers. The entrance to the building is well-lit and inviting, with a sign that clearly indicates that the toilets are open to the public.

The toilets are arranged in a spacious and well-ventilated layout. The floors are covered in easy-to-clean tiles. Large windows let in plenty of **natural light**, creating a bright and airy atmosphere.





02 Architecture

Project Brief :

Following the recent collapse of some sections of the old Zaria city Jumma'at Mosque, the Zazzau Emirate Council (ZEC) aims to design and reconstruct the existing facility to provide the mosque, not only to revive the heritage of the institution but also create an appreciative modern and futuristic complex tailored to Islamic Architecture.

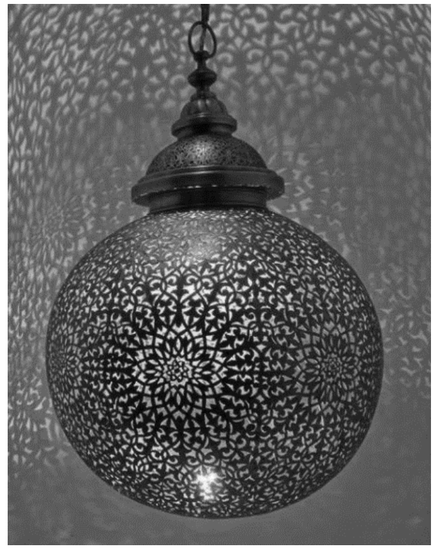
The mosque will accommodate:

- A total of **2000** worshippers in the upper ground floor:

1650 for men (1450 in the main hall + 200 in the daily prayer hall) and

350 for women.

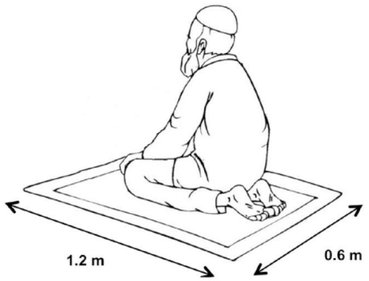
- A courtyard space to accommodate an additional **1600** worshippers.
- External Piazza to accommodate as additional **5000** to **7000** worshippers.
- Main facilities include; Imam's office, an elegant minbar area and ablution areas.
- Other facilities include a library space, Learning centre, meeting room and office spaces for administrative functions of the complex.

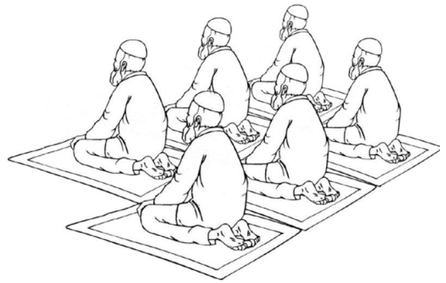


Basis Of Design

Prayer Hall:

A unit area of 0.72m² per worshipper was applied to calculate the capacity of the various prayer areas. This was based on a personal unit prayer space of 0.6 m x 1.2 m





Prayer Amenities:

- Toilets: 1 for every 100 persons (required 20 Toilets) following Saudi Awqaf Standard.
- Ablution : 1 for every 25 persons (required 80 Ablutions) following Saudi Awqaf Standard.

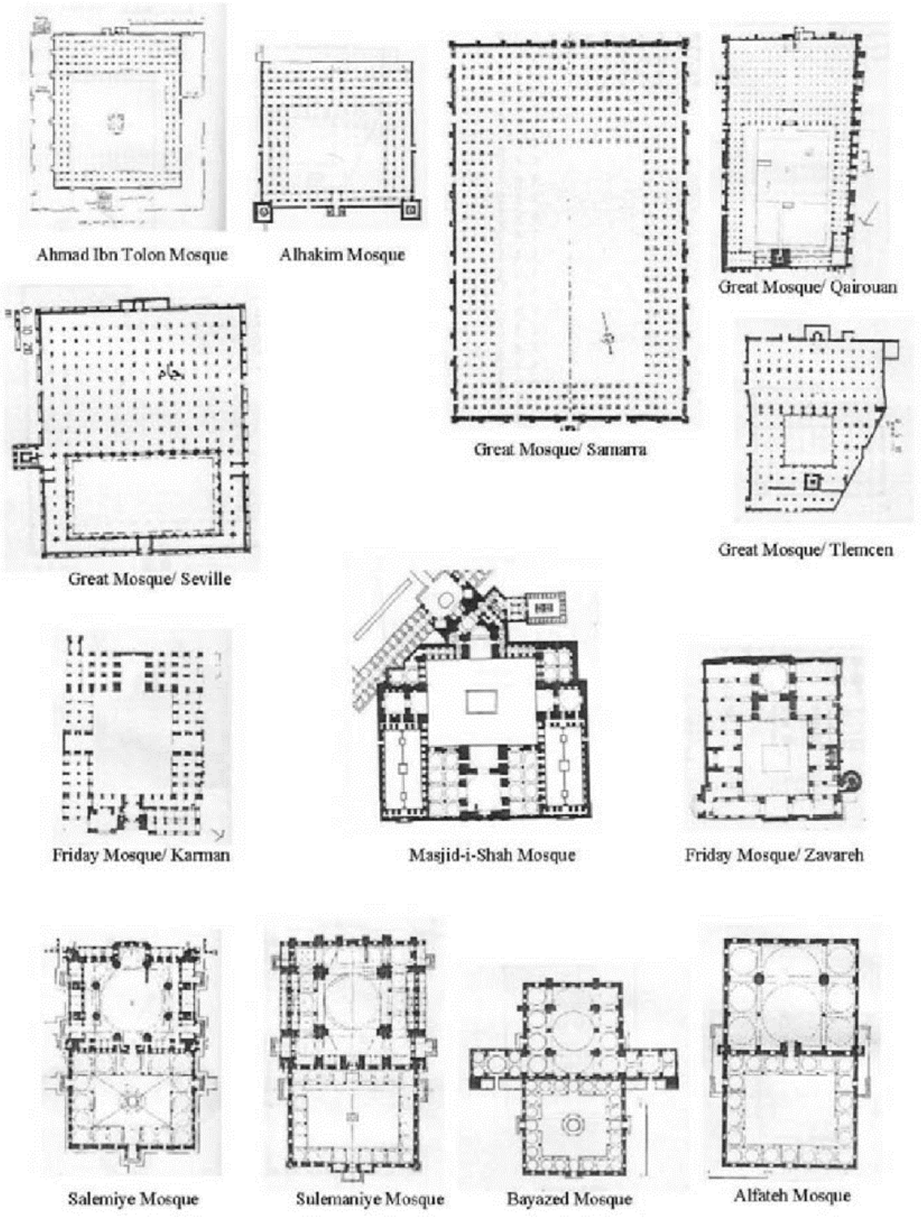
Masjid Planning

The revolution in mosque (masjid) **design planning** is marked by a modern and innovative approach.

Architects are incorporating sustainability features such as the **courtyard**, ensuring accessibility, and creating **multipurpose spaces** to cater to changing community needs.

The fusion of traditional elements with **modern aesthetics** and the use of advanced technology has resulted in visually stunning and functional mosque structures that respect tradition while embracing the future.

This revolution reflects a commitment to inclusivity, sustainability, and the evolving role of mosques in contemporary society.

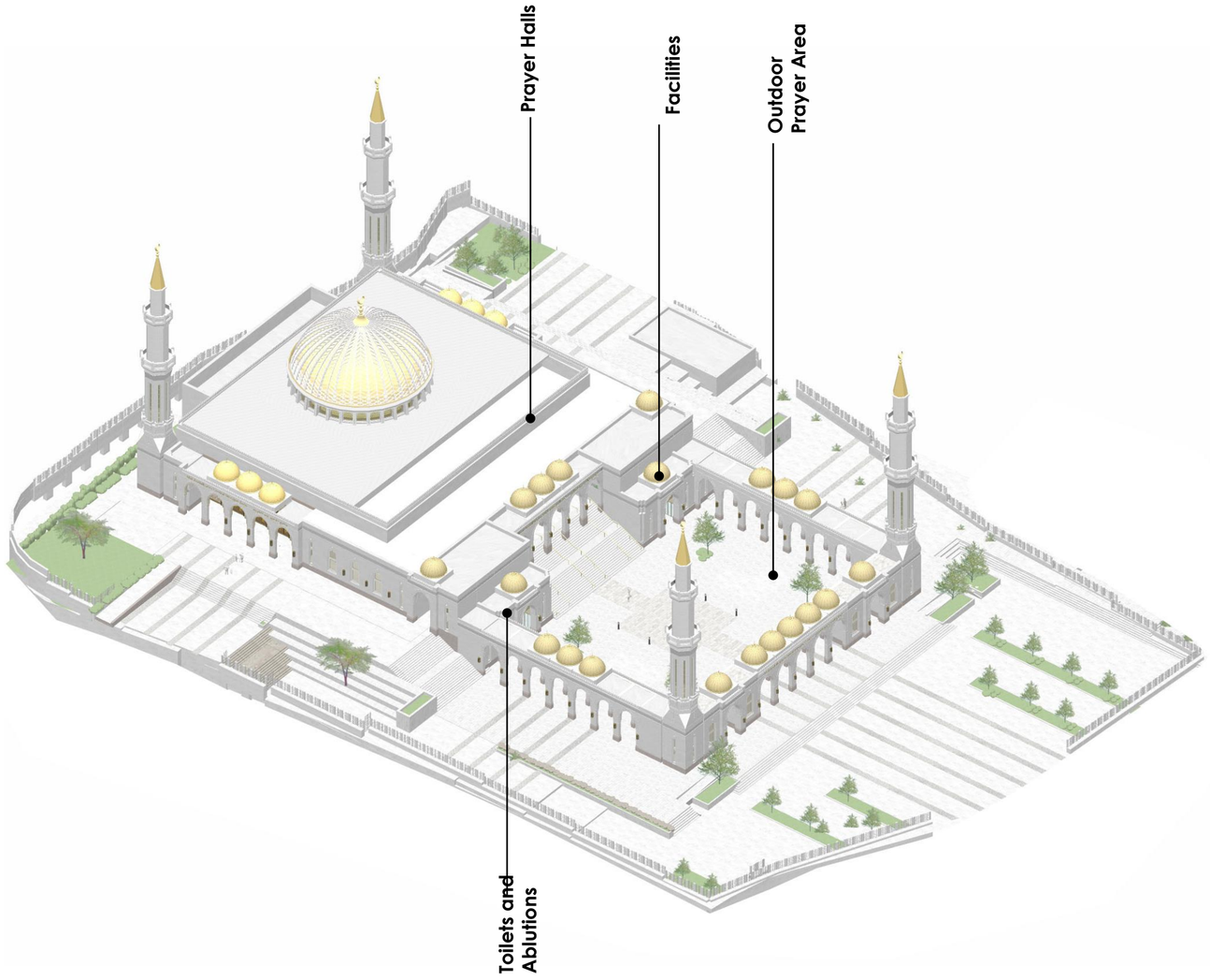


Development Program

Development Program

Space Type	Occupants	Area	m²	Comments
Lower Ground Floor Plan		**1120**		
Ablutions		210	m²	1 For each 25
Toilets		200	m²	1 For each 100
Arcades		545	m²	
Burial Preparations		35	m²	
Horizontal Circulations		40	m²	
MEP (Electro-mechanical)		40	m²	
Minarets		50	m²	
Open To Sky Court		1540	m²	Not Included In BUA
Outdoor Stairs		300	m²	Not Included In BUA
Upper Ground Floor Plan		**3350**		
Women Prayer Hall	350	375	m²	
Main Prayer Hall	1450	1380	m²	
Daily Prayer Hall	200	225	m²	
Ablutions		40	m²	1 For each 25
Women Toilets		40	m²	1 For each 100
Admins		60	m²	
Horizontal Circulations		180	m²	
Learning Center		110	m²	
Library		100	m²	
Meeting Room		110	m²	
Mehrab & Emir Services		160	m²	
MEP (Electro-mechanical)		135	m²	
Minarets		50	m²	
Shoe-Racks		110	m²	
Side - Entrance		210	m²	
Main Entrance		65	m²	Not Included In BUA
Extra Works		**22075.79**		
Outdoor Praying Area	7000 : 5000	7740	m²	Not Included In BUA
Fence		483	m	Not Included In BUA
Underground Tanks & Pump Rooms		286.7	m²	Not Included In BUA
Electrical Substation & Generator Room		136.09	m²	
Utilities And Site Works		13430	m²	Not Included In BUA
Total BUA		**4606**	**m²**	

Program Allocation



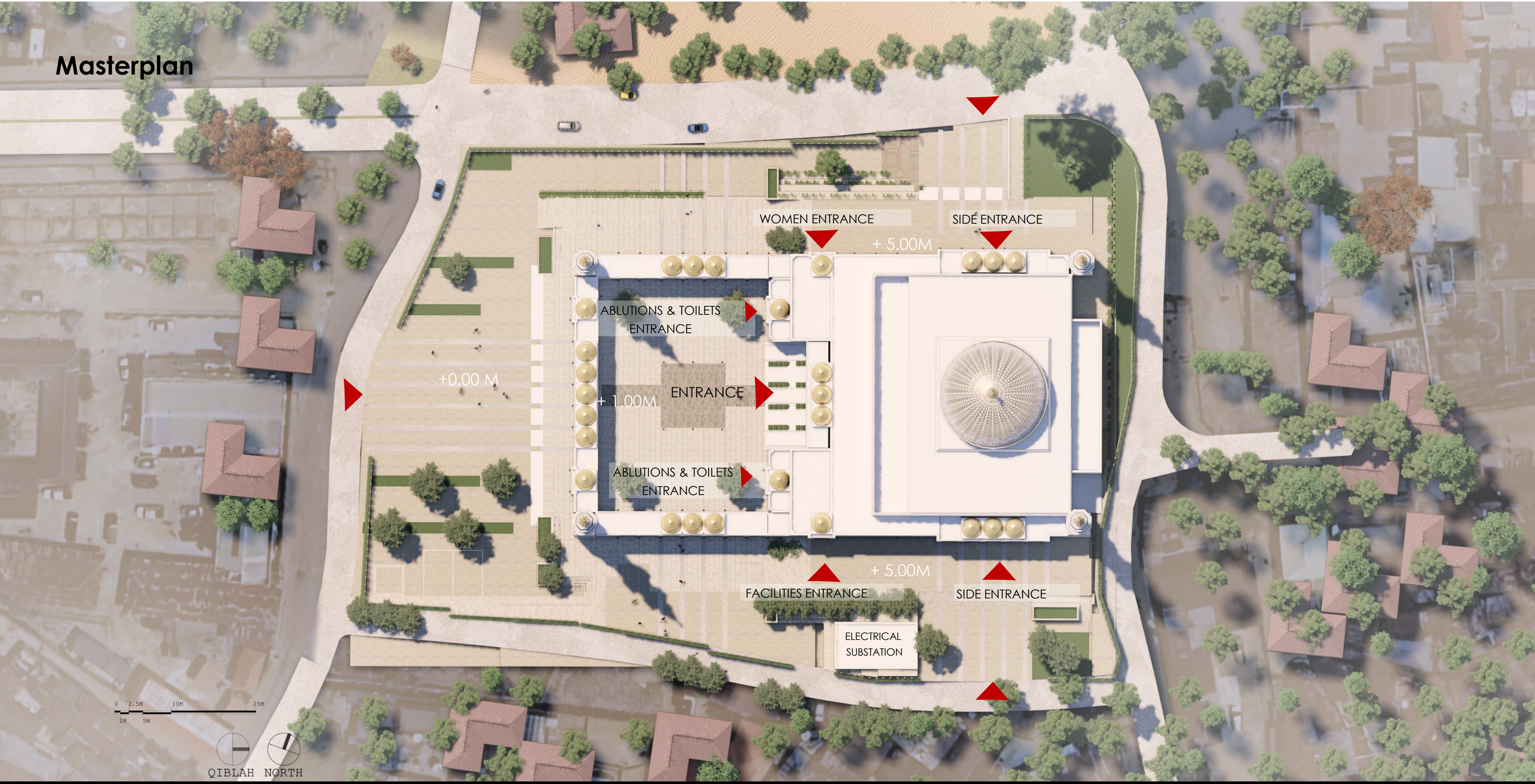
Prayer Halls
The mosque's prayer hall is the core gathering space for worshippers. With its intricate design and a mihrab indicating the direction of Mecca, it accommodates worshippers of all sizes with organized rows of prayer mats.

Prayer Amenities
In a mosque, prayer amenities such as restrooms and ablution areas are thoughtfully designed for the comfort and convenience of worshippers. These facilities ensure that worshippers can maintain personal hygiene and perform ablution before prayers.

Community Hub
The courtyard in a mosque serves as a vital community hub within the architectural design. It offers a serene space for congregational prayers, personal reflection, and communal gatherings.

Plans

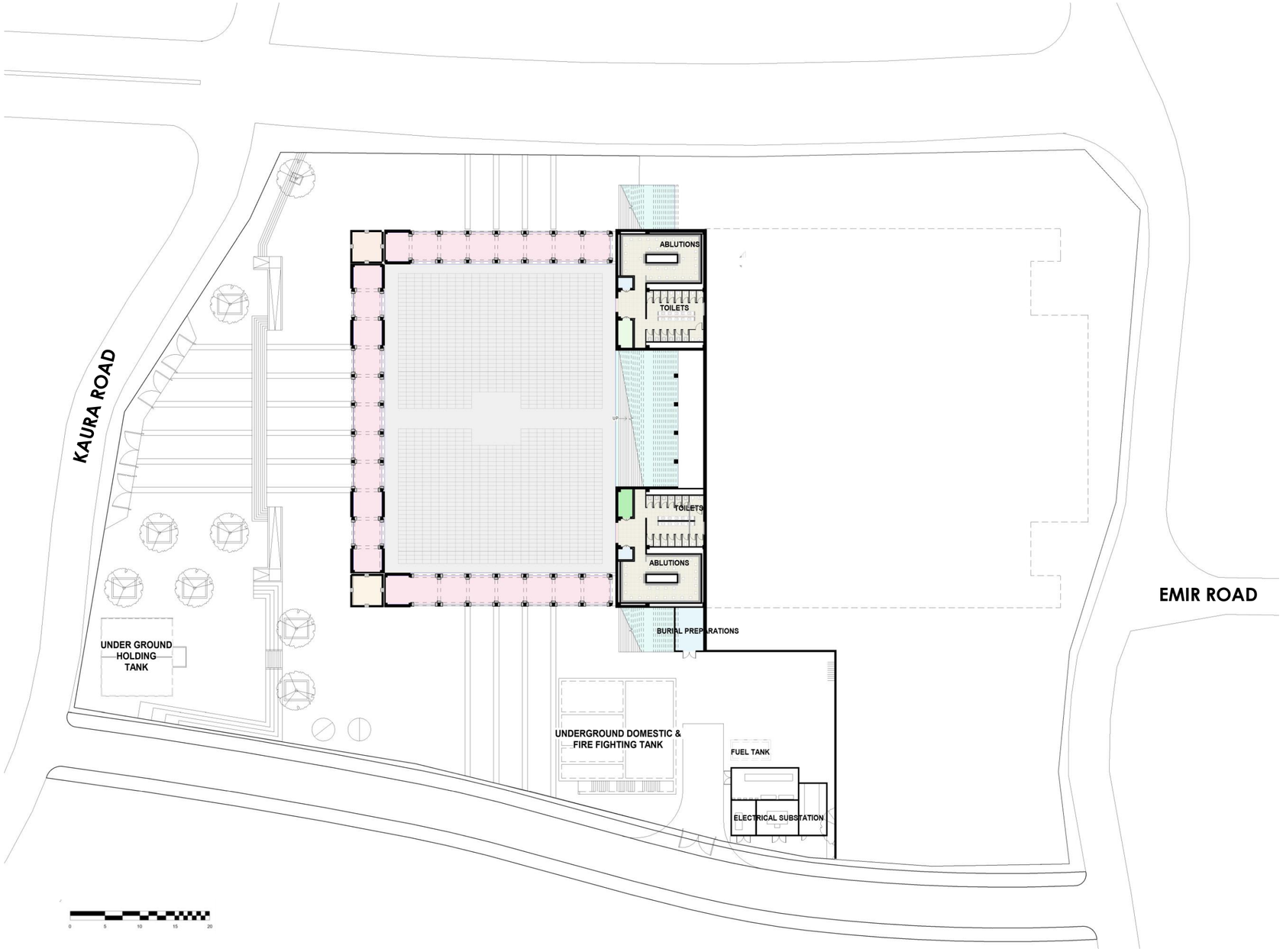
Masterplan


WOMEN ENTRANCE
SIDE ENTRANCE
+ 5.00M
ABLUTIONS & TOILETS
ENTRANCE
+0.00 M
+ 1.00M
ENTRANCE
ABLUTIONS & TOILETS
ENTRANCE
+ 5.00M
FACILITIES ENTRANCE
SIDE ENTRANCE
ELECTRICAL
SUBSTATION
0 2.5M 10M 25M
1M 5M
QIBLAH NORTH

Lower Ground Floor Plan

The Lower Ground Floor will accommodate:

- A courtyard space to accommodate **1600** worshippers.
- External Piazza to accommodate as additional **5000** to **7000** worshippers.
- The number of toilets and ablution facilities are designed to accommodate the worshippers in the main prayer hall as well as 50% of the worshippers in the courtyard area.



Space Type	Area m²	Comments
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Minarets	50 m²	
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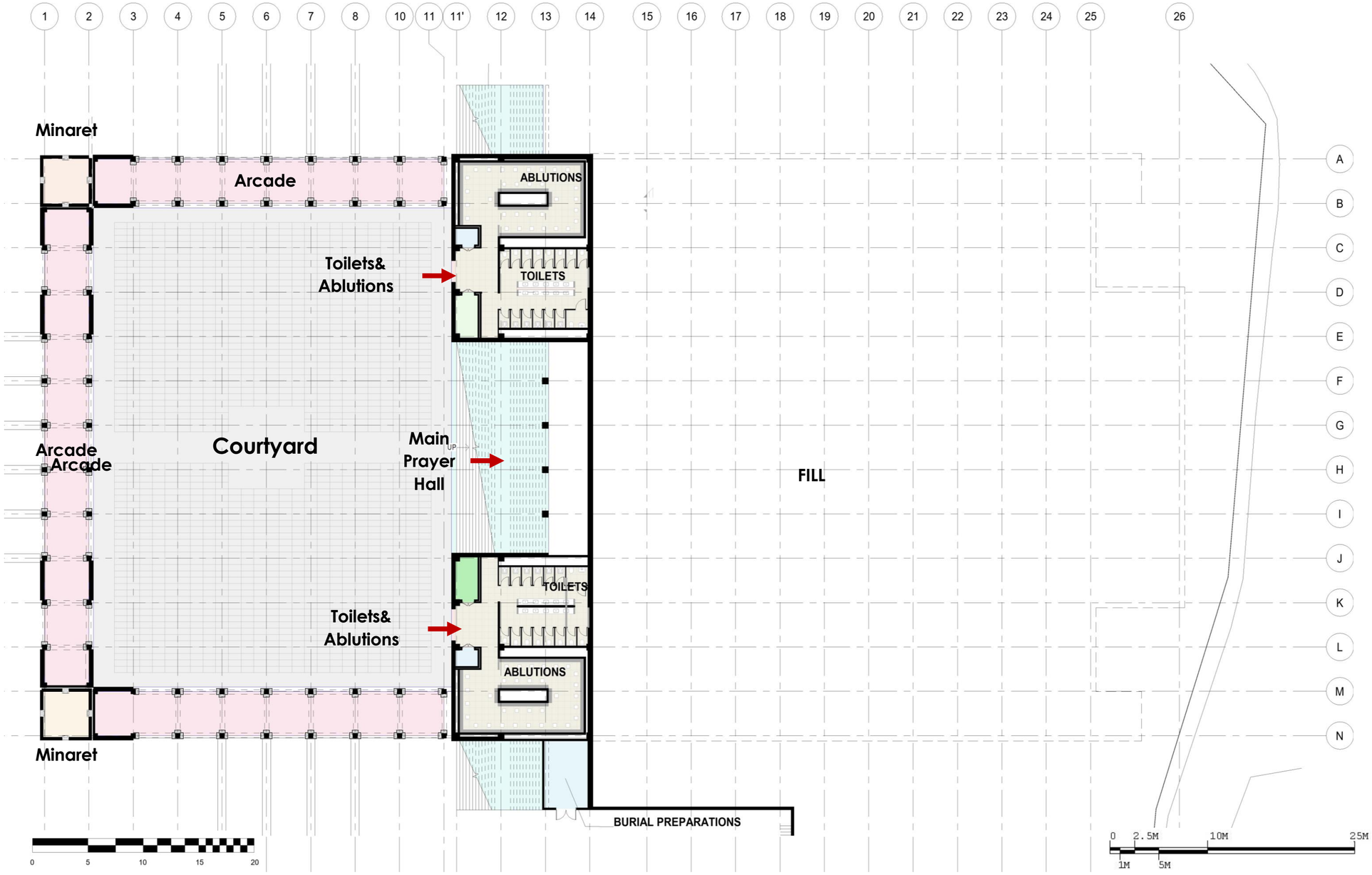
Outdoor Stairs	300 m²	Not Included In BUA

Lower Ground Floor Plan



Upper Ground Floor Plan

The upper ground floor will accommodate:

- A total of **2000** worshippers on the upper ground floor:

1650 for men (1450 in the main hall + 200 in the daily prayer hall)

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Learning Center		110	m²	
Library		100	m²	
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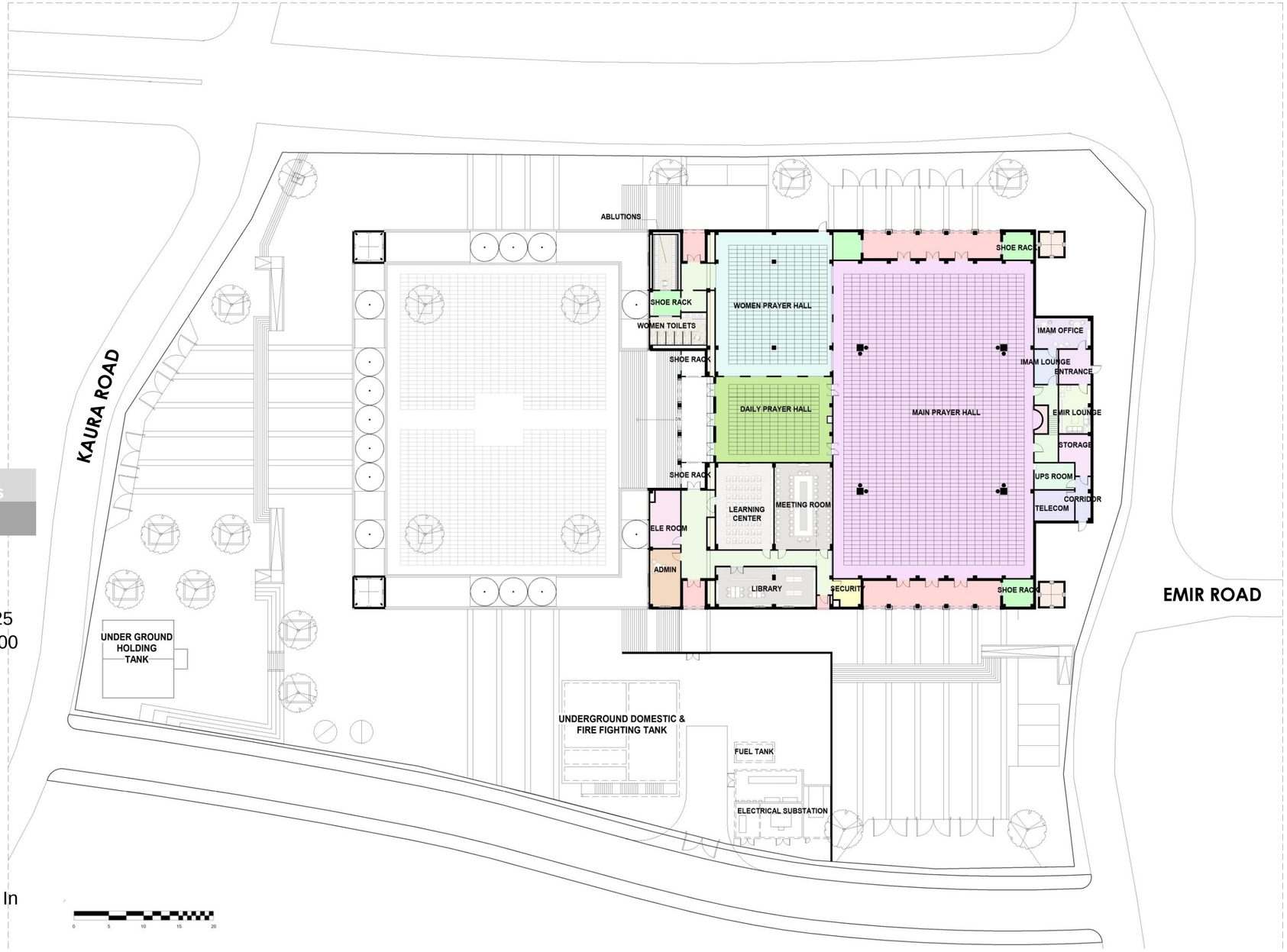
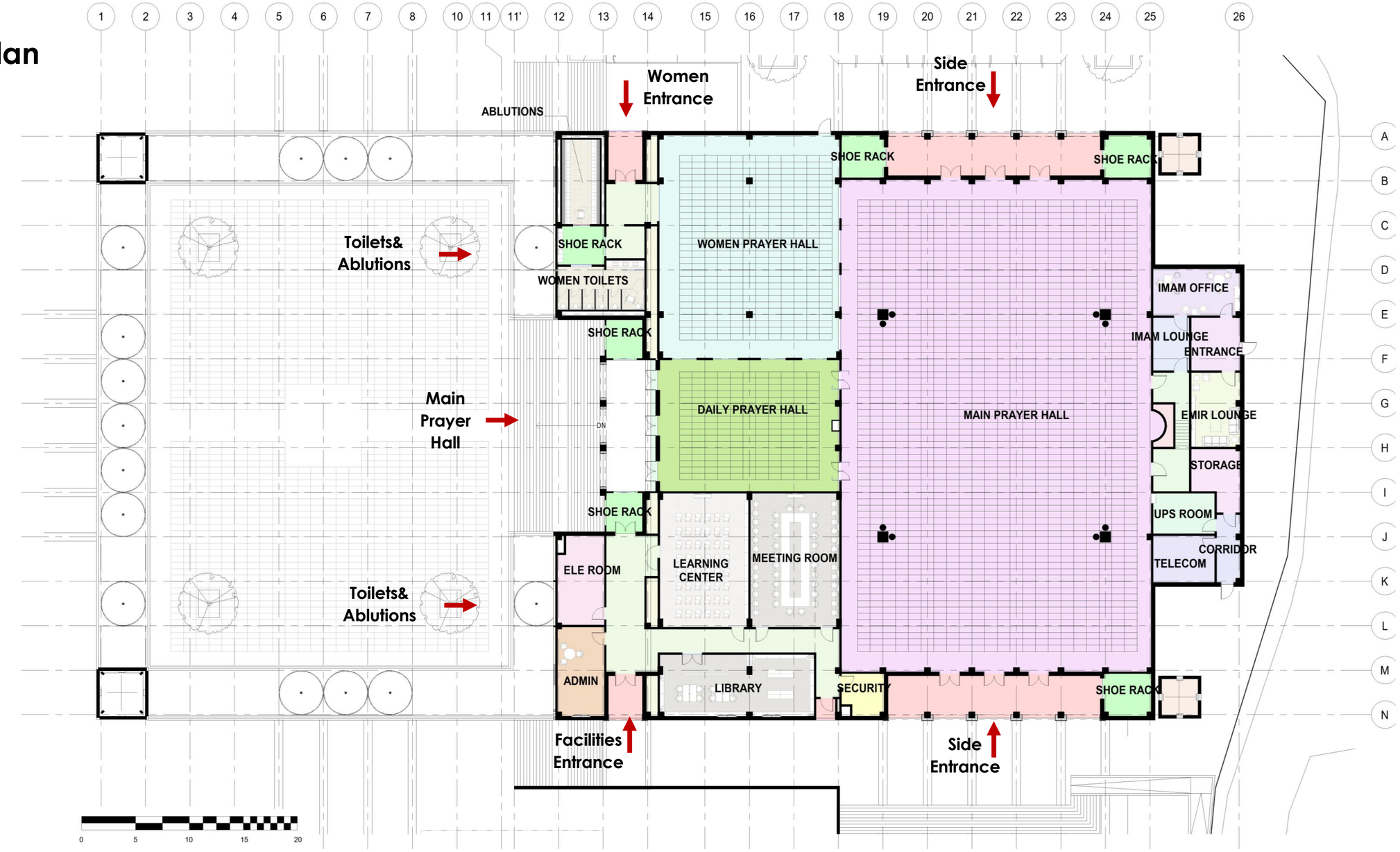
MEP (Electro-mechanical)		135	m²	
Minarets		50	m²	
Shoe-racks		110	m²	
Side - Entrance		210	m²	
Main Entrance		65	m²	Not Included In BUA



Upper Ground Floor Plan



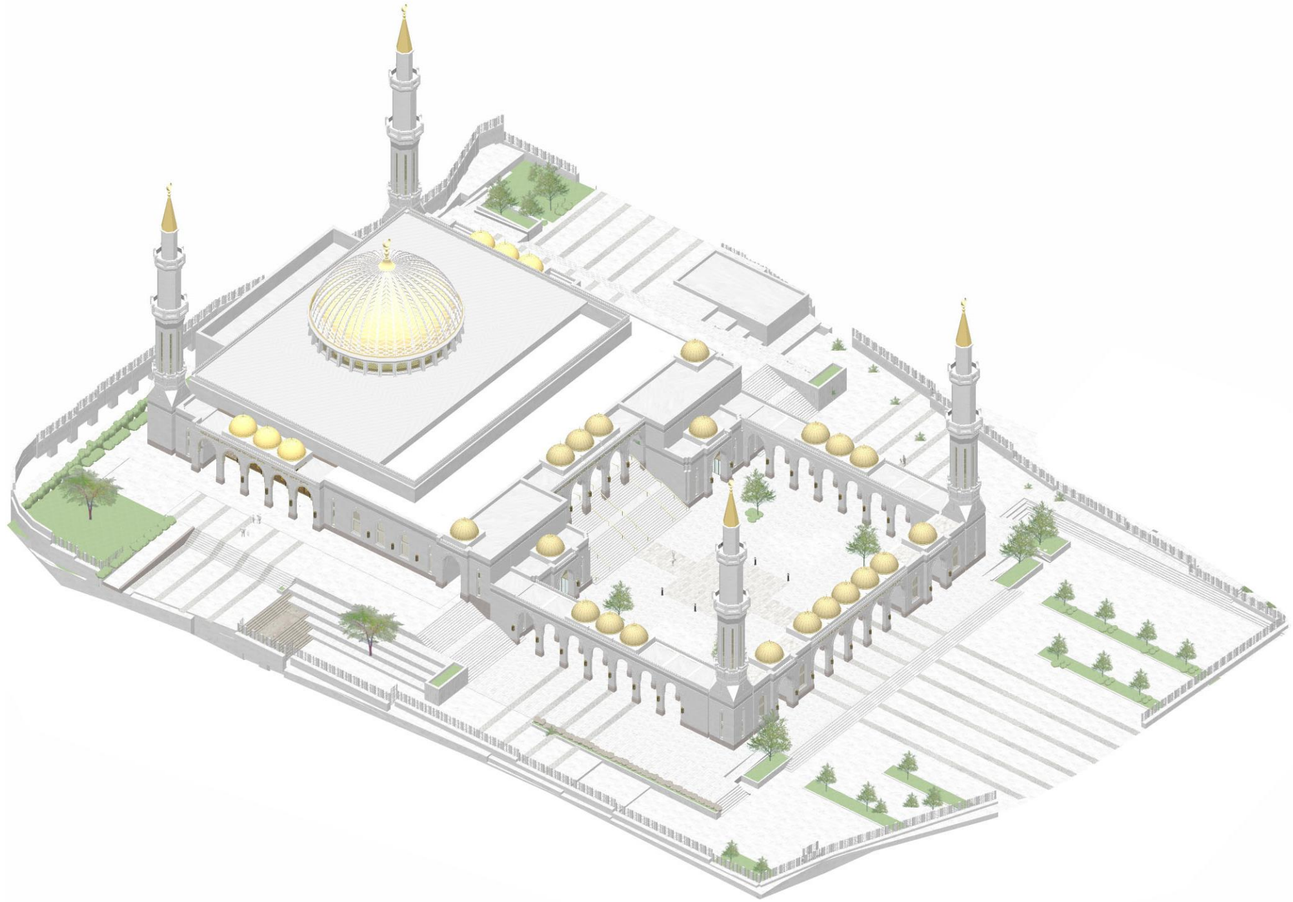
Character Influence

Character Influence

Our design is sensitive to its context by seeking integration with the context and **blends old and new** to create a unique and iconic architecture character.

Designing **harmonious masses** that seamlessly blends architectural beauty with functionality, fostering unity and spirituality in communal worship, within the city context.

Design Influences **inspired by the context** that follow the takes from the **spirit and authenticity** found in Zaria's heritage.

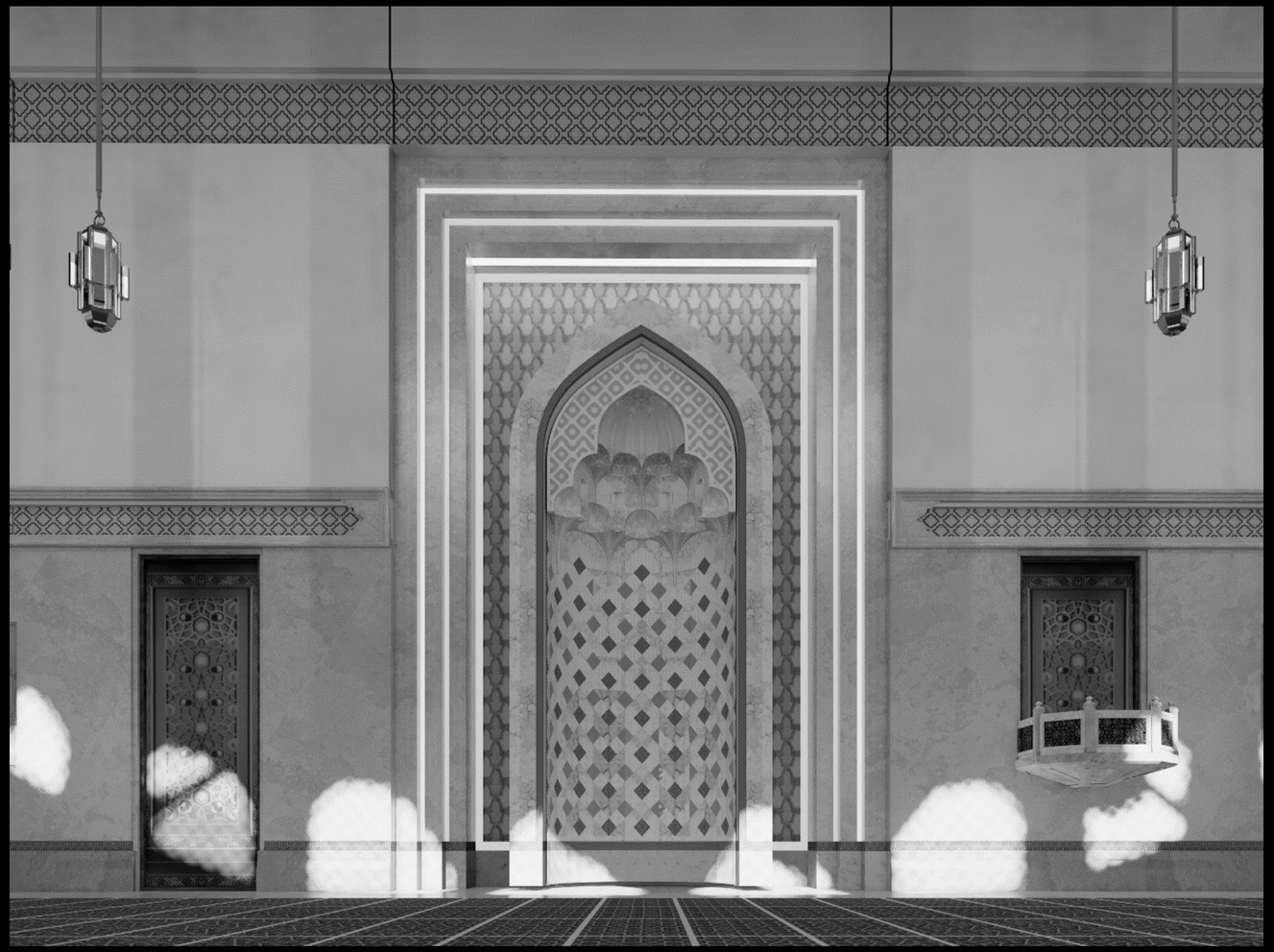


The exterior predominantly features **white finishing,** making the mosque **a prominent landmark** in the surrounding area

Introducing **continuity and modularity** through the repetition of arches along the courtyard guides the eye and adds a **sense of rhythm to the design**.

The arcade creates an **interplay of light and shadow** to evoke a serene and inviting atmosphere, enhancing the overall spiritual experience within the mosque.

The mosque **incorporates intricate details and patterns**, showcase the rich artistic traditions of Islamic and local culture



MIHRAB

Perspectives


EMIR ABDUL KARIM AMIR EL MOSQUE جامع الأمير عبد الكريم


Mal Abdulkarim Central Mosque Zaria
جامع الأمير عبد الكريم

The minarets stand taller than the surrounding structures, serving as a **beacon of modernity and tradition** in the city of Zaria.

Standing as a luminous beacon amidst its surroundings, and showcasing a seamless blend of **modern elements with traditional Islam influences**, creating a harmonious balance.

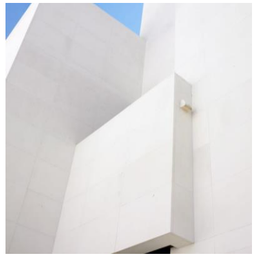

Mal Abdulkarim Central Mosque Zaria
جامع الأمير عبد الكريم


8.50 M

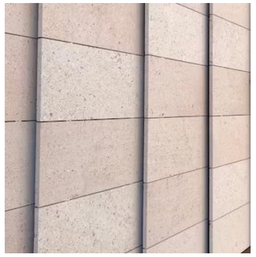
Materials

EXTERIOR MATERIALITY

01 CALIZA CAPRI LIMESTONE



02 ROSAL LIMESTONE (SKIRTING)



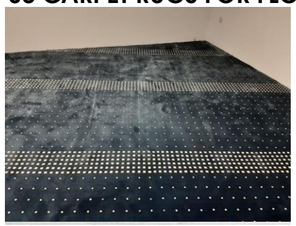
03 GOLDEN ELECTROPLATED METAL CLADDING

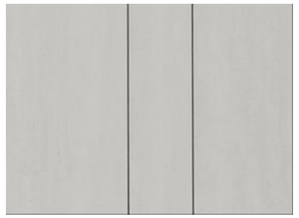
INTERIOR MATERIALITY

01 PORCELAIN TILES – FLORENCE BIANCO

02 PAINT

03 CARPET RUGS FOR FLOORING

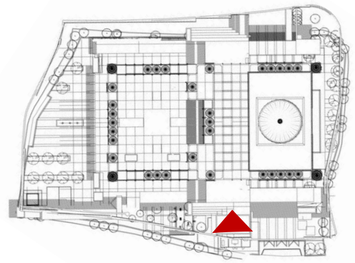


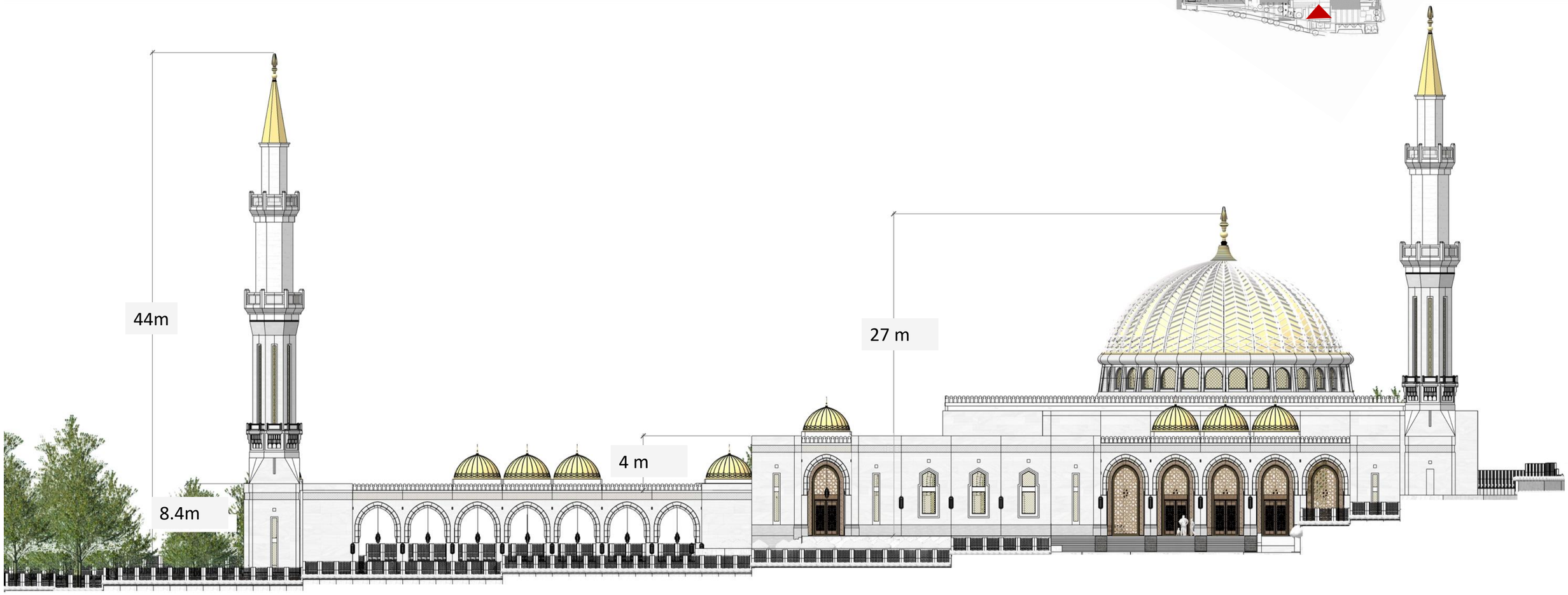


04 GRC CEILING

Elevations

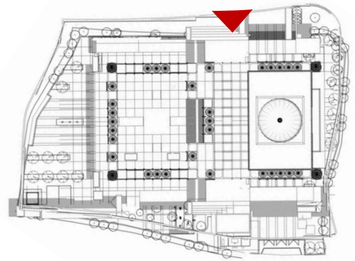
ELEVATIONS

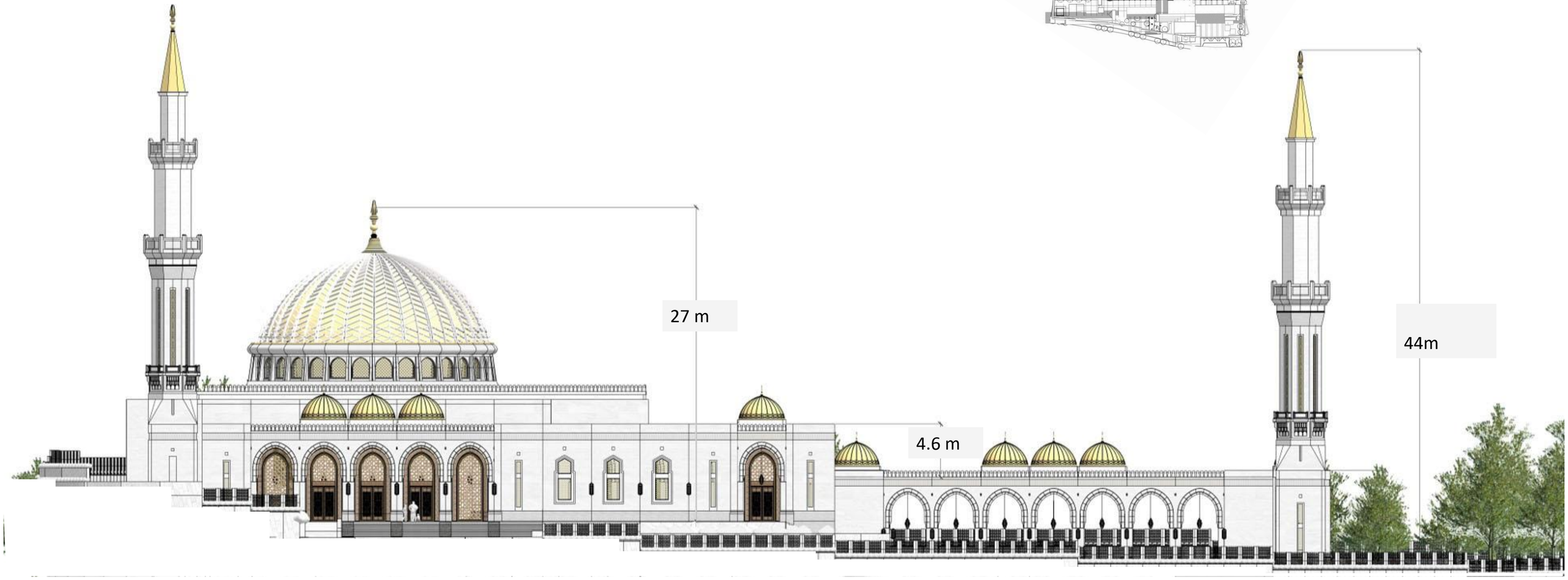




SIDE ELEVATION

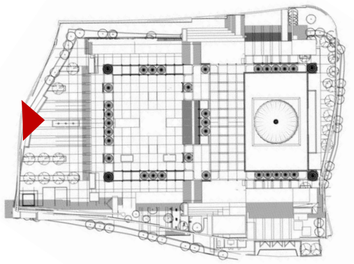
ELEVATIONS

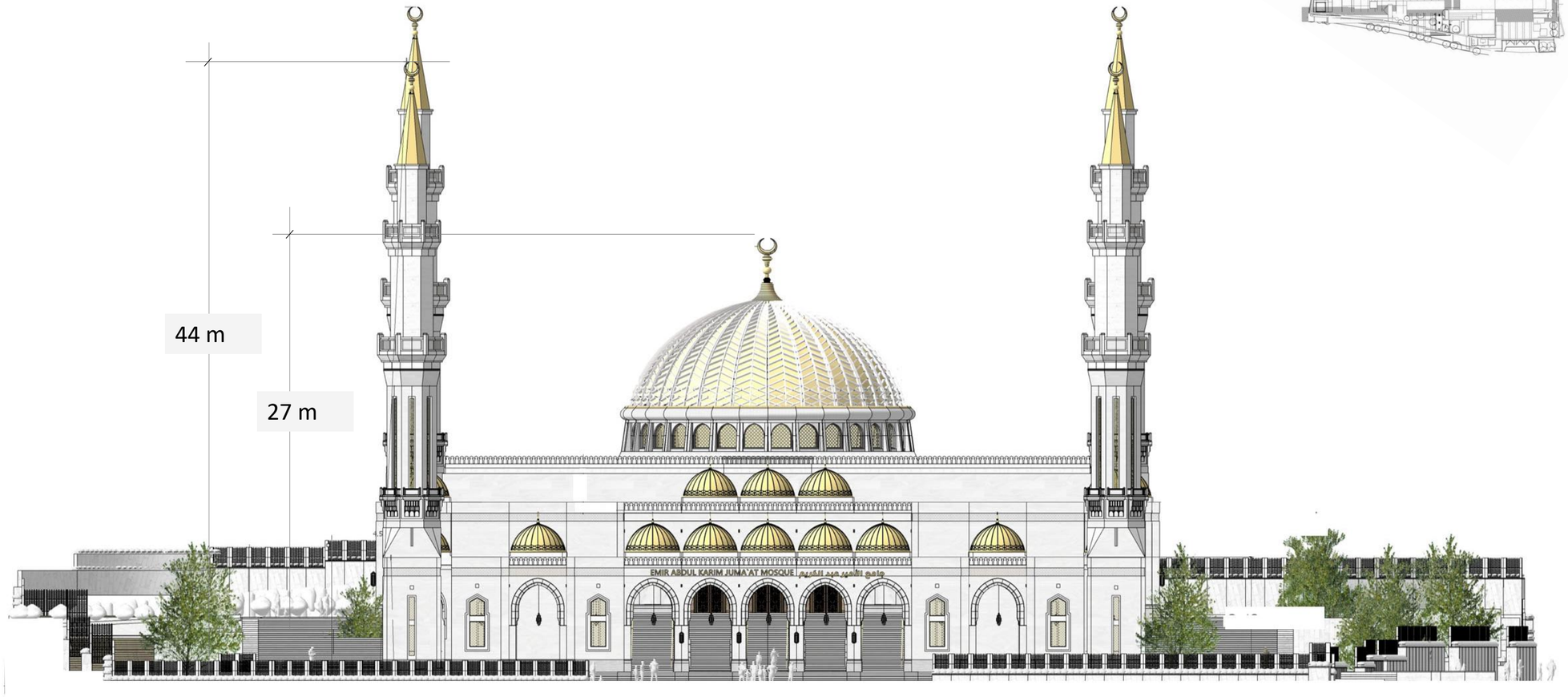




SIDE ELEVATION

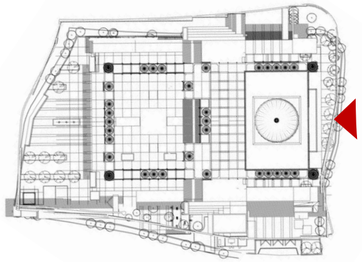
ELEVATIONS

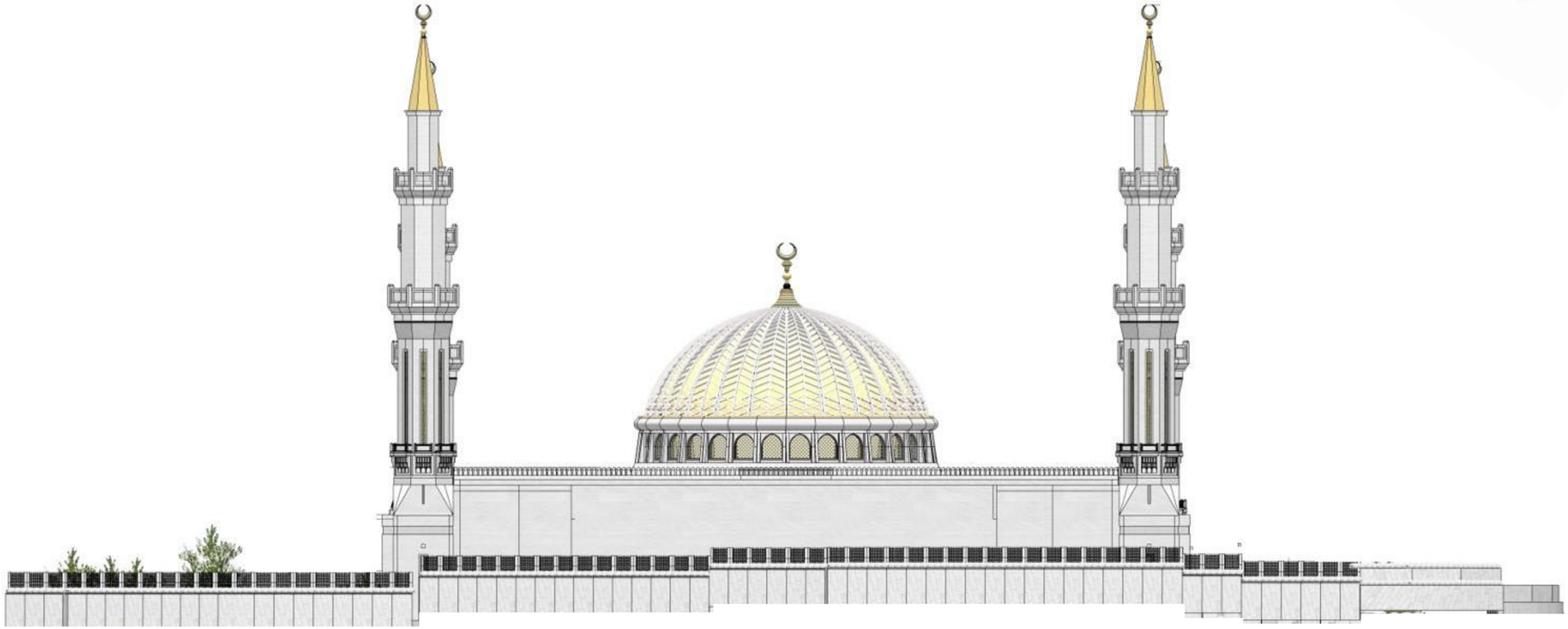




MAIN ENTRANCE ELEVATION

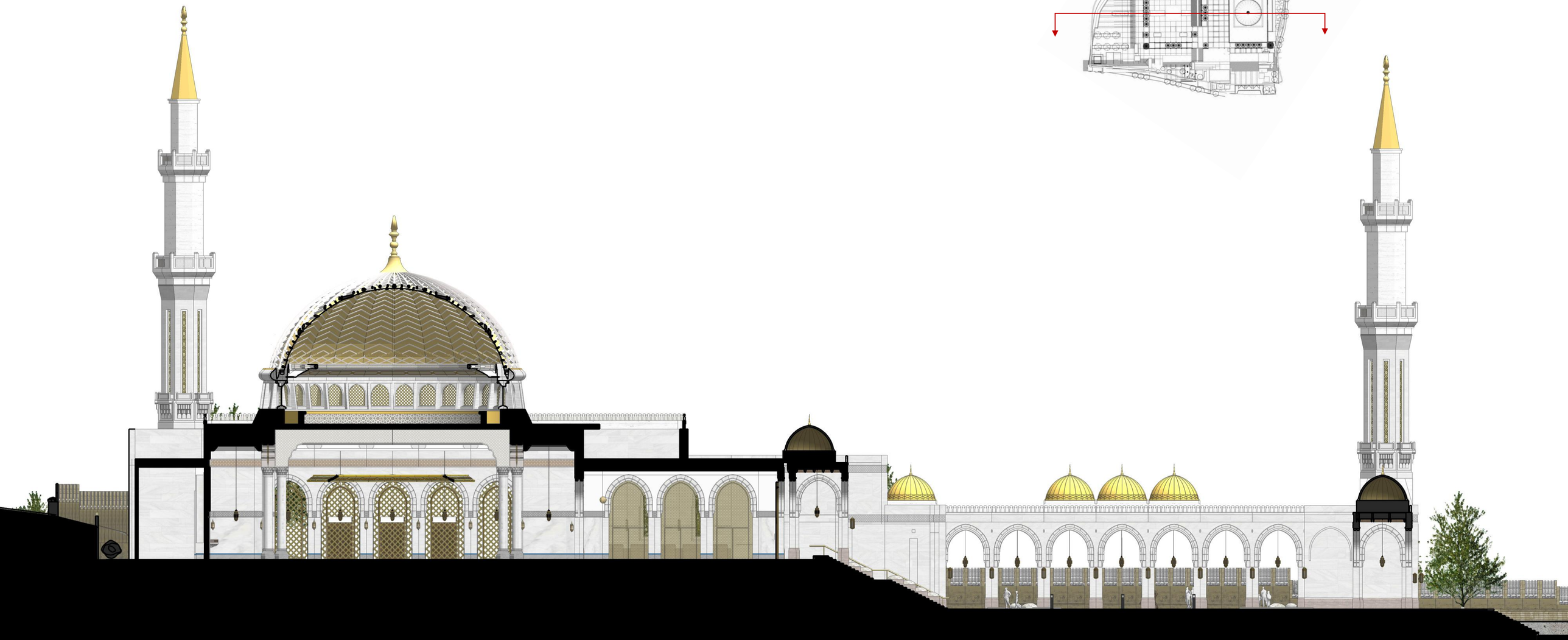
ELEVATIONS





QUBLIA ELEVATION

SECTION



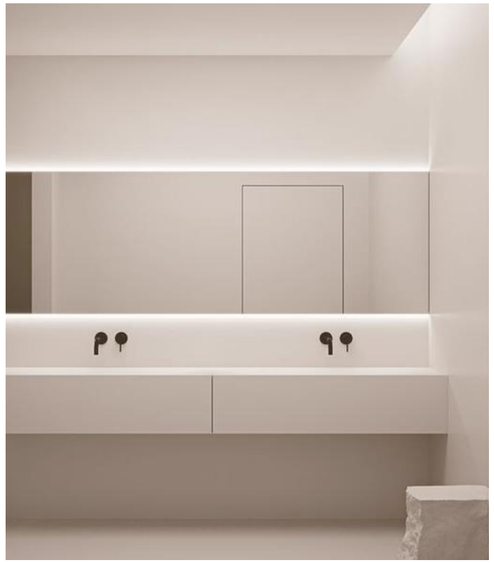
03 Interior Design

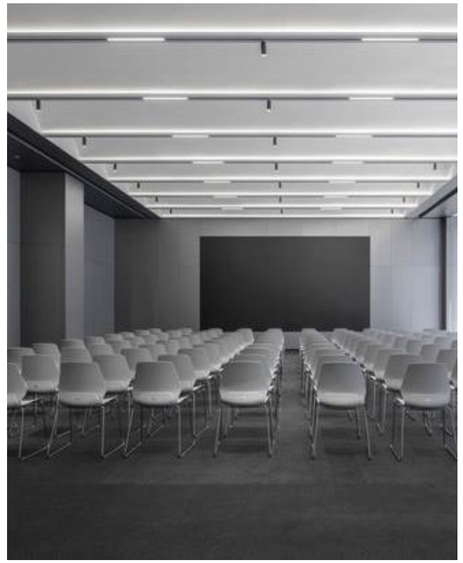
INTRODUCTION

The mosque's meeting room, office, library, and ablution area have been meticulously designed to foster a sense of harmony and peace. The meeting room, with its white walls and ceilings, embodies purity and serenity. The office space is characterized by a minimalistic and clean aesthetic. In the library, a tranquil ambiance encourages reading, learning, and contemplation, achieved through wooden furniture, gray linear carpeting for a modern touch. The Learning Center serves as a sanctuary for both knowledge and spirituality, featuring white walls. The ablution area harmoniously blends tranquility, employing white walls and earthy tones on porcelain walls and floors, fostering a serene and pure ambiance.
Lastly, the public toilet is a calming space with its white paint and earthy colors porcelain tiles, providing a place for respite and cleanliness.

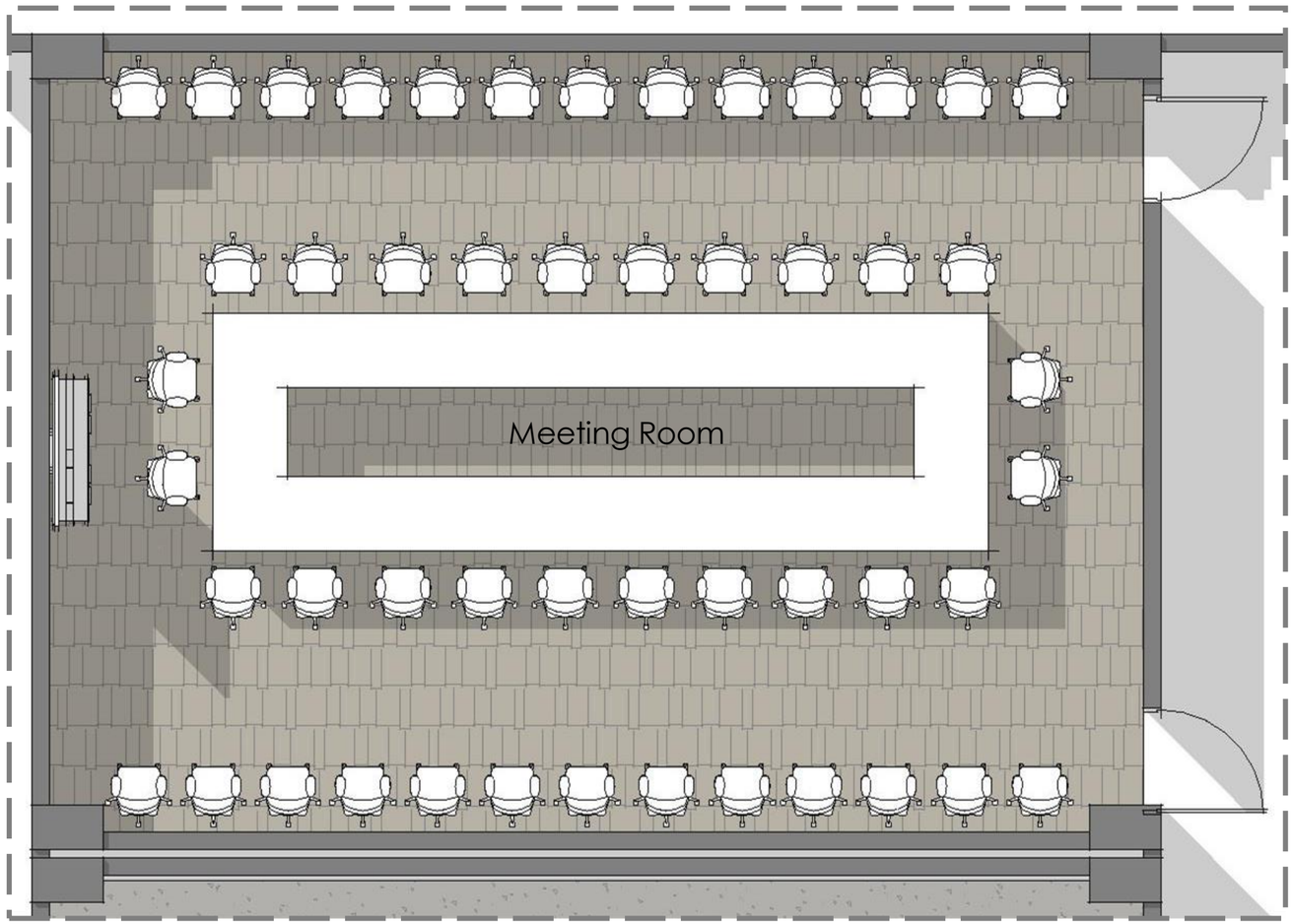
MOSQUE AMENITIES

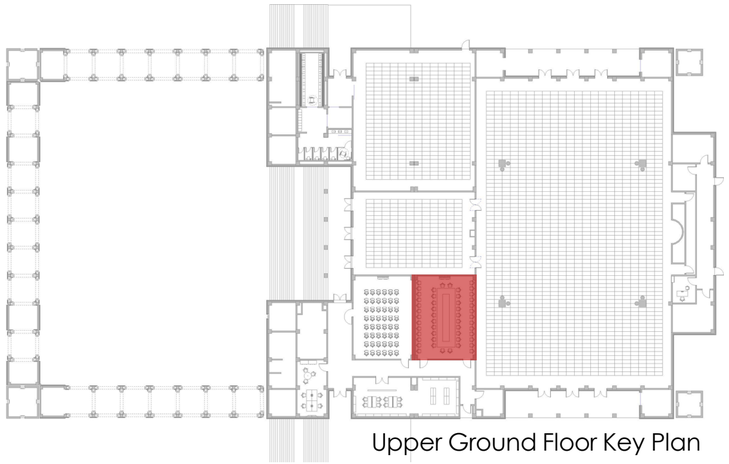
- MEETING ROOM
- LIBRARY
- ICT LEARNING CENTER
- ADMIN & IMAM OFFICE
- ABLUTION
- TOILETS




MEETING ROOM FURNITURE LAYOUT





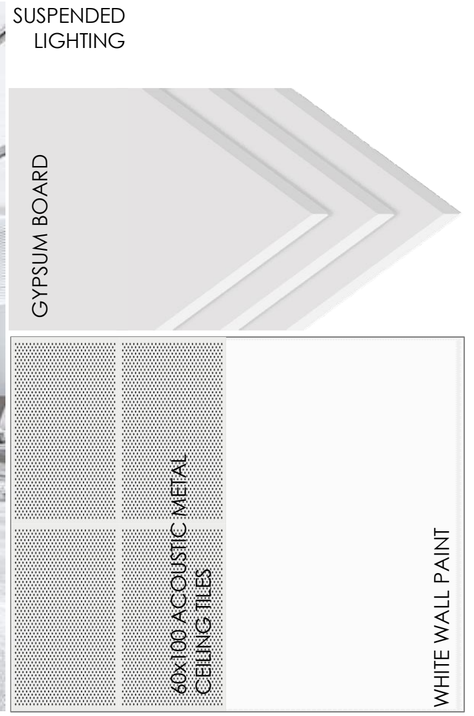
Upper Ground Floor Key Plan

Meeting Room: 8.9 M X 12.4 M

Area: 110 M2

Seats: 50

MEETING ROOM

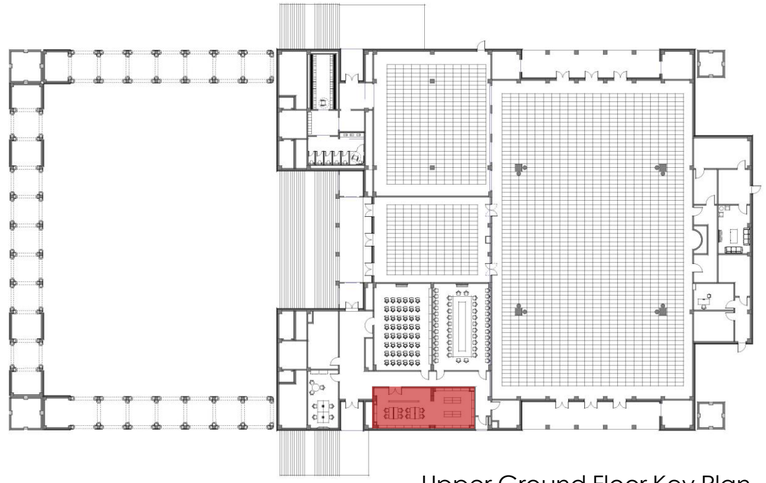


The meeting room for the mosque embraces the concept of "Harmony in Tranquility," fusing the purity of white materials to create a peaceful and inviting space for communal gatherings.
White is the dominant color for walls and ceilings, symbolizing purity and serenity. It reflects light and creates an airy, open feeling, enhancing the sense of calm.

LIBRARY FURNITURE LAYOUT

Library: 15.75 M X 5.8 M

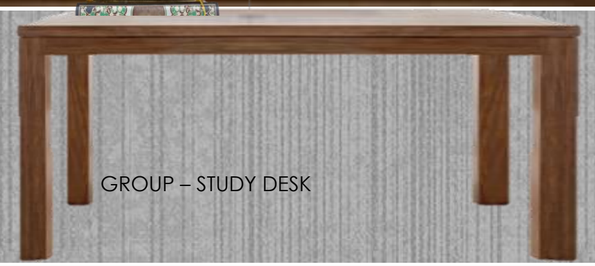
Area: 91 M2



Upper Ground Floor Key Plan

LIBRARY

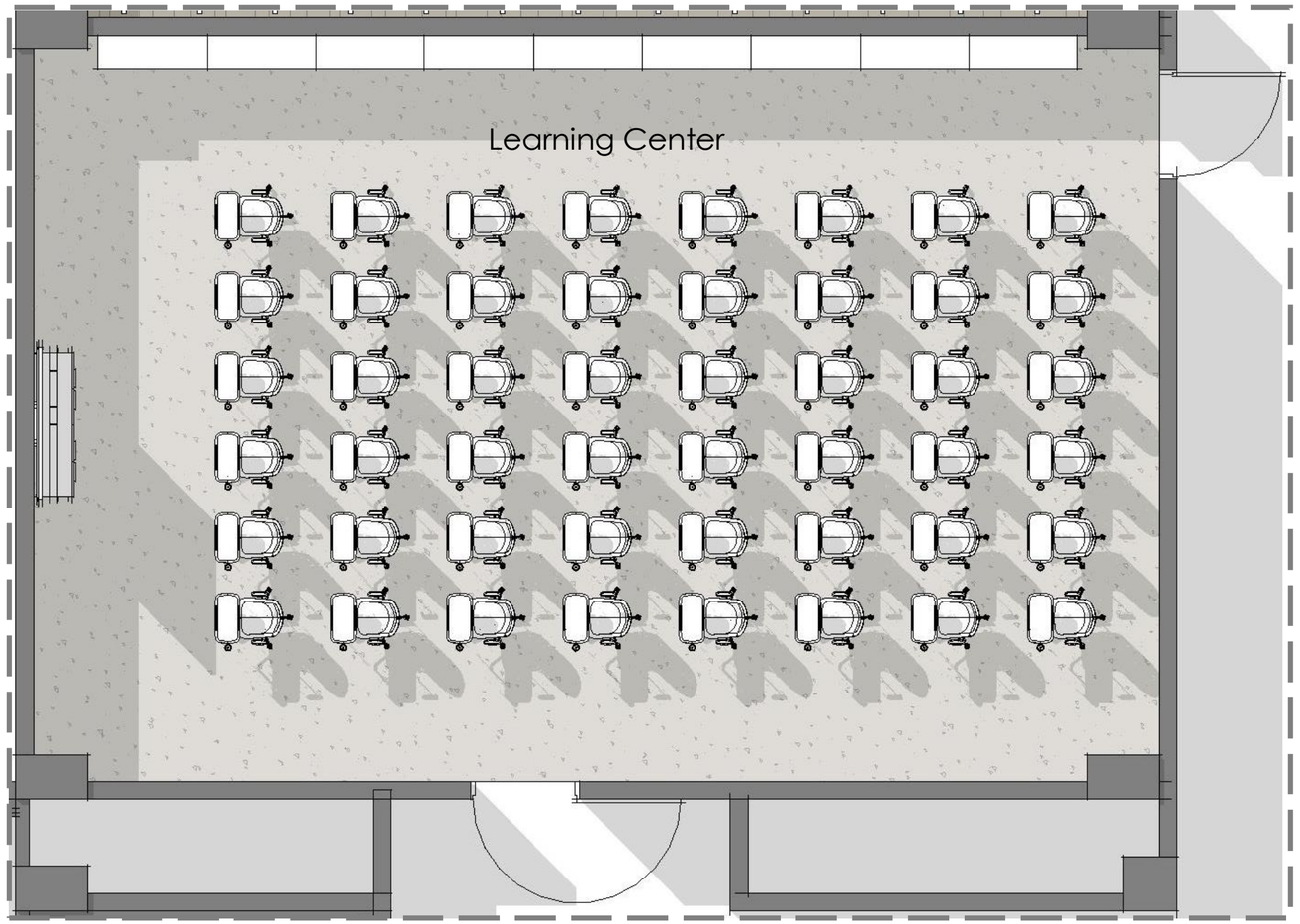
The library is planned to offer a serene and inviting environment for reading, learning, and contemplation. Key features include wooden furniture for a warm and cozy ambiance, white walls, a modern appearance with clean lines, and a comfortable feel with a grey carpeted floor. This library concept is designed to provide a tranquil and pleasant space for learning and reflection within the mosque.



GREY LINEAR CARPET

LIBRARY RENDER

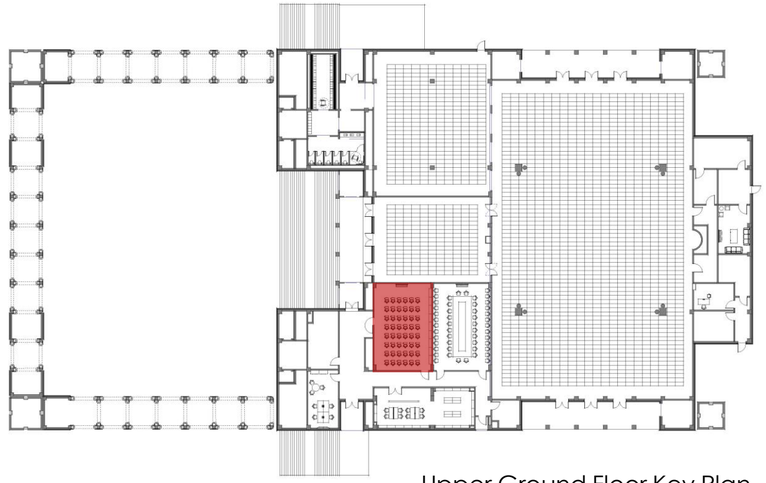
LEARNING CENTER FURNITURE LAYOUT



Learning Center: 8.6 M X 12.4 M

Area: 110 M2

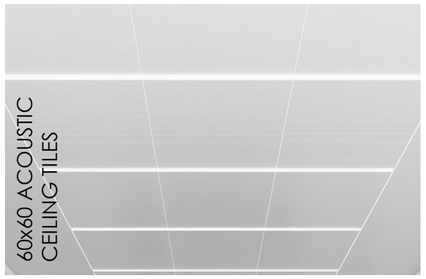
Count: 48



Upper Ground Floor Key Plan

LEARNING CENTER

ARTWORK



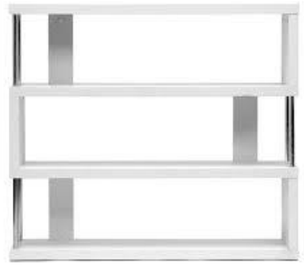
60x60 ACOUSTIC CEILING TILES

GYPSUM BOARD

WHITE WALL PAINT

The Learning Center in the mosque aims to be a sanctuary of knowledge and spirituality, where the use of white paint walls and ceiling creates a harmonious, balanced, and inviting atmosphere for all who seek to learn, grow, and connect within its walls.

PODIUM



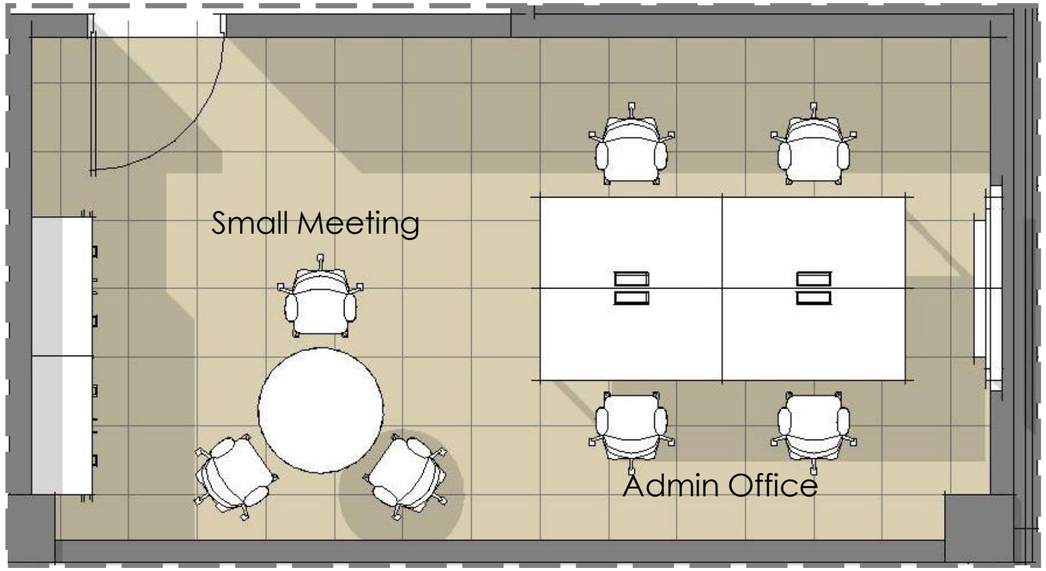
SHELVES

LIGHT GREY VINYL FLOOR TILES

CHAIR WITH WRITING TABLE

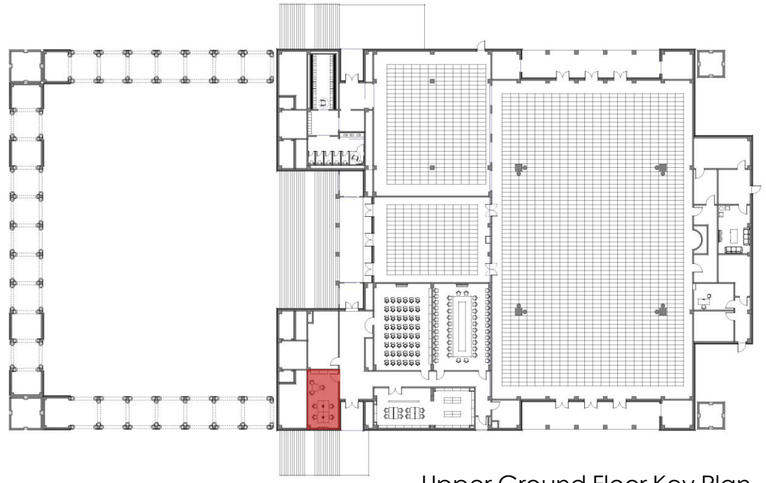
LEARNING CENTER RENDER

ADMIN OFFICE FURNITURE LAYOUT



Admin Office : 4.6 M X 8.6 M

Area: 40 M2



Upper Ground Floor Key Plan

ADMIN & IMAM OFFICE

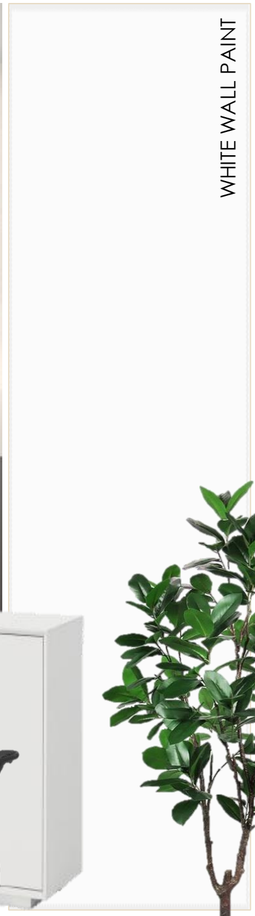
DESK

TASK CHAIR

CABINET

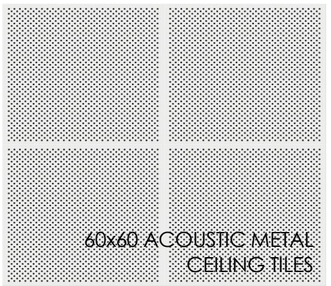
GUEST CHAIR

INTEGRATED GREEMERY



WHITE WALL PAINT

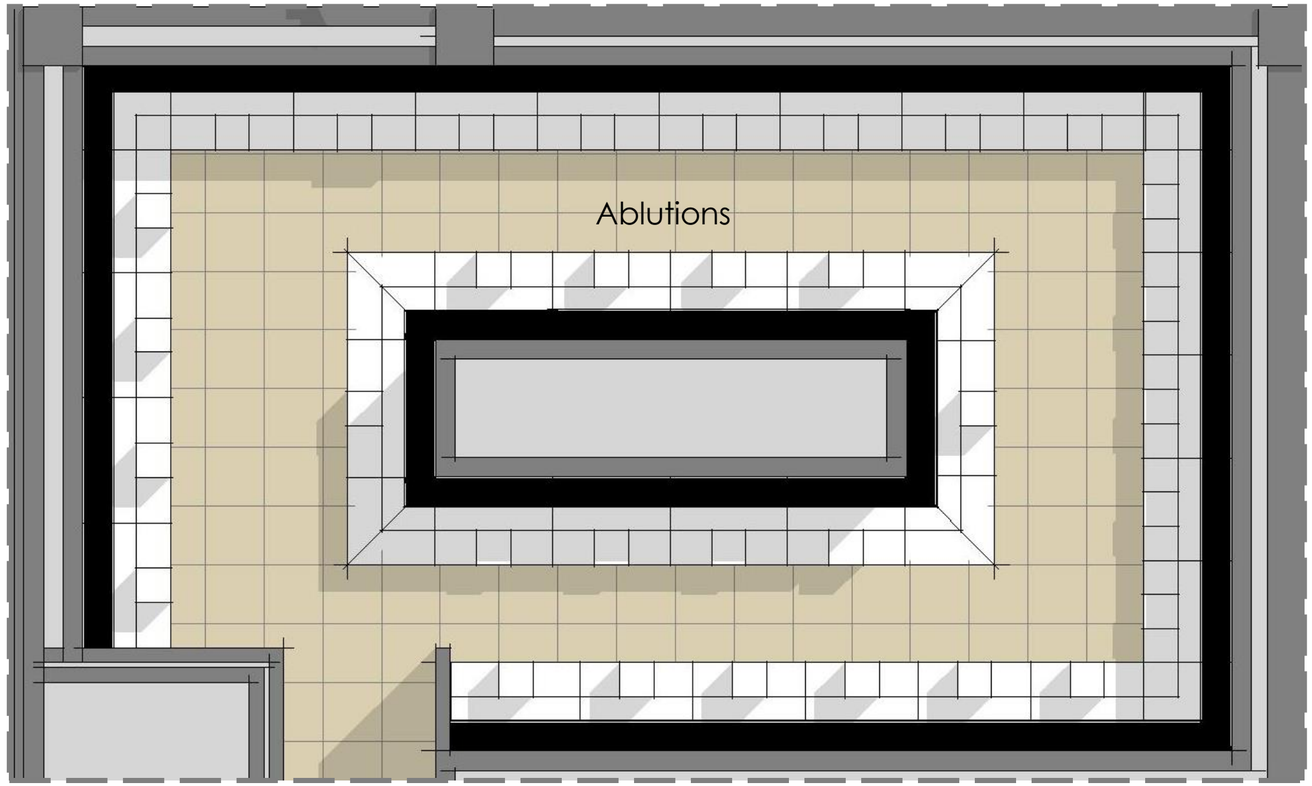
PORCELAIN FLOOR TILE – FLORENCE BEIGE



60x60 ACOUSTIC METAL CEILING TILES

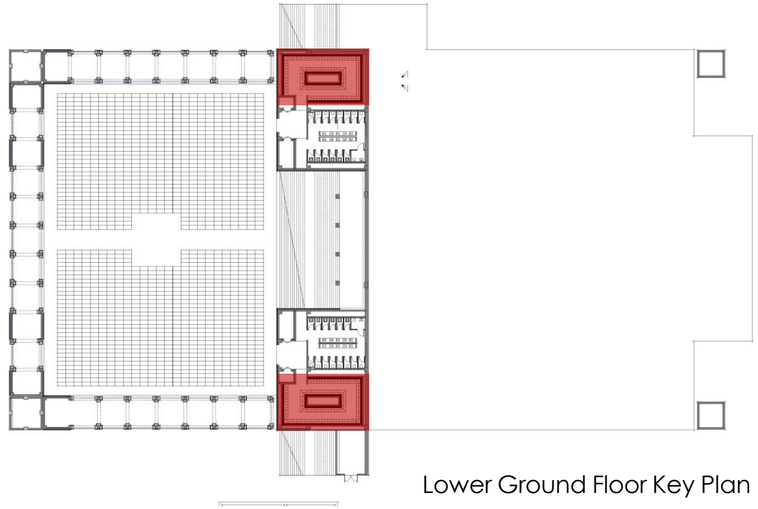
The office space in the mosque embraces a "Serene Office" concept, emphasizing simplicity and peacefulness. It features white materials for a clean and peaceful atmosphere, with minimalistic design. The space is functional offering a serene and efficient work environment.

ABLUTION FURNITURE LAYOUT



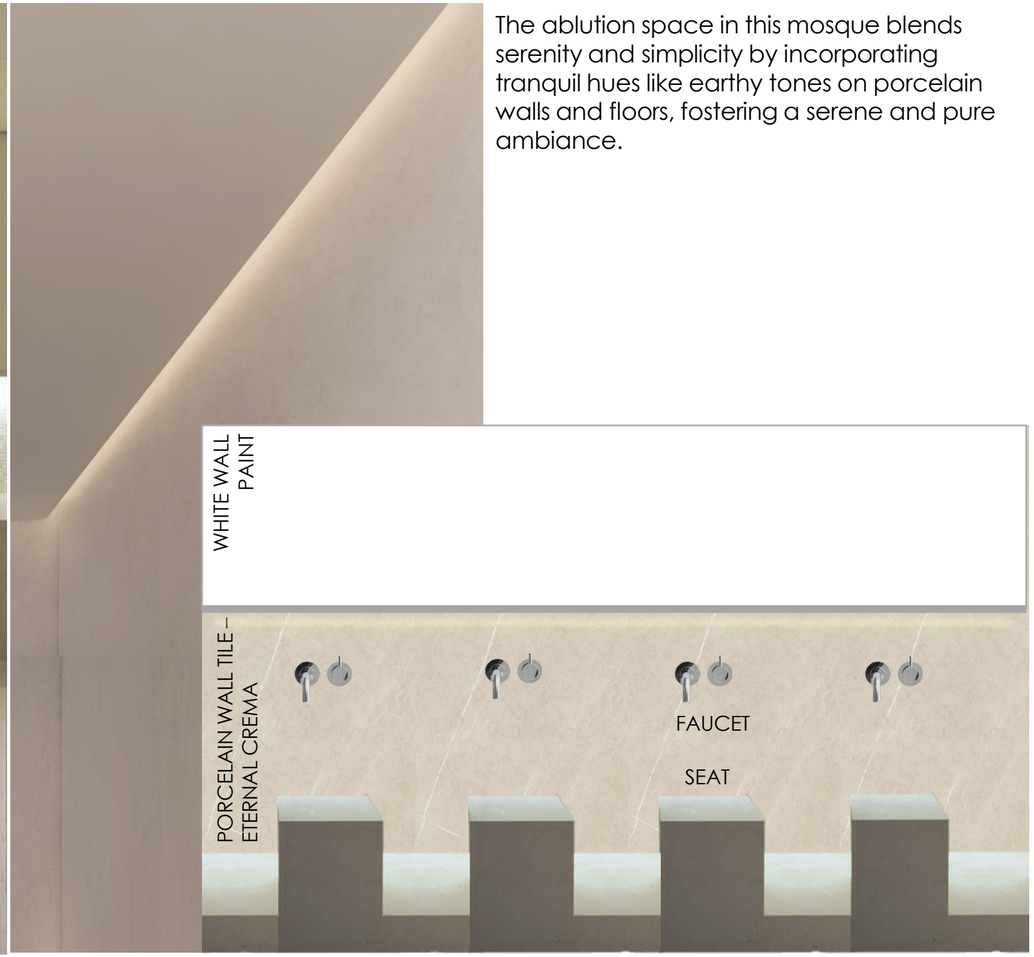
Ablution: 12.5 M X 7.4 M
Count: 33 Ablutions

Area: 93 M2



Lower Ground Floor Key Plan

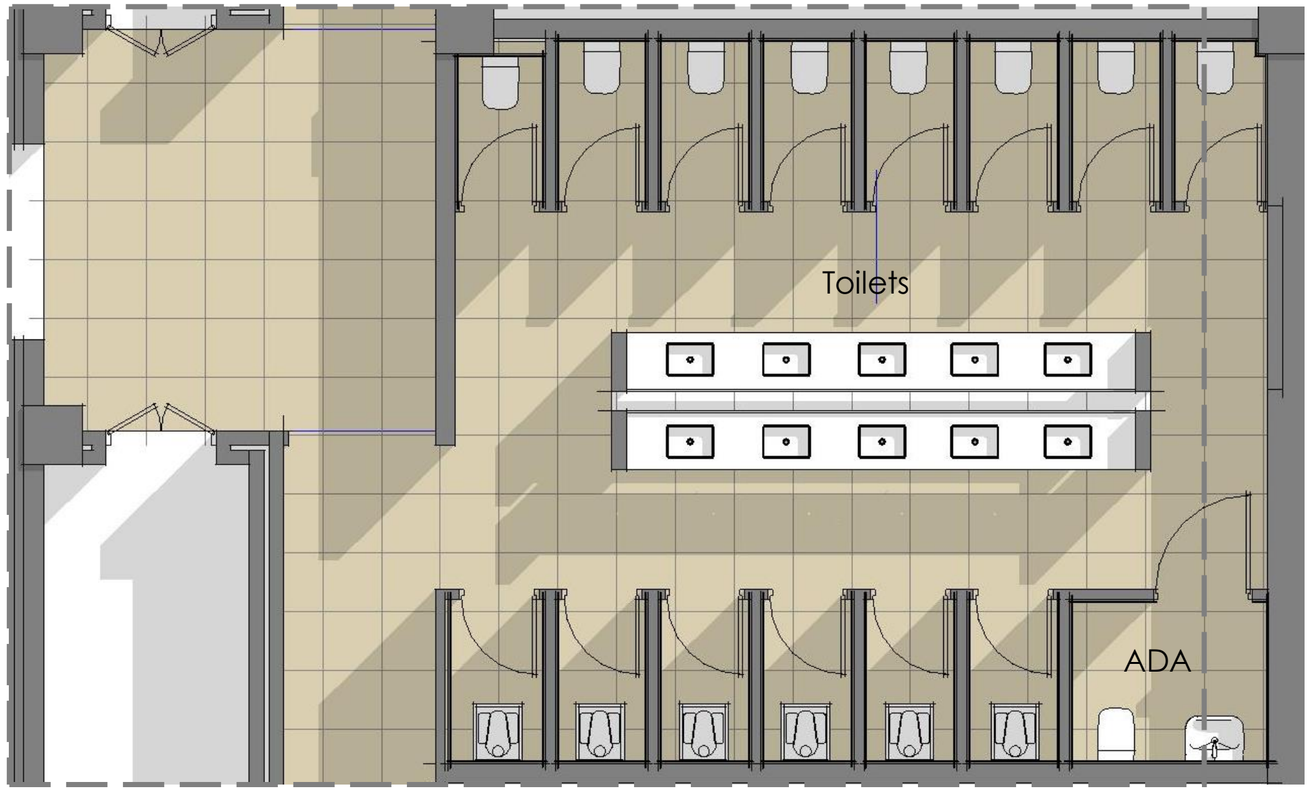
ABLUTION



The ablution space in this mosque blends serenity and simplicity by incorporating tranquil hues like earthy tones on porcelain walls and floors, fostering a serene and pure ambiance.

ABLUTION RENDER

TOILETS FURNITURE LAYOUT



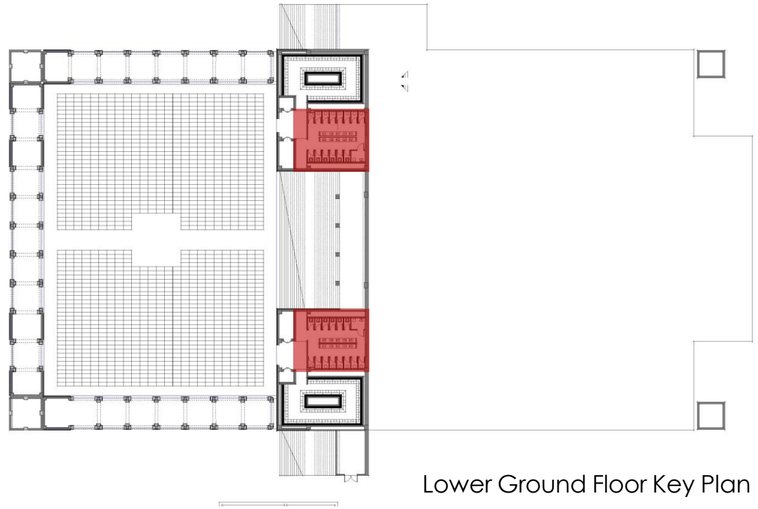
Toilets: 10.2 M X 8.6 M

Area: 88 M2

Count: 14 WCs

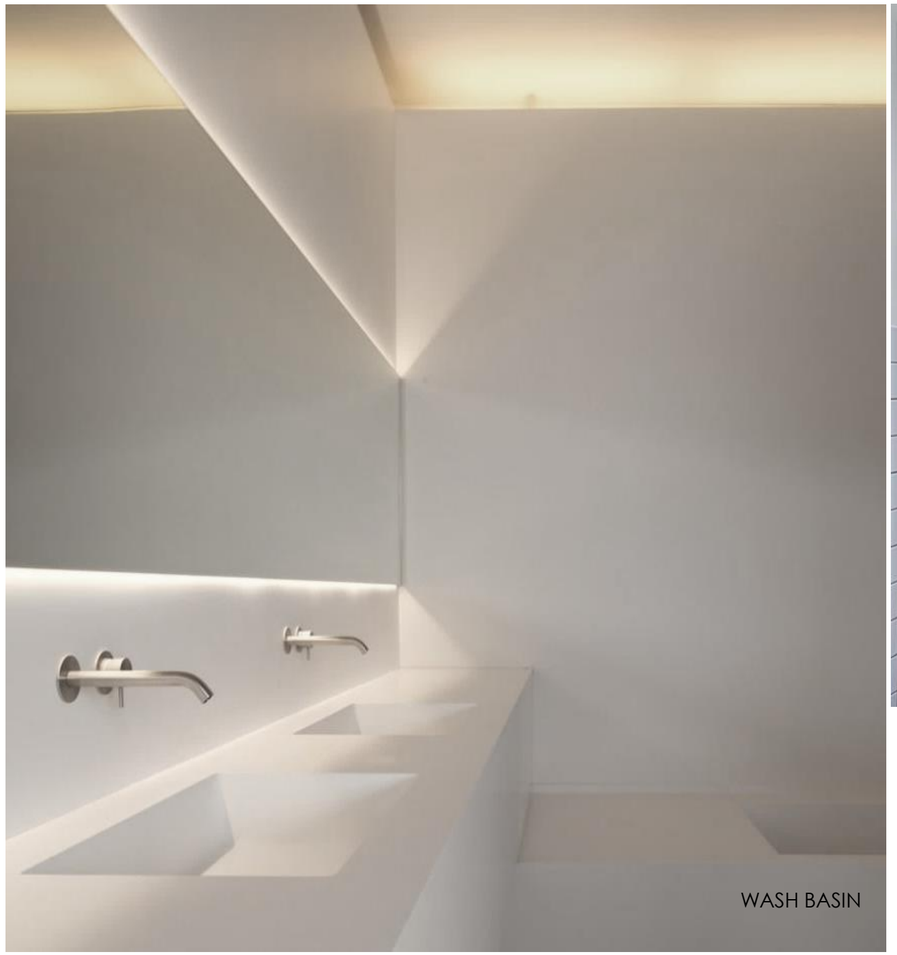
10 Lavatories

1 ADA



Lower Ground Floor Key Plan

TOILETS



A public toilet within a mosque designed with a soothing ambiance, characterized by calming white paint and earthy colors porcelain tiles. This restroom combines elegance with functionality, offering visitors a place of respite and cleanliness.

TOILETS RENDER

04 Lighting Strategy

GATES BENCHMARKING

Main Entrance

Up-lights

Arcade Lighting

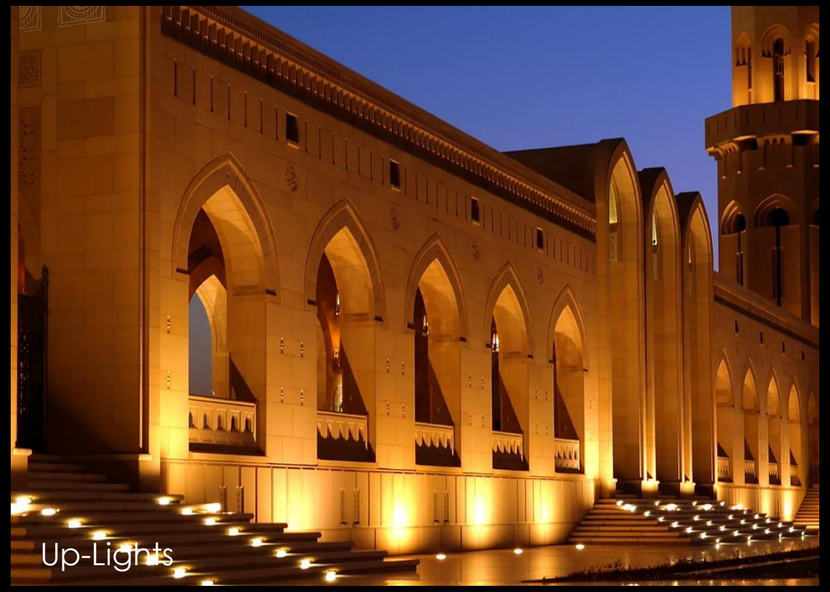
Arcade Lighting & Lanterns

MINARET & DOME BENCHMARKING

Minaret Up- Lighting

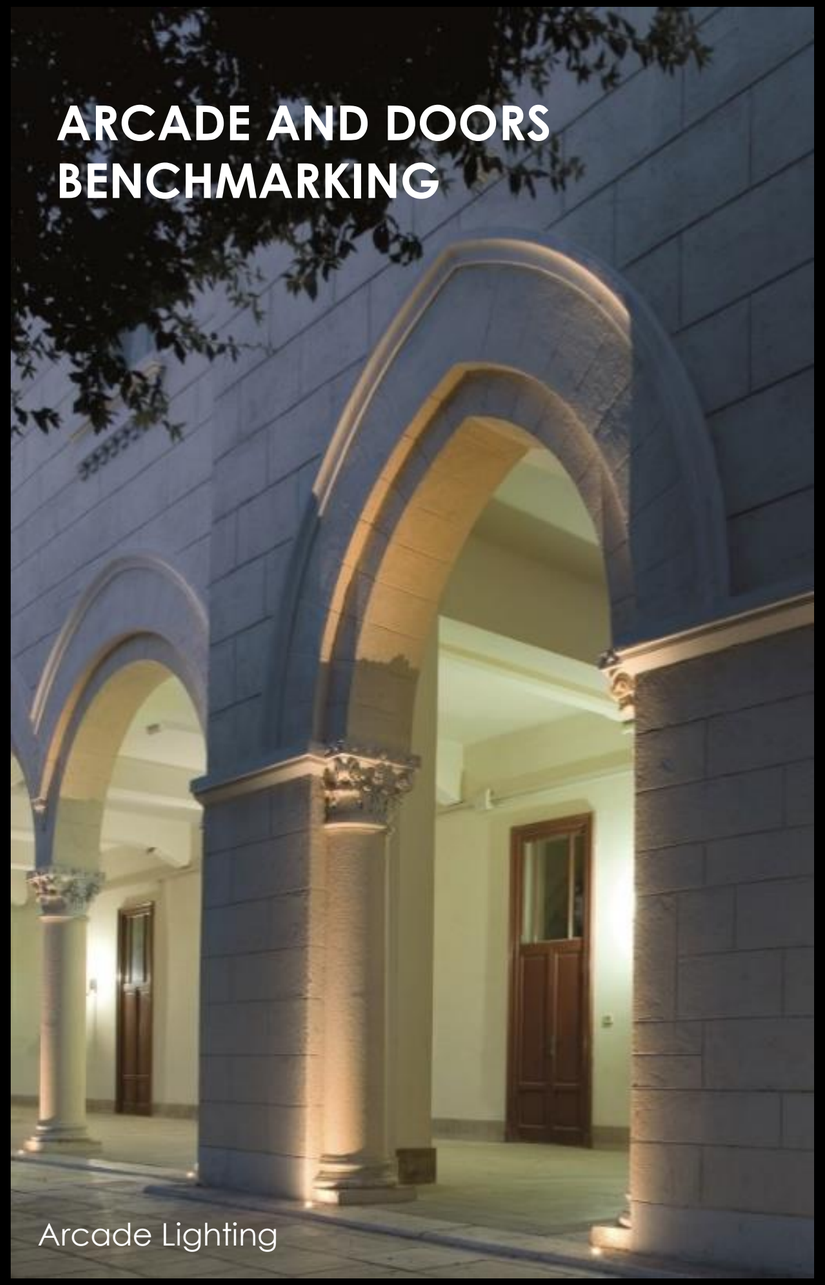
Minaret Up-Lighting

Dome Lighting



Up-Lights

ARCADE AND DOORS BENCHMARKING



Arcade Lighting

Arcade Lighting

Arcade Lighting

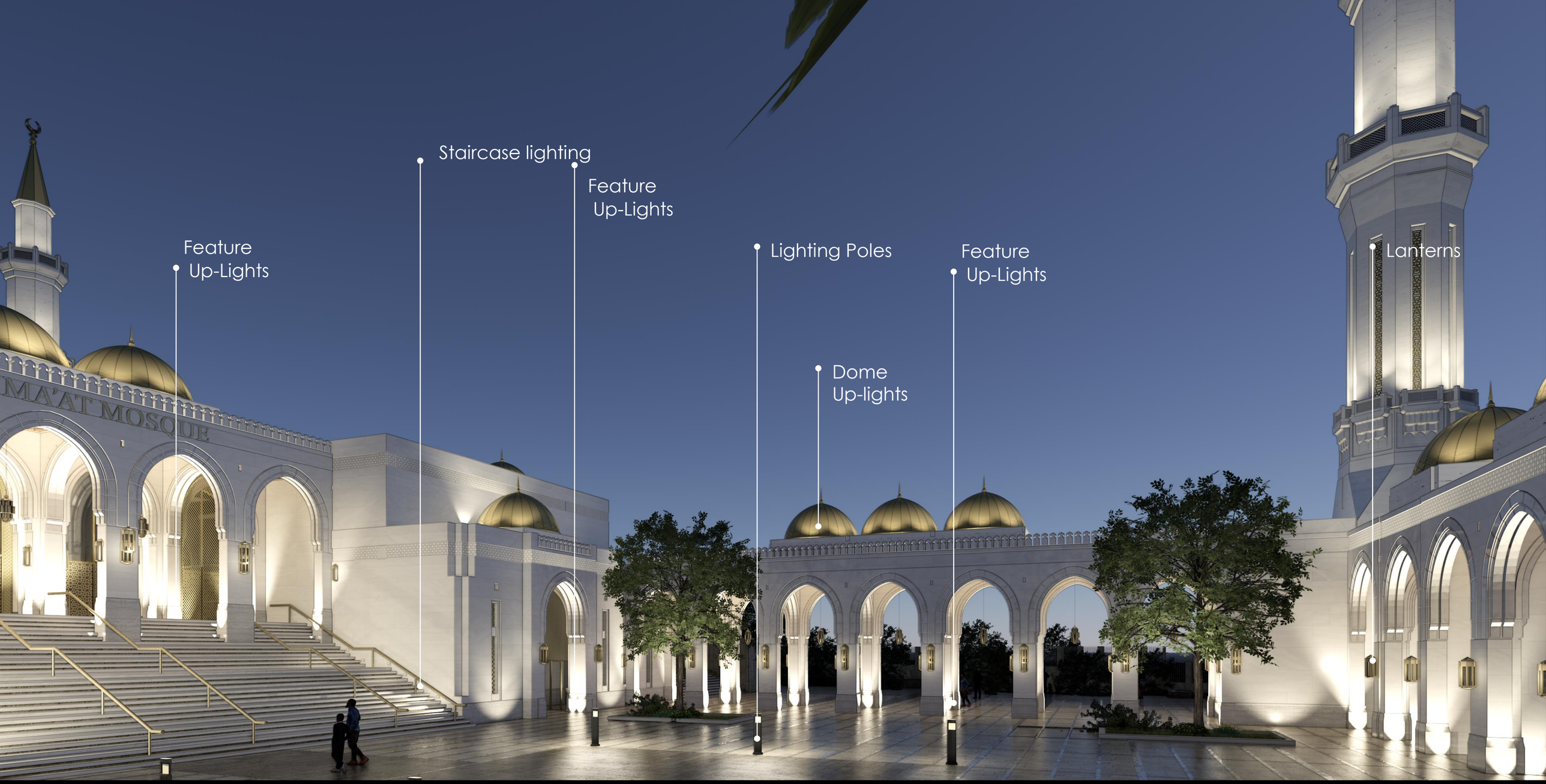
Door & Groove Lighting

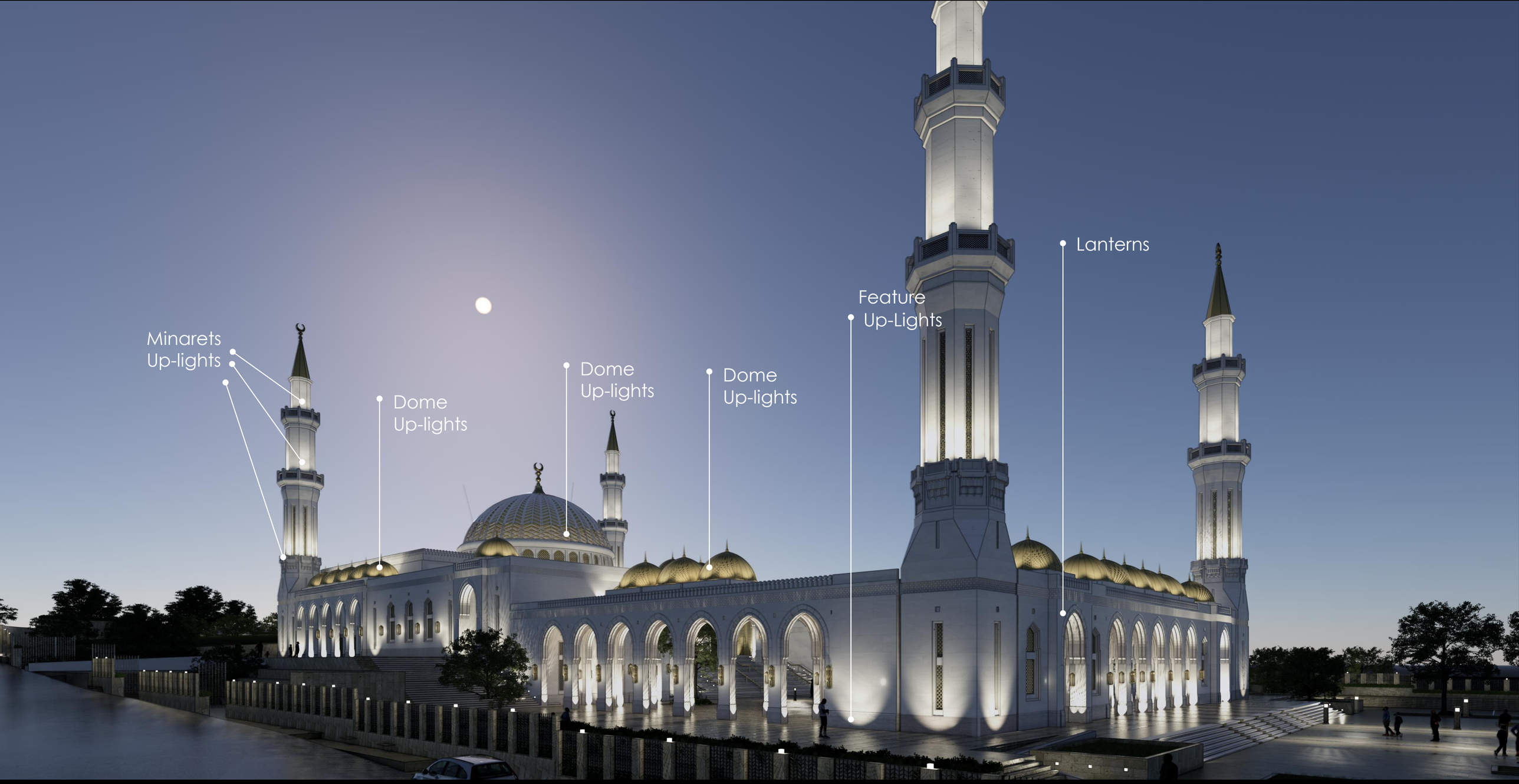
ADDITIONAL ELEMENTS BENCHMARKING

Lantern Lights

Staircase Lighting

Hardscape Lighting


Feature
Up-Lights
Staircase lighting
Feature
Up-Lights
Lighting Poles
Dome
Up-lights
Feature
Up-Lights
Lanterns
MA'AT MOSQUE


Minarets
Up-lights
Dome
Up-lights
Dome
Up-lights
Dome
Up-lights
Feature
Up-Lights
Lanterns

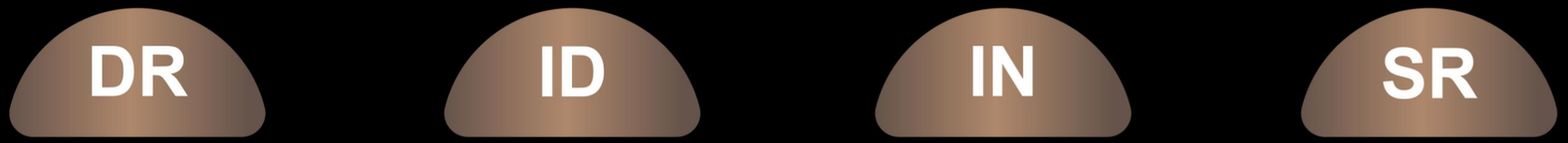
05 Signage and Wayfinding

Introduction

Wayfinding is a way to communicate information which help peopleunderstand their environment and know how to effectively move through it.

Signage design shall be **simple and effective, highly legible** for everybody to facilitate users' mobility.

There are primary types of signage that help people orient themselves, navigate to their desired destination, and know when they have reached it:



DIRECTIONAL

Signs that guide users towards a location or destination using directional Arrows.

IDENTIFICATION

Signs that identifies a specific area, usually indicating that users have reached a destination.

INFORMATION

Signs that provide an overview of where the users is in a larger context to assist them on building Egress map to help in case of fire.

SERVICES (B.O.H.)

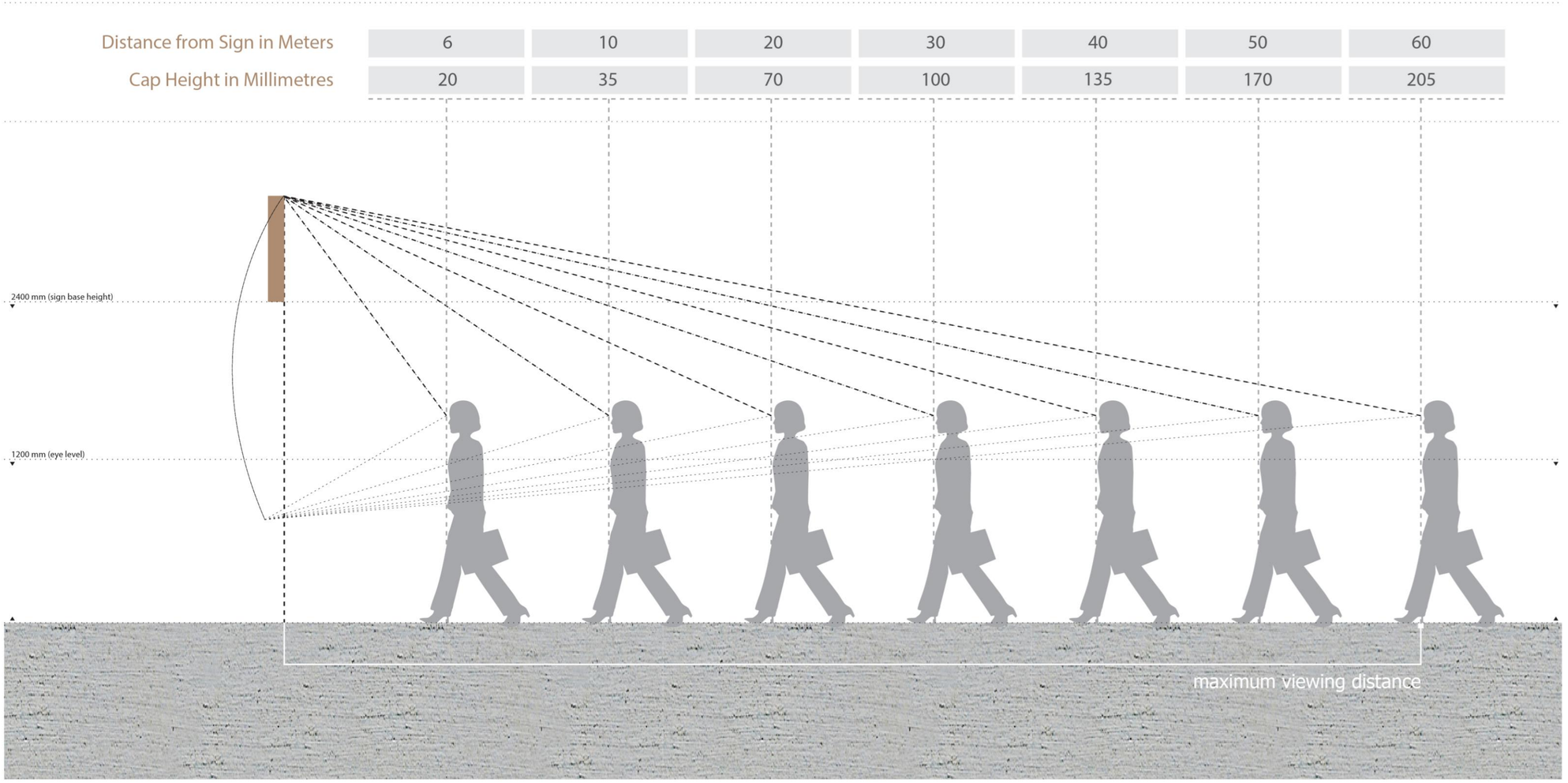
Signs that provides the staff with the services areas.

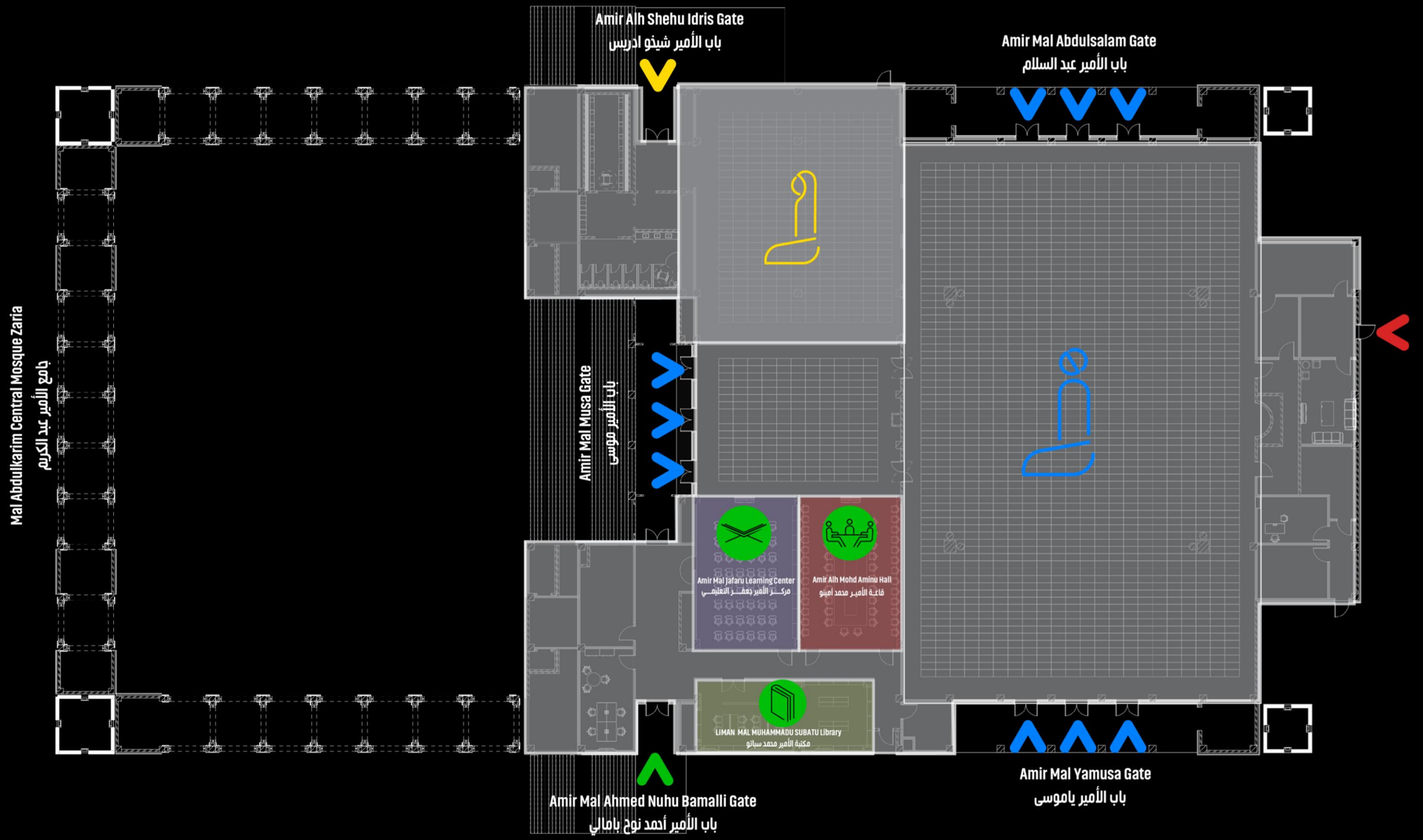
Pedestrian Viewing Distance

Font Size & Viewing Distance

Distance at which certain sizes of lettering can be read by a person with normal eyesight.

Distance from Sign in Meters	6	10	20	30	40	50	60
Cap Height in Millimetres	20	35	70	100	135	170	205





MEN PRAYER GATES

WOMEN PRAYER GATES

FACILITIES GATES

IMAM/ VIP ENTRANCE

MEN PRAYER

WOMEN PRAYER

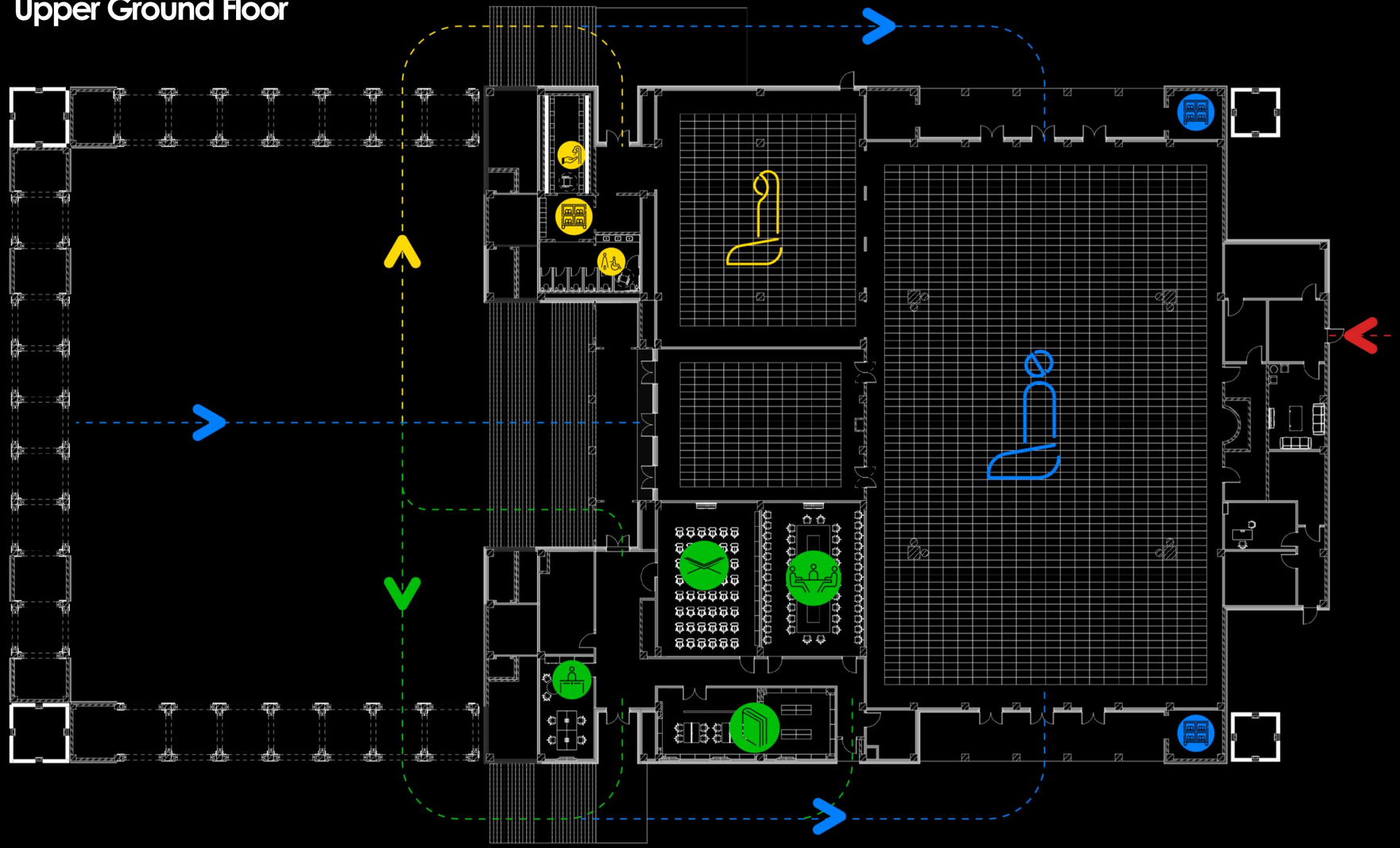
AMIR MAL JAFARU LEARNING CENTER

AMIR ALH MOHD AMINU HALL

LIMAN MAL MUHAMMADU SUBATU LIBRARY

Wayfinding Strategy

Upper Ground Floor



MEN CIRCULATION

WOMEN CIRCULATION

FACILITIES CIRCULATION

IMAM/ VIP ENTRANCE

MEN PRAYER

MEN SHOE RACK

WOMEN PRAYER

WOMEN ABLUTION

WOMEN SHOE RACK

WOMEN TOILET

MEETING HALL

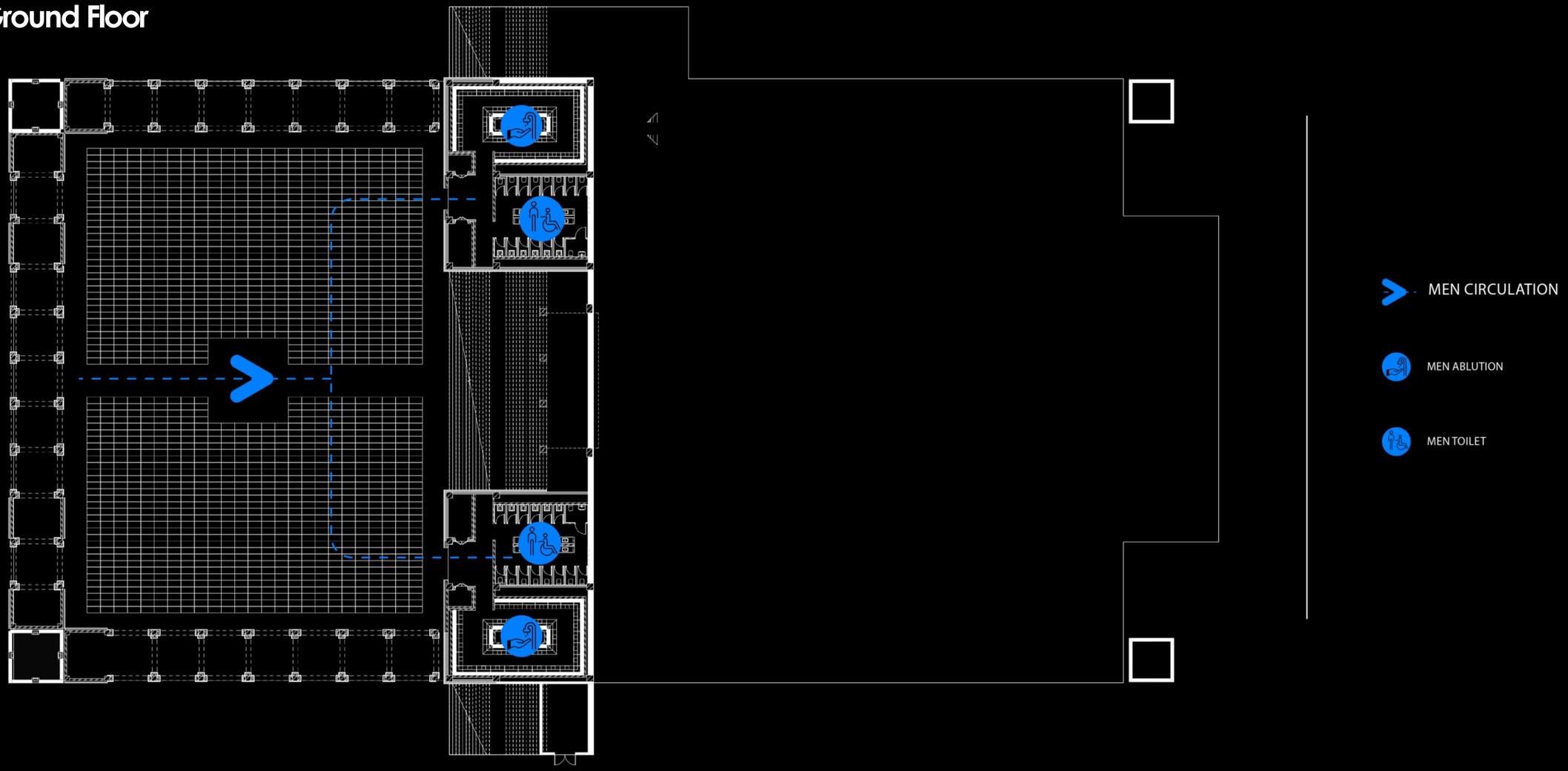
ADMINISTRATION

ICT LEARNING CENTER

LIBRARY

Wayfinding Strategy

Lower Ground Floor



Convention Graphics

TYPOGRAPHY

ENGLISH TYPEFACE

AKHAND - SEMIBOLD

Mosque

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9

AKHAND - EXTRABOLD - FOR MOSQUE NAME

Mosque

ENGLISH TYPEFACE

AKHAND ARABIC - REGULAR

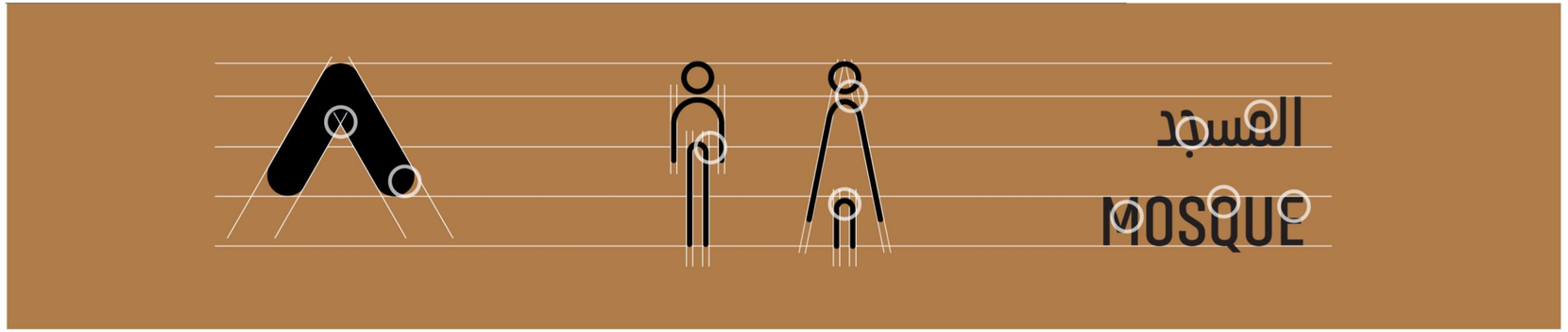
المسجد

أ ب ت ث ج ح خ د ذ ر ز س ش ص ض ط ظ ع غ ف ق ك ل م ن ه و ي لا
أ ا ب ـتـ ـثـ ـجـ ـحـ ـخـ د ذ ر ز ـسـ ـشـ ـصـ ـضـ ـطـ ـظـ ـعـ ـغـ ـفـ ـقـ ـكـ ـلـ ـمـ ـنـ ـهـ ـويـ لا

AKHAND ARABIC - EXTRABOLD - FOR MOSQUE NAME

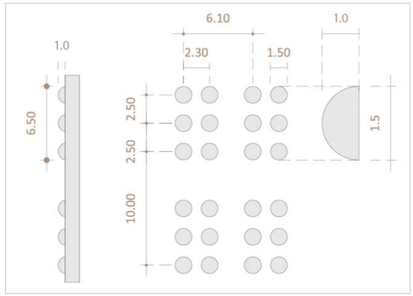
المسجد

ICONOGRAPHY DESIGN

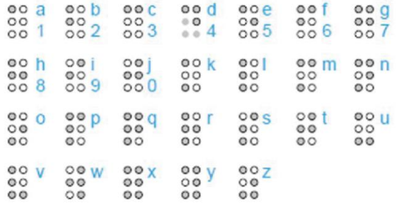


BRAILLE

BALKAN PENINSULA

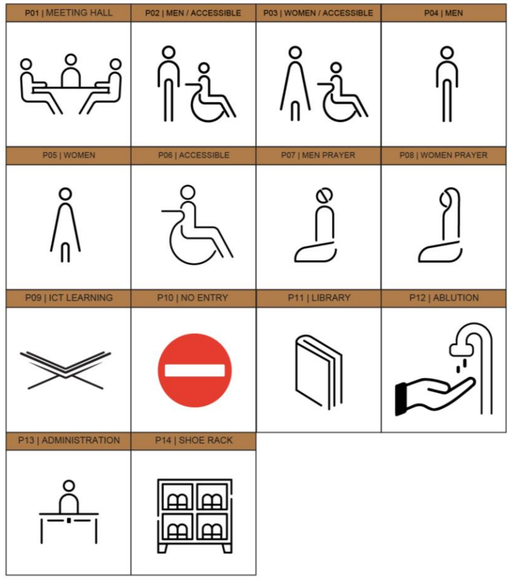


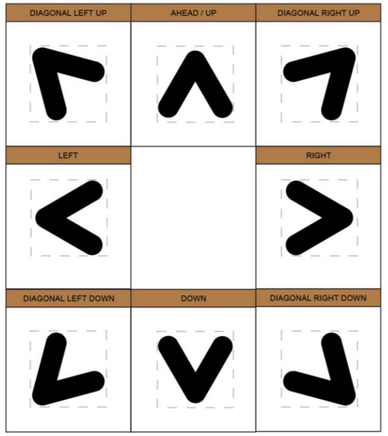
- Grade 2 braille should be used.
- Braille must be 1mm raised and domed.
- On signs with multiple lines of text and characters, the semicircular Braille locator at the of Braille text.
- Braille should be located directly below the text and/or arrow, and ranged to the left.



PICTOGRAMS & ARROWS

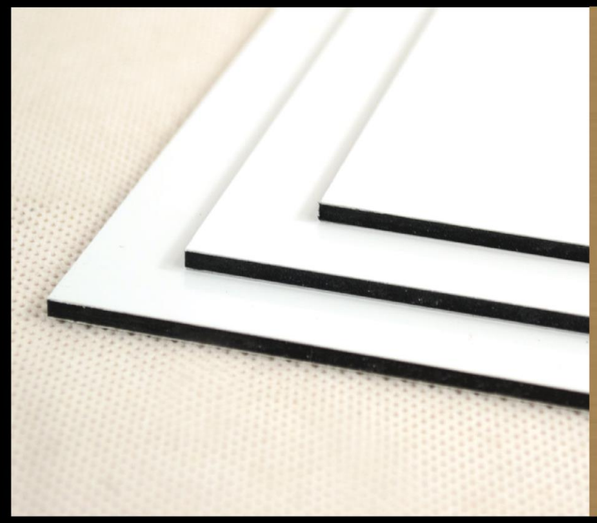
Pictograms and Arrows are following ISO Standards



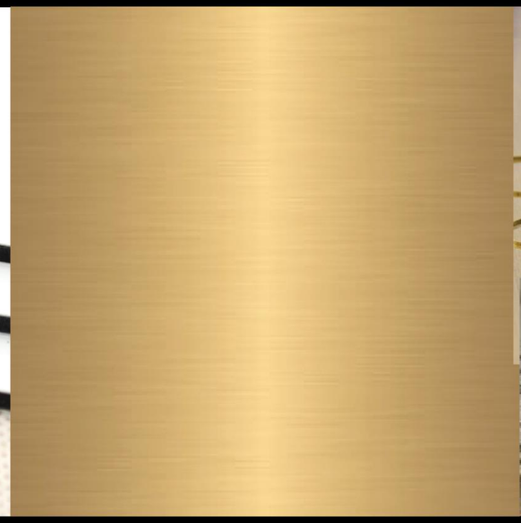


Colors & Materials

MATERIALS



ALUMINUM SHEET POWDER COATED FINISH WITH GIVEN SHAPE



ALUMINUM SHEET WITH BRUSHED GOLD FINISH

PATTERN:
ENGRAVED WITH LASER

COLOR PALETTE

WHITE

C, M, Y, K
0, 0, 0, 0

R, G, B
255, 255, 255

HEX:
#ffffff

RAL 9016
White

BLACK

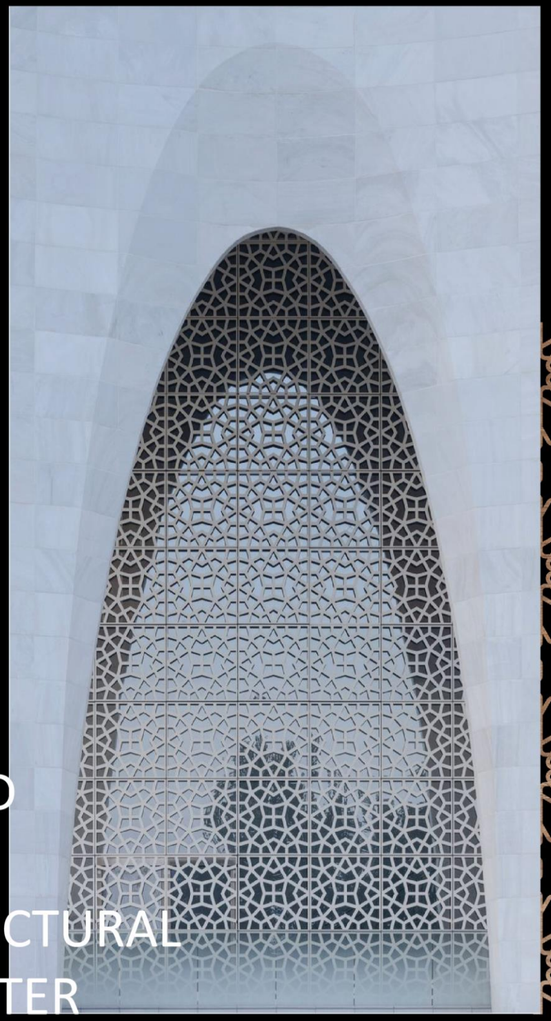
C, M, Y, K
100, 0, 0, 0

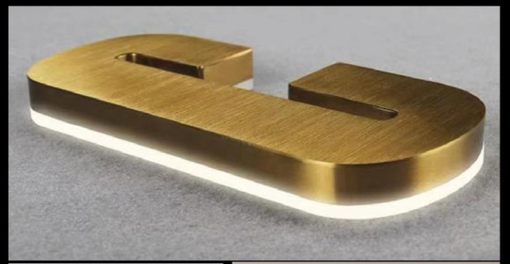
R, G, B
32, 31, 35

HEX:

RAL 9005
black

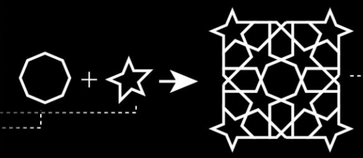
Inspiration Board

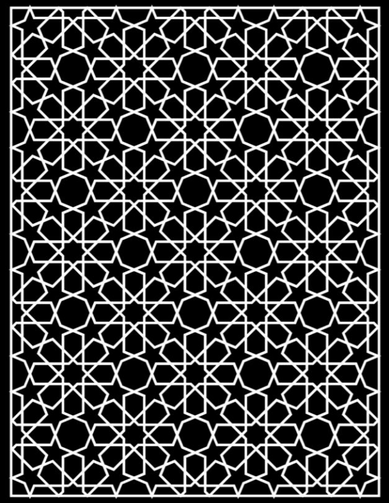


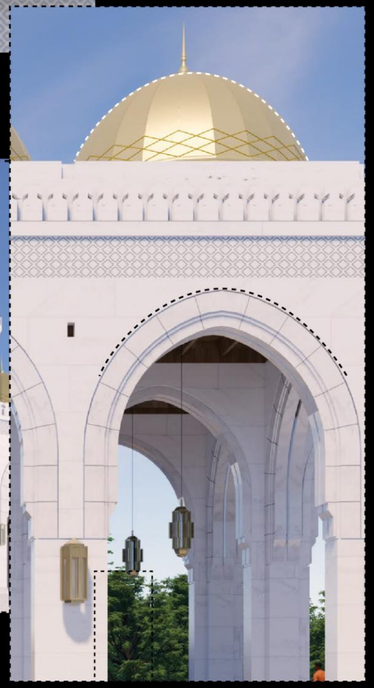


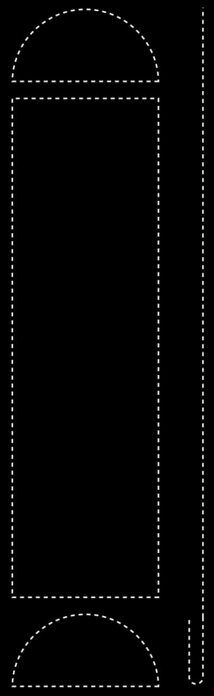
INSPIRED
FROM
ARCHITECTURAL
CHARACTER

Design Intent







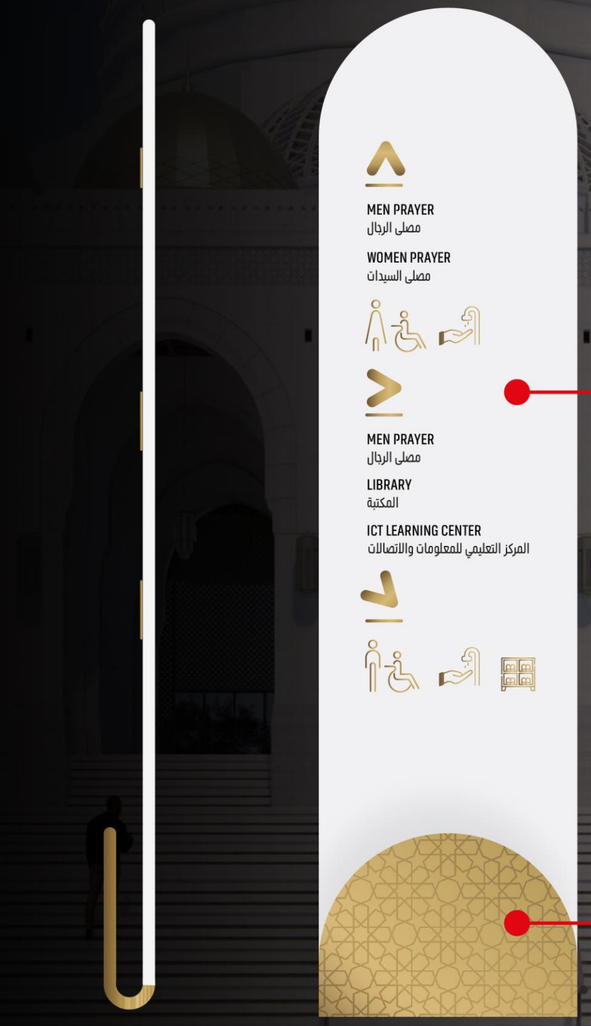


3D View

FRONT VIEW

3D View

Sign Design | Floor Standing



ALUMINUM SHEET POWDER COATED FINISH WITH GIVEN SHAPE

ALUMINUM SHEET WITH BRUSHED GOLD FINISH

SIDE ELEVATION

FRONT ELEVATION

Sign Design | Floor Standing

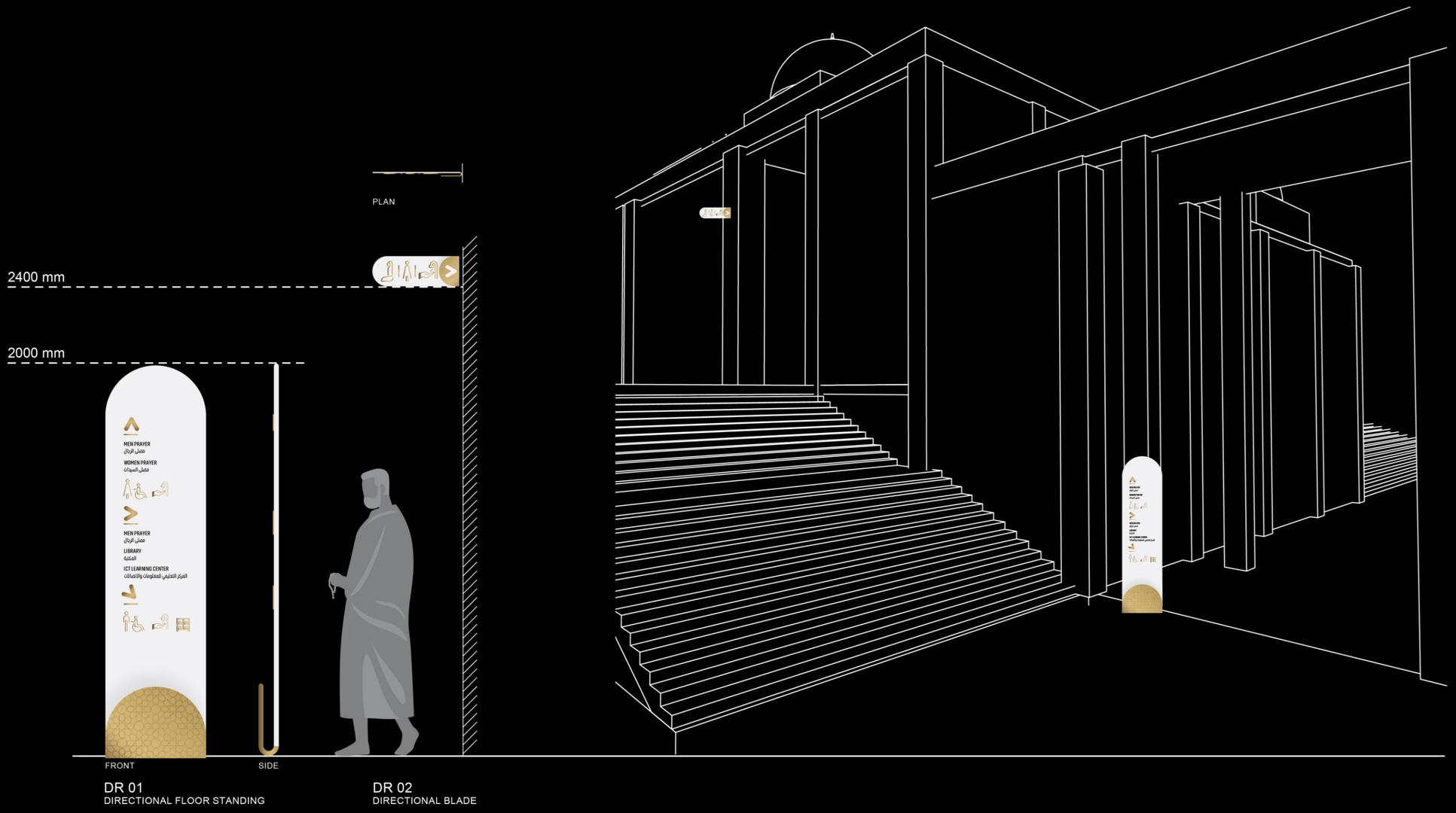
FRONT ELEVATION

SIDE ELEVATION

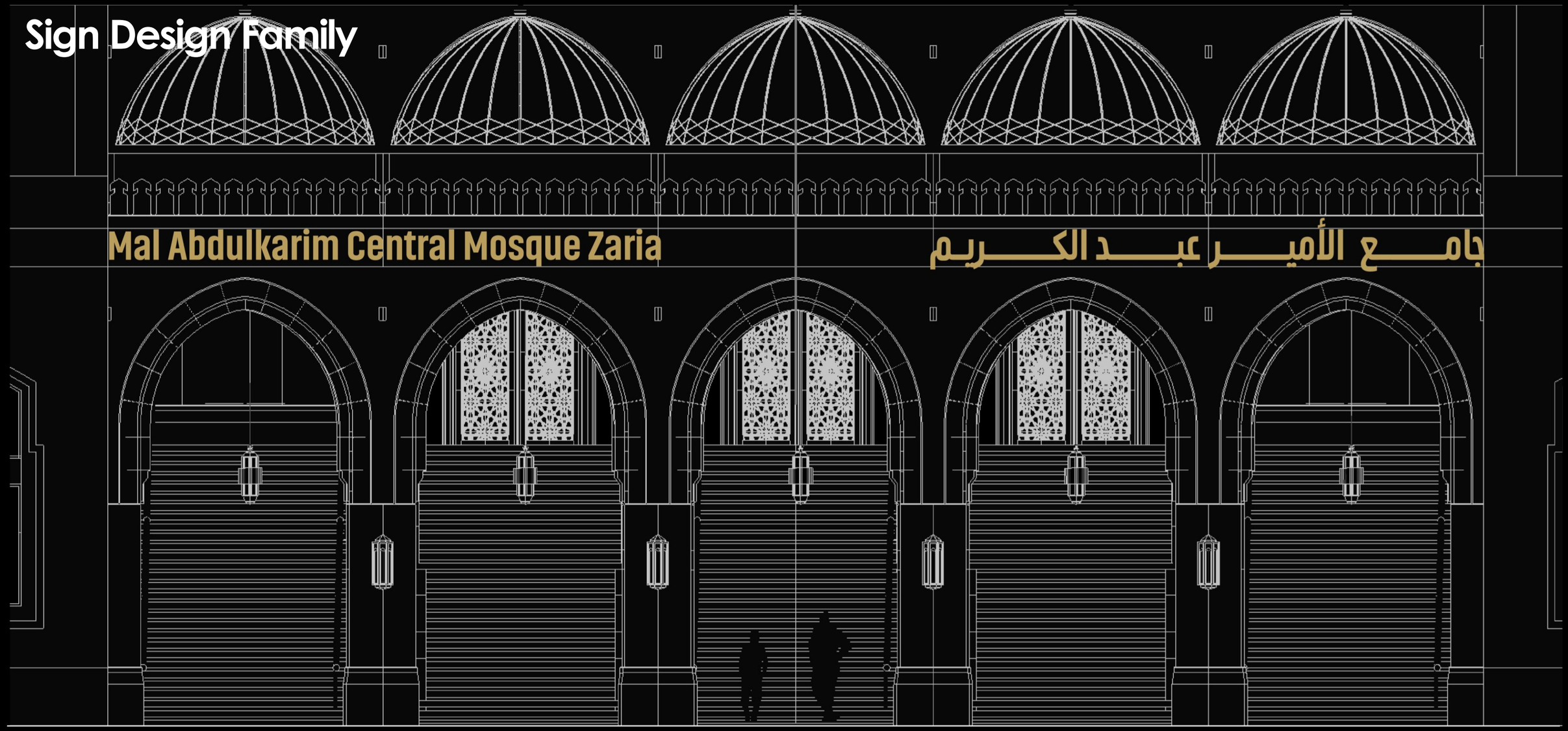
ALUMINUM SHEET POWDER COATED FINISH
WITH GIVEN SHAPE

ALUMINUM SHEET WITH BRUSHED GOLD FINISH

Sign Design Family

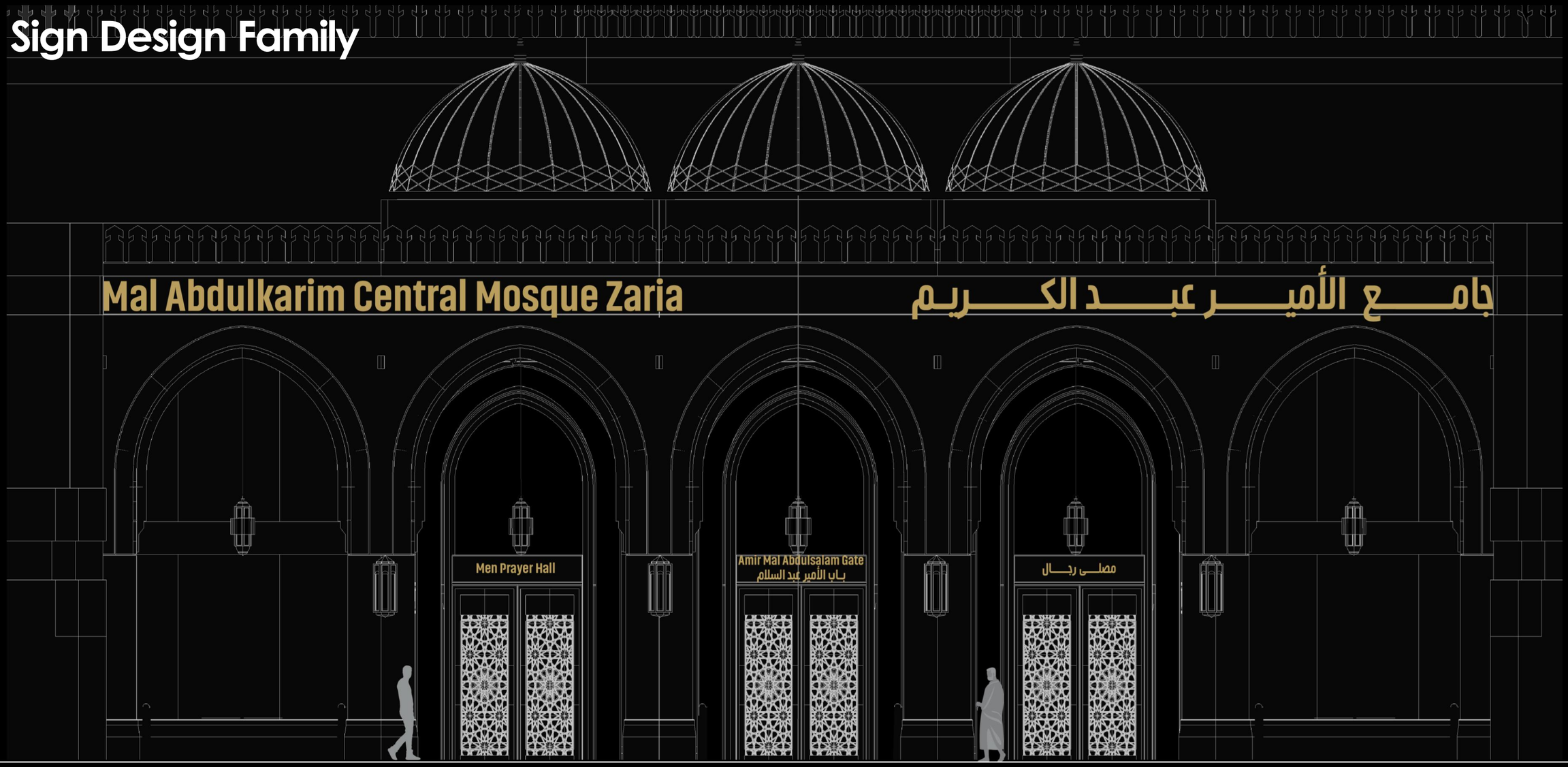


Sign Design Family



ID 01
MOSQUE IDENTIFICATIONS

Sign Design Family



ID 02
GATE IDENTIFICATION

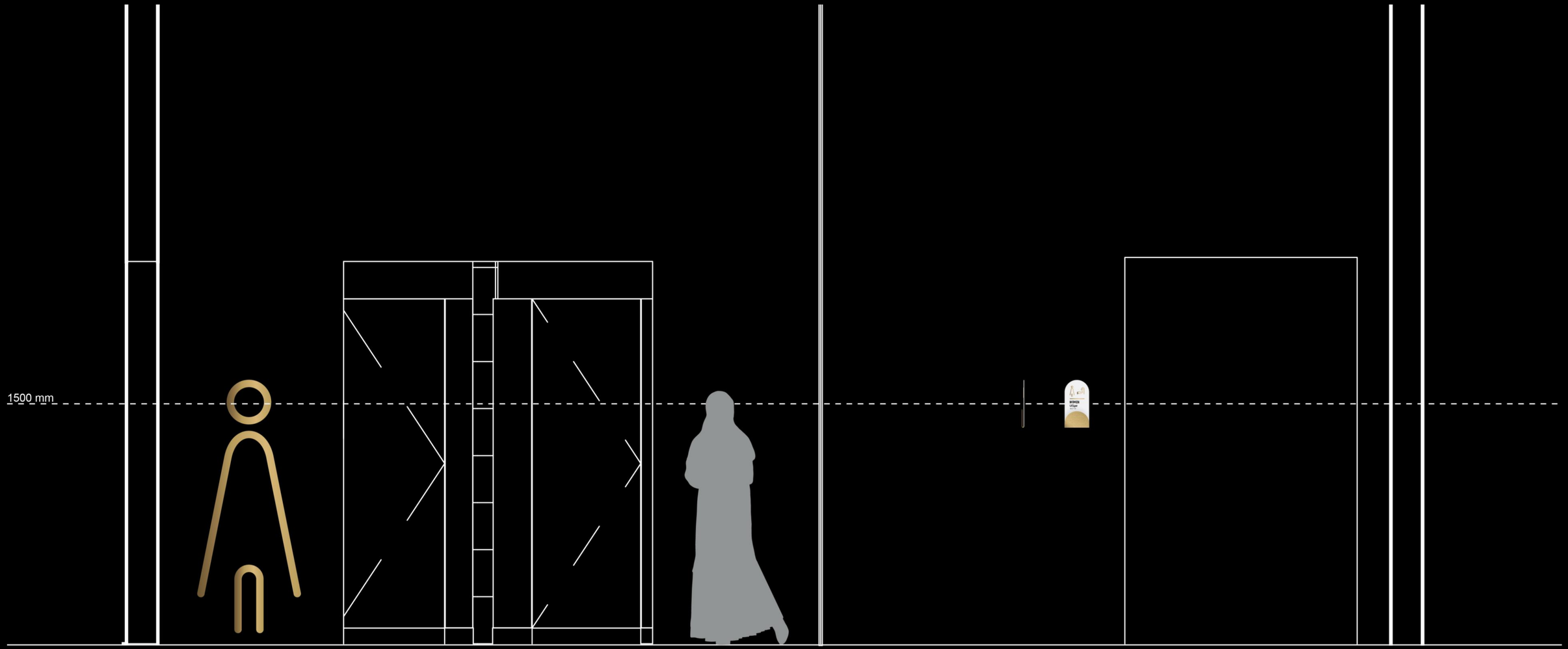
ID 03
PRAYER
IDENTIFICATION

ID 04
PRAYER
IDENTIFICATION

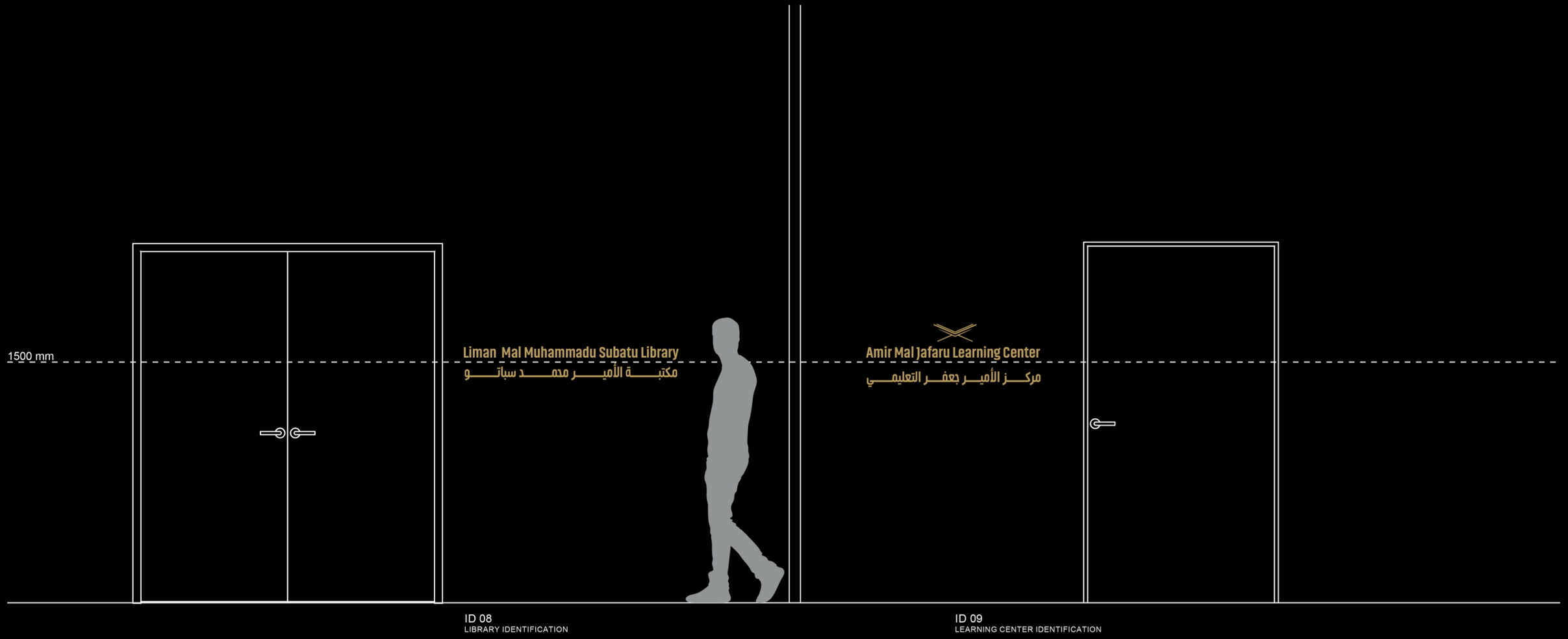
Sign Design Family

ID 05
WOMEN PRAYER GATE
IDENTIFICATION

Sign Design Family



Sign Design Family



06 Landscape

Site Analysis

The Context
Analysis

Key:

- Existing Mosque
- Built-up Areas
- Vehicular Paths
- Pedestrian Paths
- Landmarks

The Context
Takeaways

01. Environmental Takeaways

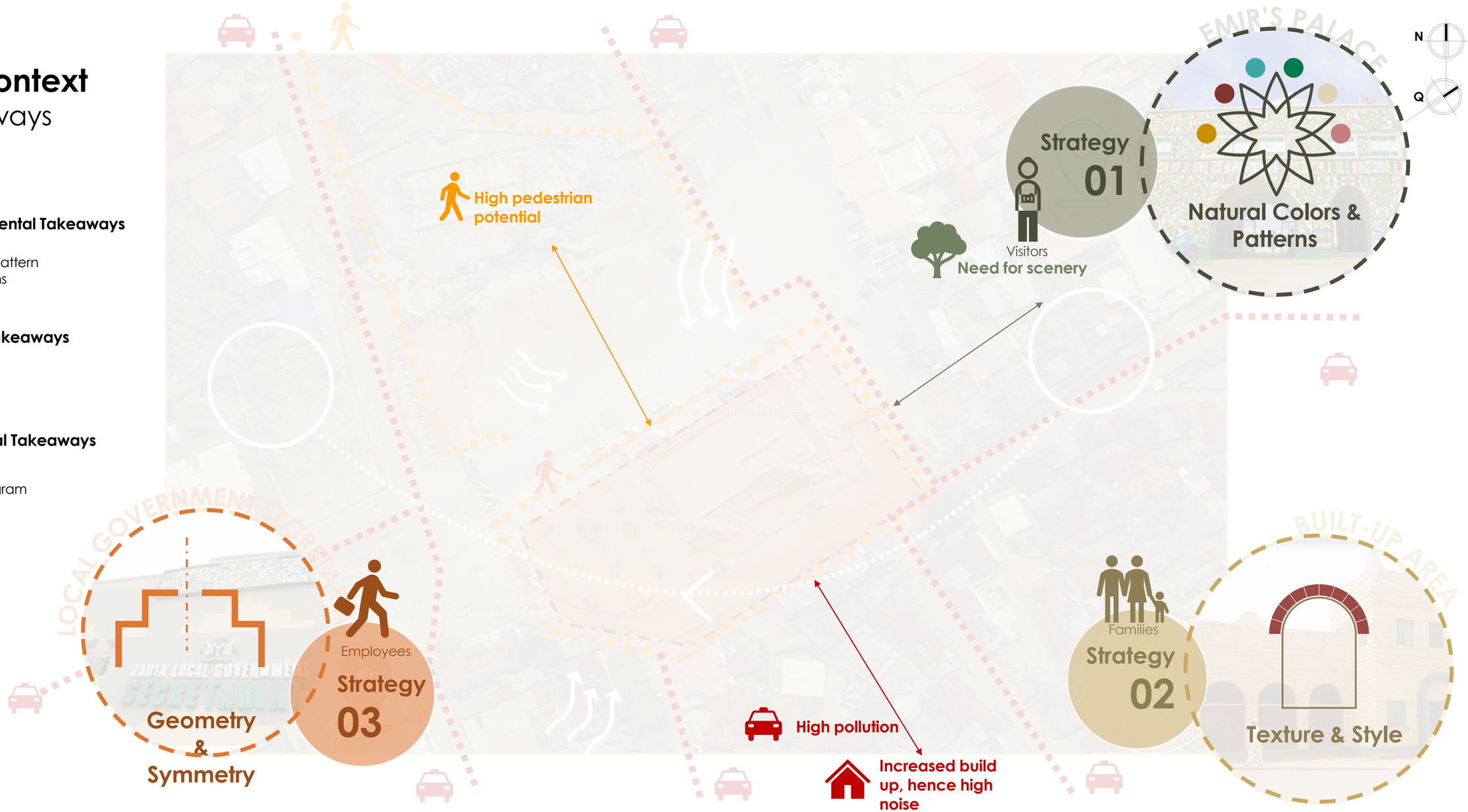
- Shading Pattern
- Wind Paths

02. Design Takeaways

- Form
- Colors
- Textures

03. Functional Takeaways

- Users
- Initial Program

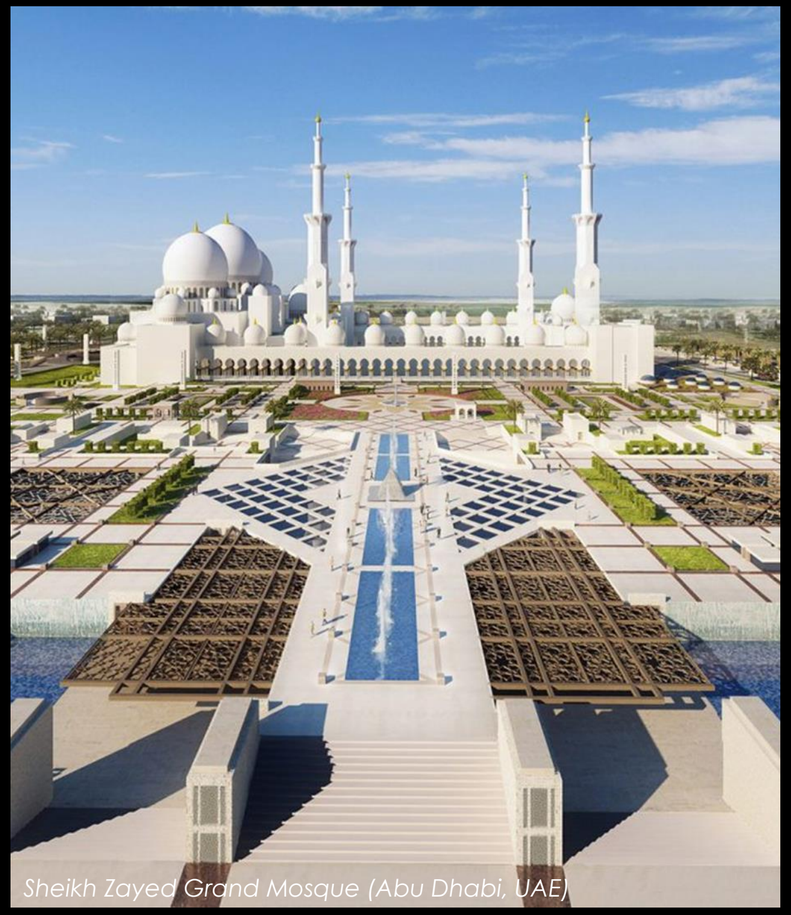


Benchmarks

Benchmarks
Precedent Projects

Mosque Typology | Geometry & Symmetry | Natural Colors & Patterns | Texture & Style

THE USE OF **GRIDS AND MODULES** FOR THE LANDSCAPE ELEMENTS



Sheikh Zayed Grand Mosque (Abu Dhabi, UAE)

THE USE OF **HARDSCAPE LINES** TO DIRECT TOWARDS THE ENTRANCES

The Abuja National Mosque (Abuja, Nigeria)

THE USE OF NATURAL COLORS IN THE **SOFTSCAPE SELECTION**

Sultan Qaboos Grand Mosque (Muscat, Oman)

Concept & Vision

Identity

People, Place, & Precedent

Gates

Grand entrance gates serve as a symbolic threshold, welcoming worshippers and visitors into the space.

People

The people of Zaria practice pottery, weaving, leatherwork, agriculture, trade, and woodcarving.

Motifs

The Dagi knot is a marking motif of Zaria City

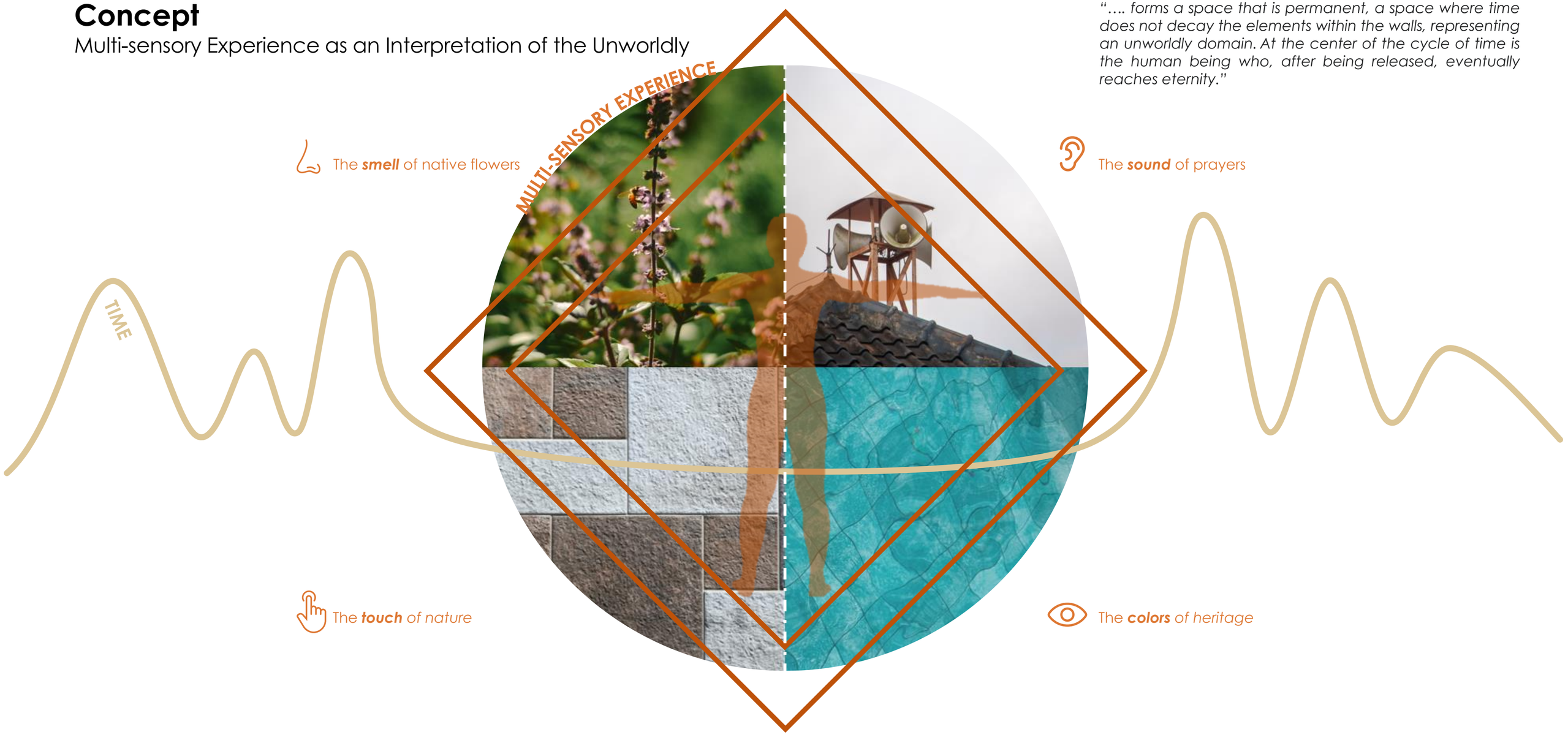
Architecture

Hausa architecture is one of the most beautiful aspects of Hausa culture. It is characterized by bright, naturally-colored, and intricately engraved buildings.

Concept

Multi-sensory Experience as an Interpretation of the Unworldly

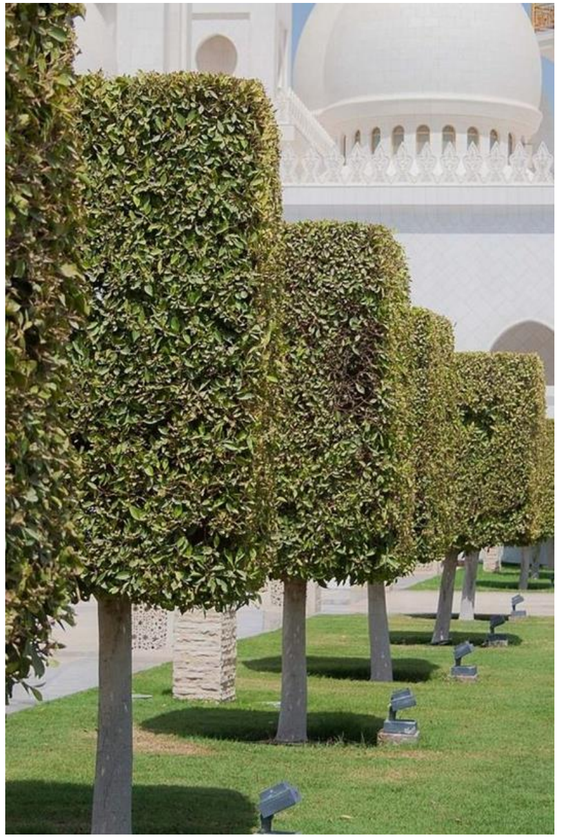
"…. forms a space that is permanent, a space where time does not decay the elements within the walls, representing an unworldly domain. At the center of the cycle of time is the human being who, after being released, eventually reaches eternity."



Mood Setting

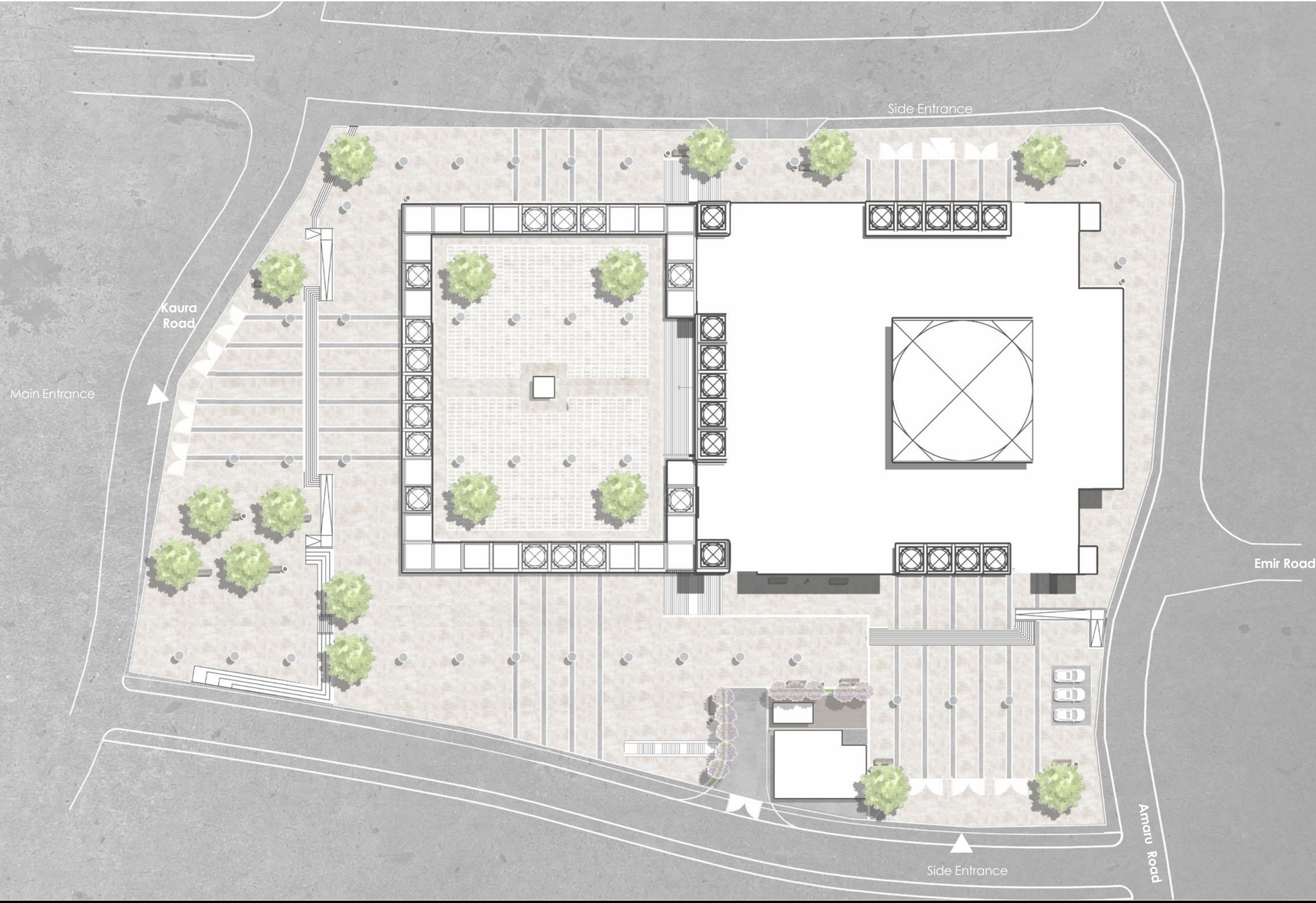
Mood Setting

Multi-sensory Experience as Design Features



Masterplan
Design & Analysis

Masterplan Design
Rendered Layout



Masterplan Design

Design Analysis

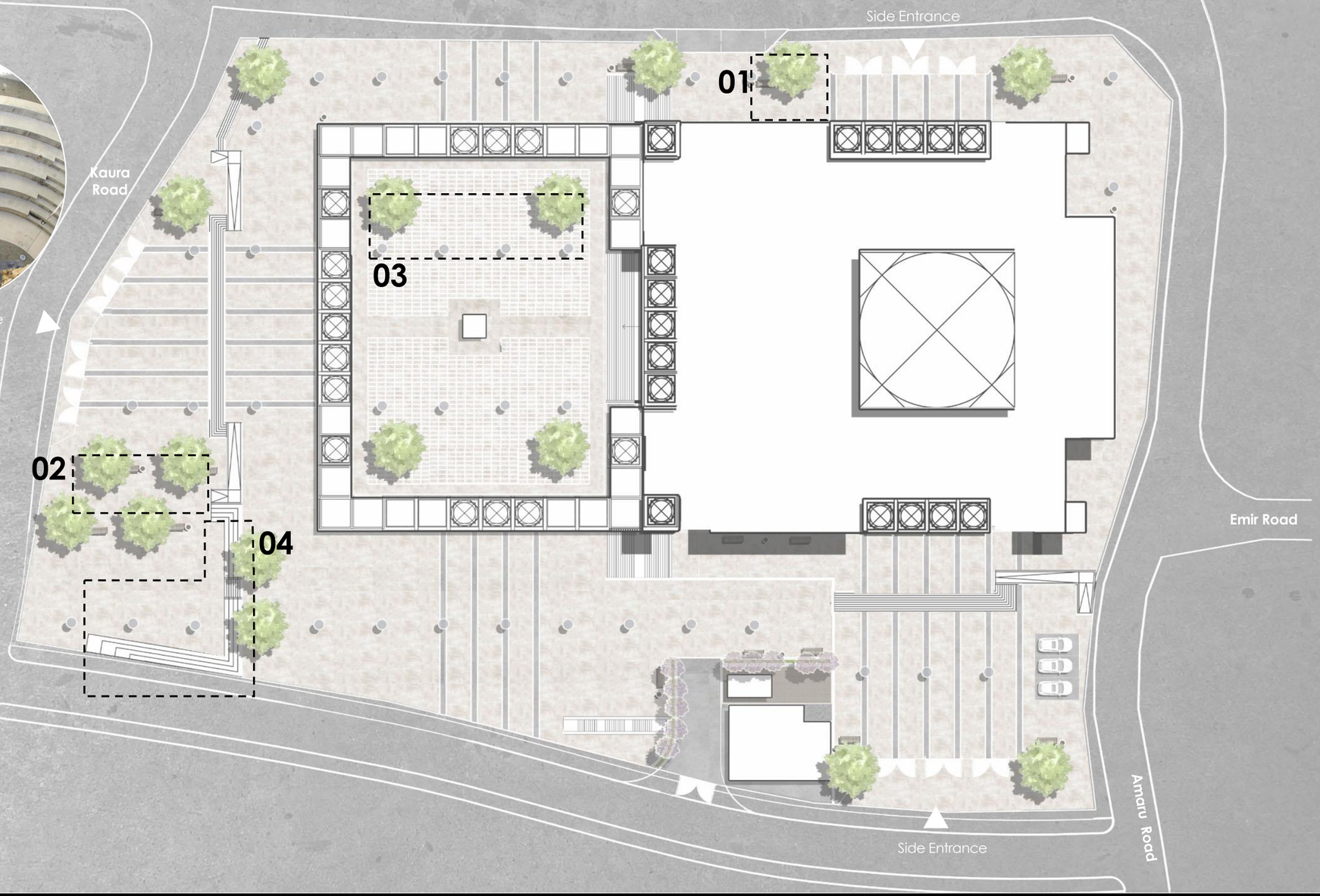
01

04

Main Entrance

02

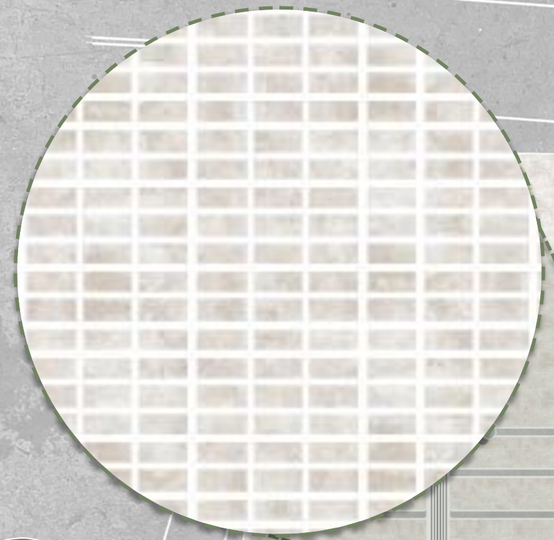
03

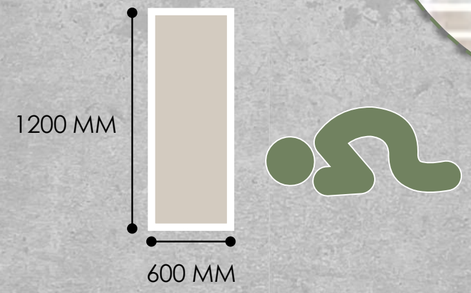


Masterplan Design

Design Analysis

Flooring Detail of Prayer Area





Masterplan Design

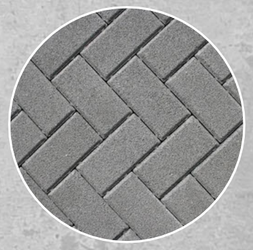
Design Analysis

Hardscape Selection

01

Floor Porcelain Tiles – Dome Bone

04

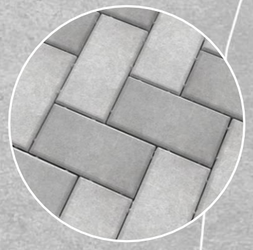


Dark Grey Interlock

02

Floor Porcelain Tiles – Stone Land

05



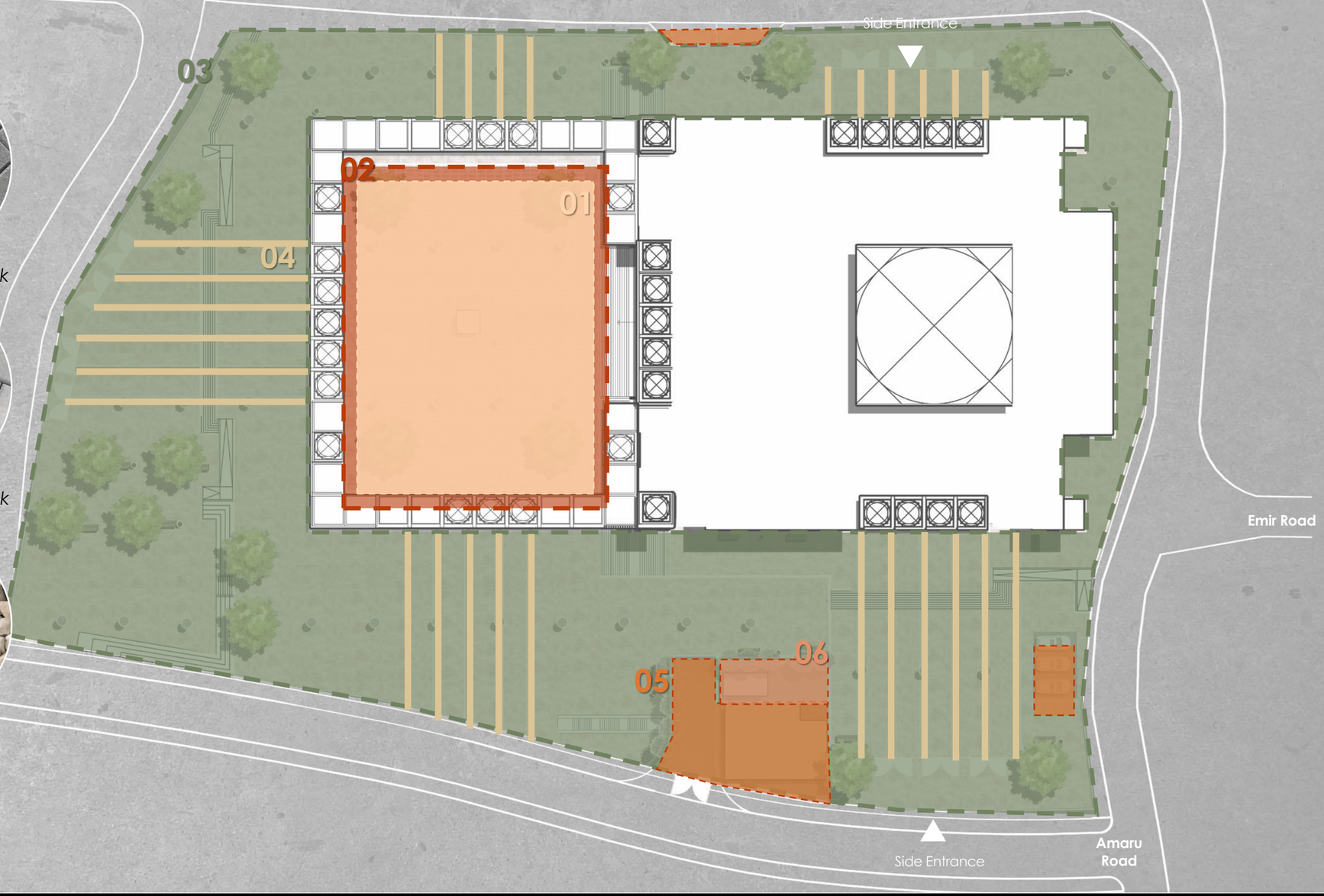
Light Grey Interlock

03

Beige Interlock

06

Crushed Gravel



N

Q

20 M

Masterplan Design

Design Analysis

Furniture & Lighting Selection

01

Seating Bench

04

Trees Up-lights

02

Litter Bins

03

Lighting Bollards

N

Q

20 M

Masterplan Design

Design Analysis

Softscape Selection

TREES

Khaya Anthotheca

Dacryodes Edulis

Manihot Esculenta

SHRUBS

Impatiens Glandulifera

Ocimum Basilicum

Mussaenda Erythrophylla

GROUNDCOVERS

Carissa Macrocarpa

Peperomia Pellucida

Tradescantia Zebrina

SUCCLENTS

Portulaca Oleracea

Agave Tequilana

Portulaca Grandiflora

07 Fire and Life Safety

1.1 BUILDING DESCRIPTION

- Jumma 'Mosque at Emir's Palace, located in Zaria, Kaduna State, Nigeria, the entire complex is to be designed on two floors as follows: lower ground and upper ground floor levels.
- The lower ground floor contains outdoor piazza which capable to accommodate 5000 to 7000 worshippers, open to sky courtyard to accommodate 1600 worshippers. In addition, the lower ground floor indicating other facilities such as (ablutions, toilets, admin offices, MEP services rooms, shoe racks and arcades the total BUA for lower ground floor is 1450 m2 and the floor height is 4 m.
- For ground floor, indicating main prayer hall to accommodate 1650 worshippers, women prayer hall to accommodate 350 worshippers, learning center, library, meeting room, imam office, shoe racks, admin offices and MEP services rooms, the total area for ground floor is 3100m2. The height of main prayer hall about 11 m
- The Jumma 'Mosque contains four minarets with height 55mm.

1.2 CODES AND REGULATIONS

The building fire and life safety strategy is designed based on BSI standards and other applicable international standards

1.3 OCCUPANCY CHARACTERISTIC

The Mosque occupancy characteristic of the building is Classified as B1 "occupant who are awake and unfamiliar with the building" (prayer rooms), A2 "occupant who are awake and familiar with the building" (Offices, lounges) and A3 (storage areas).

The substation characteristic of the building is Classified as A3(industrial areas). "occupant who are awake and familiar with the building"

1.4 RISK PROFILE

- The risk profile is given based on the occupancy characteristic and fire growth rate. The higher risk profile applies to the whole building.
- The risk profile depends on the fire growth:
  - 1 slow
  - 2 medium
  - 3 fast
  - 4 ultra-fast
- The risk profiles of the building are A1, A2 and A3.

1.5 EVACUATION STRATEGY

- The primary objective of an evacuation strategy is to ensure that in the event of fire, the occupants of the building can reach a place of ultimate safety outside the building.
- Due to the nature of occupants and type of the building, a simultaneous evacuation strategy is adopted, in case of fire the whole building will be evacuated.

1.6 CONSTRUCTION TYPES LIMITATIONS

- Based on the occupancies characteristics of the building classified above and its height the fire-resistant period for the structural elements is 60 minutes. As per table 23.

1.7 EXTERNAL FIRE SPREAD AND BUILDING SEPARATION

- External fire may spread between buildings through two basic methods. The first method is by direct impingement of flames from one building to another, where the distance between the two buildings is within 1 m. The second is by radiation where radiated heat from a burning building can give rise to fire in a nearby building. The major factors that contribute to the spread of fire by radiation is the distance between the buildings, the fire resistance of the building transmitting heat, and the intensity of the source of radiation.
- The Headquarter building has no buildings in its vicinity.

1.8 MEANS OF EGRESS REQUIREMENTS

1.8.1 GENERAL

- The height of escape routes is not less than 2m clear headroom.

1.8.2 COMPONENTS

a) Doors:

- Door openings are not less than 800mm in clear width.
- Door in a corridor is either equal to the corridor width minus 150mm or 1050mm whichever is greater.
- Where double doors are provided at least one of the leaves is minimum 800mm.
- Any door in a means of egress is side-hinged or pivoted-swinging and swings to the full required width of the opening.
- Door leaf swing in the direction of egress:
  - When serving a room with an occupant load of 60 and more.
  - Where the door is used in an exit enclosure.
  - Where the door serves a high hazard area.
- Doors are readily open from the egress side whenever the building is occupied.
- Doors required to be kept closed are self-closing or automatic closing.

b) Stairs:

- Dimensional criteria:
  - Maximum rise height 180mm (200mm for private use stairs)
  - Minimum rise height 150mm (100mm if stair is 3 steps or less)
  - Minimum going depth 300mm
  - Minimum headroom 2000mm
  - Minimum clearance (height above steps) 1500mm (1800mm when short stair flights is provided)
  - Stairs has no more than 40 rises in a consecutive flight.
- Minimum width of stair is 1100mm in downward travel and 1200mm in upward travel.
- A 1.5% tolerance in the uniformity of going is permitted.
- A 1% tolerance in the uniformity of rise is permitted.
- The width of a stair is measured between the walls or balustrades.
- Clear width and length of landings is not less than the clear width of the stair.
- Single steps are not allowed.
- Handrails are provided on both sides, clear width between them is not less than 800mm and not more than 1200mm.
- Handrails are not less than 900mm and not more than 1000mm above the surface of the tread. With a clearance not less than 50mm between the handrail and the wall.
- Handrails are continuous between flight and landing.
- Guards are not less than 900mm and not more than 1100mm.
- Openings in exit stairs are limited to door from normally occupied spaces and corridors and door assembly for egress from the enclosure.
- Stairs provide a continuous protected path of travel to a final exit.
- Winders are not permitted.

1.8.3 OCCUPANT LOAD

Occupancy	Occupant Load Factor
Prayer	1m2/person
Lounges/ Cafes	1 m2/person
Meeting	1 m2/person
Waiting	2 m2/person
Ablution	Number of fixtures
Kitchen	7 m2/person
Closed office	7 m2/person
Storage	30 m2/person
MEP	30 m2/person

1.8.4 CAPACITY OF MEANS OF EGRESS

- Egress capacity are based on the below factors:
  - Doors for B1 3.6 mm/person
  - Doors for A2 3.6 mm/person
  - Doors for A2 4.6 mm/person
- The width of corridor or escape route is not less than the width of any door leading on to it or 1200mm whichever is greater.

1.8.5 NUMBER OF ESCAPE ROUTES/EXITS

- Number of means of egress is not less than 2 from any story or portion thereof.
- If the occupant load is 60 or less 1 escape route/exit is required within the allowable 1 escape travel dimension, if more than 60 but not more than 600 not less than 2 are provided. When it's over 600 not less than 3.

1.8.6 ARRANGEMENT OF MEANS OF EGRESS AND TRAVEL DISTANCE TO EXITS

- If alternative escape routes are provided, they need to be 45 degree or more apart. If not, they need to be separated from each other by fire resistant construction.
- Travel distance and Common path are arranged in order not to exceed the following noting that additional fire protection measures are provided (automatic detection and alarm, height of ceiling between 4m and 5m).

Occupancy	Travel Distance	One-way travel
B1	85m	28m
A2	75m	26m
A3	60 m	22m

1.8.7 EXITS FROM PROTECTED STAIRWAYS

- All protected stairways discharge directly to a final exit door leading directly to outside the building.

1.8.8 ARTIFICIAL AND EMERGENCY ESCAPE LIGHTING

- The building shall be equipped with suitable lighting to allow safe movement along the escape routes, in accordance with BS 5266.
- All emergency escape lighting supplied from the ECBS system shall have a minimum duration time of 3h.
- A standby power system to be provided.

1.8.9 EXIT SIGNS

- Every doorway or exit providing access to a means of escape should be marked in accordance with BS 5499-1 and BS 5499-4.
- Directional signs shall be placed at locations where the direction of travel is not obvious.
- Final exit level from stairs should be clearly marked.
- Exit signs shall be ceiling or wall mounted, single or double faced as required, illuminated and provided with graphical legends and arrows pointing in exit direction. Exit signs shall be maintained and supplied from the ECBS system.

1.9 PROTECTION:

1.9.1 COMPARTMENTATION/SUBDIVISION OF BUILDING SPACES AND OPENING PROTECTIVE IN FIRE RESISTANCE-RATED BARRIERS

- The building spaces are subdivided by internal fire barrier separation to limit the spread of fire.
- Dead end portion of the corridor exceeding 2m are separated from the remainder of the corridor by 30min FRR construction fitted with a fire rated door FD 20S.
- shafts have the same fire resistance as the floors through which they pass, the door shall have half the period of fire resistance of the wall in which it is fitted but not less than 30 min.
- Corridors connecting different type of occupancies are 30min FRR and fitted with a fire rated door FD 20S.

1.9.2 HAZARDOUS AREAS

- Electrical and telecom rooms are enclosed by robust solid non-combustible construction having 60min FRR with fire rated door FD 60S.
- Storages not greater than 450m2, are enclosed by robust construction having 30min FRR with fire rated door FD 30S.
- Substation building is enclosed by robust construction having 120min FRR with fire rated door FD 120S.

1.9.3 CONDUITS AND SHAFTS

- The openings within the fire barriers shall be fire protected by fire stopped systems.
- Conduits & pipes crossing fire resistant barriers are designed not to impair the fire resistance of the barriers and equipped with fire stopping systems.
- Membrane penetration in fire resistance rated wall assemblies, joints between fire resistance rated penetrations in fire resistance rated wall assemblies and perimeter gaps between rated floors/roofs and exterior wall assemblies are equipped with fire stopping systems to maintain the fire resistant rated of the construction.
- Ducts and air-transfer openings penetrating walls or partitions having a fire resistance rating of 2H or more and 1h fire resistance rated shafts will be equipped with fire dampers where fire dampers don't conflict with the purpose design of the duct.
- Concealed spaces between the interior of the building and the façade cladding shall have perimeter fire and smoke stopping.

1.9.4 MATERIAL AND FINISHES

- For life safety purposes the surface flame spread, and heat release rate characteristics of the lining material should be:
  - In circulation spaces: classified B-s3, d0 (EU class) or 0 (national class).
  - In rooms: classified C-s3, d0 (EU class) or 1 (national class).
  - Small room of area not exceeding 30 m2: classified D-s3, d2 (EU class) or 3 (national class).

1.9.5 FIRE DETECTION, ALARM AND COMMUNICATION SYSTEMS

- The building is provided with a fire alarm and detection system L2.

1.9.6 EXTINGUISHING REQUIREMENTS

- Portable fire extinguishers will be provided for Mosque, Substation, and pump room.
- Clean agent extinguishing system will be provided for critical telecom room.
- Fire hydrants shall be provided within 90 m of the building entrances.

1.10 FIRE DEPARTMENT ACCESS ROAD

1.10.1 REQUIRED ACCESS

- Approved fire department accessway is provided.

1.10.2 ACCESS TO BUILDING

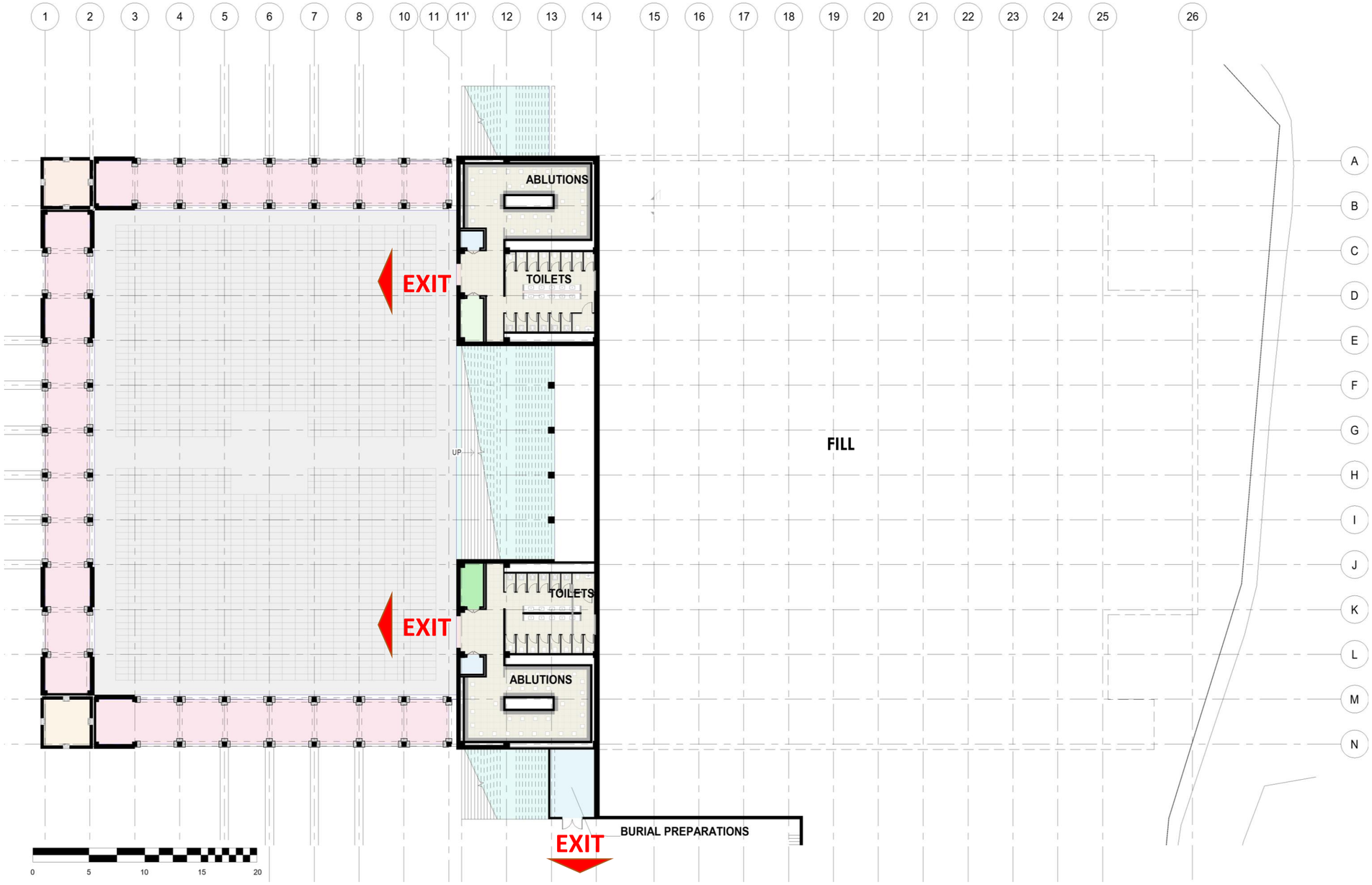
- Vehicle access should be provided to buildings (i.e. buildings between 2 000 m2 and 8000 m2) with a top story less than 11 m above ground level to within 45m of every point on the projected plan area or “footprint” of the building or to 15%(E) of the perimeter, whichever is the less onerous.
- (E) Any perimeter wall (elevation) to which vehicle access is provided should have a door, not less than 750mm wide, giving access to the interior of the building.

1.10.3 SPECIFICATIONS

- Vertical clearance of pump is not less than 3.7m.
- Minimum width between kerbs is 3.7m
- Minimum width of gateways is 3.1m.
- Minimum turning circle between kerbs is 16.8m and 19.2m between walls.
- Minimum carrying capacity is 12.5 ton.
- Dead end roads in excess of 20m in length are provided with turning circle or hammerhead.

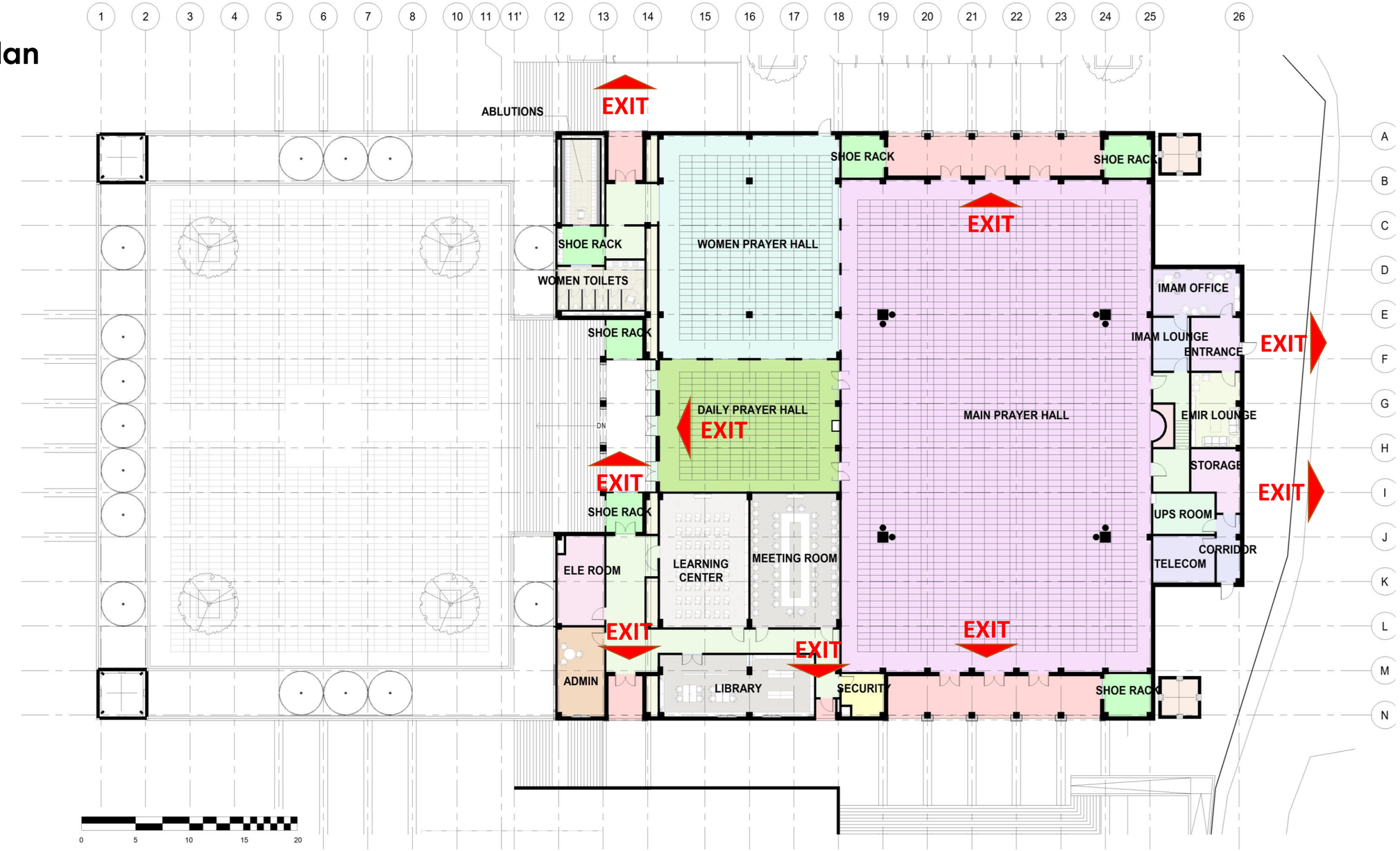
Lower Ground Floor Plan

ESCAPE DIRECTIONS



Upper Ground Floor Plan

ESCAPE DIRECTIONS



08 Acoustic

1 DESIGN CRITERIA

1.1 NOISE INGRESS

The external building envelope should be designed to control external noise break-in to each space in order to achieve the criteria specified in the following documents:

- BS 8233: Guidance on sound insulation and noise reduction for buildings
- WHO: *Guidelines for Community Noise*.

The "noise ingress" criteria specified in the above documents exclude noise contribution from activities within internal areas, noise transmitted from adjacent spaces or noise generated used in the space.

Noise Ingress Limits from Continuous Noise

Based on the above standards, Table 7.1 presents the recommended noise ingress limits in internal spaces for external sources. These noise limits should be used to ascertain the sound insulation requirements for the building envelope.

These noise limits are expressed in terms of dB $L_{Aeq,T}$ parameter. They apply to position 1.5m from any emitting source (excluding the floor or ground) in each indoor area. The time period (T) should be representative of the noise climate around each building on the site, typically between 5 minutes and one hour.

Noise Sensitive Receiver	Noise Level Intrusion dB L_{Aeq}
Prayer Hall	40
Learning Center / Library	35
Meeting Room	35
Office: Admin / Service	35
Toilets / Ablution / Corridors	40-45

Table 7.1 Building Service Noise Emission Limits

1.2 INTERNAL SOUND INSULATION

For all walls/partitions, doors, and windows, construction should be selected to control internal airborne and impact noise transfer between different spaces in order to achieve the criteria specified in the following documents:

- BS 8233: Guidance on sound insulation and noise reduction for buildings;
- WHO: Guidelines for Community Noise.

Airborne Sound Insulation Performance Requirements

Table 3, below, presents the airborne sound insulation requirements as laboratory performance of the wall delimiting typical rooms included in the project.

Impact Sound Insulation Performance Requirements

Table 7.2 presents, also, the minimum impact sound insulation performances in different types of spaces in line with the above-mentioned guidelines;

Noise Sensitive Receiver	Airborne Sound Insulation STC / R_w	Impact Sound Insulation $L'_{nT,w}$
Prayer Hall	50-55	60
Learning Center / Library	50	60
Meeting Room	55	60
Office: Admin / Service	50	65
Toilets / Ablution / Corridors	50	65

Table 7.2 Building Service Noise Emission Limits

1.3 REVERBERATION & ECHO CONTROL

For all internal floors/ceilings and walls/partitions, finishes should be selected to control reverberation and noise build-up inside occupied areas in order to achieve the mid-frequency reverberation time (Tmf) criteria specified in the following documents:

- BS 8233: Guidance on sound insulation and noise reduction for buildings

Reverberation Time Limits - Based on the standards stated above, Table 7.3 presents the recommended reverberation times in various typical office spaces as target values chosen for this specific project.

These criteria are expressed using the Tmf which refers to the mid frequency arithmetic average of the reverberation time measured in the 500Hz, 1kHz, and 2kHz octave band center frequencies.

It should be noted that the Tmf requirements are design targets rather than the absolute specific performance requirements.

Noise Sensitive Receiver	Reverberation Time T_{mf}, seconds
Prayer Hall	< 2.0
Learning Center / Library	0.6-0.8
Meeting Room	0.8
Office: Admin / Service	0.6
Toilets / Ablution / Corridors	-

Table 7.3 Building Service Noise Emission Limits

1.4 BACKGROUND NOISE

The external building envelope should be designed to control external noise break-in to each space in order to achieve the criteria specified in the following documents:

- BS 8233: Guidance on sound insulation and noise reduction for buildings
- WHO: *Guidelines for Community Noise*.

The "noise ingress" criteria specified in the above documents exclude noise contribution from activities within internal areas, noise transmitted from adjacent spaces or noise generated used in the space.

Noise Ingress Limits from Continuous Noise

Based on the above standards, Table 7.4 presents the recommended noise ingress limits in internal spaces for external sources. These noise limits should be used to ascertain the sound insulation requirements for the building envelope.

These noise limits are expressed in terms of dB $L_{Aeq,T}$ parameter. They apply to position 1.5m from any emitting source (excluding the floor or ground) in each indoor area. The time period (T) should be representative of the noise climate around each building on the site, typically between 5 minutes and one hour.

Noise Sensitive Receiver	Building Service Noise Limits NC/NR
Prayer Hall	NC/NR 35
Learning Center / Library	NC/NR 30
Meeting Room	NC/NR 30
Office: Admin / Service	NC/NR 35
Toilets / Ablution / Corridors	NC/NR 40

Table 7.4 Building Service Noise Emission Limits

2 ENVIRONMENTAL NOISE ASSESSMENT & BILDING ENVELOPE

The location of the new serviced apartment building is a residential area.

The dominating source of noise is expected to be road traffic and outdoor mechanical equipment servicing the proposed and the nearby buildings. The current noise levels prevailing on site are expected to be in the region of 50 to 65 dBA LAeq, during daytime.

Sound Insulation Requirements for Glazed Elements

Based on the expected noise levels on site, the required acoustic performance of glazed elements on all facades is in the region of STC33 to STC35 (or OITC 27 – OITC29). For reference only, This could be achieved by using a double-glazing unit comprising 6mm glass 12mm airgap, 6mm glass.

Sound Insulation Requirements for Opaque/Solid Elements

It is recommended for all spandrel panels and solid elements of the facades to achieve acoustic ratings of at least 5 dB higher than the glazing acoustic rating.

3 INTERNAL SOUND INSULATION

Construction details and Acoustic Ratings

Table 7.5 below shows, as reference onl, typical construction details and their acoustic ratings. Notice that these wall types are assumed to be extended from slab to slab.

Acoustic Rating STC / R_w	Wall Construction & Acoustic Ratings		
	Lightweight	Concrete Hollow Block	Solid Block
55	2x12.5mm plasterboard each side of a double stud framework. 100mm insulation in the cavity	300mm concrete hollow block (1200kg/m3), 13-15mm plaster both sides	200mm solid block (1850kg/m3), 13-15mm plaster both sides.
50	2x12.5mm plasterboard each side of 70mm single stud framework. 30mm insulation in the cavity	200mm concrete hollow block (1200kg/m3), 13-15mm plaster both sides	150mm solid block (1850kg/m3), 13-15mm plaster both sides
45	15mm plasterboard on both sides of a single 70mm stud framework. 25mm insulation in the cavity.	150mm concrete hollow block (1200kg/m3), 13-15mm plaster both sides.	100mm solid block (1850kg/m3), 13-15 plaster both sides.

Table 7.5 - Construction Details & Acoustic Rating *(For Reference Only)*

4 MEP NOISE CONTROL

Mechanical Rooms

For mechanical plantrooms where indoor noise level is 80dBA LAeq, or above, it is recommended to provide an acoustic ceiling and some wall treatment. This should be based on the shape and volume of the plantroom. The acoustic ceiling should be specified to achieve sound absorptive rating of NRC ≥ 0.90 or have a Class A sound absorber rating.

Generator Rooms

Perimeter Walls - Walls delimiting the generator rooms should be specified to achieve STC55 to control adequately the potential of break-in noise in the adjacent spaces. This performance can be achieved by using a construction comprising 200mm solid block (1850 kg/m3).

Louver Walls - Air intake and discharges should be attenuated to achieve noise emission levels from louvers to be no more than 80 dBA at 1m from the grilles. Notice that for generator rooms, critical grade silencers are likely required to achieve these design targets.

Generator rooms should be provided with acoustic treatment to control the indoor ambient noise levels by covering as much as the ceiling and walls areas as possible. This acoustics treatment should be specified to achieve sound absorptive rating of NRC ≥ 0.90. Typically, this can be met using 100mm mineral wool behind

Outdoor Plant

Outdoor plant equipment located should be selected and installed in a way that their noise emissions at the occupied outdoor areas meet the design target presented in Table 2 are met.

Air Distribution and AC system

As the noise emissions from the A/C ventilation system depends on the final selection of the equipment, Table 7.6 below summaries the acoustic recommendations as guidelines;

Item/Location	NR 30	NR 35	NR 40
Diffusers, Grilles & Registers	Diffusers rated at NC-25; Perforated or plaque face diffusers NC 20 selection. No dampers at the diffusers.	Diffusers rated at NC-30. No dampers at the diffusers for trim only.	Diffusers rated at NC-35. No dampers at the diffusers for trim only.
Air Velocity at Opening or Diffuser	2 m/s (or as required to meet diffuser rating of NC-25 and diffuser mechanical performance).	3 m/s (or as required to meet diffuser rating of NC-30 and diffuser mechanical performance).	4 m/s (or as required to meet diffuser rating of NC-35 and diffuser mechanical performance).
Duct Design	Gradual and smooth fittings.	Gradual and smooth fittings.	Gradual and smooth fittings.
Ductwork expressing over space	Only low pressure ductwork of 6 m/s or less	Medium pressure ductwork of 9 m/s or less	Medium pressure ductwork of 11 m/s or less
Ductwork serving the space	Low pressure not exceeding 4.5 m/s or less; lined w/ 25mm thick acoustical lining	Low pressure ductwork 5 m/s or less	Low pressure ductwork 6 m/s or less
Branch duct velocity	No more than 3.5 m/s	No more than 4 m/s	No more than 4.3 m/s
Diffuser/Feeder Duct	Flex duct at least 1.2 meters long and a max face velocity of 2 m/s	Flex duct at least 0.9 meters long and a max face velocity of 3m/s	Flex duct at least 0.6 meters long and a max face velocity of 4m/s
Return Air transfer	Air transfer ducts lined with 25mm lining, upturned elbow at each end	Air transfer ducts lined with 25mm lining, upturned elbow at each end	Air transfer ducts lined with 25mm lining, upturned elbow at each end
Distance from box and/or fan to first diffuser	3.6 meters	3.6 meters	2.5 meters
Wall Penetrations	All penetrations to be framed around 25mm gap, which is tightly packed with insulation or similar fire material (as applicable).	All penetrations to be framed around 25mm gap, which is tightly packed with insulation or similar fire material (as applicable).	All penetrations to be framed around 25mm gap, which is tightly packed with insulation or similar fire material (as applicable).
Transfer / Exhaust fans	Must be well removed from the space and provided with acoustically lined ductwork or a sound attenuator where applicable.		

Table 7.6 - MEP Building Services - Noise Control Recommendations

09 Structure

This section presents a description of the criteria and methodology that will be adopted in the design of the project structural components. The structural criteria chosen for the project addressed five elements of major importance, namely:

1) Safety of the users and systems.
2) Durability of the structural elements reducing thus the need for future maintenance.
3) Aesthetical values with special attention to adopt structural concepts in harmony with the architectural, mechanical, and electrical requirements.
4) Rationalization of structural design leading to optimization of initial construction costs
5) Construction time

Basis Of Design

Design Loads

Dead Loads:

1) Self-weight of the structural components such as slabs, beams, walls, columns, etc., based on actual weight of structural components
2) Allowance for flooring following the Arch. Design
3) Partition and ceiling loads as specified in architectural drawings.
4) Electrometrical works following the Environmental and Electrotechnical design.
5) The unit weight of the materials shall be as per ACI Code or information from the product supplier giving installed weights of materials or components. List of general used material densities is given in the table below

Material	Density KN/m3
Concrete mortar, plaster, and screed	22
Concrete masonry unit (CMU)	16-21.5(16 for hollow core and 21.5 for filled core walls)
Glass	27.4
Normal reinforced concrete	25
Plain concrete	24
Soil	18(20 for landscape areas)

Basis Of Design

Design Loads

Live Loads:

1) Live loads according to ASCE 7-10
2) All equipment loads shall be as manufacturer's data.

LATERAL LOADS (SEISMIC Loads) :

- As per Federal Public of Nigeria "National building Code" the seismic loads were considered based on the following parameters: V=ZIKCSW
- Seismic zone 0, Z=1/8
- I= 1.25
- K= 1

Converting from the Nigeria "National building Code" to the ASCE 7-10

According to ASCE 7-10

Using a Building Frame system ⟶ (Ordinary Reinforced Concrete shear wall)

WIND Load:

According to ASCE 7-10

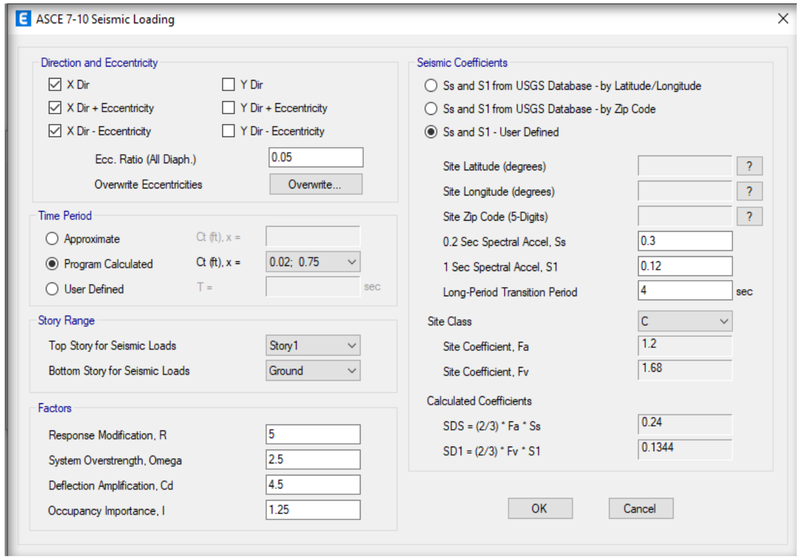
Temperature Variations :

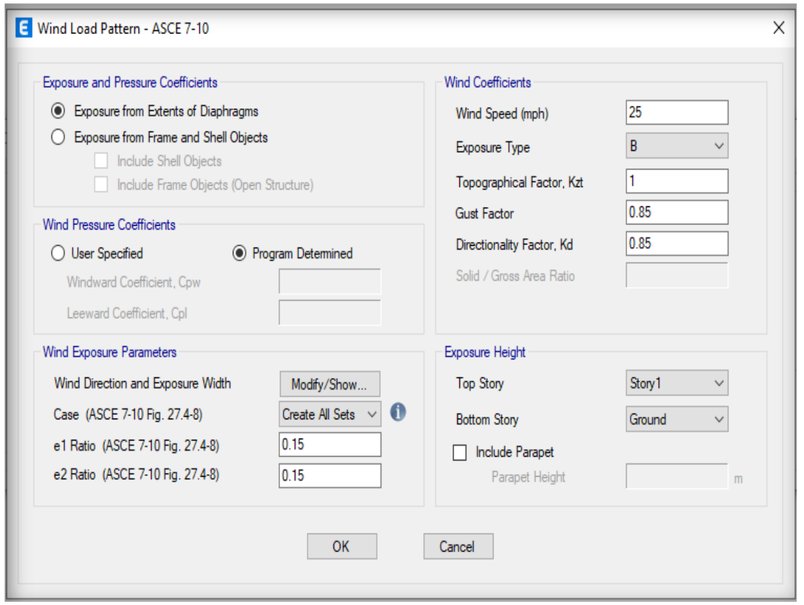
For Reinforced concrete construction:
Reference to "Federal Construction Council: Technical Report No. 65 - Expansion Joints in Buildings",
Temperature variation (ΔT) = Maximum of (Tw – Tm) or (Tm – Tc)
Where:

- Tm = Mean Temperature expected during construction (24 °C to 30 °C)
- Tw = Highest Mean Temperature during summer month (Highest one-day mean temperature 44.5 °C)
- Tc = Lowest Mean Temperature during winter month (Lowest one-day mean temperature 3 °C)

For exposed reinforced concrete structures, a value of temperature variation (ΔT) equal to ± 25 ºC shall be adopted.
For non-exposed floors, a value of temperature variation (ΔT) equal to - 15 ºC shall be adopted (reflecting shrinkage) Note that these levels are expected to be protected from prolonged exposure to direct sunlight either by the construction of the upper floor slabs or placement of the landscape fill or any other approved temporary measures.

- The design is account for seasonal temperature variation of ±25ºC for the steel structure.





Basis Of Design

Design Loads

Load Combinations

1) Load combinations for both service and strength limit states are based on the (ASCE 7-10)
2) Design loads are arranged such that the combined loads produce the most severe effect on the elements and structure as whole
3) Load combinations involving minimum dead load and maximum overturning and uplift loads will be included in the structural analysis and design. Appropriate load factors within all load combinations will be applied in accordance with the design code(s) being used. The most unfavorable load conditions for all structures will be taken into consideration

Codes Of Practice And Standards

1. Building code requirement for structural concrete (ACI 318-14)
2. Minimum Design Loads for Buildings and Other Structures (ASCE 7-10)
3. Manual of Steel Construction, American Institute of Steel Construction AISC/ASD, 15th edition, 2016.
4. Structural Welding Code: American Welding Society, ANSI/AWS D1.1/D1.1M – Latest Edition.

Structural Materials

Reinforced concrete

- The classes of concrete shall follow the project's specifications and shall reflect the minimum 28 days cylindrical compressive strength, f'c as per the design requirements.

Cement

- The Cement Type for foundations shall be selected as per the geotechnical recommendations depending on the exposure condition and the soil/groundwater chemical contamination.
- Type of Portland cement shall conform to "Specifications for Portland Cement", ASTM C150/C150M as recommended. in general Type I for all superstructure elements, and Type II for all substructure elements and Type V for sewerage. Type of cement shall be verified against the geotechnical chemical tests and as per the final geotechnical recommendations

Reinforcement

- Reinforcement for structural elements shall be deformed high tensile steel having minimum yield strength Fy= 420MPa and shall conform to ASTM A615 grade 60.
- Reinforcement having minimum yield strength Fy= 520MPa and shall conform to ASTM A615 grade 75 might be utilized as needed as well and following the codes requirements for the maximum yield strength for different design aspects.

Basis Of Design

Structural Materials

Structural Steel

- Structural Steel Shapes, Plates and Bars: ASTM A 572 Grade 50 having a minimum yield stress of 345 N/mm2 [50 ksi] or approved equal.
- Structural Steel Square and rectangular tubes "hollow square and rectangular sections" are to conform to ASTM A500 grade C having a minimum yield stress of 345 n/mm2 or equal.
- Hot rolled steel hollow circular sections are to be ASTM A 618, Grade III, having a minimum yield stress of 345 N/mm2 or approved equal.
- Headed Stud-Type Shear Connectors: AWS D1.1, type B, minimum yield strength 350 N/mm2 [50 ksi] at 0.2% offset, made from steel to ASTM A 108, with mechanical properties to ASTM A 370.
- High-Strength Threaded Fasteners: Quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A 490, or A 325.
- Metal-Arc Welding Electrodes: E70XX series of the Specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1, or the Specification for Low-Alloy Steel Covered Arc-Welding Electrodes, AWS A5.5.
- Bare Electrodes and Granular Flux used in the submerged-arc process: F7 X-EXXX AWS flux classifications of the Specification for Base Mild Steel Electrodes and Fluxes for Submerged Arc Welding, AWS A5.17, or A5.23.
- Anchor bolts and nuts are to be unpainted rods to be ASTM F 1554 Grade 55 with minimum yield strength 380 MPa or Grade 105 with minimum yield strength 724 MPa.

Stiffness

- The following modeling assumptions are made:
- Stiffness of the elements is modified from that of the full (un-cracked) section to account for cracking due to factored loads, as recommended by ASCE7-10. Thus, the flexural stiffness of the different elements is taken as follows:

  - Beams: EI = 0.35 Elg
  - Flat plates & Slabs: EI = 0.25 Elg
  - Columns: EI = 0.70 Elg
  - Walls (un-cracked): EI = 0.70 Elg
  - Walls (cracked): EI = 0.35 Elg

Basis Of Design

Serviceability Criteria

Design for Durability

Reinforced concrete

- Precautions such as high quality and low absorption blended cement will provide strong resistance to the chemical sulphate and chlorides attack if any (based on the chemical tests for the soil as per the geotechnical recommendations).
- Applying water proofing membrane will provide a barrier protection for reinforced concrete surface in direct contact with the soil against the chemical attacks
- Ample cover to reinforcement will provide high resistance for reinforcement corrosion.
- Crack control for reinforced concrete surface in contact with water will be considered

Structure Waterproofing (Below Grade)

- Water proofing membrane might be applied for surface of all sub-structure elements in direct contact with soil depending on the results of the geotechnical investigation. Water stopper might be provided across any construction joints within the sub-structure elements in contact with soil.

Deflection limits

- Deformations (vertical deflection of beams/slabs or lateral movement of columns/walls) of floors and roof will be calculated under service loads to ensure it will not impair the serviceability of the buildings.

Vertical deflection

Reinforced concrete members shall be designed to have adequate stiffness to limit deflection or any deformations that adversely affect strength or serviceability of a structure. Control of vertical deflection for beams and slabs will confirm to the maximum permissible deflection limits according to ACI 318M_14 that can be applied for all areas unless otherwise indicated.

Concrete slabs and Beams shall be designed to the following deflection criteria shown in the following table (based on ACI 318M_14 Code)

Deflection to be considered	Deflection / limits
Immediate deflection due to live load LL using cracked section. Ponding should be checked separately	Span/180
Immediate deflection due to live load LL using cracked section	Span/360
non-structural elements (Sum of the long-term deflection due to all sustained loads and the immediate deflection due to any additional live load).	Span/360
The part of the total deflection occurring after attachment of non-structural elements (Sum of the long-term deflection due to all sustained loads and immediate deflection due to any additional live load).	Span/240

Basis Of Design

Serviceability Criteria

Vertical deflection

For steel structure , the deformations (deflection of floor beams/slabs) will be calculated under service loads and will be compared to deflection limitations following AISC Manual 15th Edition, 2016 and AISC Design Guide 3 for serviceability.

Structural Element	Load Combination to Be Considered	Deflection Limitation
Structural steel beam in roof/floor construction	1) Vertical deflection due to: LL	Span / 360
	2) Vertical deflection due to: DL+LL	Span / 240
Cantilevered structural steel beam in roof/floor construction	Vertical deflection due to: LL	Span / 180

Seismic Drift

As per ASCE7-10 code, lateral seismic deflection, or drift of a story relative to its adjacent stories shall not exceed the allowable limits as shown in ASCE7-10 code

Table 12.12-1 Allowable Story Drift, Δ_a[a,b]

Structure	Risk Category I or II	Risk Category III	Risk Category IV
Structures, other than masonry shear wall structures, 4 stories or less above the base as defined in Section 11.2, with interior walls, partitions, ceilings, and exterior wall systems that have been designed to accommodate the story drifts.	$0.025h_{sx}$[c]	$0.020h_{sx}$	$0.015h_{sx}$
Masonry cantilever shear wall structures[d]	$0.010h_{sx}$	$0.010h_{sx}$	$0.010h_{sx}$
Other masonry shear wall structures	$0.007h_{sx}$	$0.007h_{sx}$	$0.007h_{sx}$
All other structures	$0.020h_{sx}$	$0.015h_{sx}$	$0.010h_{sx}$

Basis Of Design

Serviceability Criteria

Wind Drift

For Reinforced concrete buildings:

The drift calculations shall be performed using 25-years mean recurrence interval (MRI).

The allowable sway and drift limits are as illustrated below:

- Sway Limit: H/500 (H = Height of Building)
- Inter-Story Drift Limit: h/400 (h = Story height)

Statical System

The Mosque statical system

- The system of the roof consists of main prayer hall with dimension 21X21 squared meters surrounded with main concrete girders to provide the required architectural image. While the adjacent bays are 12.5X 21 squared meters with concrete paneled beams system.
- These main girders are considered as main supporting elements for the central dome.
- The intermediate floors systems are conventional concrete system with a flat slab system with drop panels and marginal beams
- The minarets will be separate structure and isolated from the mosque building.

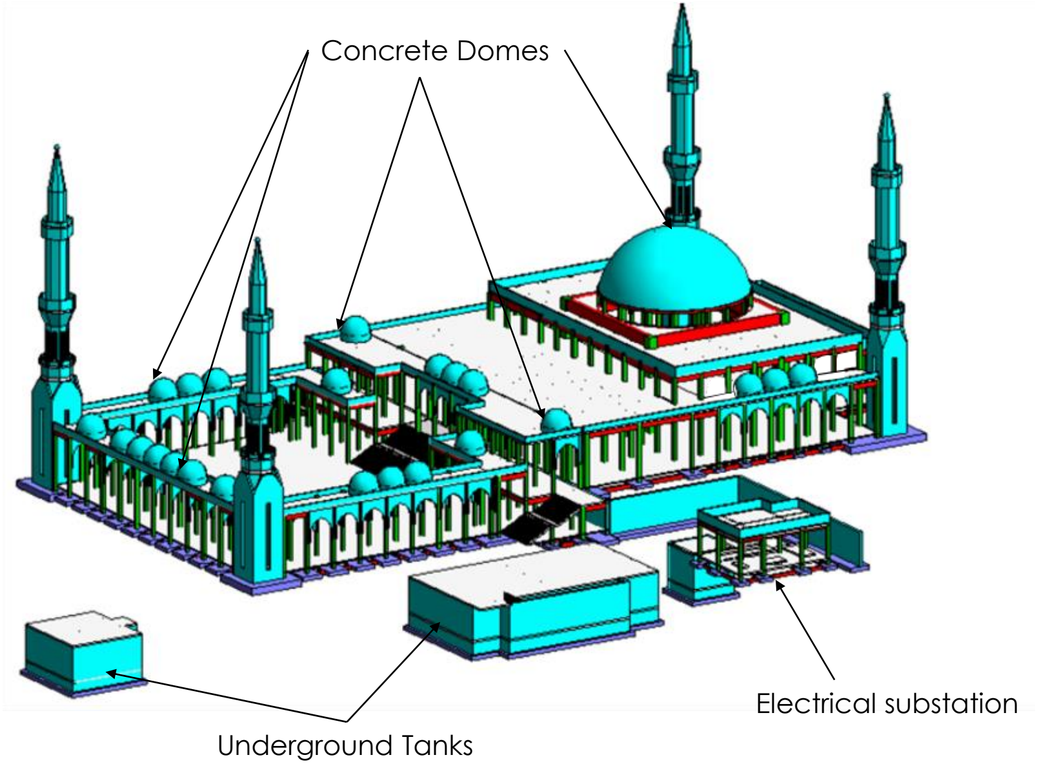
The Arcade statical system

- The entrance arcades are consisting of concrete arches supporting concrete domes to conform the main external praying hall for the mosque.

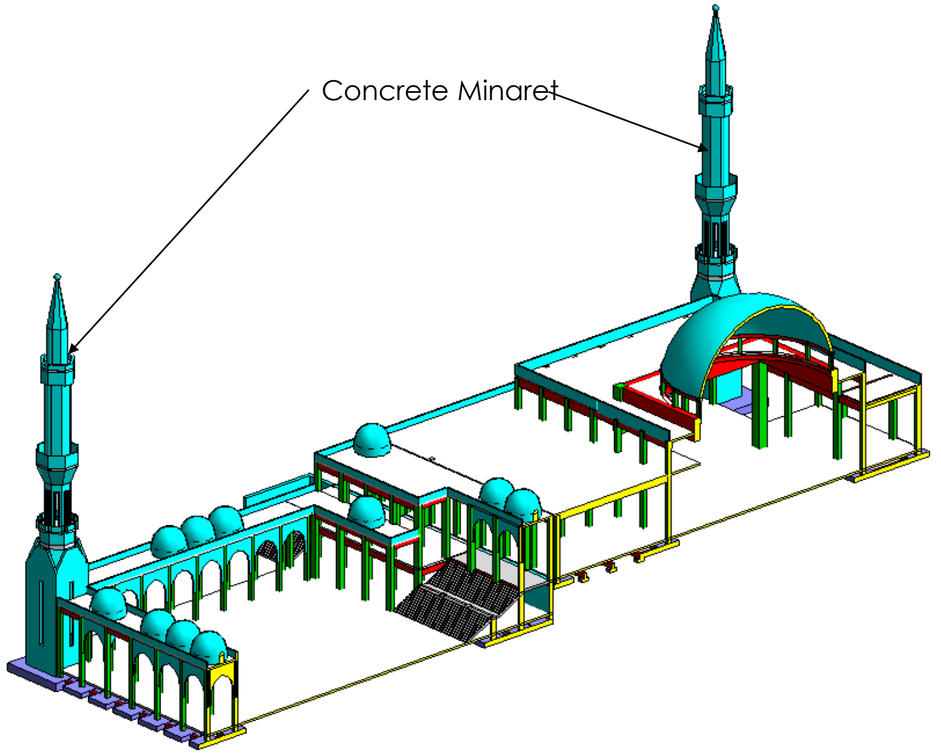
The foundation system

- The main building of the Mosque will be constructed on foundations higher than the Arcade foundations.

Statical System

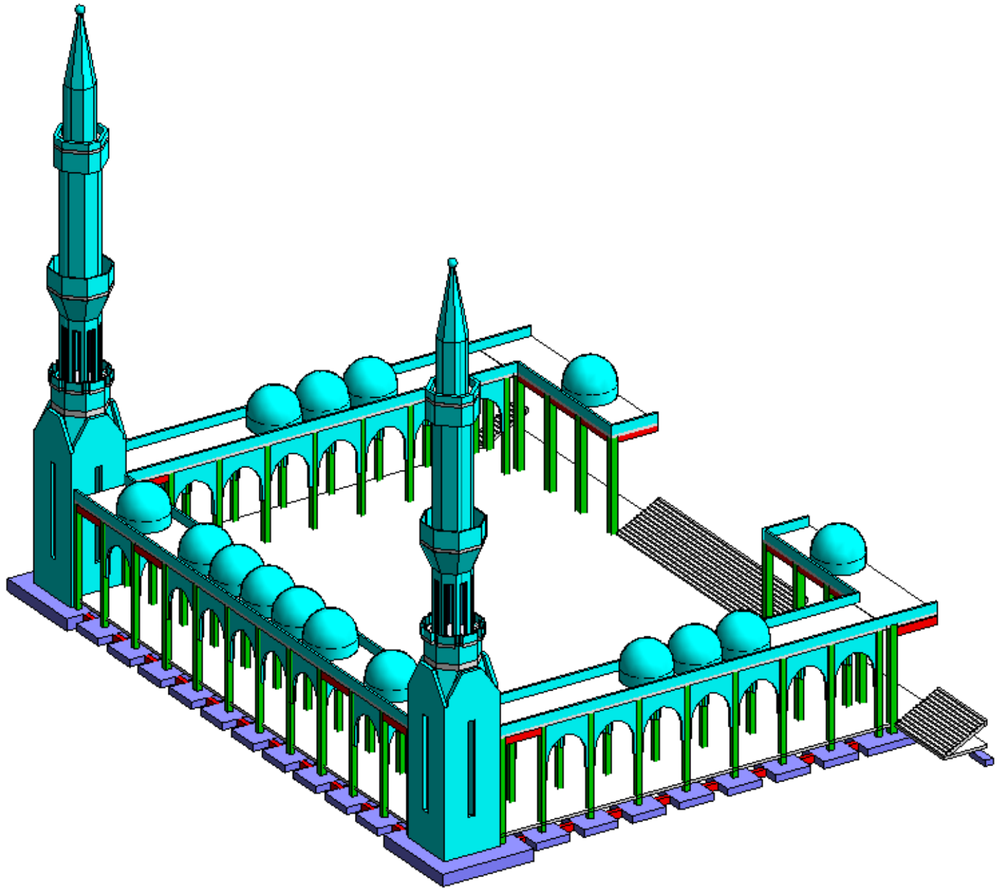


3D view

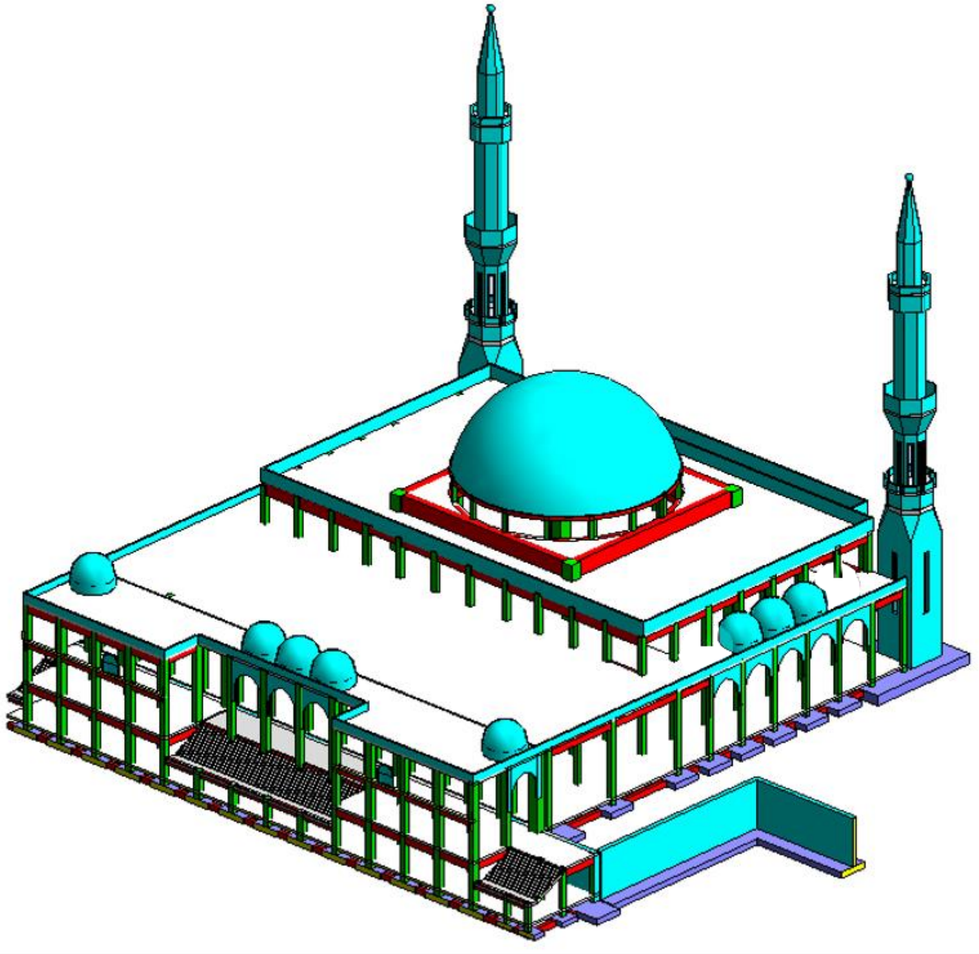


3D longitudinal section

Statical System

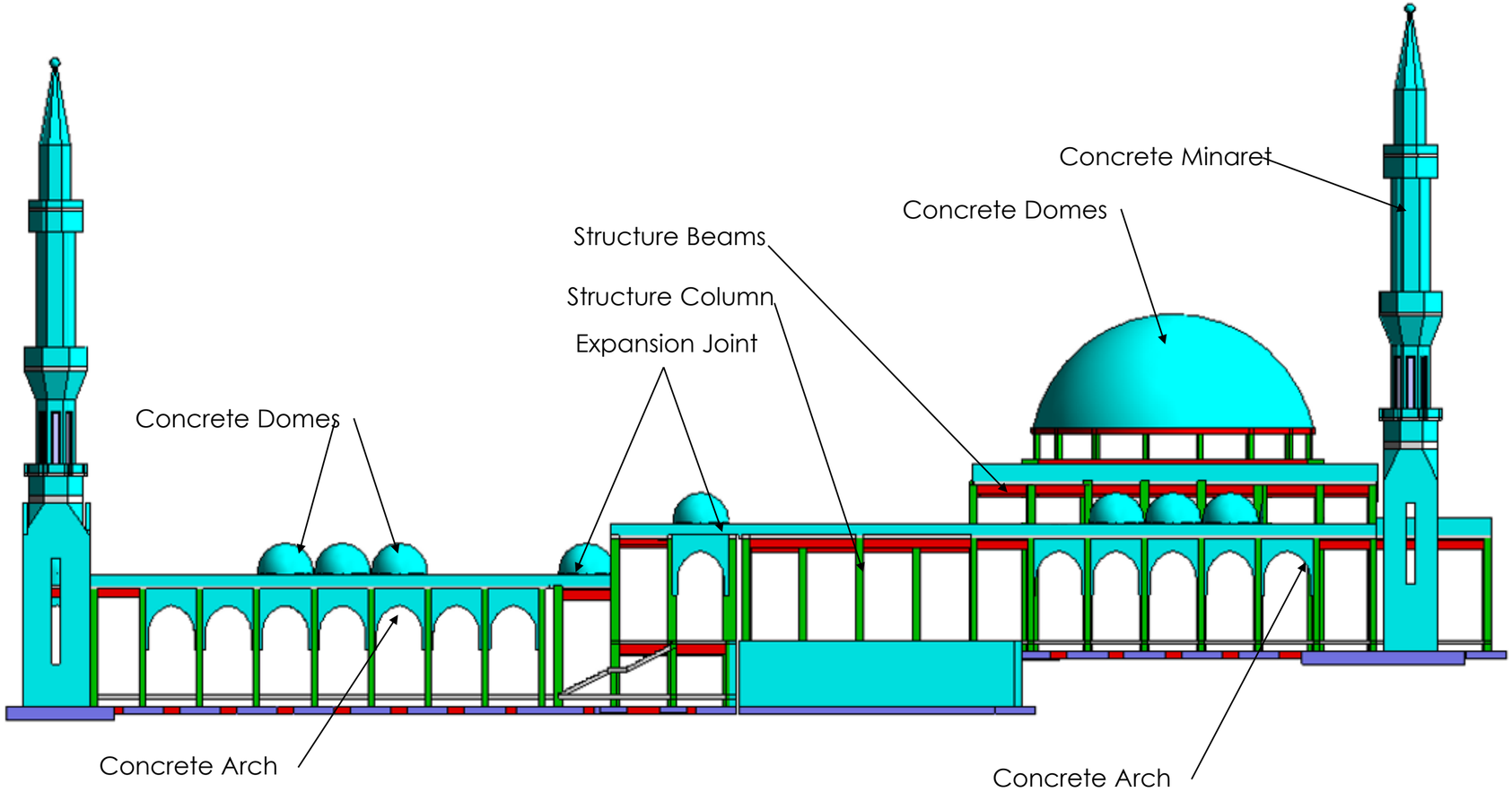


Arcade 3D



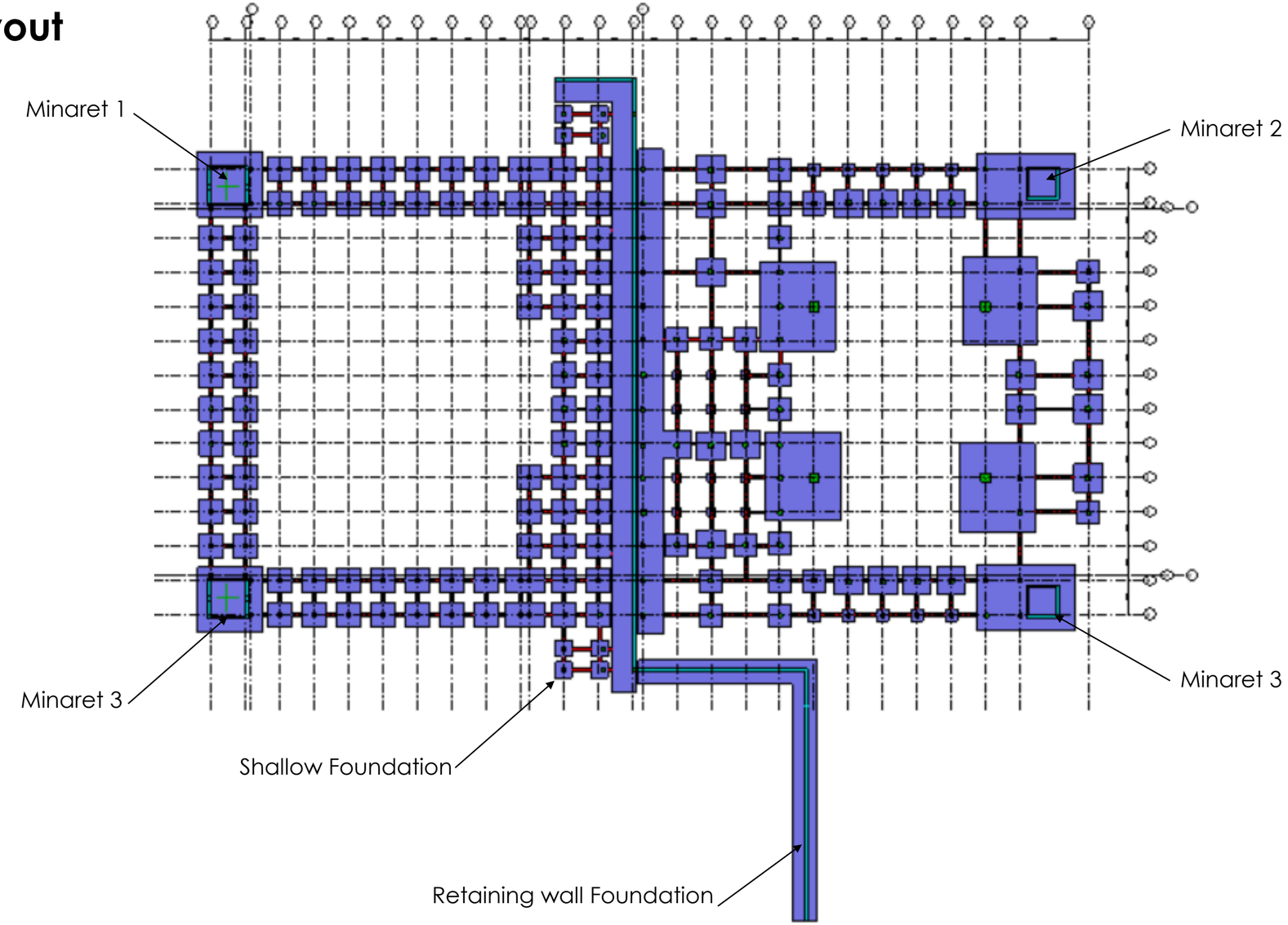
Main building

Statical System

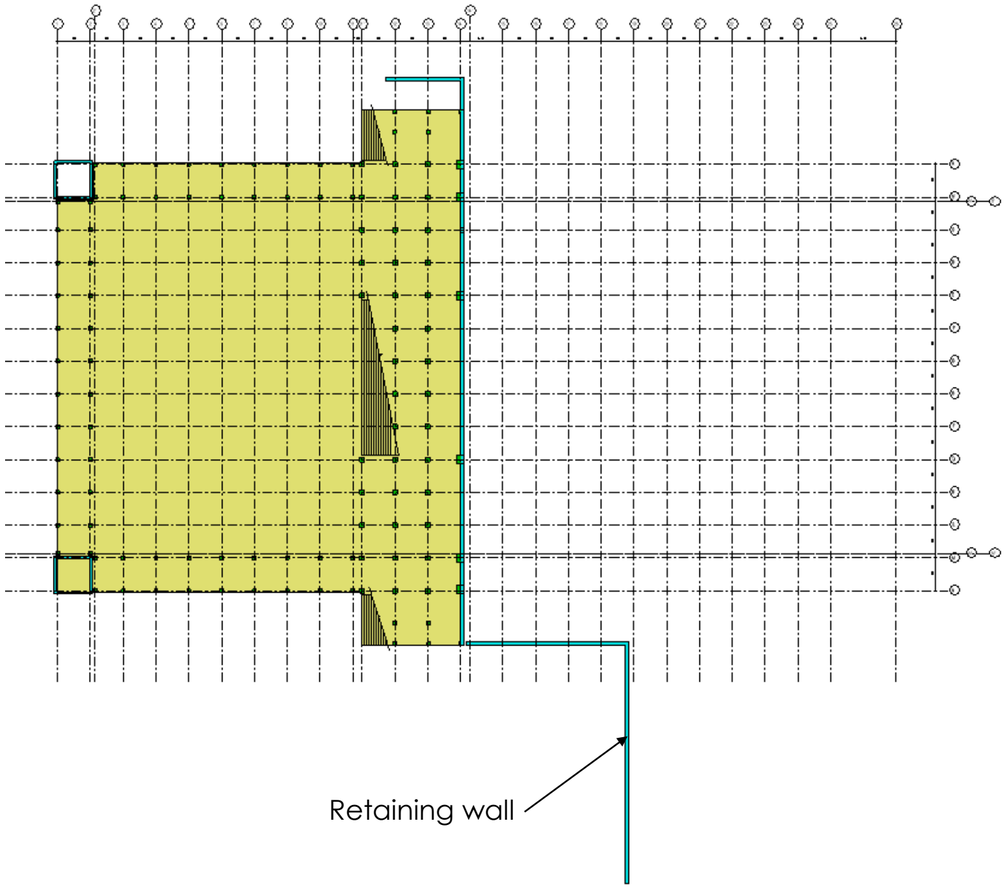


Longitudinal Section

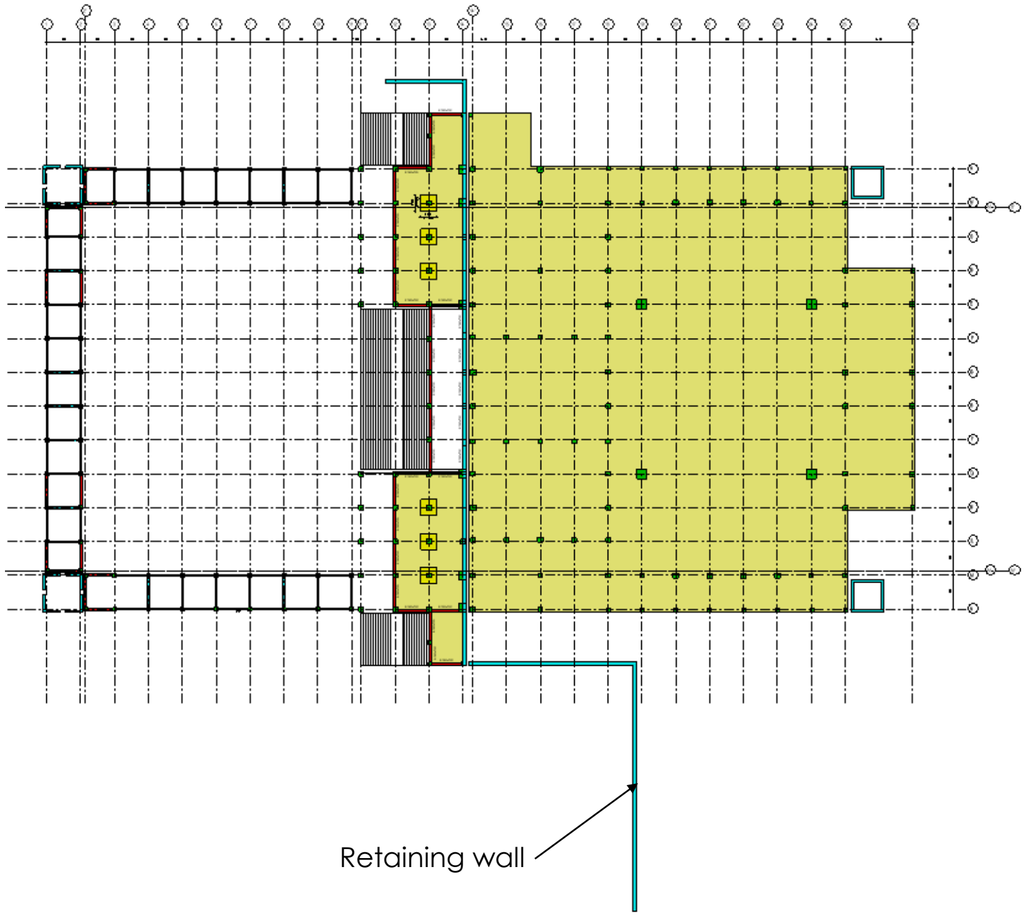
Foundation Layout



Statical System

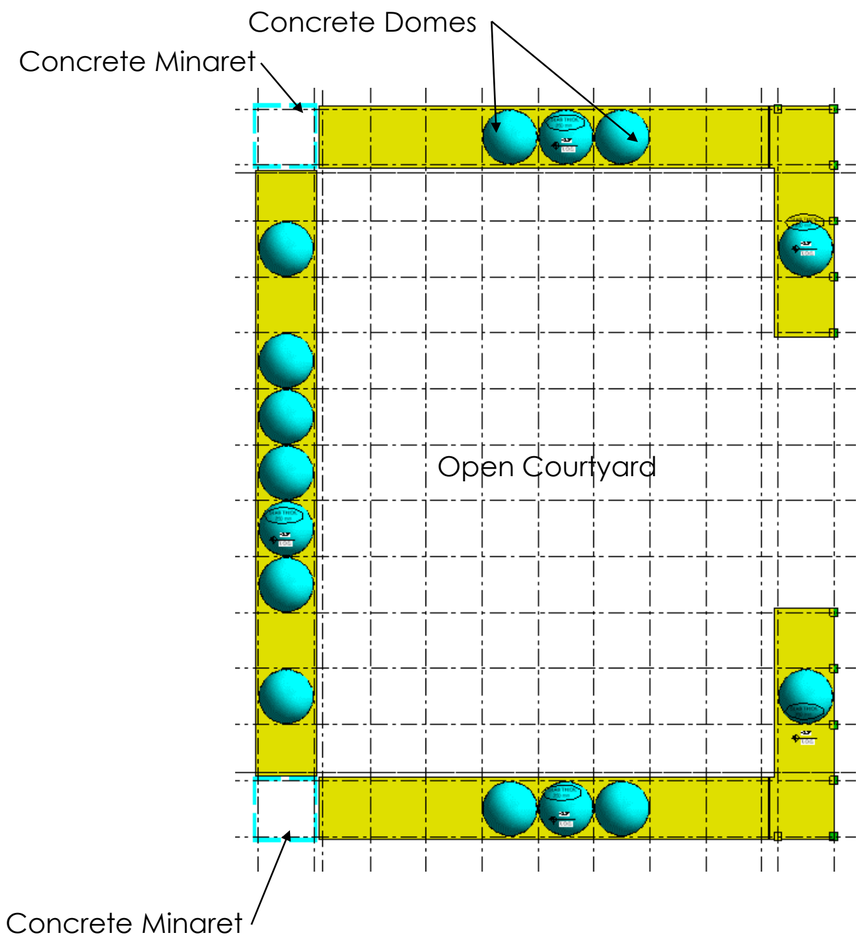


Slab on Grade at Lower Ground level

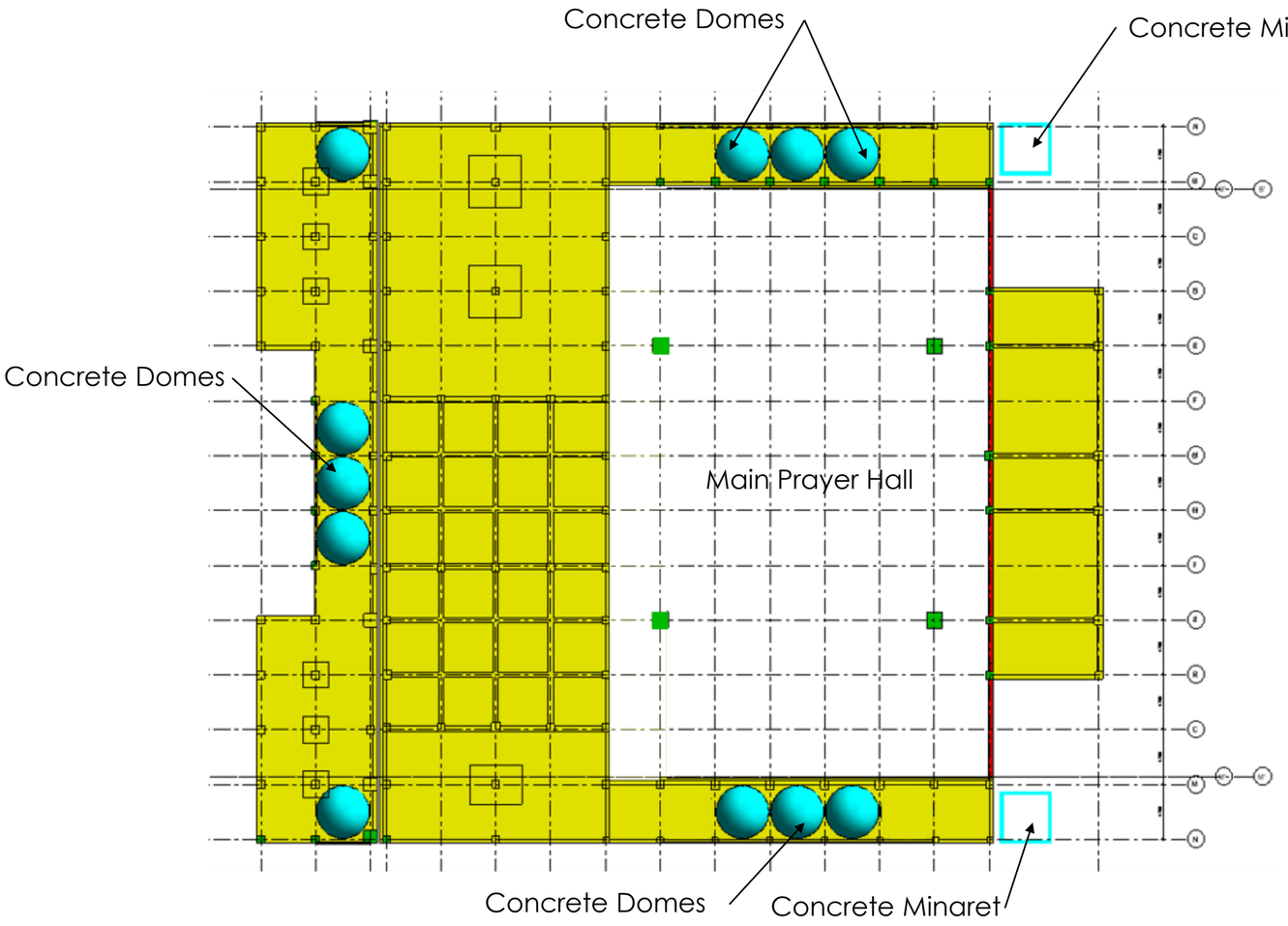


Slab on Grade Upper Ground level

Statical System

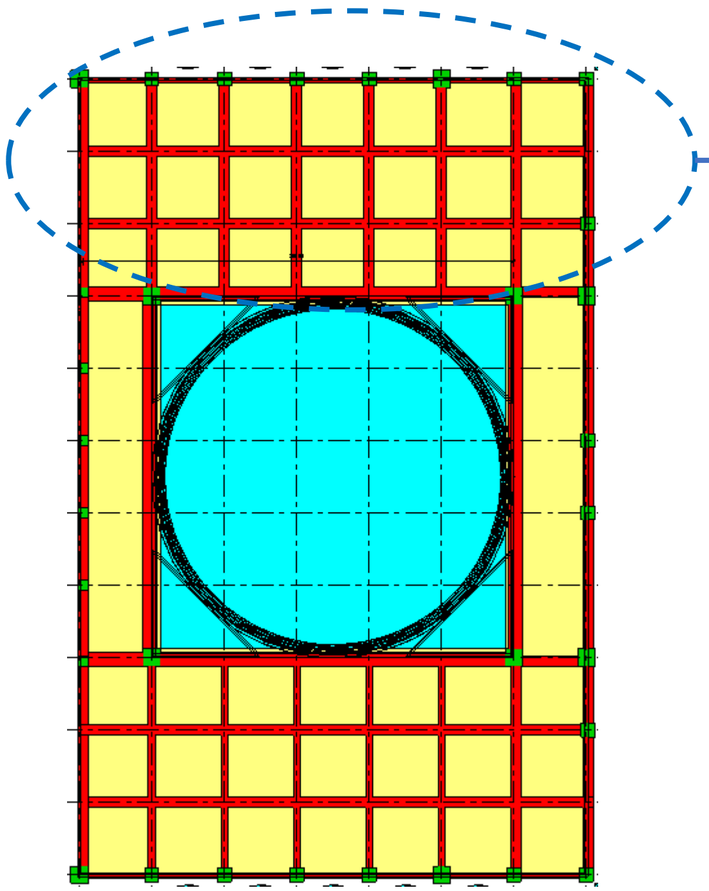


Arcade Roof Slab

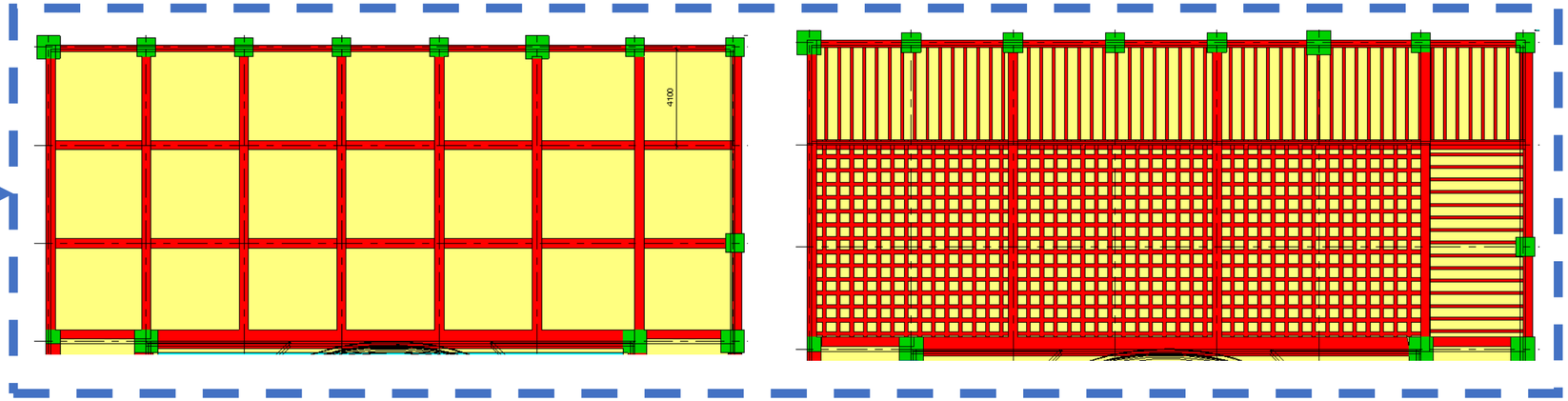


First Roof Level

Statical System



Roof floor level



Option (1) For the Roof slab Using paneled beam with solid slab

Option (2) For the Roof slab Using Hollow Block slab

	Pros.	*Cons.*
Option (1) "Paneled beam with solid slab "	1. Ease of construction 2. Less need for skilled Manship 3. Durability for wet areas 4. More human comfort especially for vibration 5. Flexibility of fixations and mounting electro-mechanical fixtures	1. Volume of concrete is slightly greater than hollow block
Option (2) "Hollow Block slab"	1. Improved insulation for sound and heat. Advantage of this slab over the solid slab is temperature control and sound damping	1. Not economic for spans < 5m 2. Adopting the system will lead to changes in the ceiling, consequently the Arch. Internal image will be affected. 3. Less durability and less human comfort 4. Limitations for mounting and post installing any electro-mechanical fixtures

10 Mechanical

HVAC | Introduction

This section of the report describes the scope of work of the mechanical services.

The objectives of the design of the mechanical ventilation and air conditioning system (HVAC) will be to consistently regulate the indoor temperature and humidity to maintain a prescribed comfort level and to ensure the recommended indoor air quality.

The HVAC System will include:

- Air conditioning system for all buildings
- Special ventilation system for different applications.
- General ventilation systems
- Fuel oil system for generator

HVAC design will ensure the selection of the optimum HVAC system with respect to life expectancy, initial and operating costs and system reliability. Materials and equipment are generally specified to the latest American Standards.

The following sustainability and energy efficiency measures are considered for the HVAC system design:

- High energy efficient equipment, Variable speed drives & High efficiency motors
- Fresh air requirements as per ASHRAE standards requirements
- No ozone-depleting chlorofluorocarbon (CFC) refrigerants will be used in the refrigeration cooling units
- The mechanical equipment will be selected and installed in a way that will minimize noise and vibration
- Consideration will be given to ease of access for equipment maintenance, redundancy and back-up

HVAC | Codes & Standards

APPLICABLE CODES AND STANDARDS

The Heating, Ventilation and Air-Conditioning systems (HVAC) will be designed in accordance with the latest editions' requirements and recommendations of the following Codes, Standards and Handbooks:

A. Nigeria Building Code.

B. American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) :

- ANSI/ASHRAE Standard 62.1 : Ventilation for Acceptable Indoor Air Quality
- ANSI/ASHRAE Standard 55: Thermal Environmental Conditions for Human Occupancy
- ANSI/ASHRAE Standard 90.1: Energy Standards for Buildings Except Low Rise Residential Buildings.
- ASHRAE Fundamental, Application and system Equipment handbooks

C. SMACNA HVAC duct construction standards.

HVAC | Indoor design conditions

BASIS OF DESIGN:

HVAC load calculations will be based on Meteonorm weather conditions based on 0.4% for annual cooling, evaporation and 99.6% for annual heating conditions:

- Summer Temperatures:
  - 42.4 °C Maximum dry bulb
  - 23.71 °C Mean coincident wet bulb
- 100% fresh air equipment will be sized based on the following maximum WBT with its coincident DBT:
  - 39.2 °C Mean coincident dry bulb
  - 32.44 °C Maximum wet bulb
- Winter Temperatures:
  - 10.7 °C Dry bulb
  - 6.12 °C Mean coincident wet bulb

HVAC | Indoor design conditions

To reach comfort conditions and proper environment, it is necessary to maintain and control

temperature and humidity within different areas to acceptable levels.

Indoor design conditions for each space are shown in the following table with below considerations :

1. The summer and winter inside design relative humidity listed above is not maintained by any humidity control. This value merely represents the design reference point; and, in actual practice, could vary with the prevailing internal loads and coil leaving conditions.

2. All other areas not specifically mentioned above but scheduled to be mechanically cooled shall have the summer inside design conditions of 24°C DB and 50% RH.

3. Tolerances:

   a. Temperature: +/- 1 °C

   b. Relative Humidity: +/- 5%

4. All areas are air-conditioned and/or ventilated properly to achieve the assigned indoor design conditions.

5. The basis of the load estimate caters for the exterior loads mainly caused by the external glazing facades, walls, internal partitions, and the roof loads as well as the internal loads generated by lights, people, and equipment/ appliance loads.

6. HVAC systems will be designed with a 10% safety factor to account for unexpected loads. HVAC load estimate will be calculated using an approved computer software program such as Carrier Hourly Analysis Program (HAP) version 6

Space	Summer Indoor design conditions		Notes
	DBT °C	RH %	
Praying areas	24	50	--
Offices / Admin areas	24	50	--
Meeting rooms	24	50	--
Library	24	50	--
Storages	26	50	--
Toilets / Ablution	--	--	Ventilation
ICT Room	24	50	--
Telecom room	20	50	--
Mechanical rooms	28	50	--
Electrical rooms	35		--

HVAC | Ventilation requirements

- Adequate ventilation and air filtration will be provided to maintain acceptable indoor air quality. In general, the building shall be under positive pressure with respect to outdoors; therefore, the minimum outdoor air shall be of sufficient quantity to maintain the positive pressurization inside the building.
- The outdoor ventilation and exhaust rates that are adopted in the design are tabulated in the following table based on ASHRAE standards 62.1

Space	Fresh air rates		Exhaust rates	
	LPS/Per	LPS/m^2	LPS/unit	LPS/m^2
Praying areas	2.5	0.3	--	--
Offices / Admin areas	2.5	0.3	--	--
Meeting rooms	2.5	0.3	--	--
Library	2.5	0.6	--	--
Storages	2.5	0.3	--	--
Toilets	--	--	35	--
Ablution	--	--	--	2.5
ICT Room	2.5	0.3	--	--
Janitor closet	--	--	--	5

HVAC | Design Criteria

Filtration

Outdoor air is filtered properly using fresh air sand trap intake louver.

Internal Heat Gain

Actual heat gain from lighting for all areas will be determined by the lighting designer. The lighting loads will be confirmed in the schematic design phase of the project and will be used for the detailed cooling load calculation. The equipment heat gain will be considered including displays, computers, sound system equipment, etc.

Noise Criteria

All equipment will be installed to meet British standards and ASHRAE recommendations with respect to noise and vibration control. The noise levels are as per ASHRAE standards as applicable. Sound and vibration associated with HVAC systems are controlled to achieve the acceptable NC levels.

Equipment and ductwork sound attenuation will be provided where required. Equipment with rotating parts is mounted on vibration isolators; ductwork and pipework are isolated from vibrating equipment by flexible connections.

Ductwork Distribution System

The ductwork sizing and room air distribution will be done in accordance with SMACNA Standards.

Friction loss and velocities are generally as follows:

Low Pressure, Low velocity Ductwork:

- Friction loss through low pressure (LP) ductwork will not exceed 0.85Pa/m of equivalent duct length.
- Air velocities in the low-pressure system will not exceed the following:
  - L.P main ducts - Supply 8.00 m/s
  - L.P main ducts - Return 7.00 m/s

- Medium Pressure/velocity Ductwork:

- Total pressure in the system should be in the range 1680 Pa to 3000 Pa

Duct Materials:

Ductwork material in general spaces will be galvanized steel and will be provided with the required volume dampers for proper balancing of air system.

Aluminium duct cladding will be accounted for all installations where duct work is exposed.

All ductwork crossing fire walls/slabs 2 hours rating & greater are provided with fire dampers where required in addition to providing fire dampers in slab penetrations and at louvers serving rated enclosures. The location and number of fire dampers will be based on the architectural life safety plans showing the wall ratings.

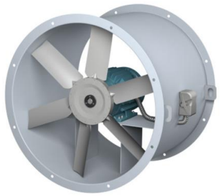
HVAC | System description

- Praying halls will be conditioned by means of rooftop package units.
- Rooftop package units will be allocated on designated locations on roof.
- Demand controlled ventilation system will be considered in prayer halls in which the fresh air flow rate will be variable according to occupancy by means of CO2 sensors and modulating dampers , in case of part load fresh air flow rate will be reduced while during peak conditions the fresh air flowrate will be increased.
- It is assumed that prayer hall doors open to outdoor will be open during peak time that will allow excess air inside the hall to be ex-filtrated.
- Admin spaces / offices will be air conditioned by means of split ducted DX units or suspended air handling units.
- Fresh air for offices / admin spaces will be introduced through sand trap louvers and connected to the return plenum of the split DX units.
- Exhaust will be considered from shoe racks and toilets by means of exhaust fans mounted on the roof.


Split DX Unit


Split DX Ceiling Suspended Air Handling Unit

Rooftop package unit



Exhaust/Fresh air fans

HVAC | Fuel Oil System

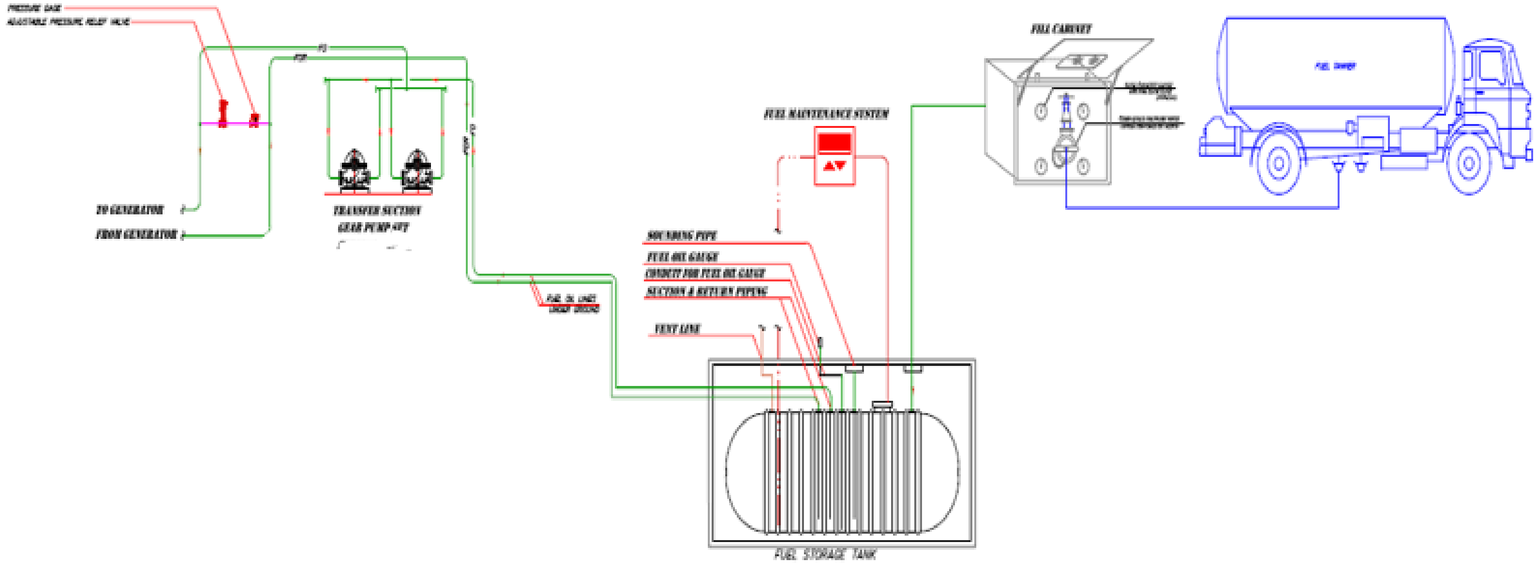
FUEL OIL SYSTEM :

Fuel oil is supplied to the generators of each substation.

The fuel oil system will be designed to have buried tanks in a concrete encasement and the fuel oil pipes will run through accessible concrete trench from tank to demand point. Fuel oil return pipes from daily tanks are part of the system.

Fuel oil pipes will be ASTM A53, Grade B; Schedule 80, black steel, while the fuel oil tanks are jacketed steel type.

Fuel tank will be designed to provide 3 days, 8 hours per day storage capacity for the generators running at full load.



Plumbing | Introduction

Plumbing systems will be selected and designed taking into consideration the selection of optimum and most efficient systems in relation with function and application for each area.

The Plumbing Systems will include:

- Domestic cold water supply system
- Sanitary Drainage system
- Vent system
- Rainwater Drainage system

The plumbing and drainage systems will be designed in accordance with the requirements of the local governing codes and of the following codes and Standards:

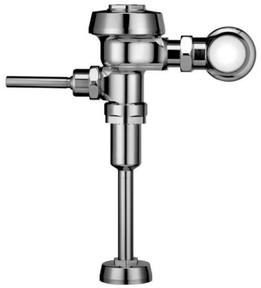
A. Nigeria Buildings Code
B. NPC - National Plumbing Code
C. ASPE - American Society of Plumbing Engineers
D. UPC - Uniform Plumbing Code

Plumbing | Water Supply System

The water supply to the project will be obtained from the main municipality water network and stored in underground concrete tank with 3 days storage capacity.

Water will be fed to the wet areas in the mosque considering the following ::

- municipality water / water from borehole will fill the underground storage tank
- Variable speed booster pump set will be provided to serve all sanitary fixtures inside the building (up feed system).
- Water closets will be flush valve type.
- The water supply network will be distributed with PPR (Poly Propylene) pipes.
- The residual pressure at fixtures connected to the water supply will be maintained at max. Value of 60 psi and minimum pressure of 20 psi.
- Water hammer arrestor will be provided in the cold water supply mains and in branches serving flush valves. A general distribution of cold water piping is in the ceiling space with branch lines to fixtures. Isolating valves will be provided for major branches and at each major fixture group. As possible water piping will be prevented from passing through critical areas.
- No hot water will be considered in the building.
- Landscape areas will be irrigated manually , hose bibs will be considered to facilitate the manual irrigation process.
- Hose bibs will be distributed at roof for cleaning purposes



Flush valve

Booster Pump Set

Plumbing | Water Supply System

Design for cold water piping is based upon the required diversified load for fixtures used intermittently on the system, otherwise known as the fixture unit method. The weight in fixture units of various fixtures is in accordance with National Plumbing Code as listed below:

Plumbing Fixture	WSFU
Water Closet – flush valve	10
Lavatory – public	2
Ablution faucet	2
Janitor/Service sink	3
Hose bib	2.5

Circulating pumps

LEGIONELLA PREVENTION:

- Water will be stored in underground concrete tanks and circulating pumps will be considered to prevent water stagnation.
- Water tank will be two compartment to guarantee having stored volume during cleaning of any compartment.

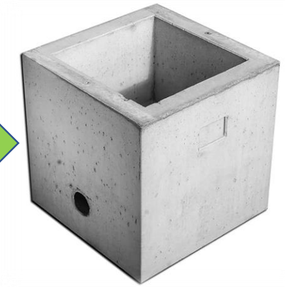
Plumbing | Drainage System

- Sanitary waste serving project will be a two pipe system (soil pipes and waste pipes).
- The connection to holding tank will be via inspection chambers and Gully traps.
- The gully traps will be connected to waste pipes prior to connecting to the termination Inspection chamber/Manhole
- Sanitary drainage will run by gravity flow wherever possible.
- Rain water will be collected by means of vertical risers located at periphery of the building and will be connected to the storm water network.

Wet Areas Drainage

Waste pipes

Gully Trap



Inspection Chamber

ManHole

Plumbing | Drainage system

- Sanitary drainage design shall be based on the fixture unit method .
- The fixture unit is identified as the unit, which considers the rates of water flow in conjunction with the diversities of demand e and usage. As such, the weight in fixture units for the proposed various fixtures is tabulated in the following table.
- pressure fluctuations. A minimum slope of 2% should be provided for pipe 3 in. and smaller, 1% for 4 and 6 in. and 0.5 % for pipe 8 in. and larger
- Horizontal drains are designated to flow at half full capacity under uniform flow to provide a minimum self- cleansing velocity of 0.6 m/s.

UPVC pipes will be used for all drainage pipes.

Fixture Type	DFU
Water Closet – flush valve	4
Lavatory – public	1
Janitor/Service sink	2
Floor Drain / Trench drain	2

Vent System

- Vent pipes are part of the sewage drainage system and will be provided as necessary to ensure sound operation of the sewage lines. A minimum slop of 1 % upward should be provided for vent pipes.
- Vent pipes will be uPVC plastic pipes.

Rain water Drainage System

- A gravity storm drainage system will be provided to collect storm water from roof areas.
- The collected storm water will be connected to main storm drainage network. The pipes, roof drains, gutters, etc. will be sized properly to cover the expected water run-off. Pipes will be laid at slopes steep enough to provide a minimum self-cleansing velocity of 0.75 m/rainwater drainage pipework will be uPVC pipes
- The rainfall run-off will be based on 150 mm per hour.
- Rain water Drainage pipework will be uPVC pipes.

Firefighting | System Description

The Mosque is designed in accordance with British Standards.

- Sprinkler system is not required: The building does not have an occupied storey over 30 meters above access level. In addition, all travel distances within the mosque are not exceeding the maximum travel distance for non-sprinklered building.
- Fire hose reel system is not required/mandatory according to British Standard.
- Fire main (landing valves) is not required: No floor higher than 11 meters above access level.
- Portable fire extinguishers will be provided and distributed throughout the building.
- Fire hydrants will be provided and installed within 90 meters from the building entrance.
- Firefighting pipes inside the pump room will be ductile iron

Fire Hydrants

Firefighting Pumps

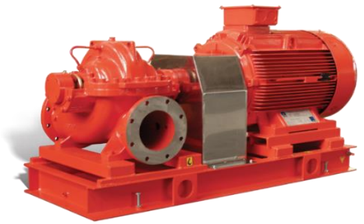
Firefighting | System Description

The firefighting water will be obtained from municipal water network and stored in underground two-compartment tank.

storage capacity will be estimated to cover 120 minutes of fire demand.

From storage tank water will be pressurised into the fire network through one electric fire pumps and another electric fire pump as standby.

Jockey pump will be provided to maintain system pressure and cater for any small leakage in the system.



Electric fire pump

Jokey pump

Mechanical | Controls Design Concept

BASIC DESIGN CONCEPT

All MEP equipment shall be controlled locally by local control panels, without any remote monitoring or control capabilities, as per the following controls strategies.

MEP equipment shall be specified with either factory supplied control panels or local starter panels with the necessary control accessories.

Manual control means, such as local room thermostats, shall be ensured to enable the user to locally operate the MEP equipment manually.

ADDITIONAL OPTIONAL FEATURES

In case required by the Client; remote monitoring and control, via any device with a standard web browser, within the project boundaries, can be considered by providing the following components:

- Direct Digital Controller (DDC) control panels, with BACnet/IP communication feature, for MEP equipment not provided with factory supplied control panel, such as toilet exhaust fans.
- BACnet/IP Communication modules for all factory supplied control panels, such as Roof Top Packaged units and Fuel Oil System.
- Data network connections, for all control panels located within the mosque, electrical substation, and the pumps station.
- Panel mounted HMI touch panel at a convenient location.

The above optional provisions will enable the user to remotely monitor and control the various MEP equipment from a single convenient location, such as an admin office, which allows for quick responding to equipment failures and alarms, as well as ease of control of the main HVAC equipment from a single point.

Mechanical | HVAC Control Strategy

CONTROLS DESIGN CONCEPT

All MEP equipment shall be controlled locally by local control panels, without any remote monitoring or control capabilities, as per the following controls strategies.

MEP equipment shall be specified with either factory supplied control panels or local starter panels with the necessary control accessories.

Manual control means, such as local room thermostats, shall be ensured to enable the user to locally operate the MEP equipment manually.

HVAC EQUIPMENT CONTROL STRATEGY:

- Praying Halls:
  - The praying halls are served by Roof Top Packaged units that will be directly controlled and monitored by its own factory supplied control panel.
  - The user shall be able to control the unit from local thermostat located in the praying hall.
  - Demond Control Ventilation (DCV) based on CO2 measurement will be provided.
- Admin spaces / offices:
  - The admin spaces/ offices are served by split A/C units that will be directly controlled and monitored by its own built-in controller.
  - The user shall be able to control the unit from local thermostat located in the served area.
- Toilets/ shoe racks area;
  - The toilet and shoe racks areas are served by exhaust fans that shall be directly controlled via an on/off button located adjacent to the served area entrance.
  - The toilet exhaust fans shall be also interlocked with the toilet lighting so that whenever the toilet lighting is turned on the corresponding exhaust fan is started automatically.

Mechanical | Plumbing and Firefighting Control Strategy

PLUMBING EQUIPMENT CONTROL STRATEGY:

- Domestic Water System:
  - Domestic water booster pumps shall be provided with factory supplied control panel along with pressure transmitter.
  - The booster pumps shall be operated to maintain an adjustable network pressure set point as indicated by the factory supplied pressure transmitter.
  - The domestic water booster pumps shall be interlocked with the water level inside the combined domestic and firefighting water tank, using a water level float switch so that whenever the water level drops to the firefighting water reserve level the booster pumps are stopped automatically.
- Draining Water System:
  - The sump pumps shall be provided with factory supplied control panel along with the necessary water level float switches.
  - The pumps shall be operated based on the water level inside the sump pit as indicated by the float switches.
- Fuel Oil System:
  - The fuel oil system shall be provided with industrial grade factory supplied control panel.
  - The control panel shall control the fuel oil pumps and the tanks' solenoid valves based on the fuel oil tanks' levels, where each tank will be provided with factory supplied oil level transmitters that will be interfaced with the fuel oil system control panel.
  - The control panel shall also monitor the tanks' factory supplied oil leakage detection system.
  - The fuel oil system control panel shall be provided with local siren and audible alarm that will be triggered whenever an abnormal conditions existing such as tank oil leakage detection.

FIREFIGHTING EQUIPMENT CONTROL STRATEGY:

- Firefighting Pumps:
  - Each fire fighting pump shall be provided with a listed factory supplied control panel, with built-in pressure transmitter.
  - The firefighting pumps shall operate based on the network pressure as indicated by the factory supplied pressure transmitter.

11 Sustainability

Sustainability

Sustainability is not a choice!

- ✓ Sustainable development is the road that will lead to the future we all seek. It provides a structure for fostering economic growth, achieving social justice, practicing environmental stewardship, and enhancing governance.

- ✓ In July 2023 was recorded as the world hottest month ever. UN secretary General has announced that "***the era of global boiling has arrived***".

- ✓ Buildings contribute to considerable load on the environment

- ✓ The project's sustainability strategy aims to closely align with UNSDGs and highly promote sustainability themes and strategies via following global standards and studies that were created for sustainable buildings

Sustainability

Integrated Sustainable Design Approach

ARCHITECTURE

- ✓ Insulated walls, roof
- ✓ High performance glazing
- ✓ Envelop air tightness
- ✓ Optimized Acoustic Performance

PLUMBING

- ✓ Low flow Faucets
- ✓ Dual flush water closets
- ✓ Sub-metering to major Water Systems

HVAC

- ✓ Energy Efficient AC Units
- ✓ Demand control ventilation
- ✓ Thermostat controls
- ✓ Adequate Fresh Air
- ✓ Air Filtration
- ✓ Exhaust ventilation
- ✓ Ozone friendly refrigerants

ENVIRONMENTAL

- ✓ Operation Waste Management
- ✓ Construction Activity Pollution Control
- ✓ Construction and Demolition Waste Management

LANDSDAPING

- ✓ Low watering Plants
- ✓ Hardscapes with high SRI
- ✓ Open Space

LIGHTING

- ✓ Optimum lighting levels
- ✓ Energy Efficient LED Lights
- ✓ Interior and exterior Lighting controls

ELECTRICAL & PLUG LOADS

- ✓ Bathroom fan controls
- ✓ Basic Commissioning
- ✓ Sub-metering to major Energy Systems

MATERIALS

- ✓ Low VOC Paints, Coating
- ✓ Low VOC adhesives, Sealants
- ✓ Sustainable Materials Procurement

12 Electrical

10.1. Introduction

The intent of this section is to describe the project concept, the basic design criteria, and special requirements that are followed in the project design with implementation of cost effective and energy efficient strategies and to achieve a state-of-art installation.
In addition, the electrical systems design and arrangements, equipment selection, distribution, and overall systems integration are also described here after. These strategies will be undertaken during subsequent design phases.
The Design of the electrical works is carried out to comply with the international, Local codes and standards as described below and to the best practice for similar types of projects in Nigeria.

10.2. List of Electrical Systems

The electrical installations for the buildings and project site shall include the following systems:

- Medium Voltage" MV" utility power supply and distribution network including switchgears -if any- and cables.
- Low Voltage "LV" Emergency standby generator power supply.
- Indoor transformer substations.
- Low Voltage " LV" network including main distribution boards, Distribution panel boards and final branch circuit panelboards, motor control centers and cables, power supply devices for mechanical and telecom equipment.
- Uninterruptable power supply.
- Central battery system for security lighting, means of egress lighting in public areas …. etc.
- Earthing system.
- Lightning protection system-.
- Interior lighting.
- Exterior lighting, façade and landscape lighting.
- Small power installations.

10.3. Applicable Codes and Standards

All electrical installations will be designed based on the requirements of applicable local standards and regulations, in conjunction with relevant international standards and practices. Standards will include but not limited to the following:

- NFPA 70: National Electric Code (NEC).
- NFPA 101: Life Safety Code.
- NFPA 110: Standard for Emergency and Standby Power Systems.
- NFPA 20: Standard for the Installation of Stationary Pumps for Fire Protection, for Electrical Supply of Fire Pumps.
- Code of interior lighting issued by Chartered Institution for Building Services Engineers (CIBSE).
- IEC: International Electro-technical Commission.
- BS EN 62305: Lightning protection system
- BS 7430: Earthing system.
- TIA 607: Generic Telecommunications bonding and grounding "Earthing "for customer premises.
- BS 7671: Requirements for Electrical Installation "IET Wiring Regulations ".
- BS EN 81-20/50: Safety rules for the construction and installation of lifts. Lifts for the transport of persons and goods. Passenger and goods passenger lifts.
- CIBSE Guide D: Transportation systems in buildings.
- NERC: Nigeria Electricity Distribution System.
- DISCO (Distribution Company)
- DPCC (Distribution Planning and Connection Code of Nigeria).

The codes and standards listed above are minimum requirements. In specific instances, the design may exceed the applicable requirements.

The applicable codes, references and standards should be reviewed and updated as the design progresses.

10.4. Power Systems Design Criteria

10.4.1. Utilization Voltages

The power supply characteristics will be as follows:

10.4.2. Medium Voltage (MV)

Utility normal MV network 11 kV, 50 Hz, 3 phases, 3 wires, and low resistance earthed neutral.

10.4.3. Low Voltage (LV):

415/230 V, 50 Hz, 3 phase, 4 wire, solidly earthed neutral.

10.4.4. Climatic Conditions

All electrical equipment, accessories and fittings employed in electrical installation will be operated in the climatic conditions as - shown in the mechanical section of the report.

Maximum ambient temperature: 42.4 °C for outdoor.

Seismic Zone: As per structural documents.

10.4.5. Design Loads

The electrical demand load of the project should consist of the following:

- General services loads of common areas including small power, internal and external lighting, e distributed small mechanical equipment etc.
- Bulk Mechanical loads such as HVAC, Plumbing, waste management. etc.
- Telecommunication systems requirements including Server, ICT center and Security systems.
- Distributed Sound system.

The preliminary estimated demand load is around 395 KVA at main LV distribution equipment (MDB)

This estimate was done based on load density (VA/m2) adapted for lighting, small power and various power consuming element, in addition to the electrical loads for the main mechanical equipment (pluming, HVAC) as received from the Mechanical team based on their estimate.

Advanced refined electrical load estimate will be obtained during the upcoming design stages, until reaching the final demand load, in accordance with actual design requirement values.

Space Program	BUA (m2)	Service Load Density VA/m2	Electrical Service Connected Load (KVA)	Demand Factor	Electrical Max Demand Load (kVA)
Lower Ground Floor					
Toilets	215	48	10	0.7	7
Ablutions	285	48	14	0.7	10
Shops	210	76	16	0.6	10
MEP Services & Shoe Racks	140	48	7	0.7	5
Vertical and Horizontal Circulation	70	48	3	0.7	2
Internal Court , open to sky	1555	4	6	0.8	5
Outdoor Arcade (Including Minarets)	530	4	2	0.8	2Upper
Upper Ground Floor Level					
Men Prayer Hall (Including Minarets)	1390	48	67	0.7	47
Women Prayer Hall	355	48	17	0.7	12
Daily Prayer Hall	215	48	10	0.7	7
Women's Toilets	50	48	2	0.7	1
Ablutions	40	48	2	0.7	1
MEP Services & Shoe Racks	230	48	11	0.7	8
Library	70	64	4	0.7	3
Meeting Room	70	64	4	0.7	3
Admin offices	35	72	3	0.6	2
Imam Office and Mihrab Services	65	48	3	0.7	2
ICT center (learning center)	70	64	4	0.7	3
Vertical and Horizontal Circulation and Side Entrances	510	48	24	0.7	17
Stairs at Main Entrance	180	48	9	0.7	6
Underground tanks & Pump rooms (Pump room only)	368	48	18	0.7	13
Electrical Substation & Generator Room	450	48	22	0.7	15
Outdoor Praying Area	7760	4	31	0.8	25
Bulk Mechanical Loads					
Mechanical Load as Received from Mech. Designer	----	----	359	0.8	287
Total Connected Load At MDB Level (KVA)			**493**		
Over All Demand Factor at MDB Level			**0.8**		
Total Demand Load At MDB Level (MDB)			**394**		

10.4.6. Incoming Service

Utility power supply will be obtained from the nearest Utility distribution substation. Either direct radial feeder or MV feeder loops will be extended from the nearest distribution substation to MV Ring Main Units (RMUs) as agreed with authorities of Discos and followed in such region.

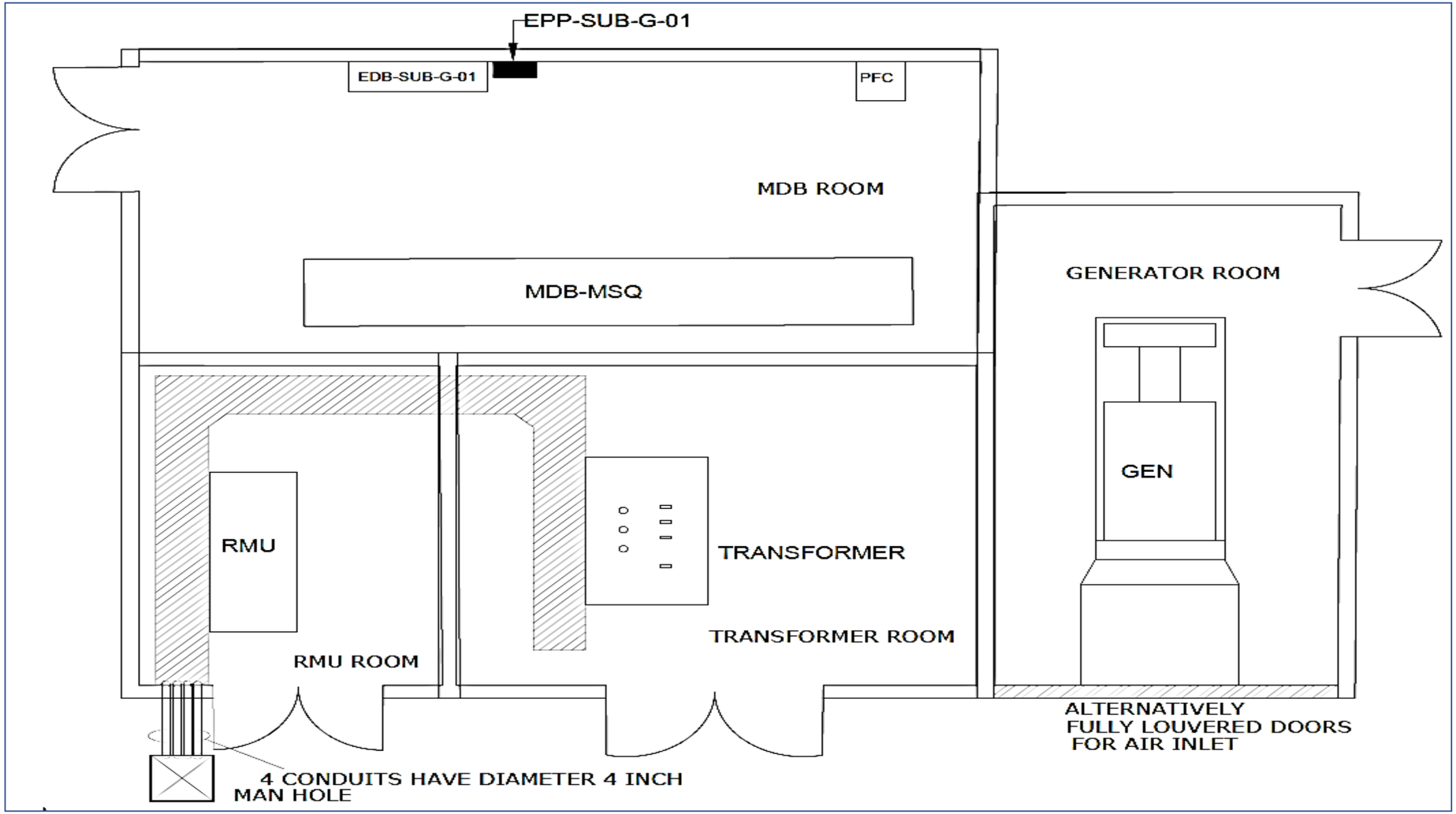
One 11 KV RMU located in a dedicated room on the building perimeter with direct access to the external road will be provided to cater for the total project load.

10.4.7. Electrical substations:

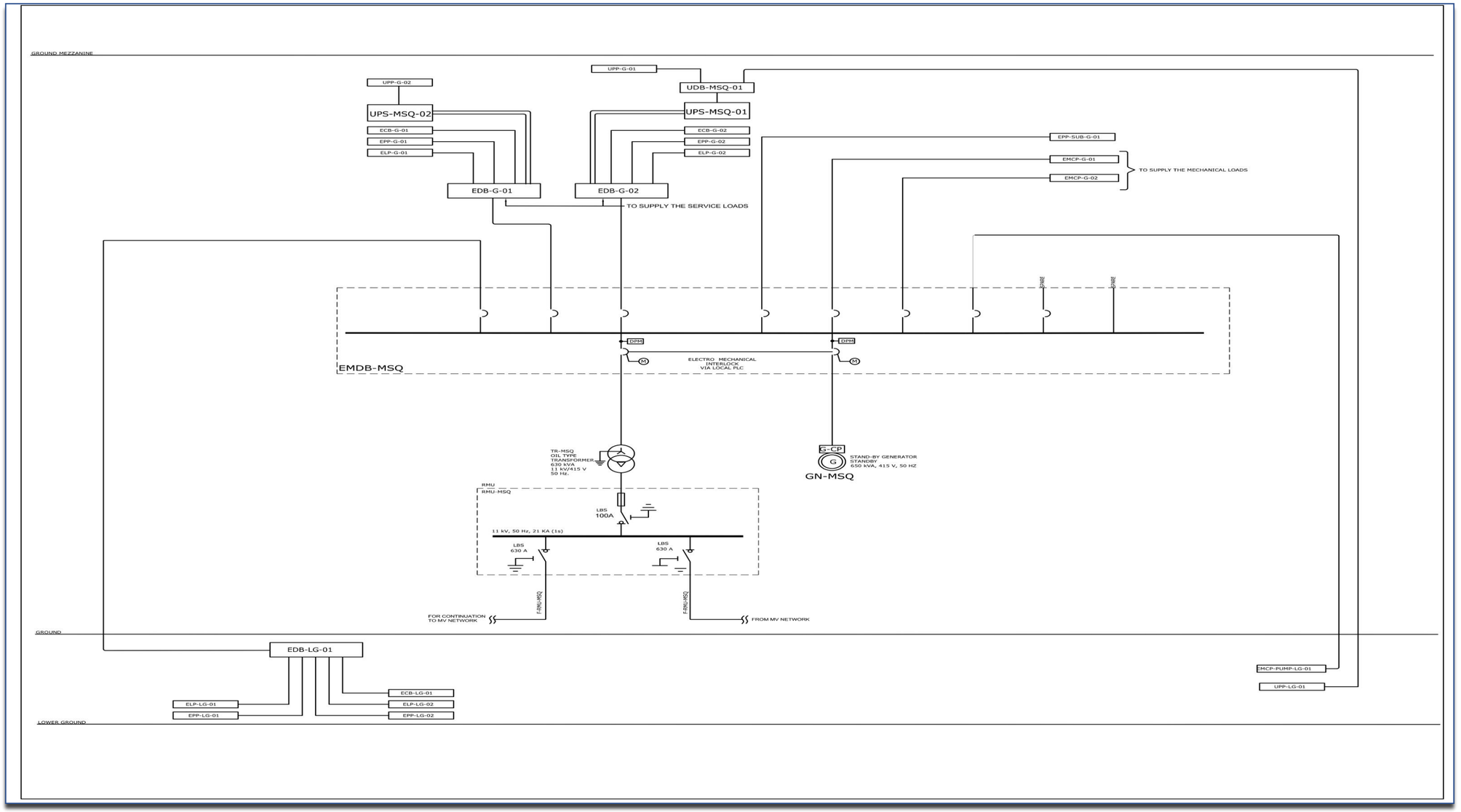
Based on the above load estimates, one electrical distribution substations (11/.415 KV) shall be provided at mosque outer periphery to supply the electrical loads of project.
The substations shall be located in accessible level, as close as possible to the center of loads, while maintaining a direct access from the road, in order to minimize cable routes and keep the accumulated voltage drop within permissible limits, while assuring adequate accessibility and handling of the electrical equipment of the distribution substations.
The proposed electrical substations including the initial ratings & quantities of transformers will be as follows, and subject to change according to the final electrical loads:

- Medium voltage Ring Main Units (RMU).
- 1x 630 kVA (conceptual rating), 11/0.415 kV oil type distribution transformer.
- One LV stand by diesel- generator with confirmed capacity 650 KVA for supplying total project load in case of normal power interruption.
- LV main distribution boards

Conceptual substation layout shown.



Conceptual LV single line diagram.



10.5. Main Component of The Electrical Substation

10.5.1. Ring Main Unit:

RMU inside the MV entry room will be of the indoor fixed ring main unit, free standing, comprising two incoming switch-disconnectors for ring main network feeders, one metering section and one outgoing fused switch for the transformer, cable terminal fittings behind dead front panels, and front mounted switchgear operating handles, control, indication and metering devices.

Typical Ring Main Unit

10.5.2. Transformer:

11/0.415 kV transformer for (where directly accessible from road level) will be 3-phase, Dyn11, 2-aluminium, oil immersed, self-cooled, solidly grounded neutral, with oil temperature rise not exceeding 65 deg c. and lightning impulse withstand voltage of 70 kV on primary side. Oil Transformers will be completed with all standard accessories; lockable manual off-load tap changer, liquid-level gauge, pressure vacuum gauge, liquid temperature indicator, drain and filter valves, and pressure relief device.

Typical Oil Type Transformer

10.5.3. Emergency Power Supply Section:

Due to frequent utility loss diesel generator shall be provided to cater for the total connected load of the mosque in case of utility loss

This is achieved by indoor diesel generator sets rated for “Stand-By” operation at 415V. 3 phase, 50Hz, 1500 rpm, Class G2 to ISO 8528-1.

Generators shall be loaded at 80% of its stand-by capacity and shall be rated to cater for the required loads.

Generator’s switchboard will be connected to (EMDB) via independent (Local PLC).

Distribution Boards The substation will be provided with Local PLC, The load will be full back up by generator.

Upon failure of normal power supply, the generator(s) will start automatically (via Local PLC) and accelerated to rated frequency and voltage and then synchronized for parallel operation. Once the normal conditions are restored, the load is automatically transferred back to the normal supply, and the generator(s) shall be stopped.

The power interruption to the loads connected to the emergency power supply will be limited to no more than 10 seconds.

The diesel generator room shall be provided with sound attenuators to reduce the noise level to the acceptable limits. Diesel generators shall be complete with associated auxiliaries, controls, exhaust system, start-up system, bulk and daily fuel storage tanks and fuel transfer systems.

The daily fuel tank shall be sized for a continuous operation of 8 hours whereas the bulk storage fuel tank will provide 3 days, 8 hours per day, storage capacity for the generators running at full load and considering adequate demand factor.

Typical Diesel Generator

10.6. LV Distribution Network

10.6.1. L.V Distribution Criteria

The Low Voltage (LV networks will be originated from transformers and generator located in the electrical substation and will comprise; Main distribution boards (EMDB's) located at substations, Distribution Boards (EDP's) located at electrical spaces, final branch circuit panelboards located at electrical spaces/closets and motor control center's/panel's (MCC's/MCP's) located at Electrical rooms.

The Main Distribution Board (EMDB's) will be provided with one busbar section along with two incoming circuit breakers synchronized by local PLC, , and adequate number of outgoing circuit breakers with adequate ratings will be used to cater for the low voltage distribution network.

In case of transformer failure generator will supply all loads with 100% backup strategy.

Cooling fans will be provided to the transformer to allow for temporary capacity increasing for more load shedding

Main Distribution Boards

The electrical substation will comprise main Distribution Board has two main incomers fed from (Main Source from transformer and Stand by generator).

10.6.2. Main Distribution Boards

The electrical substation will comprise main Distribution Board has two main incomers fed from (Main Source from transformer and Stand by generator).

The Main Distribution Board (MDB) will be dead front, completely meal enclosed, free standing

All Boards will be fully rated for the available short circuit current. All bus bars will be copper, with full size neutral and dedicated earth bus.

MDB's will have draw-out power air circuit breaker with electronic trip unit as incomer, fixed moulded case circuit breakers up to 1250A and draw out type above 1250A; both with electronic trip units for outgoing branches, Form 3a.

Typical LV Main Distribution Board

10.6.3. Distribution Boards and Branch Circuit Panel Boards

Distribution Boards (EDB's and UDB's) will be located in the distributed electrical rooms to serve the several project areas.

The Distribution Boards will be totally enclosed dead front construction, free standing or wall mounted.

Distribution Boards "EDBs" will be fed from the Main Distribution Boards

EDB's will Have molded case circuit breaker with electronic trip units as incomers and will have molded case circuit breaker with electronic trip units for outgoing ways.

Final Branch circuit Panel Boards "ELP's, EPP's and UPP's" will have molded case circuit breakers on the incoming and miniature circuit breakers on the outgoings determined by the design requirements.

In compliance with IET wiring regulation Residual Current Devices (RCD) with a rated residual current 30 mA will be provided for the following loads:

- All branch circuits supplying socket-outlets with a rated current not exceeding 32A.
- Circuits supplying Disconnecting Switches for wet locations.
- External Lighting circuits.
- Lighting circuits in wet locations like toilets.

All Panels will be fully rated for the available short circuit current. All bus bars will be copper, with full size neutral and dedicated half sized earth bus bar.

10.6.4. UPS Equipment

UPS systems will be provided to maintain continuous power to security, data and communications systems that need to remain operational at all times.

UPS will be on-line, consisting of IGBT rectifier to limit input feedback harmonic currents to less than 7%, IGBT inverter, fully rated static switch, manual bypass switch, and Li-Ion / sealed lead acid valve regulated battery.

10.6.5. Motor Control Centers/Panels

Motor Control Centers/Panels will be provided in the mechanical rooms to serve the mechanical equipment such as "Air Handling Units, Fans, Pumps…, etc".
MCCs/ MCPs will be totally enclosed, dead front, freestanding assemblies. Bus bars will be tin plated copper and braced for the available short circuit currents. All starters will be draw out type, unless otherwise indicated and will utilize motor circuit protectors.

Typical UPS systems.

Typical Motor Control Center

10.7 Low voltage Feeders

Low Voltage Cables and Wires

10.7.1. General:

The installation of electrical works shall be designed and specified in compliance with the recommendations and regulations of NECR.

10.7.2. L.V Cables:

The indoor LV distribution and sub distribution cables shall be rated 600/1000V, XLPE or PVC insulated copper conductor, flame retardant, PVC sheathed.

The External LV distribution network on site shall comprise 600/1000V CU/XLPE/PVC/SWA LV cables. LV cables installed outdoors shall be directly buried under sidewalks and pedestrian walkways, or enclosed in duct bank. Concrete encased duct banks shall be provided under road crossings.

Fire resistant cables multi-core, 600/1000V, low smoke zero halogen (LS0H) to IEC 60331, BS 6387 category CWZ and IEC 60332-1 shall be used for feeders of life safety equipment – incase used- such as fire pumps, mechanical equipment for fire control and smoke management systems etc.

Cables passing through plenum areas will be of Low Smoke Zero Halogen type (LS0H).

The final sub-circuit cables/wires for lighting and small power shall be rated 450/750 V, PVC insulated, copper conductor, flame retardant drawn in conduit or Trucking.

All circuits of both lighting and power applications shall be loaded to not more than 75-80% of the actual net rated capacity of the protection circuit breakers.

10.7.3. Branch Circuits:

Final sub-circuit cables for lighting and small power will be rated 450V/750V, PVC insulated, copper conductor with minimum temperature rating of 85 deg. C Wires will be drawn in conduit or Trunking. Branch circuits of central battery lighting will be fire rated type.

10.7.4. Raceway/Wire Ways:

Main and sub-main feeders will be run on hot dip galvanized steel cable trays.

Different types of conduits for branch circuits are to follow the nature of each space as shown in the following Table:

Application Area	Conduits
Embedded in Block or concrete	PVC
Above False Ceiling (exposed)	PVC where the ceiling is not plenum, unless it will be EMT
Wet areas - exposed inside the room	Rigid Steel/ EMT

10.8. Small Power

Socket outlets, electrical outlets and isolators will be provided to serve various fixed and portable equipment and general appliances.

Electrical power outlets and/or socket outlets shall be provided for telecom equipment, video walls, cleaning system, CCTV cameras, and windows, fan coil units, hand dryers, flush valves, provisions for façade access, provisions at seating areas, way finding signs, and advertising panels, as required by telecom, mechanical, Architectural and interior design documents.
Electrical power outlets shall be provided for media screens as required.

Socket outlets are recommended to be 3 pin standard British type, unless otherwise required by the client in general or special areas. Decorative accessories will be provided in the front of house areas.

All special purpose sockets indicated for specific equipment will be on a separate dedicated circuit.

In general, convenience sockets will be limited to no greater than 7~9 per circuit. Small Offices will be designed with two duplex sockets per wall.

Corridors will be designed with a socket spacing of approximately 10 to 15 meters.

Building Support (Equipment Rooms, Storage) will be designed with one (1) socket per wall or one (1) socket per every 15 square meters, whichever is greater.

Industrial type power sockets will be provided in the mechanical pump room, and weatherproof socket outlets will be provided in outdoor seating areas.

General use sockets will be installed in the mosque for cleaning / maintenance.

10.9. Lighting Systems Design Criteria

10.9.1. Interior Lighting:

Indoor lighting installations shall be designed in accordance with CIBSE requirements. Lighting fixtures shall be selected to provide comfort light distribution, level, uniformity and minimize glare effects.

The lighting design will be coordinated with the Architectural and the lighting layout will be arranged in accordance with the ceiling grid and other fixtures in the ceiling.

Lighting design and lamp selection will be based on achieving recommended illumination levels, proper color rendering and temperature for each task as well as suitable degree of protection of the fixture enclosure to suit for the location. Energy efficient lamps will always be selected whenever possible, in order to ensure building sustainability.

Glare shall be kept to a minimum through the correct selection and positioning of fixtures.

Lighting levels will be determined in accordance with the recommendation of CIBSE and online with the general experience as below

Room / Area	Illumination Level (Lux)
Prayer Hall	200
Library	300
Shops	300
Meeting Room	300
Outdoor Praying Area	200
Ablutions	200
Circulation / Corridors	100
Exit Stairs	100
Toilets	200
General Storage	200
MEP – Utility Areas	200
Offices	500

Table 10.3. Recommended lighting levels for basic room types.

10.9.1. LUMINARIES:

Luminaries For Back Of House shall be the standard products of reputable manufacturers and shall be the best of their respective kind. The protection class of all luminaries shall be specified according to the location where they are installed.

Islamic luminaires and chandleries will be used for mosque to best match the architecture design, please refer to the architecture section .

As lighting is a major consumer of energy, reducing electric lighting energy demand is an important strategy for reaching an energy efficient savings and sustainable design. In general energy savings are achieved by providing optimal light levels, reducing lighting power by selecting high efficiency lighting lamps and fixtures to keep the Lighting Power Density (LPD) to the minimum, and by using automatic controls in spaces where occupants are not likely to turn off lights.

In general LED lighting fixtures will be used in different project areas.

10.9.2. ILLUMINATION OF MEANS OF EGRESS AND EMERGENCY LIGHTING:

Illumination of means of egress will be provided in exit access corridors and exit stairs.

Illumination will be continuous and supplied from the ECBS (Emergency Central Battery System). Floors and walking surfaces such as public open spaces will be illuminated to at least 10.8 Lux measured at the floor level.

Addressable central battery systems will be provided to feed the life safety / escape route lighting circuits circulation corridors, escape stairs and other occupied spaces. Batteries will be sealed lead acid type adequate of 90 minutes operation as per NFPA 101requirements. .

Central battery system shall be AC/DC, fully monitored and controlled.

Exist signs shall be distributed as per NFPA 101 every 30 meters, at means of egress routes

corridors, lobbies, exit stairs, doors, and at changing directions as indicated on the life safety plans.

Alternative Solution:

Self contained luminarias could be used in the final design stage according to the final selection Islamic luminarias in case the fixtures/Chandeliers will allow for battery installation.

Typical Central Battery

10.9.3. External Lighting

In general, for the External lighting, it will be designed to give the required lighting level recommended by code in an energy efficient manner and to reduce unnecessary light pollution or increase sky glow.

Lighting fixtures shall be selected for high performance. They shall be complete with wiring, control gear and lamps. The fixtures shall be totally enclosed, dust and watertight, shock resistant and specifically designed to house the specified lamps, control gear and accessories. The body shall be made of extruded or pressure die-cast or fabricated aluminum alloy of the corrosion resistant type.

For Façade and exterior lighting refer to the architecture section.

Energy efficient fixture will be used in order to ensure system sustainability.

10.9.4. Lighting Control

Simple mosque lighting control will be provided all over the building the objectives of the lighting control system in building are to provide visual comfort, minimize the energy consumption, preserve the quality of the work environment and remote monitor of the lighting system.

lighting control in mosque will reduce or eliminating the use of artificial lighting when there is an adequate contribution of daylight within a space to maintain recommended light levels.

Fixtures connected to the central battery system will be provided with a (change-over module) to automatically turn-on lights in case of power failure.

In case of normal power failure, the lighting control system will ensure switching all emergency lighting fixtures without any dimming until the normal power is restored, it will then be able to go back to the scenario before power interruption

10.10. Earthing System

Earthing and bonding will be (TNS) in compliance with BS7430.

A complete equipment earthing system will be provided such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, metal fences, and all other conductive items operate continuously at ground potential and provide a low impedance path to ground for possible fault currents. Earthing system resistance will be 1 ohm or less.

Telecommunication system earthing will be in compliance with TIA 607.

All earth sources will be interconnected underground. All earthing materials will be made of copper or approved copper alloy.

10.110 Lightning Protection System

Lightning system will be designed in accordance with BSEN 62305. Based on the result of lighting risk assessment calculations.

The lightning protection system will consist of:

Air Termination Rods and Mesh network (bare copper mesh) installed on the roof of each element). Some exposed air terminals/ finials/strike plates may also be needed.

Copper down conductors from roof to ground level will be needed on the buildings perimeter that will run through the structural concrete columns whenever possible.

Earth termination networks (test links, earth pits, earth loop, earth electrodes), clamps and bonding to prevent side flashing.

The earthing resistance associated with lightning protection system will not exceed 10 Ohms.

13 Telecommunication

Telecom and Low Current Systems

Objective:

Objective:

The Jumma ‘at Mosque Project will be designed to be based on the objective of creating an up-to-date facility. As such, Information Communication Technology (ICT) systems will be at the forefront of the design effort in regard to providing best practice for continuity of services to the various project end users, supporting their business missions, creating and maintaining a strong image and brand, and providing state-of-the-art operations.

The overall concept is to standardize the equipment to the greatest extent possible to simplify long term operation and maintenance. The infrastructure will provide fiber optic cabling throughout the facility backbone, to allow for day one connectivity. Copper cabling will be used for horizontal access.

Various security and safety systems shall support the facility, starting from the fence and surrounding of the mosque, Closed Circuit TV (CCTV) which operate over the converged network and provide High-definition picture to provide crystal clear details for the operator to properly monitor the Jumma ‘at Mosque and identify intruders.

Fire Alarm system based on analogue addressable type that allows detection of the location of the fire at an early stage along with reporting the event to a central location within the facility as well as the civil defense.

Codes & Standards:

The telecommunication installations shall conform to the requirements of referenced industry standards and applicable sections and shall be compliant with local requirements, applicable local

regulations, and the code requirements of authorities with jurisdiction:

- Local authority and telecom service providers requirements and practices
- International Telecommunications Union (ITU) Recommendations
- Building Industry Consulting Service International (BICSI)
- Telecommunications Industry Association (TIA)
- TIA-758: Customer-owned Outside Plant
- Telecommunications Infrastructure Standard
- International Electro-technical Commission (IEC) recommendations
- Institute of Electrical and Electronics Engineers (IEEE)
- Telecommunications Distribution Methods Manual (TDMM)
- National Fire Protection Association Code (NFPA).

Sound System

The sound system will be designed and specified to not only achieve a high level of speech intelligibility but also a high quality of sonic performance. The specification will ensure that both the frequency range and permissible levels of distortion produced by the system are commensurate with the intended use of the system and the prestigious nature of the building.

The system will include the following:

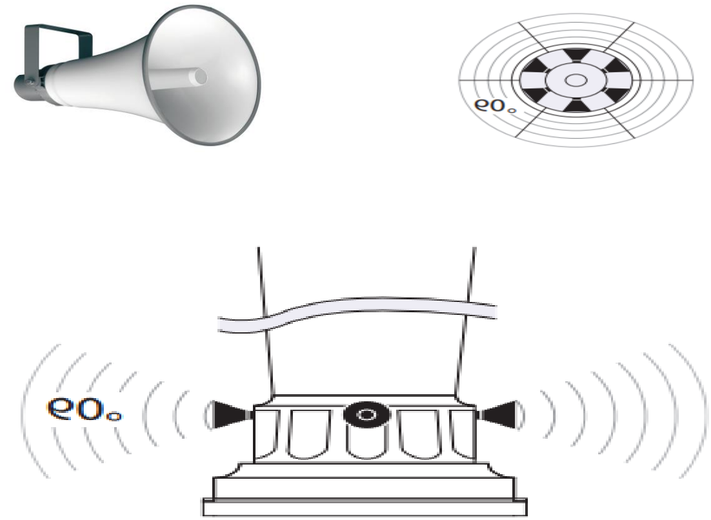
- Imam Microphones
- Audio switcher/matrix & console.
- Power amplifiers and central equipment racks.
- Loudspeakers and distribution network.

Minaret

It is anticipated that it should be possible to integrate a set of loudspeakers discretely into the structure of the minaret. Normally, horn based devices would be employed,

Horn speakers cover approx. an area of 60° angle. Six horn speakers in a minaret are ideal to cover the whole area.

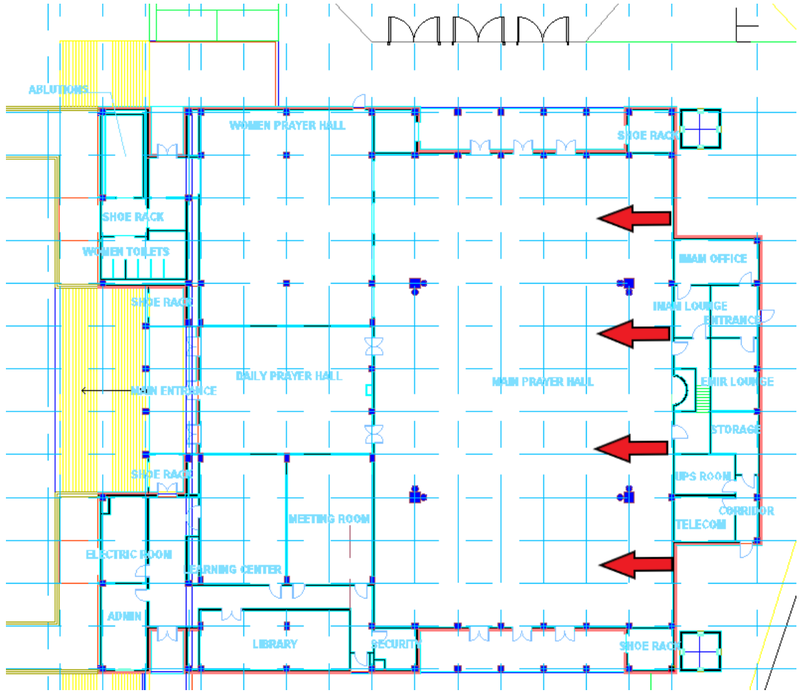
High-intelligible, high power and distance, sound quality, weatherproof horn speakers will be used.



Men Prayer Hall

It is intended to employ a series of line array column loudspeakers to cover the Men Prayer Hall, as these will offer the best speech intelligibility performance and allow the sound to originate from the direction of the Qibla. Furthermore, this type of loudspeaker can generally be readily integrated into the architecture and so provide a visually discrete solution.

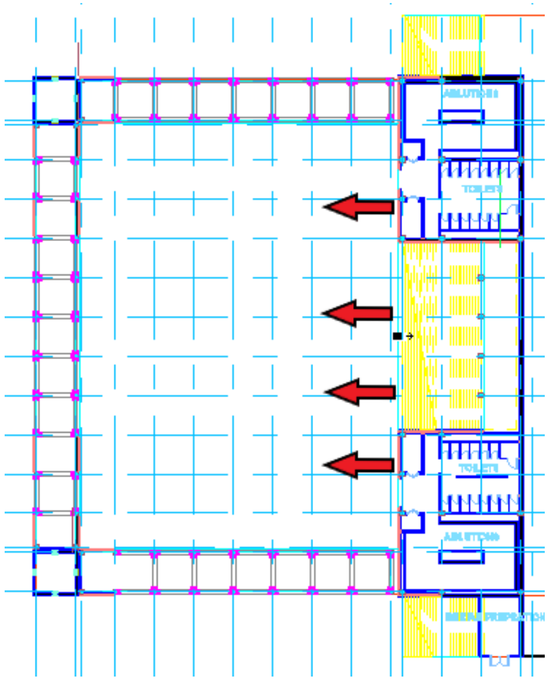
Final quantity and locations will be verified after performing the electro-acoustic calculations.



Outdoor Prayer Area

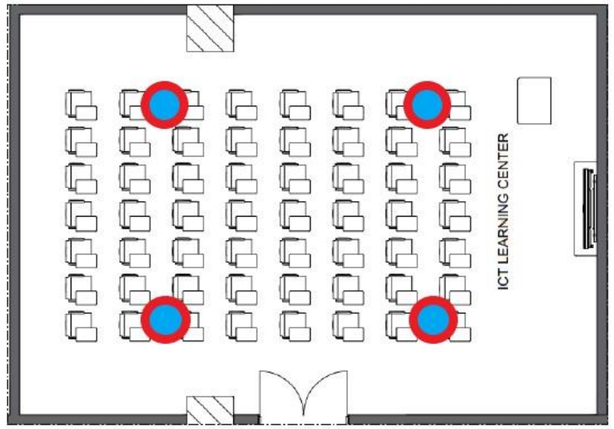
It is intended to employ a series of outdoor line array column loudspeakers to cover the Men Prayer Hall, as these will offer the best speech intelligibility performance and allow the sound to originate from the direction of the Qibla. Furthermore, this type of loudspeaker can generally be readily integrated into the architecture and so provide a visually discrete solution.

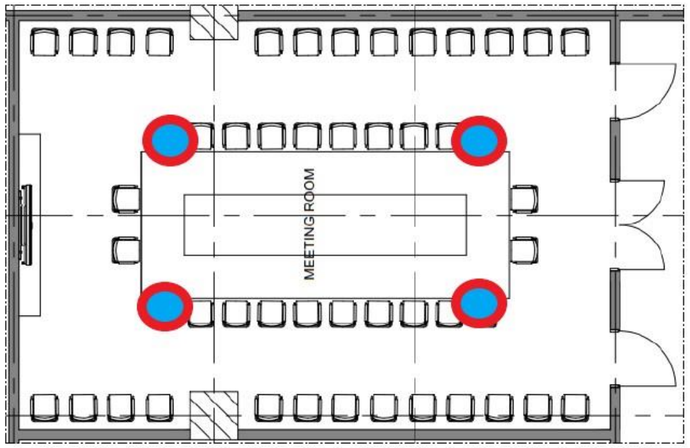
Final quantity and locations will be verified after performing the electro-acoustic calculations.



ICT Learning Center & Meeting Room

Ceiling loudspeakers will be provided to for the ICT learning center and the meeting room.





Closed Circuit Television (CCTV) System

Number of outdoor fixed cameras, indoor fixed cameras, outdoor motorized cameras, and indoor motorized cameras shall be distributed in the Mosque to cover all critical areas such as entrances, praying halls, stairs, and fence. All CCTV cameras shall be connected to the LAN via access switch which in turn shall be connected to distribution and core switches where all cameras shall be fed to CCTV Headend equipment for further processing. Cameras shall be monitored, controlled and recorded through system operators at a central Security Room. Cameras shall be monitored via operator workstation screens. Camera image recording shall be configured as per standards requirements in terms of Resolution, Frame Rate, and archiving time. Operators may manually record cameras, control motorized camera Pan/Tilt/Zoom movements, switching cameras and playback recorded camera images via control keypad/computer keyboard/computer mouse.

The system will include the following:

- IP CCTV fixed cameras.
- IP CCTV PTZ cameras.
- Storage.
- Servers.
- Workstations.
- Control equipment.

Fire Alarm System

A complete fire alarm system covering the whole project detecting the fire as earlier as possible and protecting the people from fire hazard through initiating and detecting appliances in addition to the notification appliances, appliances will be appropriate to the protected place nature. System shall utilize different types of alarm initiation devices such as smoke detectors, multi-criteria detectors and manual call points. System shall utilize alarm notification devices to announce fire alarms such as sounders, strobes and sounders with integrated strobes. Fire alarm system shall be interfaced with water sprinkler system, clean agent systems, and power generators via monitoring modules where applicable. System shall also interface with HVAC equipment via control modules including AHU's, Fan's and Motorized smoke dampers where applicable.

The system will include the following:

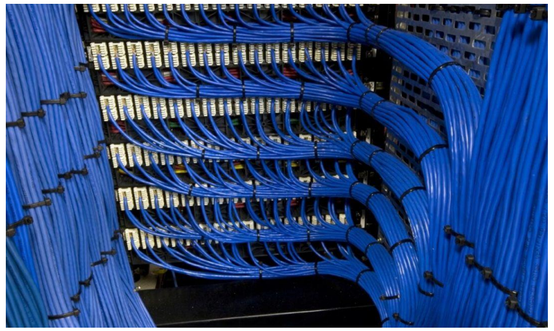
- Fire-Alarm Control Panel.
- Manual fire-alarm boxes.
- System smoke detectors.
- Non-system smoke detectors.
- Heat detectors.
- Notification appliances.
- Addressable interface device.
- System printer.

Structured Cabling System

The Facility will be provided with a single cabling state of the art infrastructure that is designed to serve all building communication systems needs, the system will be composed of:

Work area outlets: dual/single RJ-45 outlets; will be provided to each work area. Thus 10/100/1000 Megabit application will be able to be delivered. LC duplex connector will be provided for fiber-based outlets. Cat6a UTP/STP Horizontal cabling, Single and Multimode fiber optic backbone cable. Telecom room/Closets: Houses the Access switches inside equipment cabinet. UPS and Data room: Backbone cabling subsystem.

- Horizontal Cabling subsystem.
- Racks
- Optical fiber panels.
- RJ45 patch panels.
- Wire guide.
- Optical fiber cables.
- Unscreened Twisted Pair (UTP) cables.
- Optical connectors.
- RJ45 connectors.
- Patch cords.
- Cable trays.
- Outlet box and frame.
- Earthling and grounding.



Data Network Equipment

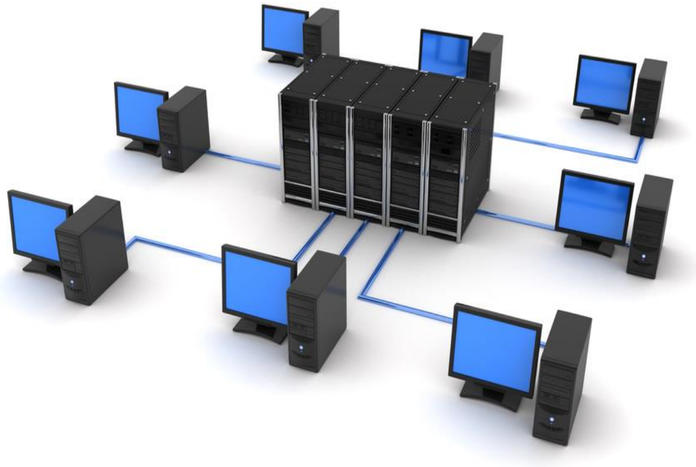
State of the art Reliable, Fast and secure converged network is to be provided not only data is transferred, but also voice and video are shared using Internet protocol (IP). The switching network solution will be provided across the Mosque. The System will be composed of Access switches located inside the Telecom Rooms, Distribution and core switches located inside the main telecom room. In addition, all needed Firewalls intrusion detection and prevention, Routers, Load balancers, route reflectors will be part of this system.

The system will include the following:

- Core Equipment.
- Distribution Equipment.
- Servers and related ancillaries.
- Access (Edge) Switches.
- Routers.
- Firewalls.
- Network Management.
- Workstations and related ancillaries.
- Other devices and equipment such as content firewall and traffic shaper.

Telephony System

A provision for civil work infrastructure will be provided for the connection with the telecom network service provider.



14 Geotechnical

1 EXECUTIVE SUMMARY

This section presents the surface geological conditions and the anticipated geohazards at Jumma'at Mosque, Zarai, Nigeria. The work presented herein is based on the review of available geological maps, satellite imagery, published literatures, and the site history. Based on the available geological data and literature, the study revealed that the project site is composed mainly of loam, sandy loam, and sandy clay with some gravels overlying the basement complex rocks of various types of granites. The expected geohazard in the project site that might represent risk during the development is lateritic soil. based on the national seismic catalogue, Zaria city is in very low seismic hazard region.

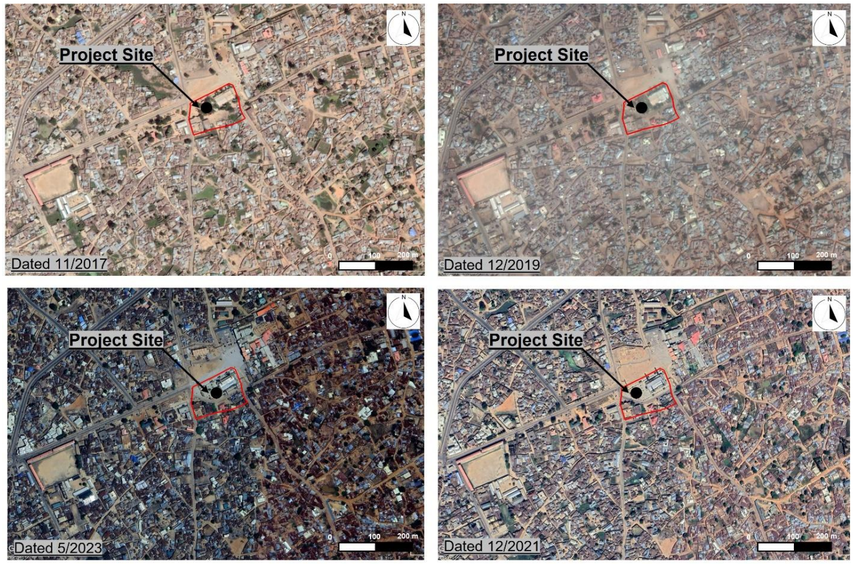


Figure 2: Satellite Images showing the project site history.

2 SITE DESCRIPTION

2.1 PROJECT LOCATION

The proposed site is located in central Zaria, Kaduna State, North-western Nigeria and it's about 14km southeast from Zaria Airport. (Figure 1). The project site is characterized by a flat topography, whereas its elevation is about 658 m above MSL.

2.2 SITE HISTORY:

Upon review the available satellite images of the project area, it is revealed that the area of Zaria's Jumma'at Mosque hasn't undergone any significant construction or development in the past couple of years except for some development of Mallam Musa Square north of the Mosque that started in 2022 (Figure 2).

Figure 1: Satellite Image showing the location of the proposed project site.

3 GENERAL GEOLOGY OF THE PROJECT SITE:

Generally, Nigeria is dominated by rocks of the following formations: gneisses and schists of Archean to Paleoproterozoic age covering the north, west and east of the country, and sometimes intercalated by the "Older Granites" and various metasediments of Proterozoic age. The Younger Granites of the Jos Plateau belonging to the Jurassic. Mesozoic and Cenozoic sediments of marine and continental types are found in basins such as Sokoto basin north-western part of the country, Chad basin in northeast and the river valleys of Benue and Niger in the south. These sediments were formed by unconformable sedimentation in depressions in the basement landmass. Quaternary and recent alluvial deposits occur along the main river valleys and the ephemeral streams.
Geomorphologically, The Basement Complex is exposed in many places, especially in the form of inselbergs, which are isolated hills or mountains that rise abruptly from the surrounding plains (T. Schluter, Geological Atlas of Africa 2nd edition, 2008).

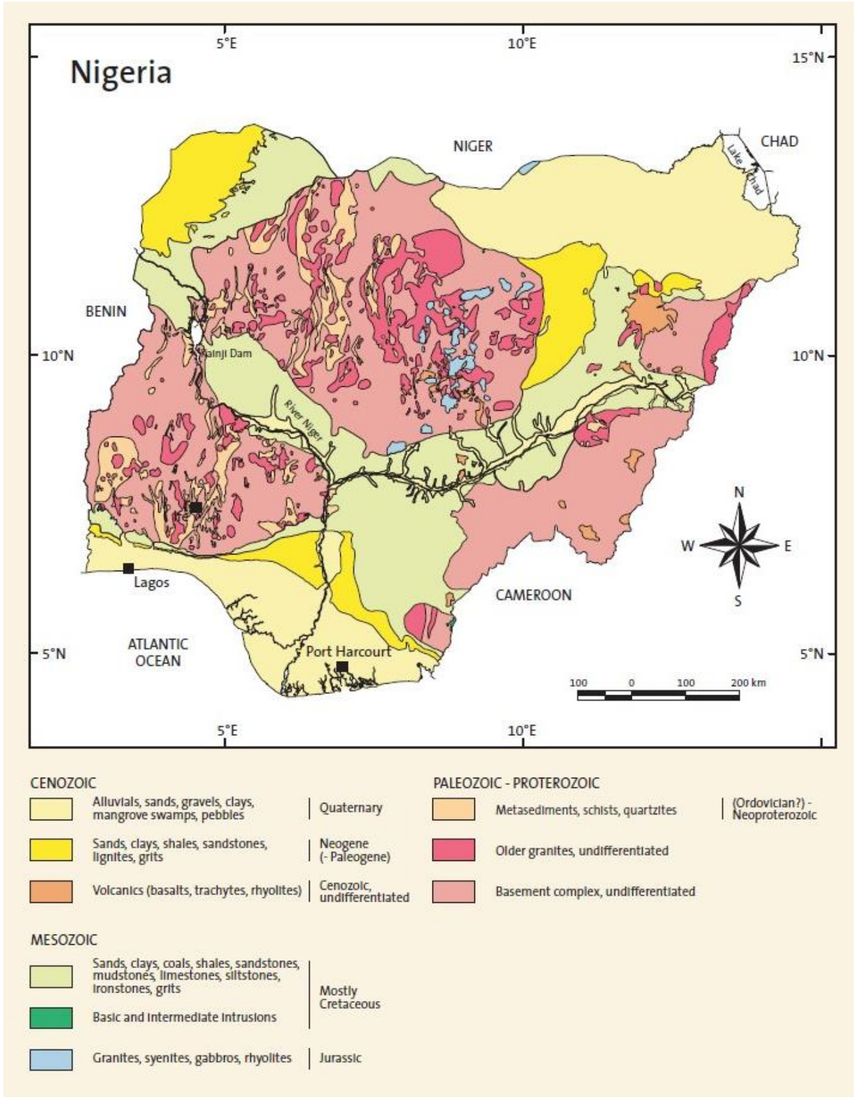


Figure 3: Geological map of Nigeria (adapted from Geological Atlas of Africa, 2008).

4 SITE SPECIFIC GEOLOGY:

The findings of this section are based on the available geologic maps. Zaria is dominated by the Precambrian Basement Complex which is the oldest and most widespread rock unit in Zaria. It consists of igneous and metamorphic rocks that formed during various thermo-tectonic events from Achaean to early Palaeozoic times. The proposed site is dominate by basement rocks comprising porphyritic biotite granite, porphyroblastic granite, coarse biotite muscovite granite (gp) (Figure 4). these rocks are mostly covered by soil, and it's expected to be lateritic soil formed from erosion of the surrounding igneous and metamorphic rocks, and consists of loam, sandy loam, and sandy clay with some gravels according to the soil field survey done by FDALR, Kaduna, Nigeria in 1990.

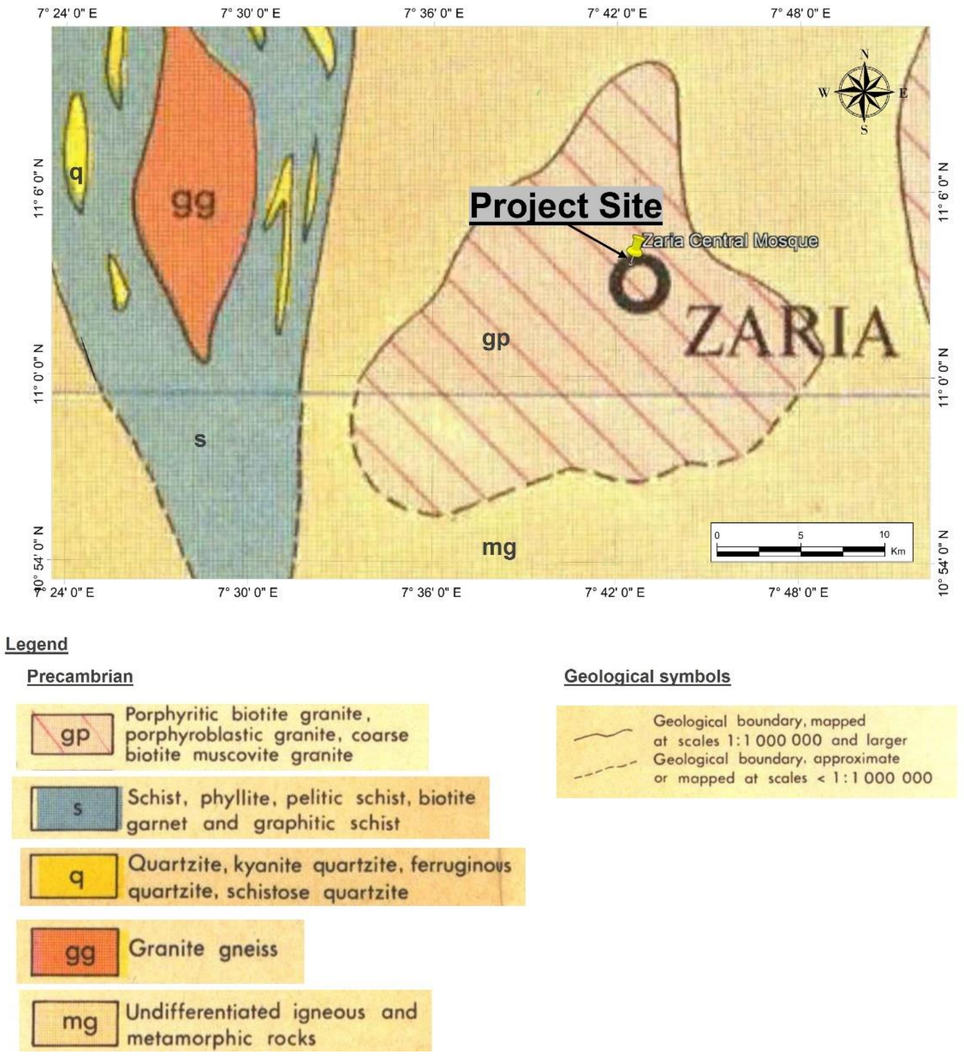


Figure 4 Geological map of the project site (adapted from Geological map of Nigeria scale 1:1,000,000)

5 SEISMICITY

Nigeria is located in the Western part of the African continent on the Gulf of Guinea which is generally considered a stable low seismic activity area, despite having proximity to active seismic zones in some regions. The project site is located in Zaria Northwestern Nigeria that is classified as a very low seismic zone showing a mean peak ground acceleration PGA ranging between 0.00g to 0.01g (Figure 5). However, national, and international seismic codes and standards should be followed in the design stage.

6 ANTICIPATED GEOHAZARDS

Investigating, evaluating, and assessing anticipated geohazards in the project site, requires a good understanding of the site geology. Based on the available geological maps and satellite imagery, the expected geological constraints in the project site can be highlighted as follows:

6.1 LATERITIC SOIL

Laterite soil is known as a soil layer that is rich in iron oxide and derived from a wide variety of rocks weathering under strongly oxidizing and leaching conditions. Lateritic soil can be expansive soil which is primarily clay-rich soil subject to changes in volume with changes in moisture content. Such soils are sometimes prone to expansion and contraction during periods of successive wetting and drying resulting in volume changes. The resultant shrinking and swelling of soils can influence all fixed structures, utilities, and roadways. Laterite soil is present across Nigeria and its presence is expected in the project site. The presence of laterite soil is a very important feature that should be investigated and considered in the design stage.

7 CONCLUSIONS AND RECOMMENDATIONS

The project site is characterized by a flat topography. It is covered by soil material of loam, sandy loam, and sandy clay with some gravels. The basement complex rocks is widespread across Zaria and underlies the soil layer comprising of various types of granites. Some geohazards are expected to be present in the project site, such as lateritic soil. Based on the geological conditions of the project area, the following are some recommendations:

- Generally, Zaria, Nigeria is located in a very low seismicity zone, however, national, and international seismic codes should be considered during construction.
- The presence of lateritic soil should be investigated and considered in the design stage.

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The project site is characterized by a flat topography. It is covered by soil material of loam, sandy loam, and sandy clay with some gravels. The basement complex rocks is widespread across Zaria and underlies the soil layer comprising of various types of granites. Some geohazards are expected to be present in the project site, such as lateritic soil. Based on the geological conditions of the project area, the following are some recommendations:

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- The presence of lateritic soil should be investigated and considered in the design stage.

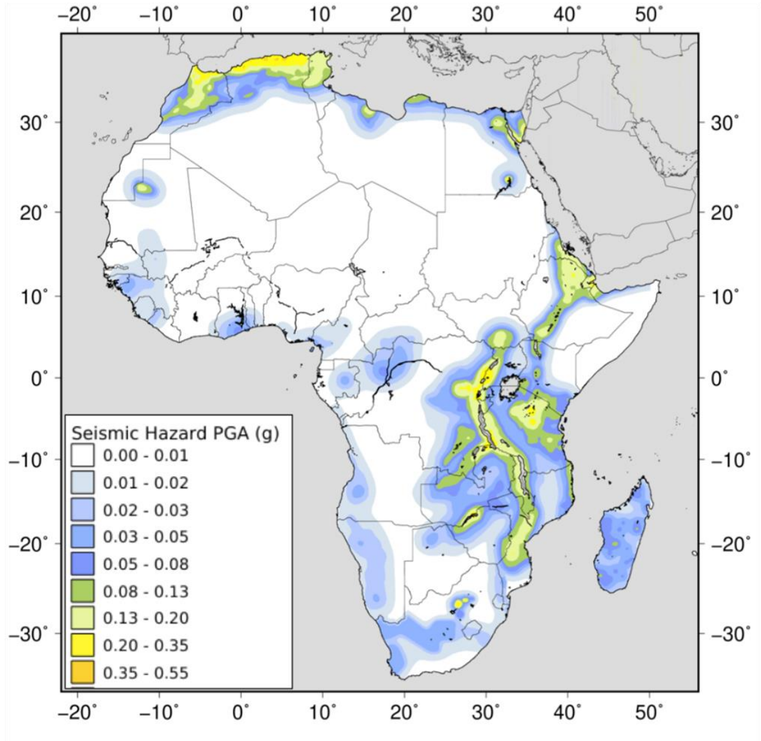


Figure 5: Seismic hazard distribution map of Africa

7.1 BUILDING DESCRIPTION

- Jumma 'Mosque at Emir's Palace, located in Zaria, Kaduna State, Nigeria, the entire complex is to be designed on two floors as follows: lower ground and ground floor levels.
- The lower ground floor contains outdoor piazza which capable to accommodate 5000 to 7000 worshippers, open to sky courtyard to accommodate 1600 worshippers. In addition, the lower ground floor indicating other facilities such as (ablutions, toilets, admin offices, MEP services rooms, shoe racks and arcades the total BUA for lower ground floor is 1450 m2 and the floor height is 4 m.
- For Upper ground floor, indicating main prayer hall to accommodate 1650 worshippers, women prayer hall to accommodate 350 worshippers, learning center, library, meeting room, imam office, shoe racks, admin offices and MEP services rooms, the total area for ground floor is 3100m2. The height of main prayer hall about 11 m
- The Jumma 'Mosque contains four minarets with height 55mm.

7.2 CODES AND REGULATIONS

The building fire and life safety strategy is designed based on BSI standards and other applicable international standards

7.3 OCCUPANCY CHARACTERISTIC

The Mosque occupancy characteristic of the building is Classified as B1 "occupant who are awake and unfamiliar with the building" (prayer rooms), A2 "occupant who are awake and familiar with the building" (Offices, lounges) and A3 (storage areas).

The substation characteristic of the building is Classified as A3(industrial areas). "occupant who are awake and familiar with the building"

7.4 RISK PROFILE

- The risk profile is given based on the occupancy characteristic and fire growth rate. The higher risk profile applies to the whole building.
- The risk profile depends on the fire growth:
  - 1 slow
  - 2 medium
  - 3 fast
  - 4 ultra-fast
- The risk profiles of the building are A1, A2 and A3.

15 Wet Utilities

Water Supply System

General:

As advised by Zazzau Emirate Council (ZEC), the existing mosque is currently supplied with water from existing municipal water supply and a borehole. It is assumed that the **same source** will supply the proposed Jumma'at mosque.

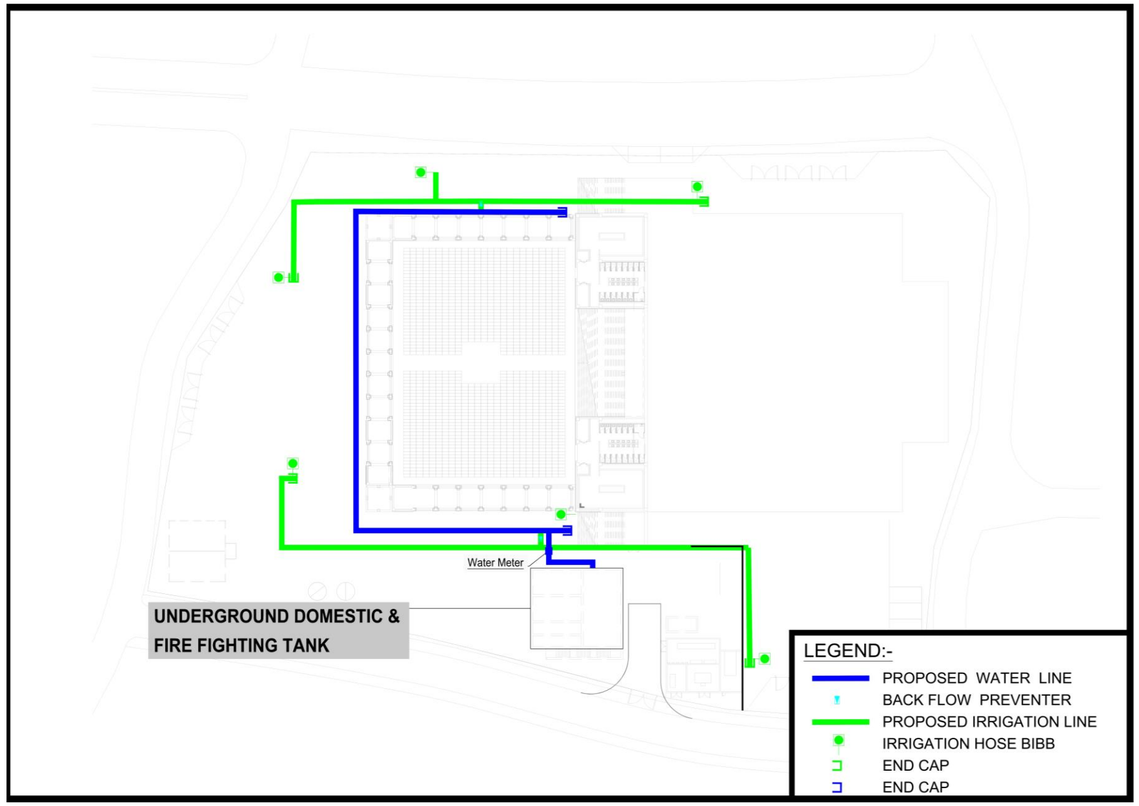
Scope of Work

As per the project RFP as well as the replies received from ZEC during the tender stage, the water supply system for the project was proposed to include the following components:

- Water ground storage tank
- Elevated storage tank
- Supply connection to feed the ground water tank from the existing municipal water network
- Supply line to feed the elevated tank from the pump room at the ground water tank
- A water distribution network to serve all mosque facilities that needs water supply

*However, as agreed with the Client in the meeting that took place in the consultant's office on 11/11/2023, the **elevated tank will be cancelled** due to its expected excessive height and instead, other options could be studied.*

Proposed Wet Utilities Network



Water Supply System

Design Guidelines:

- It is assumed that the existing municipal water supply source has enough capacity to meet the project water demands. It is also assumed that the water pressure within the municipal network is adequate to supply the ground water tank
- The project will be provided with an external firefighting network, fire hydrants together with fire pumps. The storage of fire water will be adjacent to the ground reservoir that will also store domestic water.
- The proposed water distribution network will be equipped with hose bibbs for manual irrigation of soft landscaped areas.
- The total population utilizing the mosque shall be considered as follows:
  - A total of **2000** worshippers in the **main prayer** halls
  - A total of **1600** worshippers in the **outdoor arcades**
  - A total of **5000** worshippers in the **External Piazza.**

  The above will result in a maximum total of about **8600 worshippers**.

Water Supply System - Design Criteria

Water Consumption

The water consumption for the daily use of ablutions and toilettes for worshippers will be considered on the low side as **13 l/person/day**.

Peak Factor

The total amount of water used by a household within a toilette or ablution facility may be distributed over only **a few hours** of the day during prayer times, during which the actual demand is much greater than the average. The peak factors normally related to the sizing of water distribution network is the **Peak Hourly Demand (PHD =** 2.5). The design of distribution network ensures that all lines can deliver the peak demands at the required residual pressure.

Consideration has also been given to the use of fixture units approach rather than the peak factor in the design of the water distribution network. This is to ensure that the water network will cater for all cases of demands. This revealed the following number of fixture units and corresponding flows:

- About **370 FU** with a corresponding flow of **100 gpm (6.3 l/s)** for the ablution/toilettes at the side of the **women entrance**.
- About **270 FU** with a corresponding flow of **80 gpm (5 l/s)** for the ablution/toilettes at the **other side of the mosque**.

It is proposed to design the water network based on the flows of the FU approach to ensure meeting the demands at all cases. Accordingly, the water **pump flow** shall be **11 l/s** and designed to provide a residual pressure of **3.5 bars** at the building connections. The size of the network pipes would be **100mm** diameter.

Water Supply System - Design Criteria

Hydraulic Design and Pipe material

The proposed water supply systems including the transmission lines, and main distribution networks have been analyzed hydraulically using computer program, "Water-Gems" to determine the flows and pressures all over the distribution system. The design ensures that the network provides continuous potable water supply to the selected main cities with the required quantity and residual pressure.

The software uses "Hazen – Williams" equation while performing the analysis:

$$Q = 0.278\ C\ D^{2.63}\ S^{0.54}$$

Where:

Q = Flow rate (m3/s)

C = Hazen-Williams coefficient

D = Internal pipe diameter (mm)

S = Slope of energy grade line (m/m)

Pipe Material	Hazen-Williams Coefficient (C)
HDPE	140 - 150
Polyvinyl chloride, PVC, & uPVC	130 - 150
Ductile Iron Pipe (DIP)	120 -140
Concrete	100 – 140

The Table lists the adopted values of Hazen-Williams Coefficient (C) for the different used pipe materials.

Maximum and Minimum Permissible Velocity

The maximum permissible velocity inside pipes should not exceed **2.5 m/s** in order to avoid large amount of pressure loss in the system. The minimum permissible velocity inside the network should not be less than **0.3 m/s** in case of minimum water demand.

Residual Pressure

The minimum residual pressure in the proposed water distribution network should not be less than **3.5 bars** at the building connections. This residual pressure can be achieved by the proper design of the water distribution system maintaining the suitable velocities that results in minimum pressure losses in the networks in addition to the proper selection of the pumps' head.

Pipe Material

The recommended pipe material to be adopted for the water supply network is **HDPE** or **uPVC**. Theses pipes are used for all pipes and service connections for the following reasons:

- High carrying capacity
- Low weight entailing easy in transportation and installation
- Low price and transportation & construction costs
- Durable and easy maintenance

The only drawback of this type of pipes is the derating with increase in temperature.

Water Supply System - Design Criteria

Pipe Depth

The pipes' minimum depth should be a subject to the manufacturer constrains and recommendations. However, the following are the common practice recommendations for the pipes' minimum depths:

- **1.2m** cover (min.) for pipes without protection-under roadways.
- **0.8m** cover (min.) for pipes with protection.
- **0.3m** (min.) clearance under other services (vertical clearance between two pipes).

Isolation Valves

Isolating valves are used in the distribution system to isolate sections for maintenance and repair. For this project and since the size of the water pipes is small, all isolation valves shall be of the gate type directly buried.

Firefighting Requirements

The following criteria are generally based on the **National Fire Protection Agency** (NFPA) requirements:

- One (1) fire event will be dealt with, irrespective of its location.
- Two fire streams will be applied at one time.
- The duration of the firefighting event is **120** minutes.
- Any two external hose streams will discharge **32** lit/s (**500 gpm**) at a minimum pressure of **41m** (60 psi).
- The fire hydrants shall be of the pillar type (i.e. above ground) with **2 Ø65** outlet nozzles and **1Ø100** pumped outlet.
- Hydrants will not be spaced more than **90m** apart or more than **45m** from a dead-end area.
- A hose storage cabinet shall be provided at each fire hydrant to allow for direct use of the civil defense staff.
- The size of the fire network will be **150mm** diameter.

Water Supply System

Estimated Domestic Flows

As advised by the client during the meeting that took place in the consultant's office on 11/11/2023, many worshippers do not need to utilize the ablution facilities inside the mosque.

For this concept stage, the following assumptions have been considered:

- The maximum number of worshippers that will attend the prayers shall not exceed **8600**.
- The number of worshippers that will utilize ablution facilities would be around **30%** of the maximum number of worshippers.

The **estimated domestic flows** will be based on the number of worshippers utilizing ablutions and the proposed water consumption as stated above.

The worst-case scenario could be considered in case of the Eid prayer. For this case, it is assumed that the maximum number of worshippers who will be in the mosque and will use the ablution facilities and toilettes will be **30%x8600 = 2580**. This will result in a total water demand of **33.5 m3/day**.

Firefighting Requirements

As previously highlighted, the project firefighting requirements will be provided via an external firefighting network and fire hydrants supplied from the fire ground reservoir pump room through proposed fire pumps. The storage of fire water will be in a separate ground reservoir.

Based on the fire criteria stated above, the **fire water demand** will be **230m3** stored in a separate fire reservoir.

Proposed Water Supply System

Proposed Water Network:

The proposed water supply system will consist of a water connection from the existing municipal network provided with a water meter and feeding the **ground reservoir** proposed for the project.

The ground reservoir will have a pump room with water pumps to supply the project site via a water network via direct pumping. The site facilities served will include ablution facilities, toilettes as well as **irrigation hose bibbs** which will be provided along the proposed water network to irrigate soft landscaped areas. The water network will be designed in a **loop configuration**.

A **separate firefighting network** will be provided to serve the **fire hydrants**. This network will be supplied from the dedicated firefighting pumps installed in the ground reservoir pump room.

Proposed Water Supply System

Ground Reservoir:

The proposed domestic ground reservoir will be sized to cater for **3 days** of domestic water demands. This will reveal a storage of **100m3**. In addition, a separate reservoir of a capacity of 230m3 will be dedicated for the firefighting demands.

The proposed water connection from the municipal network will be sized to provide the required daily demand as well as the fire requirements over **16 hours/day.** This will require a pipe with diameter of **80mm** to be connected to the existing nearby water source.

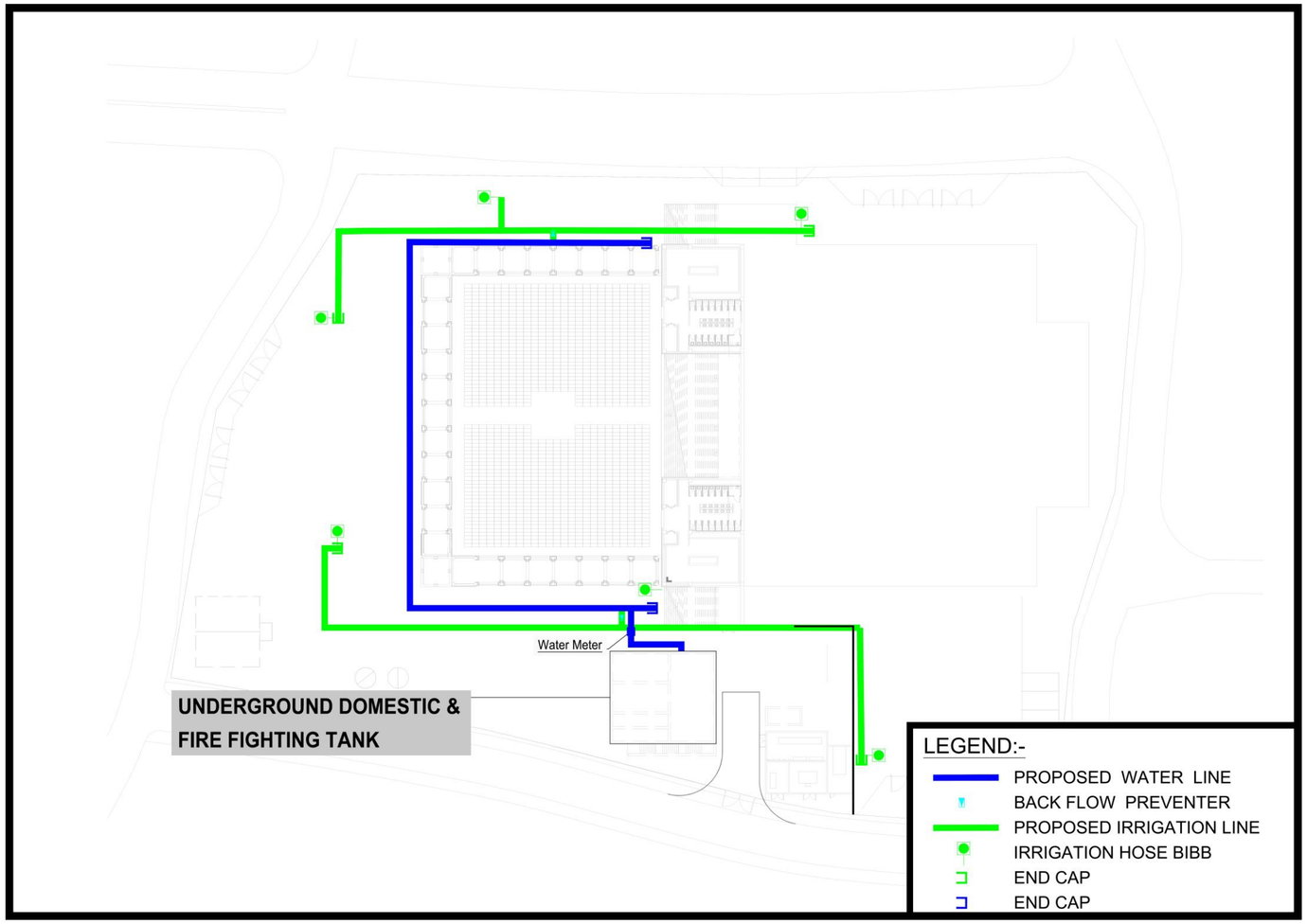
Irrigation Demands

The irrigation demands of the proposed soft landscaping will be secured via hose bibbs provide along the proposed water supply network. The locations of those hose bibbs will be selected to suit the arrangement of soft landscaping.

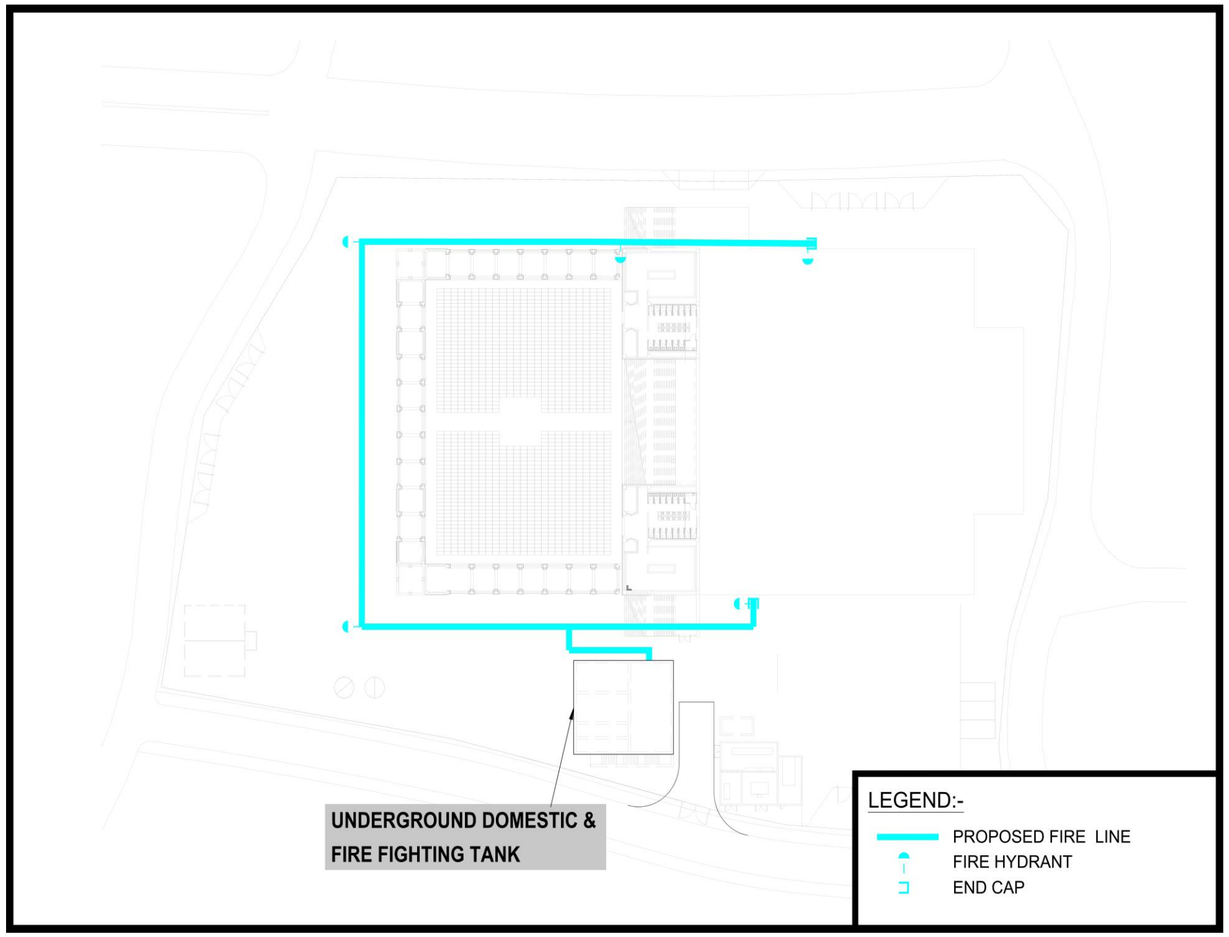
The tentative quantities of soft landscaping are about **140 m2.** This will require an average daily irrigation demand of **1.4 m3/day**.

The above irrigation demands are believed to be very minor and hence will be considered included within the design capacities of the ground reservoir.

It is worth noting that backflow preventers would need to be provided upstream hose bibbs to avoid any potential contamination of the water supply system. To reduce the number and hence the costs of backflow preventers, hose bibbs will be provided along pipe branches dedicated only for irrigation and connected to the water network where the backflow preventers will be provided.



Proposed Fire Fighting System



Wastewater Supply System

General:

As advised by ZEC during the proposal stage, wastewater collected from the existing mosque is currently drained to a soakaway pit. However, due to the greater number of worshippers expected in the proposed mosque, the use of soakaway pit may not be feasible. This will be further discussed in this section.

Scope of Work

The proposed sewerage system will comprise gravity sewers, manholes and inspection chambers. The use of a soakaway pit preceded by a septic tank for the wastewater discharge will not cater for the large flows expected from the mosque particularly during the peak scenario of Eid prayer.

As such, it is proposed to discharge into a new holding tank that will have to be periodically evacuated by municipal tankers.

Wastewater Supply System

Design Guidelines

- The design of the proposed wastewater network and holding tank will be based on the maximum number of worshippers utilizing the ablutions as presented in the water section of this report.
- The holding tank shall need to be evacuated by tankers over a period not exceeding 5 days. The tank size will be designed accordingly.

Design Criteria

Design Flows Peaking Factor

The peak wastewater flow will be calculated using peaking factor (P.F) given by the following Gift Formula

$$P.F = \frac{5}{P^{\frac{1}{6}}}$$

Where:

P.F. = Peak Factor

P = Population in Thousand

Consideration will also be given in the design to using the fixture units approach rather than the peak factor. This however will be evaluated during the next design stage.

Pipe Material

The recommended pipe materials to be adopted for the gravity sewage pipes is uPVC and HDPE pipes for all pipes and service connections due to its low construction cost (low price, low transportation due to its small weight, low installation cost, etc.), durability and easy maintenance.

For this project, it is recommended to use uPVC gravity pipes.

Hydraulic Design\ Modelling

Hydraulic design of gravity pipes is based on the Manning formula:

$$V = (1/n)\, R^{2/3}\, S^{1/2}$$

In which:

V the velocity (m/s).

R the hydraulic radius (m).

S the bed slope or hydraulic gradient (m/m).

n the Manning's roughness coefficient.

The table lists the adopted values of Manning's Roughness Coefficient "n" for different surfaces.

Surface	Manning's Roughness, "n"
PVC and HDPE	0.01

Wastewater Supply System

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Surface	Manning's Roughness, "n"
PVC and HDPE	0.01

Maximum and Minimum Permissible Velocity

The maximum permissible design velocity inside the gravity pipes should not allowed to exceed **2.5 m/sec** to avoid the pipes' scouring. However, the minimum design permissible velocity inside the network shall not be less than **0.60 m/sec** (self-cleaning velocity) to avoid sludge settling within the pipes that may cause bad smells.

Pipe Depth

The pipes' minimum depth should be a subject to the manufacturer constrains and recommendations. However, the following are the main common practice recommendation for the pipes' minimum depths:

- **1.2m cover** (min.) for pipes without protection-under roadways.
- **0.8m cover** (min.) for pipes with protection.
- **0.3m** (min.) clearance under other services (vertical clearance between two pipes).

Pipe Size

Minimum pipe diameter to be used in sewage gravity network is **200 mm** whereas in service connection pipelines, diameters of **150mm** are to be accepted. These diameters ensure easiness of maintenance and proper velocities.

Manholes and Inspection Chambers for Gravity System

Concrete manholes and inspection chambers can be constructed as in-situ or Pre-cast units. Manhole cast iron covers shall have a minimum clear opening of **600mm** diameter. In paved areas, cover levels shall be set at finished ground level, while In landscaped areas, cover level shall be set at **150mm** above final level

Proposed Wastewater Supply System

Design Concept

Estimated Wastewater Flows

The common practice for estimating the generated wastewater for a project is to consider it as a percentage of the water supply. This percent varies between **80%** and **90%** in most cases. For small projects such as the current one, generated wastewater could be estimated as **90%** of the water demand.

Considering the total number of **8600** worshippers and the proposed 30% usage of ablutions, the estimated wastewater flow is **30 m3/day.**

Proposed System

The proposed wastewater collection system will consist of a gravity network including **sewers** and **manholes**. The network will discharge into a proposed **sewage holding tank** that will need to be evacuated periodically via municipal trucks.

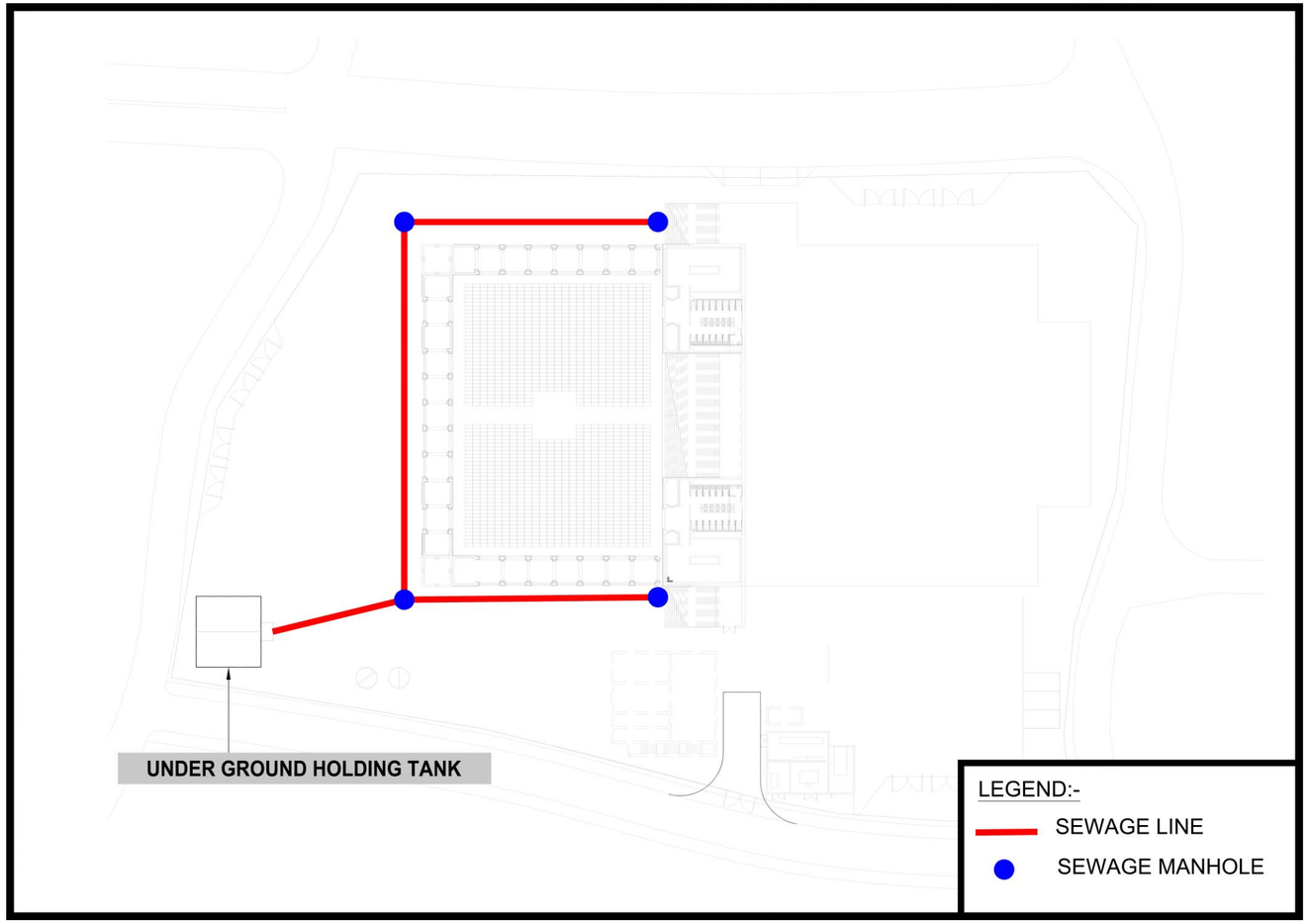
Holding Tank

The sizing of the holding tank shall be designed considering the daily flows of **30m3**. The tank capacity will be sized to cater for **5 days** of storage of the **30 m3/day** flow and hence the tank volume will be **150 m3.**

Evacuation of the holding tank over periods longer than 5 days could be considered although not recommended in order to avoid septicity of wastewater in the tank. The tank internal dimensions are proposed to be **9 x 8m** with a water depth of **2.1m**.

The holding tank will constitute of 2 compartments to allow for flexibility in maintenance. The inlet chamber to the tank will be provided with penstocks to control the wastewater discharged into each compartment.

It is proposed to provide the holding tank with pipework and couplings extended across the mosque boundary fence to outside the mosque in order to allow for suction of wastewater by tankers without the need for the trucks to enter the mosque site.



Stormwater System

General

The project site has a mild slope graded from northeast to southwest. The site is also gently sloping towards adjacent existing roads surrounding the mosque.

Apart from the mosque buildings, the site will be furnished with hardscaping, some access paved areas as well as scattered soft landscaping areas.

As advised by ZEC, all surrounding roads will be provided with storm drainage system which could be used to drain the project site.

Scope and Objectives

The scope of the proposed stormwater system is limited to the drainage of **surface run-off water** generated from the roofs, hard landscaping and paved areas within the mosque site.

It is proposed to grade the site to drain the piazza naturally towards surrounding hardscaped areas within the mosque site where drainage inlets will be provided and connected to a proposed drainage network. The roof drainage outlets will also be drained to the same drainage network that will eventually discharge into the storm drainage system along external road.

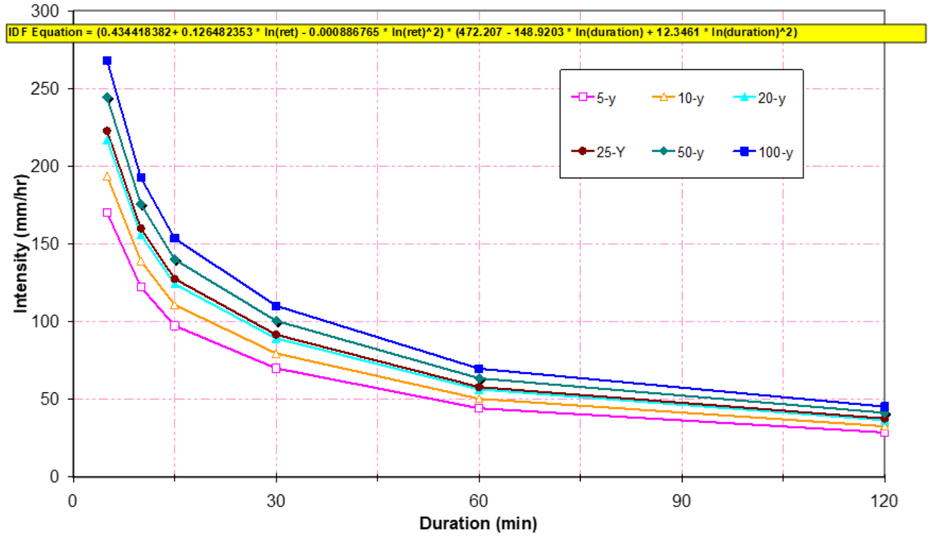
Design Guidelines

- Site will be graded to allow free surface run-off of piazza towards hardscaped areas where drainage inlets will be provided.
- Run-off water generated over landscaped areas will be allowed to percolate into the ground.

Design Criteria

Rainfall Data and Intensity-Duration-Frequency Curves

The available IDF curves previously derived by the Consultant will be considered as presented below.



Stormwater System

Design Storm Return Periods

Frequency of the storm event represents the number of occurrences of that event within a specified period of time. The frequency of the storm event reflects the degree of risk of flooding, since high frequency represents low risk. The design frequency depends on the importance of the area to be drained and the location of the drainage system.

For this project, a **5 years return** period will be considered for the drainage system design.

Rational Run-off Coefficients

For the Rational formula, the following run-off coefficients are adopted.

Time of Concentration

The following formula developed by the Federal Aviation Administration is used for calculating the time of concentration mainly for overland flow:

$$Tc = 1.8\ (1.1-C)\ L^{0.5}\ /S^{1/3}$$

Where:

Tc = Time of concentration, minutes

C = Rational method runoff coefficient

L = Length of overland flow, ft

S = Surface slope, %

*As for access roads and car parks, the minimum time of entry is taken **10 minutes**.*

Surface Description	Runoff Coefficient (C)
Asphalt Pavement	0.85
Concrete Pavement	0.85
Roof Surfaces	0.85
Unpaved roadways	0.5
Undeveloped / Soft scaped areas	0.05

Design Formulae

1- Rational Formula

The rational method is adopted to estimate the stormwater run-off based on the Intensity-Duration-Frequency (IDF) curve. The method translates rainfall to run-off using the following formula:

$$Q = C.I.A/360 \quad m^3/sec$$

Where

Q = Maximum rate of run-off in cubic meter per second

A = Drainage area in hectares

I = Average rainfall intensity in mm/hr

C = Run-off coefficient

2- Manning Formula

The manning equation with the modified coefficient is used for the calculation of flow in channels:

$$Q = (1/n) \times (A) \times (R^{2/3}) \times (S^{1/2})$$

Where

n = Roughness coefficient

A = Area of flow (m^2)

R = Hydraulic radius (m)

S = Longitudinal slope (%)

Q = Rate of discharge (m^3/sec)

Manning Roughness Coefficient

Type of channel	Manning's n
UPVC and GRP pipes	0.01
Concrete lined channels	0.015
Paved surface	0.015

Stormwater System

Pipe Material

All gravity pipes are uPVC for pipes up to 400 mm diameter and GRP for larger pipes.

Pipe Diameter, Gradients and Depths

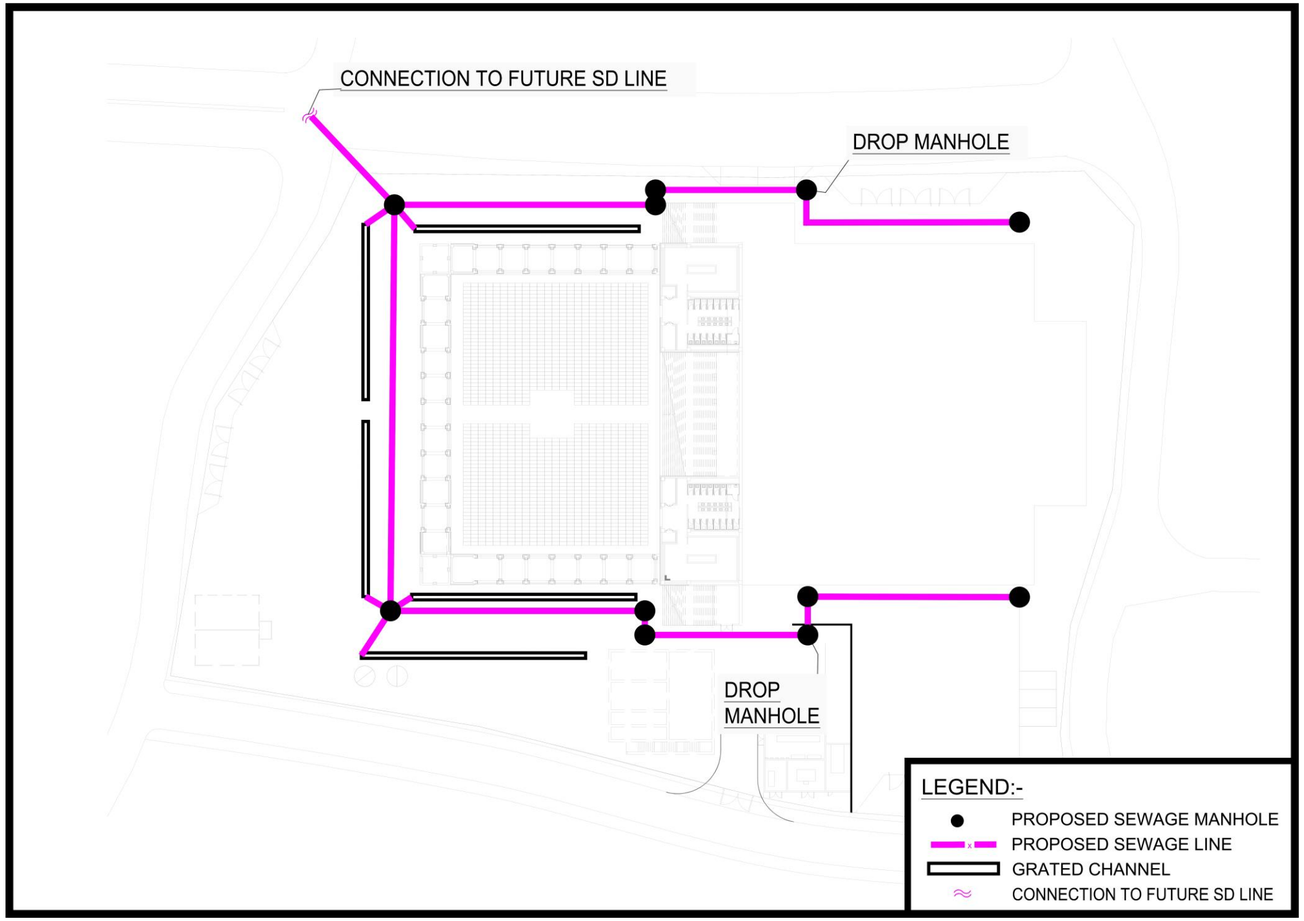
The minimum stormwater pipe diameter is **300 mm**. Recommended minimum pipe gradients are those required to maintain a minimum self-cleansing velocity of **0.60 m/s** at design flow. Wherever possible, the depth of pipe cover shall not be less than **1.20 m** under paved areas. Special pipe protection will be applied for pipes with covers less than **1.2 m** where this is unavoidable due to other constraints.

Proposed Stormwater System

The drainage of surface run-off water generated from the roofs, hard landscaping and paved areas within the mosque site will be collected via **a positive network** for further discharge into **external drainage system** along adjacent road.

The site grading will also be adjusted to drain the piazza naturally towards surrounding hardscaped areas within the mosque site where **drainage inlets** will be provided.

Type of channel	Manning's n
UPVC and GRP pipes	0.01
Concrete lined channels	0.015
Paved surface	0.015



Proposed Stormwater System


Thank You