SUDAN UNIVERSITY OF SCIENCE AND

TECHNOLOGY

COLLEGE OF ARCHITECTURE AND

PLANNING

ARCHITECTURAL DESIGN DEPARTMENT

FIFTHE YEAR BACHELOR

A SUPPLIMANTITY RESEARCH FOR ACHIEVING BACHELOR

DEGREE IN ARCHITECTURE ENGINEERING

TITLED:

ARABIC CALLIGRAPHY MUSEUEM

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ملخص البحث:

اعتقد ان الفن بجميع انواعه يلعب دورا رئيسيا في الطريقة التي نعيش بها, و الفنانين يستخدمون مهاراتهم في جميع انواع الطرق, لعرقلة او مساعدة الثورات, تحريض او مقاومة التحايل الاجتماعي, و تسليط الضوء على الظلم و اخفاء او كشف القلق الاجتماعي او ببساطة الحصول على جمالية عالية.

يرجع السبب وراء اختيار هذا النوع المحدد من الفن الى مقدار الجهل و عدم التقدير الذي يتعرض له في السودان, و كذلك لا توجد متاحف او معارض متخصصة لمثل هذا النوع من الفن.

هذا المشروع – متحف الخط العربي- هو مبنى ثقافي حيث يمكنك من المشاهدة و تعلم فنون الخط العربي في بيئة تسمح بالعمل و التدريب ومشاركة الافكار التي تتعلق بفنون الخط العربي و تقنياته الجديدة.

هذا التقرير يحتوي على خمسة ابواب - الباب الاول وفيه مقدمة عن المشروع, الباب الثاني و يوضح جمع المعلومات و النماذج المشابهة, الباب الثالث يحتوي على تحليل العلومات الخاصة بالمشروع و الخاصة بموقع المشروع, الباب الرابع يحتوي علي معلومات التصميم بدءا من الفكرة الي التصميم و الباب الخامس يتحدث عن الحلول التقنية والانشائية المستخدمة في المشروع.

النتيجة من هذا المشروع هي المقدرة على دراسة و تصميم متحف يعرض و يظهر كل فنون الخط العربي القديمة و الحديثة و تنوير الزوار باهميته, و احتواء المتحف على كل الفراغات الوظيفية المطلوبة, خطوطحركة واضحة و بسيطة و نظام انشائي مميز و ثابت.

I

Abstract:

I believe that arts on it's all kinds play a major role in the way we live, artists use their skills and imagination in all kinds of ways: to hinder or help revolutions, incite or resist social prejudice, highlight an injustice and conceal or unmask social anxieties or simply to get a high aesthetic.

The reason behind choosing this particular type of art relies on the amount of ignorance this particular type of art receives in Sudan. There are also no specialized museum or galleries for this ancient art.

This project, Arabic calligraphy museum, is a cultural building where you observe and learn Arabic calligraphy in an environment in which to work, study and share ideas about Arabic calligraphy art in new techniques.

The report consists of five chapters, the first chapter is general introduction to the project, the second chapter shows the data collection and the local and international examples, the third chapter is the analysis of the project which deals with two main things which are data analysis and site analysis and also zoning, fourth chapter of the design process which start from concept till the final design, finally fifth chapter which deals with technical solutions.

The result of this project is to be able to study and design a museum that shows all the art of Arabic calligraphy, ancient and modern, enlighten visitors of its importance, consisting of all the functional spaced needed, simple circulation, and a simple steady structure.

Dedication:

I dedicate this project to all my family members who supported me throughout this year and I will always appreciate what they have done to me. A special gratitude for my mother and father.

SAMIA ABD ALMONIEM MOHAMMED OSMAN

**HASSAN MOHAMMED AHMED MOHAMMED**

For being by my side on my ups and lows. Another special gratitude for all my siblings for all the times they were there for me.

Another dedication is for my beloved teacher and my project supervisor, for helping me reach this point of this year and guiding me throughout it,

T. Mayadaabdalrazig

The last dedication goes to my second family (**Group 11**).

CHAPTER ONE:

*PROJECT INTRODUCTION.

*PROJECT GOALS.

*REASONS BEHIND THIS PROJECT.

*PROJECT DIFFERENT ASPECTS.

1-1 Project Introduction:

1-1-1 Project name: museum of Arabic calligraphy.

1-1-2 Project definition: it's a building the provides a suitable environment for displaying legends related to Arabic calligraphy. In addition to providing a suitable environment for scientific research for the monuments, it also keeps and displays artworks of selected artists, extended with all the necessary supplies.

1-1-3 Suggested site for the project: Khartoum city.

1-1-4 The project nature: cultural, entertaining, touring.

1-1-5 The project's size: National (serves the locals plus tourists)

1-1-6 The Owner: shared ownership between the ministries of culture

and tourism, could be owned by a private sector or a foreign investor.

1-2 Project Goals:

1-2-1 General goals:

- Provision of specialized building to display art works of Arabic calligraphy in Sudan.

- create spaces that Traces the evolution of Arabic calligraphy art through the ages and document it and create galleries to present it in a modern style, informative and educational.

- One of the goals is to create a building that increases the community's awareness of the importance of arts and calligraphy art in particular.

- Providing an appropriate environment (libraries) to display books, manuscripts and sculptures (galleries) on the bases and the required standards.

- The provision of a building with basic requirements and assist in the development of Arabic calligraphy's scientific research and study the effects by optimizing the design mode.

1-2-2 Special goals:

- The use of modern methods of display takes visitors to the event.

- Modern architectural design of the building to achieve the desired function.

    - Working on a project that the interior design is an important point.

1-3 reasons behind this project:

    - Progress, intellectual and cultural development made it necessary to keep pace with this renaissance by a project that is rich culturally.
    - There are no enough numbers of museums in Sudan, and no specialized ones.
    - Museums in Sudan need a touch of modernity and evolution in presentation techniques.
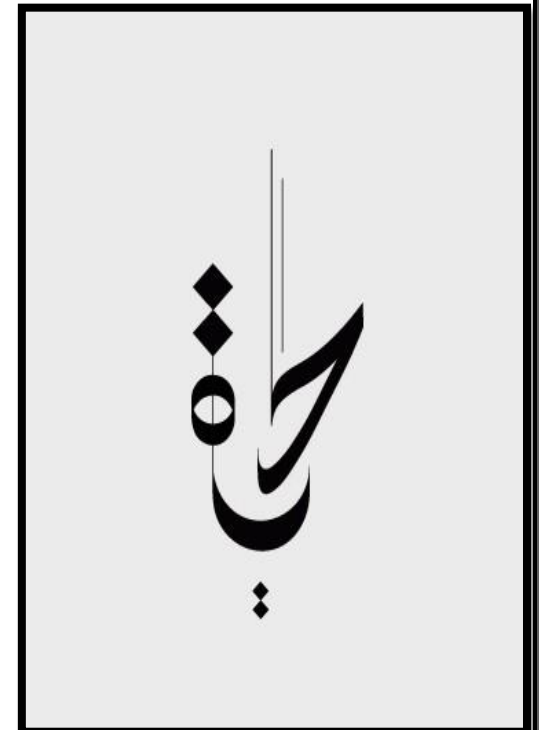
1-4 project different aspects:

Functional aspect:

- Collecting Arabic calligraphy antiquities, purchase, keep and study them.
- Save the artwork related to Arabic calligraphy and protect it from damage.
- Presenting cultural antiquities and art works in an exciting way which provides entertainment and raises the museum stander.
- Creating an integrated space for the work of artists and providing comfort and inspiration.
- Achieve flexibility and clarity of visitor movement lines while avoiding monotony and providing a thrill factor.
- Creating a humanly design that meets the needs of the mas in the first place without neglecting any aspect of balance in life to get an architectural experience that gives comfort and happiness and tempting instincts repeated.

Economic aspect:

- providing a reasonable economical cost, without affecting the project's aspects, museum's design standards and goals.
- Increasing the national income of the country.
- Creating job opportunities.
- Using the most modern and durable construction methods to meet the project's requirements and the least cost.

Constructional aspect:

- Try to balance the construction with cost as to achieve the large spans required in the type of projects.
- Demonstrate the structural system used clearly and emphasize it to integrate with the design.

Cultural aspect:

- Develop scientific research methods in relations to archeology as well as exchange of cultures among peoples.
- Raising the level of culture and technical knowledge in Arabic calligraphy.

Aesthetic aspect:

- Add a beautiful tourist interface characterized by modernity and take into account the sustainability in its composition and achieve the aesthetic purpose in the displays of exhibits.
- Create a relationship between interior and exterior spaces in ways that enhance design and increase attractiveness.

CHAPTER TWO:

*Arabic calligraphy definition

*Arabic calligraphy styles.

* About the museum.

*International similar models.

DATA COLLECTION:

2-1 The main activities of the project:

The main activities of the project can be summed up within the cultural, artistic activities, work activities, practice and scientific research.

2-2 Arabic calligraphy definition:

Or Islamic calligraphy is the artistic practice of handwriting and calligraphy, based upon the alphabet in the lands sharing a common Islamic cultural heritage. It includes Arabic, ottoman, and Persian calligraphy.

## 2-3 Arabic calligraphy styles:

1. **Kufic:** is the oldest form of the Arabic script. The style emphasized rigid and angular stroke, which appears as a modified form of the old Nabataean script.The Arabic kufic consisted of 17 letters without diacritic dots or accents. Afterwards, dots and accents were added to help readers with pronunciation, and the set of Arabic letters rose to 29.

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2. **<u>Naskh</u>**: with the rise of Islam, new script was needed to fit the pace of conversions, and a well-defined cursive called naskh first appeared in the 10th century. The script is the most ubiquitous among other styles, used in Qur'ans, official decrees and private correspondence. It became the basis of modern Arabic print.
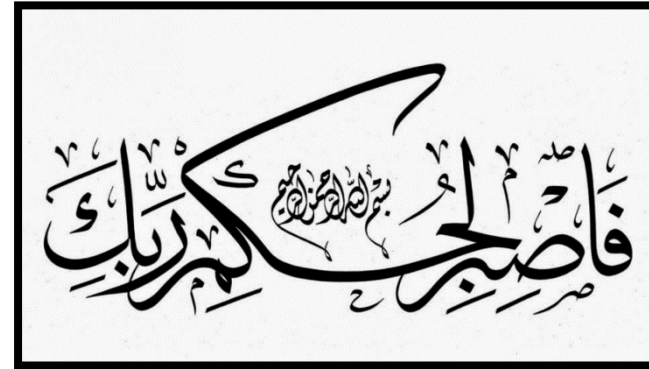

3. **Thulth :** is developed as a display script to decorate particular scriptural objects. Letters have long vertical lines with broad spacing. The name ''third'' is in reference to the x-height, which is one third of the 'alif.
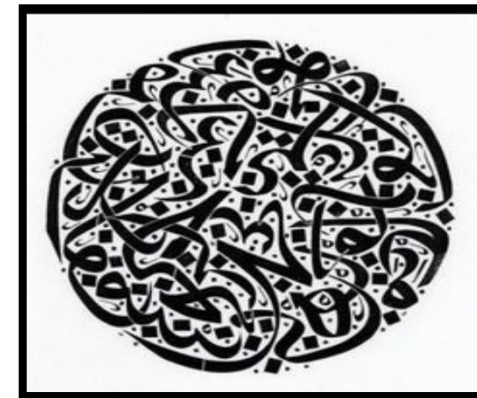
4. **Riq'ah:** is a handwriting style derived from naskh and thuluth, first appeared in the 9th century. The shape is simple with short strokes and little flourishes.

5. **Muhaqqaq**: is a majestic style used by accomplished calligraphers. It was considered one of the most beautiful scripts, as well as one of the most difficult to execute. Muhaqqaq was commonly used during the mameluke era, but the use become largely restricted to short phrases, such as the basmallah, from the 18th century onward.

6. **Nasta'liq**: is the cursive style originally to write the Persian language for literary and non-Qur'anic works. Nasta'liq is later thought to be a later development of the naskh and the earlier ta'liq script used in Iran.
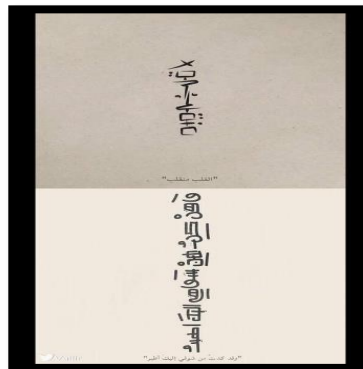
7. **Diwani**: is a cursive style of Arabic calligraphy developed during the region of the early ottman Turkish in the 16th and early 17th centuries. Diwani is difficult to read and write due to its heavy stylization, and became ideal script for writing court documents as it ensured confidentiality and prevented forgery.
8. **Sini**: is a style developed in china. The shape is greatly influenced by Chinese calligraphy, using horsehair brush instead of the standard reed pen.
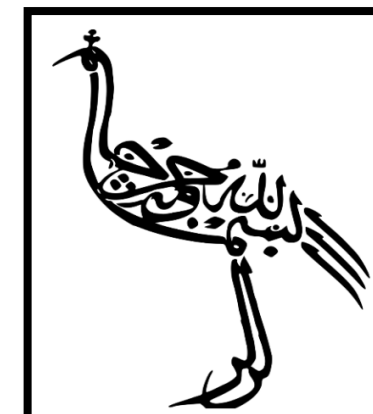

9. **Modern:** western design has influenced Arabic calligraphy in modern times, with forms such as calligrafiti.

_**2-4**_   _**About**_   _**the**_

museum:

2-4-1 museum definition:

 - an institution devoted to the procurement, care, study and display of objects of lasting interest or value.

  - a building or a place where works of art, scientific specimens, or other objects of permanent value are kept and displayed.

2-4-2 Types of museums:
* Art museums: the exhibition includes paintings, sculptures, ceramics and other high-quality objects, most known museum of this type is the French louvre museum.
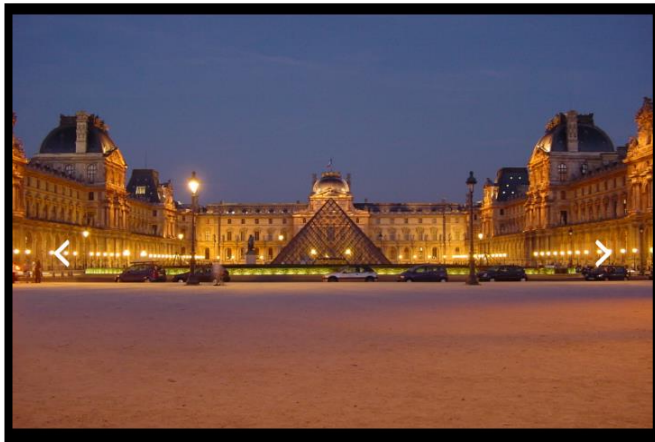
* Heritage museum: they are the museum that shows the heritage of various civilizations include tools that were used in ancient times and the development of these tools until they reached it now.
* Scientific museums: it is the presentation of scientific methods and discoveries through which I is used in the development of various environmental sciences, and industrial sciences.

* Educational museums: they are the places where samples of materials that serve the scientific and cultural aspects are displayed. This type of museums often contains several exhibitions halls, such as the exhibition hall of heritage and other monuments, and a third of the science in all its branches.

* National museums: this category of museums derives its definition from the function of the museum itself, i.e. preserving the artistic heritage of the country, and these museums need additions and constant renovations to develop the views and update the collections of art or archaeological.

* The Arabic calligraphy museum is considered an Art/Heritage museum.

2-4-3 *Museum's design considerations:*

- **Site planning:** must have a large space of green out door (outdoor 60%- indoor 40%), to minimize noise & air pollution, also stabilize the humidity. There is no standard site planning for museums.

- **Site selection:** ease of accessibility by public transportation, and from the educational centers. Also away from residential gatherings, to provide privacy. Also high security.

- **Entrances and exits:** There must be at least 2 entrances, one for visitors and other for services. There must be exits located in the right places with the right spaces to serve the certain amount of visitors.

- **Movement axes and itineraries:** there are primary axes and secondary axes.
  Must be designed in a way that allows visitors to view all the exhibits with ease and less crowding or the intersection of movement lines. Also avoid straight movement lines for it bores the visitors.

- **Main void**: Must be well ventilated and good lightings. Also must be designed to carry the capacity of the visitors at all times.

- **Security**: high level of security for the whole building.

- **Exhibitions**: must use natural and industrial lightning. Apply the space's lighting and exhibits lighting. Natural lighting is very important.
  The space inside can be divided in two ways, modern way and classical way.

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- Exhibitions display layouts: open plan- main and side rooms – linear – labyrinth – complex – round tours.

2-5 About the Arabic calligraphy museum:

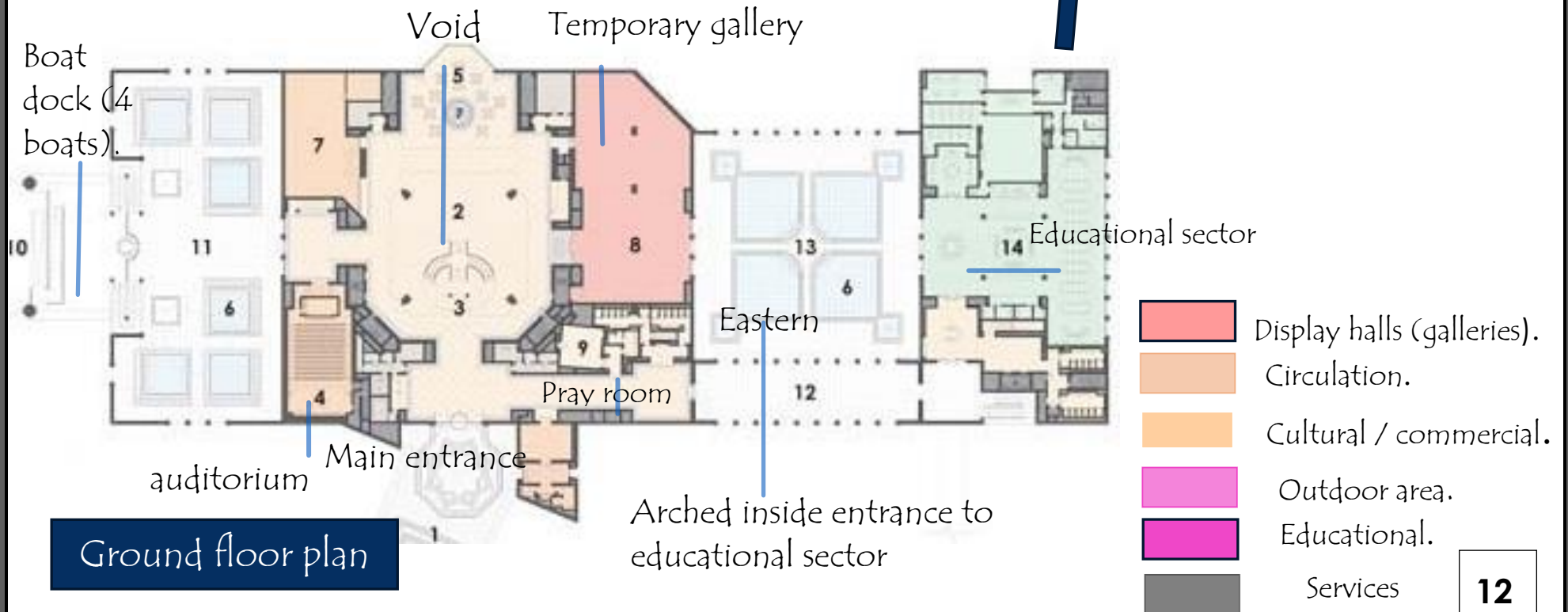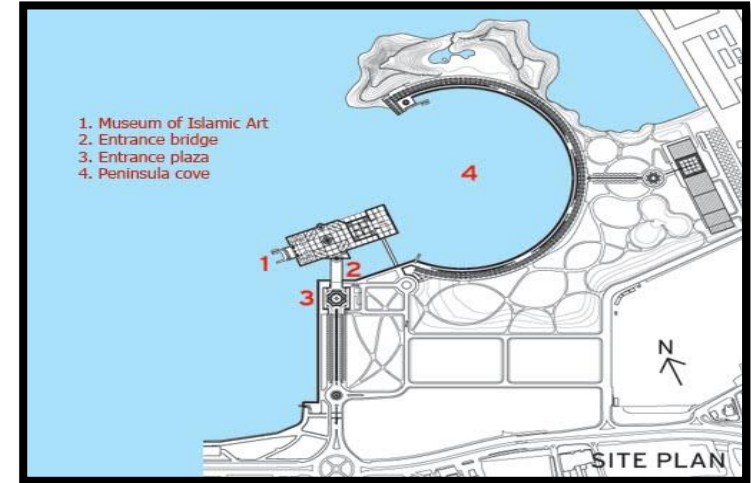### *The museum's galleries are divided in order to time eras*:

- **Historic calligraphy (610-750**): this era started since the coming of Quran, Arabs at that time were very clever and fluent with the Arabic language, there were only 17 letters, no dots on the letters and no pronunciation moves.
- **Historic calligraphy (750-1923):** at this area, more people started converting to Islam and dealing with Arab, so many foreign tongs were speaking Arabic un fluently, there for the letters increased to 27 letters because of adding the dots, pronunciation moves were added to ease the reading and writing.
- **Arabic calligraphy in non-Arabic languages**: other languages, such as Urdu, use the Arabic letters, they were active with the Arabic calligraphy art as well.
- **Modern Arabic calligraphy**: it is now used by Arabic, non-Arabic, Islamic an non Islamic artists, creating works of art that represents certain case or idea.
- The last gallery would be about **the Arabic calligraphy tools** and the techniques used in each area until the modern art.

2-6 _Similar projects study_:

2-6-1 Global models:

First model : - Project name: Museum of Islamic Art.
- Architectural designer name: Leo Ming be I.M. Pei Architect.
- The date of the opening of the museum: November 22, 2008.
- Museum site: Doha – Qatar.
- total area: 45000 m2.

1. Museum of Islamic Art
2. Entrance bridge
3. Entrance plaza
4. Peninsula cove

SITE PLAN

Boat dock (4 boats).

Void

Temporary gallery

Educational sector

Eastern

Pray room

Arched inside entrance to educational sector

Main entrance

auditorium

Ground floor plan

Display halls (galleries).
Circulation.
Cultural / commercial.
Outdoor area.
Educational.
Services

12
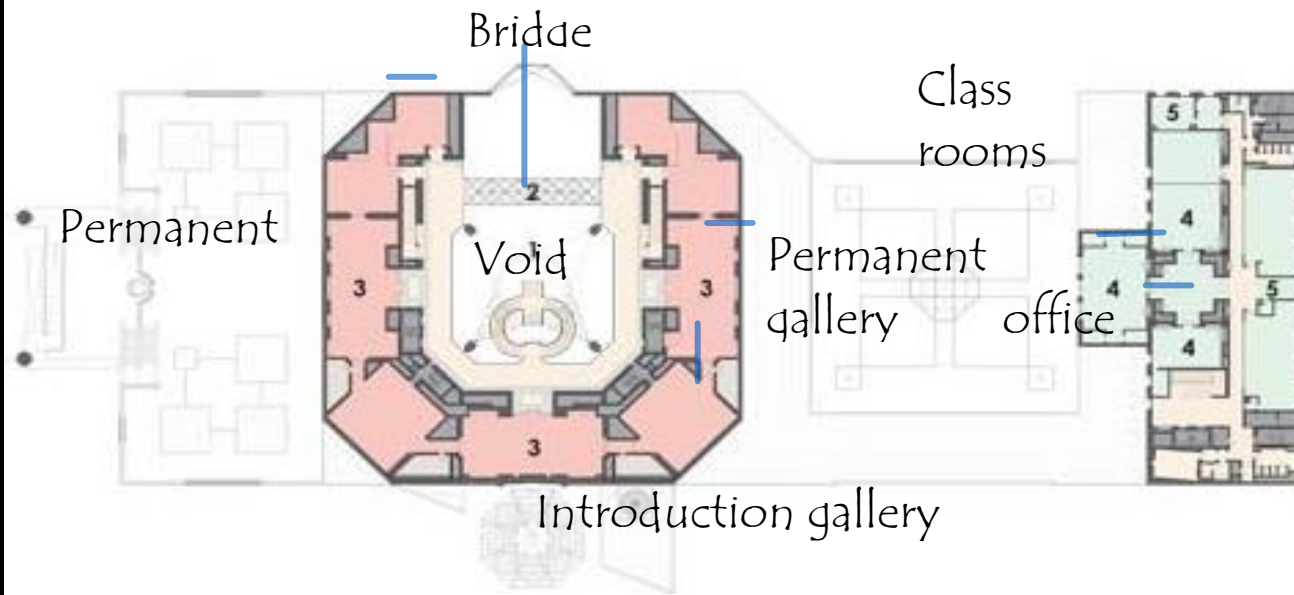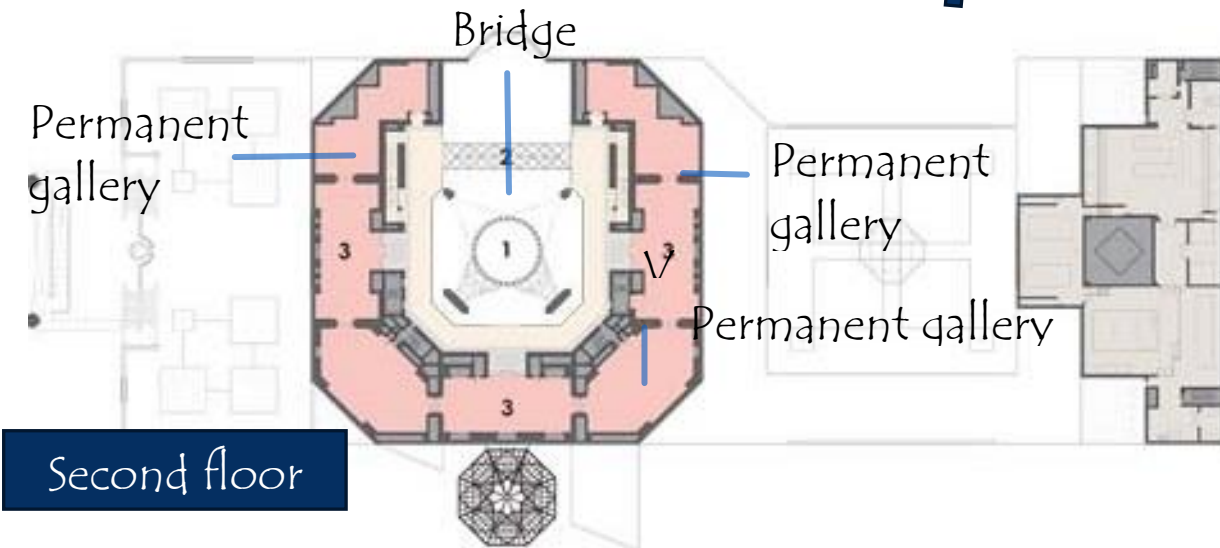
POINTS:

Auditorium	**197 seats 430sq m**
Temporary gallery	750sq m
permanent galleries	3100sq m
Gift shop	300sq m
Educational sector	1700sq m
Library	820sq m

First floor plan

Bridge

Class rooms

Permanent

Void

Permanent gallery

office

Introduction gallery

N

Second floor

Bridge

Permanent gallery

Permanent gallery

Permanent gallery

Display hall (galleries)

Circulation.

Cultural / commercial.

Outdoor area.

Educational.

Services.

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Permanent galleries with a total area of 3100sq m.

- permanent galleries all located in the first, second, third floor.

-Each permanent gallery designed with an area of 620sq m approximately.

The Permanent galleries:

Display halls (galleries).

Circulation.

Cultural / commercial.

Outdoor area.

Educational.

Services.

Introduction hall.

Calligraphy.

The figure in art.

patterns.

Science in art.

Iran 16th–19th century

India & turkey
16th–18th century

Early Islamic art
7th–12th century.

Egypt & Syria
14th–15th century.

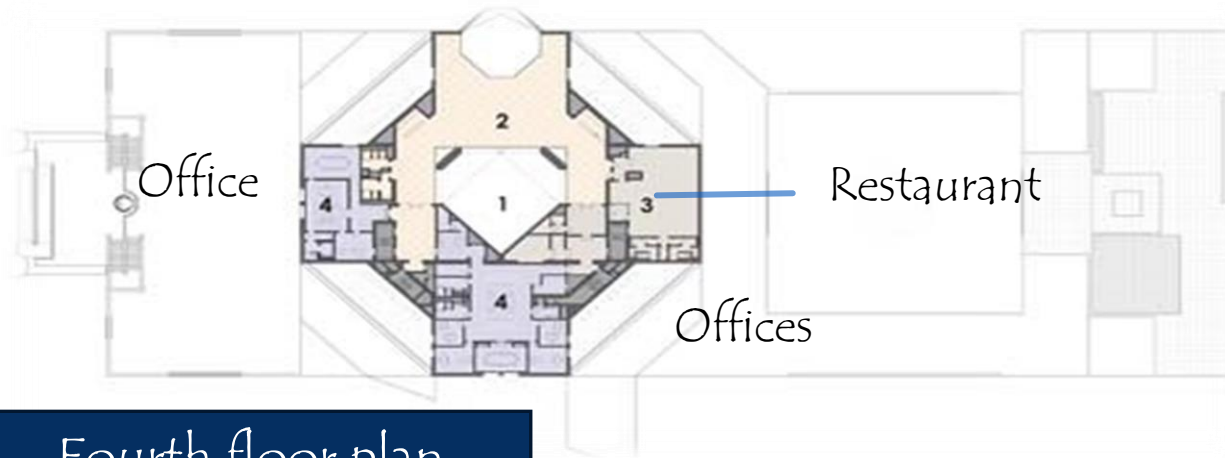Iran & central Asia
15th–16th century.

14

N

Bridge

Void

Permanent gallery

Permanent gallery

Third floor

Temporary storage

Permanent galleries with a total area of 3100sq m

permanent galleries all located in the first, second, third floor

Office

Restaurant

Offices

Fourth floor plan

Circulation.

Administration.

Restaurant.

Services.

15

Restaurant

cafe

Administrative offices.

40m
height
Curtain
wall.

Stairs

Main entrance
Main void

7

6

5

5

4

3

2

1

8

SECTION:

Floating dock

The museum has a great location on the artificial island 60 m away from shore, this allows visibility to the museum from all direction

The museum has a 40m long curtain wall on its north side, which views the gulf west bay area of Doha, from all five floors.

The museum uses a high technical security system to protect all the exhibits.(AMG)
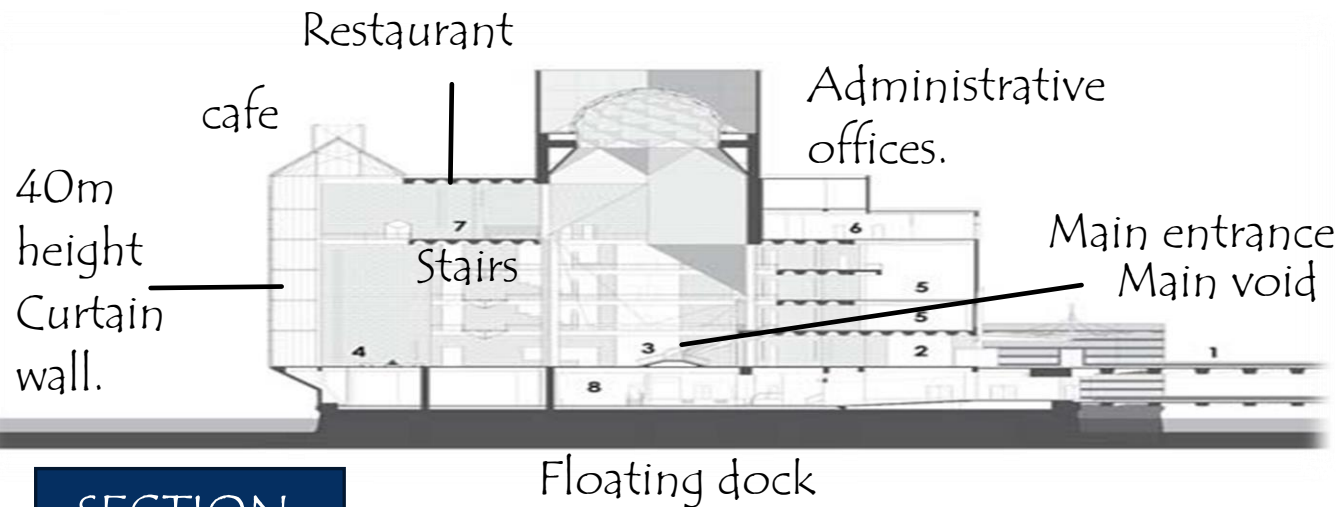
2-5-1 GLOBAL MODELS:

SECOND MODEL:

- Project name: Qu Jing history museum.
- Architectural designer name: HordorArchitecture&
Engineering Design Group, Atelier Alter.
- The date of the opening of the museum: 2015.
- Museum site: Yunnan, China .

N

POINTS:

Ground floor plan

Display halls (galleries).
Circulation
Services.
Administration.

1. VIP & office entrance	10. Bronze culture
2. Storeroom entrance	exhibition hall
3. Secondary entrance	11. Water point
4. VIP room	12. Storage room
5. Guards' room	13. Sinked courtyard
6. Office	overhead
7. Storeroom prozone	14. Exhibition hall
8. Foyer	overhead
9. Multifunctional lecture	15. Toilet
hall	16. Equipment room
	17. Colored pond

The museum is for fish fossil geology in human history.

Designed on a total area of 202,361.5 SF.

The museum is entered through center of building mass. Audiences are elevated to a concrete plateau, as they begin their exhibition routes at a strategic point in space.

The museum consists of loungeto view fossils of fish and to display the culture and folklore It also has a display of arts hall.

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POINTS:

The museum follows the closed planning system, where visitors entering once through a central space can then go on separate directions, directly to the exhibition which call their attention. the visitor chooses his destination.

Although the cantilevered roof is heavy and unstable from abroad shows, but it is in fact based on steel sections on the inside.

This model study conclusion:

- From this global model, the exterior mass is what attracts the attention.
- The outer mass design, elevations and 3D, they all made it special as required in a museum's exterior.
- This weird attractive look of the building attracts and pull visitors and tourist, they enjoy their visit and accomplishing the museum's purpose.
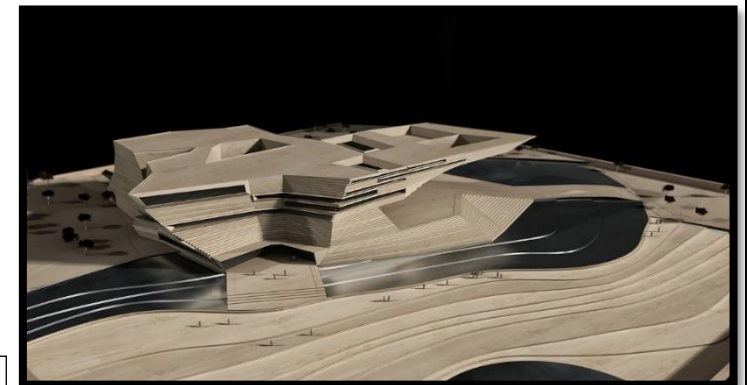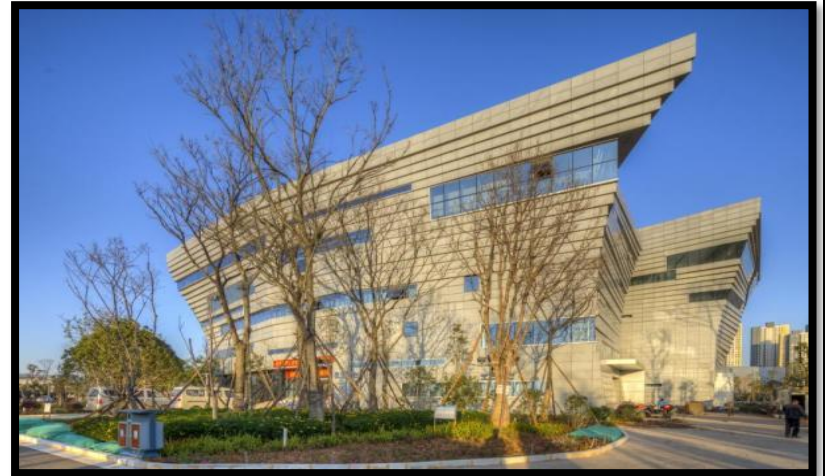
CHAPTER THREE:

DATA STUDY AND ANALYSIS:

DATA ANALYSIS:

*ACTIVITIES COMPONENTS.

*SPATIAL COMPONENT.

*HUMAN COMPONENT.

*SPACE STUDY.

*ACTIVITY SCHEDUEL.

*FUNCTIONAL RELATIONS.

*SITE SUGGESTIONS.

*SITE SELECTION.

*SITE ANALYSIS.

*ZONNIN

3-1 ACTIVITY COMPONENTS:

-each sector has its own service activities.

-the entertainment activity of having food has indoor and outdoor.

3-2 SPATIAL COMPONENT:

Activity Components

Primary

- Displaying calligraphy.
  - Historic calligraphy (610 – 750)
  - Historic calligraphy (750-1923)
  - Arabic calligraphy in non-Arabic languages.
  - Modern Arabic calligraphy.
  - Arabic calligraphy tools.
- Researching
  - Discussing activity
  - Reading about calligraphy.
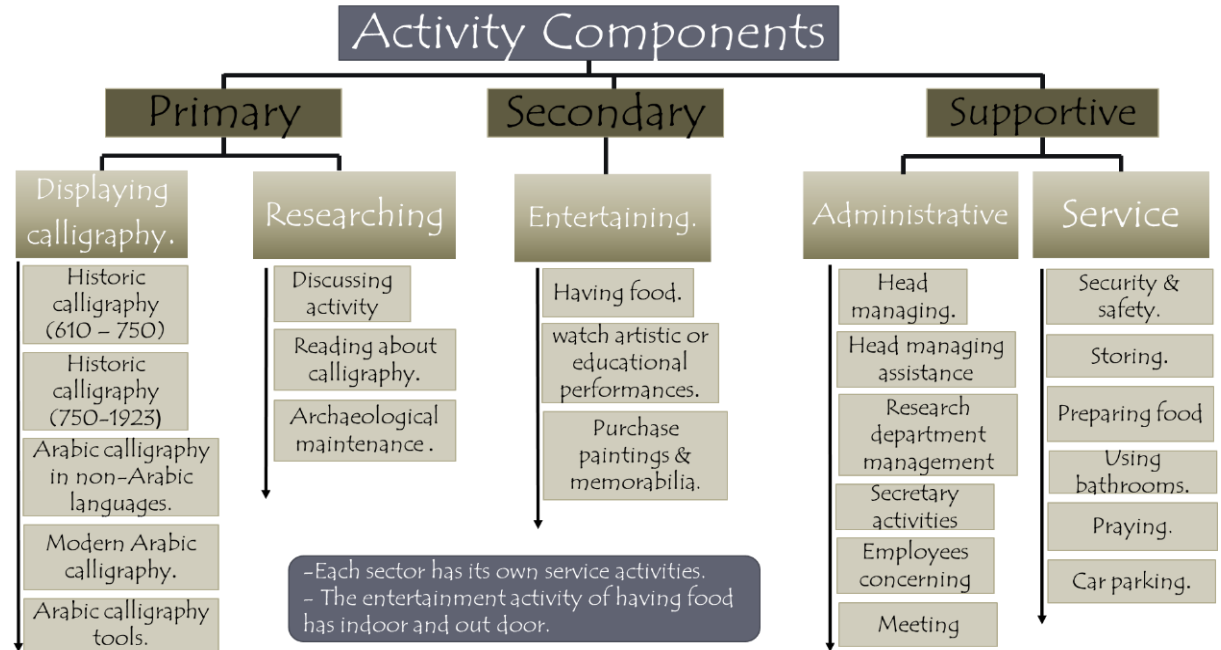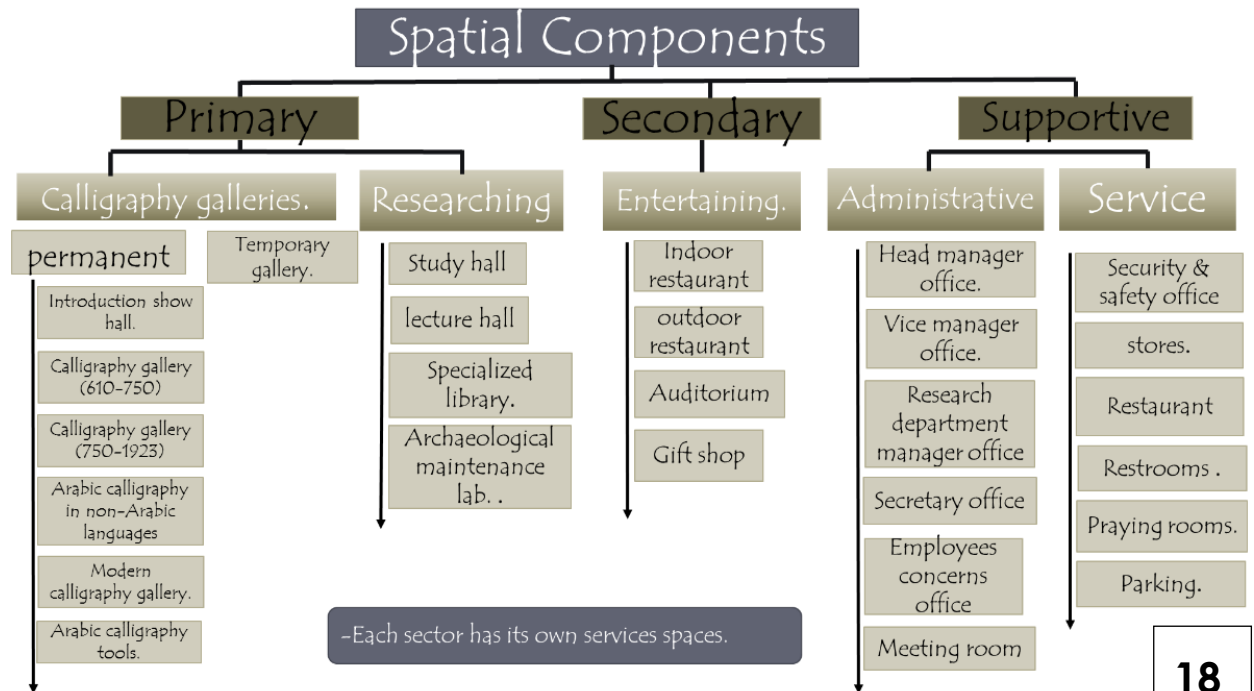 - Archaeological maintenance .

Secondary

- Entertaining.
  - Having food.
  - watch artistic or educational performances.
  - Purchase paintings & memorabilia.

-Each sector has its own service activities.
- The entertainment activity of having food has indoor and out door.

Supportive

- Administrative
  - Head managing.
  - Head managing assistance
  - Research department management
  - Secretary activities
  - Employees concerning
  - Meeting
- Service
  - Security & safety.
  - Storing.
  - Preparing food
  - Using bathrooms.
  - Praying.
  - Car parking.

Spatial Components

Primary

- Calligraphy galleries.
  - permanent
    - Introduction show hall.
    - Calligraphy gallery (610-750)
    - Calligraphy gallery (750-1923)
    - Arabic calligraphy in non-Arabic languages
    - Modern calligraphy gallery.
    - Arabic calligraphy tools.
  - Temporary gallery.
- Researching
  - Study hall
  - lecture hall
  - Specialized library.
  - Archaeological maintenance lab. .

Secondary

- Entertaining.
  - Indoor restaurant
  - outdoor restaurant
  - Auditorium
  - Gift shop

-Each sector has its own services spaces.

Supportive

- Administrative
  - Head manager office.
  - Vice manager office.
  - Research department manager office
  - Secretary office
  - Employees concerns office
  - Meeting room
- Service
  - Security & safety office
  - stores.
  - Restaurant
  - Restrooms .
  - Praying rooms.
  - Parking.

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3-2 HUMANSCOMPONENT:

According to the ministry of tourist's statics of numbers of tourists for the year 2020, there are 2,000,000 tourists during the year.
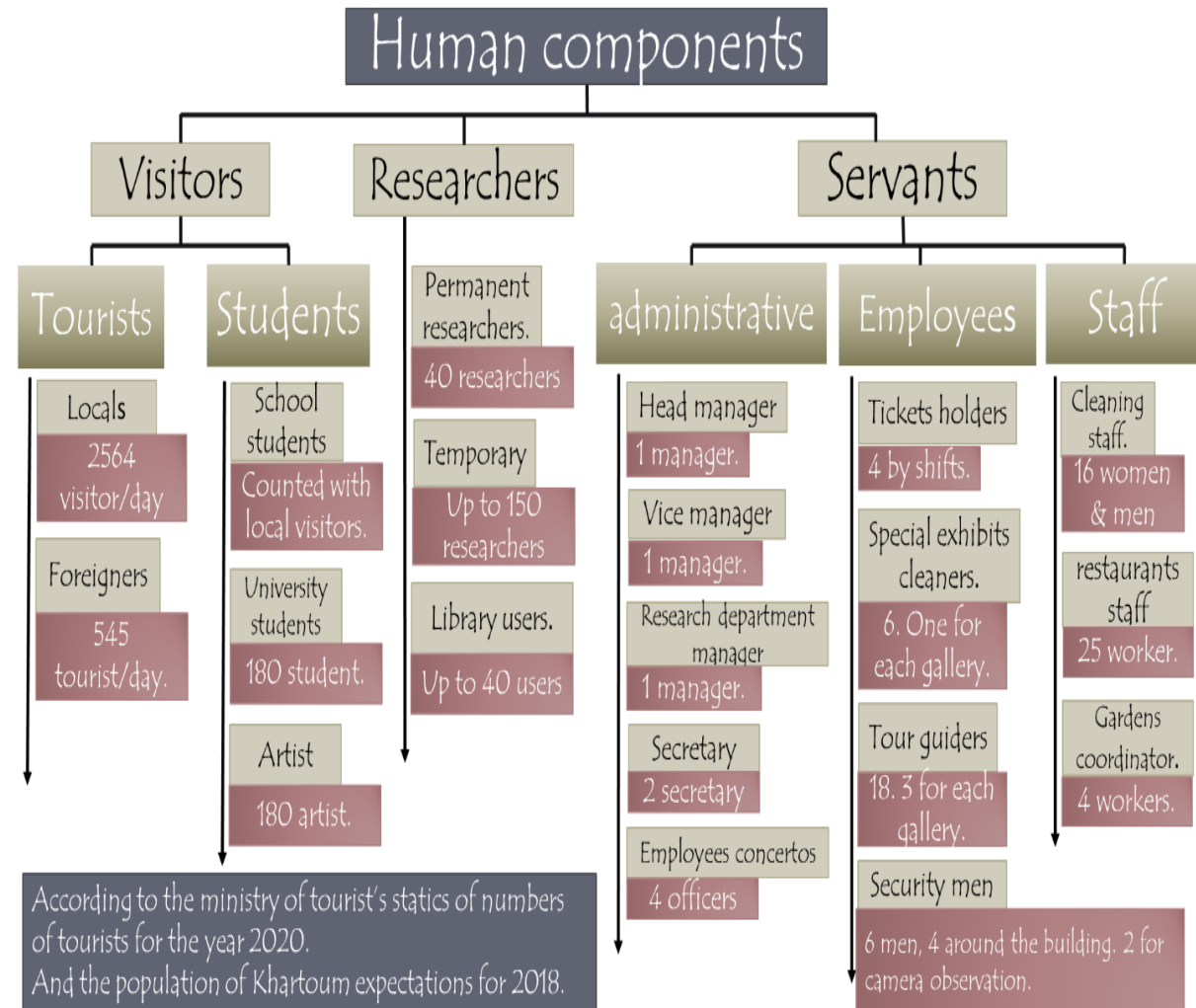
The amount of tourists who head to Khartoum are 540,000 tourists visit Khartoum/year.

The amount of tourist's visit museums are 172,800 tourists.

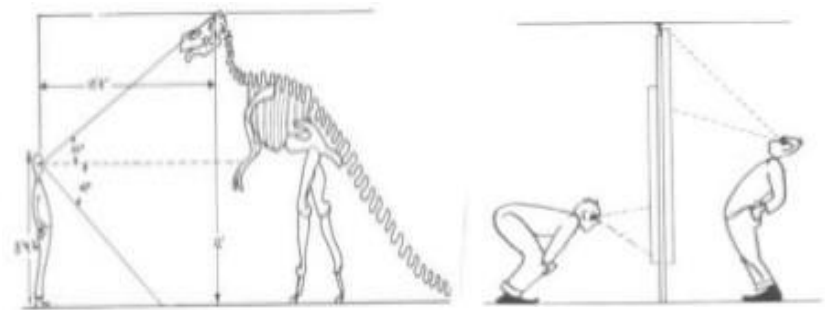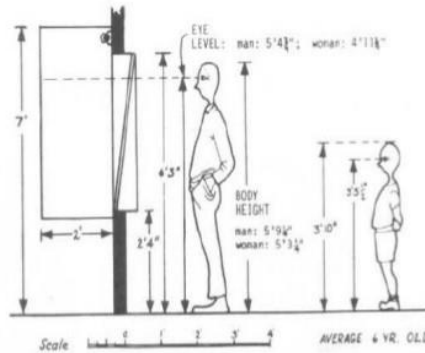Number of museum visitors for one day is 545 tourists/day.

According to the statics, the expected population of Khartoum state till 2018 is 8,700,000 persons.

The total number of visitors are 3110 visitors/day during the peak time.

Human components

Visitors
- **Tourists**
  - Locals: 2564 visitor/day
  - Foreigners: 545 tourist/day.
- **Students**
  - School students: Counted with local visitors.
  - University students: 180 student.
  - Artist: 180 artist.

Researchers
- Permanent researchers. 40 researchers
- Temporary: Up to 150 researchers
- Library users. Up to 40 users

According to the ministry of tourist's statics of numbers of tourists for the year 2020.
And the population of Khartoum expectations for 2018.

Servants
- **administrative**
  - Head manager: 1 manager.
  - Vice manager: 1 manager.
  - Research department manager: 1 manager.
  - Secretary: 2 secretary
  - Employees concertos: 4 officers
- **Employees**
  - Tickets holders: 4 by shifts.
  - Special exhibits cleaners. 6. One for each gallery.
  - Tour guiders: 18. 3 for each gallery.
  - Security men: 6 men, 4 around the building. 2 for camera observation.
- **Staff**
  - Cleaning staff. 16 women & men
  - restaurants staff: 25 worker.
 - Gardens coordinator. 4 workers.

3-3 SPACE STUDY:

- Galleries' Displaying:
- First figures show the different lengths and levels of view for visitors the comfortable Distance of vision.

and their relationship to

- it also explains the problem that results from increasing the height of the displayed board or decreasing its height more than needed.
- The images depict the standard dimensions of the viewing and Passers-by crossing the exhibits In glass bases.
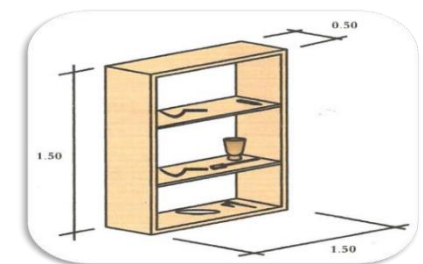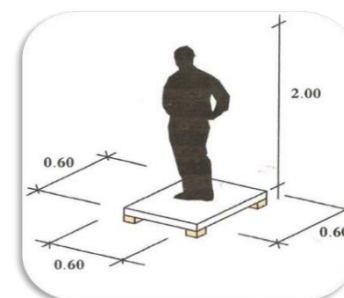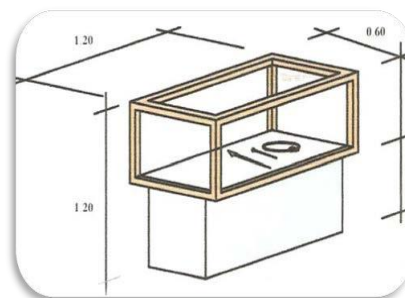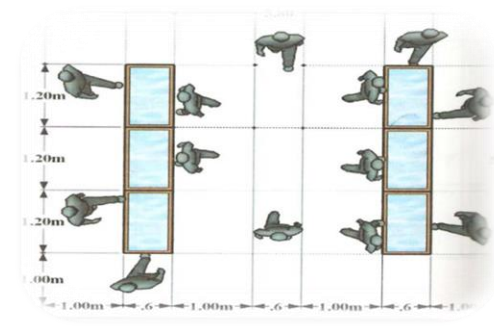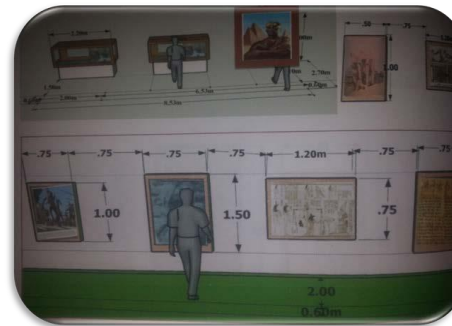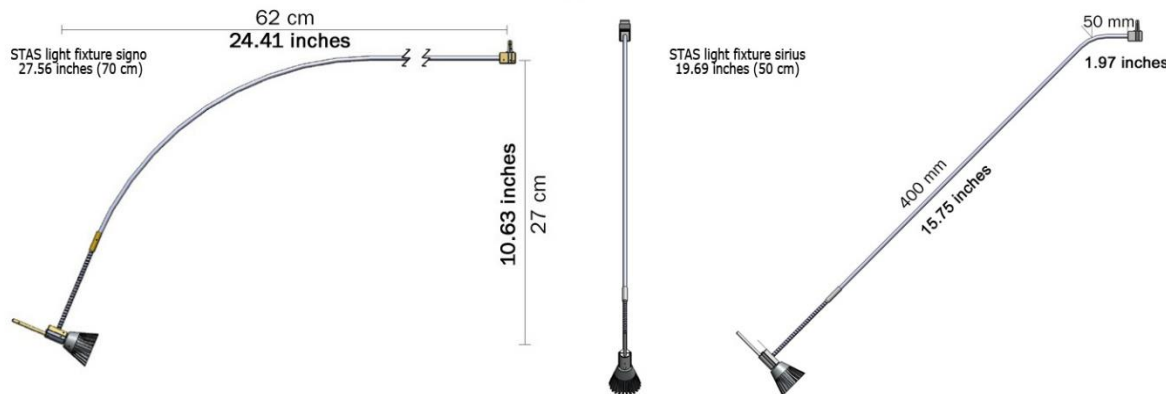
- Interior figures to showhow the displaying objects could be installed into the gallery.
- Lighting is important in galleries, here we are using both natural light and artificial lighting.
- The natural light is provided into the spaces using the (external dynamic facades), they automatically open up and can also be controlled.

- These figures shows the artificial lighting:

62 cm
24.41 inches

STAS light fixture signo
27.56 inches (70 cm)

10.63 inches
27 cm

STAS light fixture sirius
19.69 inches (50 cm)

50 mm
1.97 inches

400 mm
15.75 inches

3-4 ACTIVITIES SCHEDUELE:

Activities Schedule

Activity Type.	Activity's Name.		Users type.	User's Numbers.	Time of Use.	Environmental Requirements	Functional Requirements.	Space's Name.	Space's Number.	One space's area	Total Area.
Displaying calligraphy art	lobby		visitors	4000	10am-12am	natural light / industrial – renewed air.	Reception counter- vertical movements	Main void	1	300m2	300m2
	Displaying art	Permanent shows	visitors	500	10am – 12am	Renewed air – Natural light	Focus lights on exhibits-dark colored and non reflection floors	Permanent show halls	5	620	3850 m2
		Temporary shows		400				temporary show hall	1	750	
	Opening show		visitors	200	10am – 11am	No lights – renewed air	seats – modern film displayer- remote controls.	Introduction gallery hall	1	620	620 m2
	Services	Having food	Visitors	-	-	Natural light – natural renewed air	First aid – service room – tables - lockers	Café	2	427	427m2
		w.c						W.C	2		
Total area of displaying calligraphy arts										5,197 + **2,227**= 7,424 m2	

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3-4 ACTIVITIES SCHEDUELE:

Activity Type	Activity Name		Users Type	Users Number	Using Time	Environmental Requirements	Functional Requirements	Space's Name	Space's Number	One space Area	Total Area
Research department	Taking lessons	permanent	Researchers – students	40	4-9pm	Natural light – natural air	tables – chairs – offices – stage – projector	Study hall	2	75	495m2
		Temporary		150				Lecture hall	1	420	
	Maintenance		Researchers – students	80	4-9pm	Natural light / industrial – natural air	tables – chairs – offices – stage – work tables- stands to carry the sculptures	Archaeological maintenance lab	1	800	800m2
	Reading		Researchers – students	40	4-9pm	natural light / industrial – natural air	Tables – chairs – offices –lockers – computers –printer	library	1	820	820 m2

3-4 ACTIVITIES SCHEDUELE

Activity type	Activity name	Users type	Users number	Using Time	Environmental Requirements	Functional Requirements	Space's Name	Space's Number	One space's Area	Total Area
Research department	Resting	Researchers	35	4-9pm	Natural light – natural air	Couches –lockers Offices – chairs – first aid – store	Researcher's restroom	1	620	620m2
	Total area of research department									2735+ 279 = 3014 m2
Entertainment	meetings	visitors	197	10am – 11am	Natural light \ industrial – renewed air	Seats – stage – services	Auditorium	1	430	430m2
	Having food	visitors	200	10am – 11am	Natural light \ industrial – renewed air	Tables – chairs – store- services	Restaurant	1	600	600m2
	Purchasing memorabilia	visitors	–	11 am – 10 pm	Natural light / industrial	Display boards – chairs- cashier – cabinets	Gift shop	1	400	400m2
	Total area of Entertainment sector									1430 + 411.3 = 1,841.3 m2

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3-4 ACTIVITIES SCHEDUELE:

| Activity Type	Activity's Name	User's Type	Users Numbers	Using Time	Environmental requirements	Functional Requirements	Space's Name	Space's Number	One space's Area	Total Area
Administrative department	Public administration	Administrators	1	8-4 pm	Renewed air – natural light / industrial	Desks – tables – lockers – coaches – computer	Head Manager's office	1	44	44m2
	Public administration	Administrators	1	8-4 pm	Renewed air – natural light / industrial	Desks – tables – lockers – coaches – computer	Head manager's assistant office	1	35	35 m2
	Research department administration	Administrators	1	8-4 pm	Renewed air – natural light / industrial	Desks – tables – lockers – coaches – computer	Research department manager's office	1	24	24 m2
	Secretary	Administrators	2	8-4 pm	Renewed air – natural light / industrial	Desks – tables – lockers – coaches – computer	Secretary's office	2	20	40 m2

3-4 ACTIVITIES SCHEDUELE:

Activity Type	Activity's Name		User's Type	Users Numbers	Using Time	Environmental requirements	Functional Requirements	Space's Name	Space's Number	One space's Area	Total Area
SERVICES	Security		Administrators	6	–	Renewed air – natural light / industrial	Desks – tables – lockers – coaches – computer	Security Office	3	20	60 m2
	Storage		Storing workers	12	–	–	–	Stores	6	180	1,080 m2
	Resting	Men	Workers	8	8-7 pm	Renewed air – natural light \ industrial	Shower rooms – lockers – uniforms – seats	worker's restroom	2	16.5	66m2
		Women		8					2	16.5	
	Using bathrooms		Visitors – researchers – administrators – workers	200	–	Renewed air – natural light \ industrial	Bathrooms accessories	W.C	24	2.00	48 m2

3-4 ACTIVITIES SCHEDUELE:

Activity type	Activity name		Users type	Users number	Using Time	Environmental Requirements	Functional Requirements	Space's Name	Space's Number	One space's Area	Total Area
SERVICES	Saying prayers	men	Visitors – researchers – administrators – workers	200	–	Renewed air – natural light \ industrial		Praying room	1	160	224 m2
		Women		80					1	64	
	Total area of services sector										1478 + 344 = 1822 m2
	TOTAL BUILT AREA										14,369.3 m2

– ALL SPACE'S AREAS ARE SPECIFIED BASED UPON THE SIMILAR PROJECTS.

SALES

- displaying calligraphy art
- Researches.
- Entertainment
- Administrative
- Services.
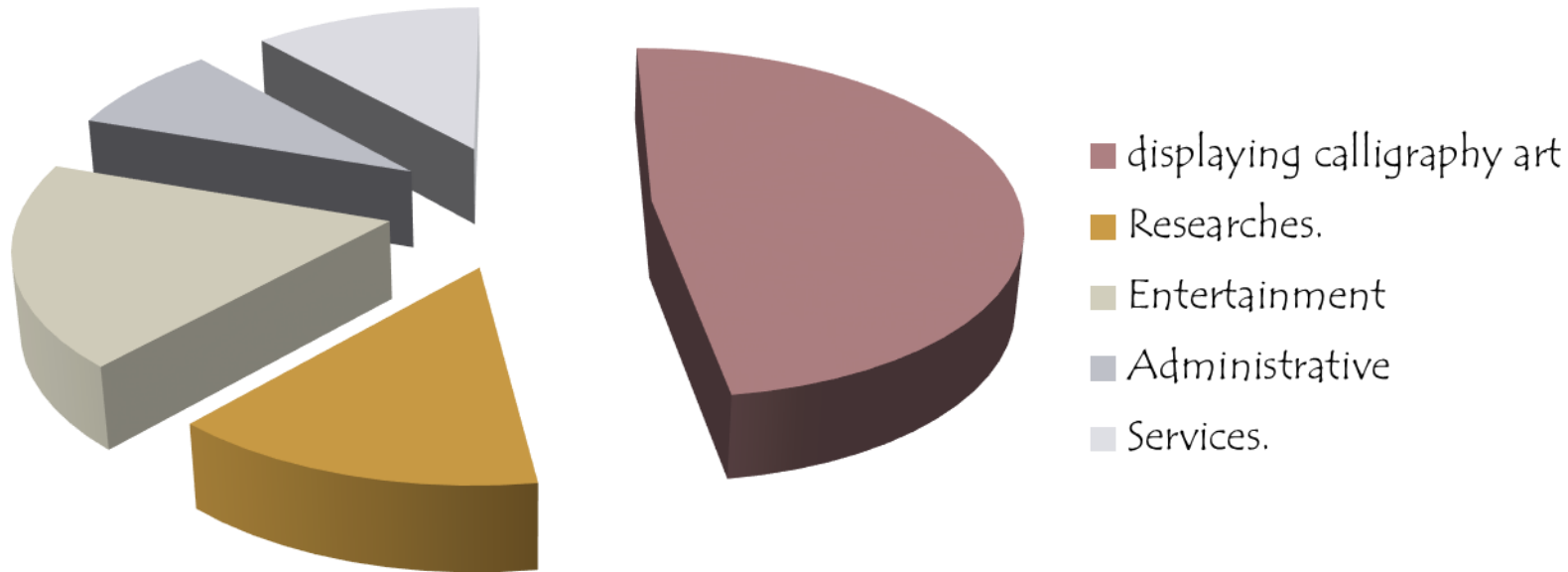
- Used area : 39,600 sq m.
- Built area : 40% = **14,369.3** sq m + **15%** movement space between spaces : **14,369.3** + **2,827.6** = 17,196.3 sq m.
- Out door area : 60% = 25,230.7 sq m:
    - Green landscape : 25% = 12,883.2 sq. m.
    - Parking area : 19% = 9,791.3 sq. m.

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3-5 FUNCTIONAL RELATIONS DIAGRAM:

Functional relations diagram

General pyramid matrix :

Major adjacency.

Minor adjacency.

Convenient adjacency.

displaying calligraphy art.

Research sector.

Entertainment sector.

Administrative sector..

Services.

Main void
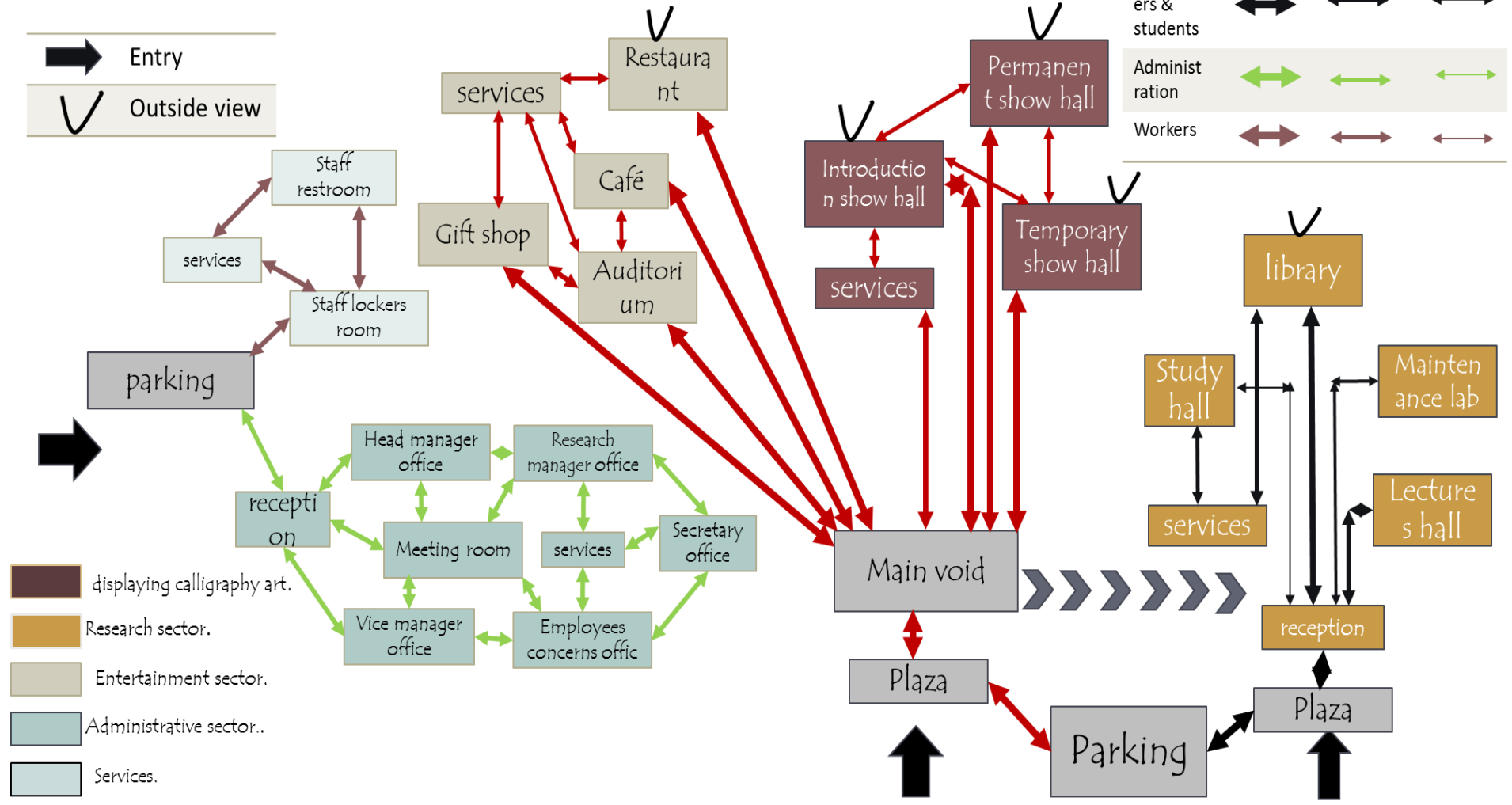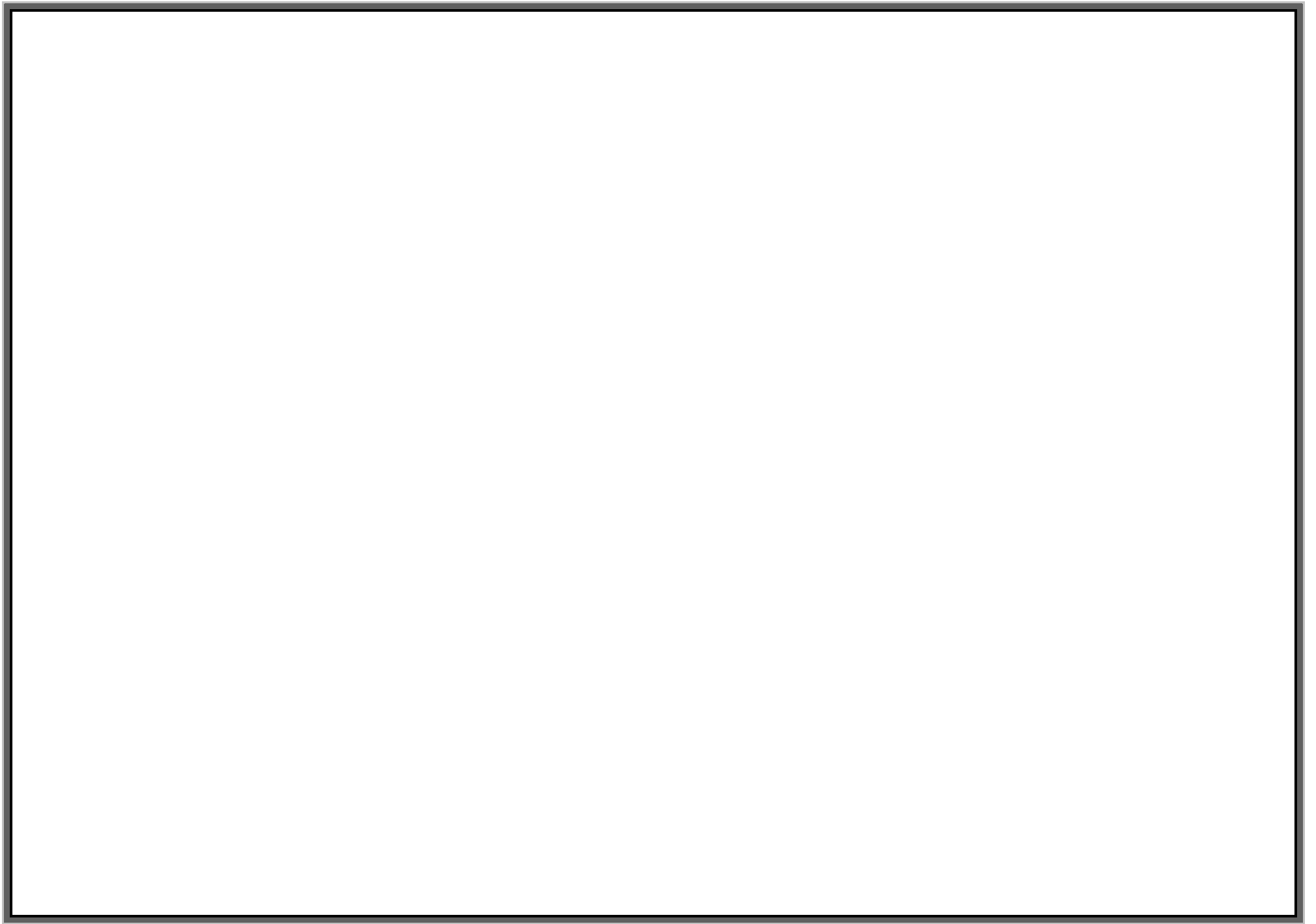Temporary show hall
Introduction show hall
Permanent show halls
Study and lecture halls
Maintenance lab
Library
Auditorium
Restaurant.
Gift shop
Café
Administration offices
Meeting room
Bathrooms/pray rooms
Stores
Workers restrooms
Parking
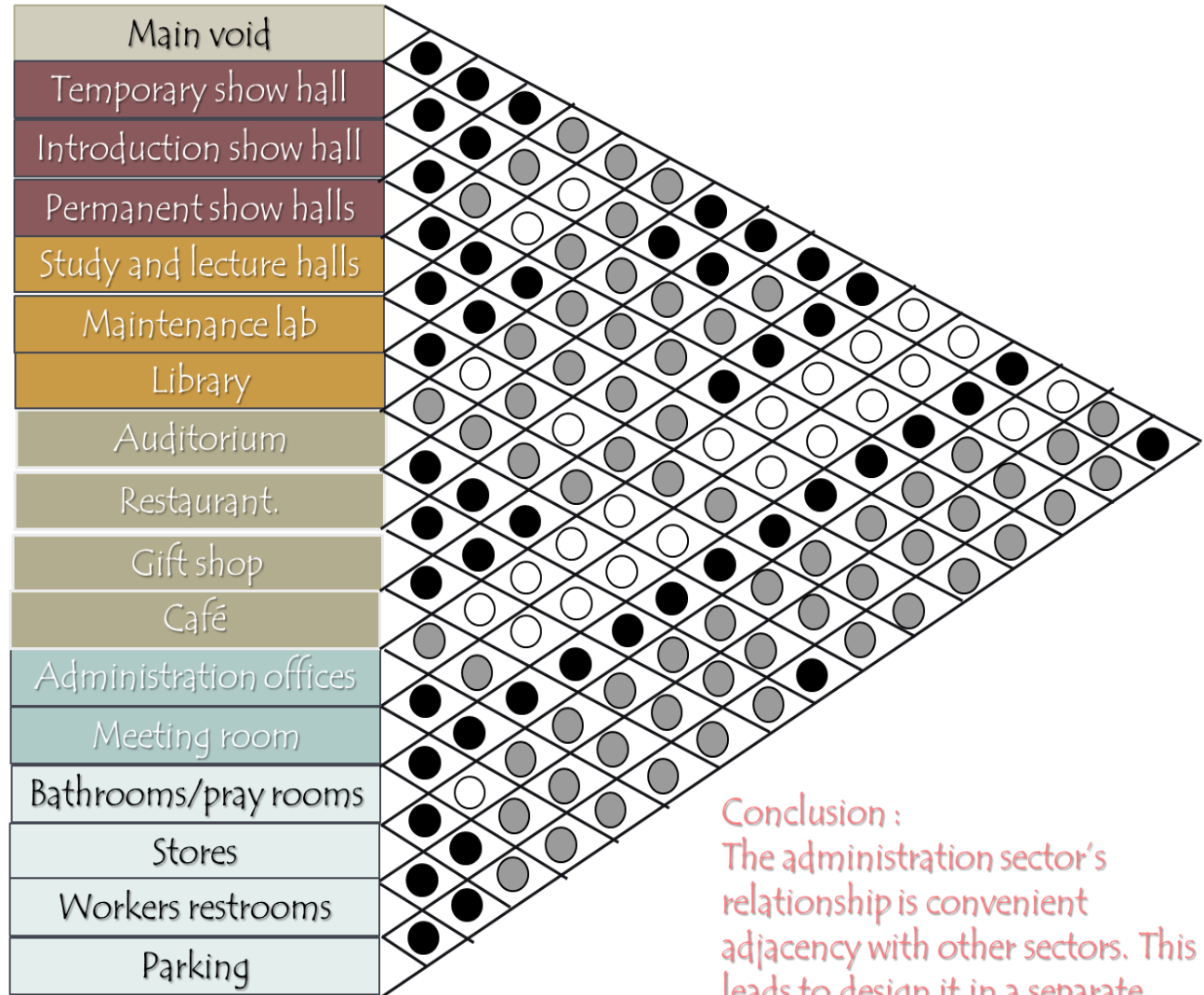
Conclusion :
The administration sector's relationship is convenient adjacency with other sectors. This leads to design it in a separate building or on the last floors.

Functional relations diagram

General bubble diagram:

→ Entry

V Outside view

Major adjacency.
Minor adjacency.
Convenient adjacency.

Restaurant
Café
Gift shop
service
Auditorium

permanent display hall
Temporary display hall
Services
Introduction show hall

Staff restroom
Staff lockers
Services

library
Maintenance lab
Collection storage
Lecture hall
Study hall.
Service
reception

Secretaries office
Head manager's office
Employees concerns office
Meeting room
vice manager's office
service
Research sector manager.
Security office

Main void

plaza
parking

displaying calligraphy art.
Research sector.
Entertainment sector.
Administrative sector..
Services.

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Functional relations diagram

General movement diagram:

Entry ➡

⋁ Outside view
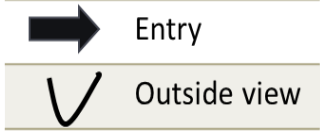
User	major	minor	convenient
visitors	⟷	⟷	⟷
Researchers & students	⟷	⟷	⟷
Administration	⟷	⟷	⟷
Workers	⟷	⟷	⟷

Restaurant

services

Café

Gift shop

Auditorium

Staff restroom

services

Staff lockers room

parking

reception

Head manager office

Research manager office

Meeting room

services

Secretary office

Vice manager office

Employees concerns offic

Permanent show hall

Introduction show hall

Temporary show hall

services

Main void

Plaza

Parking

library

Study hall

Maintenance lab

services

Lectures hall

reception

Plaza

- ■ displaying calligraphy art.
- ■ Research sector.
- ■ Entertainment sector.
- ■ Administrative sector..
- ■ Services.

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3-6 SUGGESTED SITES:

FIRST SITE	Second SITE	Third SITE

-SITE : Khartoum.
-LOCAL : Khartoum.
-OWNER : Sudanese government.
-AREA: 24.336 m2 (2.4 Hectares).
-NEIGHBORS :-
North : Al-Mogran park.
East : oil towers.
West : white Nile.
Southern west : white Nile.

-SITE : Khartoum.
-LOCAL : Totty island.
-OWNER : Sudanese government.
-AREA: 51.533 m2 (5.1 Hectares).
-NEIGHBORS :-
North : Residential quarter.
East : green space & Totty's bridge.
West : Investment .
South : Blue Nile.

-SITE : Khartoum.
-LOCAL : Khartoum.
-OWNER : Sudanese government.
-AREA: 34.655 m2 (3.4 Hectares).
-NEIGHBORS :-
North : Saida-Sanhory mosque.
East : Residential.
West : Investment.
South : Nasr Elden college.

Differentiation between Sites

Difference spot	First site	Second site	Third site
site's total area 22%	2.4 Hectares 10	5.1 Hectares 22	3.4 Hectares 15
Accessibility 20%	12	18	12
Site's shape & orientation. 8%	5	6	4
Site's neighbors 5%	3	4	2
Services availability 8%	5	5	3
View 5%	3	5	2
Distance from educational centers 5%	2	4	3
The possibility of future expansion 10%	7	6	5
Suitable for tourist activity 20%	8	10	5
Appropriation with the Map of the city 5%	3	5	2
Total 100%	58%	85%	53%

SELECTED SITE :

-AREA: 51.533 m2 (5.1 Hectares).
-NEIGHBORS : North : Residential quarter.
   East : green space & totty's bridge.
   West : Investment . South : Blue Nile.

STREETS , NEIGHBOURS & ACCESABILITY

Souq Omdurman, Omdurman.
15 m by vehicles.

Al-wosta station, Bahry.
10 m by vehicles.

SITE

Hotel

Sudan's national museum

Down town
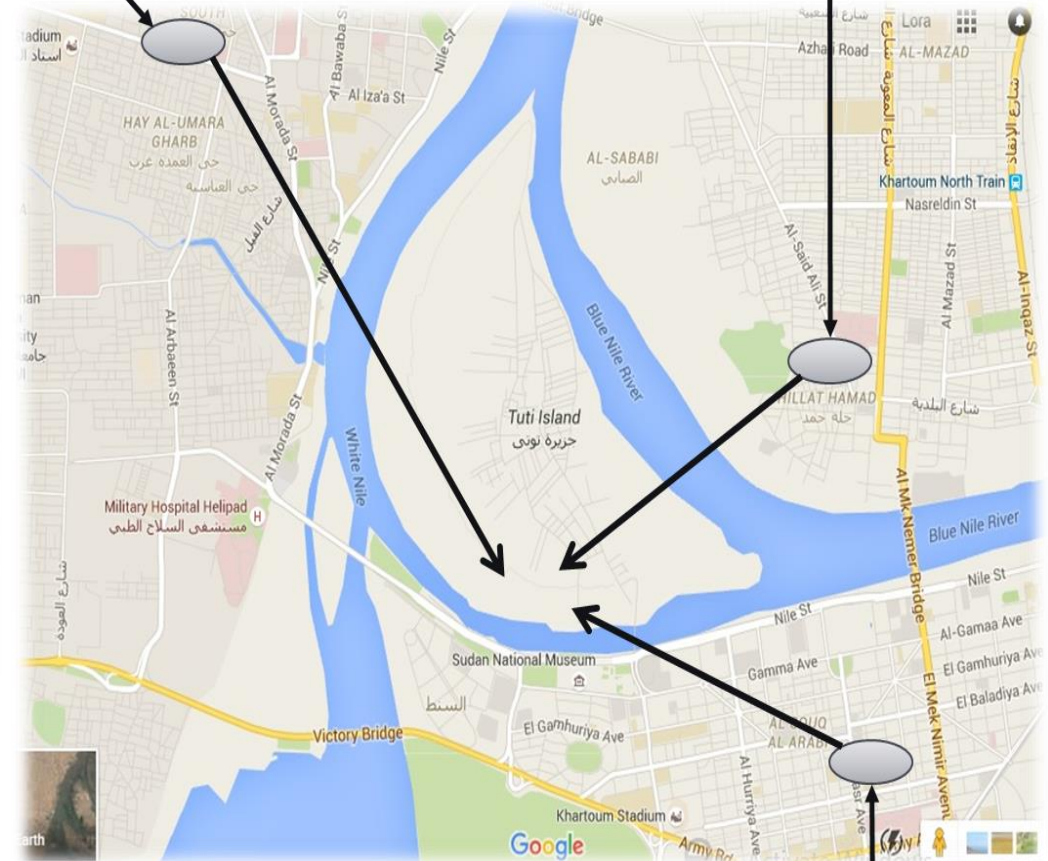
- In addition to ease Access from the University of Khartoum and universities Other existing in the region, such as the University of Al-Neleen , Sudan University and other.

Al-Souq alaraby, Khartoum.
5 m by vehicles.

35

3-8 SELECTED SITE ANALYSIS:

ENVIROMENTAL ANALYSIS

CONCLUSION :

- The best orientation for the building to receive natural cooling is north-south in a 75 degree.

- The increased noise and air pollution from the north-eastern and north sides of the site, Nile views should be exploited to the fullest.

-Use building materials with high thermal content with the use of thermal insulation.
-Use horizontal and vertical sun breakers, to minimize the damage caused by unwanted sun radiation.

-A lot of rain :august : 42.7 mm.
-Little of rain: January may. Nov. & Dec.

Water supply arrives from Totty's water station.

Electricity supply arrives from Al-Mogran power station.

Investment site

low air pollution

Residential

Green yard

Medium air pollution

40 m. street

15 m street

280.002

Highest temperature : may 42.7
Lowest temperature: January 15.8

Summer's long day.

Clay soil. Need of a deep foundation.

SITE

257.770

-Highest humidity : August 51%.
-Lowest humidity: April 13.3.

15 m street

15 m street

Investment site

winter's short day.

Nile River

The Blue NiLe view.

Blue Nile

	Dominate wind.
	Summer wind
– – – –	Noise pollution

N W E S (compass)

36

According to the analysis's results:

DESIGN'S INDICATORS	DESIGN'S GUIDELINES
The southern side of the site is the best spot for the building for its Nile view and good ventilation.	Specify the number of entrances and exits and be able to control them.
The main entrance must be located on the north side of the site for the accessibility from the street.	Design one main entrance for visitors to reach displaying halls and to direct their movement.
Use the bystreet for the service's entrance, also for the worker's entrance.	Use the internal displaying in a smart way to attract visitors to the far display hall
Gather the spaces around a central space works as a main void and lobby to all the main activities.	Must locate the administrative sector where the users can do their work effectively.
Orientation of the building where we can use the maximum benefits of the sun light.	must place all the project's spaces and activities where the Nile's view serves it well.
Use the auditorium and the gift shop to increase the income of the museum.	Separate the auditorium car's entrance from others.
Use highly designed technology on displaying the exhibits to fit the universal standards.	Surrounding the site with buffer zones to avoid noise pollution.

3-9 SITE ZONNING

Ground floor zoning:

Legend:
- Entry.
- Path.
- Green spaces.
- Outside view.

- displaying calligraphy art.
- Research sector.
- Entertainment sector.
- Administrative sector..
- Services.

ZONNING

Investment site
Residential
40 m street
15 m street
Investment site
Nile River

First floor zoning:

Legend:
- Entry.
- Path.
- Green spaces.
- Outside view.

- displaying calligraphy art.
- Research sector.
- Entertainment sector.
- Administrative sector..
- Services.

ZONNING

Investment site
Residential
40 m street
15 m street
Investment site
Nile River

EXAMPLES OF THE MOST USED STRUCTURES

- Concrete Folded structures
- Concrete Barrel vaults structures
- Concrete domes structures .
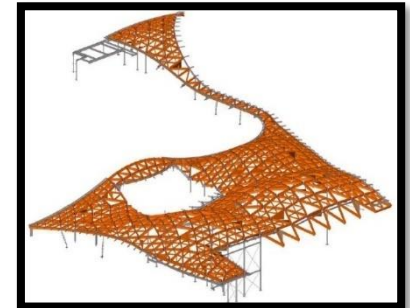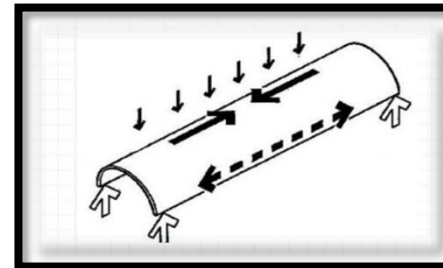
- Portal frame structures.
- Trussed portal frame structures.
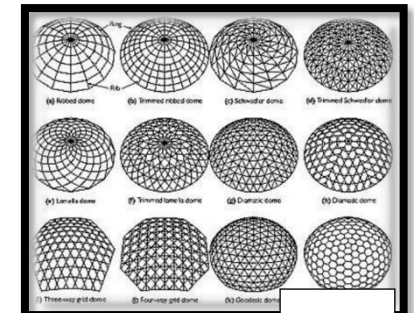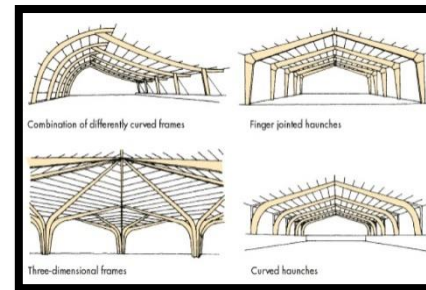
- Steel domes
- Grid shell Structure

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CHAPTER FOUR:

ARCHITECTURAL DESIIGN:

- Design's concept.
- Design's floor plans.
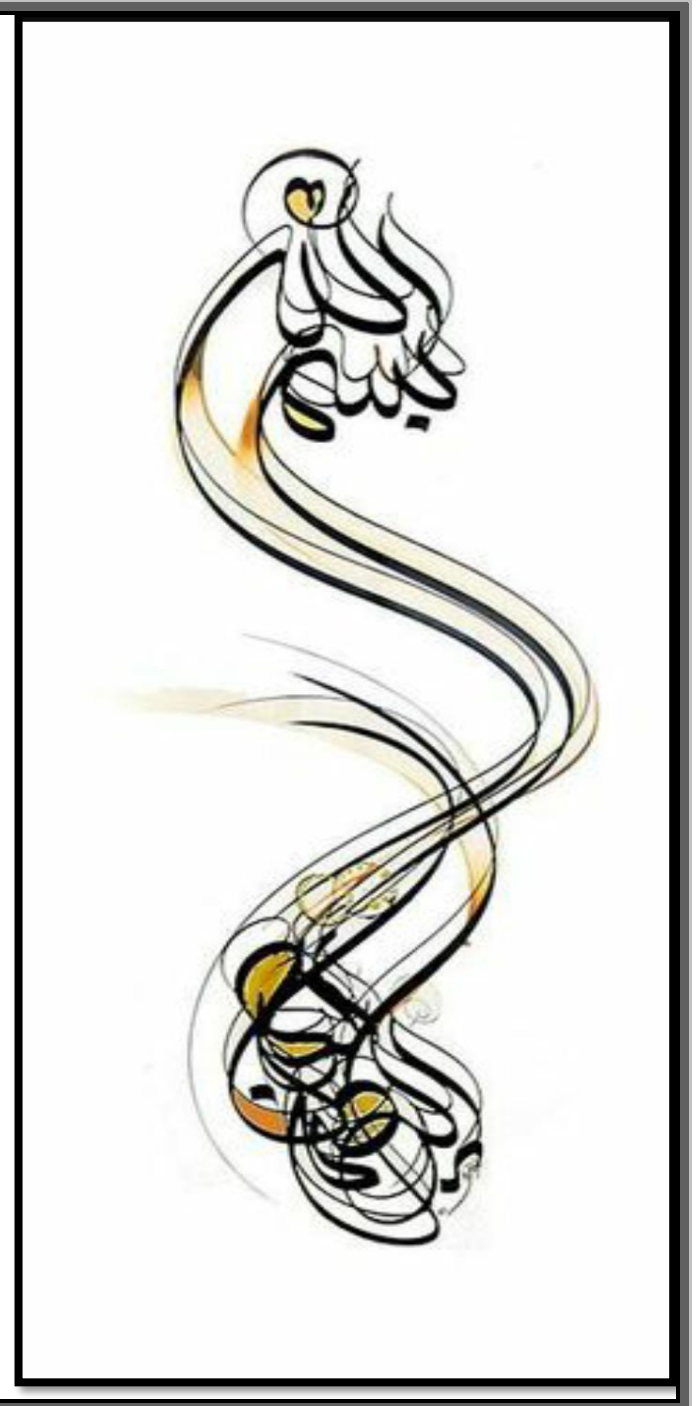
4-1 CONCEPT:

- Due to my project's nature, a museum, the exterior mass should definitely present certain ideas, such as power and potentials, prestige, admiration and curiosity that will attract people.
  From that point, I came to the decision of using triangles.
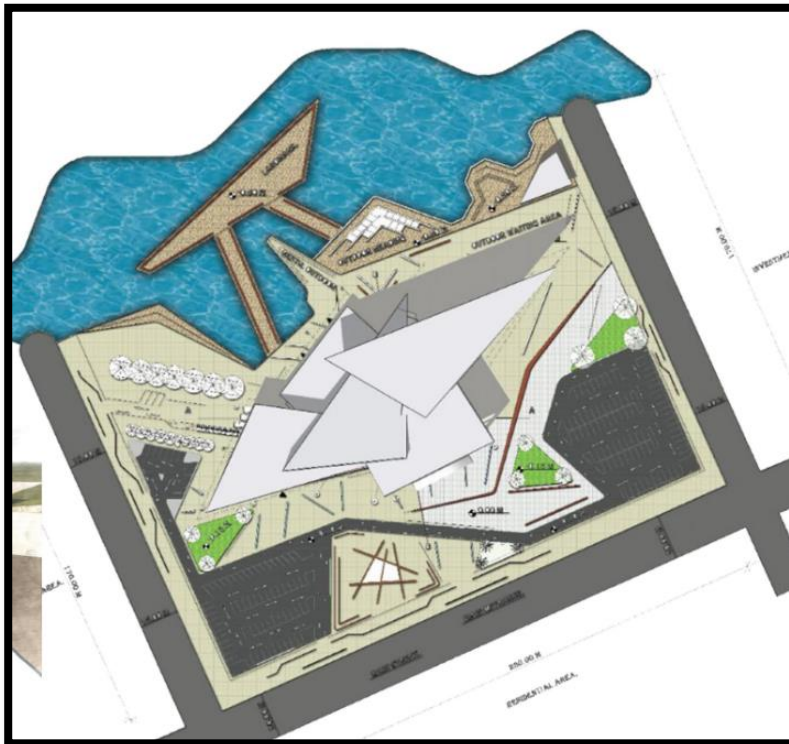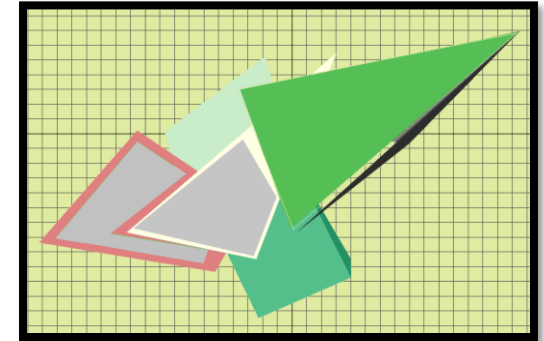- Triangles as a geometric shape, is considered the strongest shape, it represents stiffness and consistency.

First sketch (site plan).
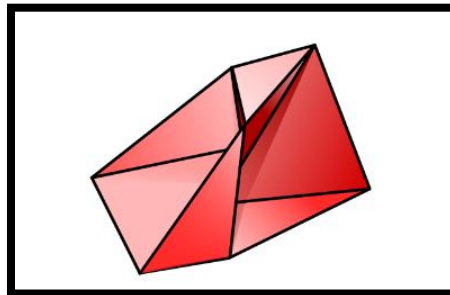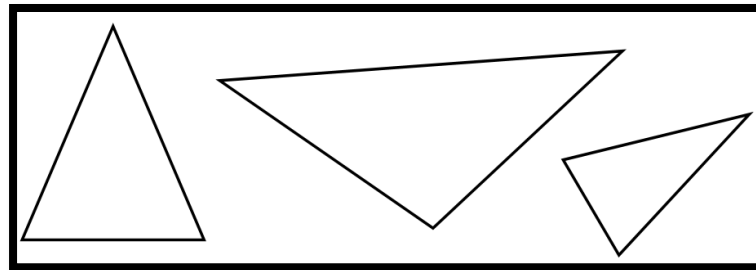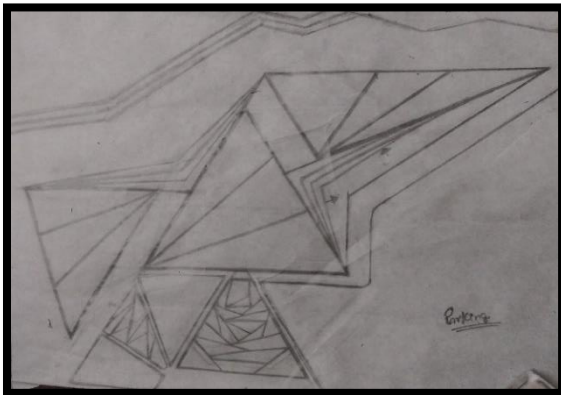
Second sketch on a later on step. (site plan)

39
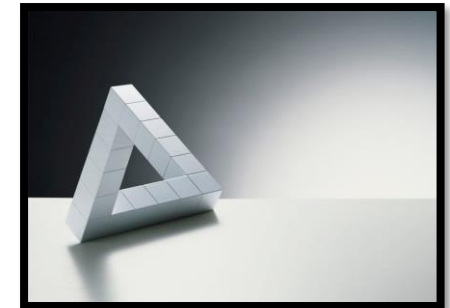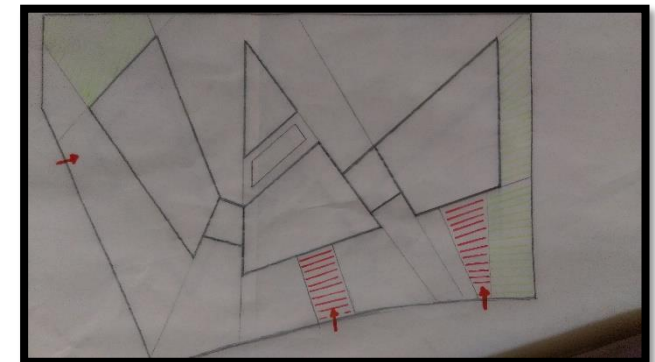
- After proceeding with the design work, I came to realize that it is better to interact couple of triangles together, in addition of adding other geometric shapes i.e. squares.

- **Third sketch.**

-**project's site plan.**

- **project's views.**

- **Ground floor plan.**

Restaurant with services.

Library: books section and Scripts section

Permeant gallery, ram and rest area included.

Gift shop.

Temporary gallery, with temporary storage

Training class.

Training class

Auditorium, 190 seats, with

Training class.

41
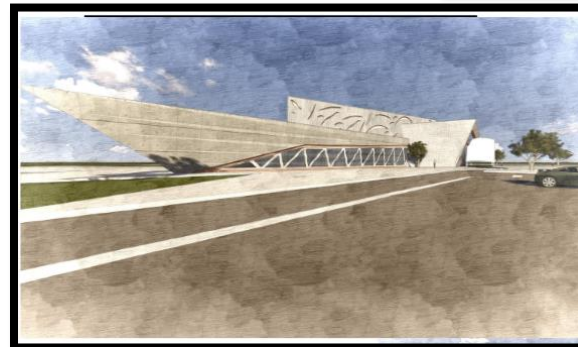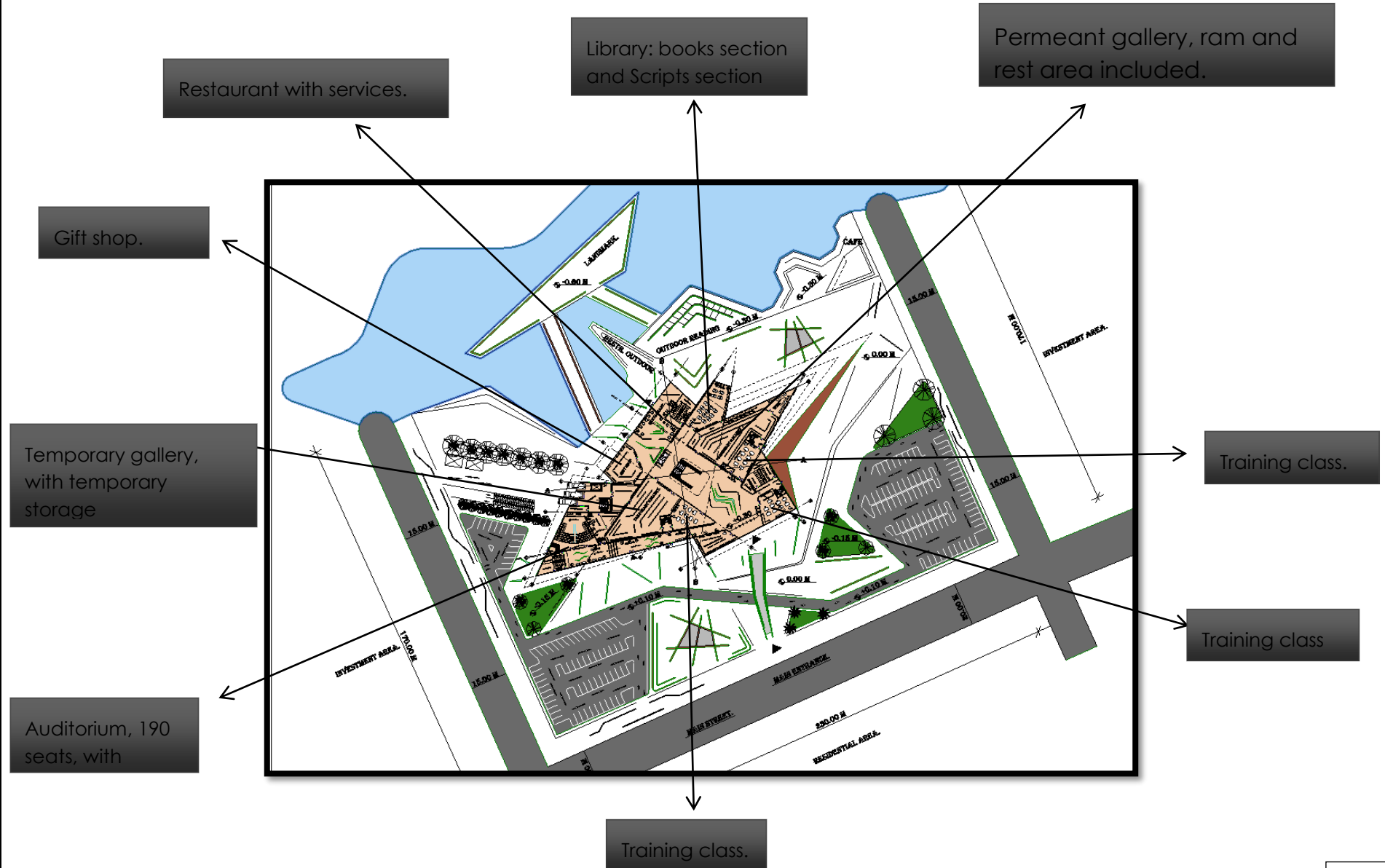
CHAPTER FIVE:

TECHNICAL SOLUTIONS:

- Structural solutions.
- Water supply.
- Drainage and sewage.
- Electricity supply.
- Treatments site.
- Security system.
- Materials, sound and lighting solutions.
- Air conditioning.
- Firefighting / fire alarm systems.

5-1 STRUCTURAL SOLUTIONS:

- STEEL:

The structure used is **diagrid steel system**.

- Diagrid system is a framework of a diagonally intersecting metal, concrete or wooden beams that is used in the construction of building and roofs.
- It requires less structural steel than a conventional steel frame.
- Reasons behind using this structure system is the need of long spans without interior columns, Ease and less time in constructing and more flexible.

- CONCRETE:

- A central concrete core was used to help carrying the floors weight, with a thickness of 30cm.The core is located in the center carrying lifts.

- **OTHER STRUCTURAL COMPONENTS:**
  - **1- Foundations:**Reinforced Concrete piles: a pile isa vertical structural element of a deep foundation,driven or drilled deep into the ground at the building site.


FRONT VIEW   SIDE VIEW
EXISITNG STRUCTURE
FOUNDATION
VOID AFTER LIFT
STEEL SHIMS
CONCRETE CYLINDER
CONCRETE CAP
12" LENGTH, 6" DIAMETER AND / OR
8" LENGTH, 4" DIAMETER PILE SECTIONS ALL 5,000 PSI
TENSILE STRENGTH PROVIDED BY TWO COLUMNS OF #4 SCHEDULE 60 REBAR GROUTED IN PLACE
REBAR SHALL BE IN 24" SECTIONS
PRESSED PILINGS SHALL BE DRIVEN TO REFUSAL
FOR ILLUSTRATION ONLY
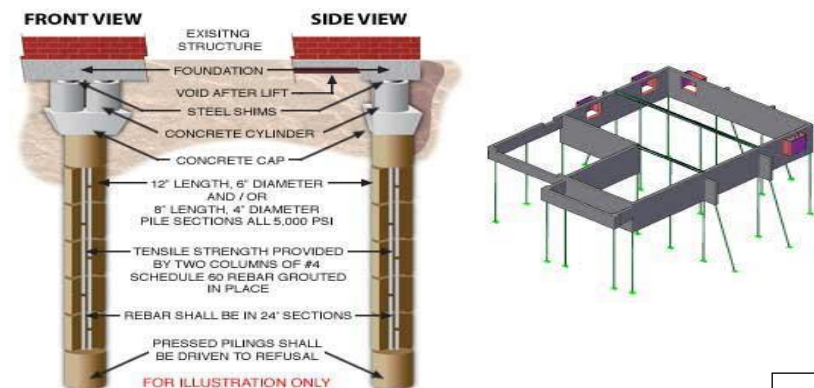
2- Columns: They are the elements that transfers the loads fromthe building to the foundation. Steal I-section columns.

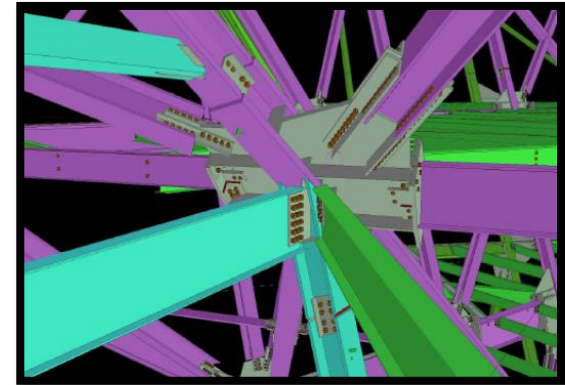**3- Slabs:**Flat truss beams with 6cm thk reinforced concrete.
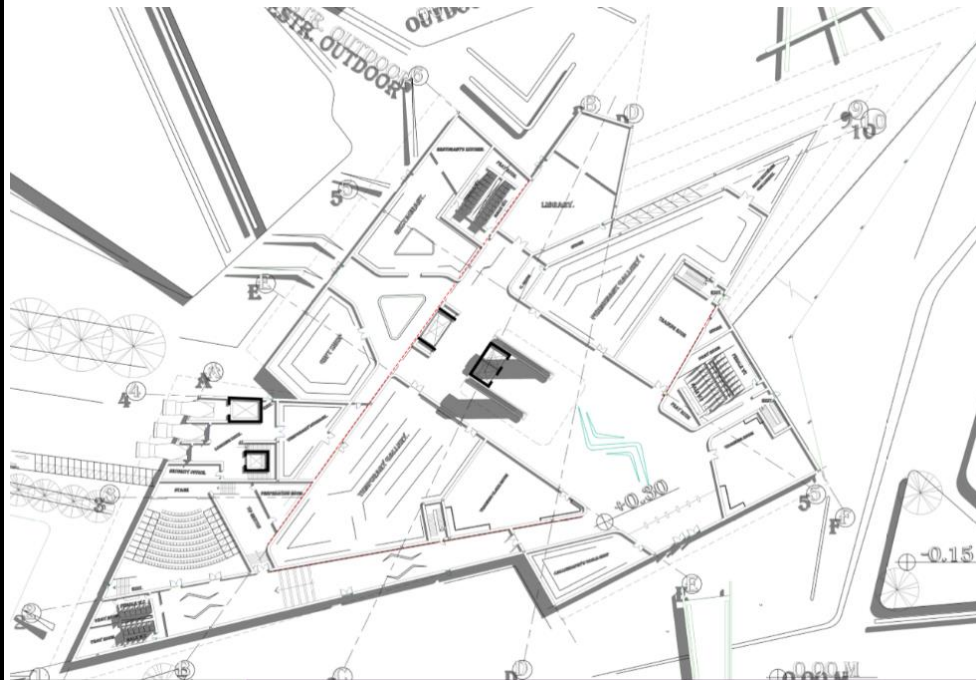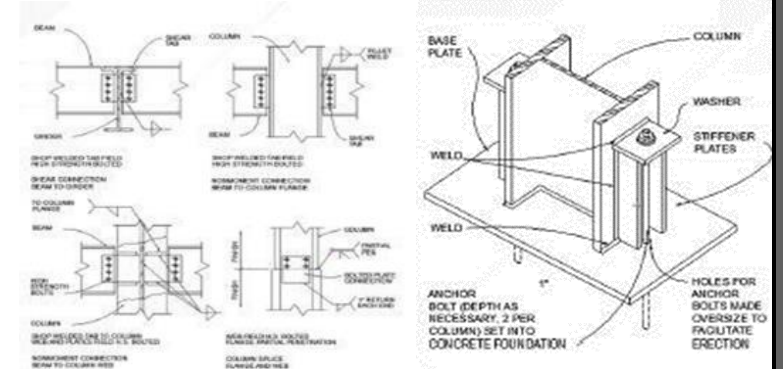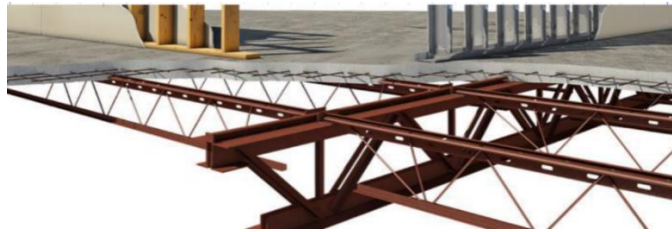
- Construction joints been used because of the difference in levels.
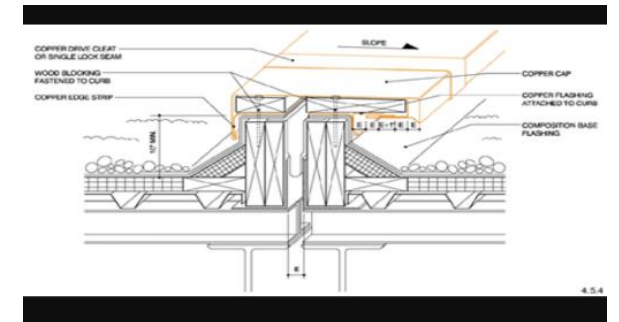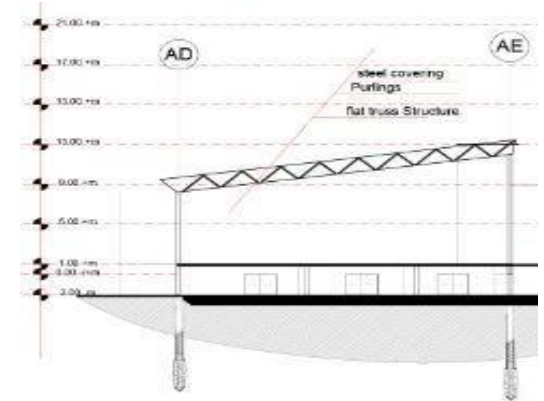
Structure plan.

structure 3d &joints.

Connection between steel frames & concrete shor columns
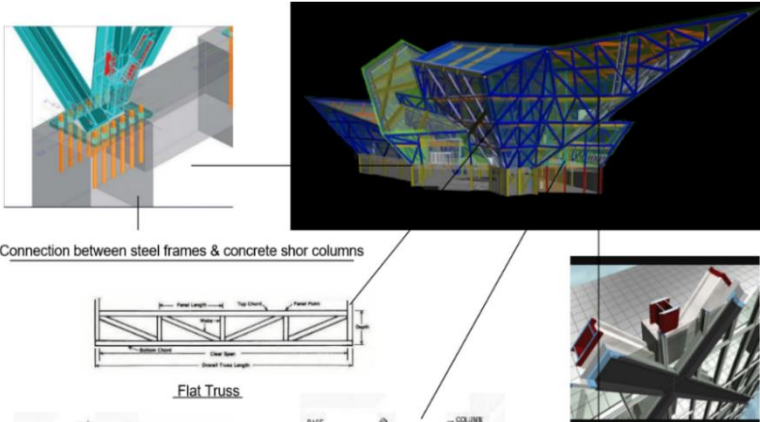
Flat Truss

5-2THE BUILDING'S FAÇADES:

- **Dynamic façade:** (adaptable sun shade façade), used for the need to control the building's interior environment.

  Also to reduce our reliance on air conditioning, heating systems (in other countries) and artificial lightning.

- **Building's façade:**
  - high technology shading system –sun breaks- prevents solar heat gain.
  - This façade's elements protect automatically from solar heat gain using sensors planted on each element, it can also be manually controlled by a simple mobile app available for android and apple phones.
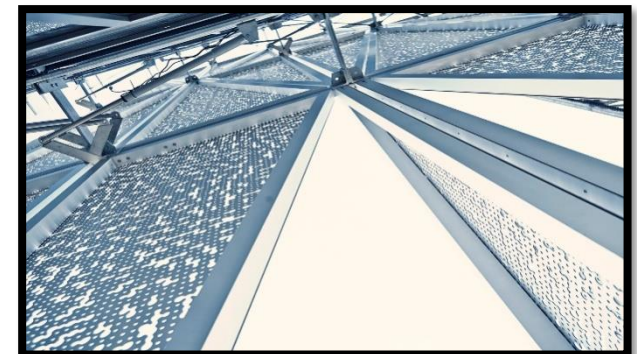
- These elements also offer a unique visual impact. in addition, it also uses renewable energy from the photovoltaic panels.

- **Outdoor roofs facades:**
  - plastic balls create a dynamic façade, moves within mesh fabric envelopes as the wind blows.
  - The light weight spheres create new patterns of light and shadows in the ground beneath it.


5-3 SECURITY SYSTEM:

1- In museums and galleries, the security part is really important to maintain the safety of all the objects put for display.

2- The system used is **SensMax SensGuard** museum security system. This security system of art objects consists of **wireless alarm sensors**, security alarm collector, and security system control key-chain to

arm or disarm security sensors.

3- Wireless alarm sensors are one peace, small and standalone devices that uses innovation optometric object control technology, it makes them protected from any cheating using magnet.

4- Wireless alarm system sensors are very easy to **install without any cabling work**, as well as its **easy to uninstall** sensors in case of temporary installation.

5- Wireless security sensors work at **distance of 2-3 cm** from objects.

6- Their battery life lasts for 5+ years.

7- Any movement of the object or sensors itself will cause **90Db loud sound alarm** at alarm collector and local buzzer, as well as you will see light indication of alarm zone at the collector.

8- It can control up to **200 sensors splatted in 10 zones in range of 150m**. remote control key-chain used to unable and disable alarm.
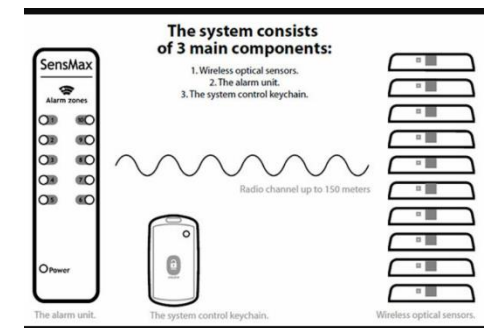
5-4 WATER SUPPLY:

-The system used in water supply:

-Feeding system aggregates the pressure of the public water network with the pressure of the tanks.

-In this system the pressure from the public network is used to feed the ground floor, also there is a ground tank collects water, controlling the amount of water by using a float. Then the water moved to upper tanks

located on selected places by using pumps connected to a main feeding pipe, then from upper tanks to all the other floors.

- **Water supply on the site:**

-The water line is located on the southern side of the site, al-Mogran water station. Entering the site from the public water network pipe ppr 8".

coming from

- **Water capacity**

Amount of water needed by the building users:

- Visitors: 30*2500 =75000 L.
- Auditorium: 10*200 =2000 L.
- Restaurants: 35*1500 = 52500 L.
- Administrator: 45*12 = 540 L.   =130,040 * 0.25
- Total water needed by the building = 32,510 L/PERSON.
- The building contains 3 upper tanks, so the capacity of
- each upper tank = 32,510 % 3 = 10,837 L.**Water supply site.**

5-5 DRAINAGE AND SEWAGE:

1- **DRAINAGE**:

- The site has a slight slob against the Nile on the northern
  side of the site, which helps all the water on that part tobe cleared into the

Nile.
- Landscapes and parking has their own drainage pipes, which all connect to two side ranches on the eastern and
- western side of the site, that both lead to the Nile.
- The building roofs has specific slobs came from the design stage, they define the water direction and the drainage pipes location.
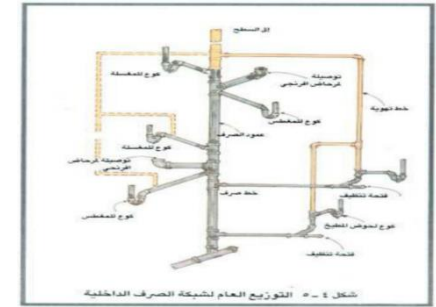
2- **SEWAGW**:

- The sewage system used is two pipes system.
- In this system we use one pipe to clear the sewage water with air pipe, another pipe is used for water.
- Several manholes are used to collect all the sewage water from all the building and deliver it to the septic tank.
- There are two septic tanks located on two different sides of the site, both are near a service road to help on preparing operation.

drainage and sewage site.

5-6 ELECTRICITY SUPPLY:

- The electricity supply line is located on the south side of the site, coming from the Mogran power station. **Electricity supply site.**

- The electric line inters the site is 3kvolt, directly directed to enter a transformer that is located in the electricity room to lower it down to 450 v, then to 220.
- From a main switch to generators to the main control room, then supplies all the sub control panels that are located in the building.
- Then electricity room is located in the basement.
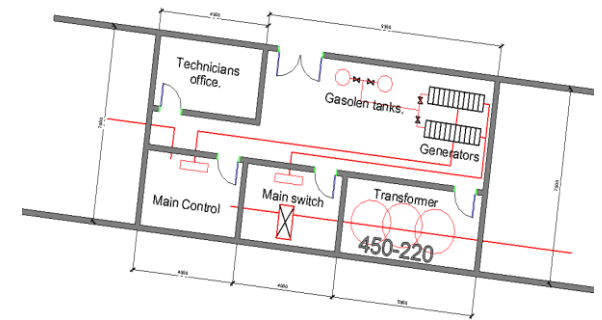
ELECTRICITY ROOM PART PLAN.

5-7

A	-American zinc sheets. -Reinforcing steel. -concrete 6 cm. -insulation. -white roof paint.
B	-English Grass 10cm. -Flotary layer 10cm. -Hard core 15cm.
C	-Timpered glass. -Structural perimeter frame.
D	-Interlock - Gray. -Normal Sand. -Hard core.
E	-Asphalt main layer 20cm. -Asphalt sublayer. -Hardcore 25cm.
F	-Wood floor finishing with water insulation. -float dock.
H	-White paint. -water insulation. -Reinforced concrete.
I	-White paint. -water insulation. -Reinforced concrete. -Wood railings.

TREATMENT SITE:

5-8MATERIAL, SOUND AND LIGHTING SOLUTIONS:

- **Auditorium:**

1-**FINISHINGS**:

-floors: cork flooring has been used because of its durability and its ability to absorb sound. This reduces ambient noise caused by movement of people within the auditorium. It also is able to

CORK FLOORING

handle the expected heavy traffic requiring much maintenance.

-walls: teak timber wood is used in the wall as slat as the stage wall and ceiling panel. It is good for acoustic due to its reflective nature. The timber is treated with a matte vanish. The play with timber slats give a neutral for the largely red color scheme taming it.
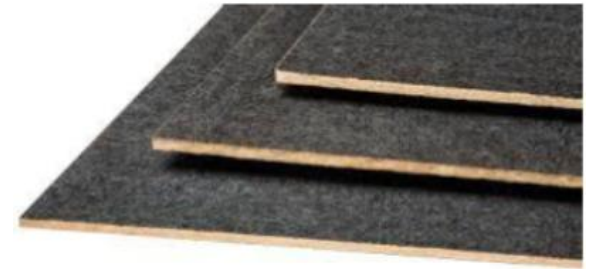
-Ceiling: fiberboard has been used in the acoustic ceiling panels

Because of its ability to reflect   sounding a controlled manner. The

dark grey color used on the fiberboard reduces distraction

FIBERBOARD

By the ceiling panels keeping the focus on the stage.
- Polyurethane foam has been used in the seats as well as in the wall panels at the back of the auditorium.
- It has been used because of its ability to absorb sound and prevent echo.The seating is designed to absorb sound even when theauditorium is not fully occupied. The seats use high destiny

TEAK TIMBER

foam because of its long lasting nature in the covered in dark colored leather keeping it mute.


Auditorium plan.
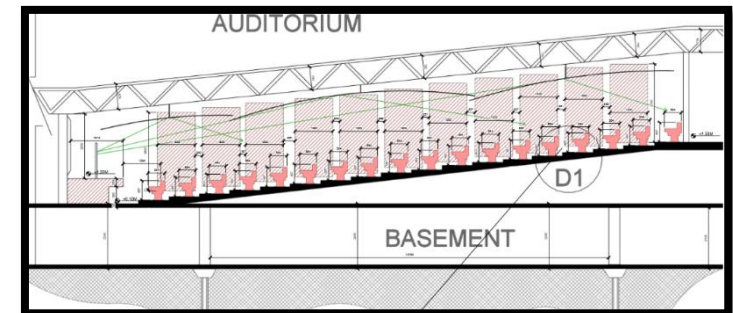
Auditorium section.

50

5-9 AIR CONDITIONING SOLUTIONS:

- Using All Air system to provide air conditioning to the building.
- The reasons behind choosing this particular system is the hugesize of the building, the function of the building (museum) and the large spans.
- **How it works:**
  The main unit (chiller) is located outside the building. Air is blown across the cold evaporator coil and then delivered by ducts to the rooms that require cooling. Air system can effectively ventilate, filter and dehumidify air.
- The advantage of all air system is complete control over
- air quality is possible.
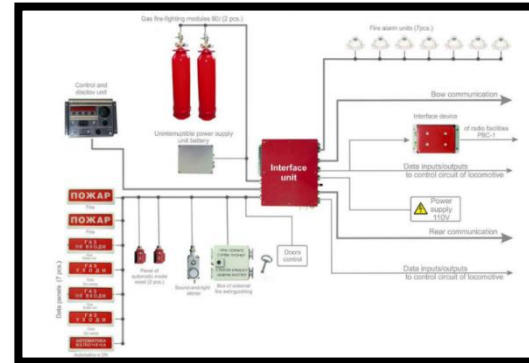- The main disadvantage lies in the bulky ductwork that is required.
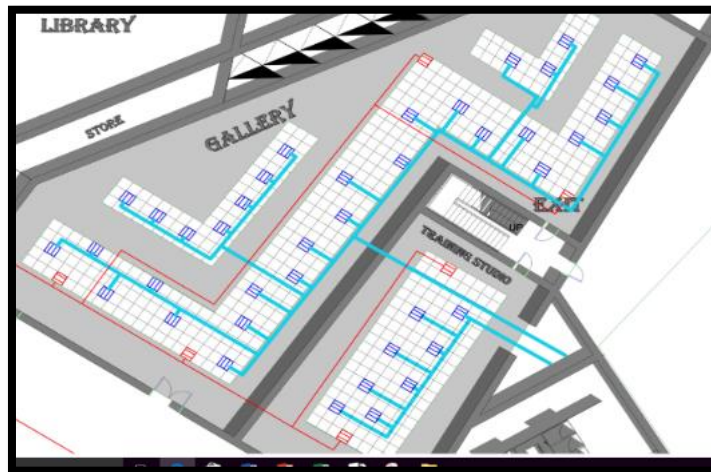
AC part plan.
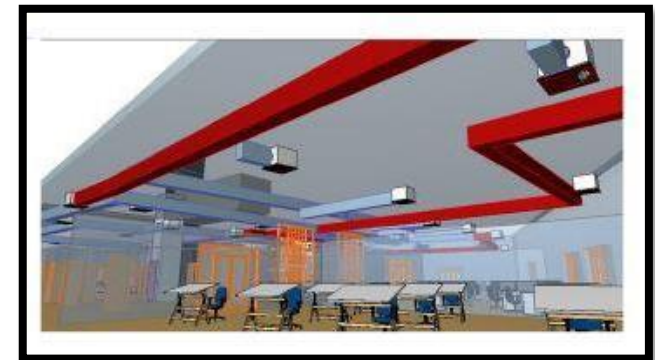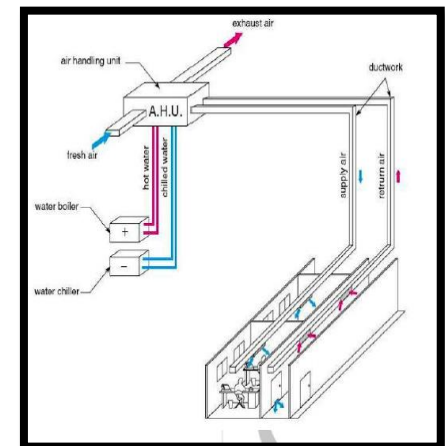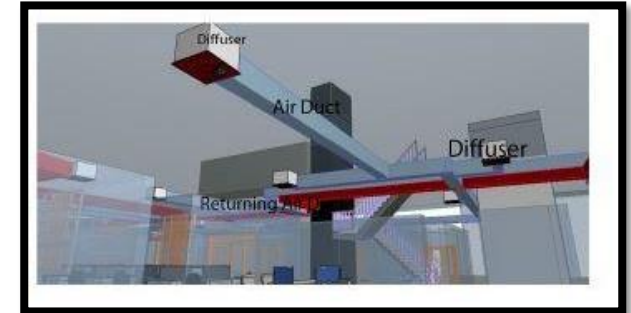
5-10 FIRE ALARM-FIREFIGHTING SYSTEMS:

1-The system used is the sprinklers system.

- The reason behind using it is the great amount of people

using the building and it's exceeding over 465m2 area.

2- **Gas sprinklers:**

- An active fire protection method using co2 gas.

3- **fire extinguishers:**

- Extinguishers are multi use ones, for the expectations of fire of the type AC.
- Extinguishers of A1 type.
- Longest distance between extinguishers and another is 23m.
- Extinguishers are located near every entrance or stairs.

4- **fire alarms:** - Each space includes both smoke and heat detectors.

- Manual fire alarms are located above every extinguisher and entrances.
- Each space contains Fire alarm speakers.

Gallery's firefighting and fire alarm ceiling plan.
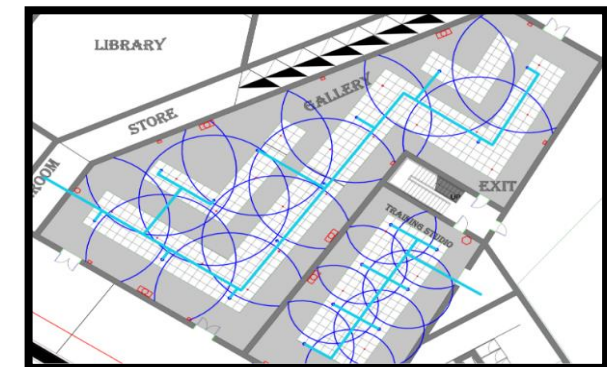
- **Sources and references:**

- Previous studies and reports.
- Other similar international projects.
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