SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF ARCHITECTURAL DESIGN

F I F T H Y E A R B A C H E L O R ' S

GRAPHIC DESIGN COMPANIES COMPLEX

A dissertation submitted in partial fulfilment of the regulations for the degree of BSc in Architecture in the Sudan University of Science and Technology, 2015

DESIGNED BY: AHMED GIHAD IBRAHIM HAMAD

SUPERVISOR: DR. SALEEM ALZAIN ALHASSAN

SEPTEMBER 2015

Abstract (English):

Graphics are the creation of visual statements on some surface, such as a wall, canvas, pottery, computer screen, stone or landscape. Its meaning then evolved to involve signs, charts logos, graphs, drawings, lines, art, symbols, geometric designs, animation and so on.

Graphic Design Companies Complex is a complex for companies specialized in Graphic Design, to communicate and deliver a certain message in a visual way by combining words, symbols and images to come up with various products such as: logo design, 3D design, product decoration, packaging, signs, identities, animation videos, etc.

The main goals of the project are: improving the reputation of Sudan in the field graphic designing within the region and help it to be an acknowledged and legitimate contender in the region and to create a central location which brings all the customer's needs and demands to a single place While allowing freelance designers to expand their knowledge of the business, improve and gain additional exposure and therefore provide more jobs.

The report is divided into five chapters, the first chapter is a general introduction to the project, the second chapter has two sections the historical side of the project and then some international examples, the third chapter is the project study and analysis which deals with two main things which are the data analysis and the site analysis till you reach the zoning, the fourth chapter is the design process which starts with the concept of the design going through the different phases and the stages the design went through till the final design, finally the fifth chapter which deals with the five sides of technical solutions which are structure, finishing, water supply, drainage and sewage, electricity, and HVAC and firefighting.

The main result of this project is to be able to study and design a complex which has all of the needed spaces for the project, functional, simple in circulation, structurally stable, appealing to the eye and finally able to profit the designers, the companies, the owners and finally the country as a whole.

ABSTRACT (ARABIC):

الجرافيكس (المرئيات الايضاحية) الا وهو عبارة عن انشاء بيانات مرئية على سطح معين مثل الحوائط, الاقمشة, الفخار, شاشات الكومبيوتر, الاحجار أو المساحات الارضية الخالية. معنى الكلمة تطور مع الزمن ليشمل تصميم الشعارات, المخططات, الافتات, الرسومات البيانية, الرسومات, الخطوط, الرموز, الاشكال الهندسية, الرسومات المتحركة الخ.

مجمع شركات التصميم الجرافيكي هو عبارة عن مجمع للشركات المختصة في مجال التصميم الجرافيكي, للتواصل وايصال رسالة معينة بوسائل مرئية عن طريق ربط الكلمات, الرموز, والصور للوصول لمنتجات متعددة مثل الشعارات, تصميم المنتجات, انتاج المجموعات التعرفية عن الشركات, اللافتات, الرسومات المتحركة الخ.

الأهداف الرئيسية للمشروع هي: تحسين سمعة السودان في التصميم الجرافيكي المجال داخل المنطقة ومساعدتها على أن يكون منافسا معترفا به في المنطقة في هذا المجال وإنشاء موقع مركزي يجمع كل احتياجات العملاء في مكان واحد وفي نفس الوقت يسمح للمصممين المستقلين توسيع خبرتهم، وتوفير المزيد من فرص العمل.

وينقسم التقرير إلى خمسة فصول، الفصل الأول مقدمة عامة عن المشروع، الفصل الثاني يحتوي قسمين الجانب التاريخي للمشروع وبعد ذلك بعض الأمثلة المشابهة الدولية، الفصل الثالث هو دراسة وتحليل المشروعالذي يتعامل مع اثنين من أهم الأشياء التي هي تحليل البيانات وتحليل الموقع حتى تصل إلى مخطط التنطيق، الفصل الرابع فيه يتم شرح عملية التصميم الذي يبدأ مع مفهوم التصميم والفكرة ثم يمر بمراحل مختلفة ومراحل تطور التصميم حتى التصميم النهائي، وأخيرا الفصل الخامس الذي يتناول الجوانب خمسة من الحلول التقنية التي هي الهيكل الانشائي، التشطيب، إمدادات المياه والصرف الصحي و الصرف السطحي, الكهرباء والتكييف ومكافحة الحرائق.

والنتيجة الرئيسية لهذا المشروع هو أن تكون قادر على دراسة وتصميم مجمع شركات التصميم الجرافيكي الذي يحتوي كل المساحات اللازمة للمشروع، متكامل وظيفيا، بسيطة في الحركة والتنقل، مستقر من ناحية الهيكل الانشائي، جميل وذو شكل جذاب، وأخيرا كون المصممين ,الشركات ,المالكين وأخيرا البلد ككل قادرين على الاستفادة من المشروع.

Dedication:

I dedicate this humble project of mine to all of my friends who once stood by my side and protected me from all sorts of harm, the ones who left this world for us. To all of the graphic designers in Sudan, whether they are freelancers or full time employees, asking and praying to God that you may all get the right opportunities to reach your full potentials, expand your knowledge, build yourselves on international standards and ground and be a part of this countries Growth into something bigger.

ACKNOWLEDGMENT:

First and foremost I would like to thank God the blessing me with the knowledge needed to work on this project.

I present my humble thanks and appreciation to my supervisor Dr. Saleem ElZain for all of the help he provided and for guiding me throughout the project, all of the teachers in the college of architecture and planning and the ones associated with it for providing us with the needed information and experience through the years.

Lastly I'm offering my sincere gratitude and thanks to my parents and both of my brothers for everything they have done in my life and for picking me up when I was at my lowest and giving me the strength to move on and reach this chapter in my life, my dear friends for being my second family and my spine and my sources of happiness and joy.

TABLE OF CONTENTS

Index of Figures:

Index of Tables:

CHAPTER I: Introduction

- Project's description
- Project's purpose
- Project's objectives
- Reasons behind the selection of the project
- The different aspects of the project

1 INTRODUCTION

1.1 PROJECT'S DESCRIPTION:

Graphics (fromGreekγραφικός, *graphikos*) are the production of visual statements on some surface, such as a wall, canvas, pottery, computer screen, paper, stone or landscape. It includes everything that relates to creation of signs, charts, logos, graphs, drawings, lines, art, symbols, geometricdesigns etc.

Graphic designing companies complex is a complex for companies specialized in Graphic Design, to communicate and deliver a certain message in a visual way by combining words, symbols and images to come up with various products such as: logo design, 3D design, product decoration, packaging, signs, identities, animation videos, etc.

1.2 PROJECT'S PURPOSE

The complex is a group of companies and businesses specialized in graphic design, offering independent professionals a pro-business environment and enabling them to operate with collective synergy and freedom whilst providing an ecosystem where they can showcase their products and services and get a chance to interact with some of the leading marketing companies in the region.

1.3 PROJECT'S OBJECTIVES

- Improve the reputation of Sudan in the field graphic designing within the region.
- Aid the country in becoming an acknowledged and legitimate contender in the region whilst ultimately contributing to Sudan's GDP.
- Create a central location which brings all the customer's needs and demands to a single and unified address.
- Allow freelance designers to expand their knowledge of the business, improve and gain additional exposure.
- Provide more jobs and improve employment within the industry.

1.4 REASONS BEHIND THE SELECTION OF THIS PROJECT:

Choosing a field like graphic designing to be the speciality of a companies' complex in Sudan will make a difference to the GDP of the country throughout the huge impact it will have on the region as a whole and through creating more jobs in the country . In addition, it will provide Sudan with the opportunityto have connections with companies and countries as a whole which will lead to helping with the politics of the country.

Graphic designing is considered one of the ever growing fields of design,through its growthalonghistory. With that being saidhaving such a project in Sudan will help it put its mark on the world of design, andwill help the graphic designers in Sudan grow and exchange information with the whole scene of graphic design which will benefit Sudan as country.

1.5 THE DIFFERENT ASPECTS OF THE PROJECT:

1.5.1 Functional Aspect:

Designing an office spacesuitable for graphic designers to help them be as creative as they get. Designing the project to be functional, safe, welcoming and to achievethe bestconnection between the different indoor activates and the outdoor spaces.

1.5.2 Structural Aspect:

Designing, achieving and using a structural system that can solve all of the structural problems of the design with a unique touch to match the project.

1.5.3 Financial Aspect:

Reducing the cost of building, repairing and functioningthe building. Plus, finding a way to make the project financially stable throughout the years.

1.5.4 Aesthetic Aspect:

Making the project and all of its components reflect the image of creativity and uniqueness,which represents graphic designers,being simple and elegant while reflecting a more serious look and feel which showcases the nature of the project.

CHAPTER II: Data Collection

- International Examples

2 DATA COLLECTION

2.1 THE DEFINITION OF GRAPHIC DESIGN, ITS LITERATURE AND HISTORY:

2.1.1 Graphic Design Definition:

Graphics (fromGreekγραφικός, *graphikos*) are the production of visual statements on some surface, such as a wall, canvas, pottery, computer screen, paper, stone or landscape. It includes everything that relates to creation of signs, charts, logos, graphs, drawings, lines, art, symbols, geometricdesigns etc. Graphic design is the art or profession of combining text, pictures, and ideas in advertisements, publication, or website. At its widest definition, it therefore includes the whole history of art, although painting and other aspects of the subject are more usually treated as art history.

2.1.2 History of Graphic Design

Hundreds of graphic designs of animals by the primitive people in the Chauvet Cave, in the south of France, which were drawn earlier than 30,000 BC, as well as similar designs in the Lascaux cave of France that were drawn earlier than 14,000 BC, or the designs of the primitive hunters in the Bhimbetka rock shelters in India that were drawn earlier than 7,000 BC, and the Aboriginal Rock Art, in the Kakadu National Park of Australia, and many other rock or cave paintings in other parts of the world show that graphics have a very long history which is shared among humanity. This history together with the history of writing which was emerged in 3000-4000 BC are at the foundation of the Graphic Art.

2.1.3 Examples of Graphic Design throughout the history:

2.1.3.1 Writing:

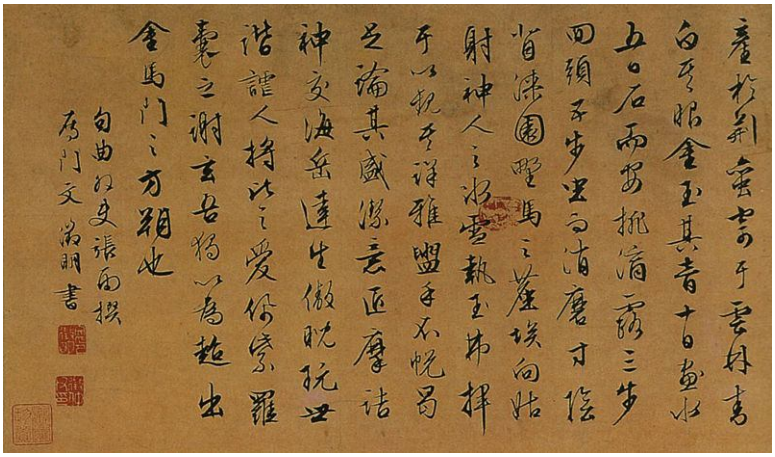


Figure 1:A Chinese traditional title epilogue written by Wen Zhengming in Ni Zan's portrait by Qiu Ying. (1470–1559)

2.1.3.2 The Quran:

In Islamic countries graphic designs were used to decorate their holy book, the Qur'an. Muslim scribes used black ink and golden paper to write utilizing an angled alphabet, called Kuffi. Such writings appeared in 8th century, and reached their apex in the 10th century. Later on decoration of margin, page and other graphic techniques were added in order to beautify the book. In the 12th century, the Naskh alphabet was invented, which instead of angled lines used curves.

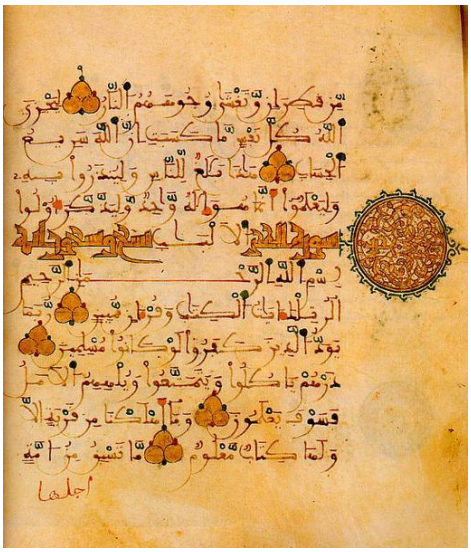


Figure 2: Graphic art in an Egyptian Quran of the 9th or 10th century.

2.1.3.3 Calligraphy:

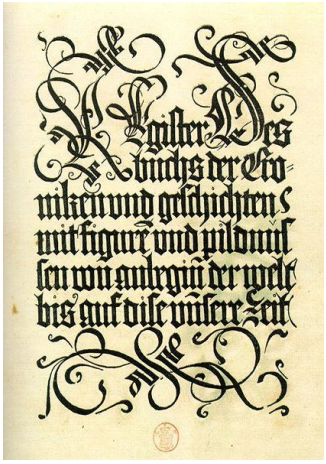


Figure 3: An example of Calligraphy

Many believe that calligraphy adds a mystical dimension to a writing. Such mysticism appears to be consistent with the feeling that a religious text tries to convey. This is why many religious texts use it.

2.1.3.4 Byzantine art:

The Byzantine Empire began when the Emperor Constantine moved the headquarters of the Roman Empire from Rome to Byzantium (present day Istanbul) which he renamed Constantinople. The Byzantine Empire, although marked by periodic revivals of a classical aesthetic of the art of the Roman Empire and ancient Greek, was above all marked by the development of a new aesthetic which Josef Strzygowski viewed it as a product of "oriental" influences. The subject matter of Byzantine art was primarily religious and imperial. Byzantine art is more spiritual in content (figures presented as representations of the soul rather than the body) and yet more "worldly" in form with a show of gold, silver, precious and semi-precious stones.

Figure 4: Mosaic from Basilica of San Vitale in Ravenna, Italy, showing theEmperor Justinian and Bishop Maximian of Ravenna surrounded by clerics and soldiers. Here the graphic statement conveys the unification of the church and state.

2.1.3.5 Heraldry:

Heraldry is the practice of designing and displaying coat of arms and heraldic badge and is rather common among all nations. For example Romans used eagle as their coat of arms, French used fleur de lis, and Persians used the sign of their god, Ahura Mazda. The origins of heraldry lie in the need to distinguish participants in combat when their faces were hidden by iron and steel helmets. Eventually a formal system of rules developed into ever more complex forms of heraldry.

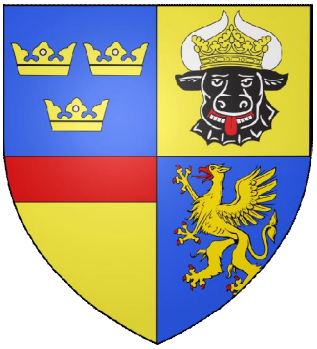


Figure 5: This the coat of arm ofAlbert of Sweden. He was the King of Sweden from 1364, and in 1384 he inherited the ducal title of Mecklenburg and united the two countries in a personal union.

2.1.3.6 Logos and trademarks:

Figure 6: This graphic design of the Coca-Cola logo is the work of Frank Mason Robinson who created it in 1885. This old Logotype has been around more than a century, a successful logotype will create a sense of loyalty among the clienteles.

2.1.3.7 Emergence of the print and design industry:

Around 1450, Johann Gutenberg's printing press made books widely available in Europe. The book design of Aldus Manutius developed the book structure which would become the foundation of western publication design. With the development of the lithographic process, invented by a Czech named Alois Senefelder in 1798 in Austria, the creation of posters become feasible. Although handmade posters existed before, they were mainly used for government announcements. William Caxton, who in 1477 started a printing company in England, produced the first printed poster. In 1870, the advertising poster emerged.

2.1.3.8 Engraving:

Engraving is the practice of incising a design onto a hard, usually flat surface, by cutting grooves into it. The process was developed in Germany in the 1430s. Engravers use a hardened steel tool called a burin to cut the design into the surface, most traditionally a copper plate.

2.1.3.9 Etching:

Etching is the process of using strong acid or mordant to cut into the unprotected parts of a metal surface to create a design in intaglio in the metal. This technique is believed to have been invented by Daniel Hopfer (c. 1470-1536), who decorated armour in this way, and applied the method to printmaking. Etching soon came to challenge engraving as the most popular printmaking medium. Its great advantage was that, unlike engraving which requires special skill in metalworking, etching is relatively easy to learn for an artist trained in drawing.

2.1.3.10 Modern graphic design:

Perhaps it would be possible to consider William Morris the father of modern graphics. In the second half of the 19th century his Kelmscott Press produced many graphic designs, and created a collectors market for this kind of art. In Oxford he associated with artists like Burne-Jones, and Dante Gabriel Rossetti. Together they formed the Pre-Raphaelites group, and their ideas influenced the modern graphic design considerably.

2.1.3.11 Posters post World War II:

After the Second World War, with the emergence new colour printing technology and particularly appearance of computers the art of posters underwent a new revolutionary phase. People can create colour poster on their laptop computers and create colour prints at a very low cost. Unfortunately, the high cost sophisticated printing processes can only be afforded mostly by the government entities and large corporations. With the emergence of internet the role of posters in conveying information has greatly diminished. However, some artist still use the chromolithography in order to create works of arts in the form of print. In this regard the difference between painting and print has been narrowed considerably.

2.1.3.12 Computer aided graphic design in posters:

With the arrival of computer aided graphic design an assortment of novel effects, digital techniques, and innovative styles have been emerged in poster designs. With software such as Adobe Photoshop, Corel and Windows' Paint program, image editing has become very cheap, and artists can experiment easily with a variety of colour schemes, filters and special effects. For instance, utilizing various filters of Photoshop, many artists have created "vectored" designs in posters where a photographic image is colorized, sharpened, rendered into watercolour or stained glass effects or converted into bare lines with block colours. Other designs created soft or blurry styles, ripple or cascade effects and other special filters.

2.2 INTERNATIONAL EXAMPLES

2.2.1 Lamar Advertising Corporate Headquarters

Architects: Eskew+Dumez+Ripple

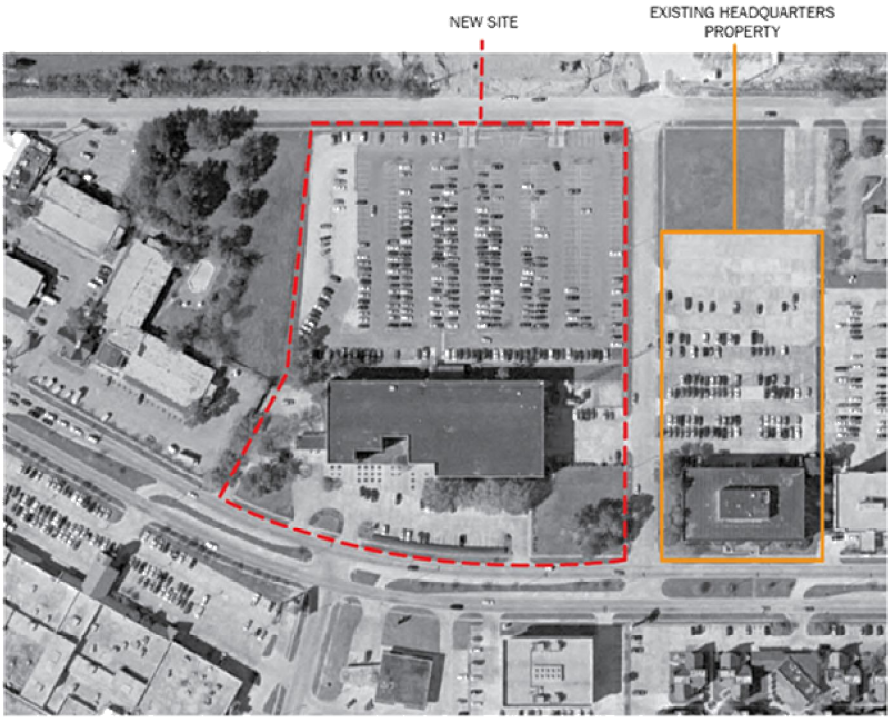
Location: Baton Rouge, Louisiana, USA

Consultants: Henderson Engineers Inc.; Fox-Nesbit Engineering, ABMB Engineers INC.

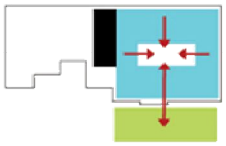
Completion: 2012

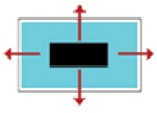
Client: Lamar Advertising Company

Project Size: 115,000 square feet



By removing structural bays of the large floor plate of the former data center, the design transforms Lamar's office environment from one externally oriented to one more inwardly focused.





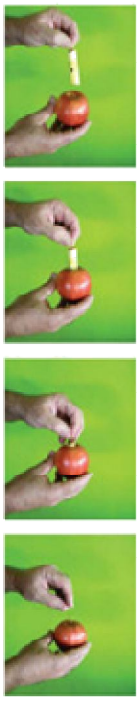
NEW SITE

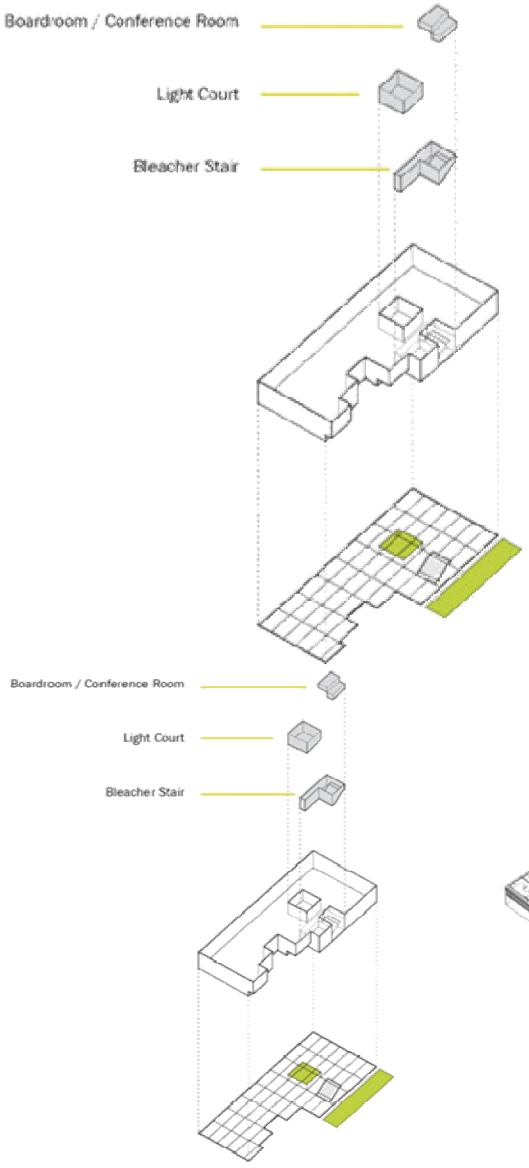
EXISTING HEADQUARTERS PROPERTY

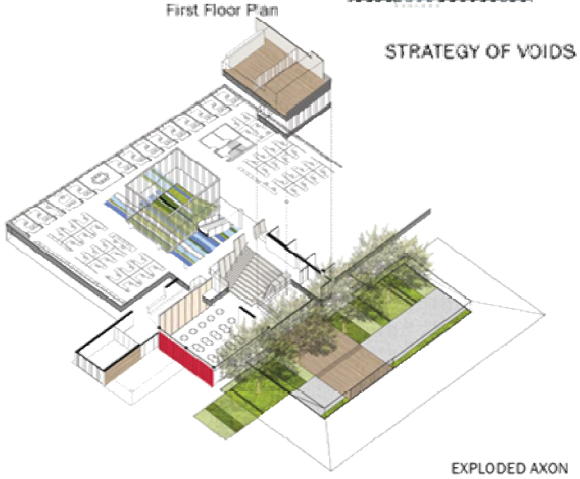
Figures 7 to 13: Site context diagram showing the existing headquarters and the designated site for the new building extension plus its drawings and views

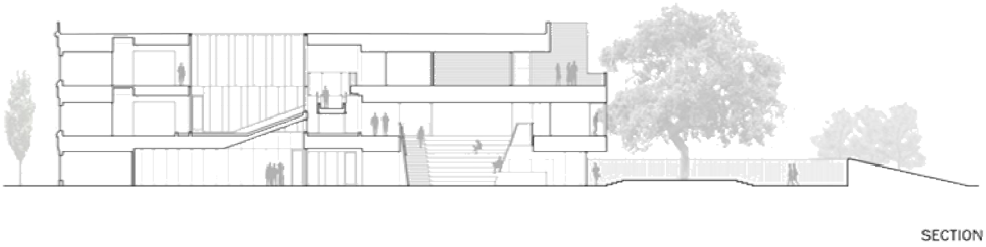
This new corporate headquarters for a local advertising agency is a reaction against the standard issue office environment. People require interaction in today's workplace. They go to work to collaborate, to brainstorm, to do research, to "work" in non-traditional sense of the word.

Much of what we observe in creative environments involves informal interaction in atypical settings, such as corridorencountersor conversations around the coffee pot. This design is structured







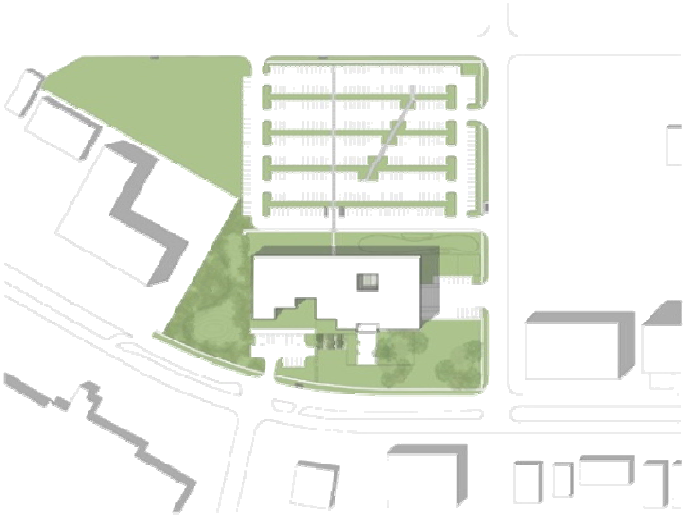


to reinforce that culture of openness.

At its core, the design is informed by these basic tenets: people like variety; they need places to congregate; casual inter-action fosters team-work and creativity; natural light is a good thing;

and a little visual excitement can't hurt. To accomplish this, the architects radically altered the internal configuration of an 115,000 square foot 1970's era data centre while leaving the exterior essentially unchanged. In addition to the insertion of a large, interior light court dropped into the building,

Further structure was removed to connect the space between floors into one communicating whole – reinforcing the culture and identity of the company as a single creative community.



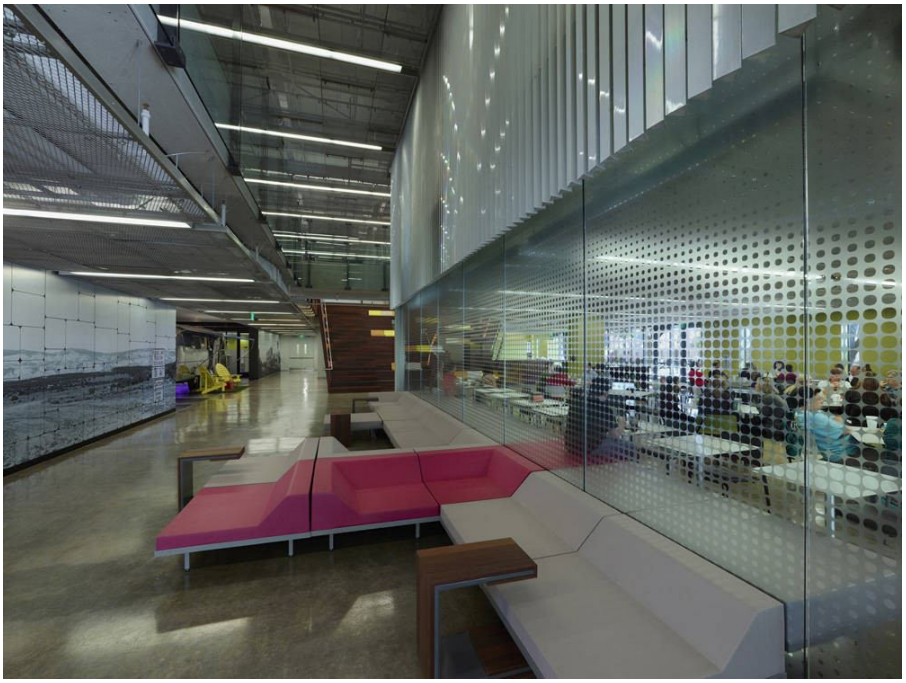
SITE PLAN

Pros:

• Good connection between spaces in a horizontal and a vertical manner

• Having a void for good ventilation and good connection between the indoor and the outdooractivities

• Good interior design that would stimulate the designers to bring out their best



Cons:

• There isn't a space designed for public interaction

2.2.2 Pullpo Advertising Agency

Architects: Hania Stambuk Marasovic

Location: Santiago, Chile

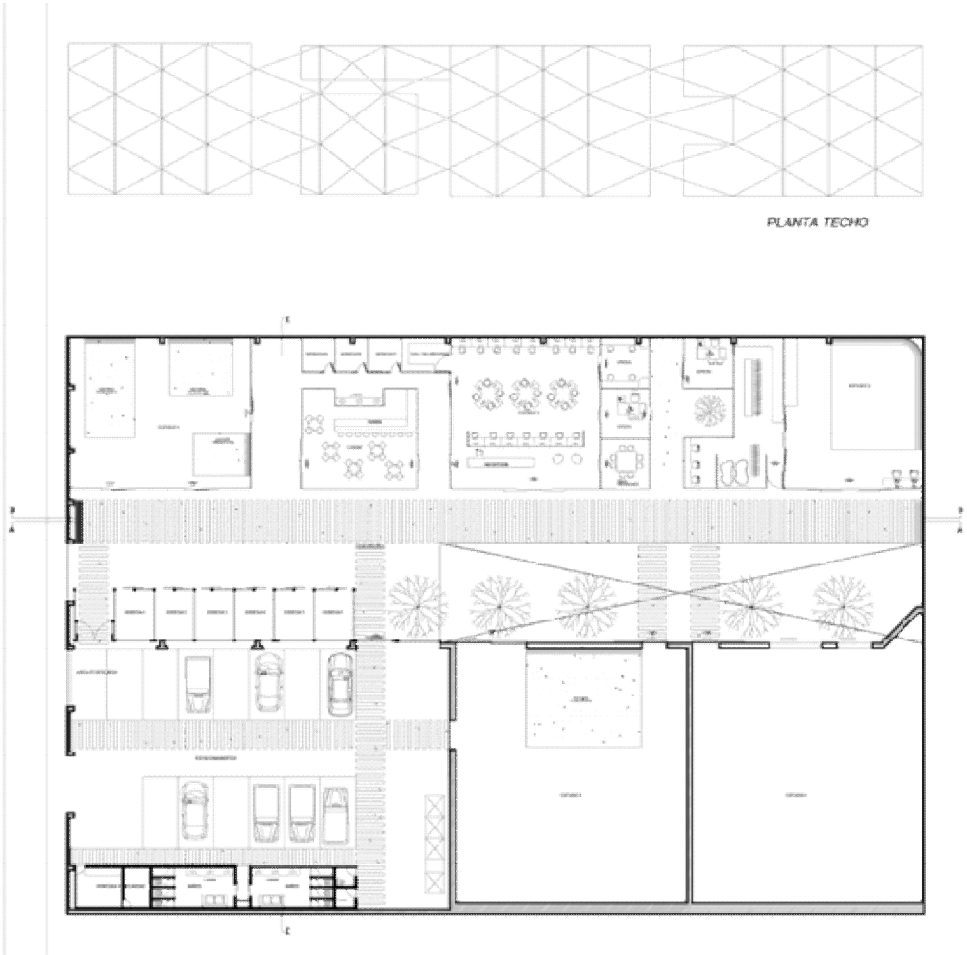
Structure Engineer: Claudio Hinojosa

Surface Area: 2,447 sqm

Constructed Area: 674 sqm

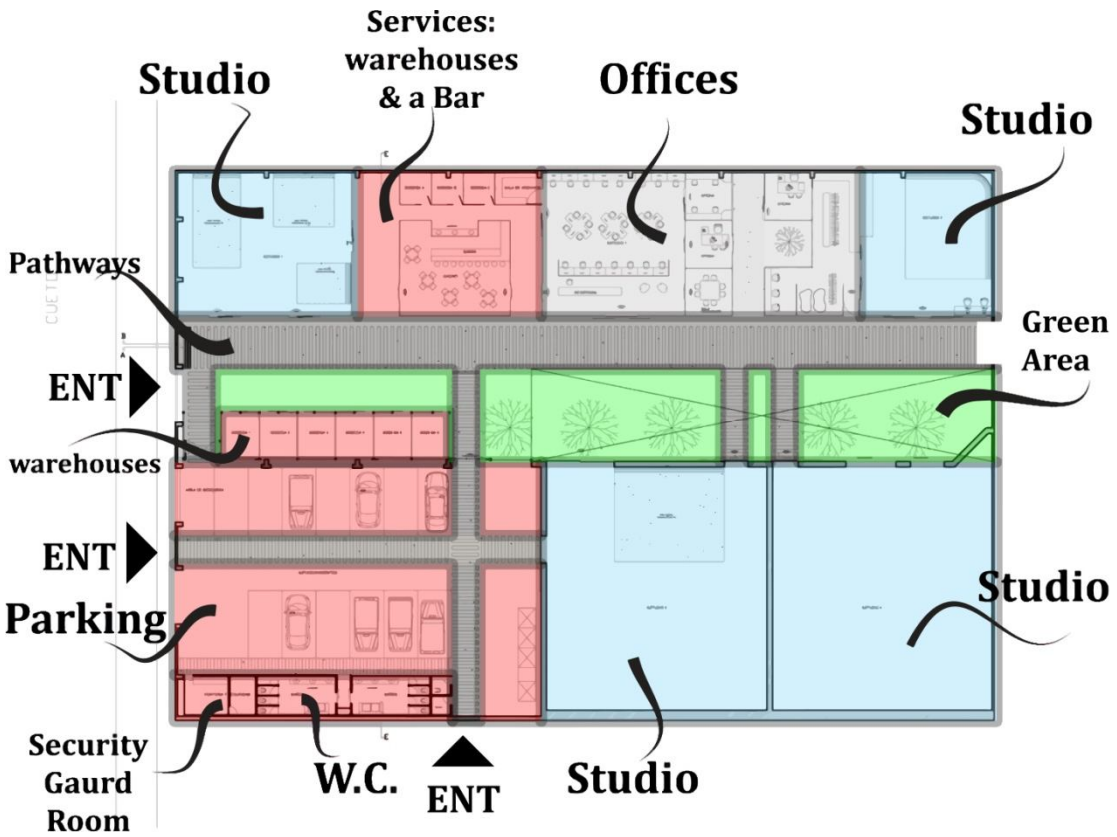
Construction year: 2008

Starting the project from the abandoned facilities of a salt factory in the western sector of Santiago Chile, the commission is considered as a counterpoint of industrial aesthetics of the precarious versus a clear and contemporary proposal that complies with the various demands of an advertising agency.



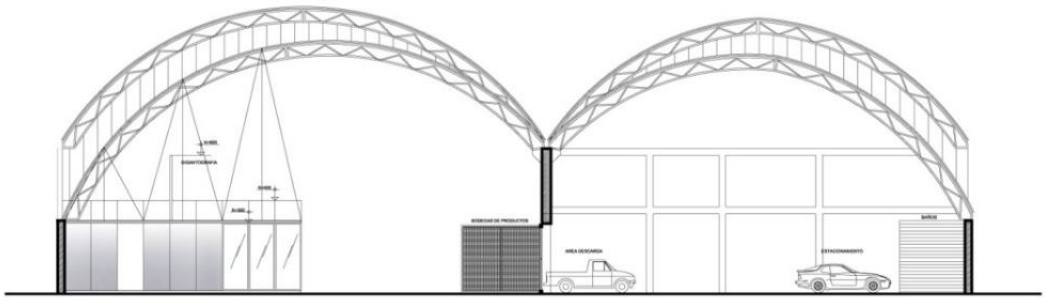
Figures 13 to 18: The new building make over plans, sections and views.

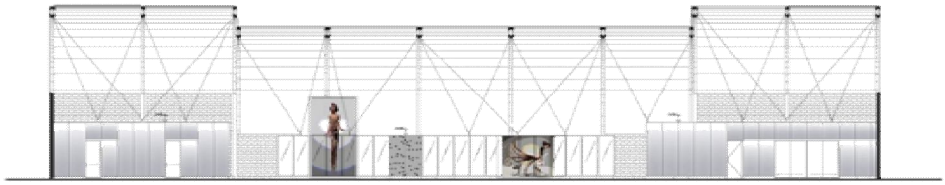
The program is developed considering a workplace for the creative staff that includes offices, conference rooms, photographic studios, service and storage areas, cafeteria, restrooms and incorporated parking. The project's strategy consists of providing a human scale to a place conceived for productive processes. For this effect, a number of inter-related flexible units are arranged to host the diverse activities inherent to the world of advertising; activities that range from ordinary situations to unlikely ones, like photography of wild animals or vehicles.



From the standpoint of plasticity the project is expressed as a huge meccano, an image congruent with a prefabricated system of construction based on low cost serial modulation, consequently materials that enabled quick assembling were used: steel, glass, and Isopol panels. The panels have great thermal capacity and were developed for industrial use in refrigerating chambers. Additionally, it was chosen for its rigidity, versatility, and low weight, permitting easy transport.

Programmatic units are structurally joined by braided steel cables anchored to the existing trusses, in order to obtain the maximum structural capacity of the constructive elements that comprise those units; thus creating a non-dissociable relationship between the old and the new project (host and guest).





CORTE BB

Pros:

• Reinventing the old space into something new and modern.

• Having enough space for the agency's work and activities.

• Good circulation between the main activities of the project.

• Having various types of studios for the many styles and ways of filming.

• Taking advantage of the existing structure.

Cons:

• The WC is far from the offices.

• Only one entrance is secured.

• The warehouses are far from some studios.

2.2.3 Dubai Media City

Architects: Emaar Group

Location: Dubai, UAE

Construction year: 2000

Figures 19 to 26: Showing the site of the project, the zones of the project and the views.

List of companies:

Sports:

- International Cricket Council HQ

Some News Agencies:

- APTN
- Reuters

Some Television stations:

- Al Aan TV
- Al Majd TV
- Arabian Travel TV
- BBC World News
- CNN International

Some Radio stations:

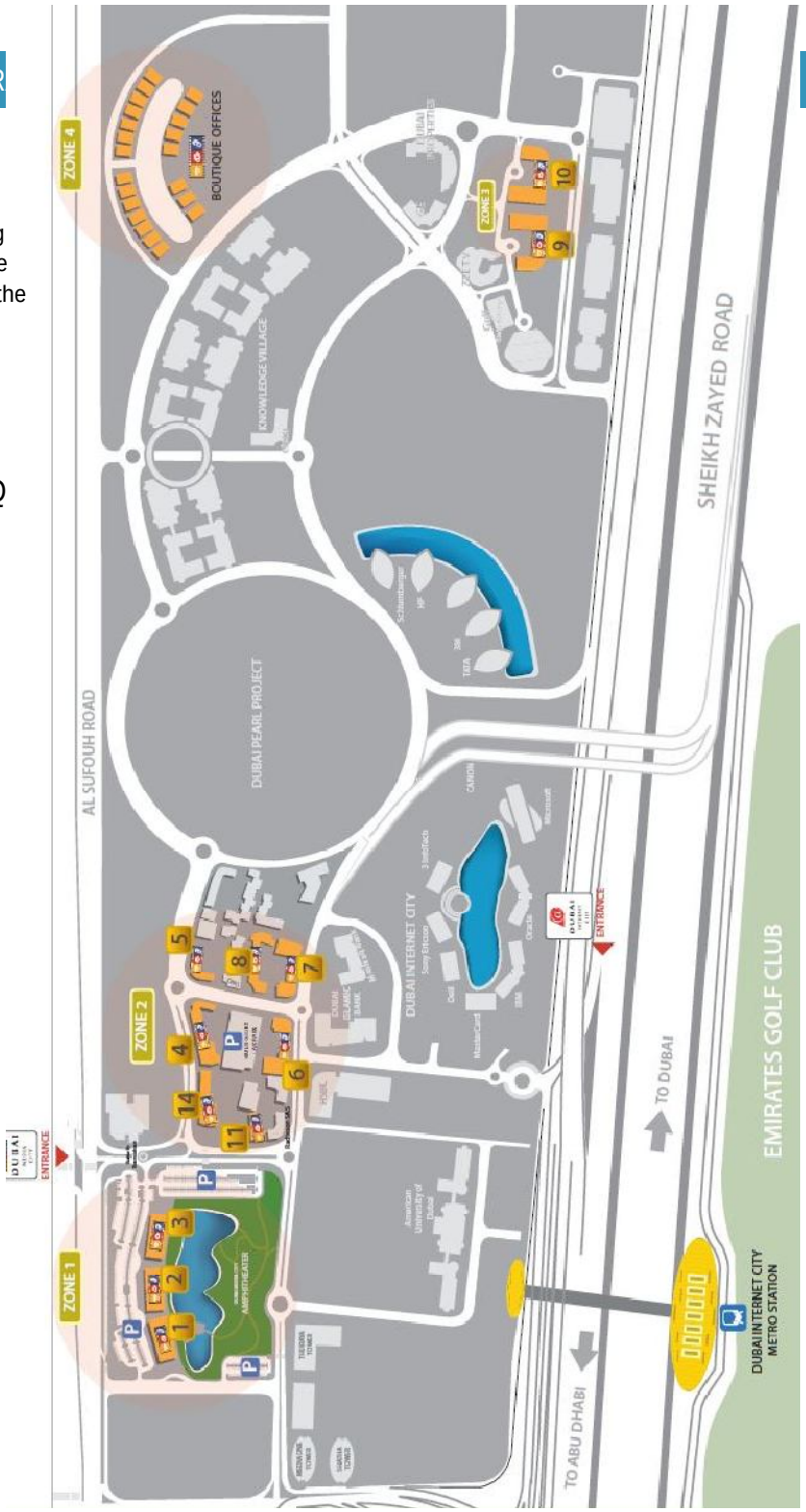
- Radio Sawa
- Arabian Radio Network

Some Websites' HQs:

- Kipp Report
- AMEinfo.com
- Kalam TV
- Eurosport Arabia

Some Newspapers' HQs:

- The Financial Times
- The Economist Group



• The Times

• The Sunday Times

Magazines:

• MEED

• Lavish Magazine

• Rolling Stone

• L'Officiel

• EveningZ Magazine

Advertising Agencies:

• Spoton media services and events

• Best Focus

• ICS Dubai

• DDB

• Denstu

Others:

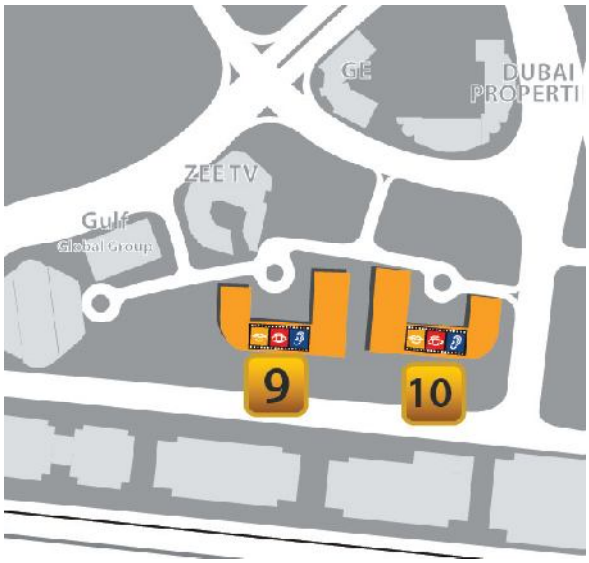
• Dubai Bliss -- Dubai's Finest News, Gossip & Entertainment Website

• Epic

• Economist Corporate Network

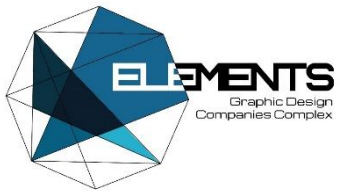
• EMAP

• Arthur D. Little



CHAPTER III: Project Study and Analysis Activities

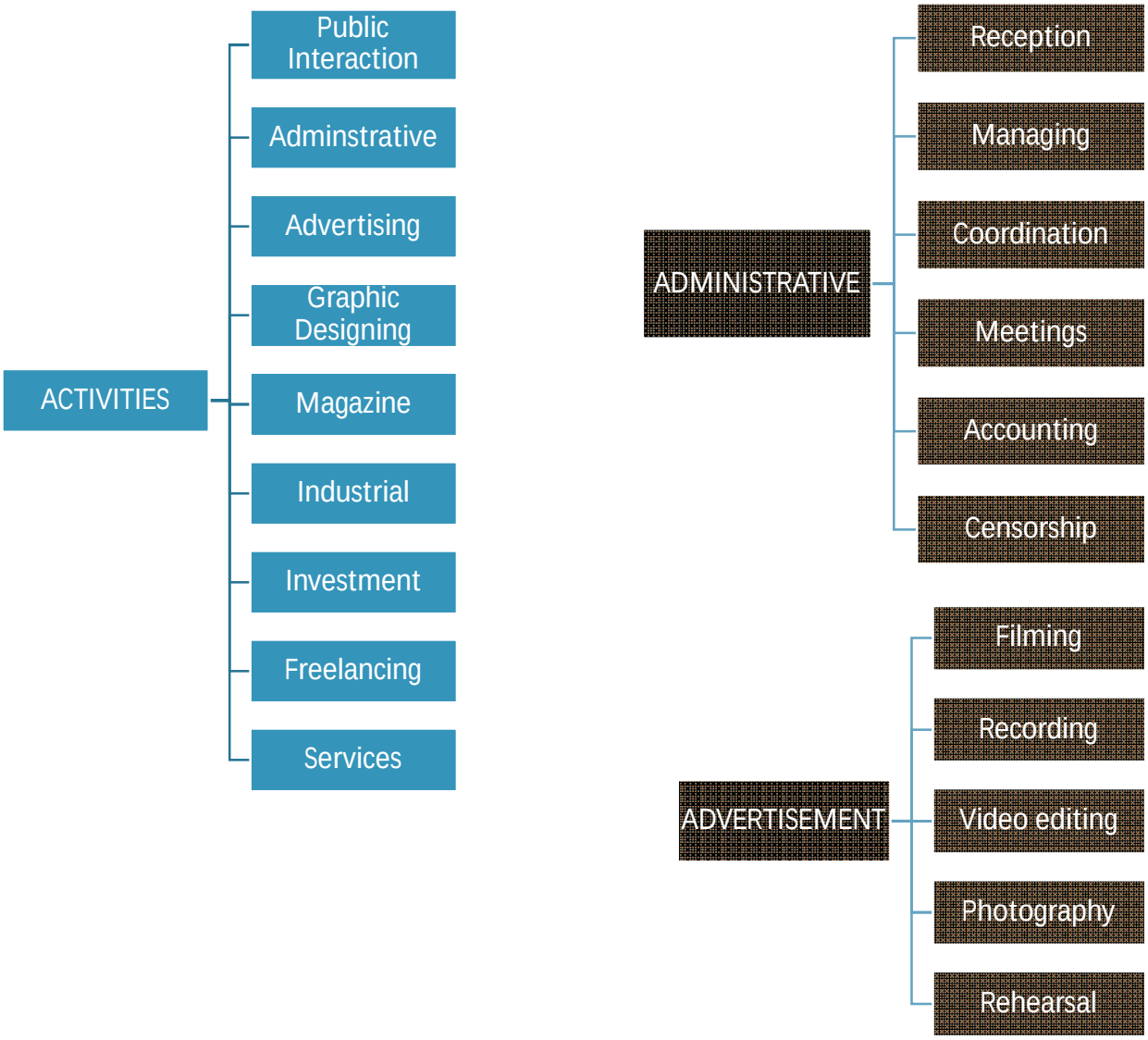
- Human Component
- Spatial Component
- Spaces Study
- Tables Of Areas
- Functional Relations
- Circulation Diagrams
- Site Selection
- Indicators and Guidelines
- Zoning

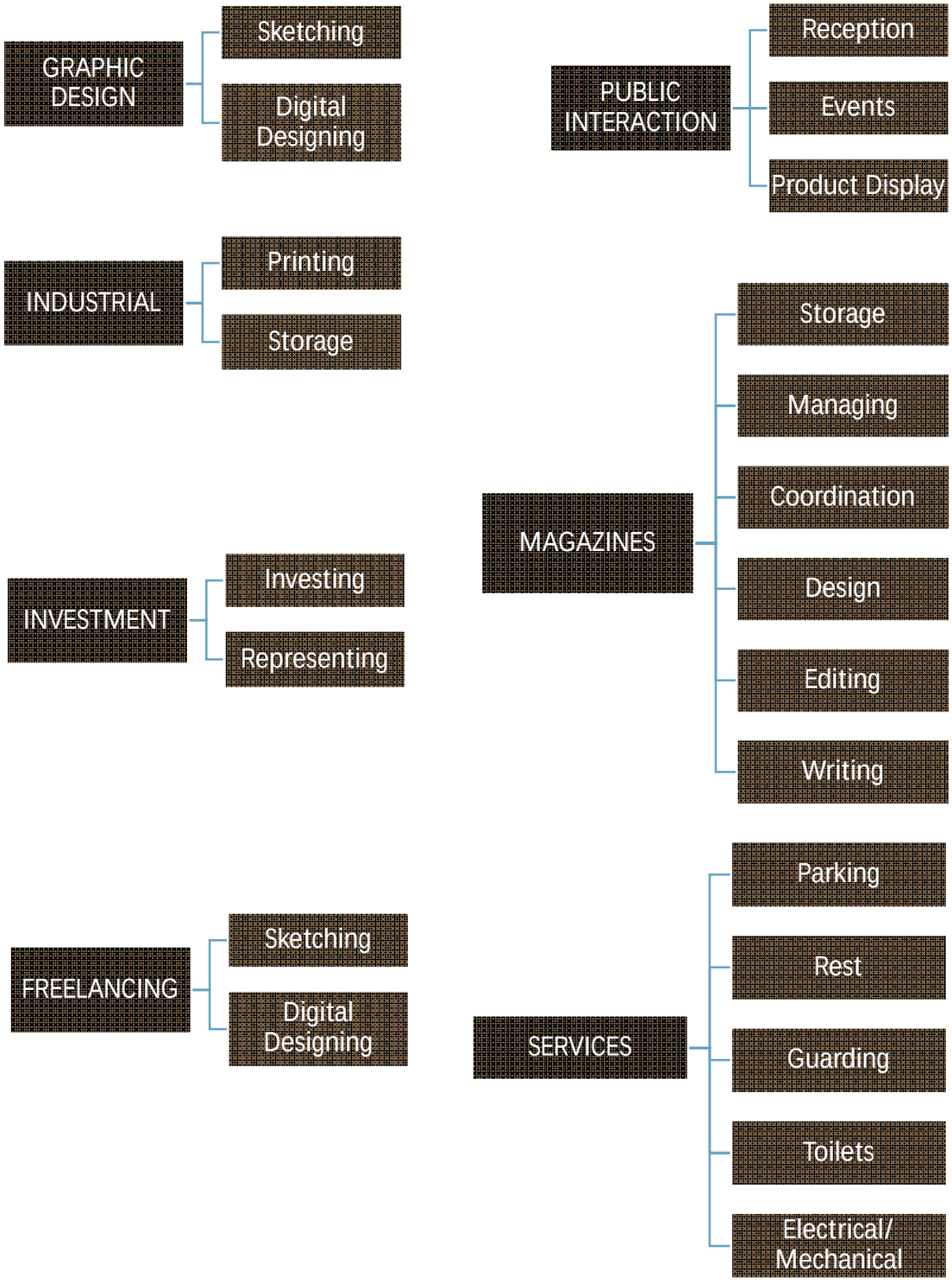


3 PROJECT STUDYAND ANALYSIS

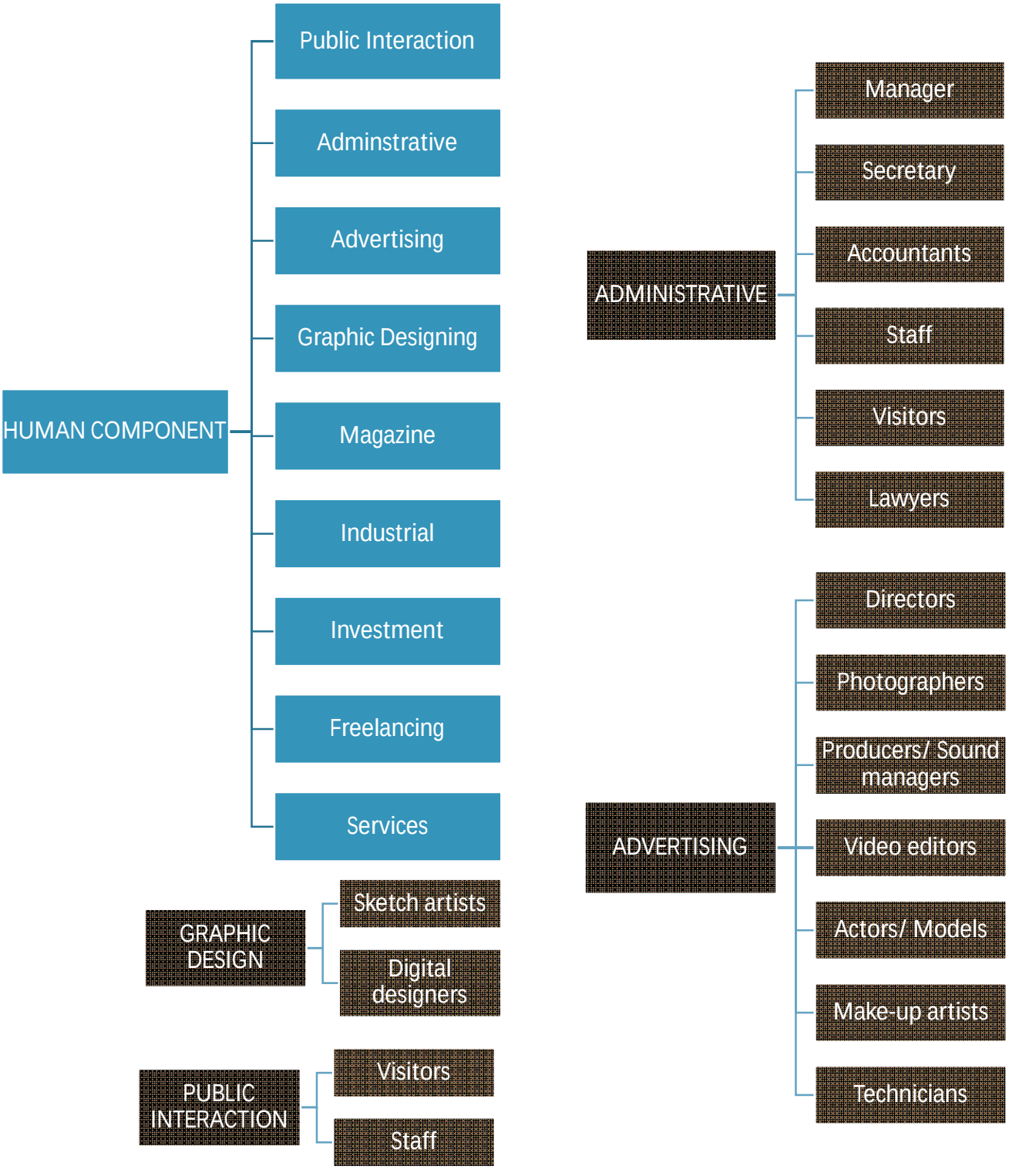
3.1 DATA ANALYSIS

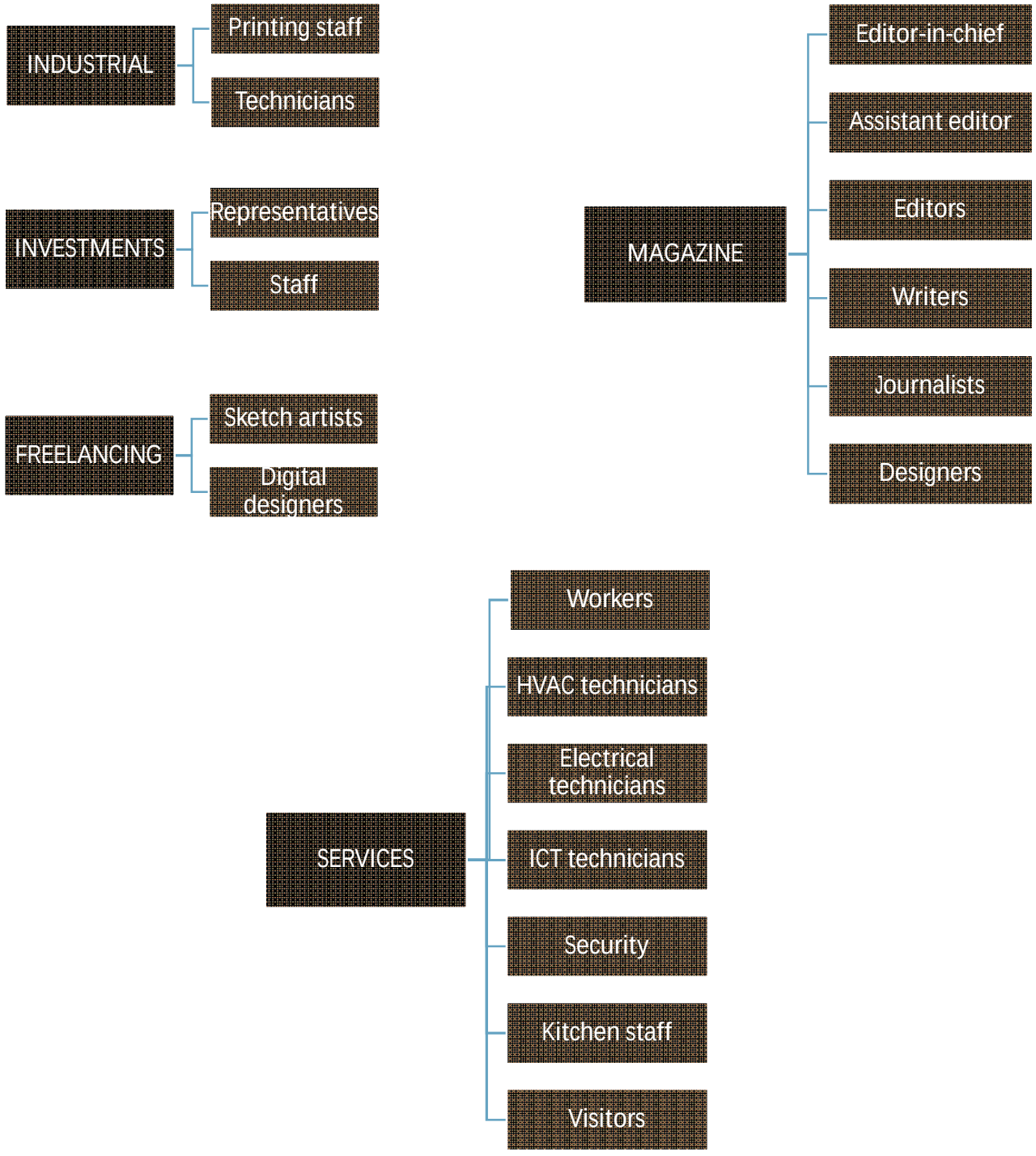
3.1.1 Activities



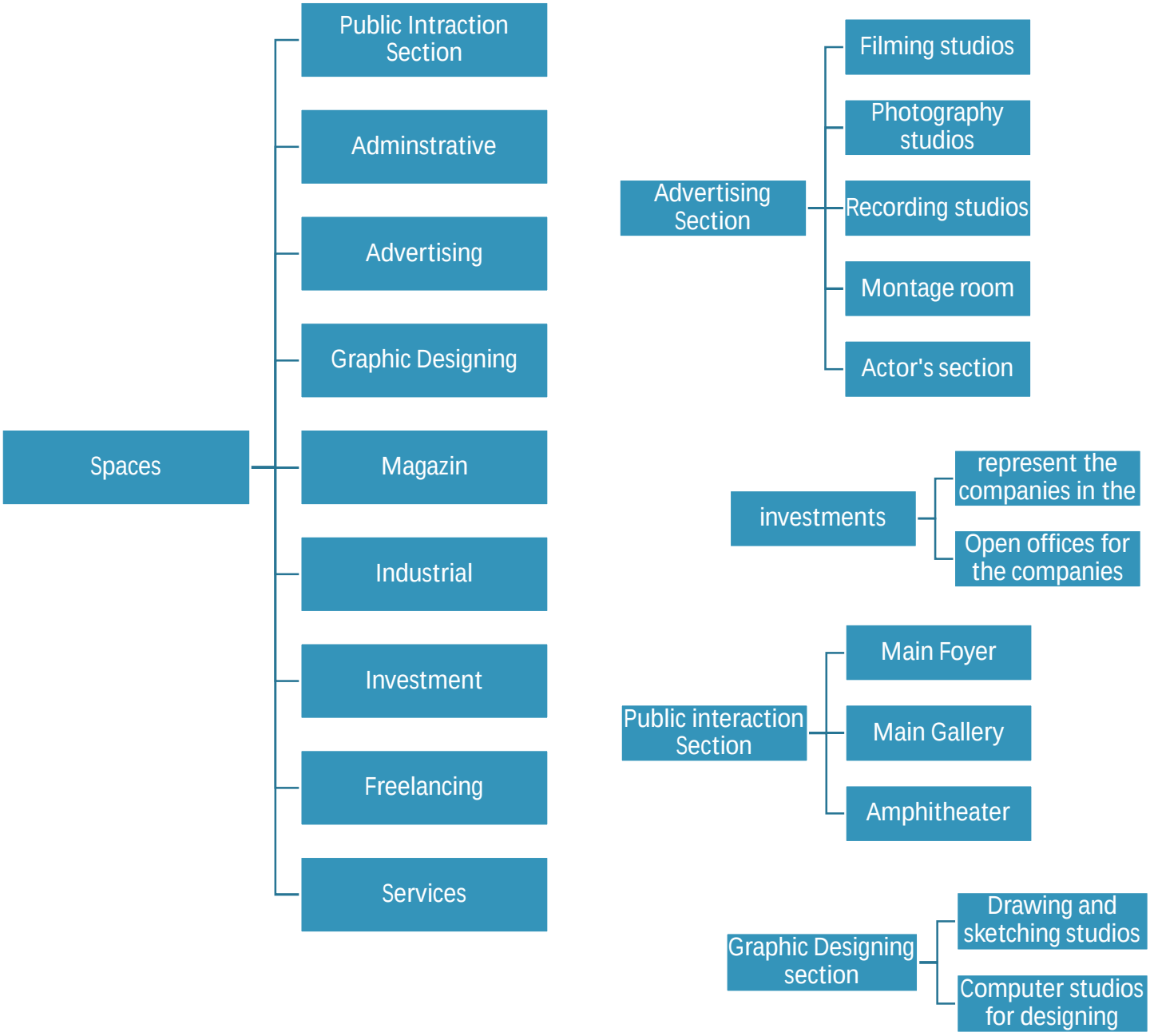

GRAPHIC DESIGN
Sketching
Digital Designing
PUBLIC INTERACTION
Reception
Events
Product Display
INDUSTRIAL
Printing
Storage
MAGAZINES
Storage
Managing
Coordination
Design
Editing
Writing
INVESTMENT
Investing
Representing
FREELANCING
Sketching
Digital Designing
SERVICES
Parking
Rest
Guarding
Toilets
Electrical/ Mechanical

3.1.2 Human Component

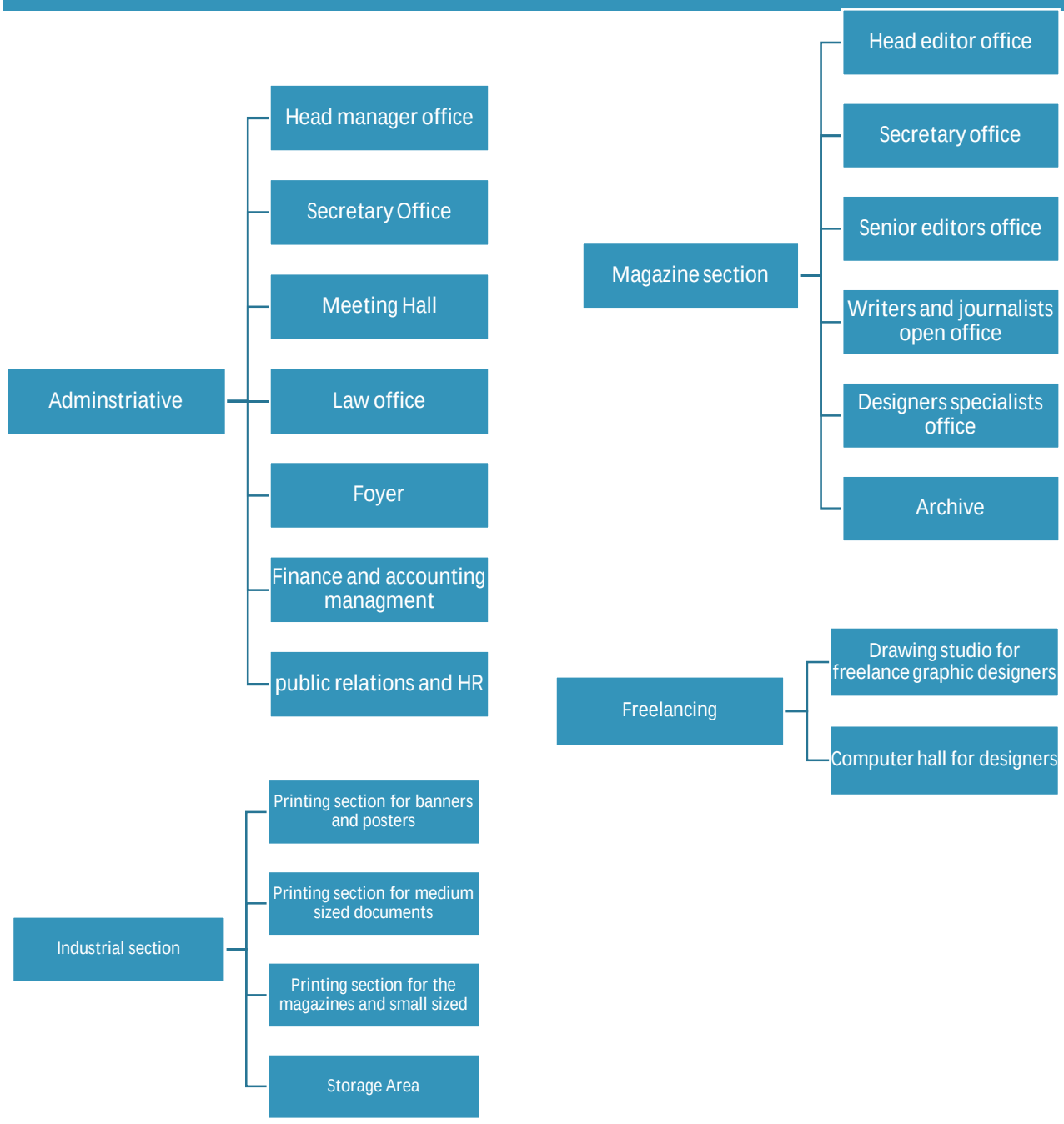



INDUSTRIAL
Printing staff
Technicians
INVESTMENTS
Representatives
Staff
FREELANCING
Sketch artists
Digital designers
MAGAZINE
Editor-in-chief
Assistant editor
Editors
Writers
Journalists
Designers
SERVICES
Workers
HVAC technicians
Electrical technicians
ICT technicians
Security
Kitchen staff
Visitors

3.1.3 Spatial Components



GRAPHIC DESIGN COMPANIES COMPLEX



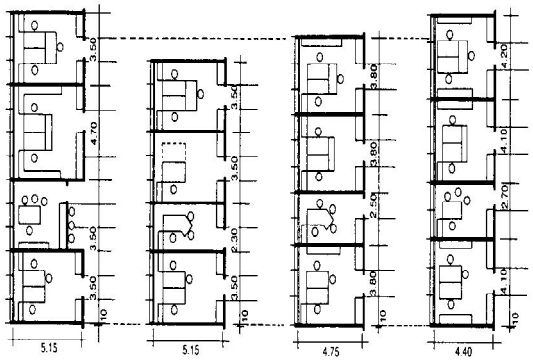
3.1.4 Spaces Study:

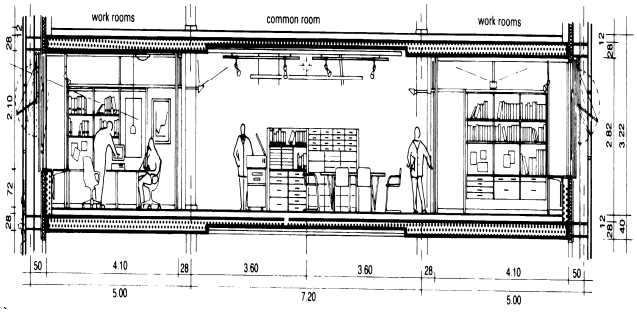
3.1.4.1 Offices

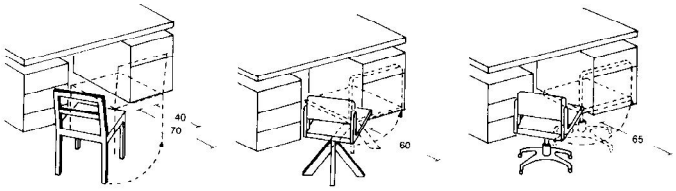
This is the main space of the building which the different types of workers do their daily jobs, and there are two types of offices, the "Open Plan Office" and the "Closed Plan Office".

These are the needed spaces for the offices:

- Computer user: 2.3 square meters.
- Employee who deals with the visitors and the audience: 2.5 square meters.
- Secretary office: minimum of 20 square meters.
- 9square meters per an employee in a private close office.
- 10 square meters for two employees in one closed office.
- 2.5 square meters per one employee in the meeting room.
- Lighting depth is between 4.5 meters.
- Circulation area 30%



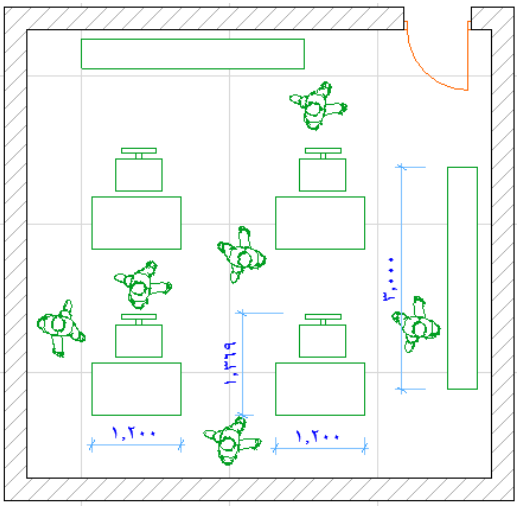




3.1.4.2 Drawing Studio

In this space most ideas come to live, it's where graphic designers first come to sketch, draft and draw their ideas.

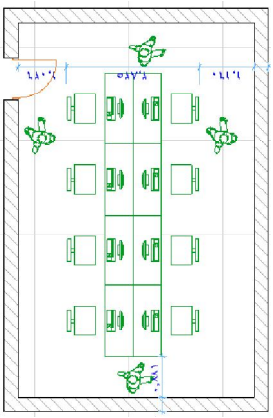
- Calculating that a single drawing studio has 4 people in it.
- Working area for a single designer is 3.6 square meters.
- The overall working area for all 4 designers is 14.4 square meters
- Cabinets' area is 3 square meters, circulation area around the Cabinets is 9 square meters
- Circulation paths around the working area with a width of 1m.



- Total area: 40-50 square meters.

3.1.4.3 CAD Studio (Computer Aided Design Studio)

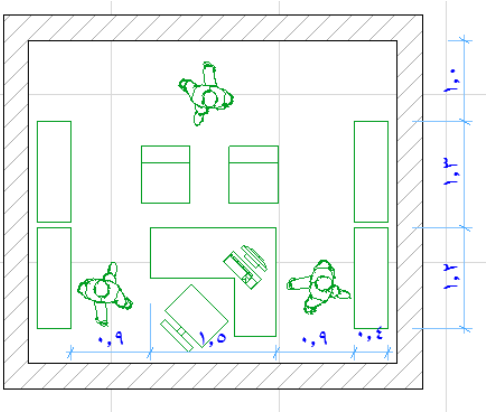
Graphic designers use this space to make their ideas detailed more and products that needs to be worked on using the computer.



- Number of users is 8 graphic designers.
- Working for a single designer is 2.4 square meters, total working area is 19.2 square meters.
- Cabinets' area is 6 square meters, the circulation area around the cabinets is 9 square meters.
- 1m paths around the working area.
- Total area of the space is 40-50 square meters.

3.1.4.4 Head writer's office

This place is used for the head writer and journalist of the magazine where he edits the scripts and rechecks them.



- Number of users is: One User
- Working area is: 1.8 square meters
- Cabinets' area is 2.4 square meters
- Circulation area around the cabinets is: 4.3 square meters
- Sitting area for two people: 0.8 square meters
- Circulation behind the disk: 1 meter
- Total Area: 16-20 square meters

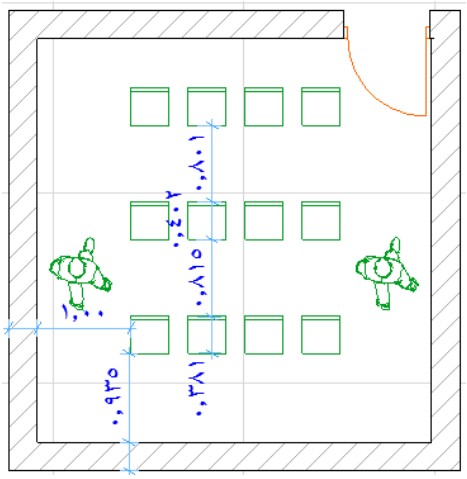
3.1.4.5 Video shooting studio:

In this space the advertisement companies can video shoot whatever they need for a certain advertisement and they can use the special effects to create whatever environment they want

3.1.4.6 Screening Room:

It's used for watching the progress of an animation movie or something they are working on to see the progress of the work.

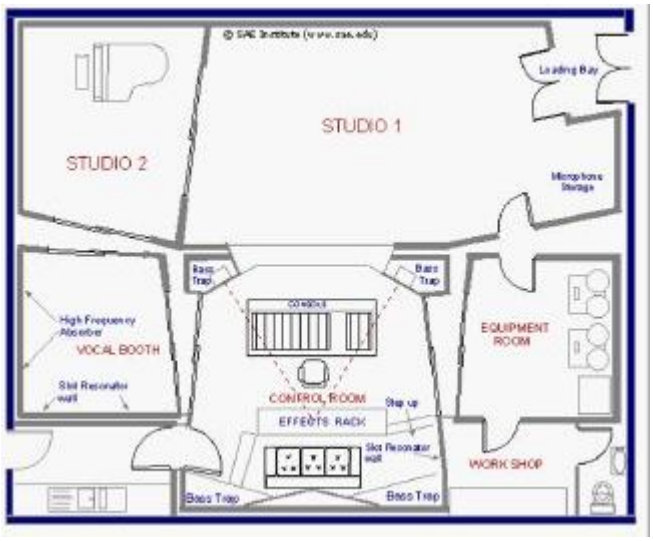
- Number of users: 12 people
- Single person's area is 0.8 square meters with the minimum distance from the screen is 1.2m.
- Total area is 20 square meters.



3.1.4.7 Audio recording studio:

In this space all of the audios needed, adding audio effects, audio production and mixing are being done.

- Total area: 150-200 square meters



3.1.4.8 Montag room:

Also called the video editing room is where they edit the videos and everything connected to that.

- Total 45 square meters

3.1.4.9 Central printing

It's where all of the printing of the project happens, whether it's a banner, a poster etc.

- Number of printers in the Banners section: 12 people
- Number of printers in the posters section: 12 people
- Printer working area in the banners section: 40 square meters
- Printer working area in the posters section: 20 square meters
- Circulation area in the banners section: 120 square meters
- Circulation area in the posters section: 60 square meters
- Storage area: 250 square meters.
- Total area: 1550 square meters.

3.1.5 Tables of Areas:

Per Company

Activity	Users	Space name	Number of users	Space (m^2)	Number of spaces	Total space (m^2)
Filming	Directors, Photographers and actors	Filming (Chroma) studio	20	200	4	800
Photographing	Photographers and models	Photography Studio	20	350	4	1400
Audio recording	Producers, artists and vocalists	Recording studio	12	200	4	800
Montaging	Montage Specialists	Montage room	8	45	4	180
Resting and rehearsing	Actors	Actor's Section	3	16	10	160
Advertising section totals			63			3340

Activity	Users	Space name	Number of users	Space (m^2)	Number of spaces	Total space (m^2)
Drawing and sketching	Sketching Designers	Drawing studio	42	500	4	2000
Computer designing	Computer Designers	Computer studio	42	500	4	2000
Graphic Designing section totals			84			4000

Activity	Users	Space name	Number	Space	Number	Total

			of users	(m^2)	of spaces	space (m^2)
Reception	Visitors and staff	Main foyer	285	150	1	150
Displaying the products	Visitors and staff	Main gallery	240	2500	1	2500
Celebrating	Visitors and staff	Amphitheater	450	500	1	500
Public interaction section totals			975			3150

Activity	Users	Space name	Number of users	Space (m^2)	Number of spaces	Total space (m^2)
Managing	Head manager	The head manager office	1	40	4	160
Coordination	Secretary	The secretary office	1	20	4	80
Discussing and meeting	Staff	Meeting hall	10	50	4	200
Accounting	Accountants	Finance management	8	45	4	180
Censorship	Lawyers	Law office	2	16	4	64
Managing affairs	Visitors and staff	Public Relations and HR office	16	90	4	360
Reception	Staff	Foyer	20	30	4	120
Administrative section totals			58			1044

Activity	Users	Space name	Number of users	Space (m^2)	Number of spaces	Total space (m^2)
Managing	Head editor	The head editor office	1	40	4	160
Coordination	Secretary	The secretary office	1	20	4	80
Managing and editing	Senior editors	Senior editors office	1	20	4	80
writing	Writers and journalists	Writers and journalists office	34	100	4	400
Designing	Designers	Designer's studio	34	100	4	400
Files storage	Staff	Archive	4	36	4	144
Magazine section totals			75			1264

Activity	Users	Space name	Number of users	Space (m^2)	Number of spaces	Total space (m^2)
Large documents printing	Workers	Large printing section	12	600	1	600
Medium documents printing	Workers	Medium printing section	12	300	1	300
Magazine and small documents printing	Workers	Magazine and small docs printing section	12	400	1	400
Storing	Workers	Storage area	12	250	1	250
Industrial printing section totals			48			1550

GRAPHIC DESIGN COMPANIES COMPLEX						
Activity	**Users**	**Space name**	**Number of users**	**Space (m^2)**	**Number of spaces**	**Total space (m^2)**
Representing	Representatives	Representation offices	2	20	20	400
Investing	Staff	Open offices	40	400	20	8000
Investment section totals			42			8400

Activity	**Users**	**Space name**	**Number of users**	**Space (m^2)**	**Number of spaces**	**Total space (m^2)**
Drawing and sketching	Designers	Drawing studio	42	400	2	800
Computer designing	Designers	Computer studio	42	400	2	1800
Freelancing section totals			84			1600

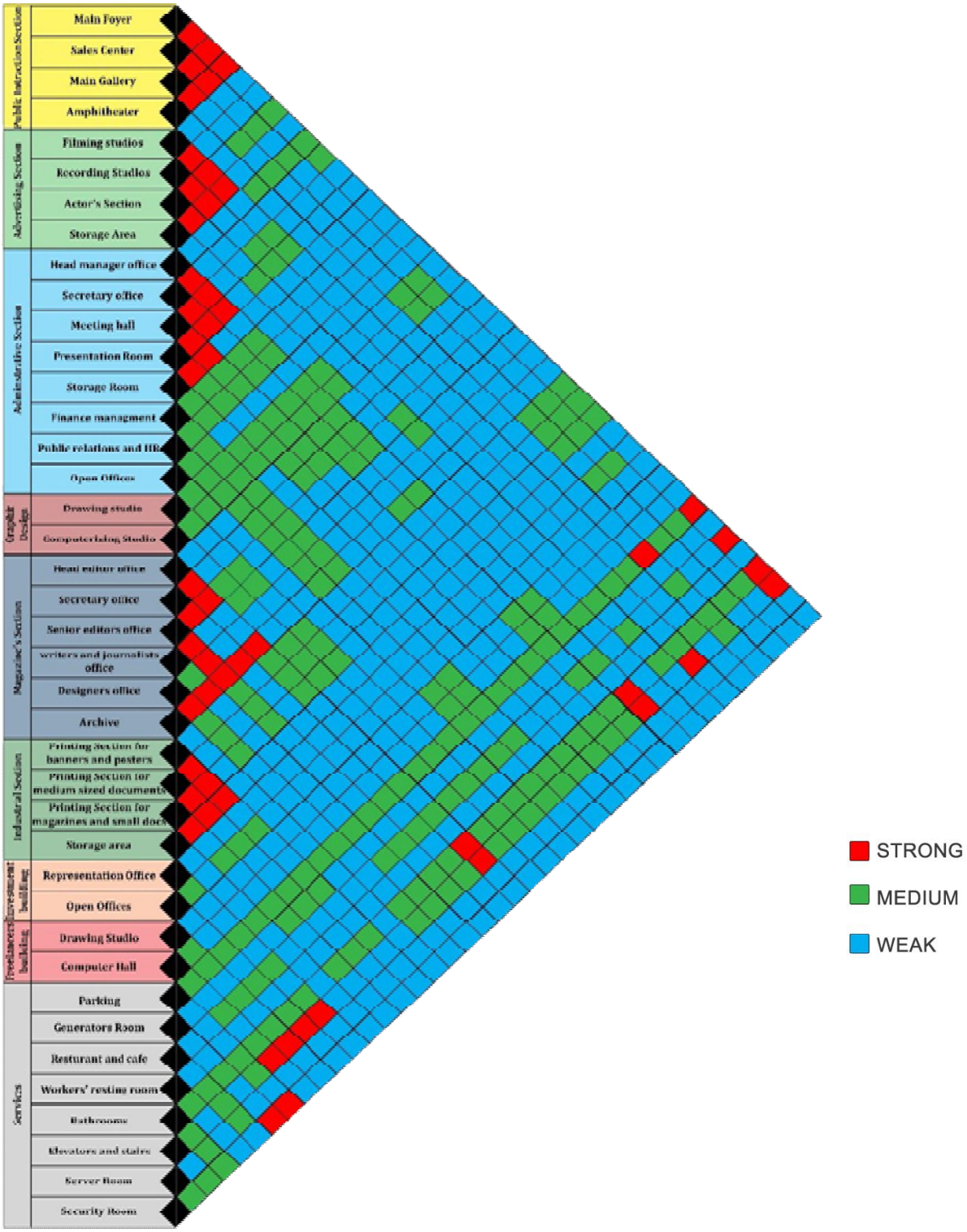
Activity	**Users**	**Space name**	**Number of users**	**Space (m^2)**	**Number of spaces**	**Total space (m^2)**

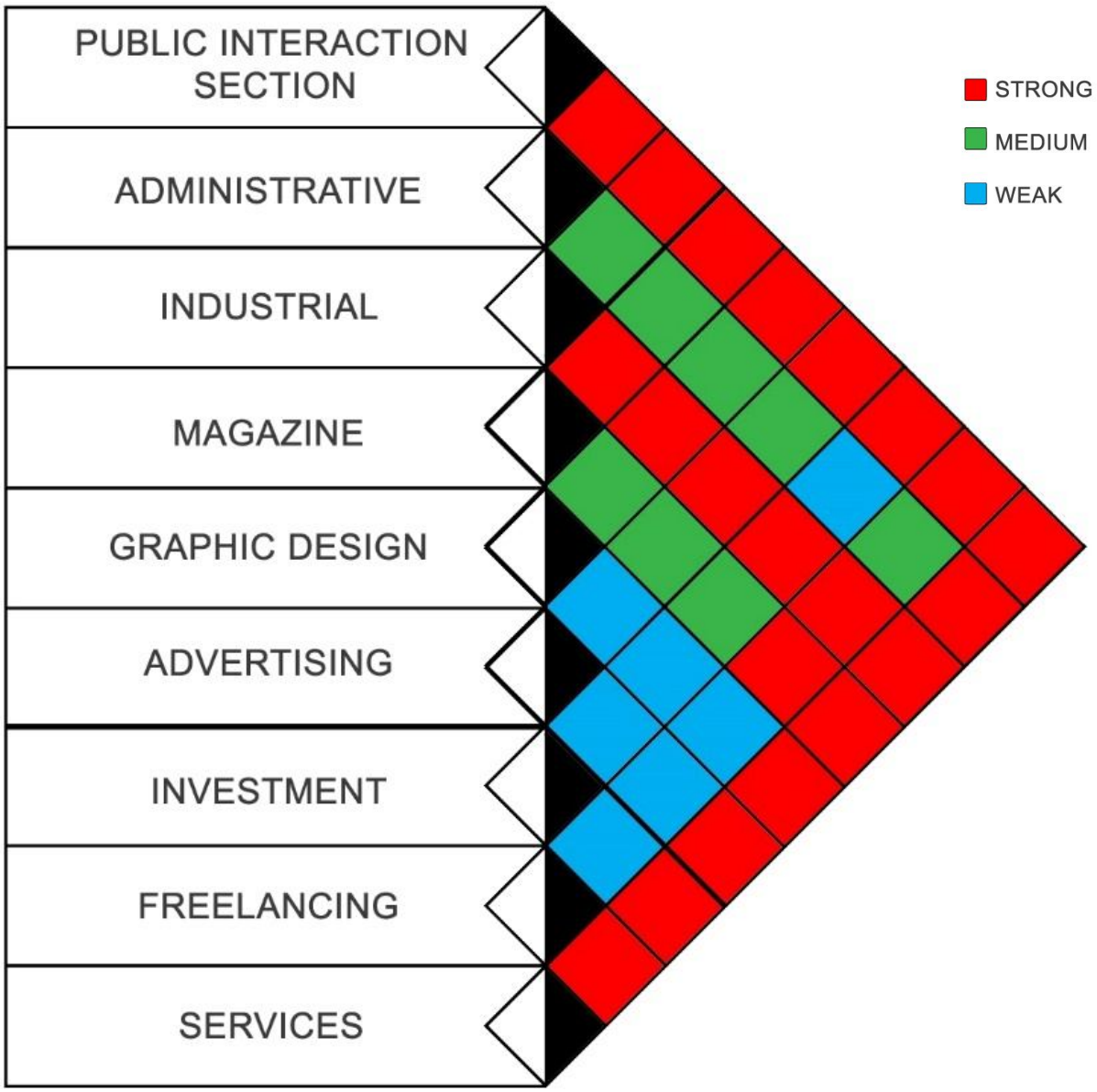
Parking	Everyone	Parking	All	12.5	1000	12500
Generating electricity and conditioning	Workers	Generators and HVAC room	-	80	4	320
Eating and drinking	Everyone	Restaurant/Café	10	50	4	200
Resting	Workers	Worker's resting room	-	100	4	400
Using the bathroom	Everyone	Bathroom	Max 10	26.7	130	3471
Circulating Vertically	Everyone	Elevators	Max 21	6.76	13	87.88
Connecting the offices	Computer Specialists	Server room	3	60	4	240
Guarding	Security Guard	Security room	1	20	2	40
Services section totals						17258.88

Total Built Spaces	51618.88 m^2
Needed Non-Built Space	25285.5 m^2
Needed site	63213.75 m^2

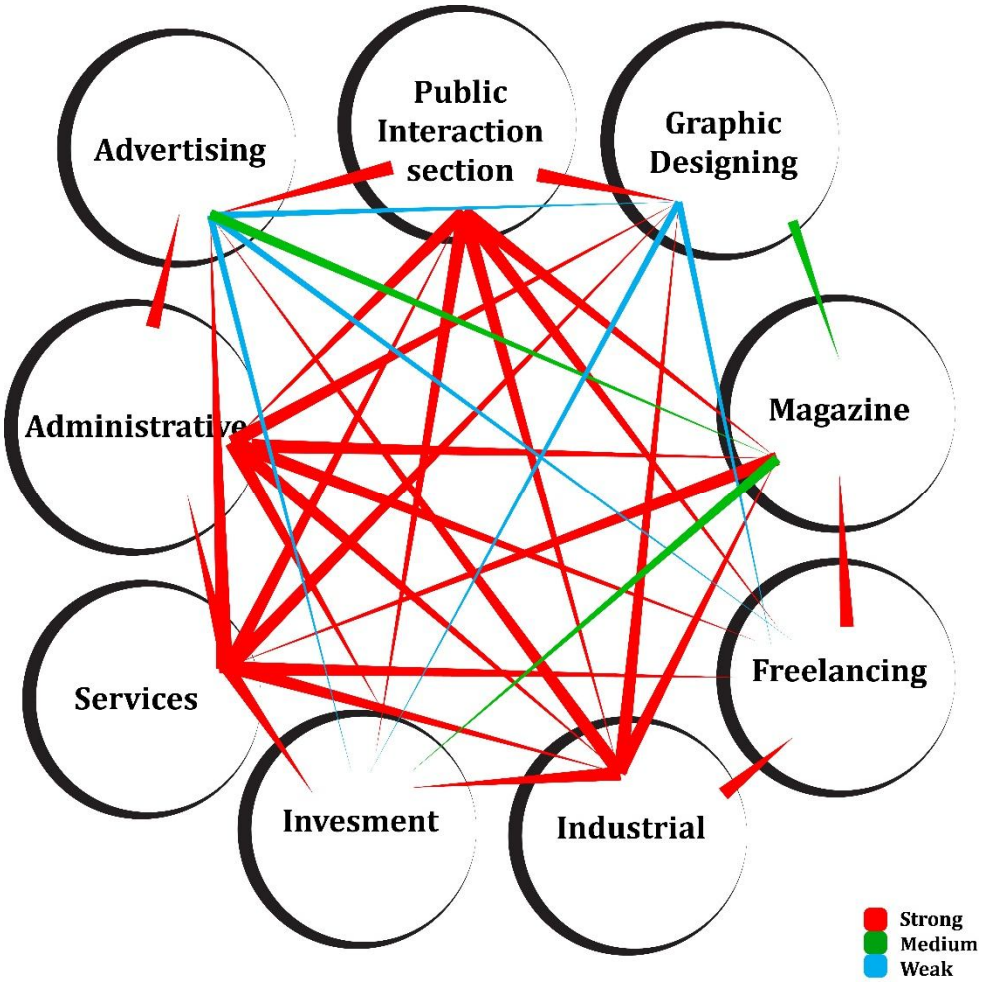
3.1.6 Functional Relations

3.1.6.1 Matrix Diagram

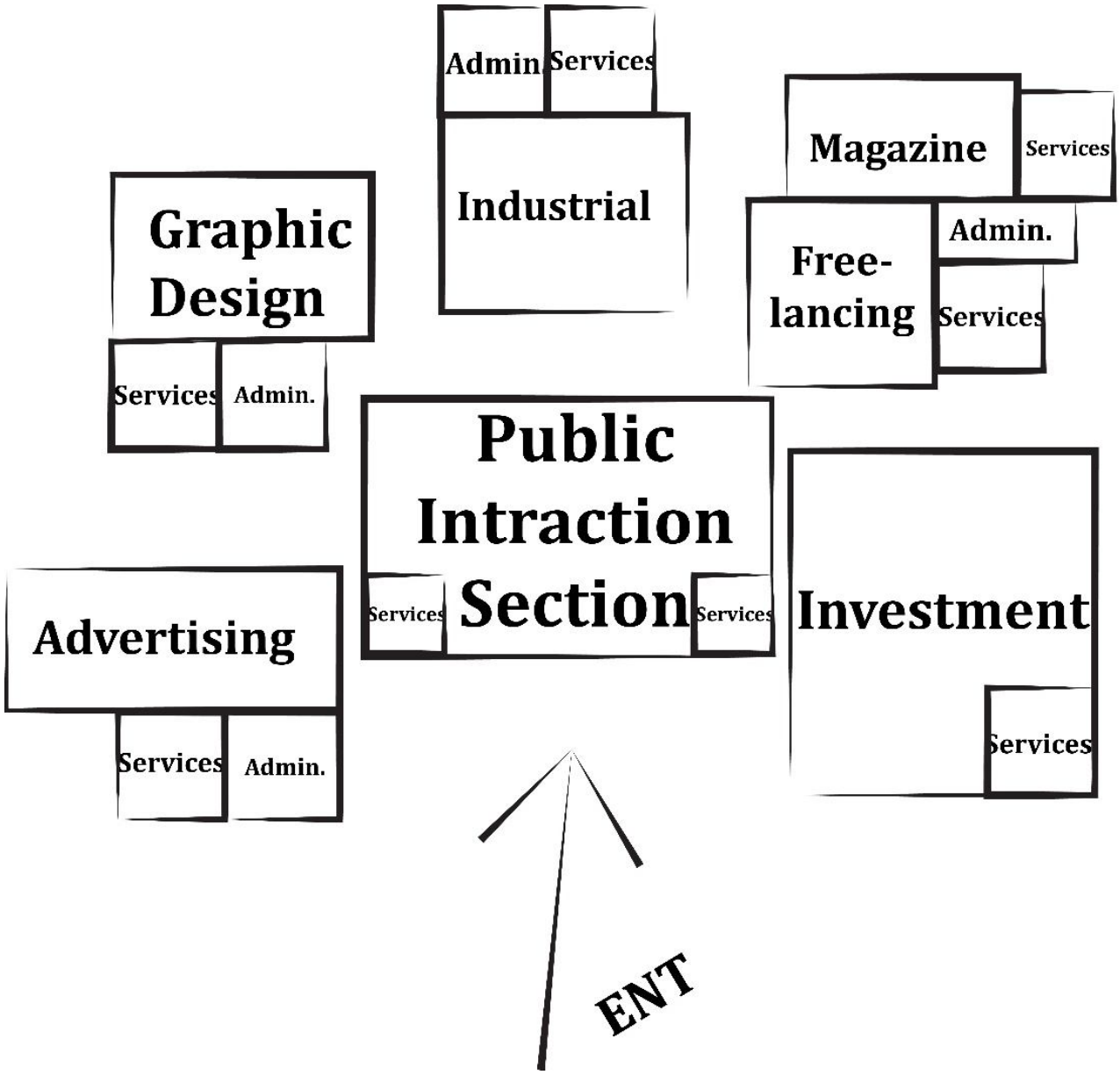



PUBLIC INTERACTION SECTION
ADMINISTRATIVE
INDUSTRIAL
MAGAZINE
GRAPHIC DESIGN
ADVERTISING
INVESTMENT
FREELANCING
SERVICES
STRONG
MEDIUM
WEAK

3.1.6.2 Bubble Diagram



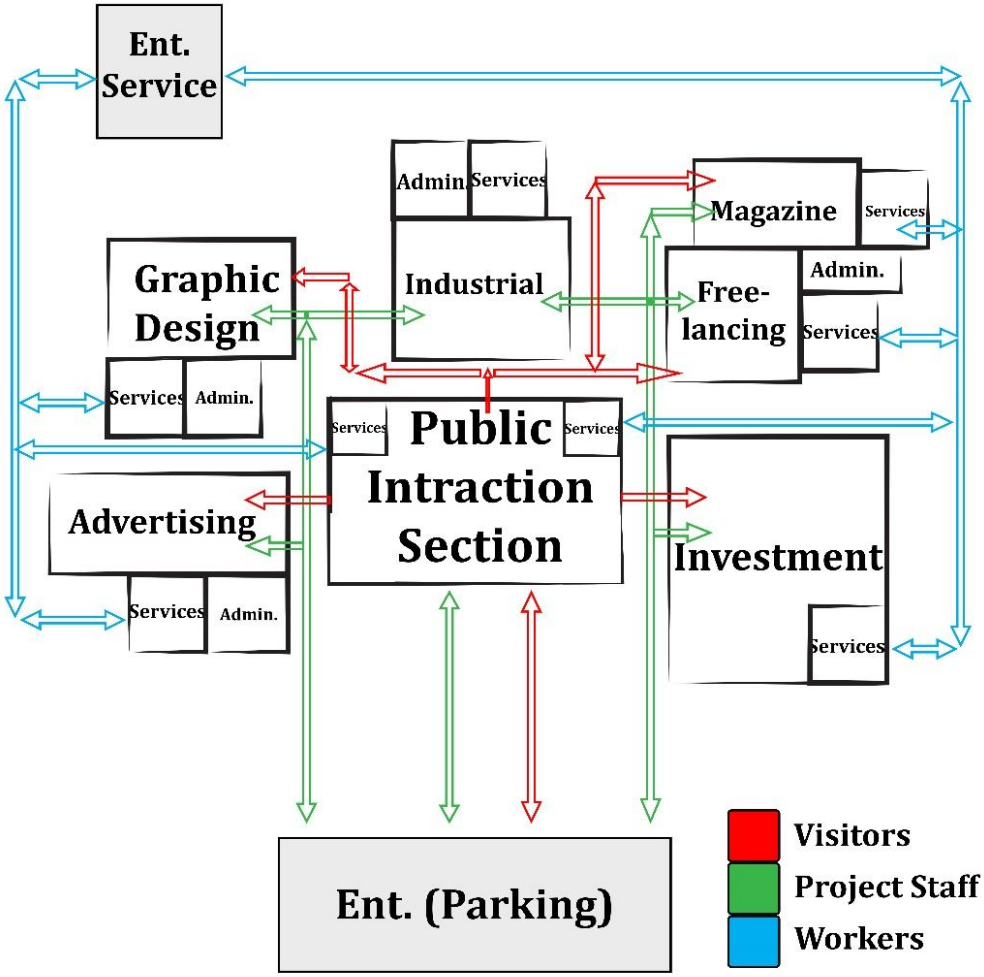
3.1.6.3 Zoning Functional Diagram:



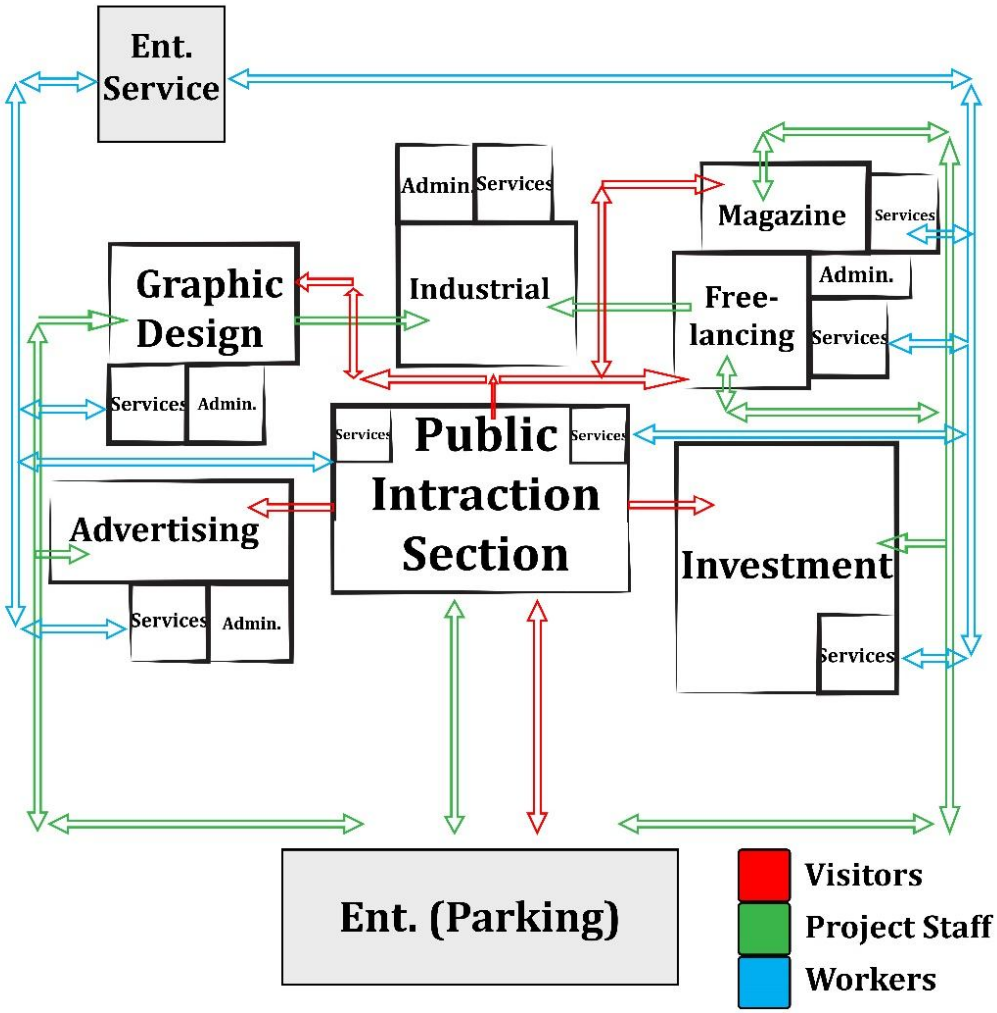
3.1.7 Circulation Diagrams

3.1.7.1 Horizontal Diagram

3.1.7.1.1 First Suggestion:



3.1.7.1.2 Second Suggestion:



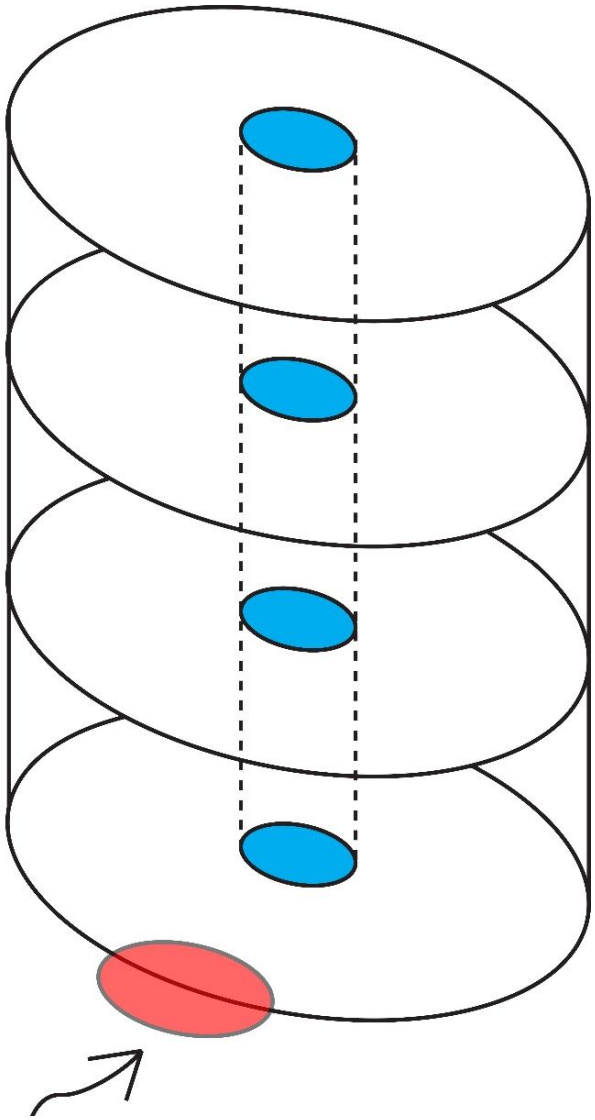
3.1.7.2 Vertical Diagram:

Third Floor:
General Managment + Services

Second Floor:
Open Offices/ Computer Designing Studio/Montage and its supplemnts/ Editors and + Services

First Floor:
Open Offices/Drawing Studio/Filming Studio Services

Ground Floor:
Public intaction section + Services



3.2 SITE SELECTION

3.2.1 Introduction

Site selection is the most crucial part of the design process. It involves a detailed analysis and study of the impacts the project would have on its surroundings on the short and long terms. It considers the macro-climate, accessibility, geography, history, and land uses to locate a suitable and feasible site that would benefit the client and user.

Khartoum is the capital and second largest city of the Republic of Sudan and of Khartoum State. It is located at the confluence of the White Nile, flowing north from Lake Victoria, and the Blue Nile, flowing west from Ethiopia. The location where the two Niles meet is known as the "al-Mogran", meaning the Confluence. It is situated on latitude 15.50 N, and longitude 31 32 E, and it is 1253 ft. above sea level.

Divided by the Niles, Khartoum is a tripartite metropolis with an estimated overall population of over five million people, consisting of Khartoum, and linked by bridges to Khartoum North and Omdurman to the west.

Considering the general location requirements for the Complex, it is apparent that it must be located in Khartoum's central business district or 'CBD', accessible to the majority of businesses, the airport and main roads in order to serve clients efficiently. The CBD is currently located in Khartoum city, northeast of the airport, extending from Khartoum 2 to the recently developed Al-Sunut, as shown in the figure below.

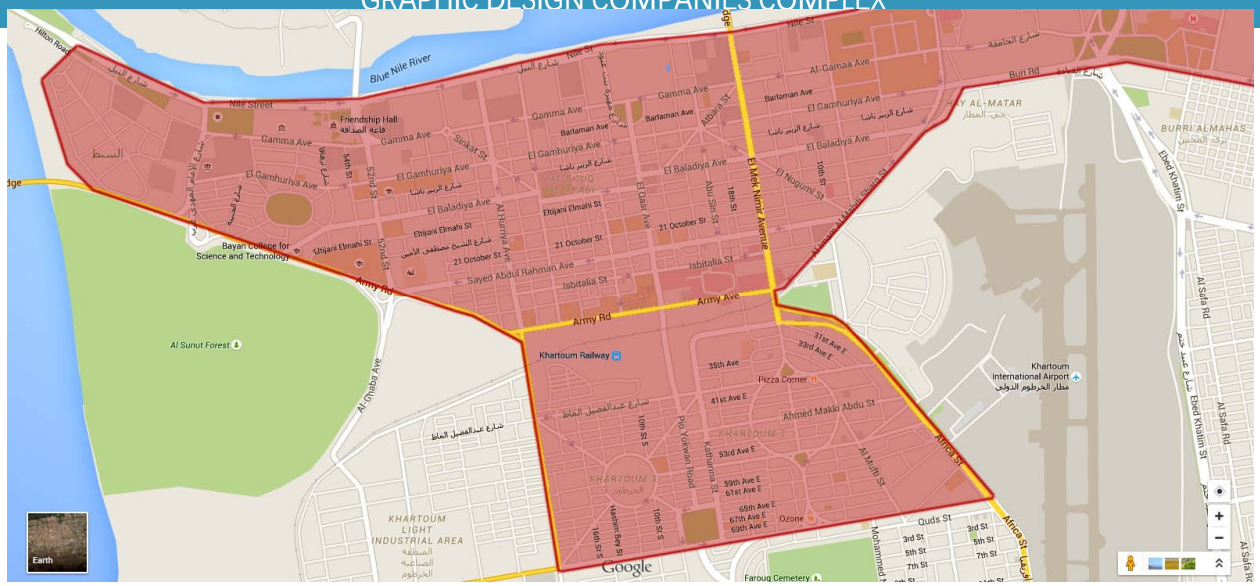


Figure 27: Map data @2015 Google; demonstrating an approximation of the current CBD in Khartoum to narrow down a suitable site that meets the given criteria

The project would need to serve large businesses and corporations in the Khartoum area as well as Omdurman and Bahri, all while considering the future expansion of the current CBD. The site also needs to be located in an area where parking and traffic is relatively lower whilst maintaining its central location and accessibility to services and the market.

This central location would be surrounded by offices and retail, high density residential, education, leisure and recreation facilities, community centre, and hotel and conference facilities. Figure 1 of King's Hill Business Park demonstrates this relationship between the project site and its surroundings.

Additional requirements exclusive to the project include:

1. ***Mixture** of **sizes** of **unit*** can be achieved by variable location of cross-walls in the terrace or by providingtwo or more groups of buildings of increasing size.
2. ***Office and amenity accommodation*** can be eitherintegral within the volume of building (where sitearea is restricted) or as an attached block (where thedeveloper requires the maximum rental fromproduction/storage area).
3. ***Goods access*** sufficient heavy goods vehiclemanoeuvring and parking areas must be allowed
4. ***Security*** is important - both physical (mainly theftof high-technology equipment) and intellectual (lossof staff to neighbouring firms).
5. ***Car parking*** required for occupants and visitors

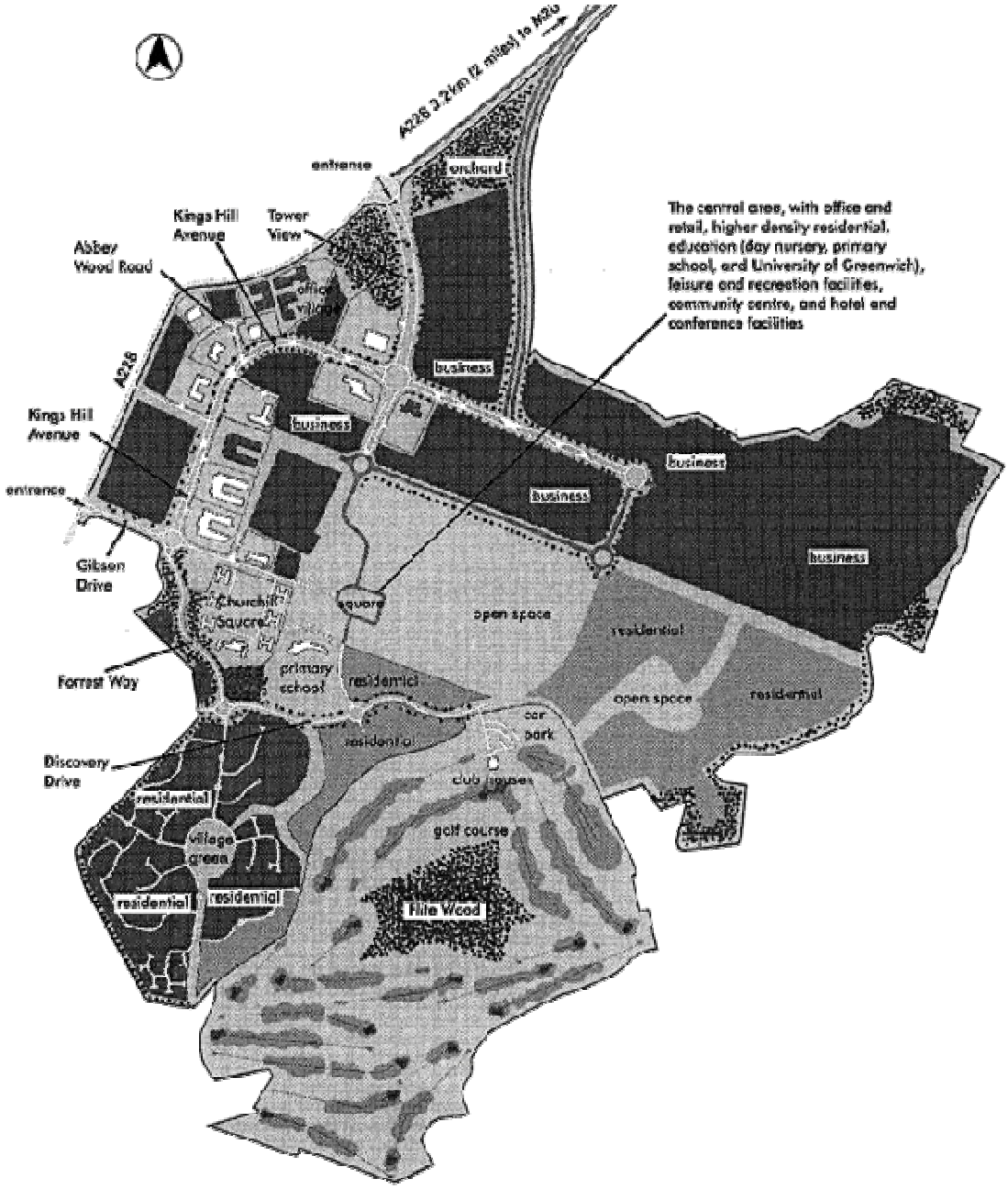


Figure 28: King's Hill Business Park, West Malling, Kent; September 1997 masterplan, for illustrative purposes only (Developers: Rouse Kent Ltd and Kent County Council. Illustration designed by Wordsearch Communications, reproduced by kind permission of Rouse Kent Ltd.)

Architects' Handbook, Pg. 17

Through careful consideration of the requirements, a site located within the Al-Sunut development was found to match the above criteria in addition to providing the project with stunning and unmatched views of the White Nile and Victory Bridge. It neighbours Petrodar tower, GNPOC tower, Zain HQ, Central Bank of Sudan as well as the Coral Hotel, all of which contribute to the previously mentioned 'central location'.

3.2.2 Site Information

Location: South of Nile Street, North of Victory Bridge and west of the Central bank of Sudan

Neighbors:

North: Investment Site

East: GNPOC Tower and Petrodar Operating Company

West: The White Nile

South: Victory Bridge

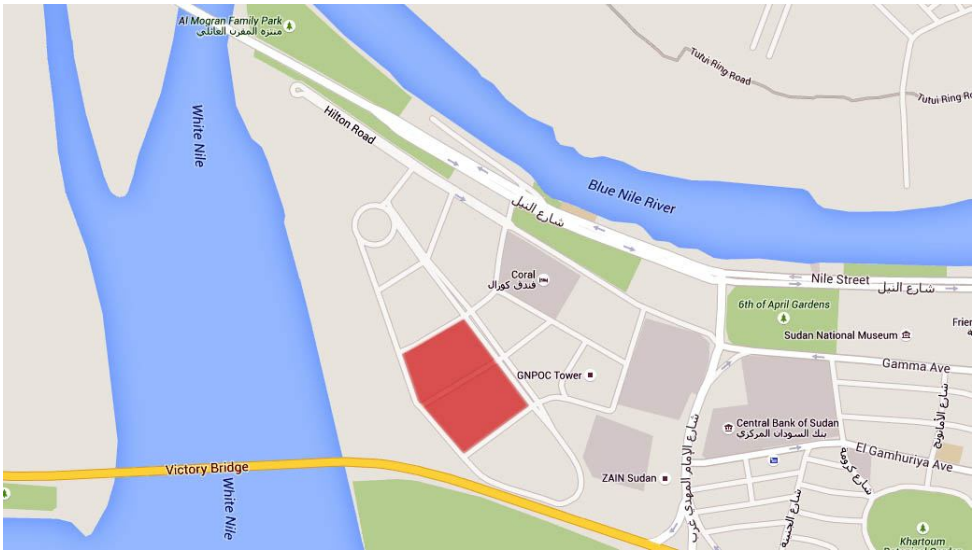
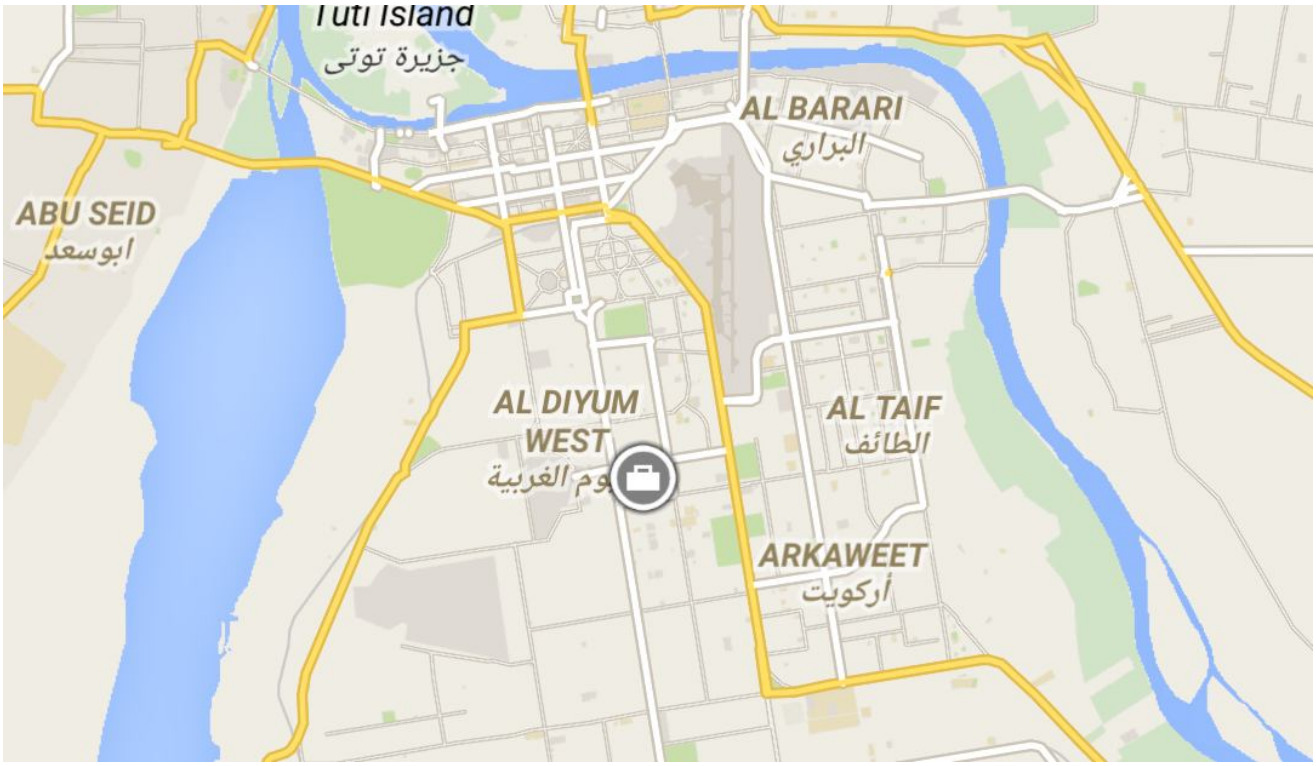


Figure 29: Map Data @2015 Google; showing the selected site located within the Al-Sunut development, access roads and neighbouring structures

Total site area: 6.5 hectares

The site is conveniently surrounded by access roads from all sides, with appropriate orientation for both ventilation and daylight in spite of its irregular shape. The area currently has little to almost no traffic, however future developments also wouldn't pose a threat considering the infrastructure already built for the development. The neighbouring forest offers great ventilation by cooling the air coming from the White Nile on the southwest side of the site via natural evaporative cooling and filtering dust particles.

3.2.3 Site Location



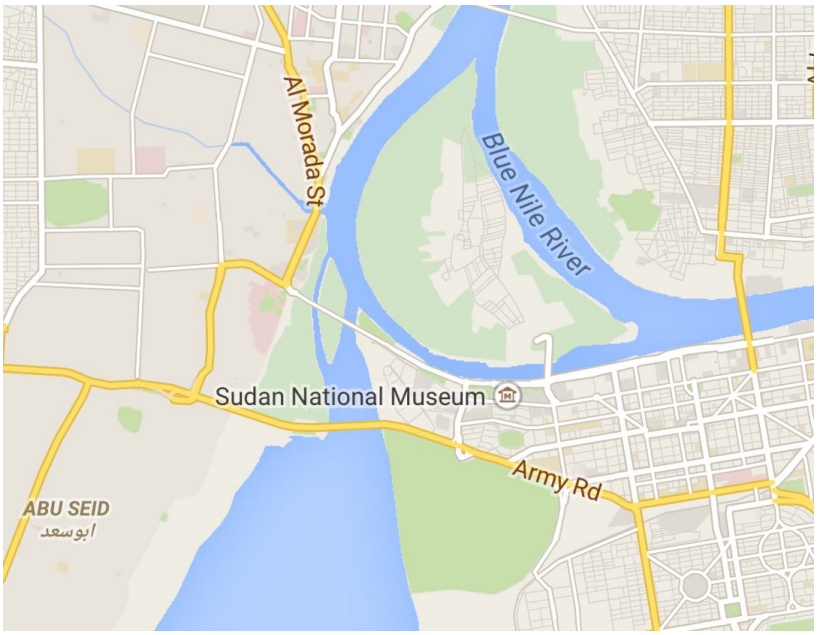


Figure 30 to 31: Map Data @2015 Google; showing the location of the selected site of the project which lines in "Al-Sunut" in the city of "Khartoum" in "Sudan"

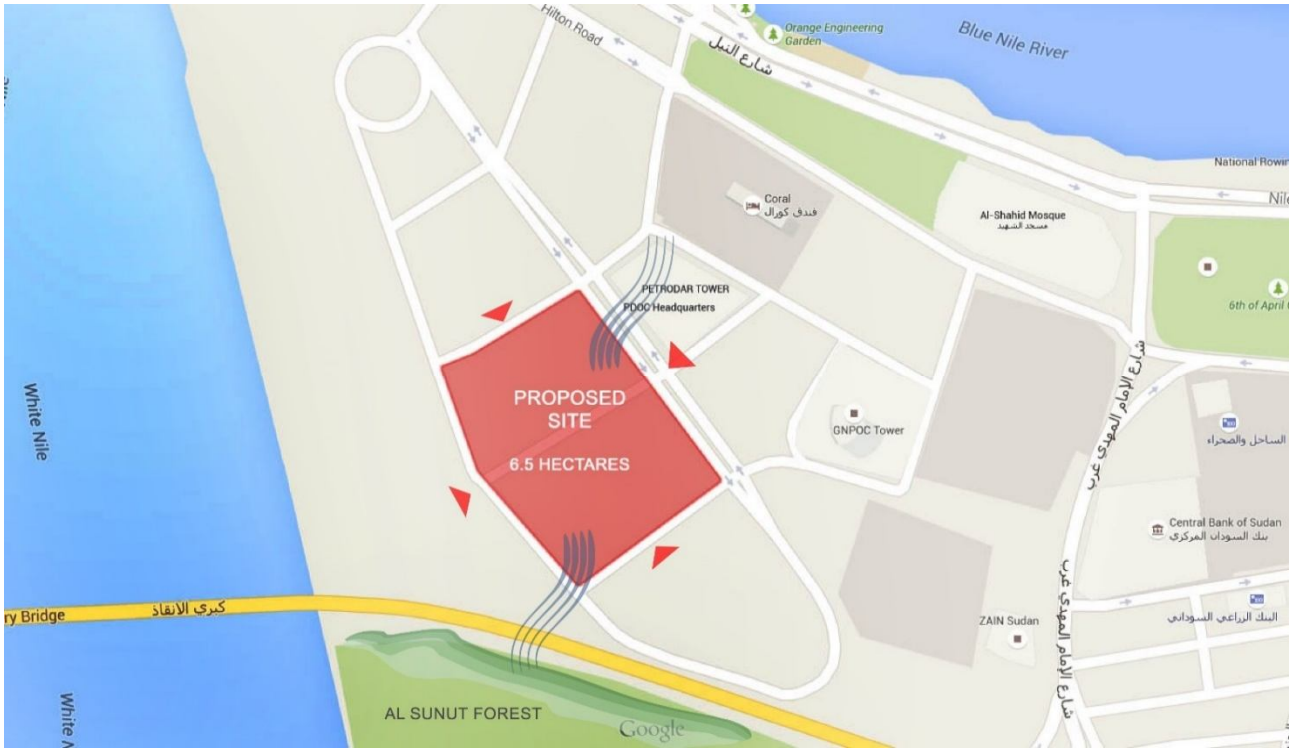


Figure 32: Map Data @2015 Google; showing the selected site and the direction of wind affecting it.

3.2.4 Urban Environment:

3.2.4.1 Reaching the Site

The following figures will show how the site is connected to the main transportation Areas in the city of Khartoum plus Khartoum's International Airport because this project is supposed to be Regional so its connection to the airport is important.

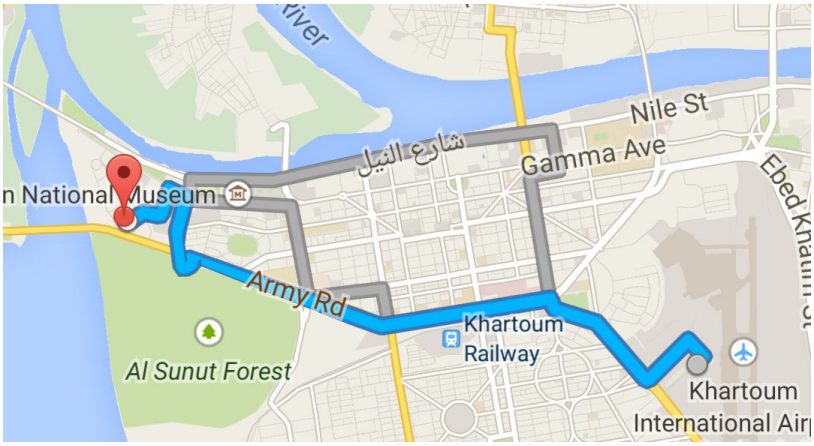


Figure 33: Map Data @2015 Google; showing the possible roads to Khartoum International Airport, the shortest route is marked in Blue with the distance of 7.2KM.

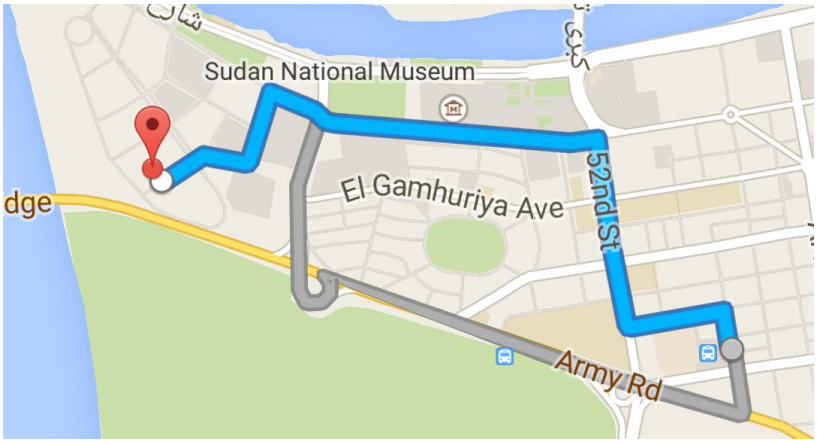


Figure 34: Map Data @2015 Google; showing the possible roads to Khartoum Bus Station (Stadium Station), the shortest route is marked in Blue with the distance of 2.9KM.

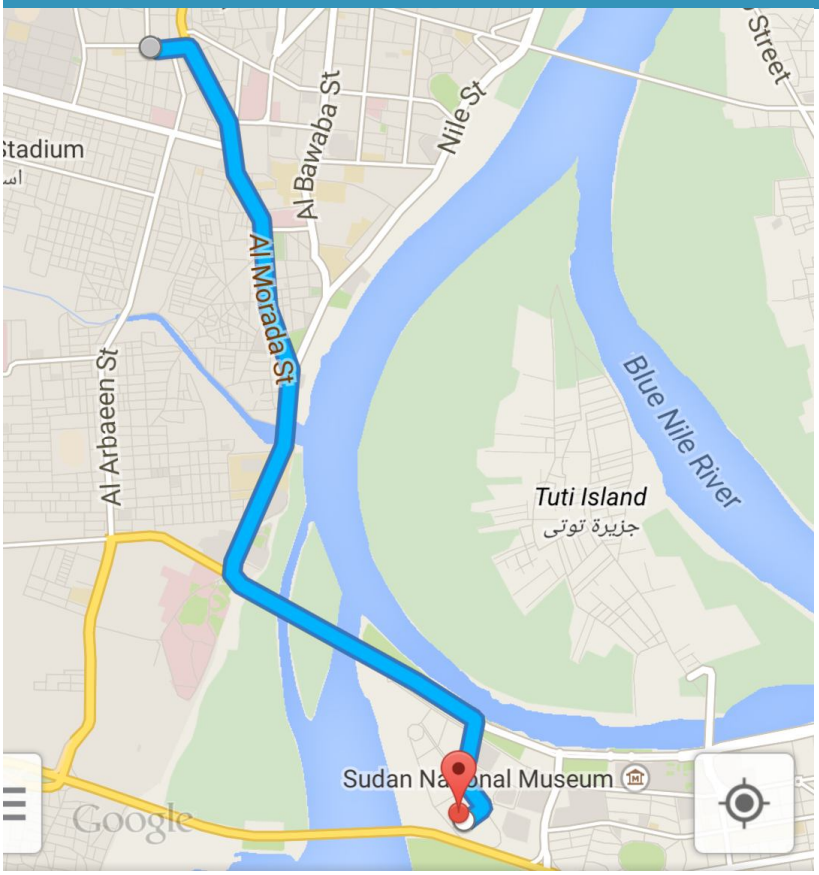


Figure 35: Map Data @2015 Google; showing the possible roads to Al-Busta Station in Omdurman, the shortest route is marked in Blue with the distance of 6.0KM.

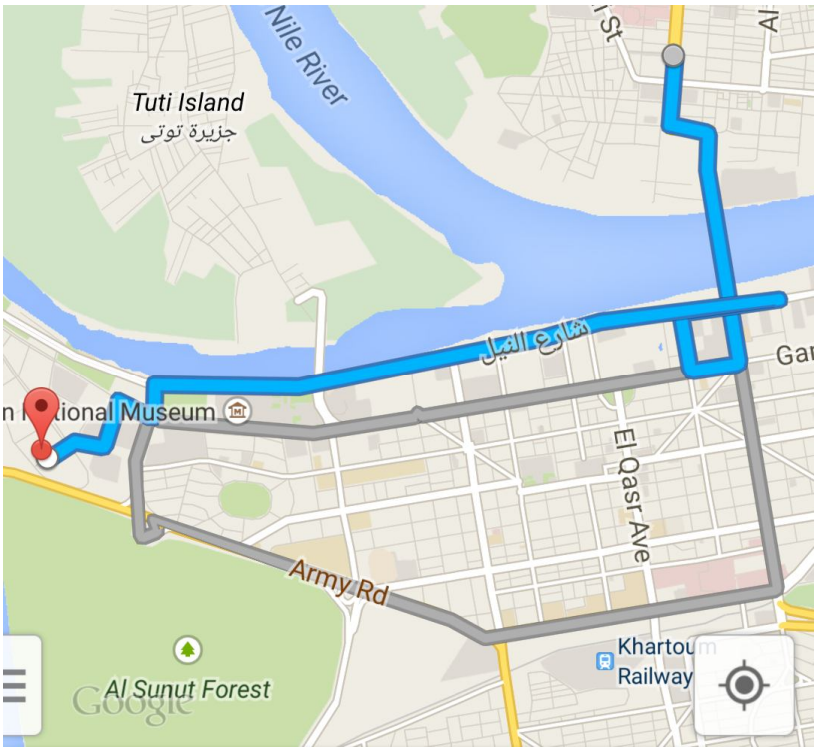


Figure 36: Map Data @2015 Google; showing the possible roads to Bahri Central (Al-Wosta Station), the shortest route is marked in Blue with the distance of 7.3KM.

3.2.4.2 Pollution:

- The road on the east of the site has the highest level of traffic in it because there are two companies there and a parking between them which lead to it being the main source of noise and pollution to the site.
- On the south of the project lies the Victory Bridge which can have a moderate effect on the site in the aspect of noise and pollution.
- The 4 roads have low levels of traffichencethe noise and pollution coming from them and affecting the site are low.

3.2.5 Natural Environment:

- Khartoum 15.50 N, 32.54E.
- Altitude 382m above sea level

3.2.5.1 Temperature:

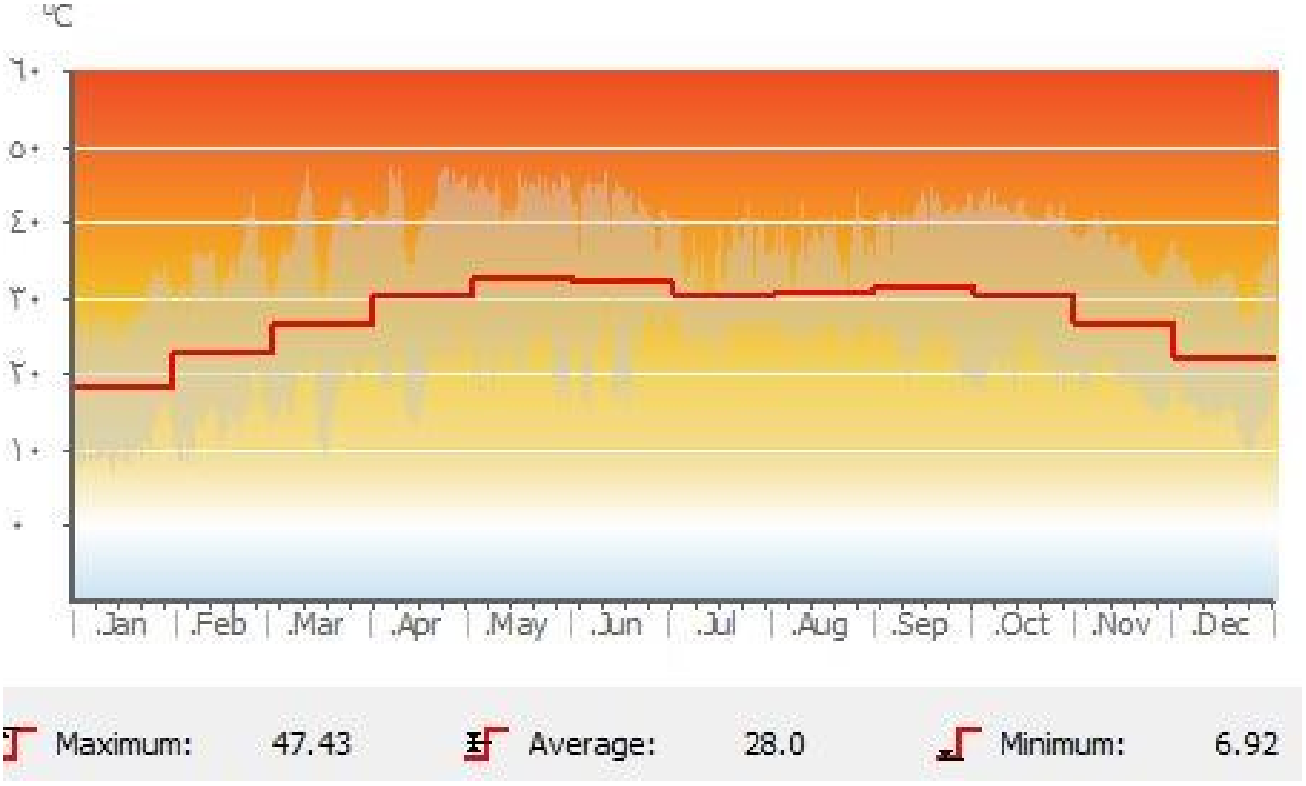


Figure 37: Weather data, showing the variations of temperature in the site throughout the year.

- The maximum average Temperature of a month is in May 33º.
- The Minimum average Temperature of a month is in January 19º.

3.2.5.2 Relative Humidity:

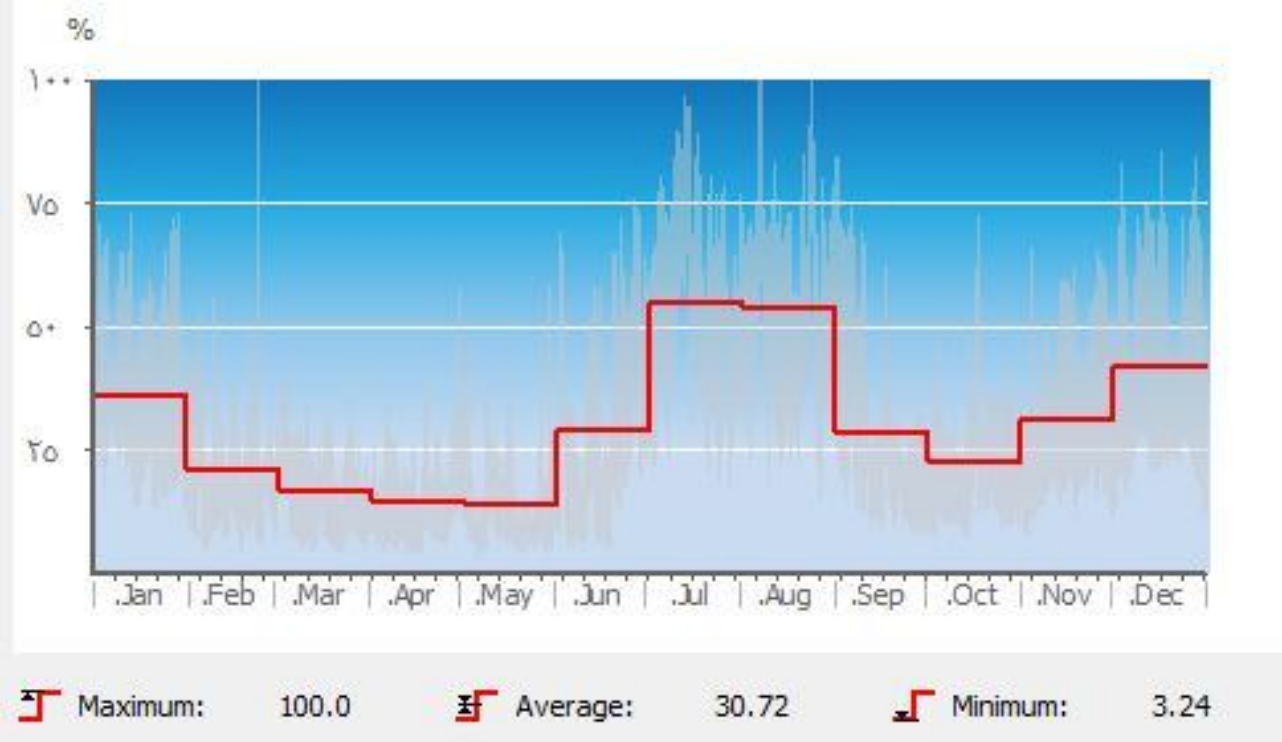


Figure 38: Weather data, showing the variations of Relative Humidity throughout the year.

- The maximum average relative humidity of a month is in July 57%.
- The Minimum average relative humidity of a month is in May 14%.

3.2.5.3 Solar Radiation:

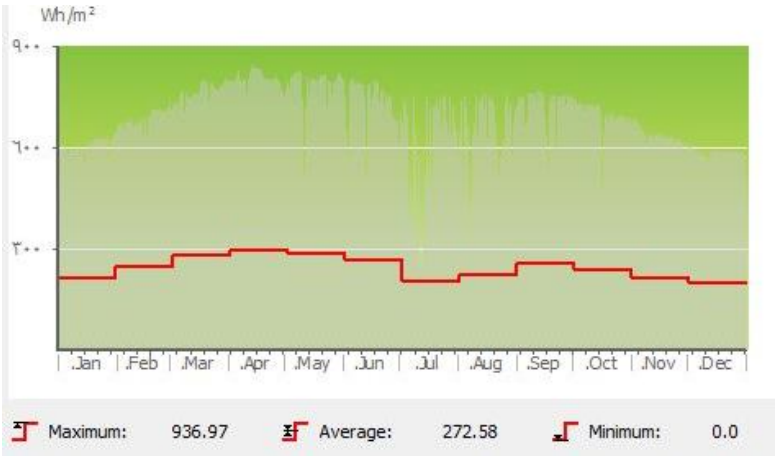
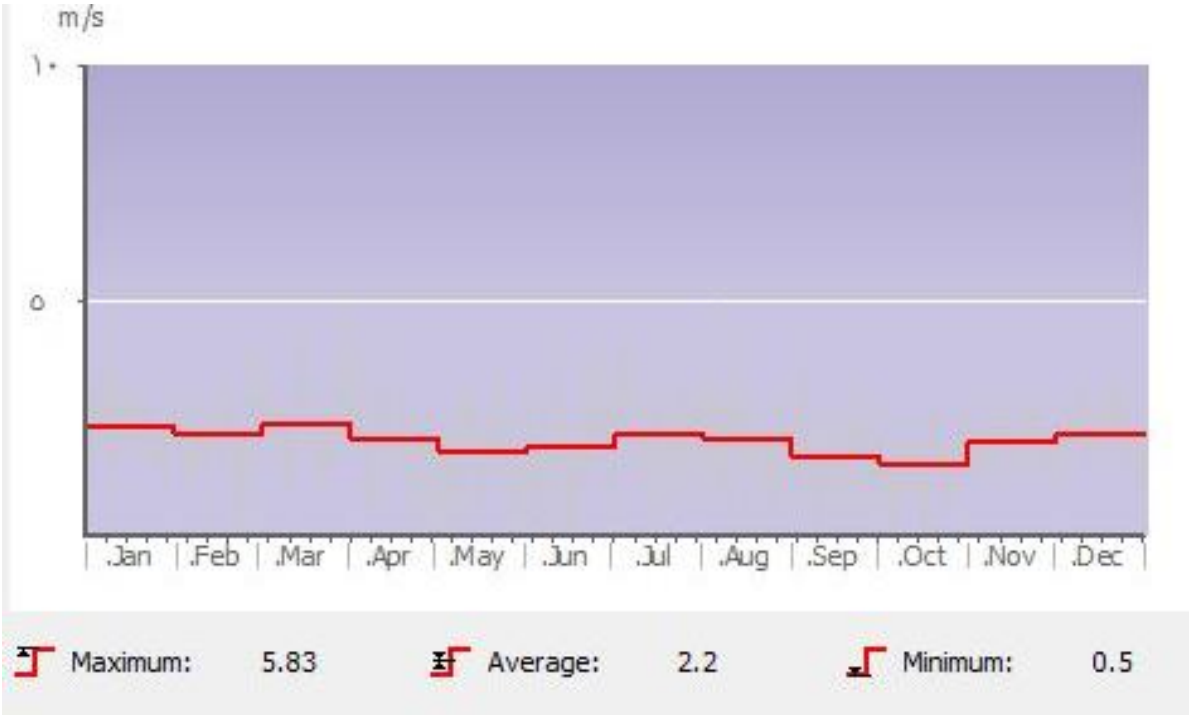


Figure 38: Weather data, showing the variations of Solar Radiation throughout the year.

- The maximum average solar radiation of a month is in April 300 Wh/m^2.
- The Minimum average solar radiation of a month is in July and December 200 Wh/m^2.

3.2.5.4 Wind Speed:



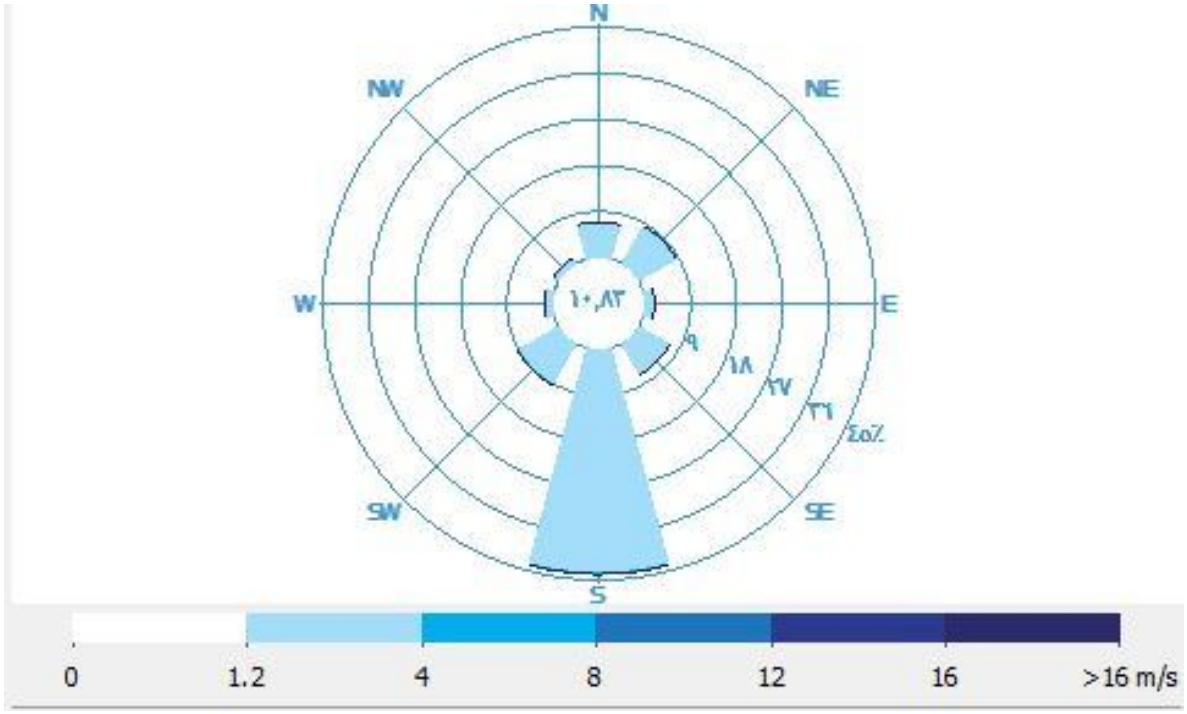


Figure 39 and 40: Weather data, showing the variations of wind speed throughout the year in Khartoum

3.2.5.5 Rain:

- Rain falls in the months of July and August (winter season)
- Khartoum receives an average of 14mm of precipitation per month in winter.

3.2.5.6 Terrain and Topography:

The site is pre planned by the Ministry of planning and so it is now flat without any terrains in it.

3.2.5.7 Hydrology:

The White Nile is close to the site which can affect the buildings and the foundations of it.

3.2.6 Indicators and Guidelines:

3.2.6.1 Indicators:

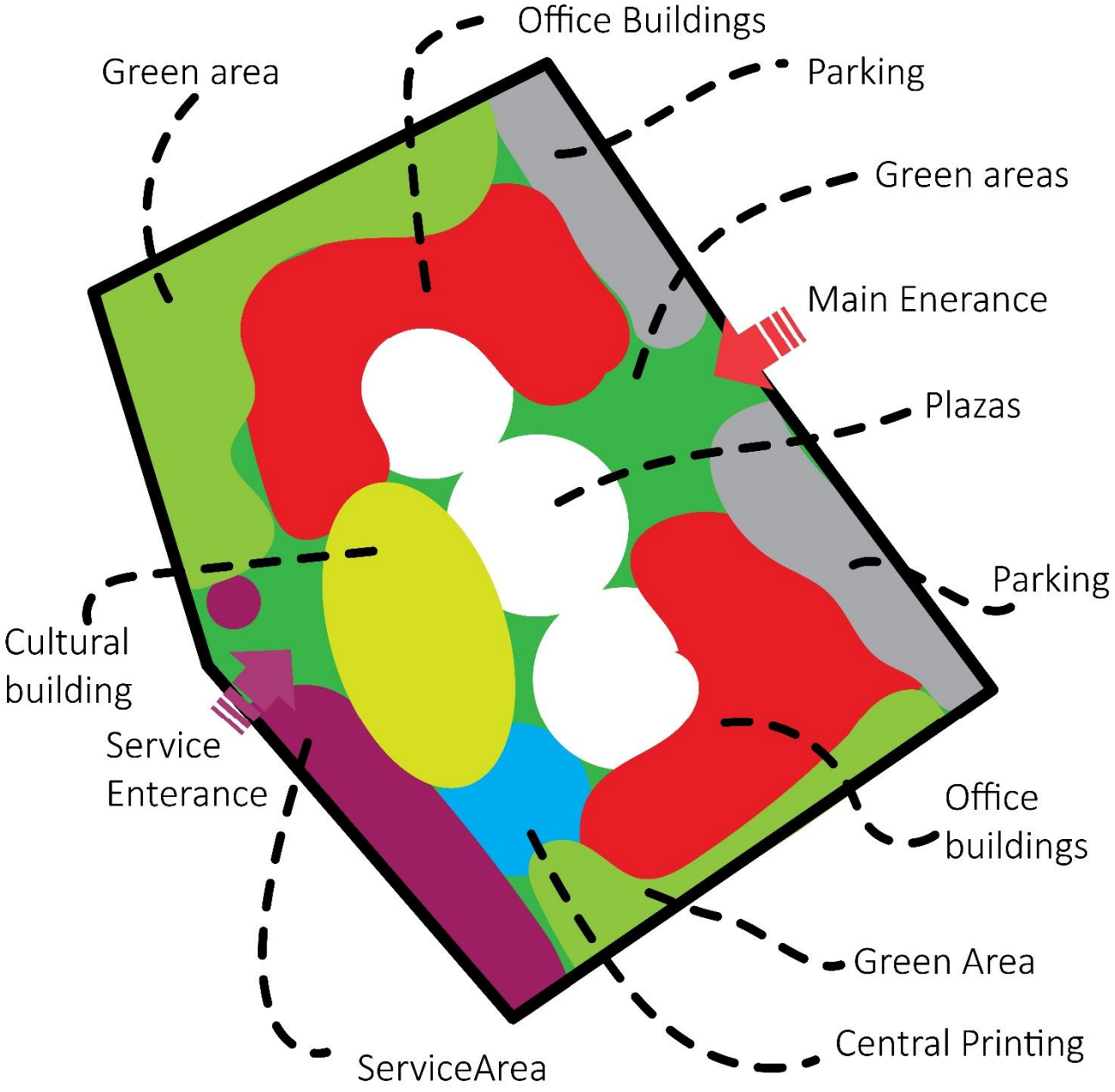
- The widest road is one the east of the site and it's the closest from the entrance of the Sonot project therefore themain entrance is from the eastern side.
- Placing some trees around the sides of the project to protect it from the different types of pollution.

3.2.6.2 Guidelines:

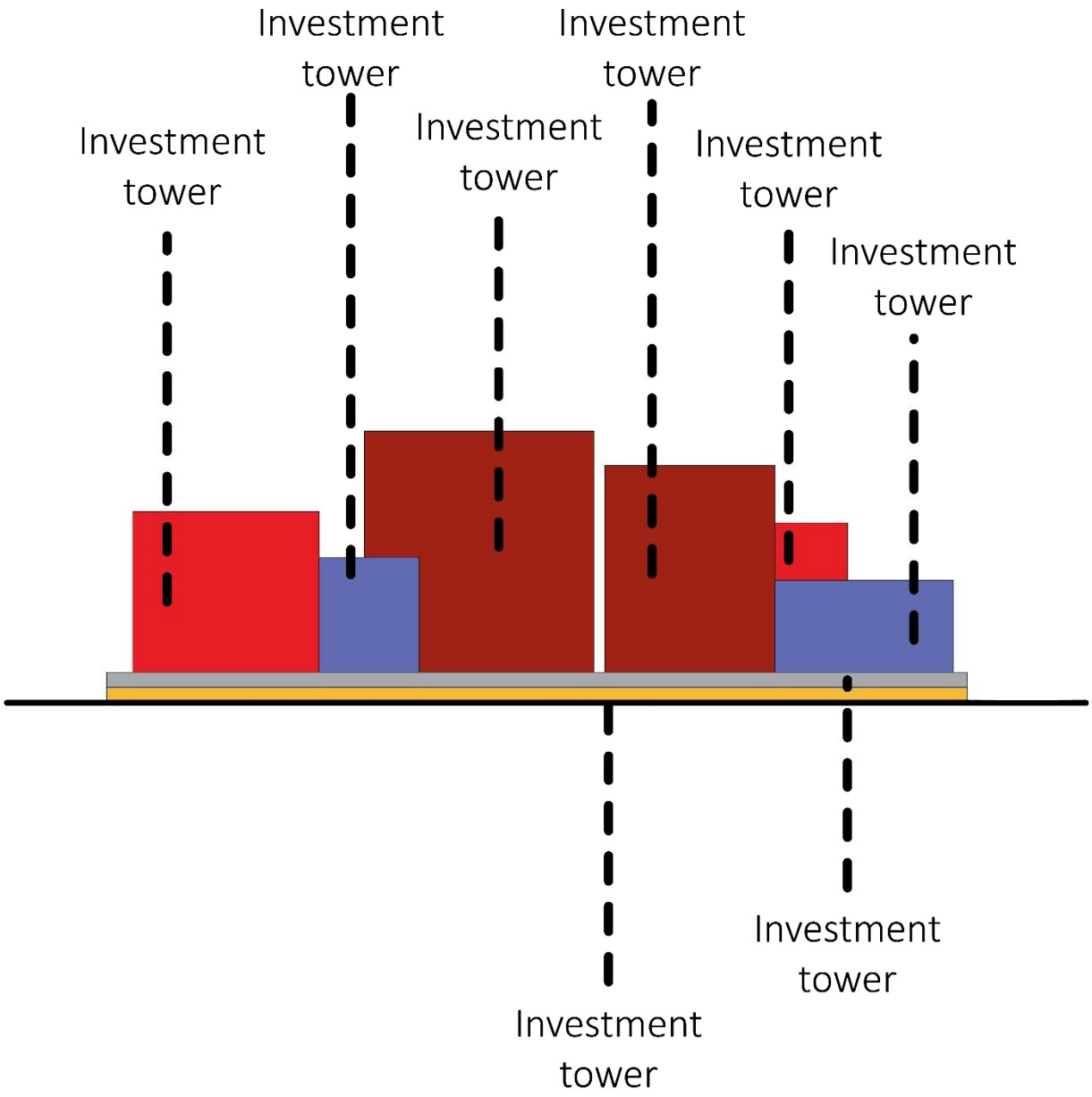
- Providing an entrance and a standalone parking for the investment building because it has alargenumber of users.
- Placing the central printing building in the west side to be close to the services area and the services entrance.
- Placing the spaces which are used by the visitors in the ground floor or in a central area to be accessed easily.

3.2.7 Zoning:

3.2.7.1 Horizontal Zoning:



3.2.7.2 Vertical Zoning:



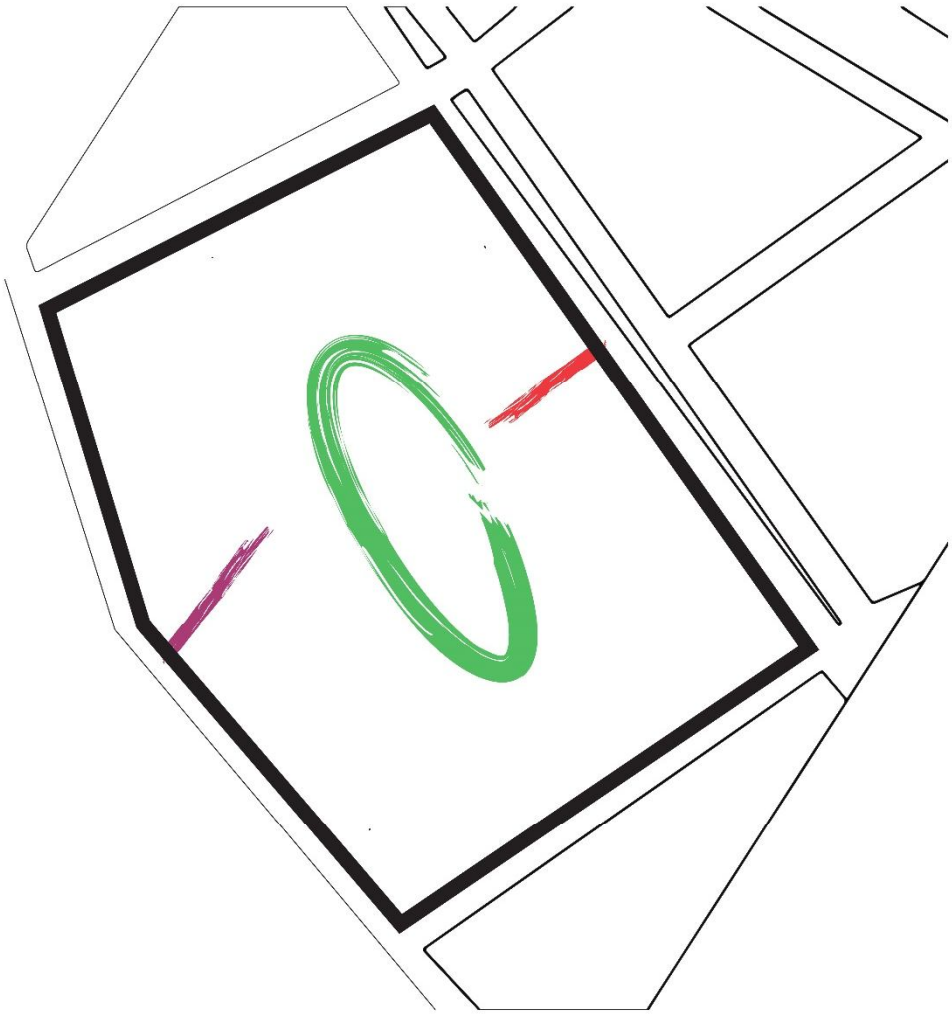
CHAPTER IV: Design Process

- Design Concept
- Design progress and development
- Final Design

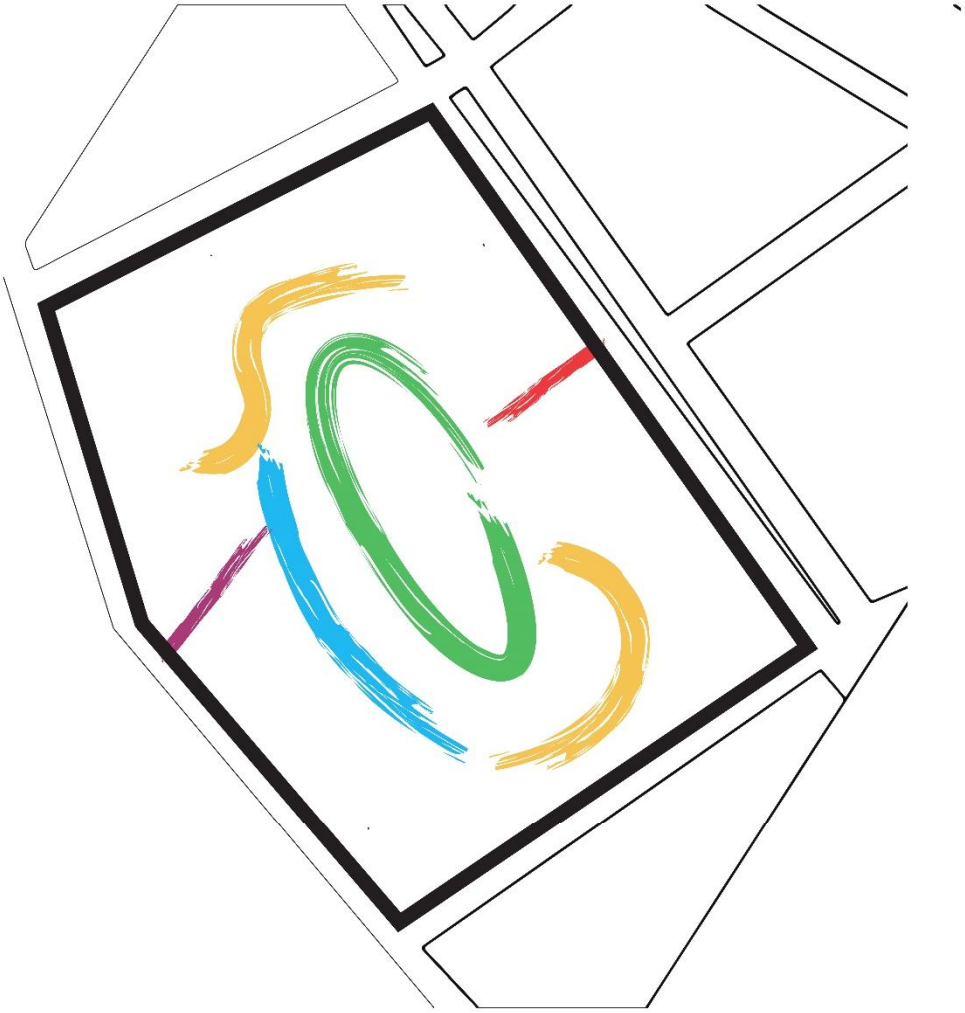
4 DESIGN PROCESS:

4.1 DESIGN CONCEPT:

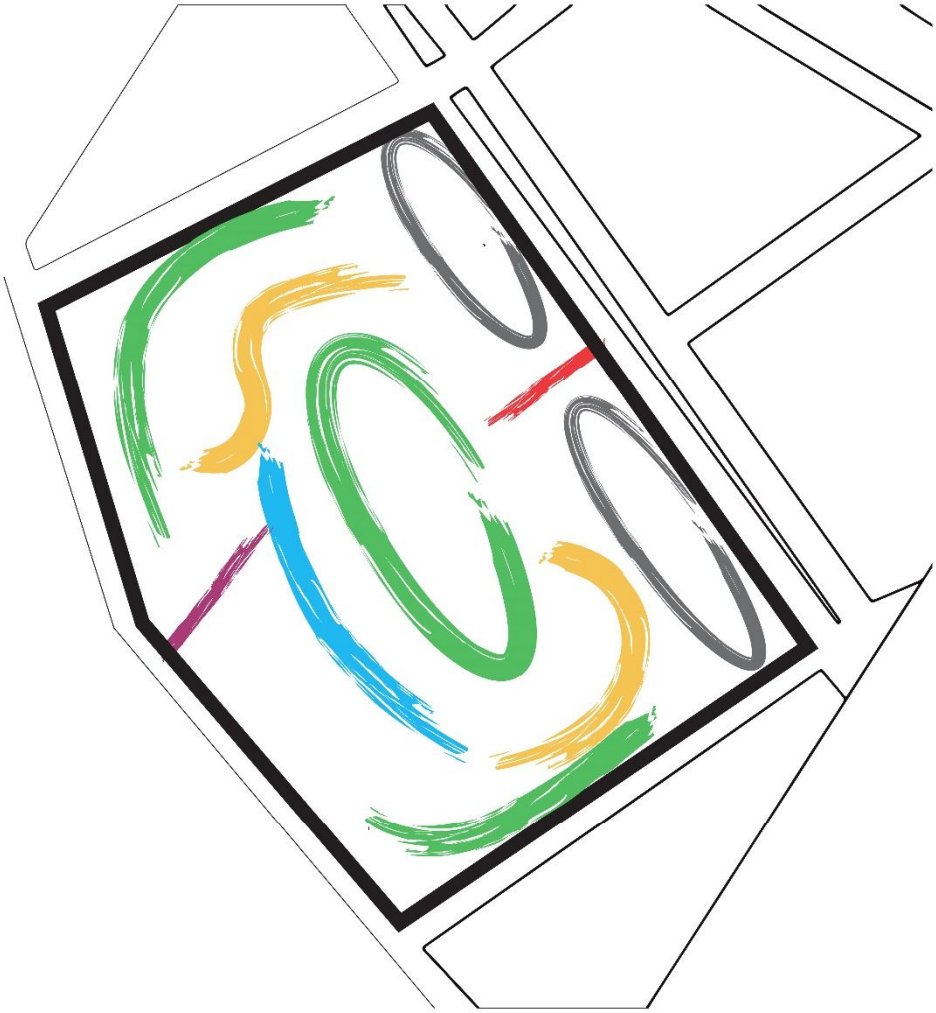
4.1.1 Site Plan and forming Concept



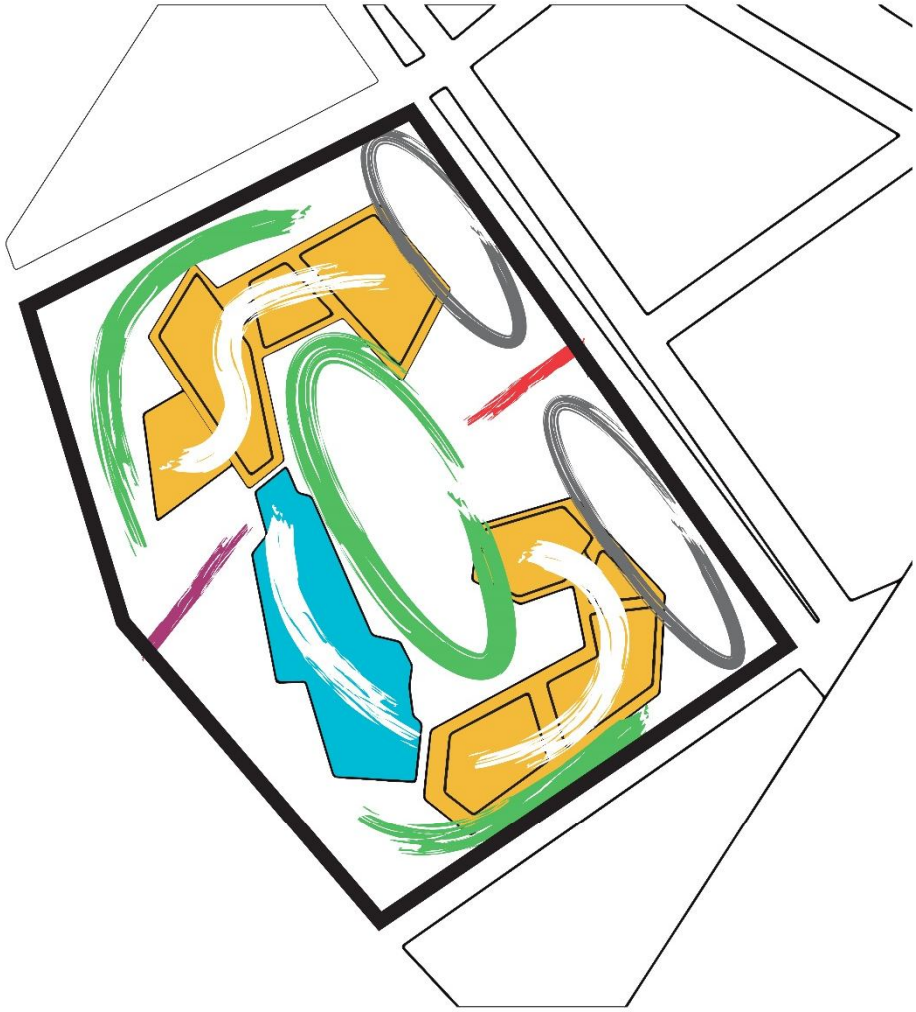
The red line on the east side of the project represents the main enterance
The purple line on the west side of the project represents the service enterance
The green oval in the middle represents the main plaza where people circulate to the different parts of the project



The **Golden lines** around the oval represents the office buildings, how they are going arund the oval to creat a central space and make the circulation easier in the project
The **Blue line** on the left side of the oval represents the cultural section of the project, its on the left side alone to connect the office buildings, be closer to the services enterance and to be the front door for visitors

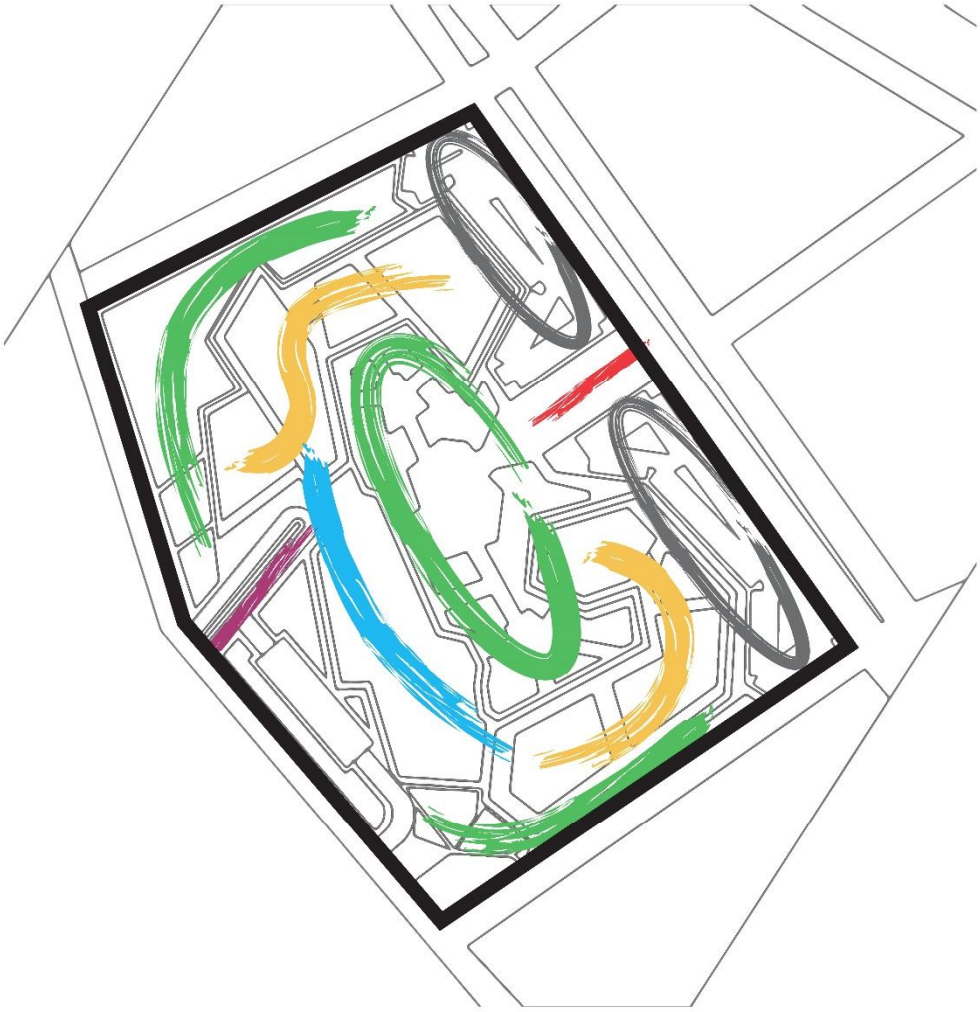


The Grey Ovals represent the parking areas, how they are close to the main enterance on both of its sides and on the main street
The Green Lines on the outside side of the project behind the buildings represents the green areas of the project

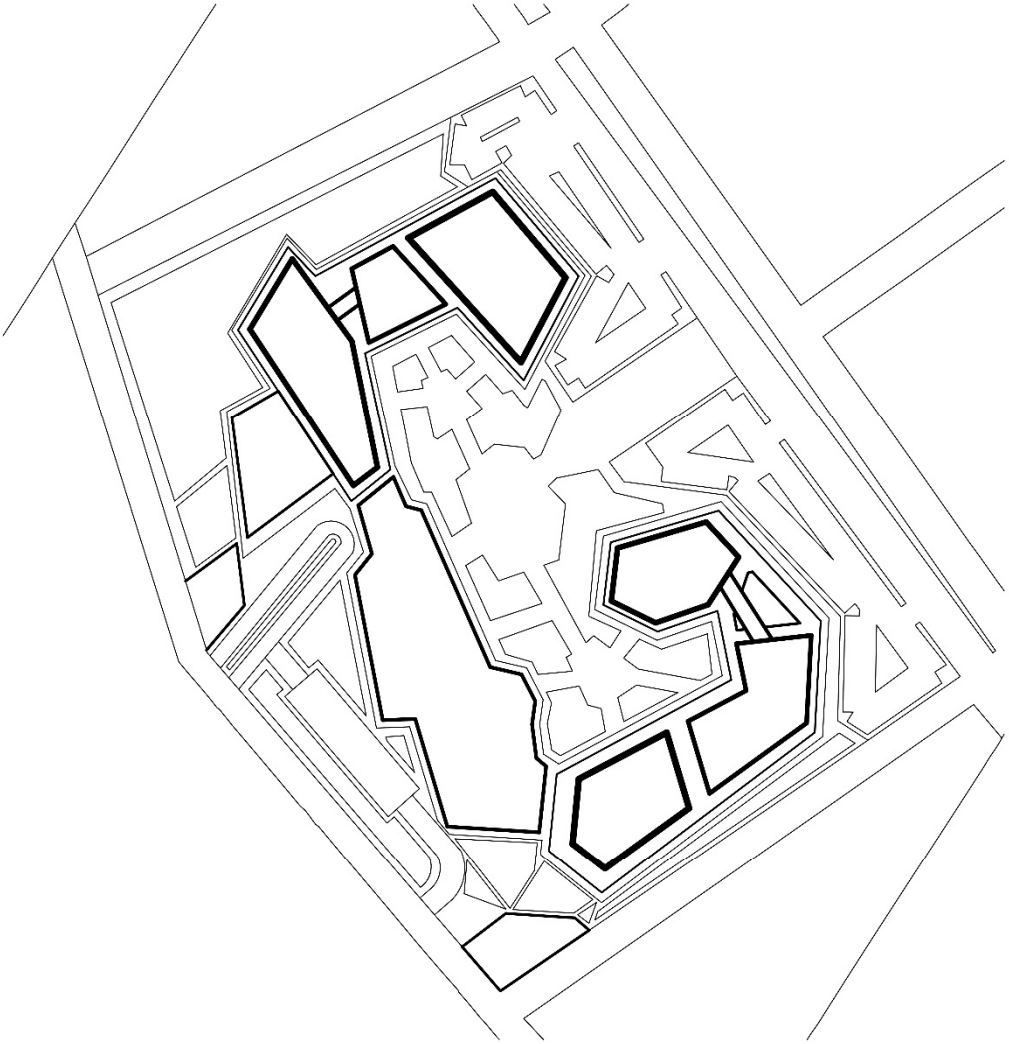


Shaping the buildings around their lines of circulation by using triangle and mainly acute angles in the project

The use of acute angles and triangles represents simplicity because triangles are one of the simpliest shapes, plus the fact that they are out of the ordinary and so they reflect creativite side of the project



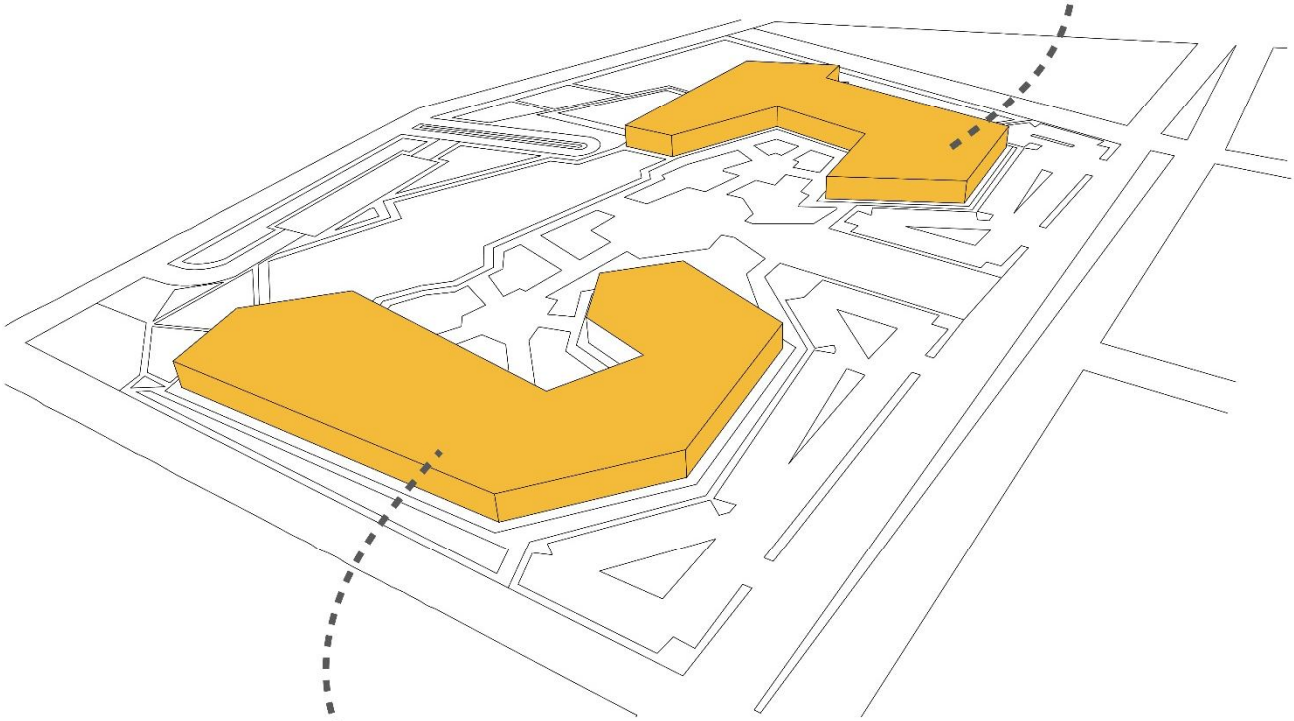
Shaping the landscape, the parking, the service enterance and the pavments according to the concept by using triangle and acute angles, this drawing shows the lines of circulationing and the zones and how the shapes of the buildings are connected in a linear way



The final site plan according to the concept

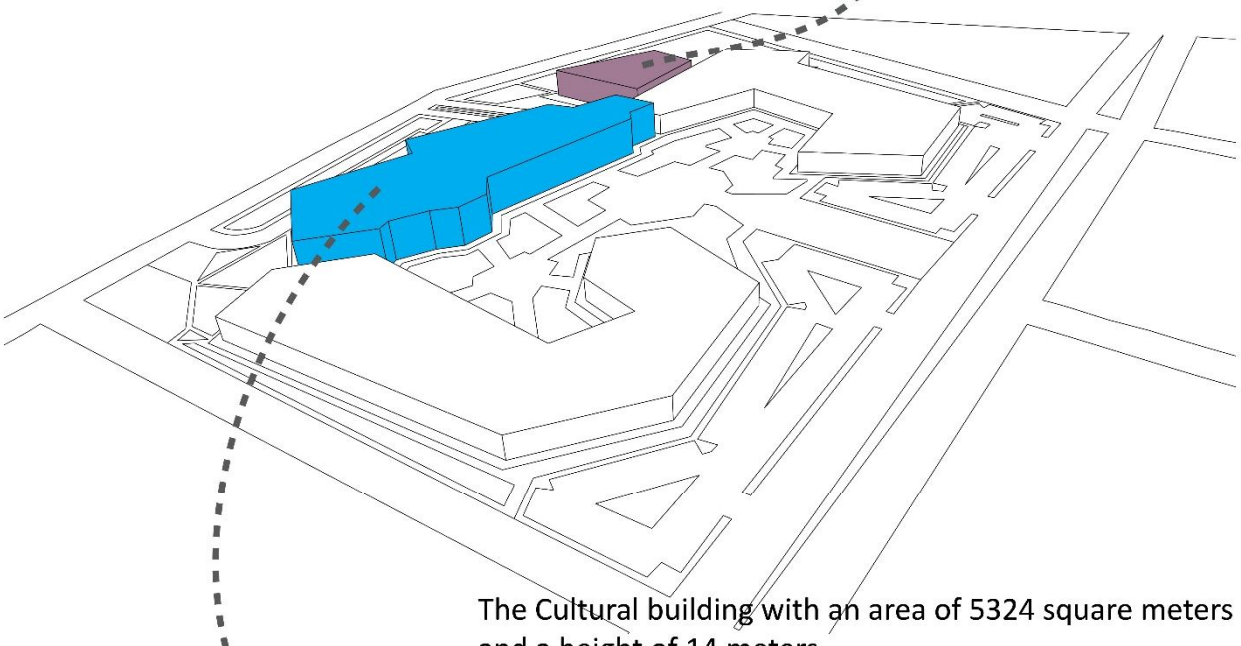
4.1.2 The 3D Concept

The north base with an area of 8054.4 square meters containing the Public Intraction offices in the ground floor with a height of 4 meters
Containing the services and entertainment spaces with the height of 3 meters



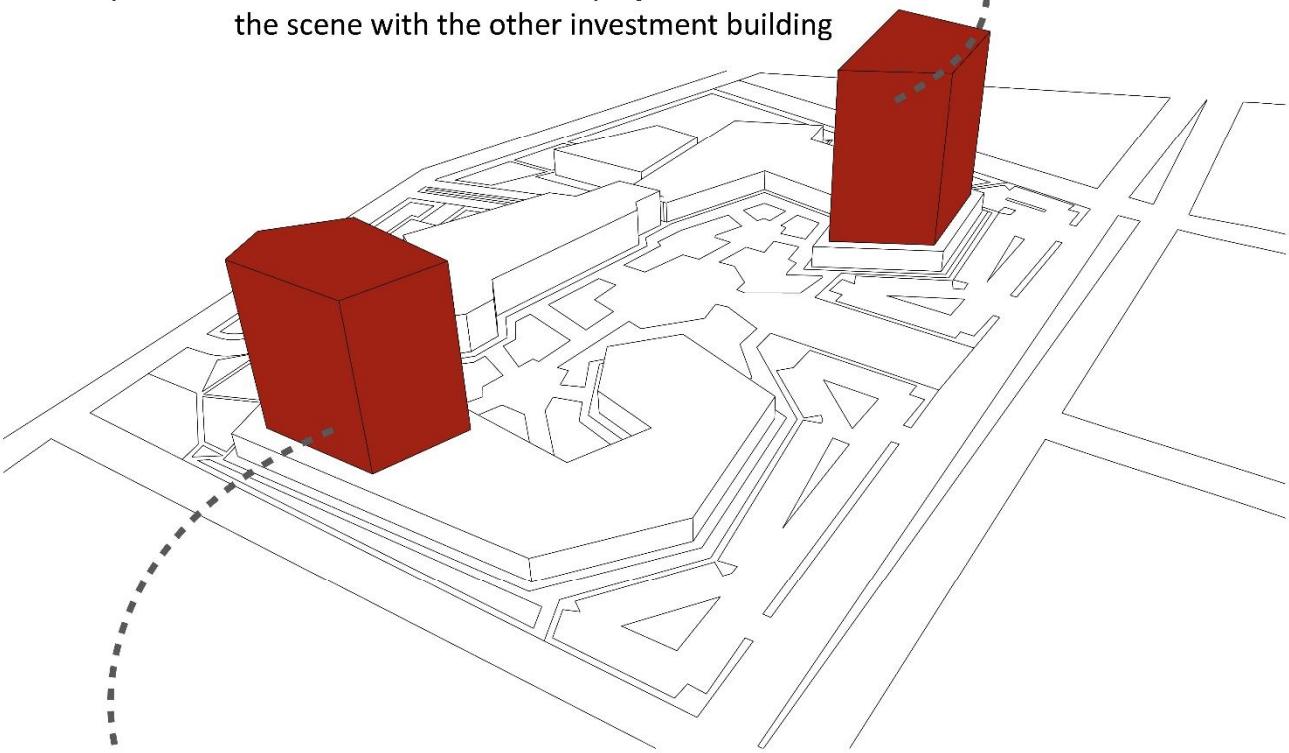
The south base with an area of 7507 square meters containing the Public Intraction offices in the ground floor with a height of 4 meters
Containing the services and entertainment spaces with the height of 3 meters

The Video shooting studio with an area of 1200 square meters and a height of 11 meters
Its facing towards the west side of the project to be close to the service enterance



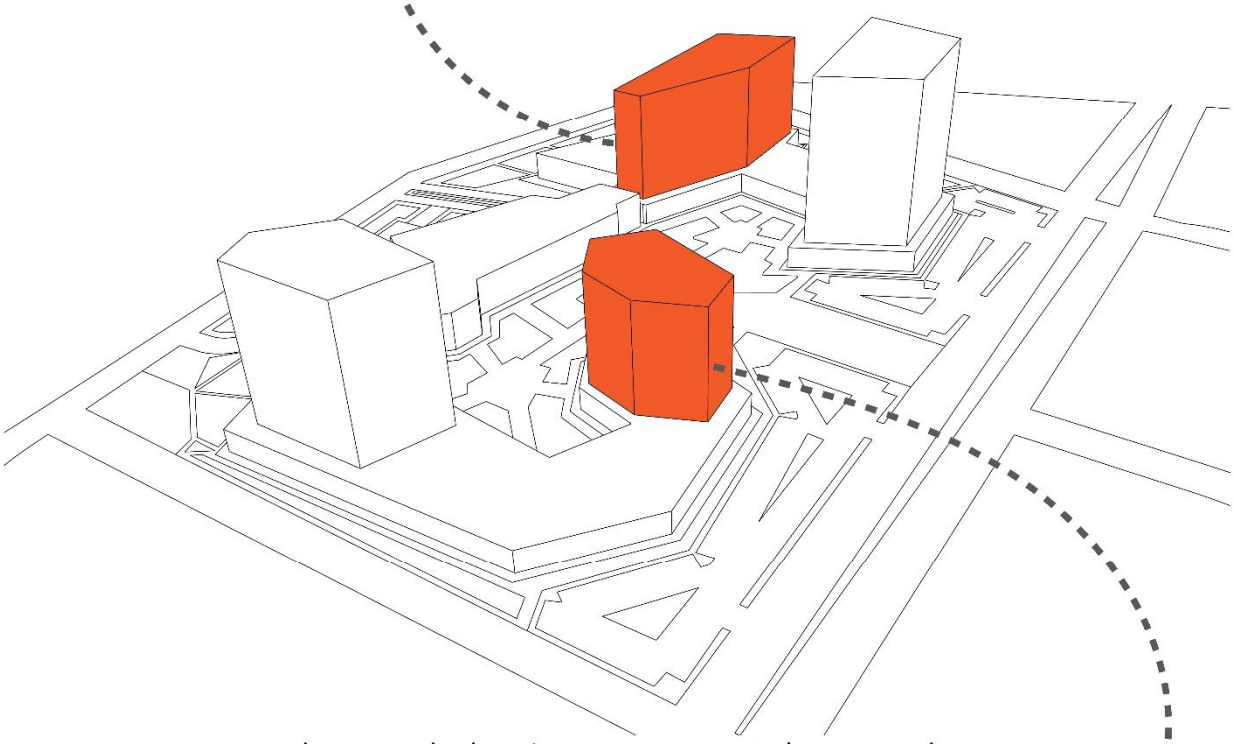
The Cultural building with an area of 5324 square meters and a height of 14 meters
containing a Gallery in its north part attached to it is the VIP lounge
In the middle is the stage/theater with its lounge
In the south part is the centeral printing area with its storage area and the offices
Placed right infront of the enterance to welcome visitors

The north investment tower with an area of 960.22 square meters and 63 meters high
The tower contains open floor plans which are available for rental for other companies
Its placed on the north east side of the project to balance the scene with the other investment building



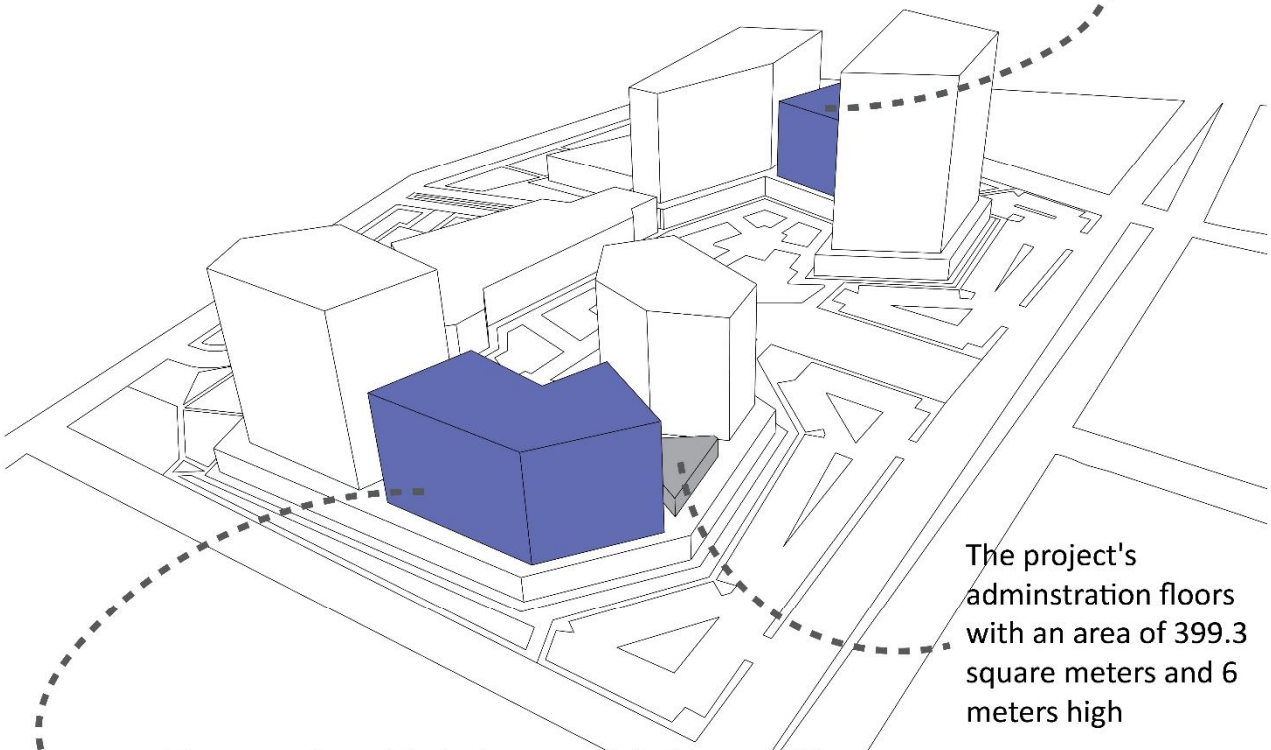
The north investment tower with an area of 1155.89 square meters and 54 meters high
The tower contains open floor plans which are available for rental for other companies
Its placed on the South west side of the project to balance the scene with the other investment building

The first advertisments companies' tower with an area of 1196.63 square meters and 42 meters high
The tower contains offices for the freelances so they can represent themselves in a proper way, offices for advertising companies and offices for a magazine HQ.



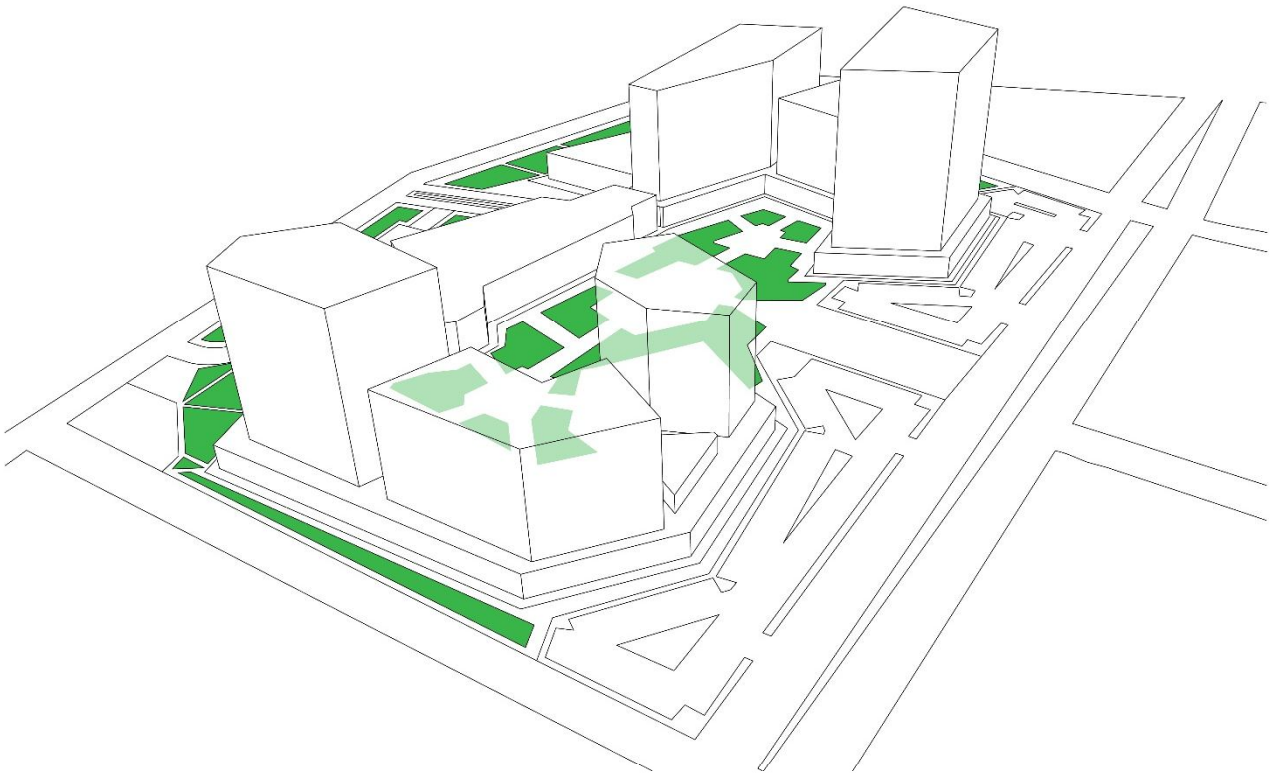
The second advertisments companies' tower with an area of 716.88 square meters and 39 meters high
The tower contains offices for the freelances so they can represent themselves in a proper way, offices for advertising companies and offices for a magazine HQ.

The first graphic design companies' tower with an area of 714 square meters and 30 meters high
The tower contains open offices for the workers, audio recording studios, montag spaces ..etc. all of the needed spaces for the companies to do their job as they should.



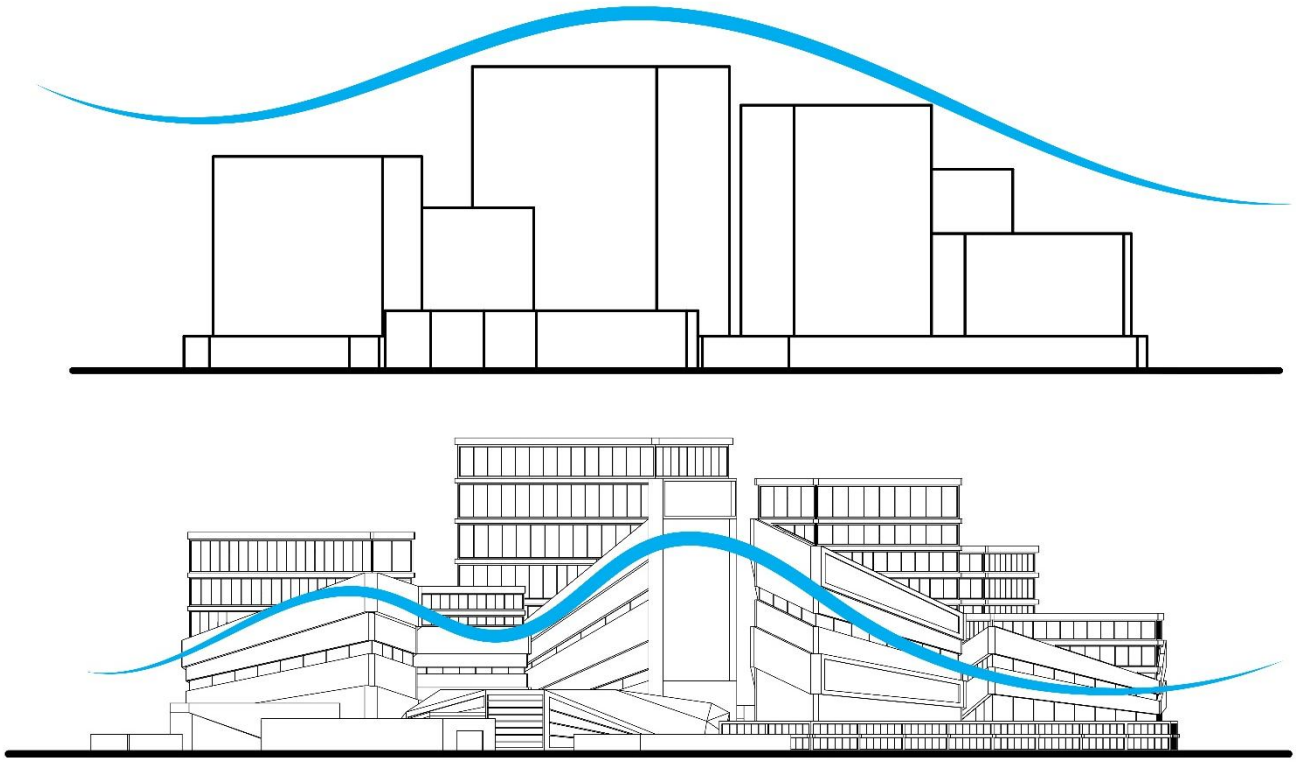
The project's adminstration floors with an area of 399.3 square meters and 6 meters high

The second graphic design companies' tower with an area of 1519.65 square meters and 24 meters high
The tower contains open offices for the workers, audio recording studios, montag spaces ..etc. all of the needed spaces for the companies to do their job as they should.

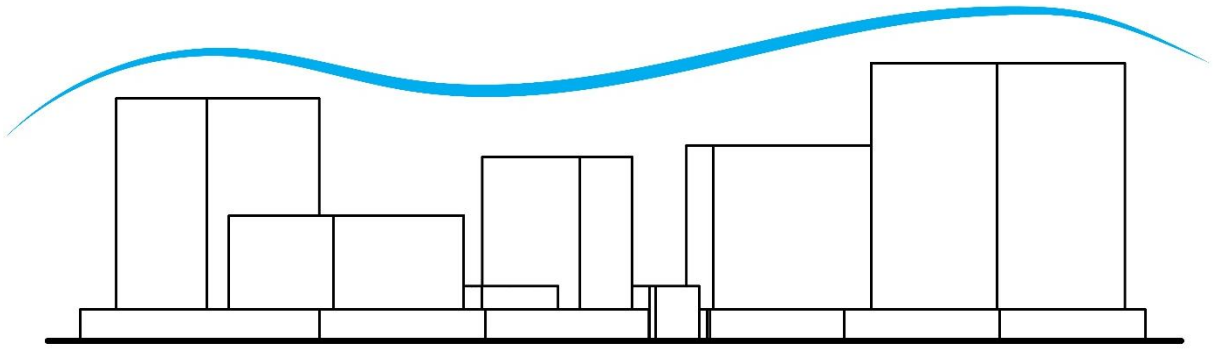


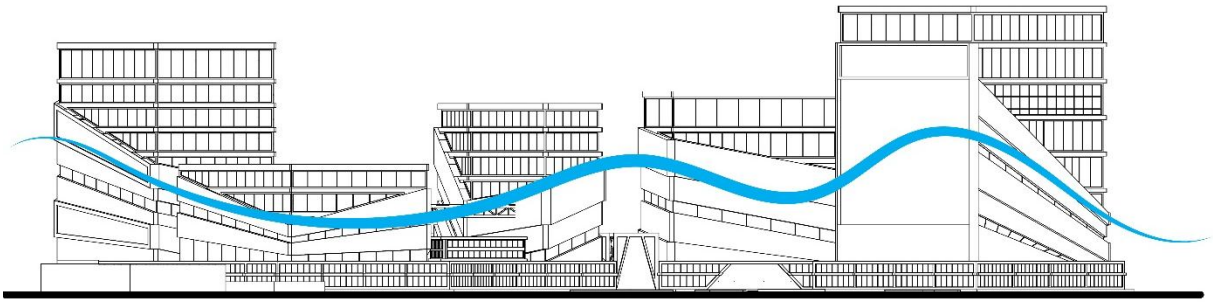
This figure showcases the landscape of the project, the grass to be more specific, how the central plaza can help circulate people through the project by having clear and direct pathways which are restricted by the grass and trees. Having a central plaza which then breaks into two secondary plazas help the visitors and the workers in the project to navigate easier plus they give the feeling of being welcomed since they are surrounded by all of the companies around them and they are all easy to reaach.

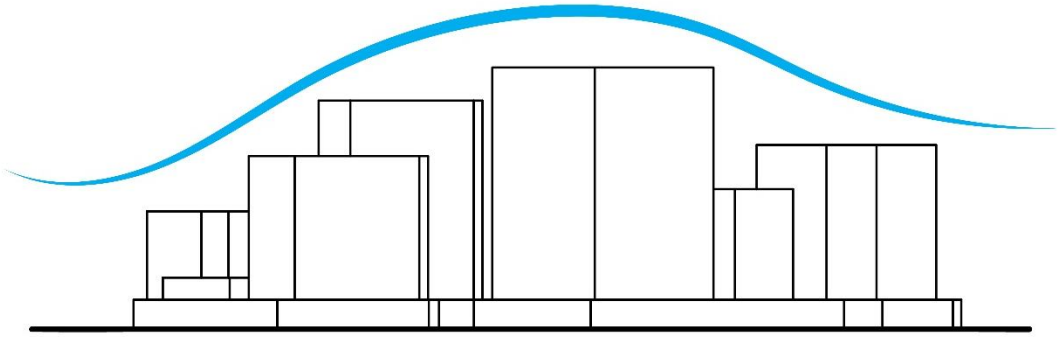
The landscape on the back side of the building is to clean the air of any dust hitting the buildings and to cool of the air of the project as well.

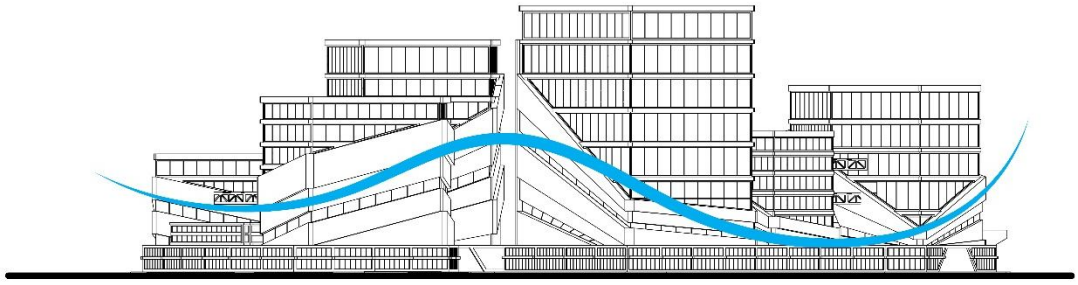


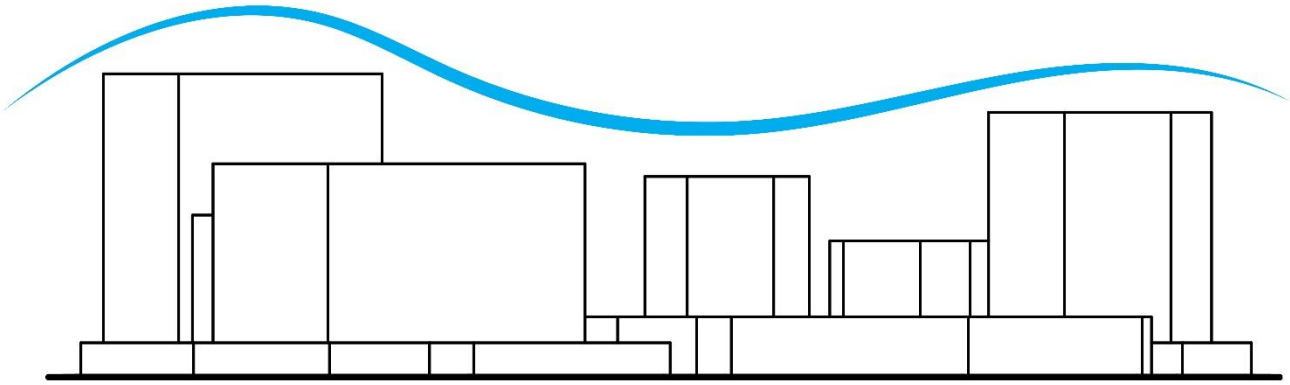
The upper picture shows that the leveling in the project works not only functional but also to create a smooth leveling in the elevation which is balanced, and the blue line showcases hows the leveling is smooth.
The lower picture represents how the use of the smooth transition on leveling can work in the case of detailing the elevation shown by the blue line, the part below the blue line is designed and detailed in a trianglar system which reflects the form of the project, connect the different buildings and towers together in a visual matter from any side of the project and to give the impresion of creativity and being out of order of the 90 degree angle to be different which is what graphic designing is all about.
The part above the blue line is detailed in an all 90 degrees horizontal and vertical lines to give the feeling and impresion that even though this project is all about creativity but it can still be formal and serious which reflects on the the works who will be as creative, serious and pasionate about their jobs.

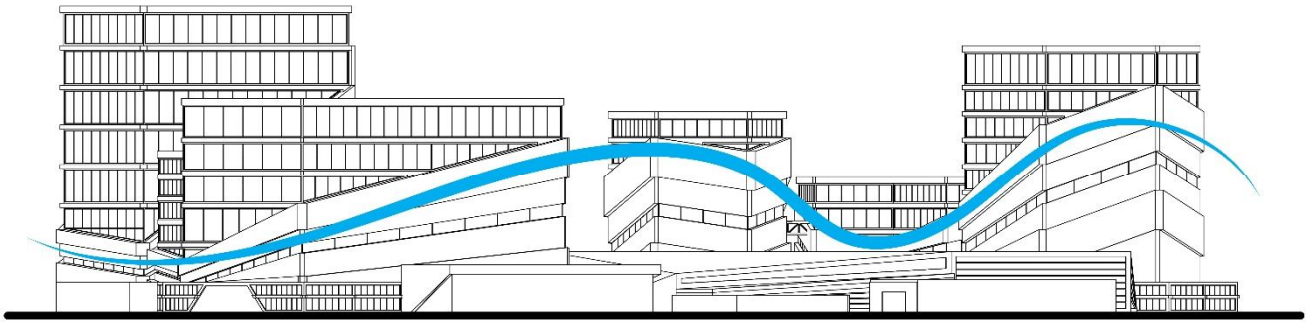








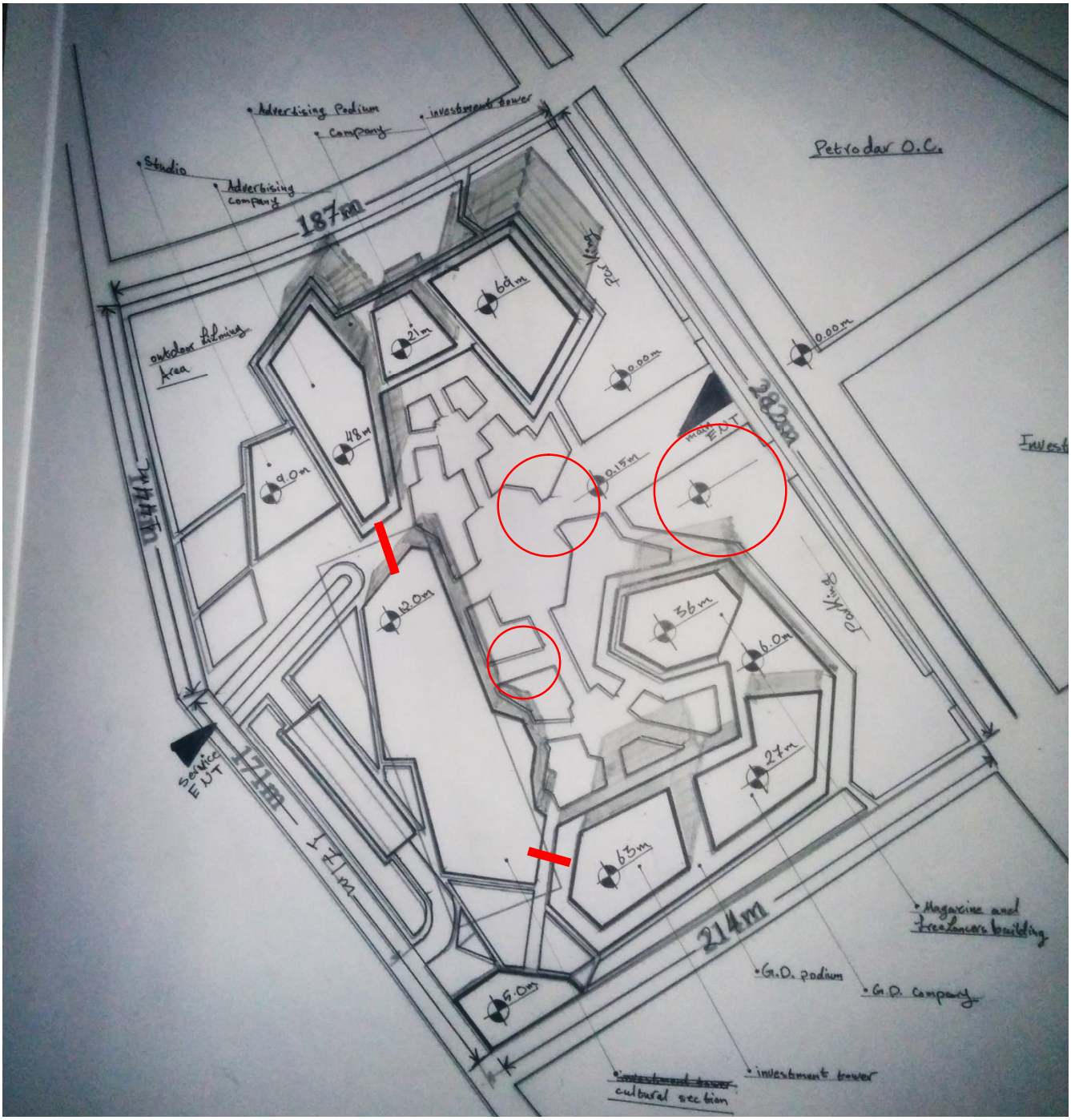




4.2 DESIGN PROGRESS AND DEVELOPMENT:

4.2.1 Initial Idea Phase

4.2.1.1 The Site Plan:

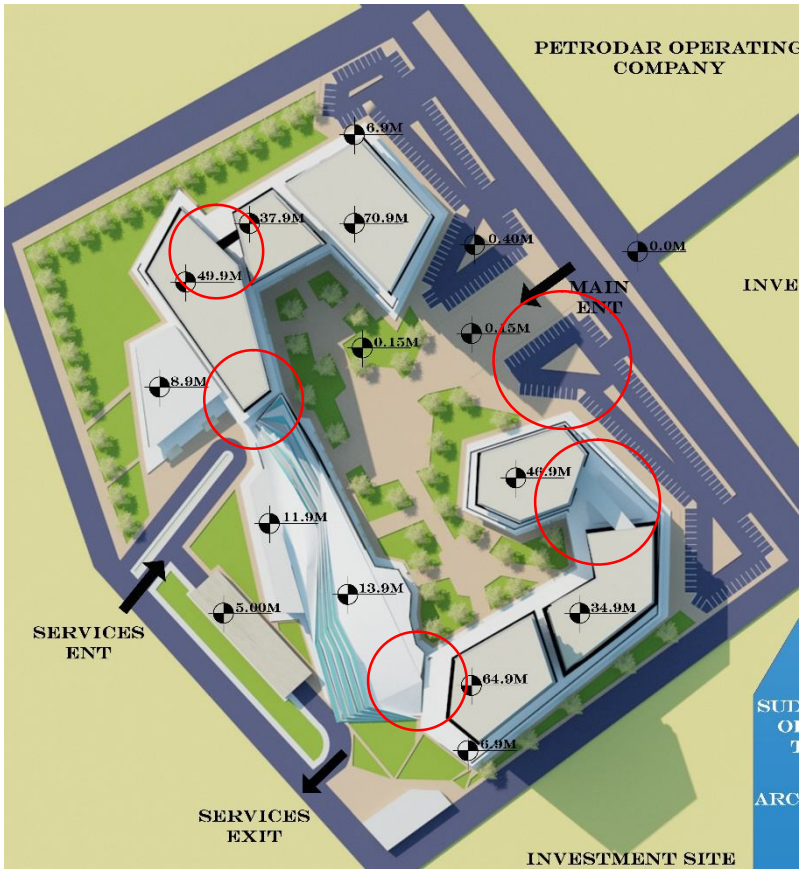


The flaws in the design (marked on the site with red):

- People come in from the entrance from a wide into one that is narrower which can cause the place to be crowded at certain hours.
- The parking spaces are not divided to show exactly how many cars the parking space can take.
- Some of the paths in the landscape in the site are not designed to be the shortest path to the destination.
- There is a gap between the three buildings which causes confusion to the users, it breaks the separation between the service area and the main part of the project plus it causes visual penetration for the viewer.

4.2.2 Developed Idea Phase

4.2.2.1 The Site Plan

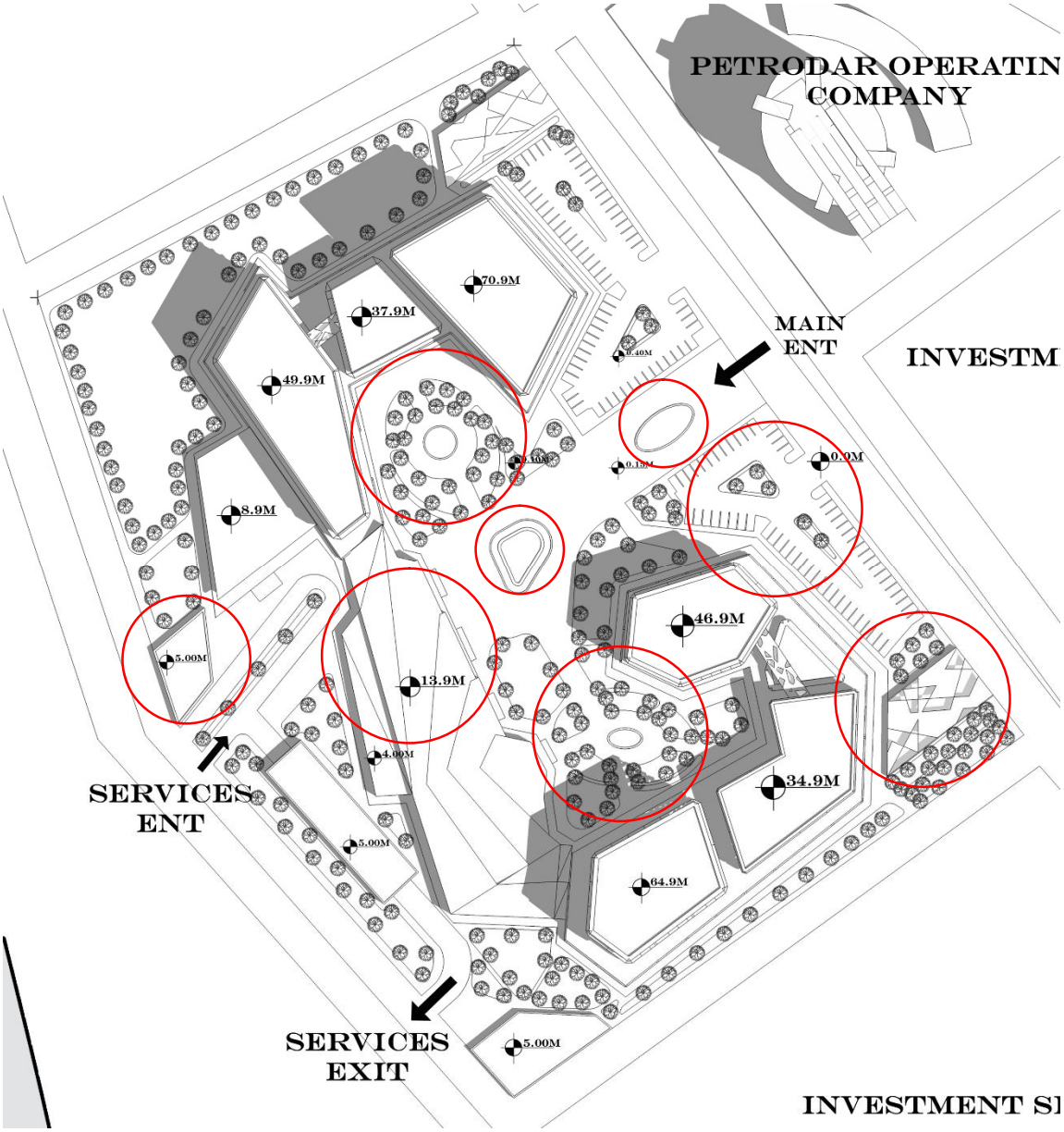


The difference from the older site (Shown in red circles):

- Fixed the problem of the gap between the buildings.
- Divided the parking spaces.
- Connecting the advertising towers with the graphic design towers with bridges.
- Detailing the cultural building.

4.2.3 Semi-Final Phase

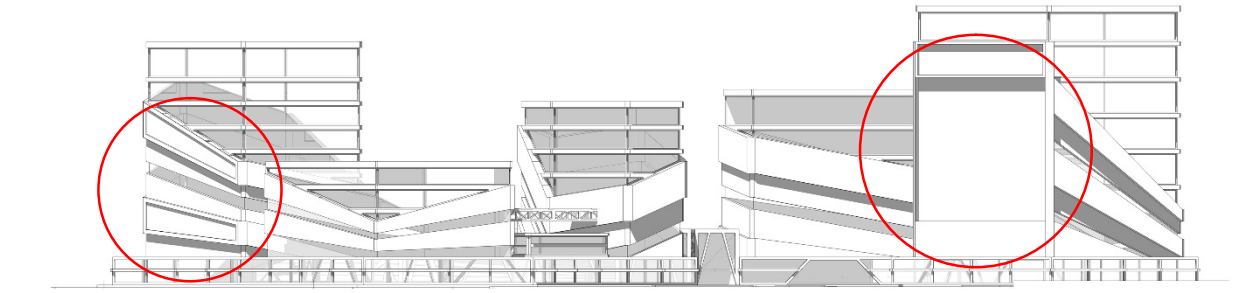
4.2.3.1 The site plan

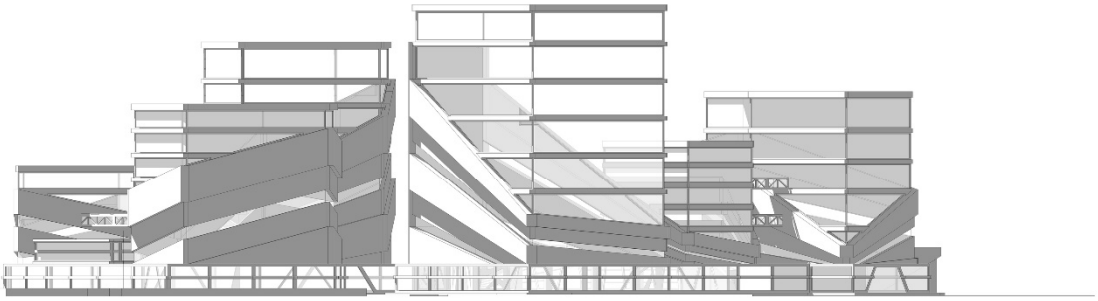


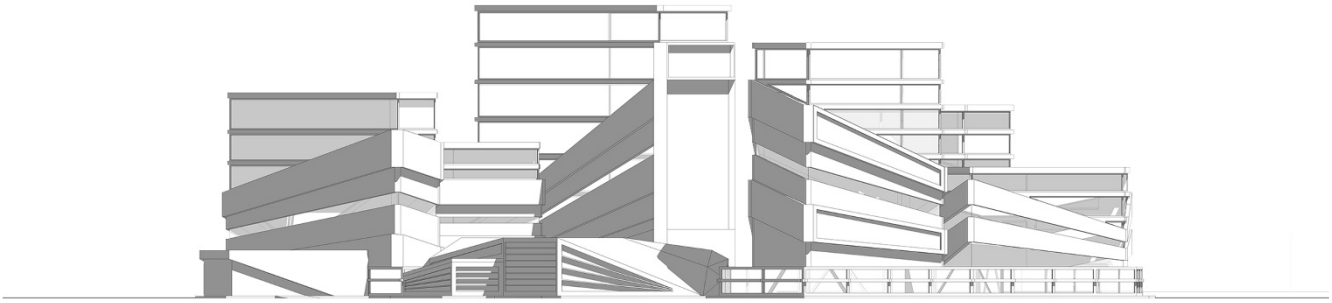
The difference from the older site (Shown in red circles):

- Changed the way the cultural building is detailed and its roofing system.
- Adding two ramps that lead to the basement to expand the parking area.
- Changed the landscaping from being in straight lines to curvy lines and circles to create a contrast between it and from the built area, plus adding some grass and trees to the parking.
- Adding some water and fountains in the site to make it alive and human friendly.
- Adding another generators and water tanks rooms.

4.2.3.2 The elevations:





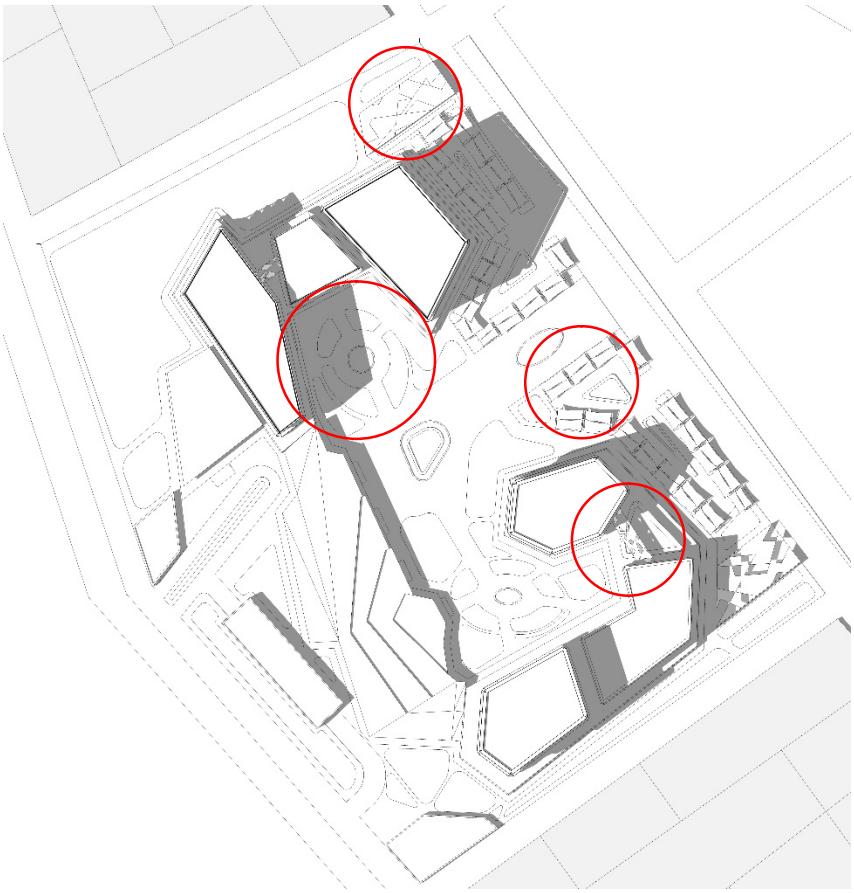


The difference from the old elevations (shown in red circles):

- The difference around the staggered lines showed(above and below)
- The use of three LED screens in the investments buildings, and directed in a way that they are visible from the Victory Bridge to be efficient in advertising.
- Creating a clean serious elevation for the podium of the project.

4.3 FINAL DESIGN:

4.3.1 The Site Plan:

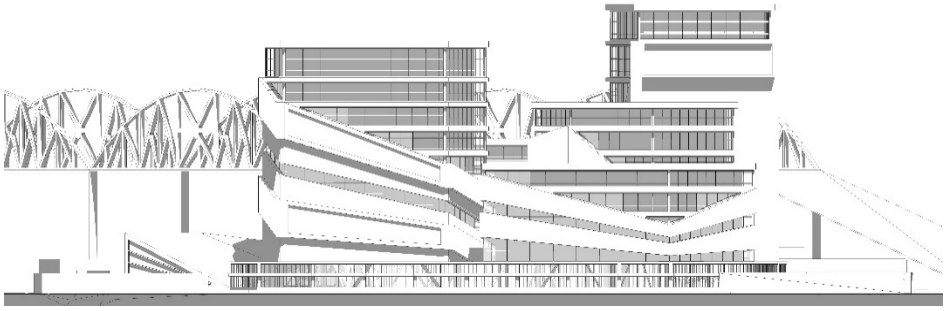


The difference from the older site plan (Shown in red circles):

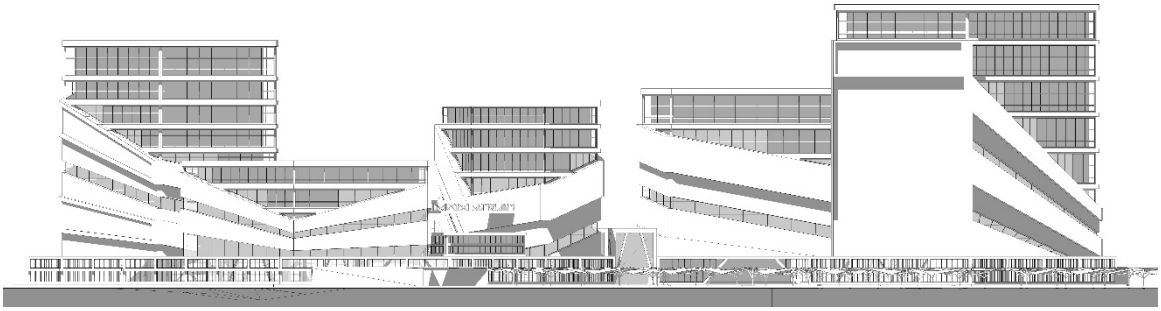
- Working more on creating the contrast between the landscape and the built areas.
- Using shades to cover the parking spaces
- Detailing the bridges and adding more glass to them to link them with the outside
- Detailing the ramps with a roofing material that allows the light through.

4.3.2 The Ground Floor Plan:

4.3.3 Elevations:



South Elevation

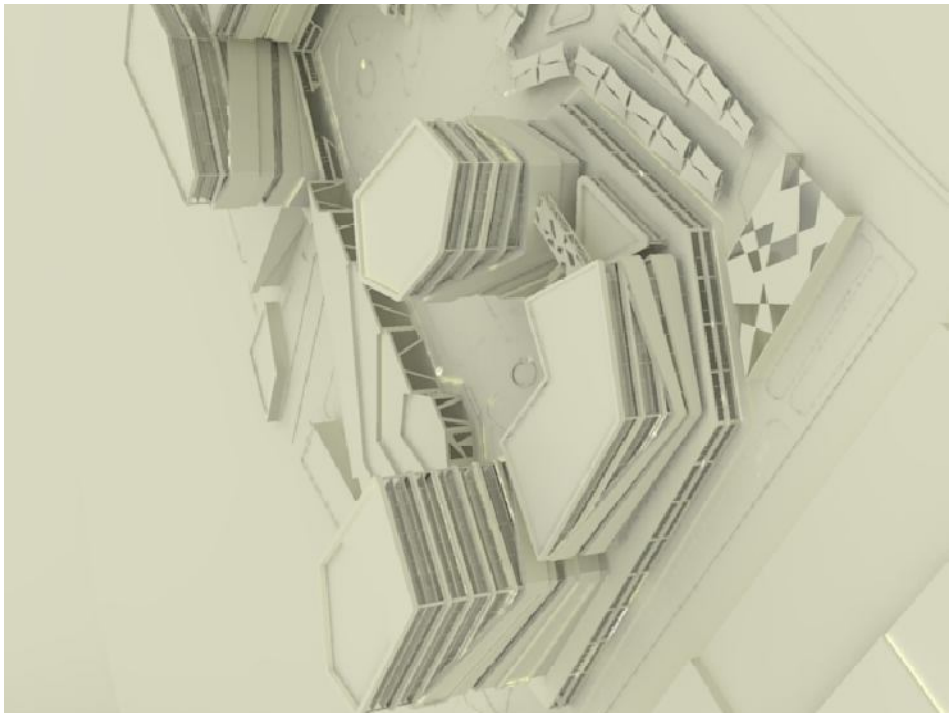


East Elevation

The difference from the old elevations:

- More details in the parts above the staggered lines
- Changing the design of the podium of the buildings (The two bases) with a simpler cleaner design.
- The change in the elevations of the bridges is showing now.

4.3.4 Perspective:



CHAPTER V: Technical Solutions

- Structural solutions
- Finishing solutions
- Water supply, drainage and sewage solutions
- Electricity solutions
- HVAC solutions

5 TECHNICAL SOLUTIONS

5.1 STRUCTURAL SOLUTIONS:

5.1.1 The Types of structural systems used in the project:

- Concrete core with supporting steel columns (In three of the towers)
- Steel frames "Column and beam" (in the remaining three towers plus the project administration's building)
- Steel frame "Portal frame" (In the video shooting studio and in the cultural building)
- Steel frame "Steel Beams" (for the connecting bridges between some of the towers)

5.1.2 Reasons for choosing each structural system:

5.1.2.1 The concrete core with the supporting steel columns:

Because of the height of these towers plus because of their small area, a concrete core was required to be able to handle the high wind speed and to have no columns in the plan so the companies can rearrange the walls however way they want to.

The steel columns were used in the projectasthe concrete core is far from some of the walls in the ground floor and the first floor in the project,hencethe columns are needed to support the far ends of the buildings.Theystop at the first floor because then the area of the towers get smaller after that and the joined building stops.

5.1.2.2 Steel frames "Column and beam":

The remaining four buildings' plans are already divided so a concrete core will notbeneeded. The choice of steel frames instead of concrete is due to the large spans ofthe buildings which cannot be achieved by concrete frames.

5.1.2.3 Steel frames "Portal frames":

Portal frames are used in this project in the cultural building where no columns are wanted in the middle of a space so it gives me the desired span in the most effective way. Portal frames are cost effective and using them gives enough clearance and height to placethe lights and the speakers in the desired areas.

5.1.2.4 Steel frame "Steel Beams":

The steel beams are used to connect two cores or two columns to transfer the loads to them from the bridges.

5.1.3 Detailing the different parts of the structural systems:

5.1.3.1 Foundations

A raft foundation is used in this project because of the large built area plusthere is a basement in the project.

Deep piles foundations are coming down from the raft foundation, because the project is located in a place where the ground is muddy at the top,so deep foundations are required to be able to reach the solid grounds plus the deep piles foundations are needed to support the height of the towers in the project.

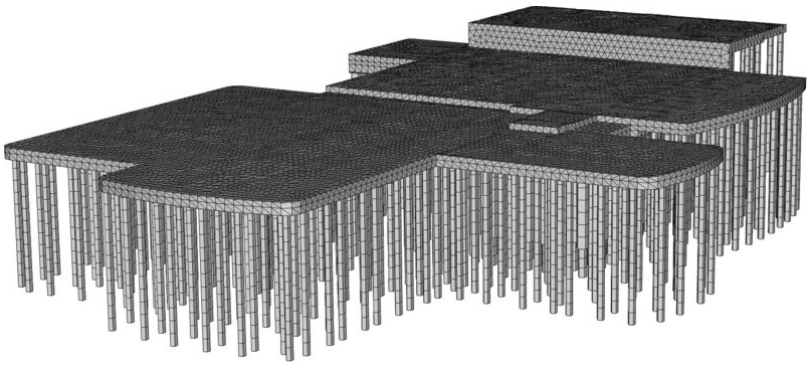


Figure 41:3d diagram of how the piles are connected to the raft to form the foundation.

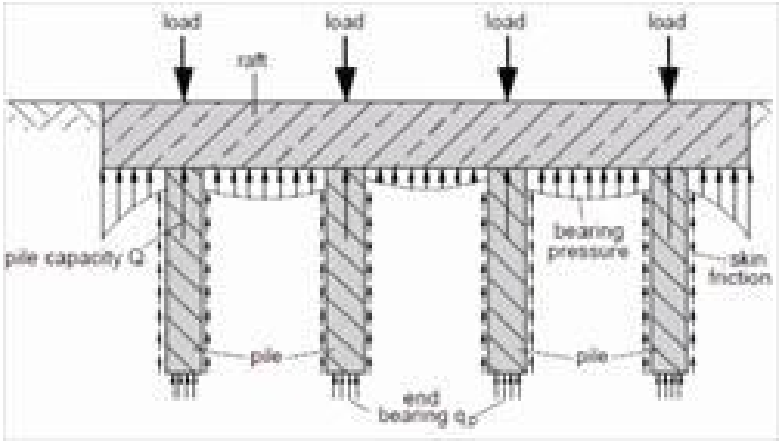


Figure 42: Showing how the load is transferred to the piles in a cross section.

5.1.3.2 Columns:

The columns in the projects are all I-section universal steel columns covered by concrete to insulate the steel and give it more strength to resist fire. The columns are covered by marble to give a luxurious look that represent the project.

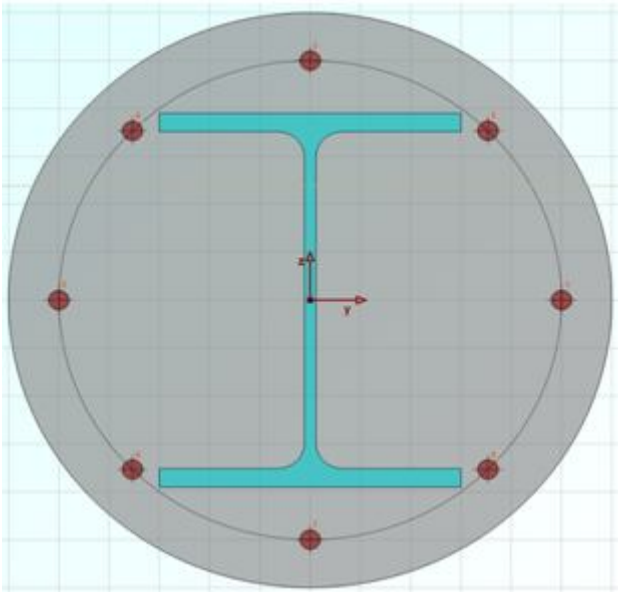


Figure 43: Image that shows how the Steel column is covered with concrete.

5.1.3.3 Beams

The project has steel I-Section beams that connect the columns together to achieve more stability.

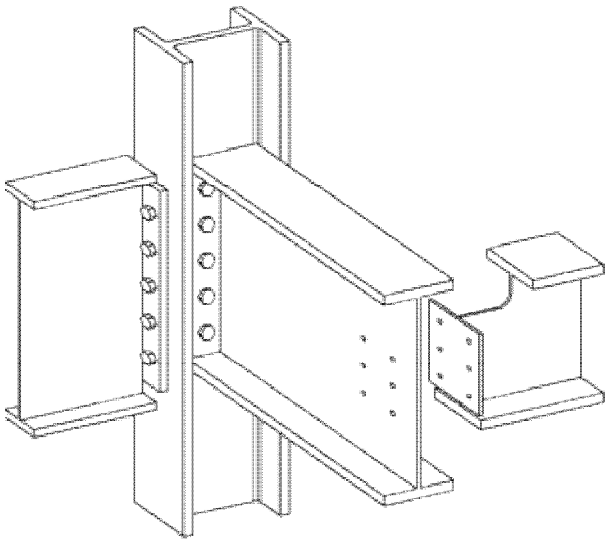


Figure 44: Detail that shows how the beam is connected to the column.

5.1.3.4 Roofs and Slabs:

There are two types of roofs and slabs in the site, a composite deck slab which exists in the towers and the building administration building aluminium sheet roof which covers the cultural building roof.

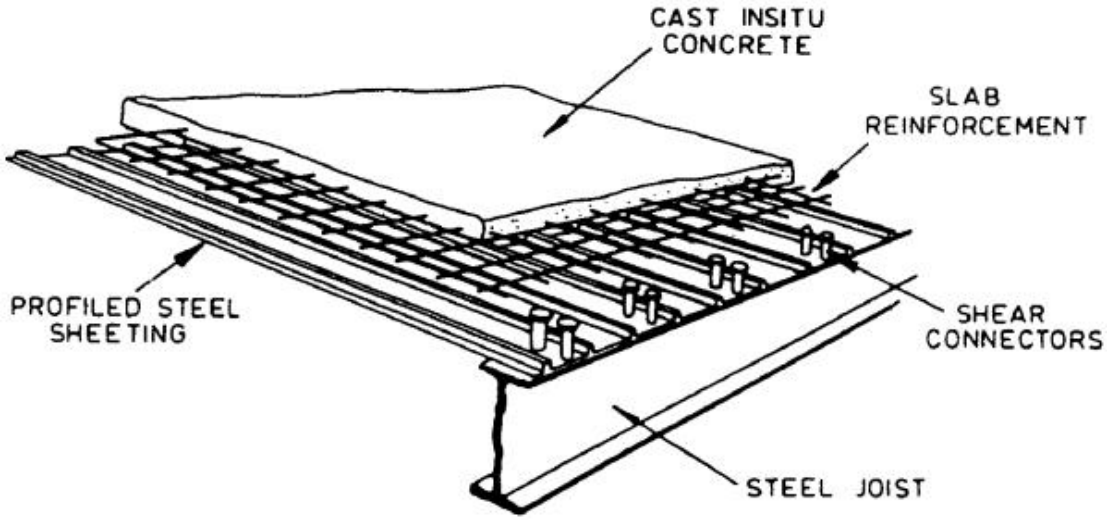


Figure 45: 3d Image to show the building slab.

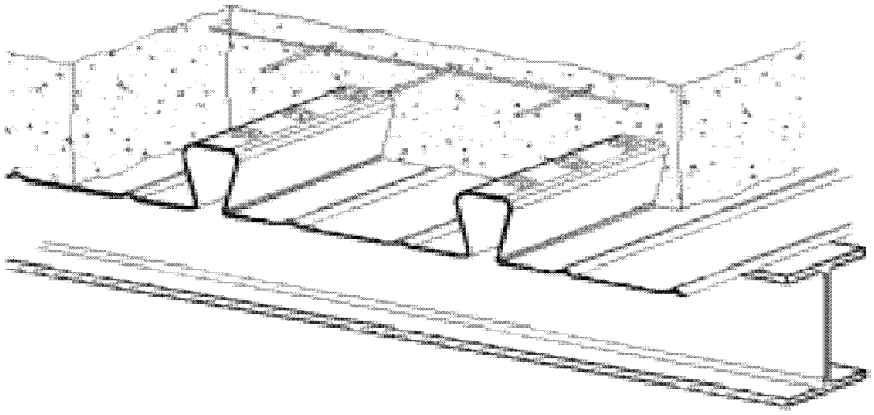


Figure 46: Closer look on the composite slab

5.1.3.5 Pictures from the Project to show case the structural system:

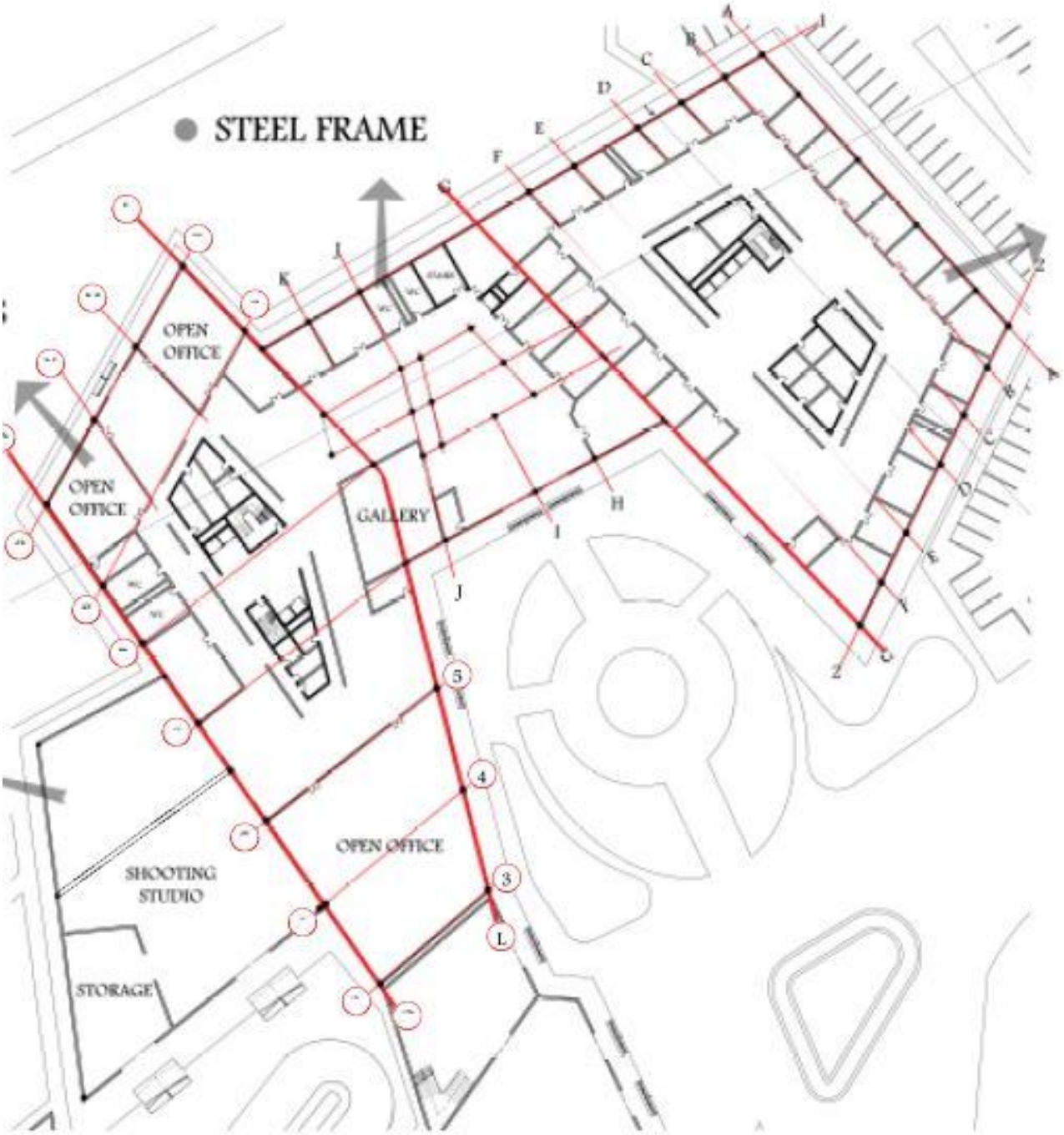


Figure 47: Structure in the Ground Floor Plan.

The thin red lines represent the grid, the thick red lines represent the joints.

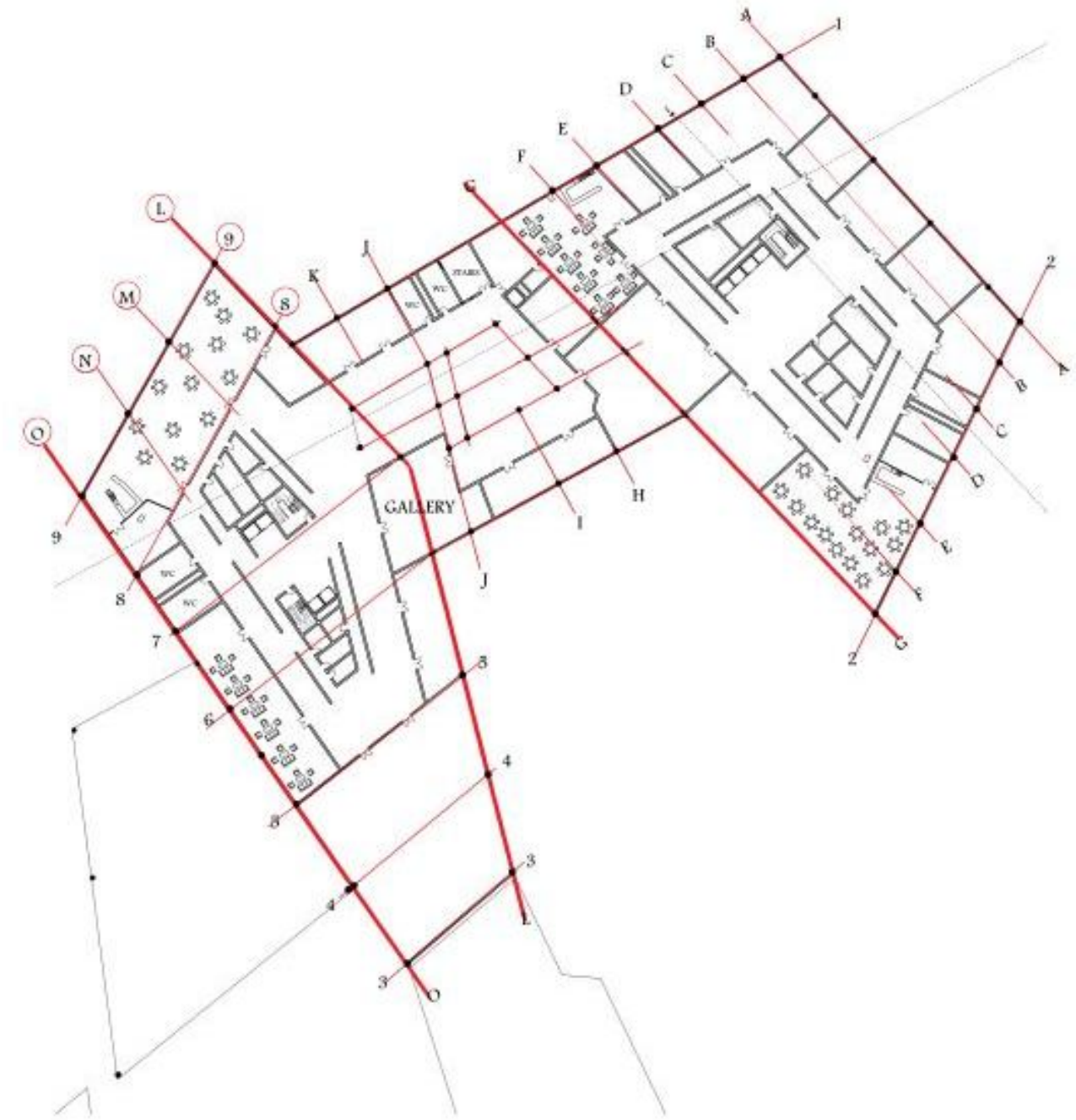


Figure 48: Structure in the First Floor Plan.

The thin red lines represent the grid, the thick red lines represent the joints.

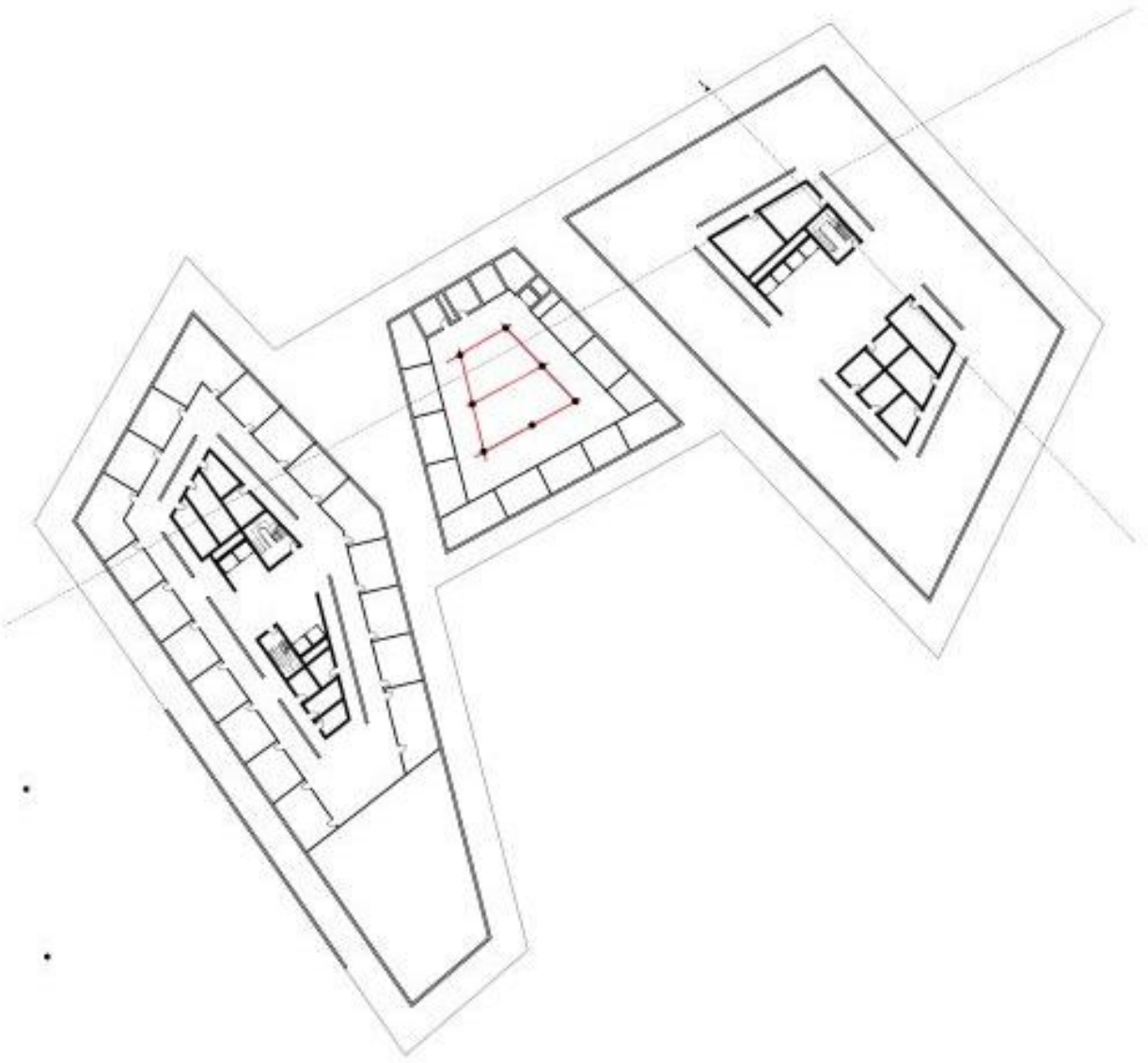


Figure 49: Structure in the Second Floor Plan.

The columns away from the cores are removed and now the core can carry and transfer the loads with the area being less in this floor.

Figure 50: Section in the buildings to showcase the structures

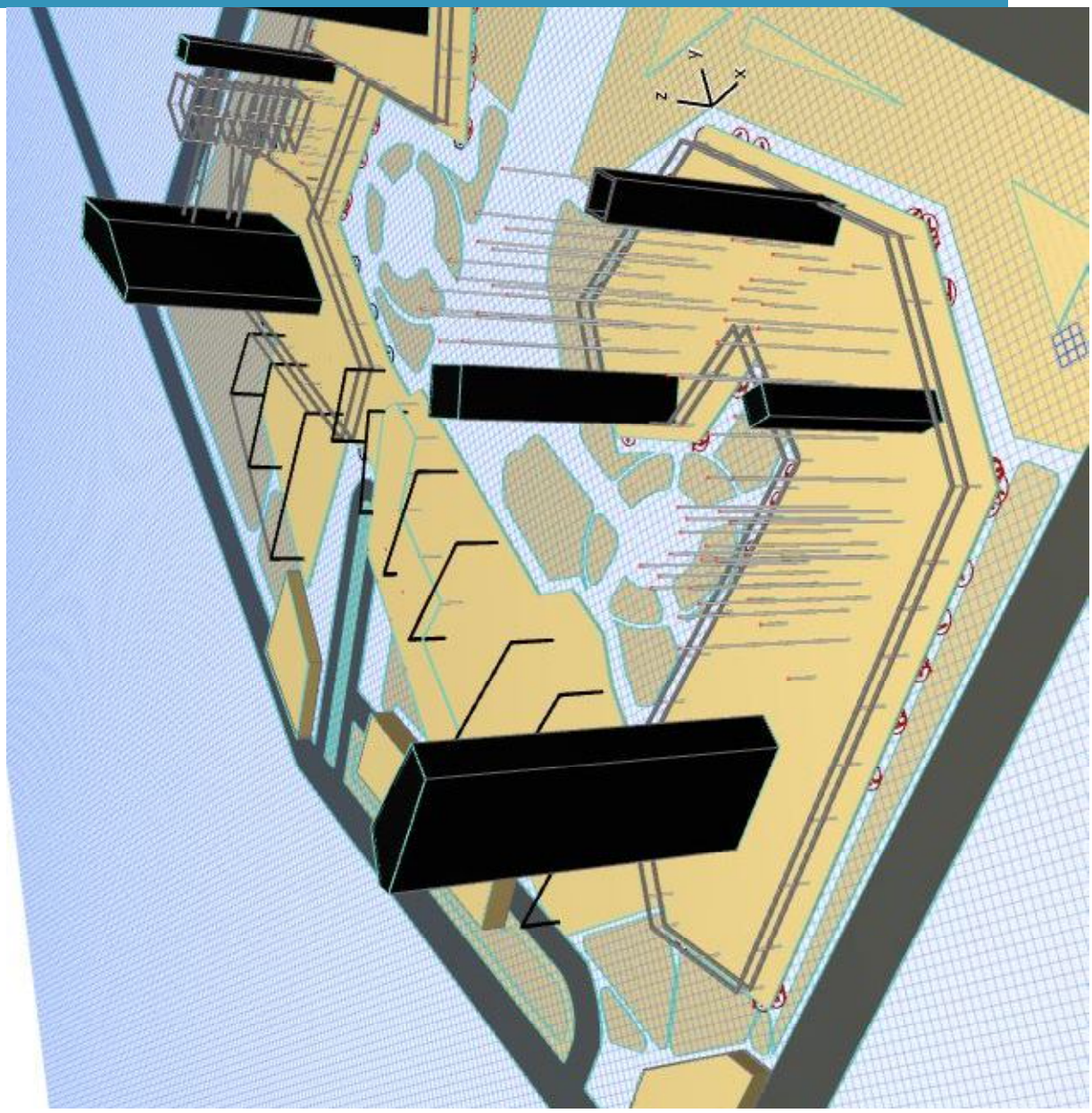


Figure 51: A 3D Illustration of the structure

5.2 FINISHING'S SOLUTIONS:

5.2.1 Site finishing and treatments:

The site plan has different types of finishes on it which are:

- Asphalt (for the parking).
- Brick pavement (in the pathways and corridors). Brick was chosen because it can handle the different weather elements and the friction caused by the high number of users in the project.
- Cement tiles (in the slab around the buildings).
- Grass.

- Trees, to supply the needed shade and shadow for the project.
- Fountains and water elements.
- Composite slabs (in the buildings of the project) which consists of: White concrete layer, c/s mortar, 3 insulation layers of D.P.C., zinc sheet, steel beams.
- Aluminium sheets (in the cultural building) which has the following layers beneath it: Insulation layer, Air space, Insulation layer, steel purlins, steel beams, portal frame girder, steel purlins and beams, aluminium frame for the false ceiling, false ceiling elements 60cmx60cm.

5.2.2 Interior finishing:

5.2.2.1 Floors:

- Porcelain tiles 90cmx90cm in the main corridors and in the receptions.
- Carpet floor in the offices to reduce the noise in these spaces
- Wooden floors in the meeting rooms to give the luxurious look.

5.2.2.2 Walls:

- White paint with some stripes of other colours to motivate the designers and inspire them more.

5.2.2.3 Ceilings:

- Gipson board false ceiling 60cmx60cm.
- White paint with some coloured stripes.

5.2.2.4 The Effect of Acoustics:

Calculating the acoustics for this project is a main thing, because most of the spaces in this project has to be quite and get no noise from the outside nor from the other spaces such as the drawing studios or the recording studios since they will disrupt the designers or the audio engineers while in work.

5.2.3 Details of the used finishes:

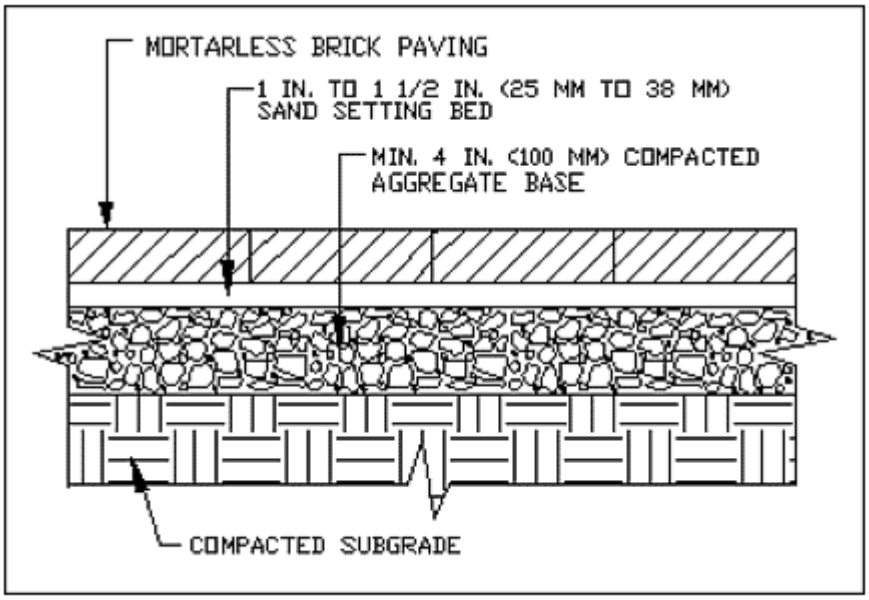


Figure 52: Brick pavement detail

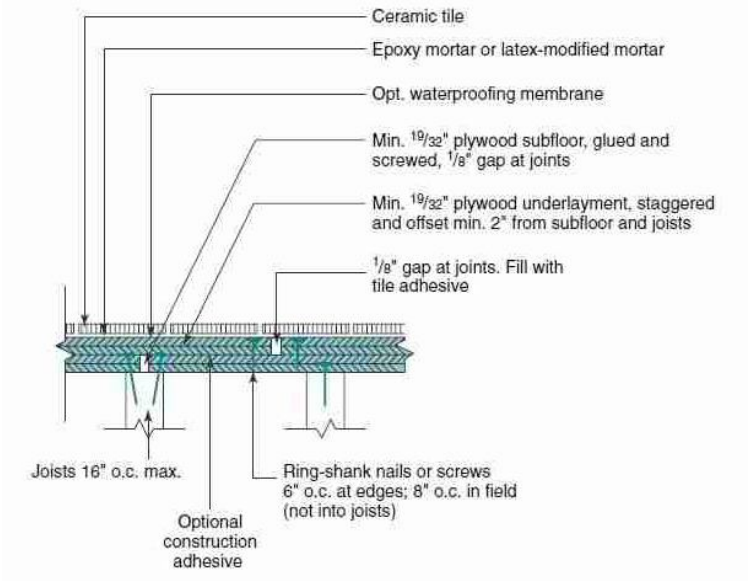


Figure 53: Cement Tiles detail

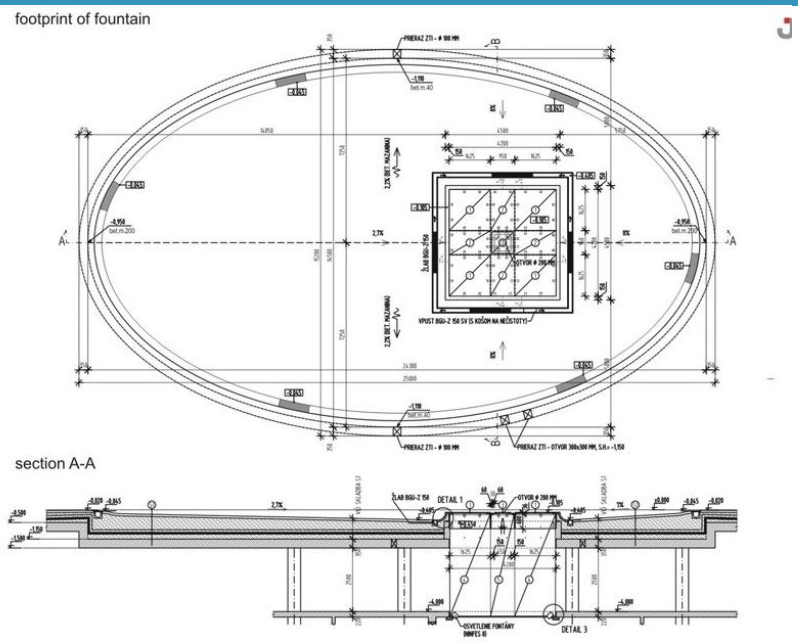


Figure 54: Fountain detail

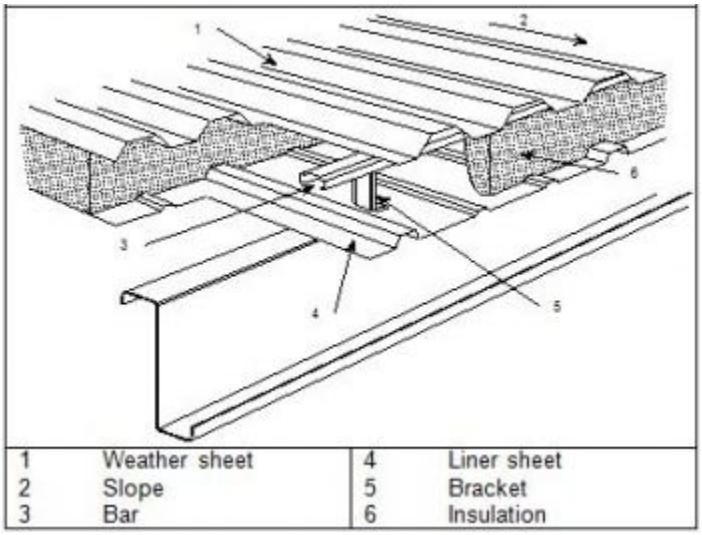


Figure 55: Aluminium roofing sheet detail

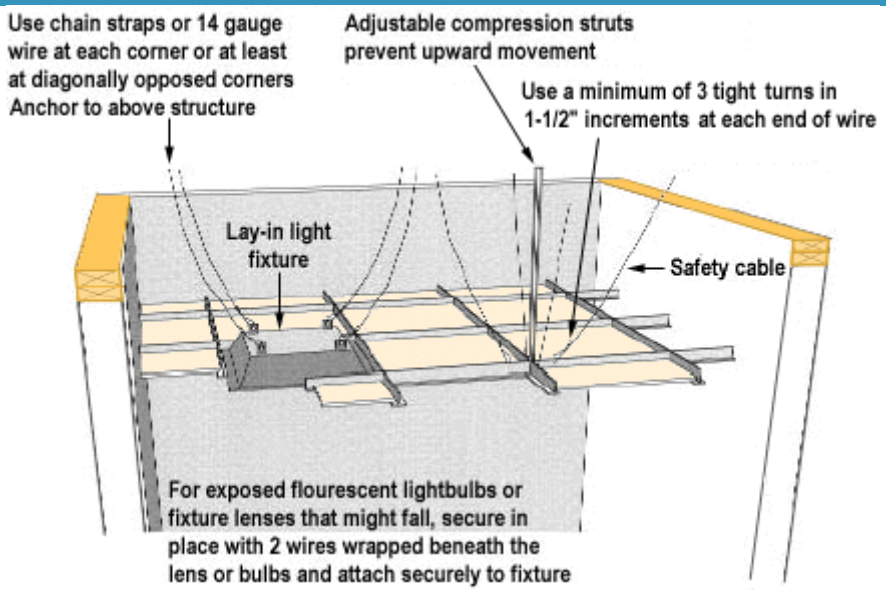


Figure 56: False ceiling with lighting installed

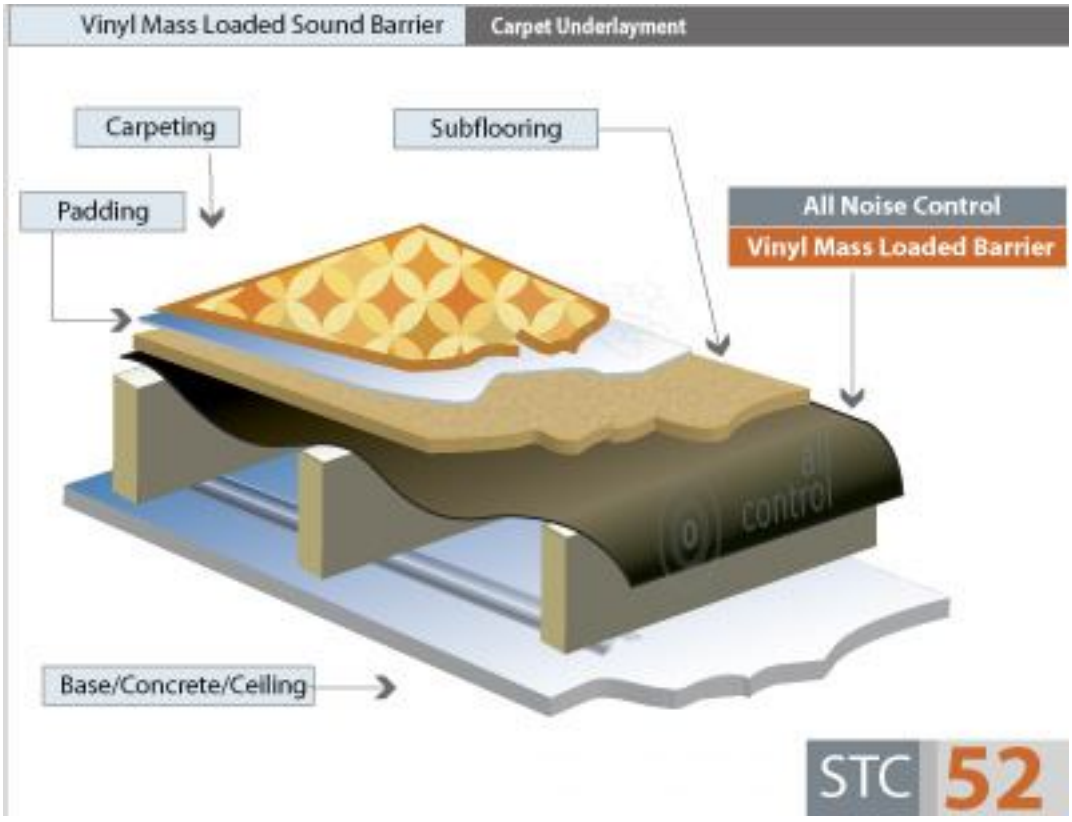


Figure 57: Carpet finishing detail

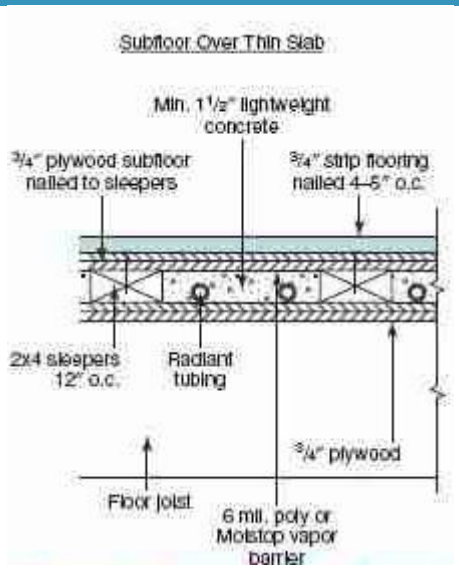


Figure 58: Wooden Floor finishing detail

5.2.4 Pictures from the project

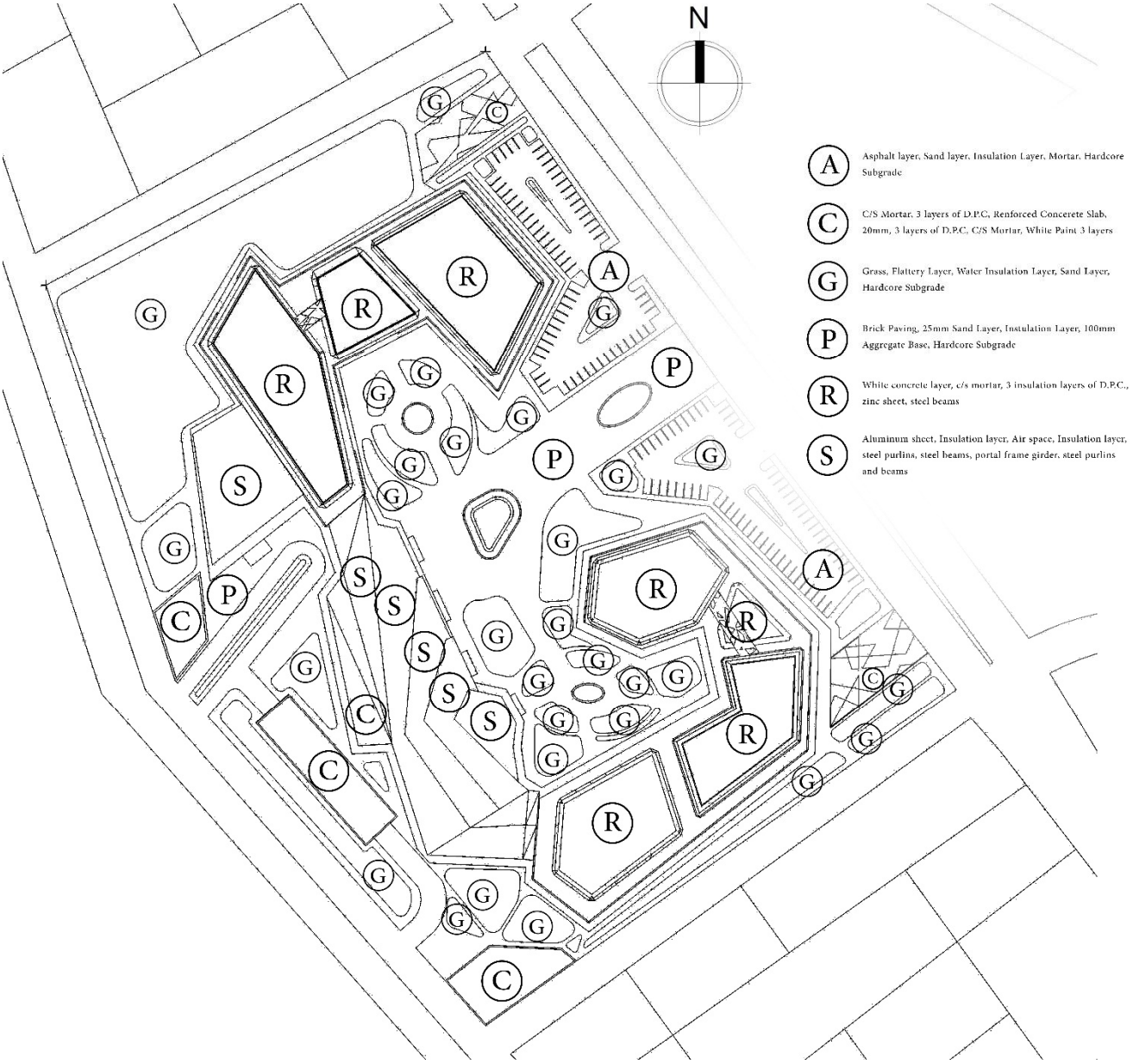


Figure 59: Site Plan showcasing the finishing materials used in the site

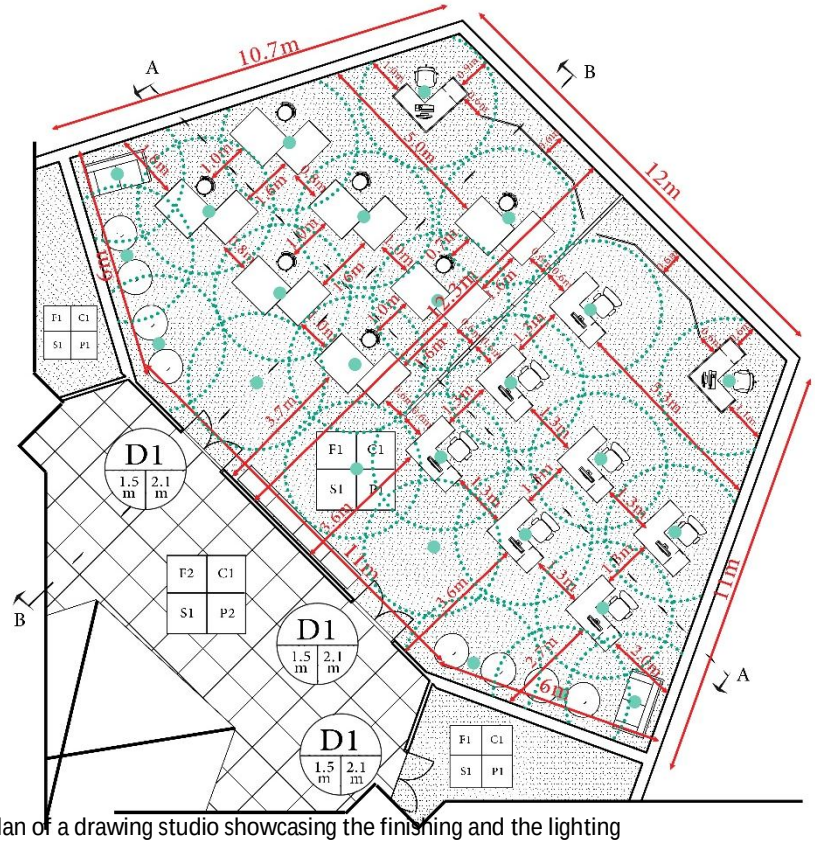


Figure 60: Part plan of a drawing studio showcasing the finishing and the lighting

C1 (Ceiling): 60x60cm False Ceiling units with Aluminium Frames, steel purlins, c/s mortar 1:8 mix 0.02 thick, D.P.C 3 layers, Composite Slab.

F1 (Floor): Carpet Layer, Glue Layer, Concrete tiles 60x60cm, c/s mortar 1:8 mix 0.02m thick, D.P.C 3 layers, R.C., Composite Slab.

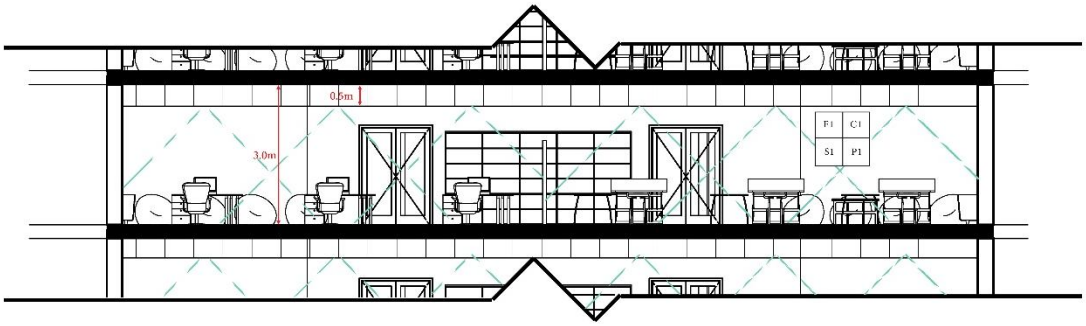
F2 (Floor): Porcelain tiles 90x90cm, c/s mortar 1:8 mix 0.02m thick,D.P.C 3 layers, R.C, Composite Slab.

S1 (Skirting): Ceramic tile skirting to the height of 0.1m

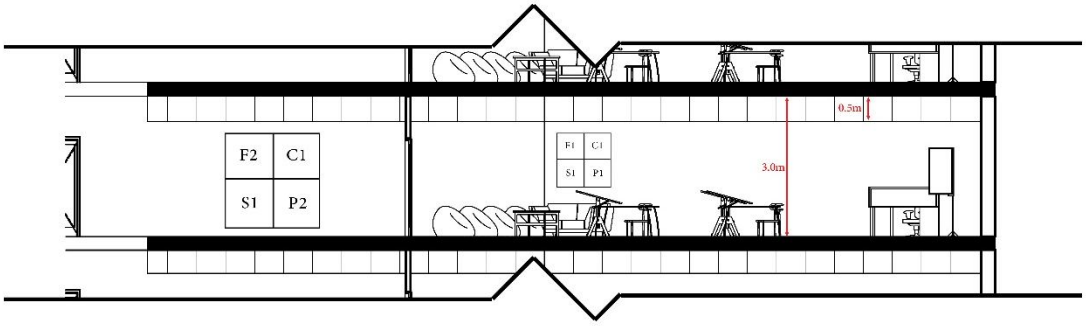
P1 (Partition): White paint 3 layers, c/s plaster1:8 mix 0.02 thick, redbrick wall 30cm, c/s plaster1:8 mix 0.02 thick, White paint 3layers

P2 (Partition): Aluminium partition with glass panels.

The dotted lines represent the radius of lighting from each light bulb which are represent by a solid green circle.



Section A-A



Section B-B

Figure 61: Part section that showcasing the finishing of the drawing studio and the lighting.

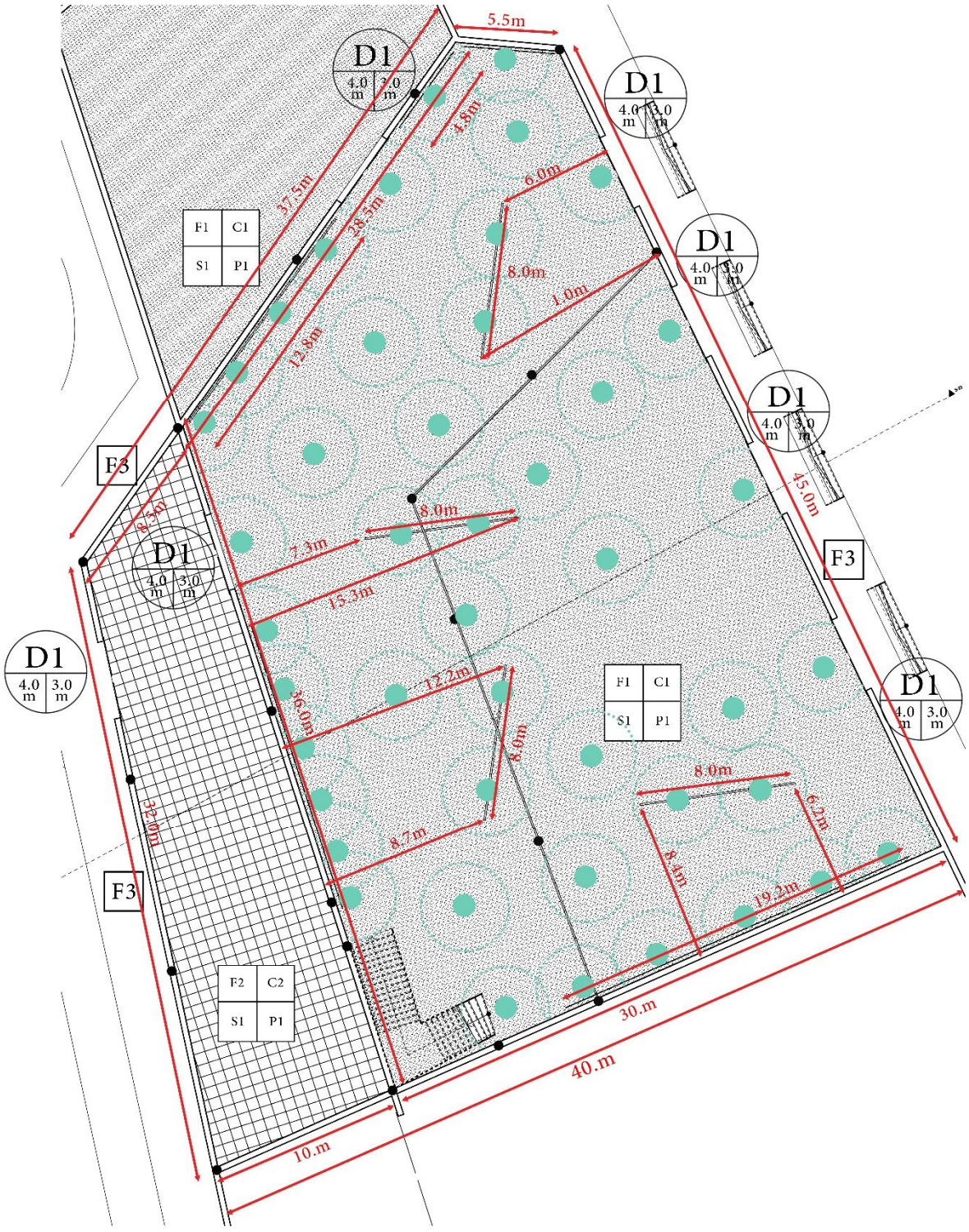


Figure 62: Part plan of the gallery showcasing the finishing and the lighting

C1 (Ceiling): 60x60cm False Ceiling units with Aluminium Frames, steel purlins, c/s mortar 1:8 mix 0.02 thick, D.P.C 3 layers, Composite Slab.

C2 (Ceiling): White paint 3 layers, c/s mortar 1:8 mix 0.02 thick, R.C Flat slab 1:2:4 mix 0.2m thick.

F1 (Floor): Carpet Layer, Glue Layer, Concrete tiles 60x60cm, c/s mortar 1:8 mix 0.02m thick, D.P.C 3 layers, R.C., Composite Slab.

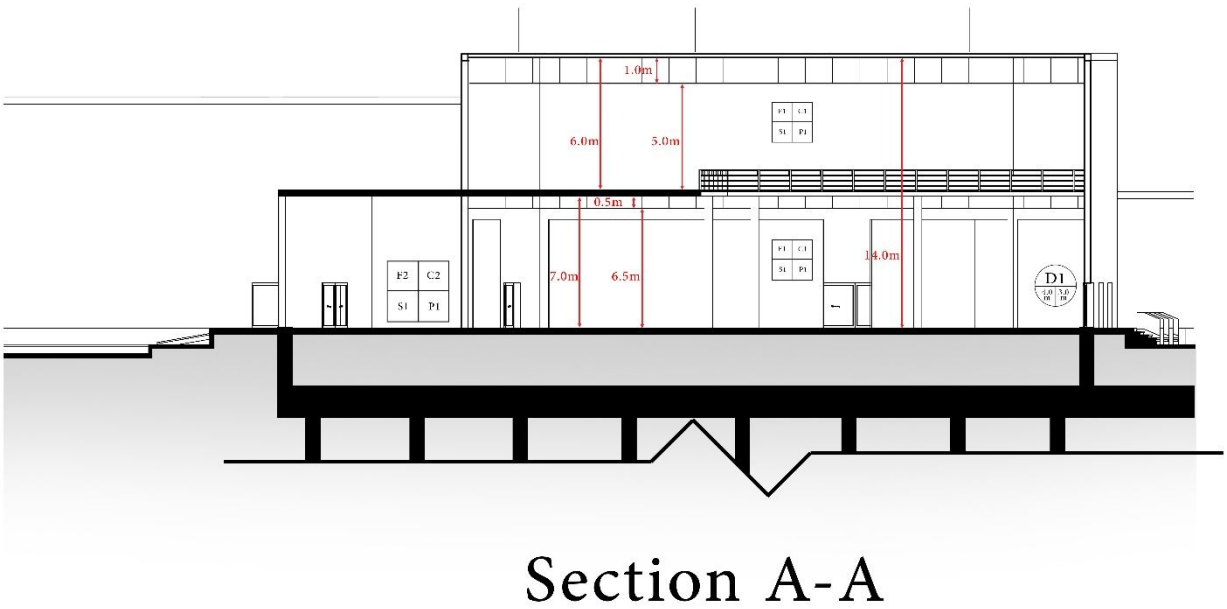


Figure 63: Part Section of the gallery showcasing the finishing.

5.3 WATER SUPPLY, DRAINAGE AND SEWAGE SOLUTIONS:

5.3.1 Water Supply:

Water is supplied to the buildings with the use of a pump and an upper water tank to keep the water pressure stable for all of the floors of the buildings, that with the help of another water tank that will be at the middle of each tower to help supply the higher tank and the lower floors too. Two tanks are used to fix the issue of the pressure of the farthest floors from the tank plus to keep the tanks full and make sure the water doesn't run out of the buildings. The water tanks will be located on top of the bathrooms' duct being the place needing most water supply

5.3.2 Sewage:

The two pipes system is used for the sewage of the bathrooms to get rid of the smell and to make sure that the pipes don't get close,by helping to maintain the air pressure inside of the pipes, then the waste is transferred into the lines where it goes through the manholes till it reaches the main sewage line that is surrounding the site.

5.3.3 Drainage:

Draining the water from the roofs of the buildings from the rain isdone by slope of 1:100directing the water towards the down pipes placed inside the ducts of the buildings to prevent the water from running down the elevations of the buildings which will affect the elevationsand so on.The water will then be drained towards the landscape of the project then the angle of the landscape will take it outside of the project.

5.3.4 Pictures from the project:

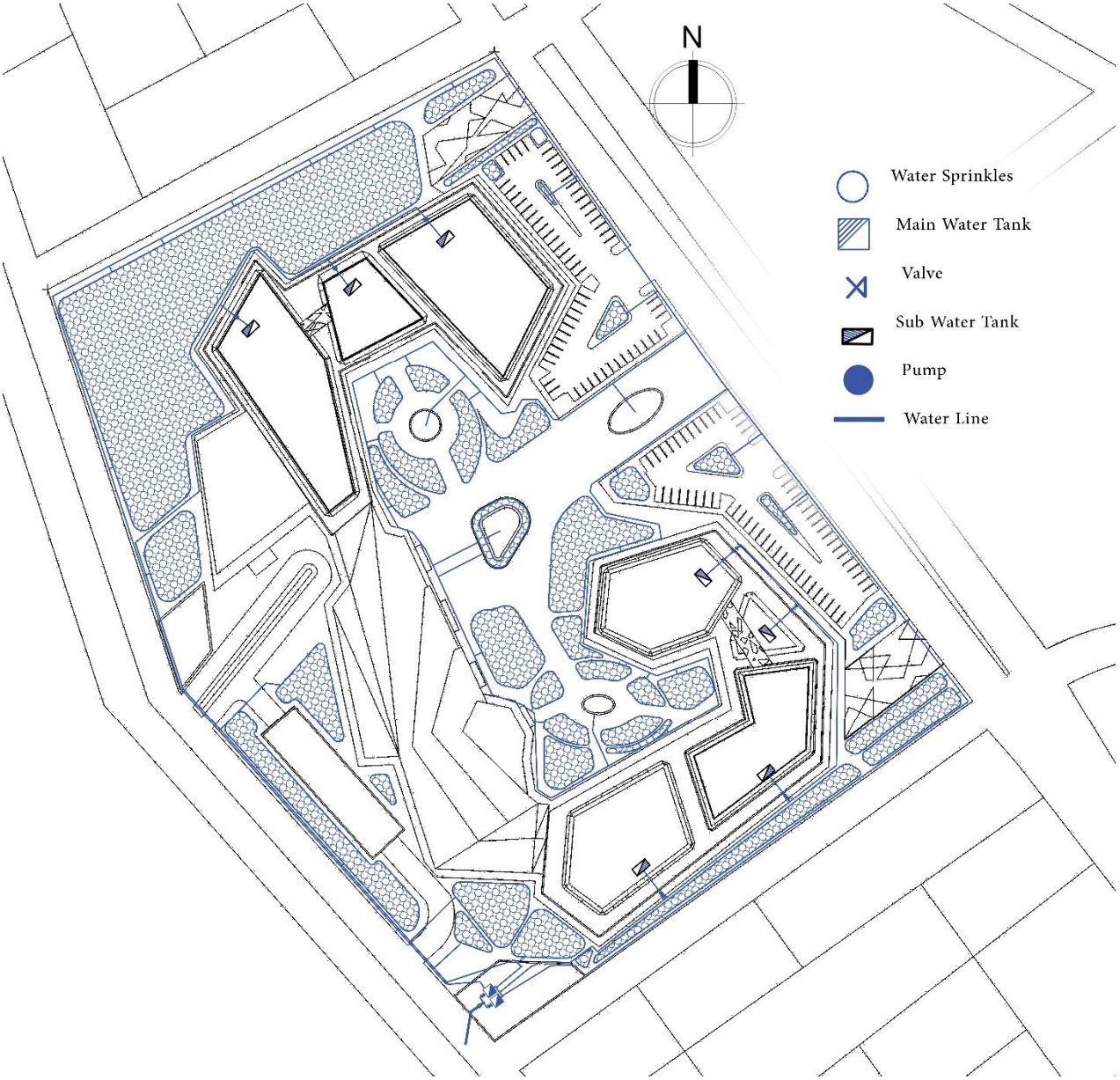


Figure 64: Site Plan showcasing how the water is supplied to the building and to the landscape.

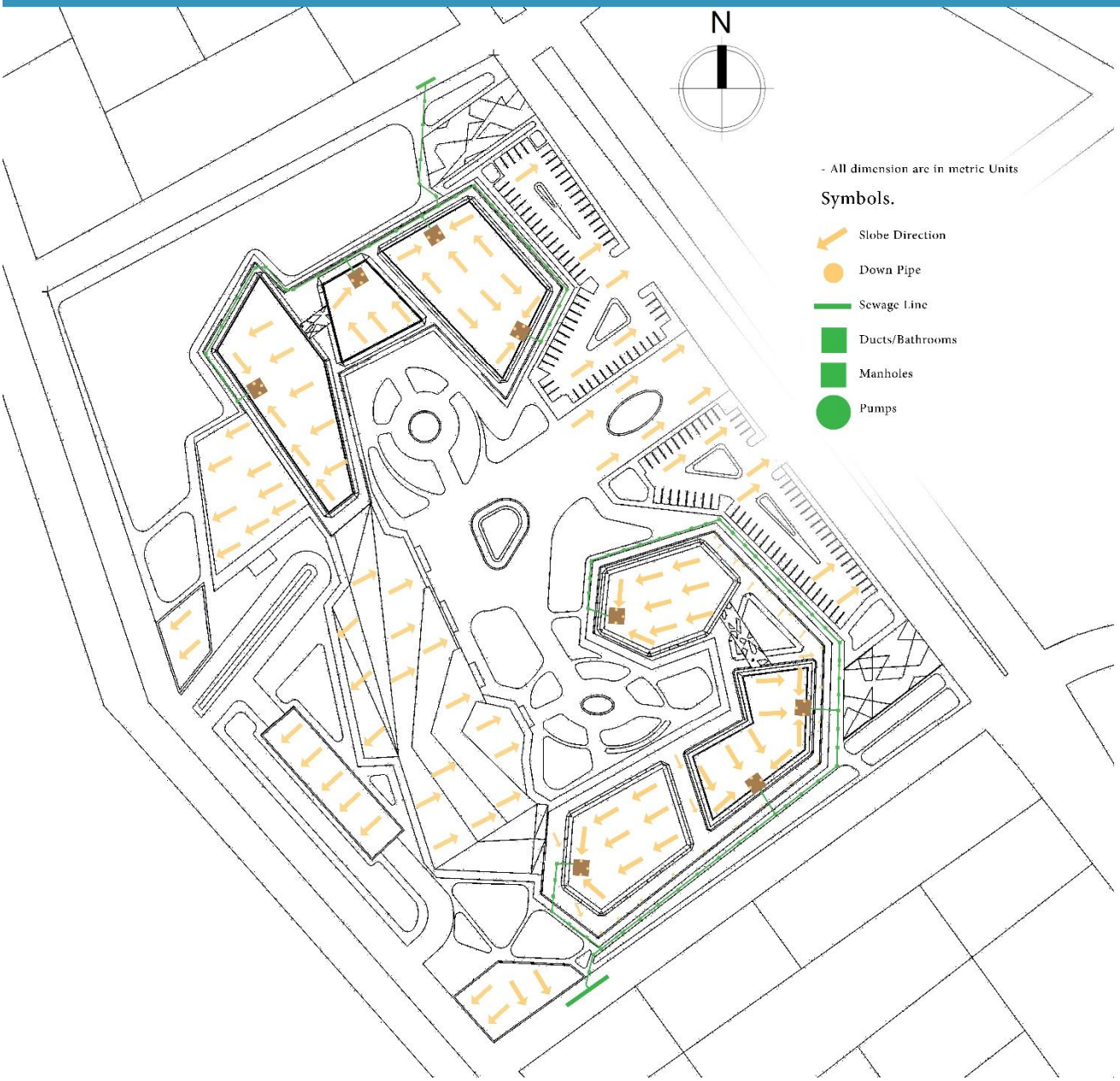


Figure 65: Site Plan showcasing how the sewage system and the drainage system are working.

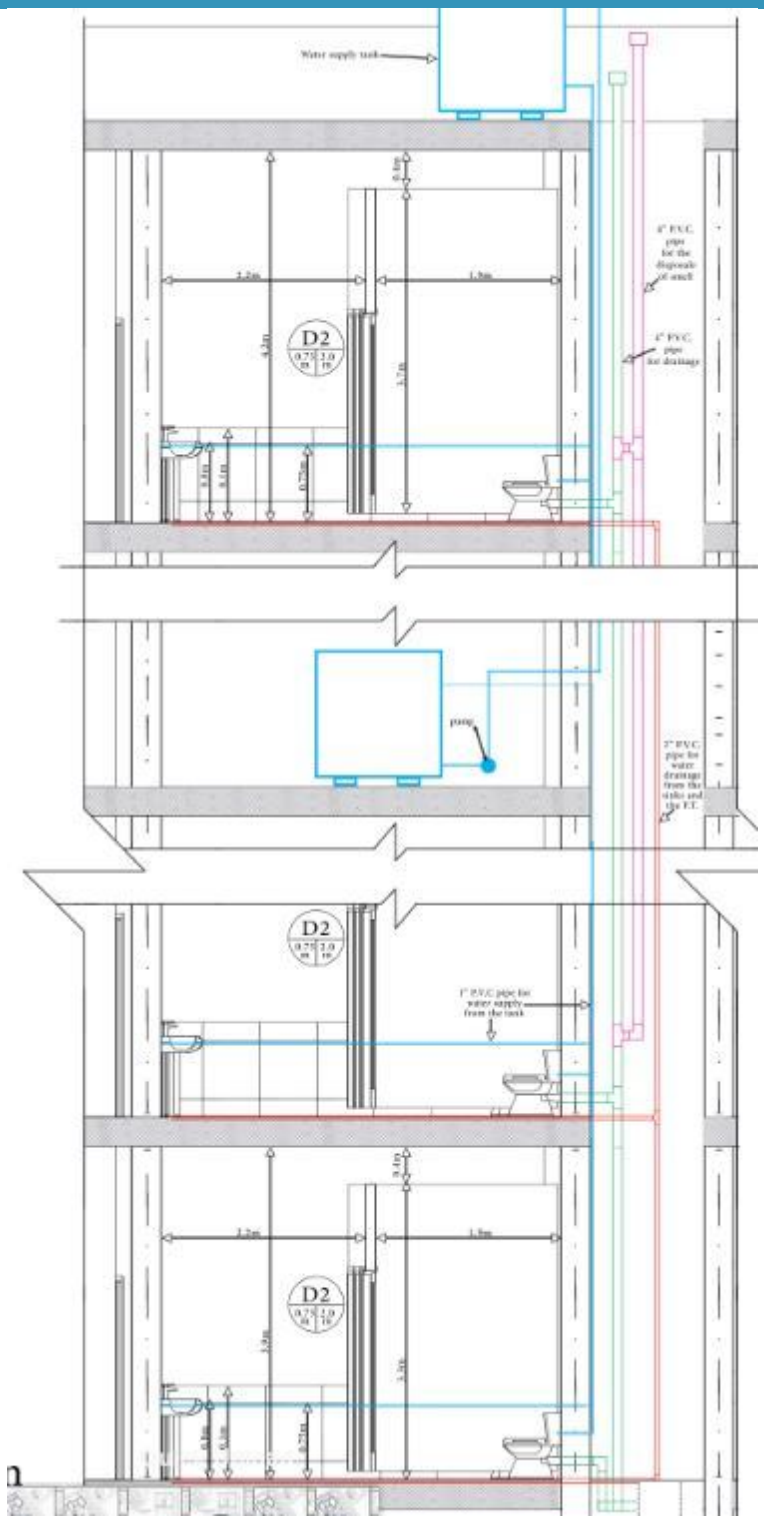


Figure 66: Section in the bathrooms to showcase how the water supply system is providing water through the two water tanks method.

5.4 ELECTRICITY SOLUTIONS:

5.4.1 Electricity:

There are two electricity rooms in the project, one on the south west corner and the other room is in the west side of the project. Two electricity rooms are needed from the project because of the distance between the buildings, so one of the rooms will supply electricity to the south building and half of the site's lamps, the second room will supply electricity to the north building, the cultural building and for the other half of the site's lamps.

Both electricity rooms have large window spaces to help with the ventilation of the electricity machines.

There is an LED screen on two of the building's elevations, one building has one LED screen which is 37mx36m and two are installed on another building which are the same size which is 20mx8m, all three LED screens are powered by solar panels which are installed on the elevations of the same buildings and these panels are connected to batteries which lay in the emergency floor with their control panels so they can store energy for the night hours.

Electricity gets from the main line as 33KV then gets transformed into 11KV then 415V inside of the building.

5.4.2 The LED Screen Calculations:

The main screen size is: 36mx37m=1332m^2.

The type of the LED screen is called "LED strip curtain display".

The square meter of the LED screen consumes 70KW per hour.

Which means the Screen consumes 93240KW per hour.

The solar cells used to power up the screen are called "three junction concentration" also known as "photovoltaic cells" which as a minimum efficiency of 44% per hour.

The total area of the solar cells on the elevations are 1527.255m^2.

Considering the solar energy of Sudan and the average hours of the day the average these solar cells can produce is 134376KW/h which is enough to power up the LED screen and also charge the battery for the night hours

5.4.3 Pictures from the Project:

Figure 67: Site plan to showcase the electricity lines in the project with a part plan of one of the two generators room.

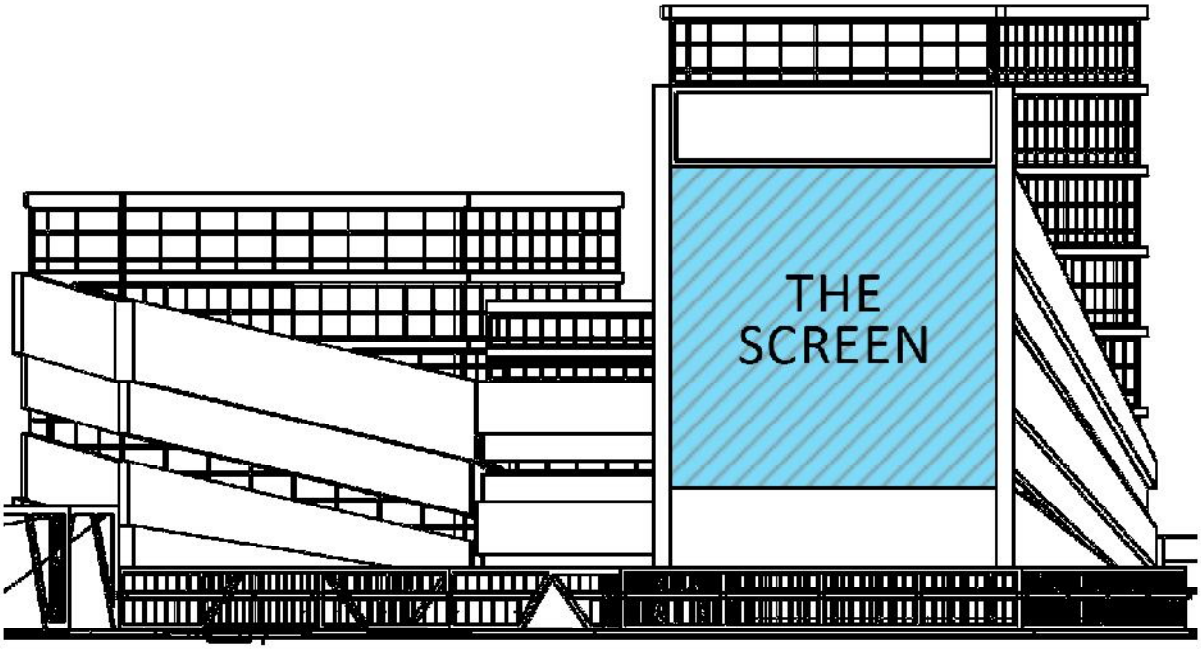


Figure 68: Site plan to showcase the electricity lines in the project with a part plan of one of the two generators room.

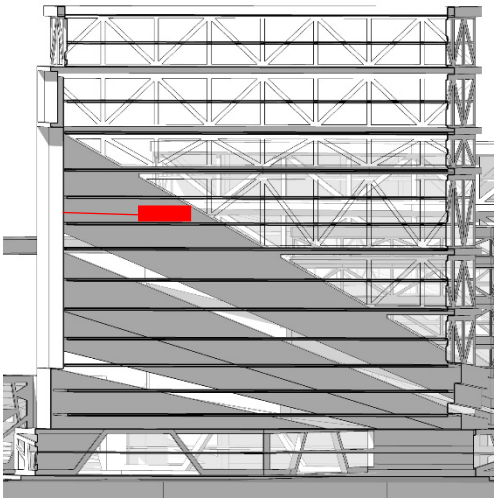


Figure 69: Section of the building that contains the LED screen and the battery connected to it.

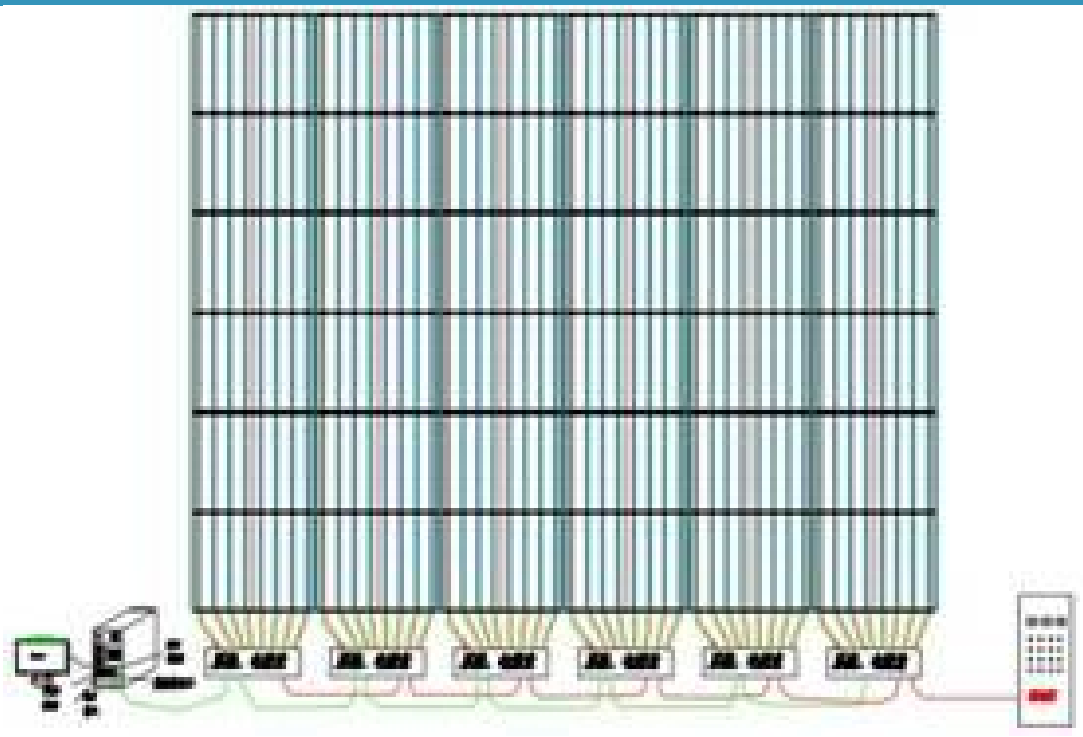


Figure 70: Diagram that showcases how the LED screen is connected to the servers and how to panels are connected to each other.

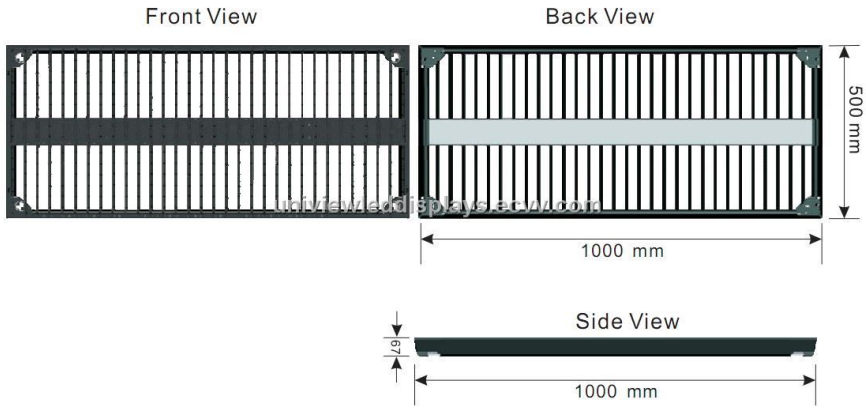


Figure 71: A picture of the LED screen panels and their dimensions.

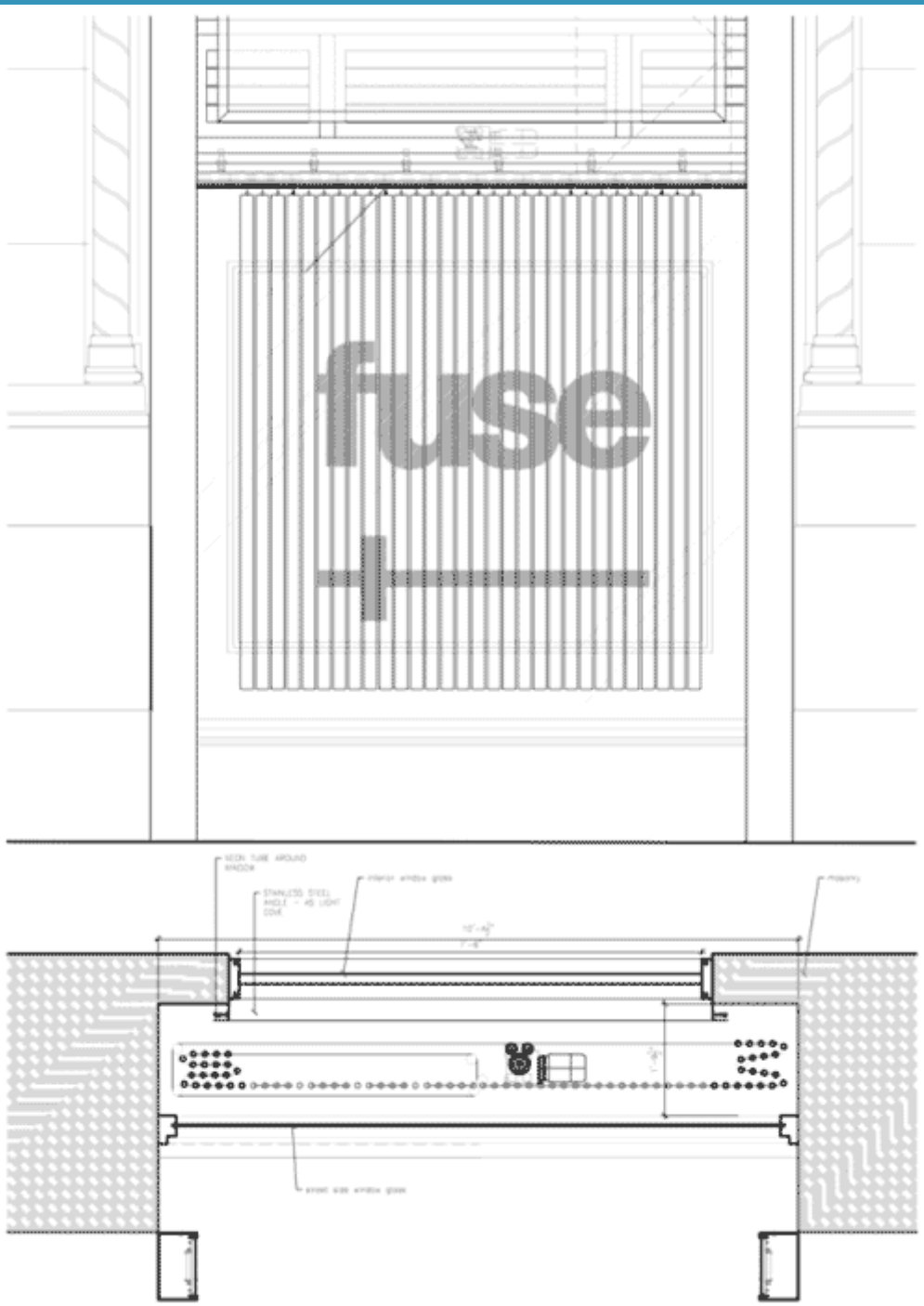


Figure 72: A section with a detail to show case how the screen is installed into the building.

5.5 HVAC And Firefighting Solutions:

5.5.1 HVAC system:

Choosing the right HVAC system depends on many factors and major points which lead to choosing "The all water system".

The main factors are:

- The project consists of many spaces.
- The HVAC system needed for this project should be able heat or cool the spaces.
- The most important things for the HVAC system to supply are: keeping the temperature stable whether by heating or cooling, renewing the air and using a quite HVAC system.
- The least important things are: sterilizing the air and controlling the humidity of the air.
- The HVAC system should be controllable from all of the spaces.
- It should be more suitable from smaller spaces than larger ones.

The above points were the reason of choice for the "All water system" because it supplies the needed things for the projects and the buildings.

5.5.2 Firefighting system:

Is project as a whole has some major points that affected the choice of the right firefighting system, and these points are:

- The project consists of main buildings with some scattered unites.
- It has an "Ordinary" level of hazard.
- Spaces are divided into: storage, offices, kitchens and parking spaces.
- In case a fire took place the materials that would catch fire are divided into: carbonic solid materials, electrical equipment, metals and chemicals.
- The buildings go higher than 5 floors.

After keeping the above points in mind, the firefighting system should have the following stuff in it:

- Having fire blankets in the kitchens.
- Using CO2 and dry powder to put down the fire so it doesn't affect the electrical equipment.
- The use of sprinkles is a must because of the height of the building plus putting hand held fire extinguisher inside of the spaces too where they are put beside of the door of each space.
- Each sprinkle will cover 12 square meters.

For the fire detecting, an ionic detector is put in the storage areas to detect the smallest sigh of fire in them. In the food court and the offices a smoke detector is needed, in the kitchen an extra heat detector is put and in the cultural building smoke detectors are put there too.

5.5.3 Pictures from the project:

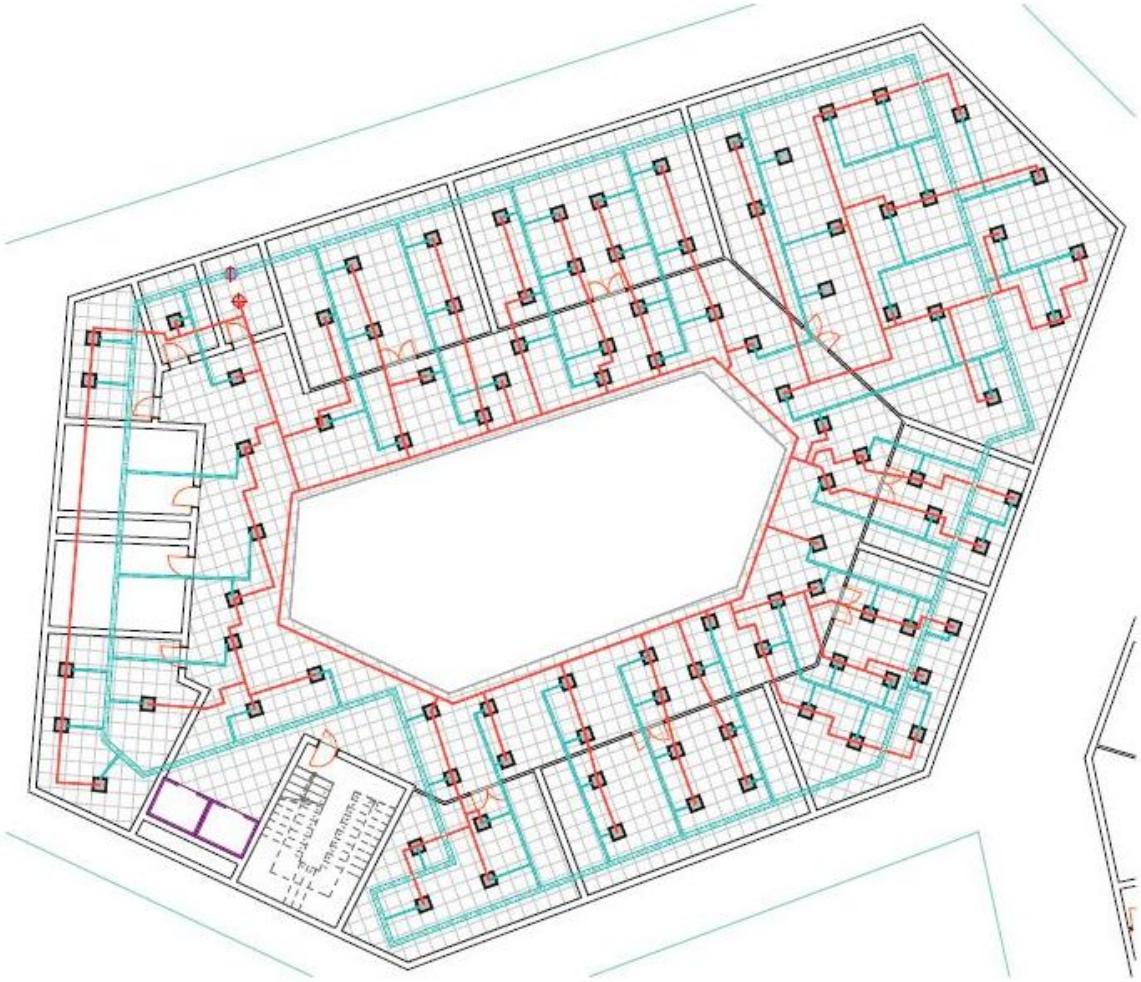


Figure 73: One of the office building's plan to demonstrate how the all water system is installed.

With the light squares being the false ceiling grid, the heavy squares are the diffusers, the blue lines are the "In" water lines, and the red lines are the "Out" water lines.

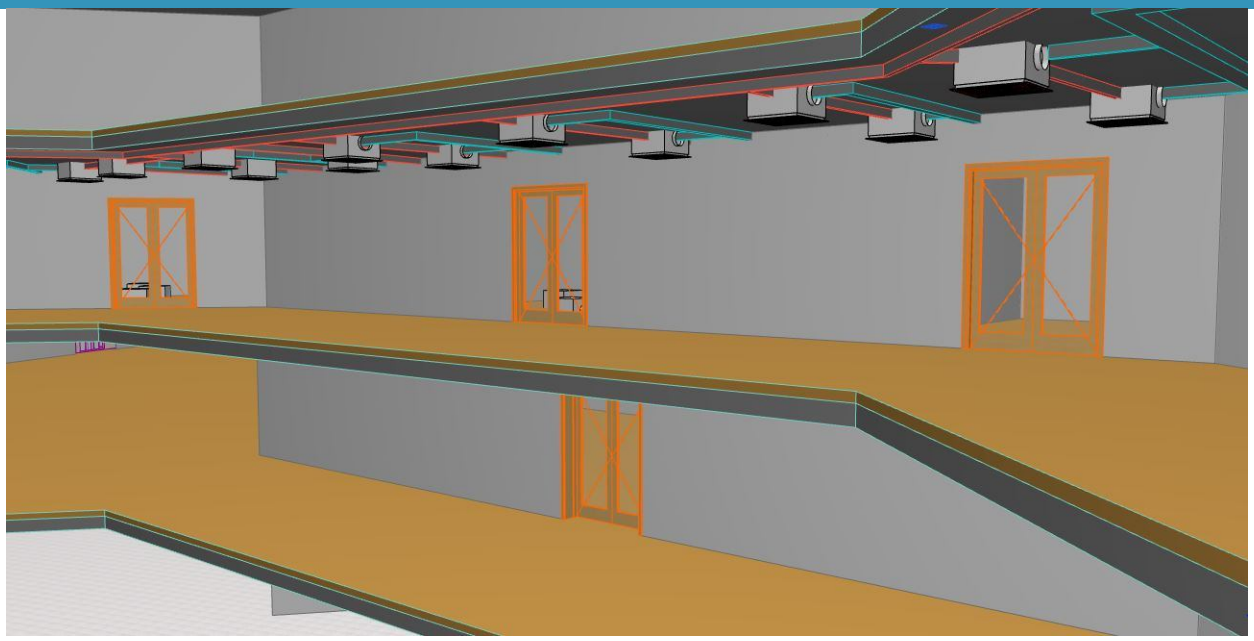


Figure 74: Interior 3D to showcase the diffusers and both of the types of the water lines.

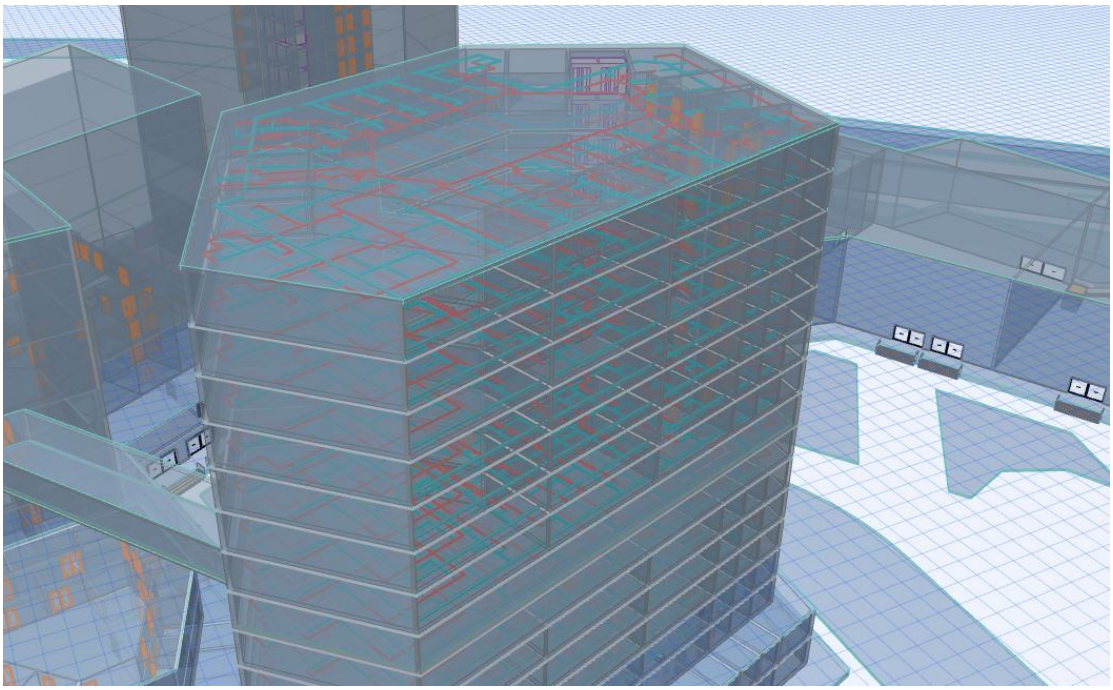


Figure 75: A 3D that showcases the "All Water" cooling system in the whole building.

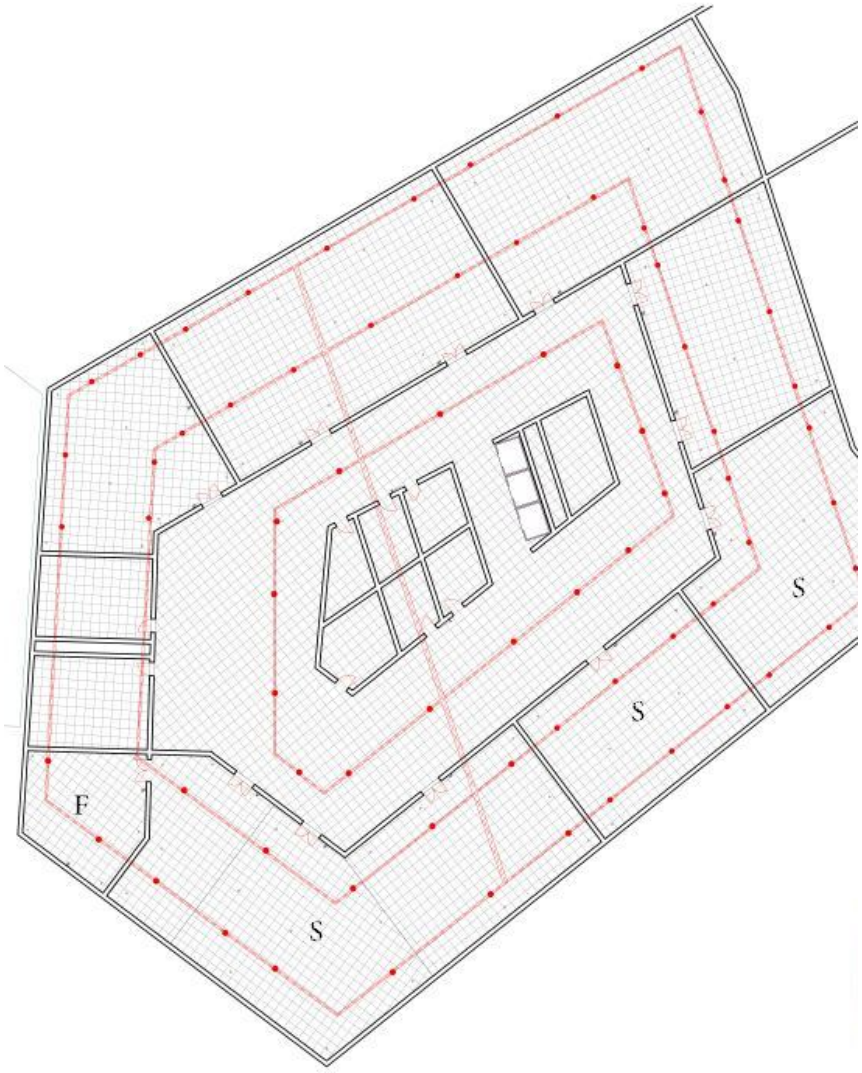


Figure 76: Part plan of one of the Commercial towers that showcases the firefighting system used in the project.

The letter "S" represent the spaces where there are Smoke detectors.

The letter "F" represent the spaces where there are Flame detectors.

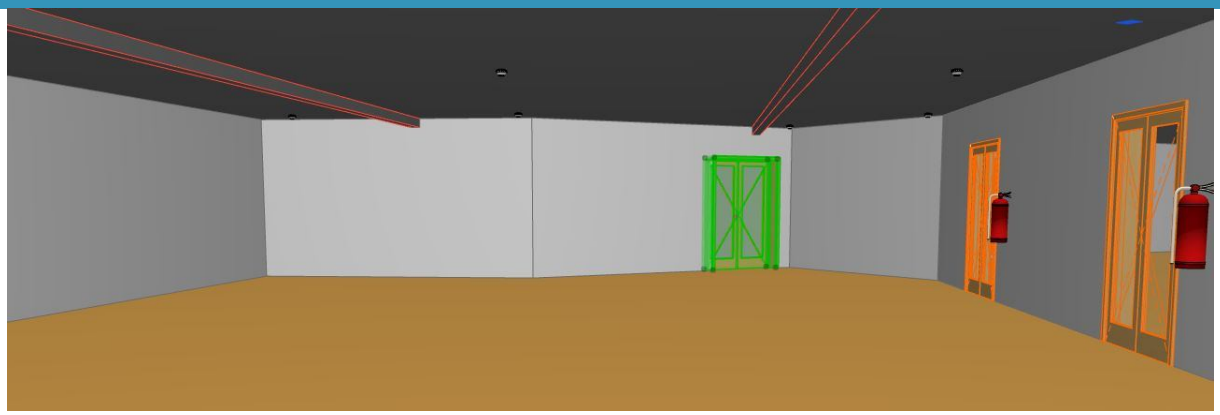


Figure 77: Interior picture that showcases the water lines of the firefighting system and how the detectors are installed and how the handheld fire extinguisher next to the doors.

6 REFERENCES

- Wikipedia.
- Google.
- Google Maps.
- Archdaily.com.
- Architect's Handbook.
- Time saver for building types 2nd edition by Joseph De Chiara & John Callender.
- Neufert Ernst and Peter – Architecture Data 3rd edition.
- Ministry of National Planning in Khartoum.