SALAHADDIN UNIVERSITY
COLLEGE OF ENGINEERING
ARCHITECTURE DEPARTMENT

WATER RESEARCH CENTER

REVIVING OF THE LITTLE ZAB

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Sup. By: Ms. ANSAM SALIH &
THE STAFF

Fifth Stage@2019

DEDICATION

This Thesis Is Dedicated To Each Of

My Parents	*Muayad Hussain & Bushra Ali, your encouragement, attention, and unconditional love made this possible, thank you from the heart, may allah protect you.*
My Sisters	*Noor, Zainab & Leena, for your continuing attention and support, thanks for always being there for me.*
My Supervisor	*Ms. Ansam Salih for your continuing encouragement, guidance and for believing in my abilities. I'll forever be grateful for you.*
Thesis Staff	*Dr. Salahaddin, Dr. Hamid, Dr. Hussain, Dr. Faris, Dr. Dara, Ms. Lana, for their instructions and guidance, without their assistance and advice this thesis wouldn't be done.*

Glossary of Terms

W.R.C.	Water Research Center
U.W.R.L.	Utah Water Research Laboratory
H.U.S.L.	Height Above Sea Level

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INTRODUCTION

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Chapter 1

1.1 General introduction

This chapter contain a general description to the project, problems that has to contaminated water that Iraq is facing, the reasons of selecting the project, the goals and the beneficiaries of this project.

1.1.1 Iraqi water sources

1.1.1.1 Surface water sources-rivers:

Tigris and Euphrates rivers and their tributaries are known as the main water resources in Iraqi areas, they supplied water since ever.

This source faces several pollution problems.

1.1.1.2 Underground water:

Enormous amounts of underground water are existed in Iraq specially in Western desert and Musil island a wealth not yet exploited.

This source is the most **drinkable** one.

1.1.1.3 Waterfalls:

The north region of Iraq is rich with waterfalls that many of them Are used as tourist destinations.

This source has few pollution problems in some areas.



1.1.2 The Damage of polluted water in Iraq

Health Damage: there are two types of health effects on the humans the first one is the **Bacteriological** pollution where the individual gets ill **once** he/she drinks the contaminated water such as (Fever, cholera, Hepatitis), The other one is **cumulative** effect that appears after a long period intake of water containing a high percentage of salt or a specific percentage of chemicals, this effect causes many illnesses such as (kidney failure and Gastrointestinal problems).


Economical Damage: this includes a number of effects, the **first** one is a result of the previous point (Health Damage) that results in ill people who need **treatments and medicines** that has its cost, the **second** is the increase of diseases as cholera reduces people's confidence in the tap water and make them dependent on **bottled water** consumption, which is an additional cost for the householders.

There are no accurate numbers and statistics in **Iraq** to show the percentages of these affects.


1.1 General Introduction

1.1.3 Iraqi Water Survey

This survey included the diagnosis of problems related to water, sewerage, and municipal services in Iraq for the years 2004-2006, in order to be solved.

عدد السكان الكلي وعدد السكان المخدومين بشبكات توزيع المياه الصالحة للشرب وتسعيتهم المئوية
حسب البيئة على مستوى العراق لسنة 2005

البيئة	عدد السكان الكلي	عدد السكان المخدومين %	نسبة المخدومين %
حضر	17259925	13795892	79.9
ريف	8779347	5406216	61.6
المجموع	26039272	19202108	73.7

*عدد السكان حسب تقديرات الجهاز المركزي للإحصاء وتكنولوجيا المعلومات عدا إقليم كوردستان .
المصدر المسح البيئي في العراق لسنة 2005 قطاع (الماء ـ المجاري ـ الخدمات البلدية)

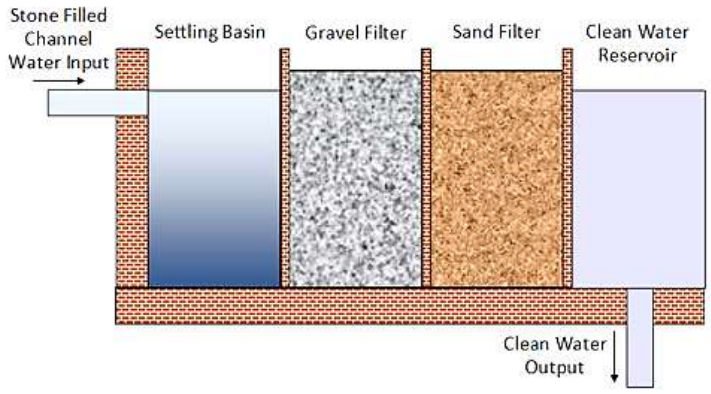
1.2 Historical Background

1.2.1 The beginning of pollution

"After decades of neglecting the treatment during the sanctions in the 1990s and environmental damage caused by conflicts after 2003, pollution in Iraq has reached a peak level. The water quality of the Tigris River, the lifeline of the country, has deteriorated in recent times".

1.2.2 First water filter system

The first recognized large-scale water filtration system was invented in 1804 by John Gibb, a Scottish engineer. The system used a series of earth material filters to purify water supplying a bleaching plant in Paisley, Scotland. In this system, water passed from a stone-filled channel into a settling basin then moved successively through a gravel filter and a sand filter prior to entering a central water storage basin. Surplus water was sold to the public.

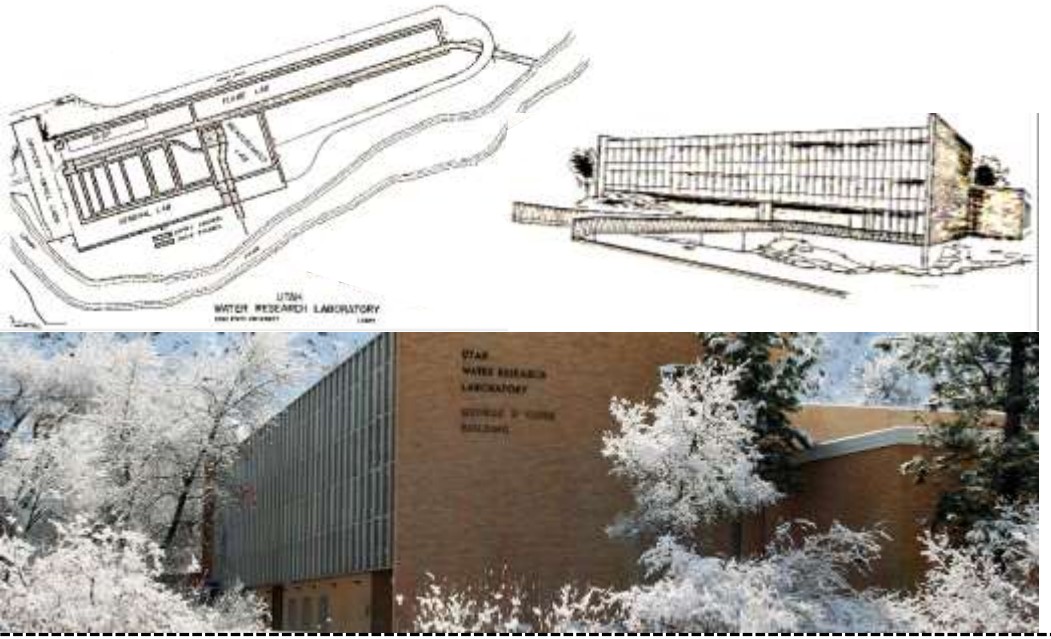


1.2 Historical Background

1.2.3 First water research institute in the world

The Utah Water Research Laboratory (UWRL) is a research institution at Utah State University. It is the oldest and one of the largest water research facilities in the United States, and is considered one of the most well-respected such facilities in the world.[1] The UWRL has completed more than 100 major projects around the world and operates with more than $400 million in international funding.

Layout of The **U**tah **W**ater **R**esearch **L**aboratory (**UWRL**)



1.2.4 Oldest Iraqi similar project

In 1911 the **first step** was taken to provide refined drinking water by building a project for **filtering** water as well as building a **dam** called **Al-Hindia Barrage** on Euphrates river, the construction of the dam with a length of (250m) lasted between (1911-1913).

Between 1984 and 1989, a new dam was built several kilometres upstream as a replacement for the Hindiya Barrage.

1.3 **Thesis statement**

Recognizing the damages that are caused by contaminated water and the fast growing demand for potable water in Iraq and the whole world is a good start that leads to provide solutions including creating filtering and researching projects using high quality processes to meet the need.

Is not it the time to take a step?

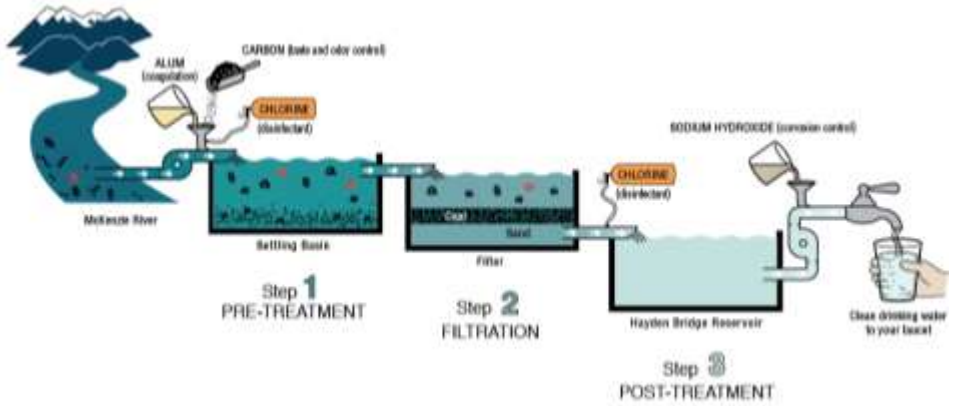
1.4 **Definitions**

About The Project

This project presents solutions to problems that relates to water pollution and water crisis in Iraqi areas, it also deals with recycling and reuse of wastewater, Through researches and specific technologies.

1.4.1 Water Filtering: Represents a key part of this projects that consists of several consecutive stages through which water passes and gradually it is filtered, using new water filtering technologies.

1.4.2 Research center: A building or group of buildings established with the purpose of researching, studying and discovering data that has to water issues through applying new techniques other than traditional ones.
Making a suitable environment for Iraqi and foreign scientists to conduct researches.



1.5 Goals of the project

1.5.1 Economical goals

- To reduce the need for water bottling plans
- To reduce family spending on bottled water
- To make extra use of existing water sources:

  Many areas in Iraq specially in Kurdistan depend on wells for water supply rather than rivers as a water source, this project will help reducing water Crisis by make use of sources that is not sufficiently exploited.

1.5.2 Social goals

- To reduce diseases caused by unrefined water
- To provide the Iraqi scientists with an opportunity to make studies about finding solutions to problems facing their country.
- To create awareness to the public

1.5.3 Environmental goals

As the research part of this project will work on diagnosing the problems of the river water many damages could be avoided

- To protect Animal Wealth (fish wealth)
- To protect the Plant Wealth

1.5.4 Goals achievement

1.5.4.1 By filtering and cleaning the water using latest filtering technologies.

1.5.4.2 By providing drinking water through water treatment.

1.5.4.3 By providing labs with latest devices.

1.5.4.3 By providing learning lab.s, seminar and auditorium halls

1.6 why I selected this project?

1.6.1 The increase of potable water demand.

1.6.2 The increase of the river pollution.

1.6.3 The agricultural and animal wealth decay.

1.6.4 High poisoning cases due to water pollution.

1.7 Beneficiaries of the project

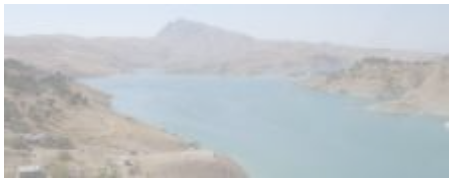
1.7.1 Ministry of Water recourses

1.7.2 Ministry of Health

1.7.3 The Community

1.7.4 Students of Similar Disciplines



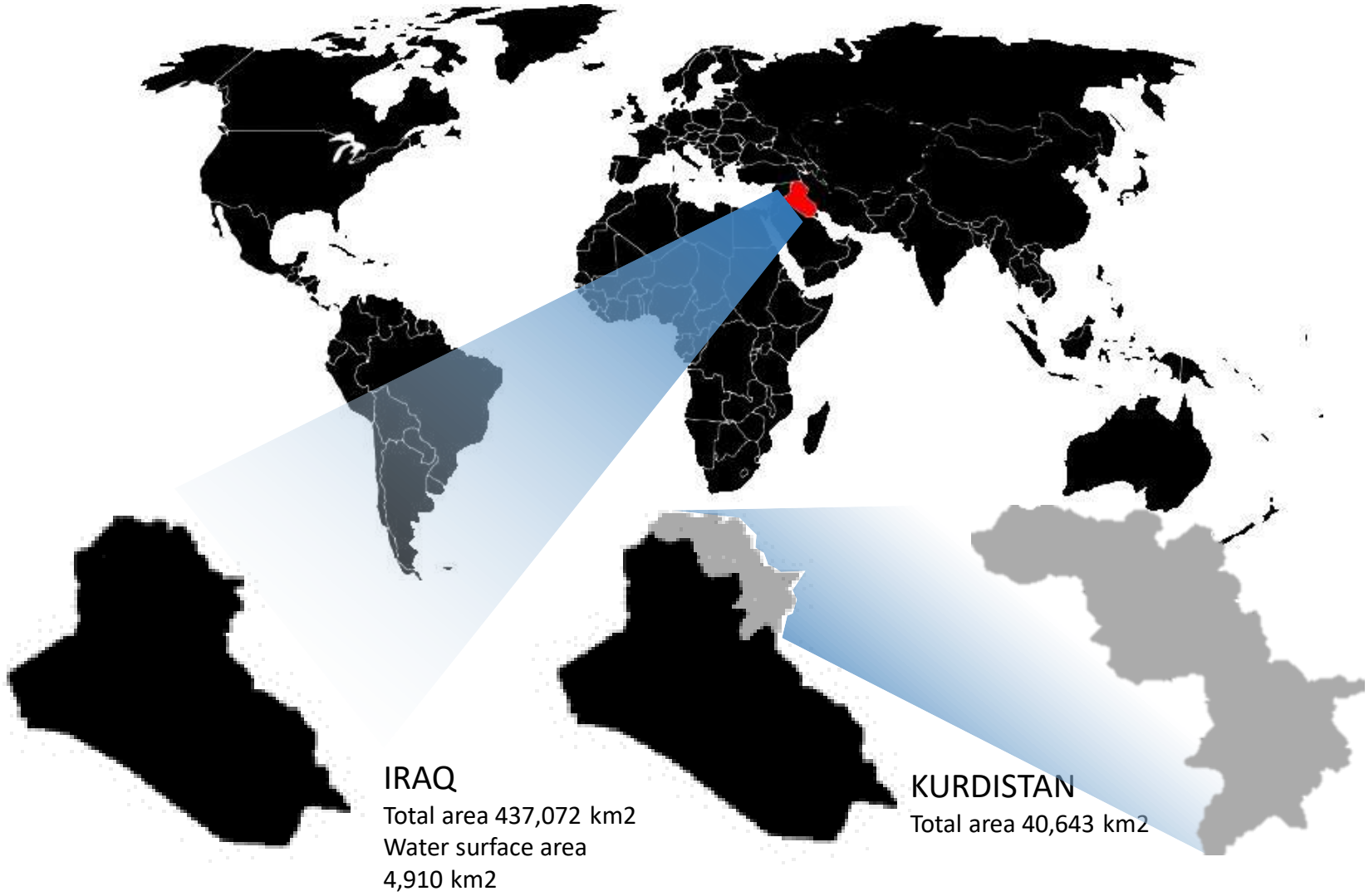



1.8 This chapter provided a brief introduction to the whole project which is contributory to a clear understanding about the WRC,being the first step leading to the following chapters.

SITE SELECTION

Content

2.1 **General location**



2.1.1 Introduction to The Little Zab

The Little Zab or Lower Zab originates in Iran and joins the Tigris at Al-Huaija town just south of the Greate Zab in the Kurdistan region of Iraq and ends up at Tigris river.

Length: 249 mi – 400 km

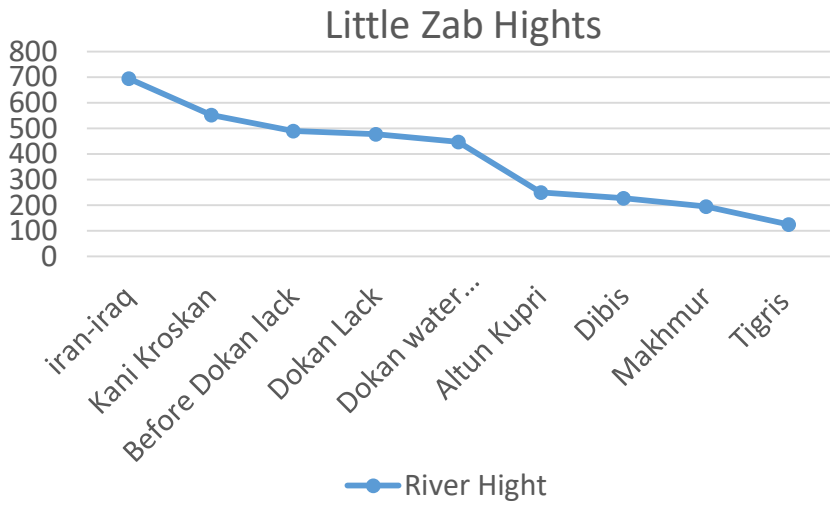
Discharge: 6,985 ft³/s

Basin area: 8,494 mi² - 22,000 m²

Country: Iraq

Mouths: Tigris, Lake Dukan

For having several water problems at this river and the areas surrounding it, the selected sites is located on the riverbank of the Little Zab.



2.1.2 Similar projects on the Zab

Water treatment projects have been built on The Zab a long time ago, suppling clean water to many cities and areas in Kurdistan region of Iraq.

Starting from the beginning of the river down to the Zab junction with the Tigris River, respectively:

- Kani Kroskan – Sulaymaniyah water treatment plant

  Hight ASL: 1200m

  Services: Sulaymaniyah city

  3.3km from the Main Road

- Dokan Water Treatment Plants

  Hight ASL: 541m

  Services: Sulaymaniyah city and surroundings

  Directly on Dokan Road

- Dibis Treatment Plants

  Hight ASL: 237m

  Services: Dibis

  0.5km from the Main Road

2.2 **Site selection criteria**

2.2.1 General criteria

• Surrounding Landuse	Includes: residential, Agricultural, vacant areas.
• Utility	Includes: Electricity, water supply, Sewerage.
• Accessibility	Includes: Main road, secondary roads, reachability.
• Soil validity	Includes: type of soil as rocky is not Suitable while gravel and sand is.

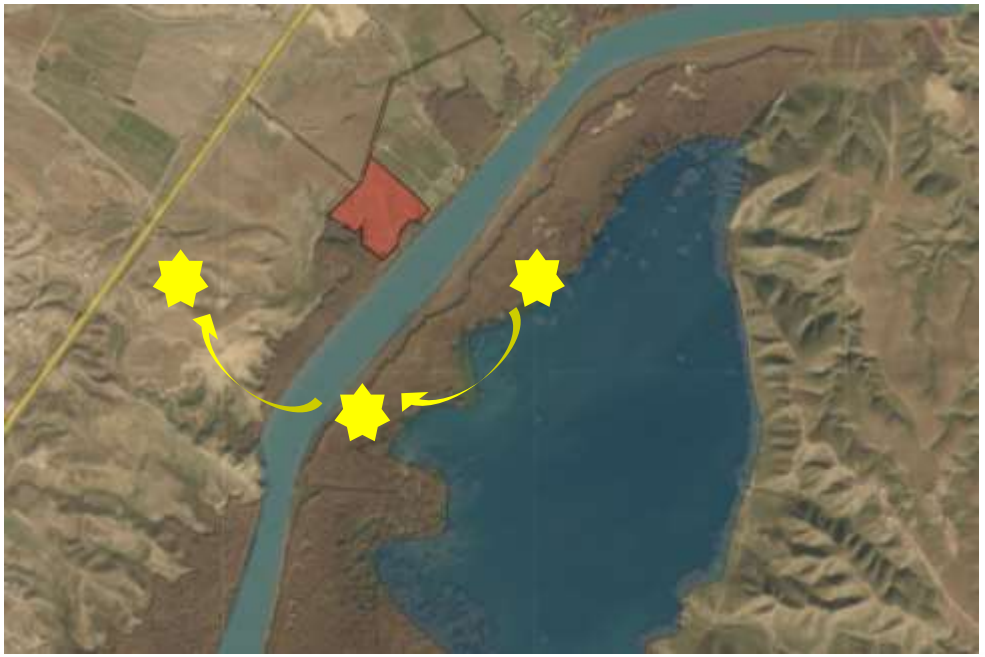
2.2.2 Specific criteria

• Distance from Water source	Close to a natural water source.
• Problem	Includes: lake of drinking water, pollution, water crisis.
• Water flood	Includes: water flow speed.
• Topography	Includes: Levels of site, height above sea level.
• Low Cost	According to the location of the site the cost will be determined.
• Area	Large area for different project zones, future expansion.
• Distance from city center	Measure the dimension to the Center of the city.

2.3 **Introduction to the selected site**

- Location: close to Altun Kupri city
- Coordinates: 35’43’30”N 44’07’01”E
- Area: 37,000 m²
- 3.9km from Altun Kupri
- 6.6km from dibis
- 670m from arlterial road
- 4.5km from main Kirkuk road
- Connected with a local road

Figure: Showing Distance to nearest cities



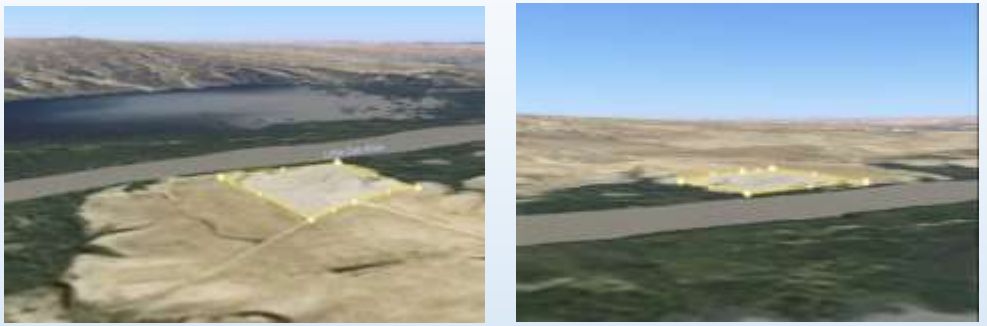


Figure: Showing view towards the fluid area & the opposite side

2.4.1 Site analysis according to Specific criteria

Distance from water source

- The site located on the river's edge.
- Direct relation with the water source.

problem

Problems to solve in the area :

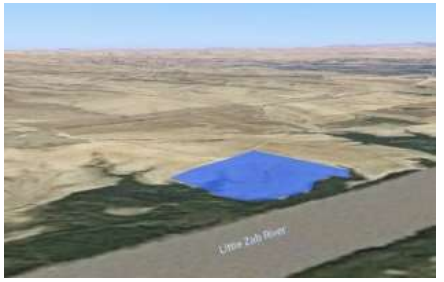
- Water turbidity
- Water crisis

Water flood

- The site is located where the river width increases, that will support the project

Topography

- The site has slight slop
- 251m above sea level



Distance from city center

- The site is 38km from Kirkuk center
- 3.9km from Altun Kupri
- 6.6km from Dibis

Area

- Total site area=38,000 msq.
- Able for future expansion

Low cost

- The site is easily reachable
- Not located on high mountains

2.4.2 **Site analysis according to** General criteria

Surrounding landuse

- Residential areas
- Agricultural areas

Utility

As the site being close to residence nodes it can be easily supplied by main utilities.

Accessibility

- Distance from Kirkuk road 4.5km
- Distance from arterial road 670m
- Local road-Available

Soil validity

Type of soil: rocky lands in Iraq aren't suitable for construction as the gravel and sand land like my site

2.5 This chapter introduced the location and the site specified for the project, the criteria in this chapter will be quite helpful and influential in the design process.

CHAPTER CONCLUSION
SITE SELECTION

SIMILAR PROJECTS

CONTENT

3.1 General introduction - Similar projects

Biomimicry – water research center

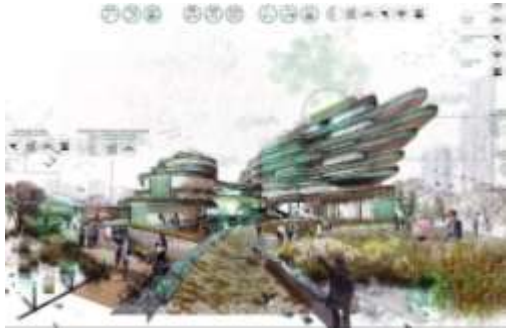
Ocean Research Center

Ocean Research Center

1 2 3 4 5 6

Water institute headquarter

The living water education & research center



Qandil Water Project

3.2 **Biomimicry – water research center**

3.2.1 **General Information**

This project has won the **first** prize of (**Next Generation**) Competition,In 2014 for **Africa** middle east, For architect (**Jurie Swart)**.

The Water Research Centre not only addresses the issue of water research but also how architecture reacts to its surrounding context and the effect that it has on how the building operates and functions. The architecture is activated by the environment's transformation from one season to the other. The water is the lifeline of the building, it not only supplies water to the building but the architecture in return purifies, creates habitats for fish and birds, it lives in symbiosis with nature.

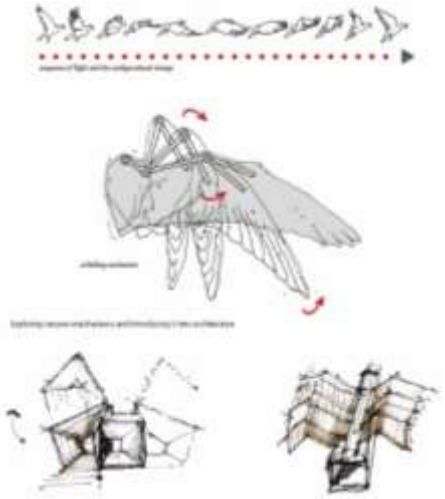
Project -1-

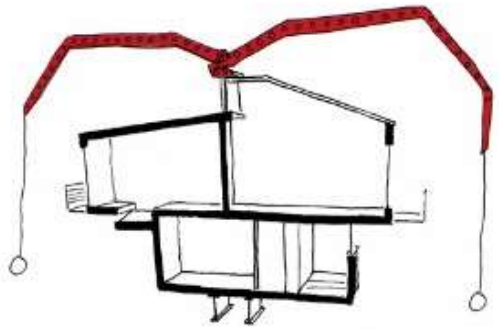
This example will be useful for:

- the **research** part of the project
- Architectural **Sustainable** methods

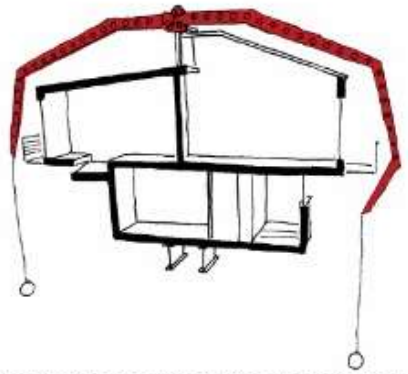
The **concept** driving the design of the Water Research Center of the University of the Free State in South Africa is known as bio-mimicry, learning from nature's regulating processes to inspire an understanding of architecture in sync with the environment. Architecture, according to the project's author, can mimic the mechanisms at work in nature to produce architectural structures that can sustain themselves, while in symbiosis with nature.

The project aims to amalgamate the land mass and bodies of water with a dam constructed on existing pillars to form a hybrid landscape. The building evolves into a kind of living creature or organism with a roof-like structure opening or closing according to the seasonal rainfall.





Water level forces structure to open [winter]



Water level forces structure to close [summer]

3.2 **Biomimicry – water research center**

In architecture transformation can have an effect on the function of a building. By mimicking nature the design transforms with nature in a seasonal way, by exploring water levels and rainfall. With the increase and decrease in the water level of Fika Patso Dam the water tension would passively force the building to open and close. A slow but functional way of adapting to climate change.

GINA principle

Geometry and Functions In "N" Adaptions)

"Industrially produced hybrid fabric made from a stabilizing mesh netting support and an outer layer that is both water-repellent and resistant to high and low temperatures is suitable for this application." (BMW GINA, 2008:online).

As one approach the proposed site the design exposes itself and one is greeted by the presence of a skin-like element growing over the existing tectonic structure. This element is introduced as an abstraction of nature powered by the forces of nature. The skin moves in a seasonal manner as the elements of nature change, resulting in a design effected by the way nature adapts. The skin seemingly melts away into the surrounding context of nature, reacting and moving to its ever changing character.

3.2.2 **Site Location and Analysis**

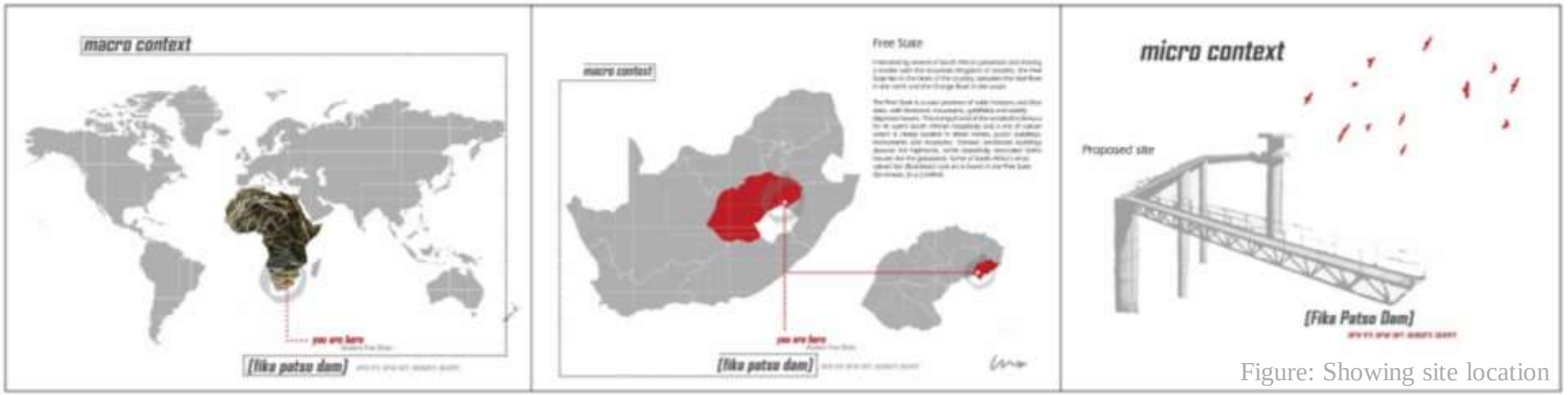


Figure: Showing site location

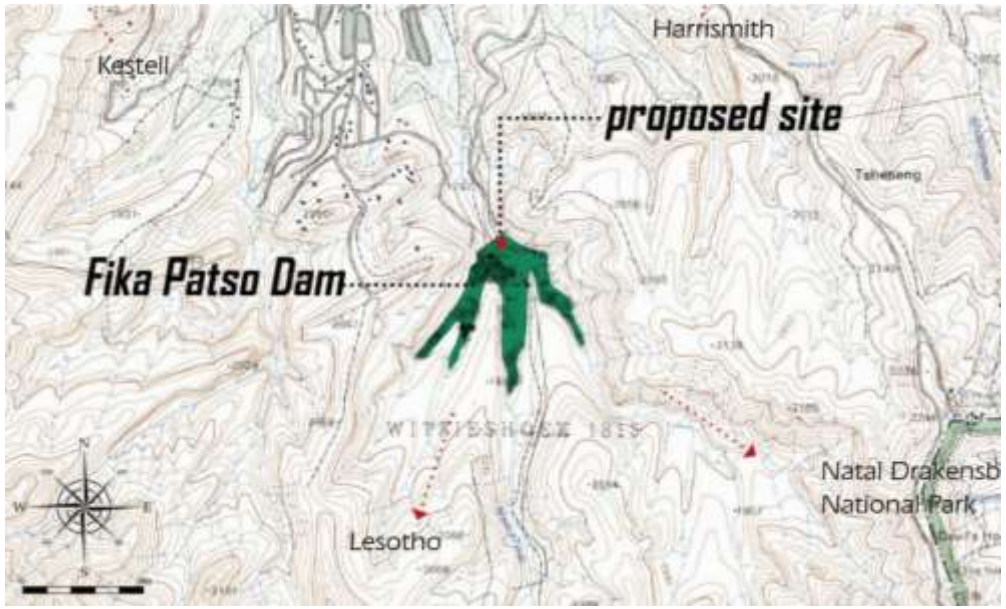


Figure: Showing site location

Figure: Showing site location

3.2.2 **Site Analysis**

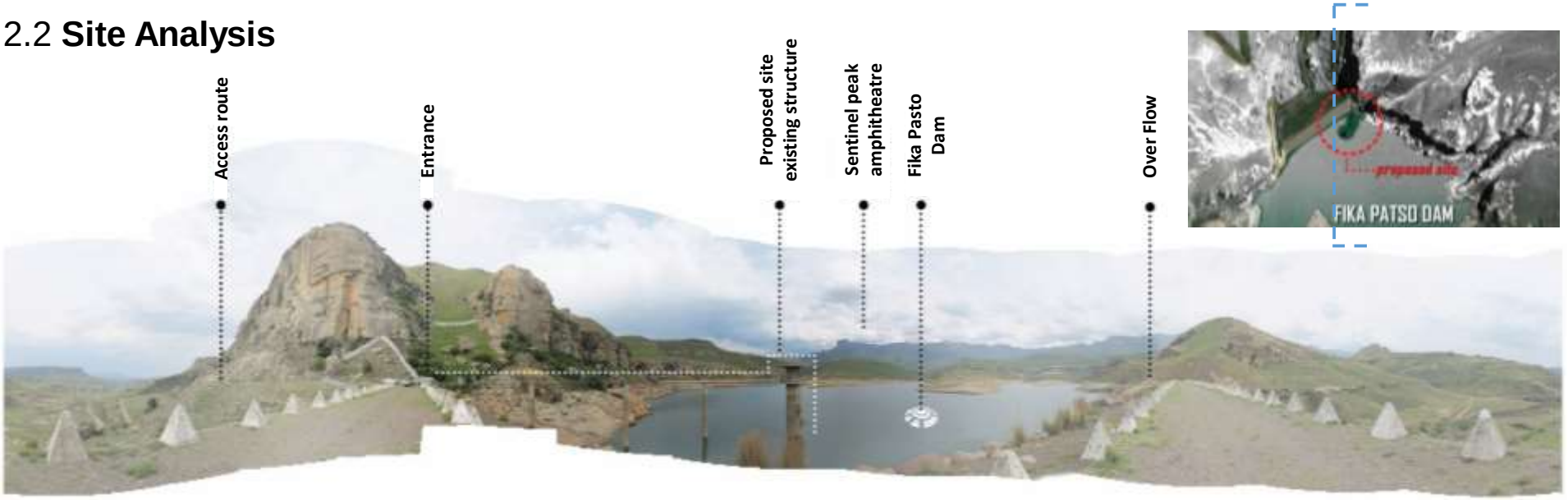


Figure: Section through the site

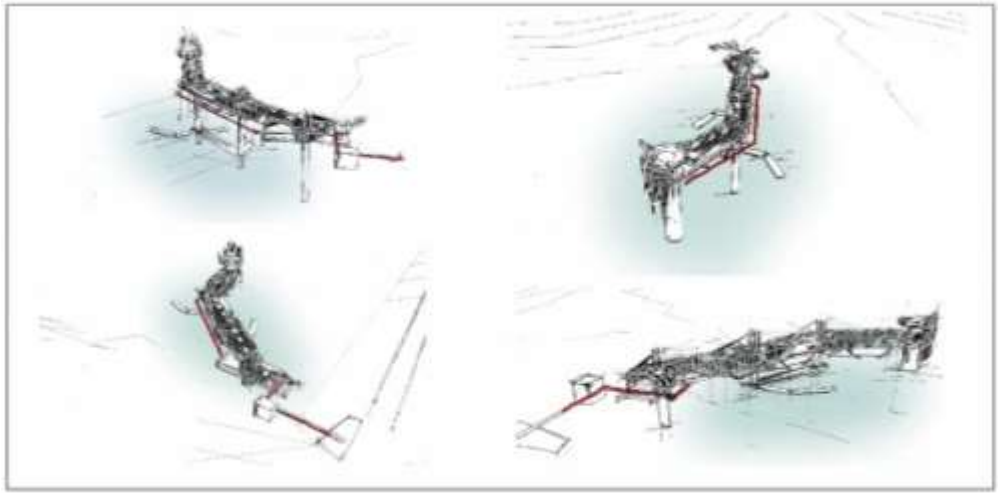


Figure: Conceptual sketch showing the linear shape

The linear design merges onto the existing column **structures**, juxtaposing and creating a tabula rasa.

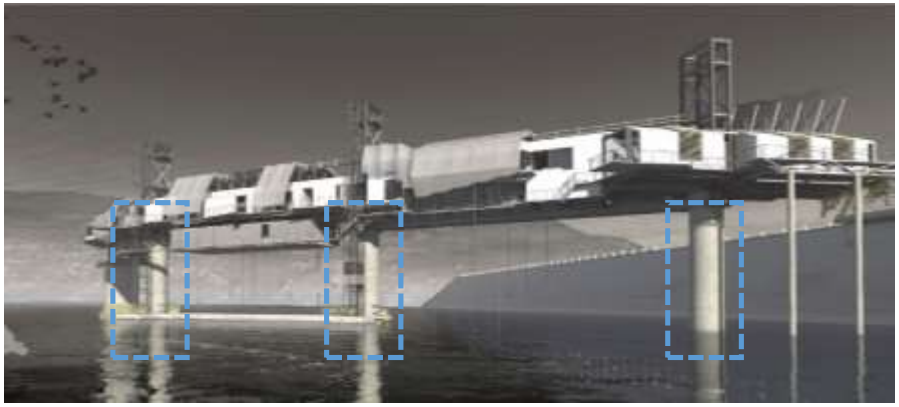
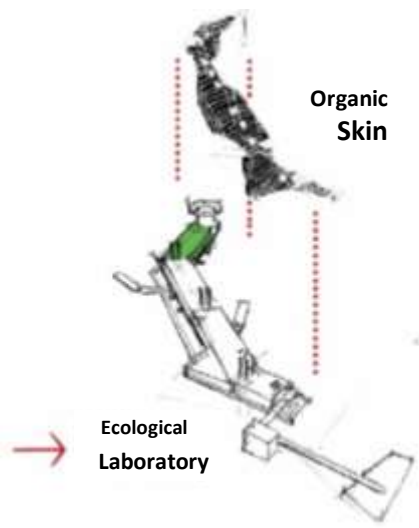
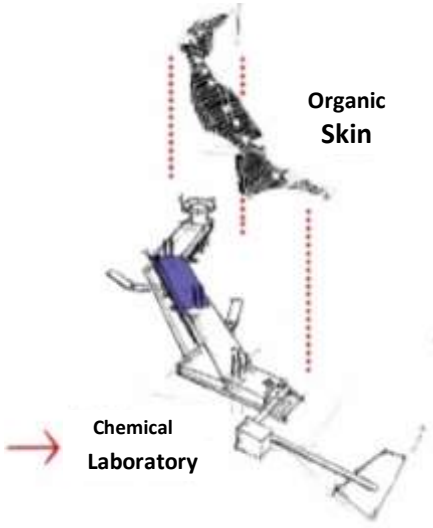
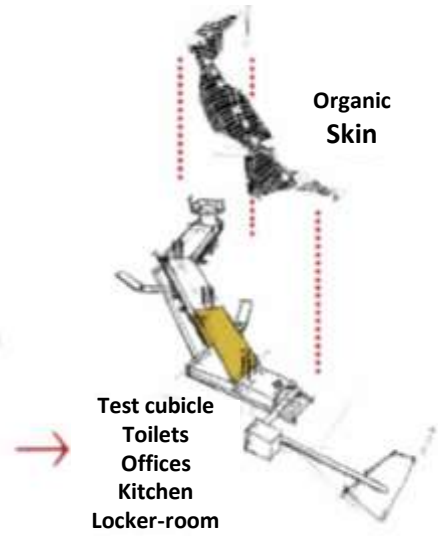


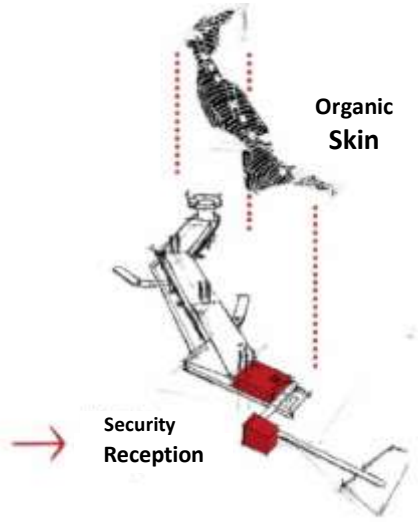
Figure: pic. showing the column structures

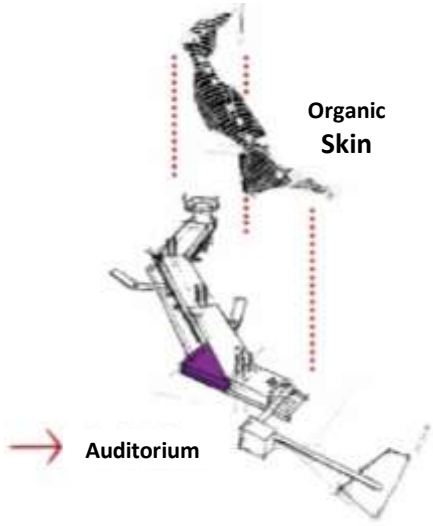
3.2.3 **Plan Analysis - 3D**

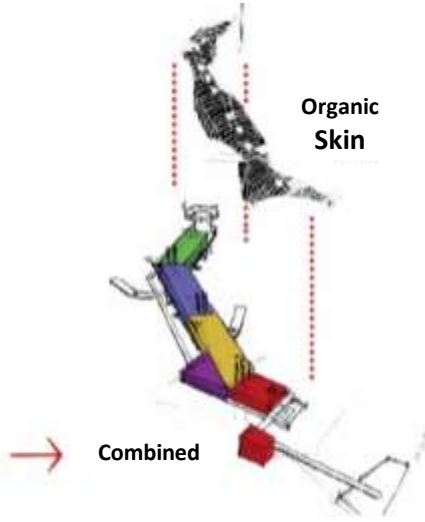






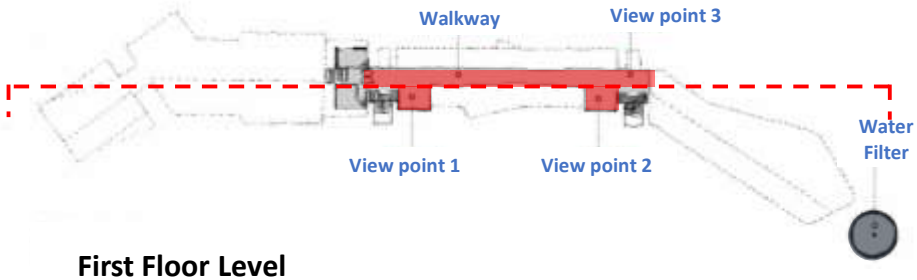




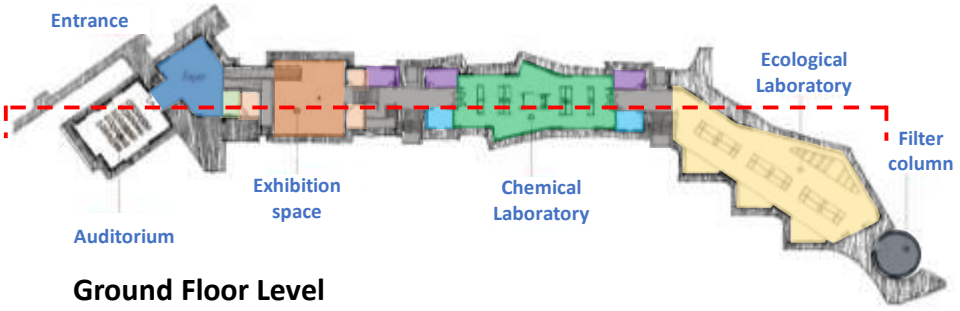


All floors Zoning – 3D

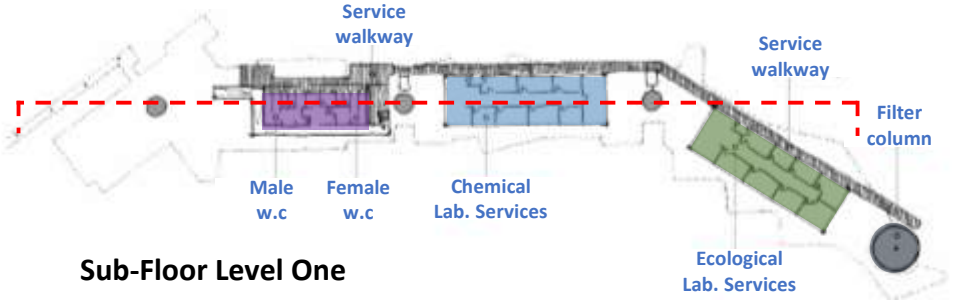
3.2.3 **Plan-Section Analysis**



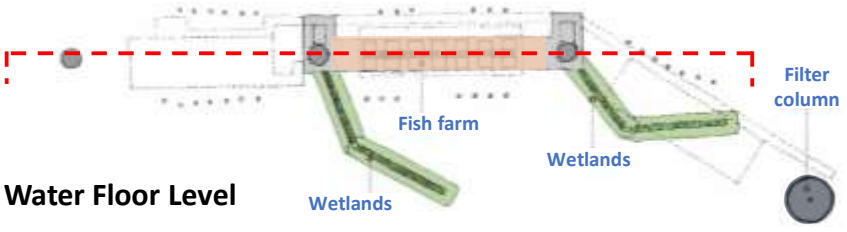
First Floor Level



Ground Floor Level



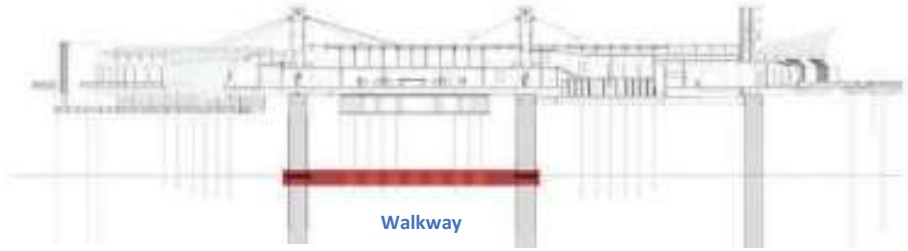
Sub-Floor Level One



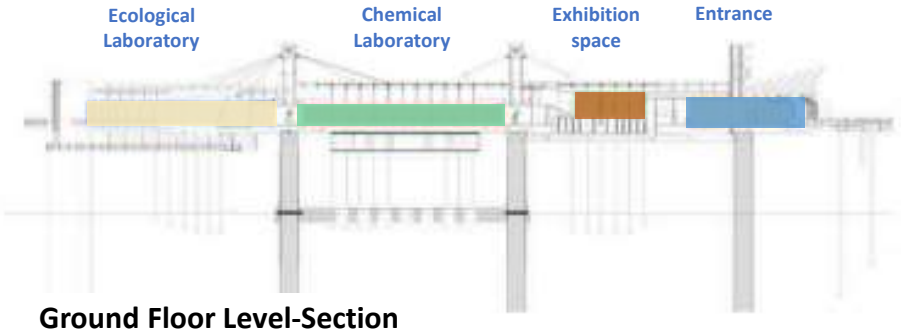
Water Floor Level

- Foyer
- Exhibition Space
- Offices
- Chemical lab.
- Ecological lab.
- Test room
- Reception services
- Horizontal + Vertical circulation
- Filtration Column
- Walkway
- W.C
- Chemical Lab. Services
- Ecological Lab. Services
- Fish Farm
- Wetlands

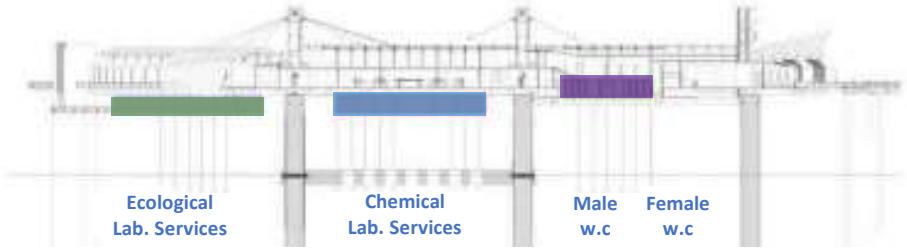
3.2.4 **Section Analysis**



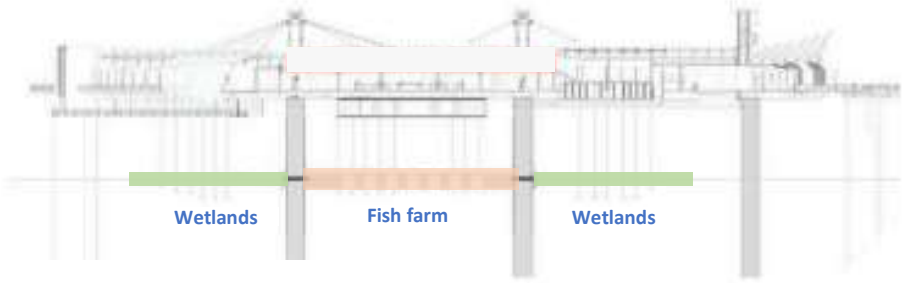
First Floor Level-Section



Ground Floor Level-Section



Sub-Floor Level One-Section



Water Floor Level-Section

3.2.5 **space program**

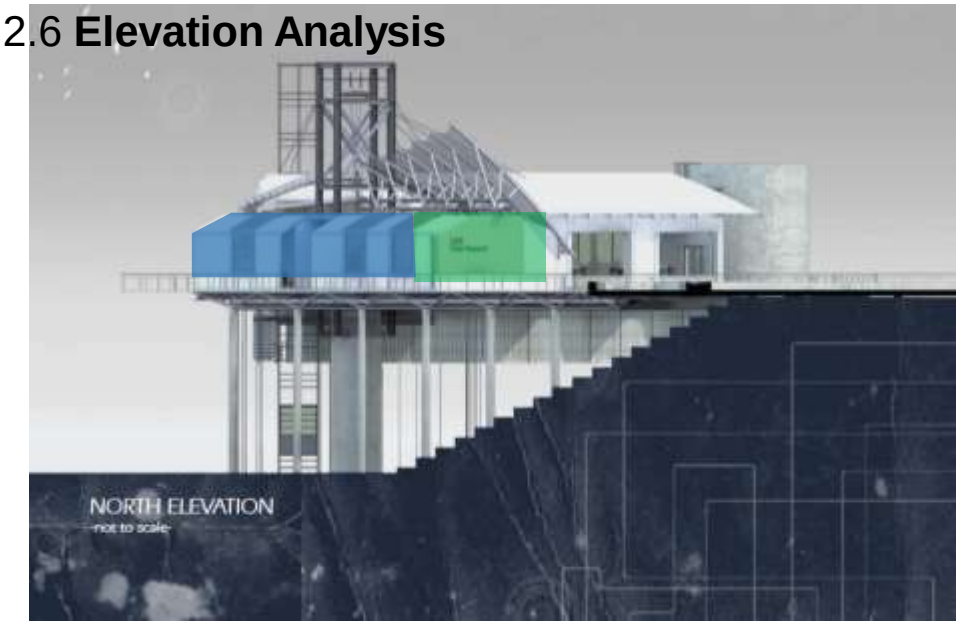
Facilities	No. Of Spaces	Net Area (sqm.)	Total N-Area (sqm.)
Reception	1	8	8
Foyer	1	55	55
Auditorium	1	77	77
Exhibition Space	1	95	95
Storage	1	7	7
Kitchen	1	8	8
Server Rm.	1	6	6
Office	4	9	36
Test room	1	15	15
Test cubicle	2	8	16
Cleaning rm.	1	6	6
Chemical lab.	1	145	145
Ecological lab.	1	216	216
Water filtration system	1	23	23
Floating foundation	1	155	155
Flouting wetland	1	155	155
Male restroom	-	-	21
Female restroom	-	-	17
Outdoor areas+ walkways	-	-	143

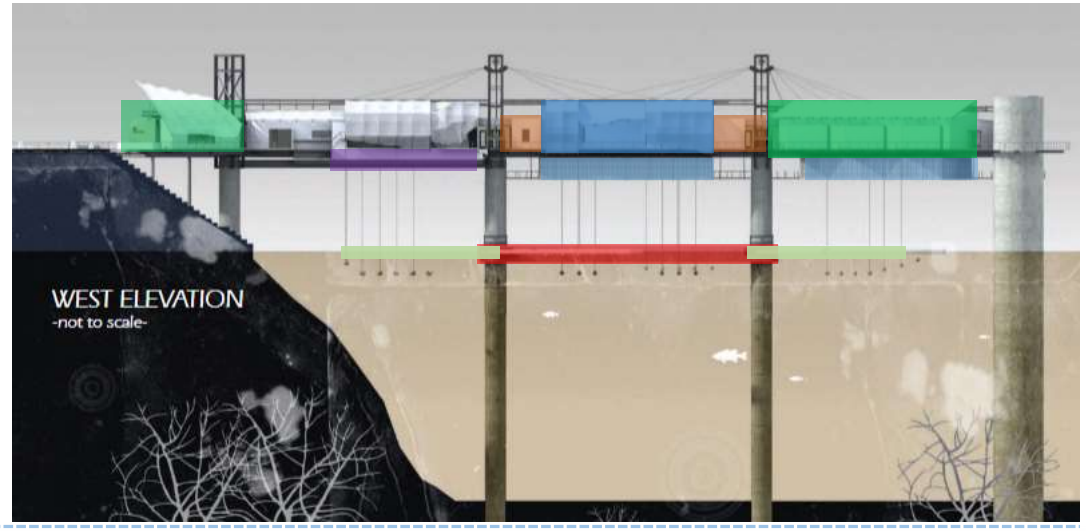
Chemical laboratory	No. Of Spaces	Net Area (sqm.)
Decontamina-tion	1	20
Temperature Rm.	1	7
Dark Rm.	1	20
Hazardous waste	1	10
Purge Rm.	1	8
Chemical storage Rm.	1	9
Equipment Rm.	1	9
Generator Rm.	1	7
Gas Rm.	1	6

Ecological laboratory	No. Of Spaces	Net Area (sqm.)
Sanitizing area	1	21
Temperature Rm.	1	9
Waste area	1	8
Equipment Rm.	1	10
Storage Rm.	1	6
Generator Rm.	1	8
Dark Rm.	1	7
Purge Rm.	1	12
Gas Rm.	1	8

No. of Researchers for **each** Lab. = **12 Researchers**
Total area of the project = **1402** msq.+ **30%** = **1820** msq.

3.2.6 **Elevation Analysis**





Chemical lab.
Ecological lab.
Walkway
Horizontal circulation
Entrance
Male+Female W.C
Wetland

3.2.7 **Ground Floor Level Analysis**

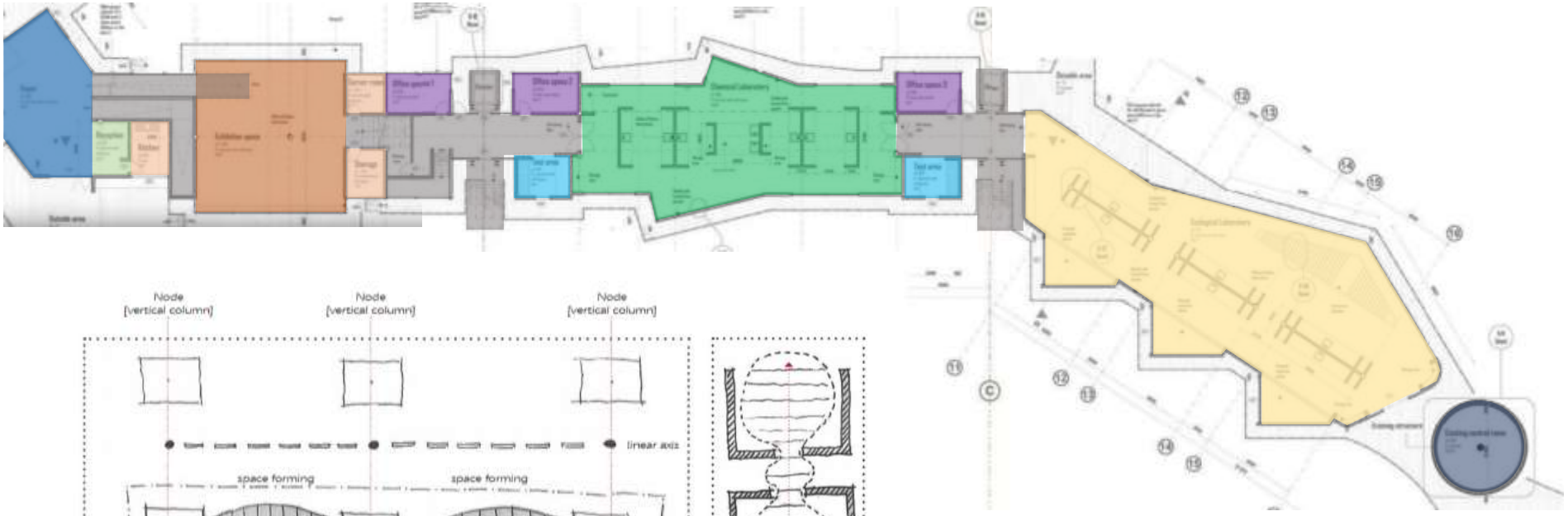
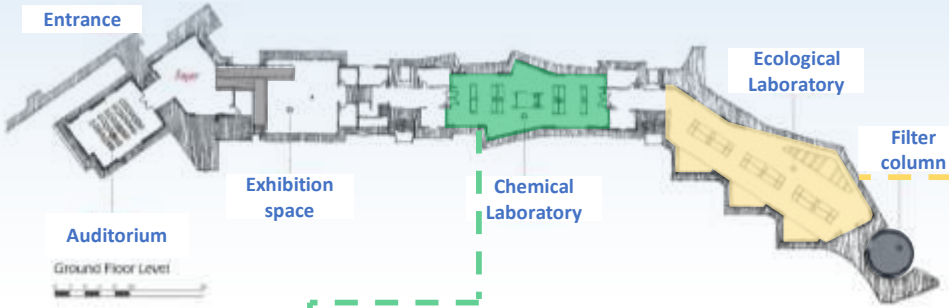


Figure: Showing how movement connects space

Figure: Showing how space is influenced by its borderline

Foyer
Exhibition Space
Offices
Chemical lab.
Ecological lab.
Test room
Reception
services
Horizontal + Vertical circulation
Filtration Column

3.2.7 **Ground Floor Level Analysis**



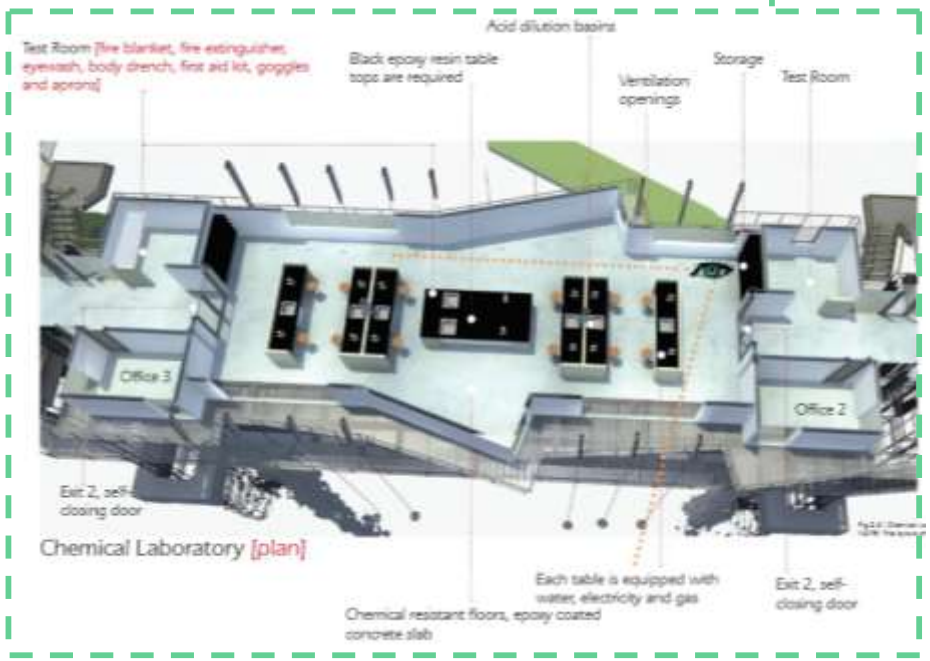


Figure: Chemical Lab. Plan - 3D

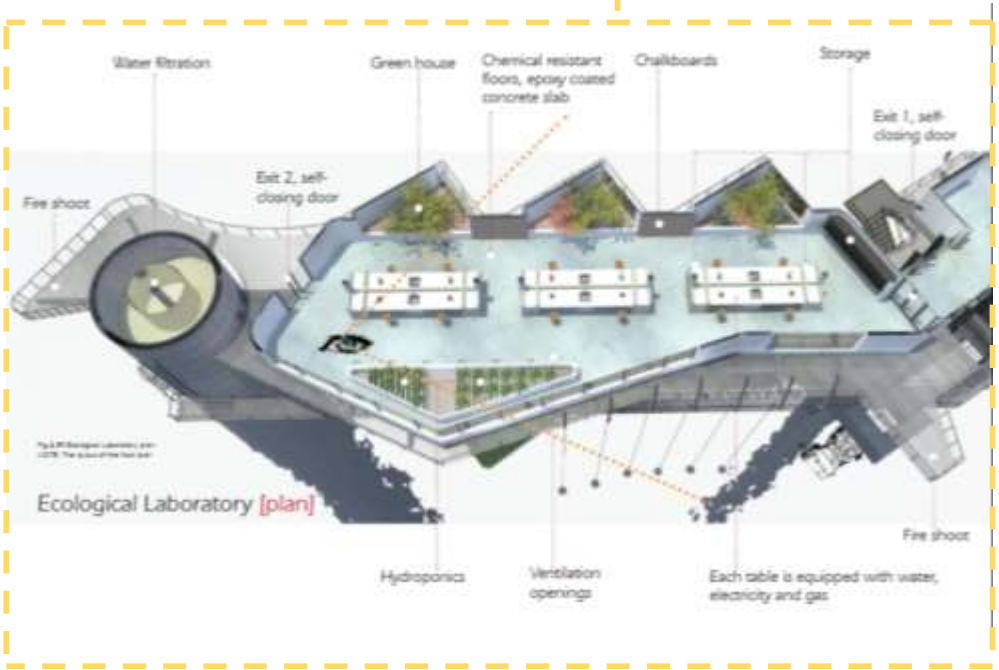


Figure: Ecological Lab. Plan - 3D

3.2.8 **Structure Analysis**

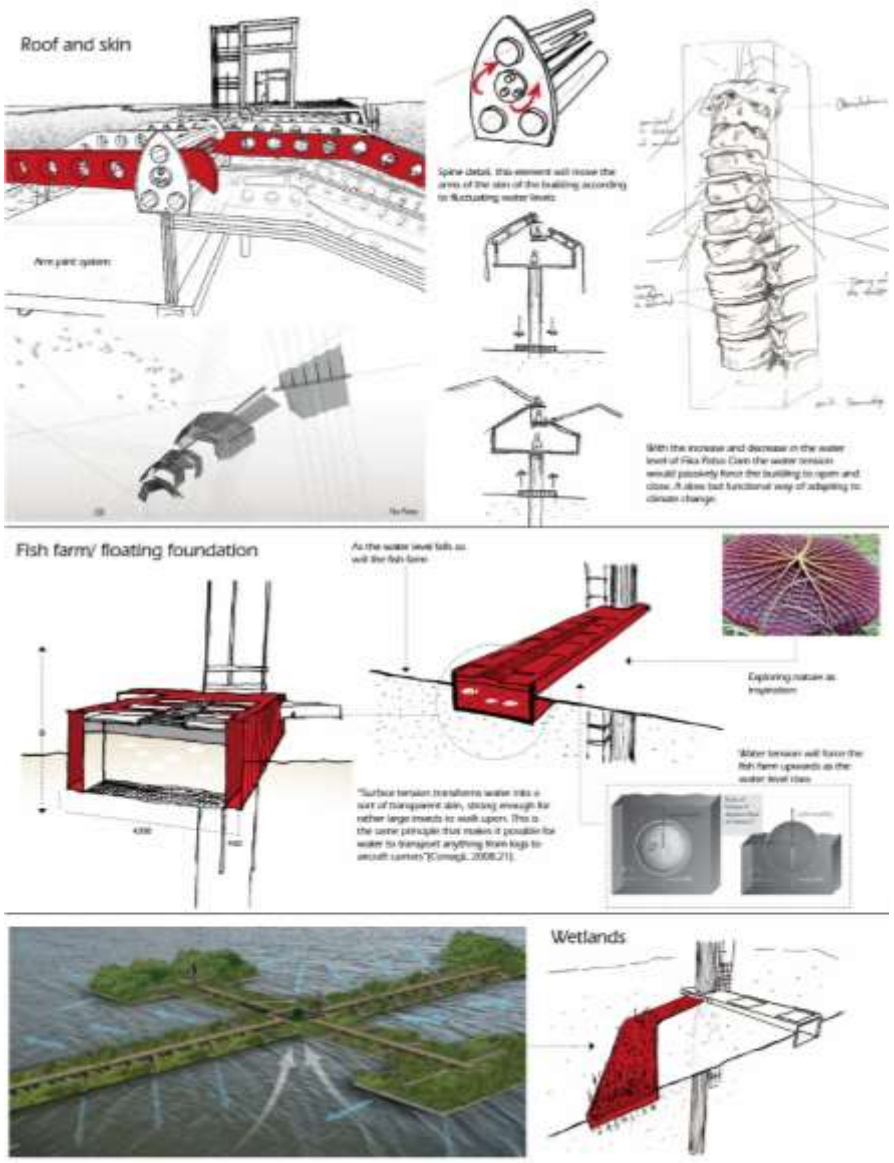


Figure: Showing structural wing position in summer-winter

2.3 **Longitudinal Section**

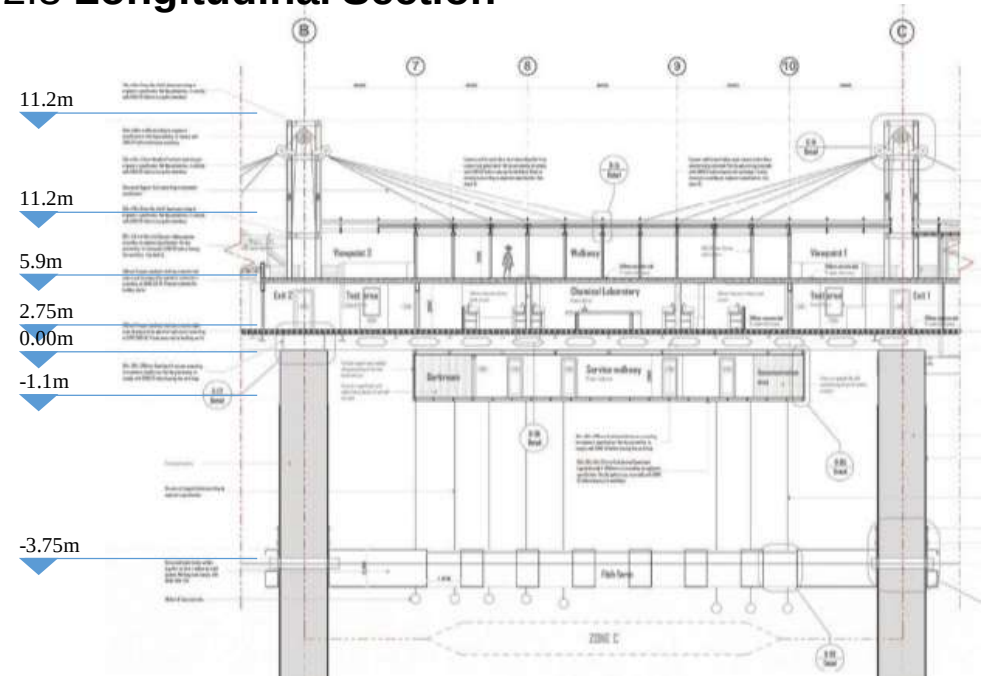


Figure: Showing Entrance & Interior view of the lab. In summer

3.2.8 **Structure Analysis**

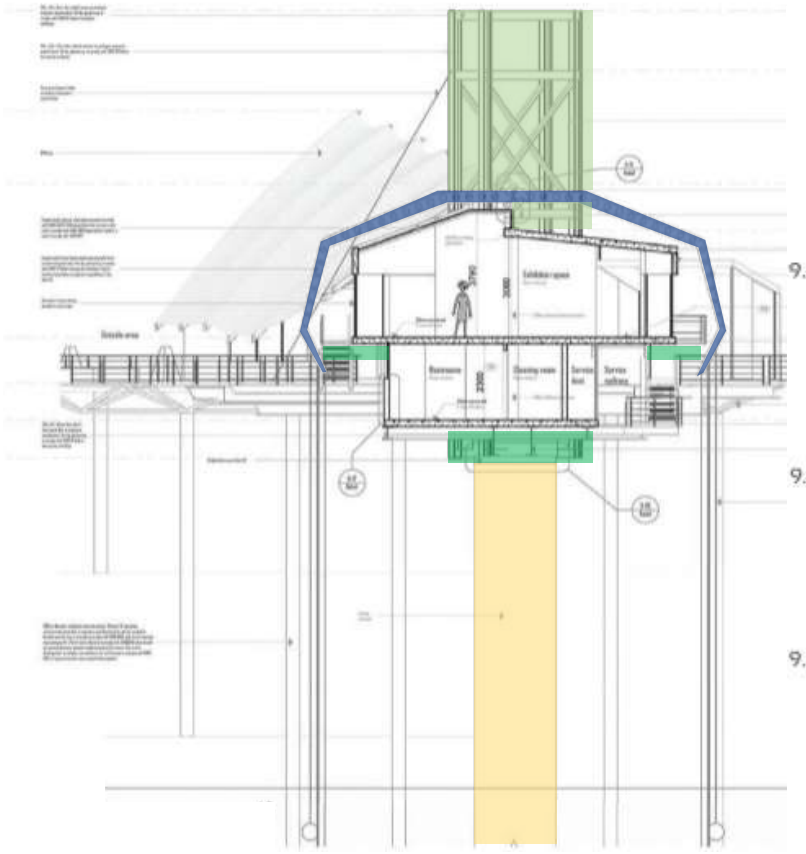


Figure: Showing the structure system through a Section

Figure: Sective showing Interior view of the lab. And lab. support In summer

Roof and skin

Sub-Structure

Steel structure supports the skin

Main support column

3.2.9 **3D views**

Figure: Interior view showing the Chemical Lab. In summer

Figure: Interior view showing the Ecological Lab. In summer

Figure: Interior view showing the Ecological Lab. In winter

Figure: Exterior view showing the main Entrance of the project

3.2.9 **3D views**

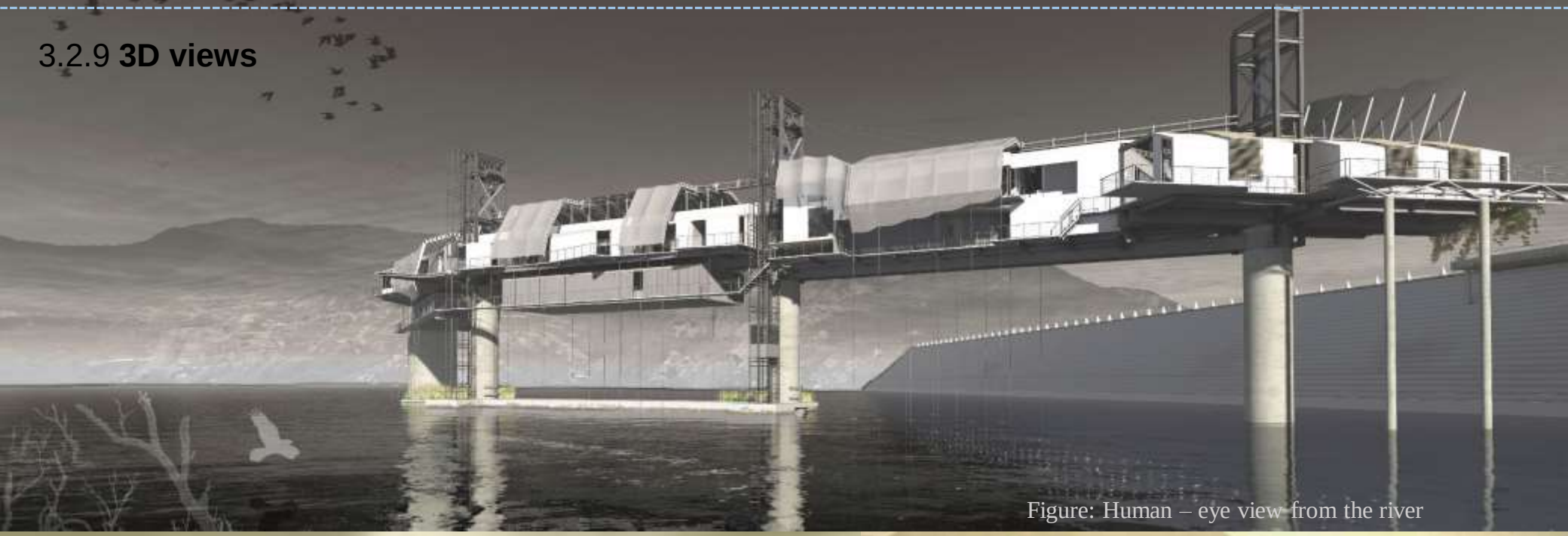
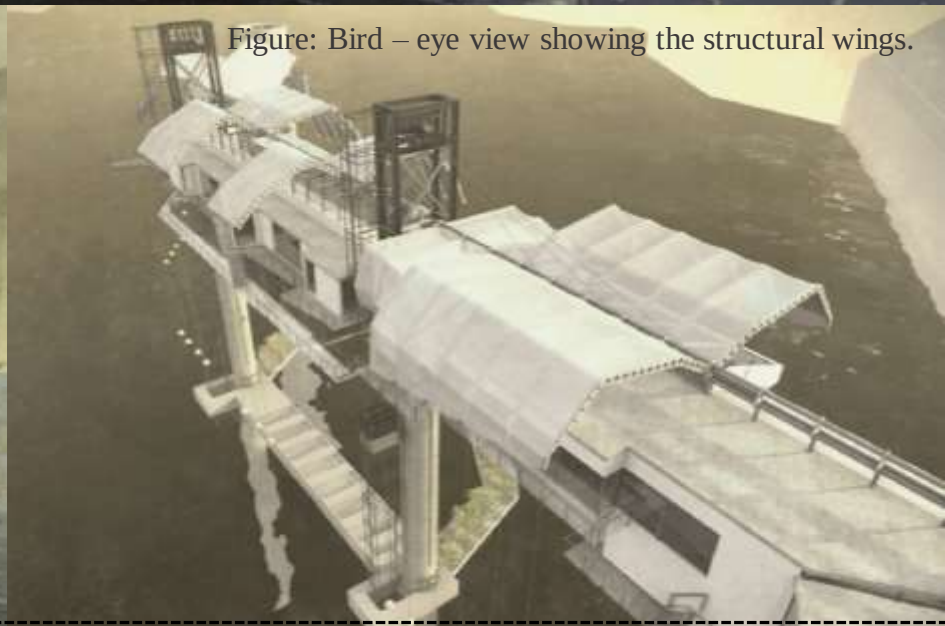


Figure: Human – eye view from the river

Figure: exterior view from the river side.

Figure: Bird – eye view showing the structural wings.



3.2.10 **Conclusion**

3.2.10.1 Advantages

- Using already existing **structures** and design the project above them, making the project **unique** and simulating the site.
- Using a **clear main path** within the design which is **linear path** enhances the function of the labs.
- Highly respects the surrounding **climate** by creating **movable** structural **shells** (close in summer and open in winter)
- Applying very modern, suitable **materials** and design methods within the **laboratories**.
- Linking the filtration and the research part **creatively**.
- Creating natural testing ways for more realistic study results though taking **samples** directly and creating **wetlands**.

3.2.10.2 Disadvantages

- Linking the labs with some lab supports by a **vertical** circulations which not as **strong** as the **horizontal** relation.
- Low **capacity** project.

3.3 Water Institute gulf Headquarters

3.3.1 General Information

Designed by **Perkins+Will** sits on **Mississippi River** The designer has created a waterfront building for a research organization in Baton Rouge, **Louisiana**, that is designed to remain fully functional during **floods**.
Founded in 2011, the Water Institute of the Gulf is a nonprofit organization that conducts research focused on water systems and coastal communities.
Its new headquarters is located on the banks of the Mississippi River.

The **concept:** The **wedge-shaped** building sits atop a **concrete pier** that rises 35 feet (10.6 metres) **above** the water. The elevated position enables the building to withstand **seasonal flooding**, which can leave the shoreline completely submerged.

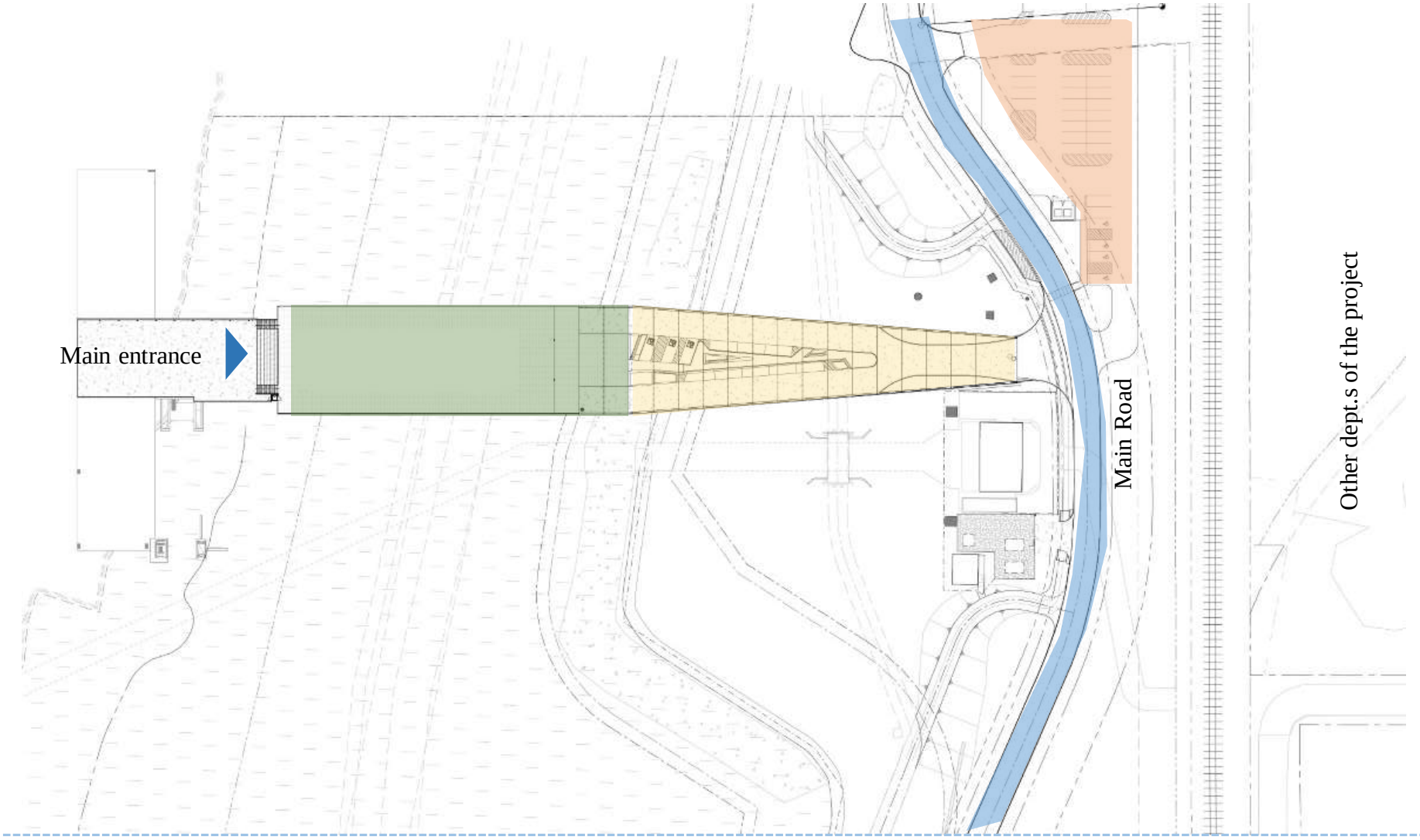
Project -2- This example will be useful for:

- the **research** part of the project
- Dealing with the surrounding environment

10.6 meters concrete pillars hanging the whole building.

3.3.2 **Site Plan Analysis**

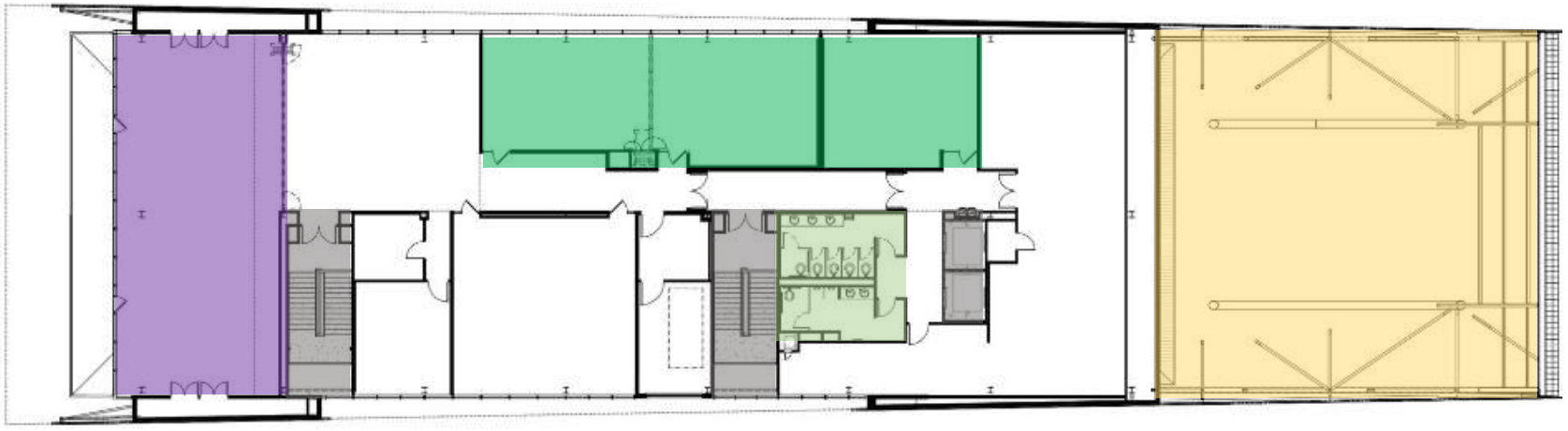
3.3.2 **Site Plan Analysis**



3.3.3 **Plan Analysis**

Encompassing 34,000 square feet (3,159 square metres), the facility contains a range of workspaces. The ground floor houses offices and laboratories, while the second floor contains the main offices for the institute. The third level encompasses an 8,000-square-foot (743-square-metre) conference centre, where the organisation is able to host a range of events.

Ground Floor – 2D

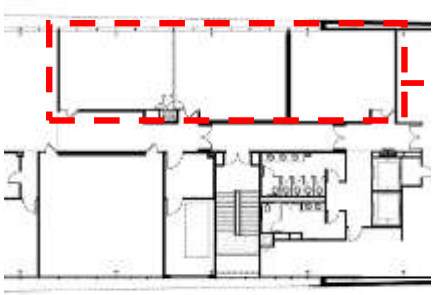


First Floor – 2D

A walkway **encircles** the building, allowing **visitors** to peer inside and observe **research** activities.

Main offices
Laboratory
Walk way
Vertical circulation
Conference hall
W.C
Lab. Support
Roof

3.3.4 **Interior Views**

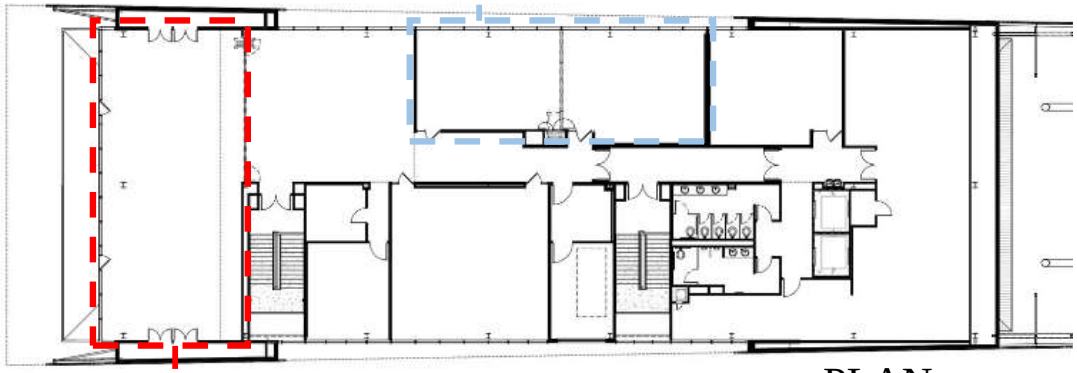


PLAN

Interior views for lab. Meeting room, offices.

3.3.4 **Interior Views**

Interior views for lab. Meeting room, offices.



PLAN

Interior views for lab. Meeting room, offices.

3.3.5 **Exterior Views**

3.3.6 **Conclusion**

3.3.6.1 **Advantages**

- Providing a loop path to let the public see the whole project like an exhibition place to increase their knowledge about water issues.
- Supporting the laboratories as well as the offices with nice views of the river and surroundings.
- Providing enhanced and suitable interior environment for working through using open offices which increases the productivity of employees.

3.3.6.2 **Disadvantages**

- there are no social or recreational spaces for the employees.

3.4 Ocean Research Centre

3.4.1 General Information

Designed by **Open Architecture** in Shenzhen, **China** in **2016**. Is a laboratory and office building. The architects wanted to create a vertical campus that integrated plenty of social spaces while also referencing the nature of the research, which focuses on the deepest part of the ocean. Made almost entirely from **concrete**, the 60-metre-high structure features volumes that protrude from the front to shade the outdoor spaces underneath.

"The exterior shading devices also efficiently cut down the heat gain, yet still offers good **views** for the **lab** and **offices**,"

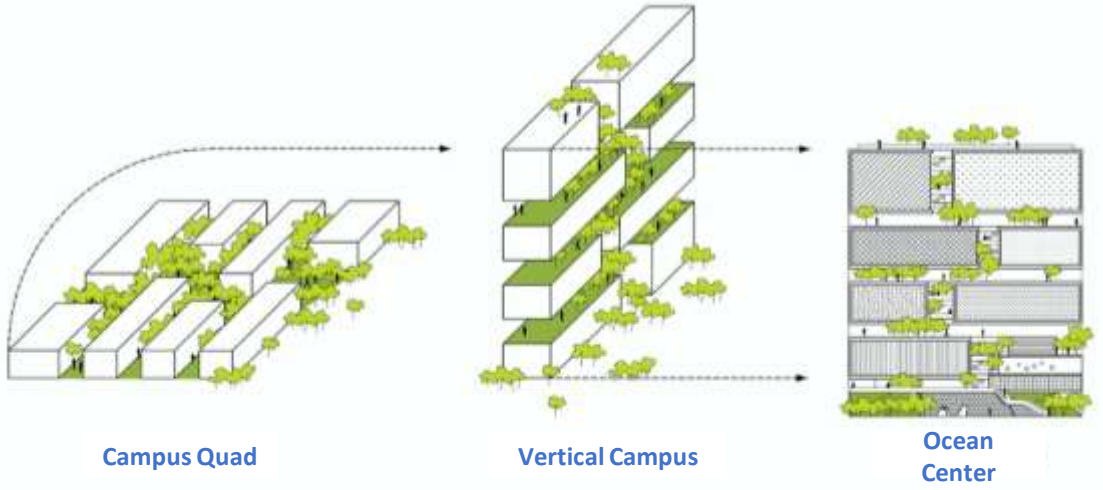
Project -3- This example will be useful for:

- the **research** part of my project

Laboratories and **offices** occupy the boxy volumes, which are joined by staircases. However, some of the volumes contain meeting rooms, and these feature round porthole-like windows instead of louvres.

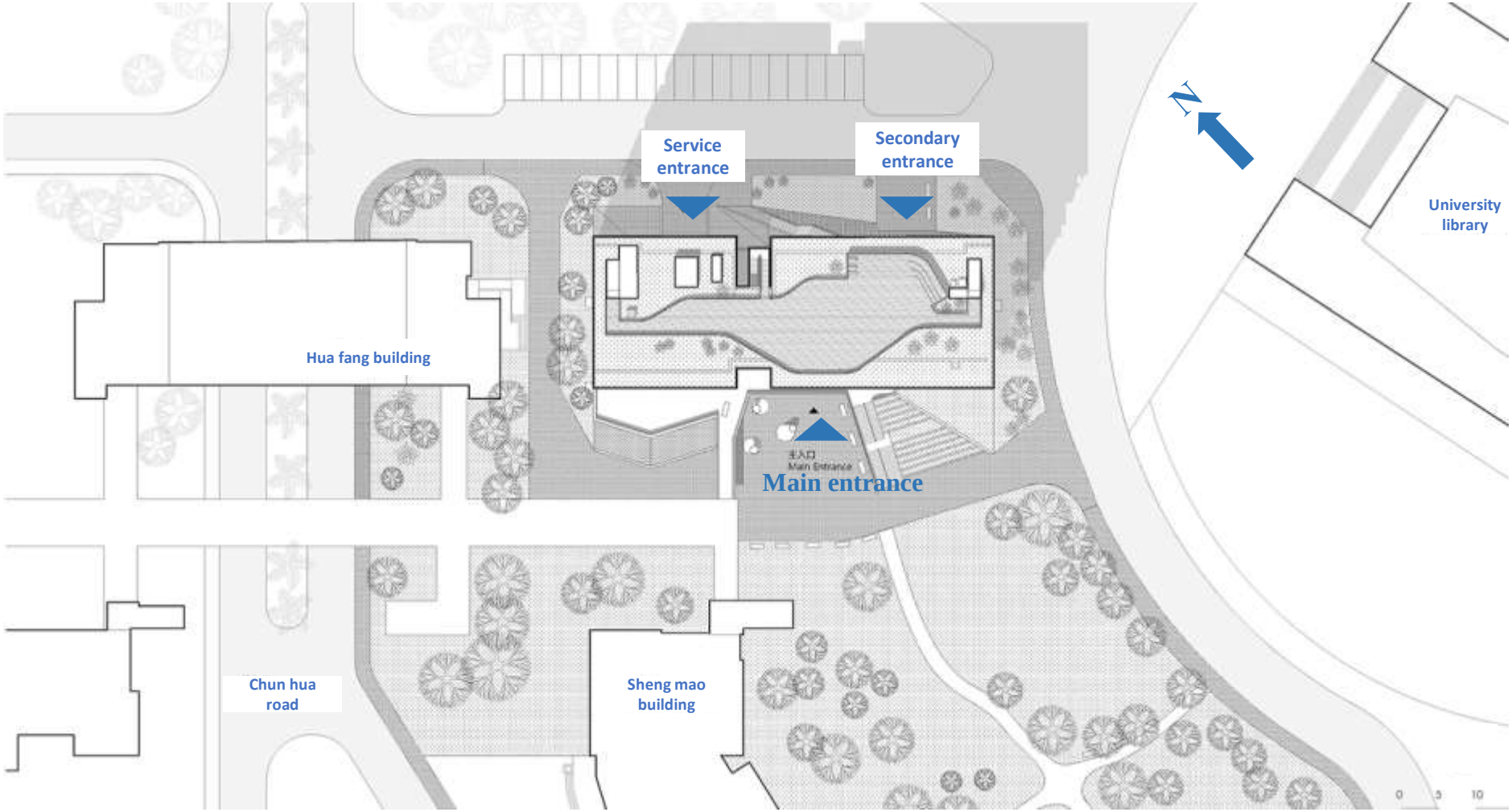
Shared **levels** are also integrated into the building. They include **conference** rooms, a brain-storming area, **exhibition** space, study rooms, cafes and plenty of greenery.

3.2.3 Concept Analysis



3.4 **Ocean Research Centre**

3.4.2 **Site Plan Analysis**



3.4 **Ocean Research Centre**

3.4.3 **Plan Analysis**

Basement Floor

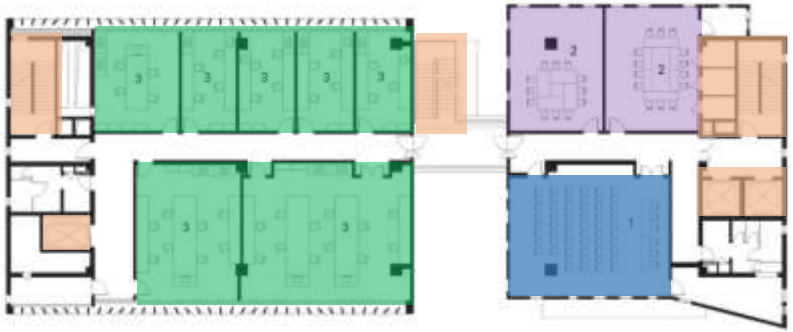
Ground Floor

Fire pool
MEP
High pressure lab
Instrument storage
Assembly space Experiment
cistern
Lobby
Exhibition hall
Loading dock &Fire control Rm.
office
Network Rm.& Specimen Rm.
Storage

3.4.4 **space program**

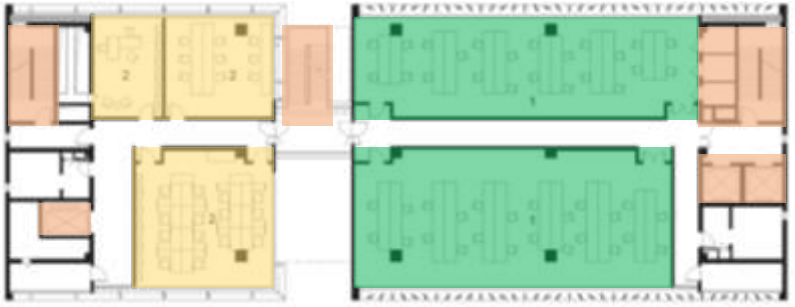
Facilities	No. Of Spaces	Net Area (sqm.)	Total N-Area (sqm.)
Lobby	1	268	268
Exhibition hall	1	215	215
Loading dock	1	215	215
Fire control Rm.	1	54	54
office	1	22	22
Network Rm.	1	22	22
Specimen Rm.	1	47	47
Storage	1	49	49
Fire pool	1	70	70
MEP	6	7-70	230
High pressure lab	1	47	47
Instrument storage	1	22	22
Assembly space	1	220	220
Experiment cistern	1	170	170
Large conference Rm.	1	95	95
Conference Rm.	2	50	100
Laboratory	7	24-100	300
Public conference Rm.	2	30-40	70
Public space	1	120	120
Public classRm.	2	40-50	90
Open laboratories	2	165-200	365
offices	3	30-90	160

3.4.3 **Plan Analysis**



6th Floor plan

Second Floor plan



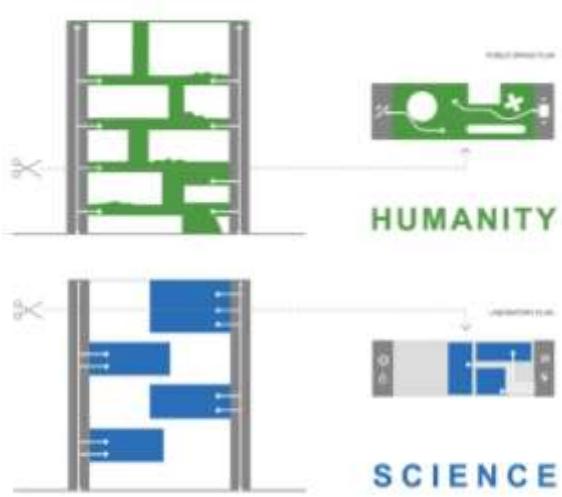
11th Floor paln

- Large conference Rm.
- Conference Rm.
- Laboratory
- Public conference Rm.
- Public space
- Public classRm.
- Open laboratories
- Offices
- Vertical circulation

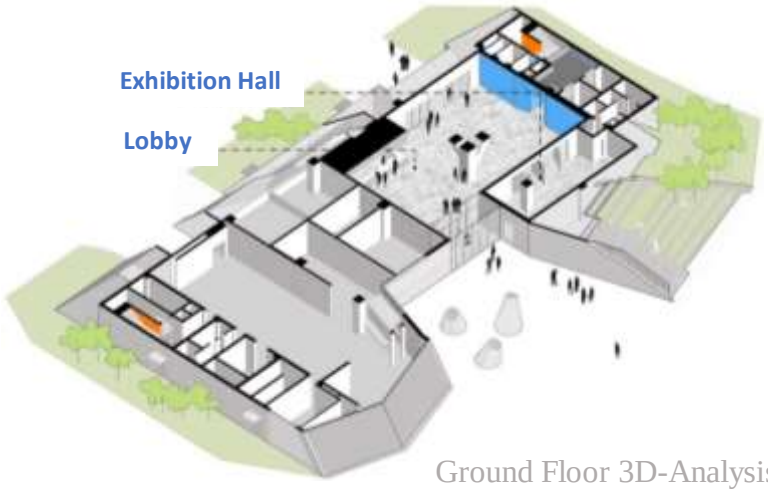
3.4.5 **Section Analysis**

- Public floor
- Conference Rm.
- Laboratory
- Exhibition hall
- MEP
- Lobby

3.4.6 **3D Plan Analysis**

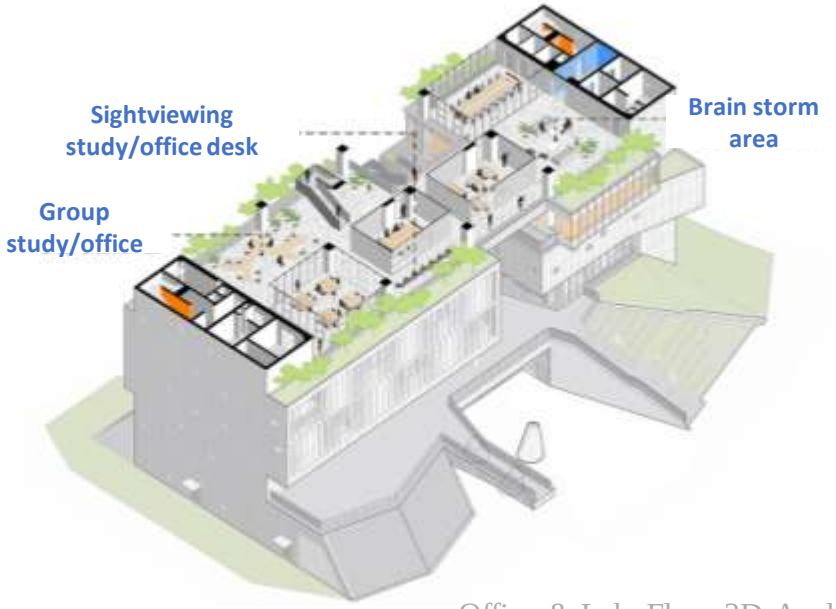


- The humanity plan is a schematic plan for the public floors (social floors)
- While the science plan is the schematic plan for all laboratory floors



Ground Floor 3D-Analysis

Social Floor 3D-Analysis



Office & Lab. Floor 3D-Analysis

3.4.7 **Conclusion**

3.4.7.1 Advantages

- Providing brain storming areas for students which enhances their productivity.
- Applying some sustainable design techniques.
- Supporting the team work system through using open laboratories.

3.4.7.2 Disadvantages

- the development of the project is vertically which weakens the relations between the spaces.

3.5 **The Living Water** Education and Research Center

3.5.1 General Information

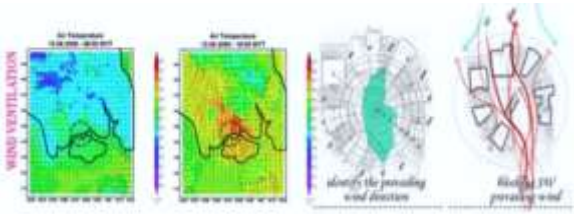
Project **concept**: The Living Water Education and Research Centre is a "Living Building" that is heavily rooted in the indigenous characteristics of a building's eco-region in order to sustainably generate their own energy: capture, treat and use their own water; and operate by embracing the essence of what the site can provide. In this way, the Living Water Education and Research Centre not only strives to have a net zero impact by integrating water management strategy as a teaching tool to educate and create awareness to the public but also improve the local hydrological cycle through the ecological approach.

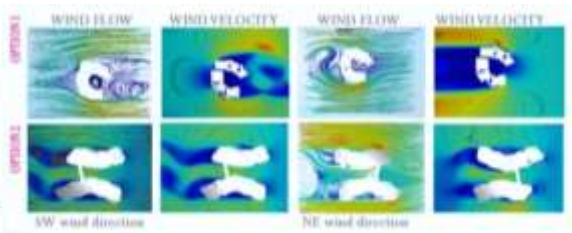
Project -4-

This example will be useful for:

- the **research** part of the project
- Architectural **Sustainable** methods

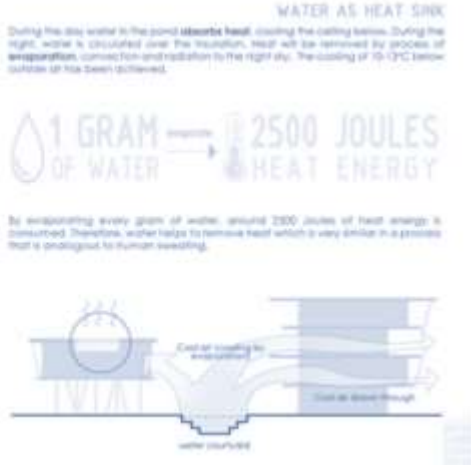
Through the **integration** of water management approach at various scales, the impacts can be minimized and ensure a more sustainable urban environment, while adding value to the **social** and **ecological** aspects of areas in accordance with community **needs** and **water issues**. Lastly, it is never enough to create a sustainable architecture, but Living Water Education and Research Centre hopes to bring the ecological closer to people's daily experience.





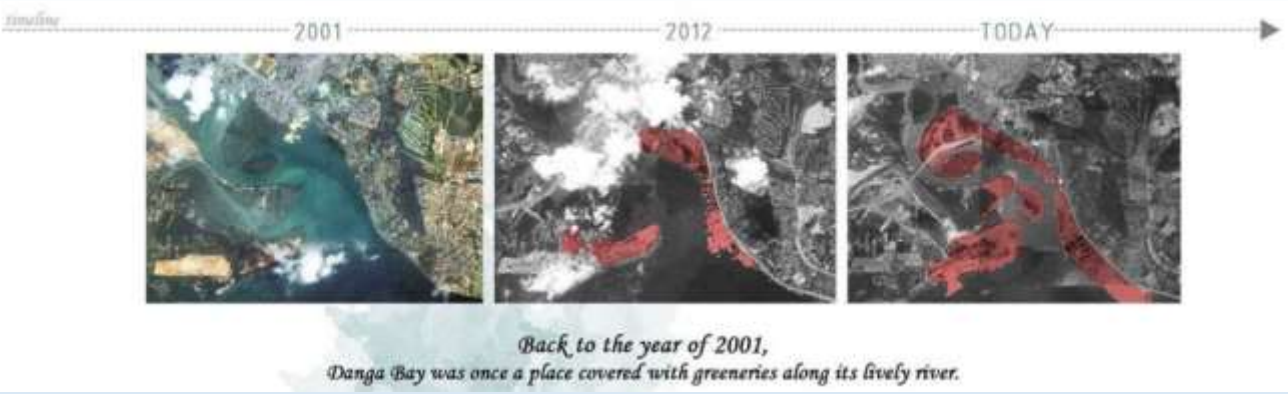
The design is consists of two main masses designed according to the wind flow so as to let the wind reaches the interior of the masses passing though the space between the masses.

A water courtyard is used to be evaporated by the hot weather cooling the air above it, the cool air will be driven into the buildings by the prevalent wind.



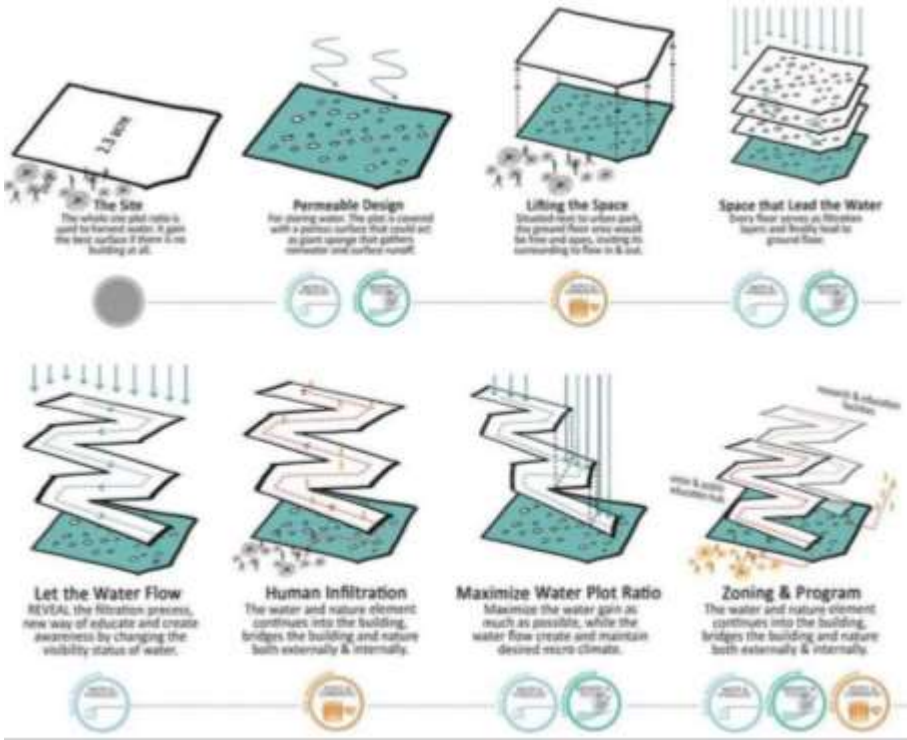
3.5.2 **Site Location and Analysis**

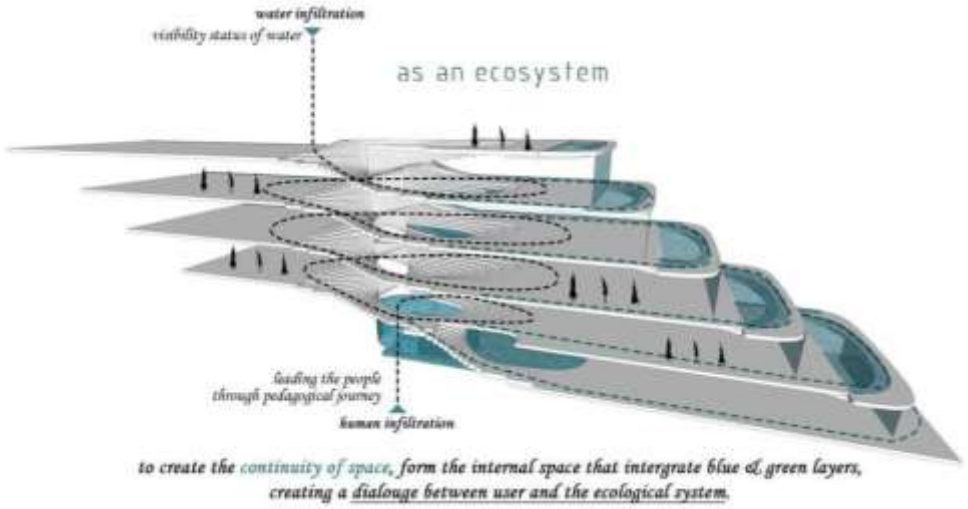
Micro Site Issues **Danga Bay** was once a place covered with greeneries along its lively river. Since the land reclamation project started in 2000, the development has caused a severe degradation in water quality and environmental degradation. When the local hydrology cycle has been severely altered, this will lead to more environmental impacts, not only to human and habitat but the entire ecosystem in Danga Bay.



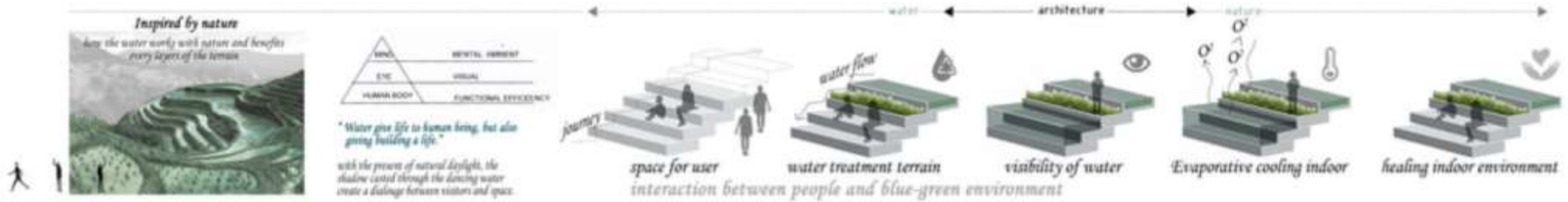
3.5.2 **Site Location and Analysis**

3.5.2.1 **Design Development**



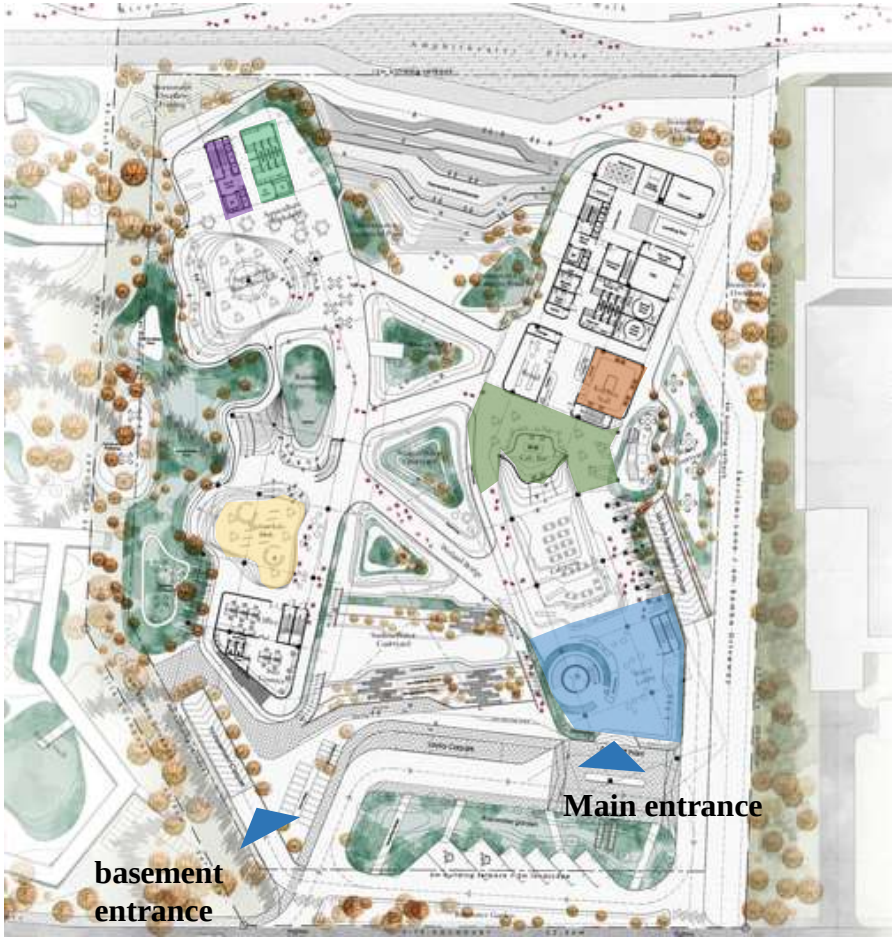


Urban Waterscape intervention: The site is an interface between the developed urban area and the edge of the riverfront which acts as microenvironments that foster varying plant, animal, and human ecologies. By doing so, the urban site not only becomes a vibrant gathering space for the citizen but also a playful educational spot for the public to better understand the mechanism of storm water management.



3.5.3 **Plan Analysis**

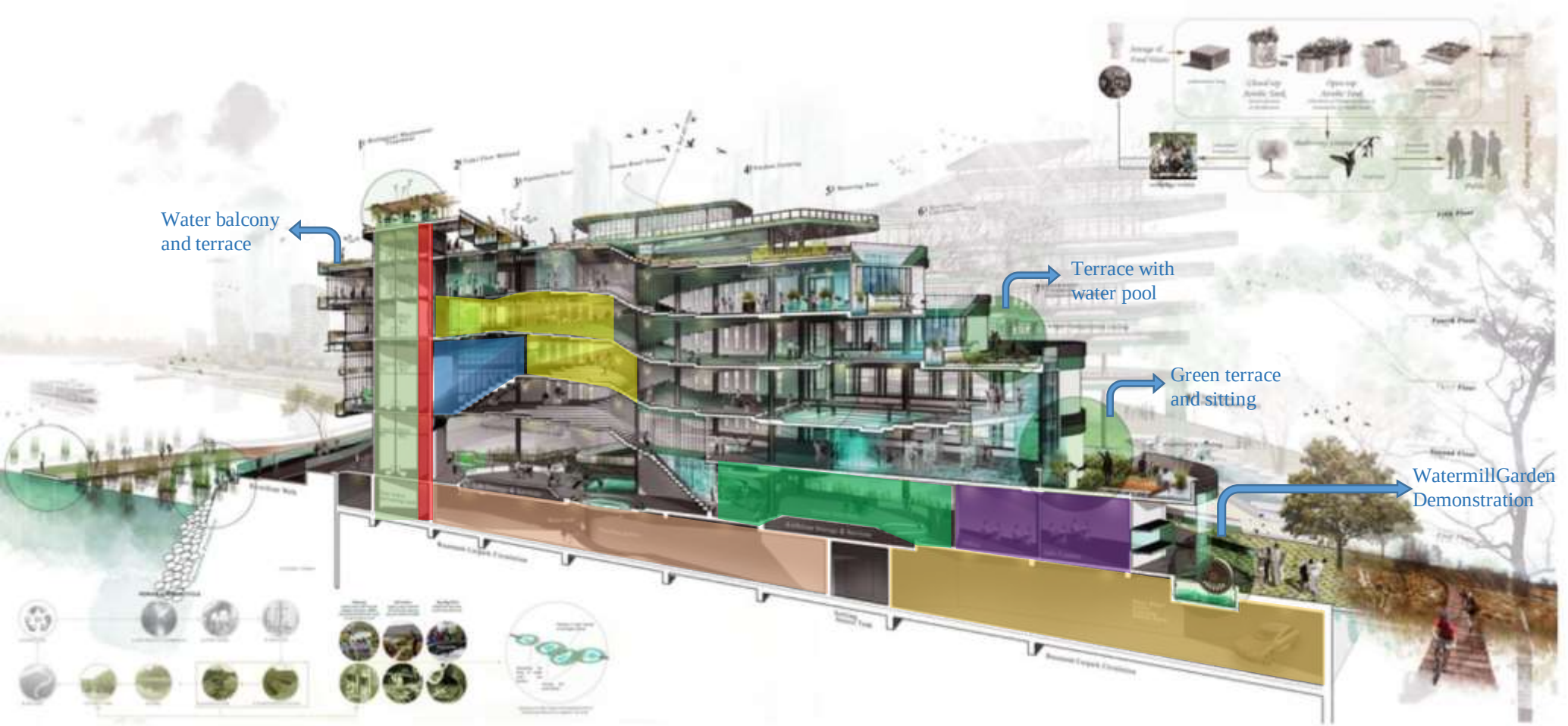
Ground Floor with Surrounding



Ground Floor Level

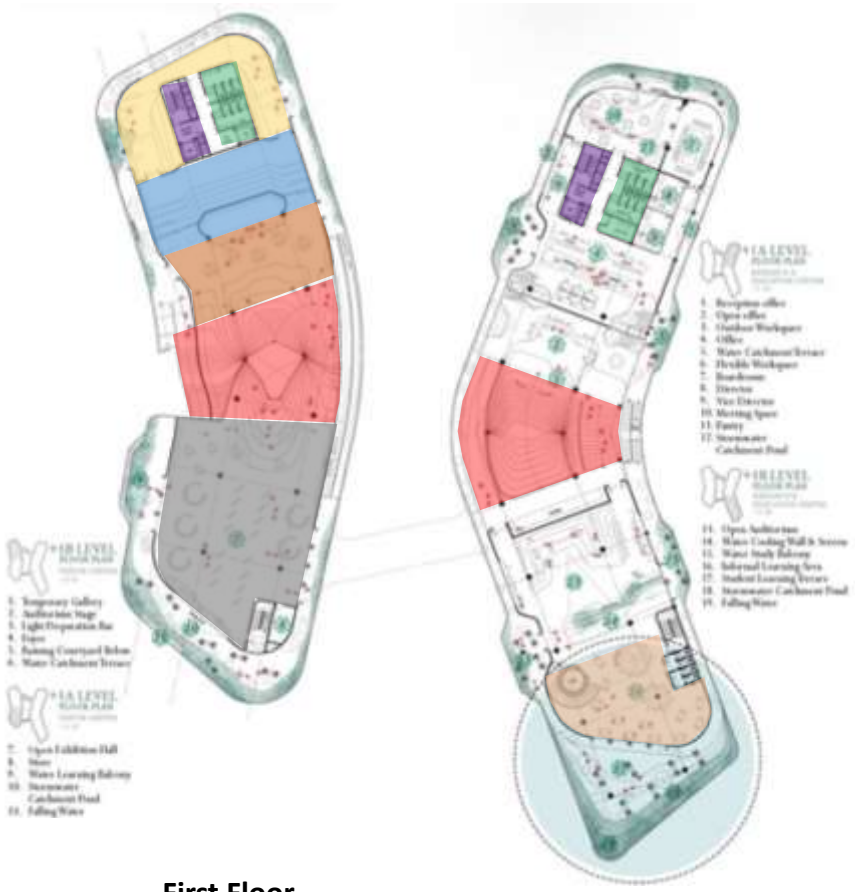
Lobby
w.C + store
Open working space
Kitchen
Vertical circulation
Filtration Column
Café

3.5.4 **Sective**



Biological public teaching lab
Auditorium
Water filter + mechnical
Vertical circulation
Offices
W.C
Seminar halls
Basement parking

3.5.5 **Plan Analysis**

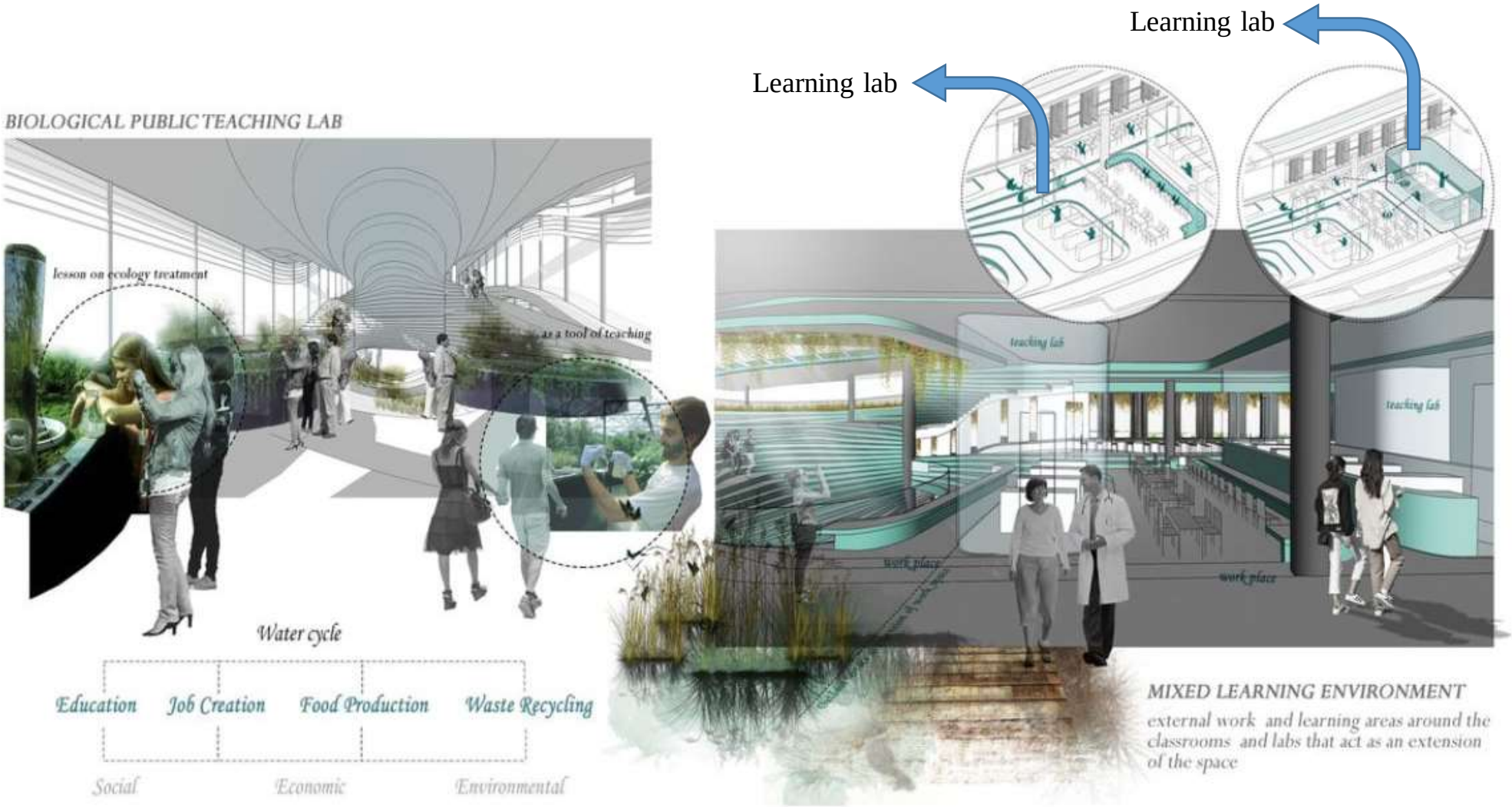


First Floor

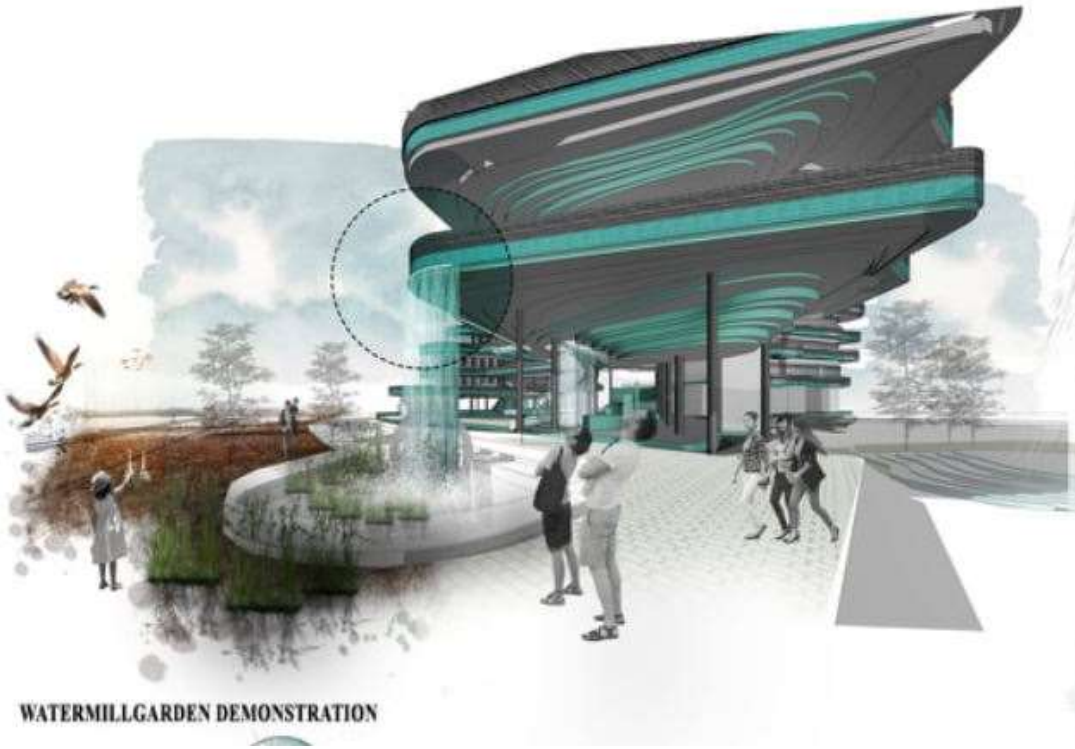
Second Floor

- Outdoor social space
- Temporary gallery
- Vertical circulation
- w.C + store
- Foyer
- Learning lab.
- Lecture Halls
- Social space
- Exhibition Hall
- Main Auditorium
- Stepped Ramps

3.5.6 **Interior Views**

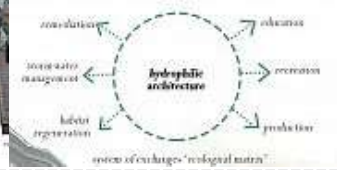


3.5.7 **Exterior Views**

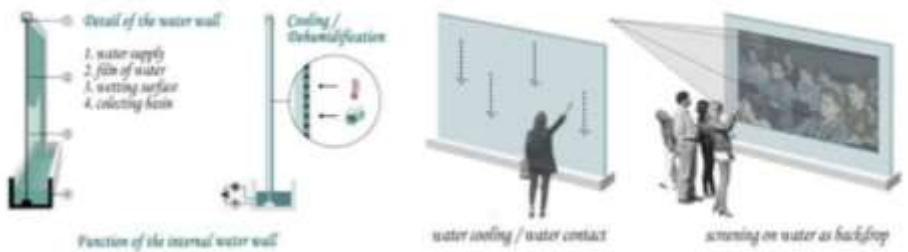


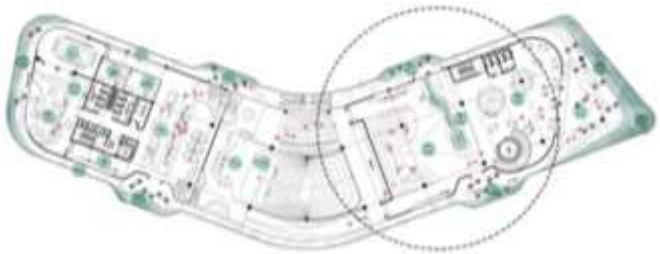
Watermill Garden Demonstration

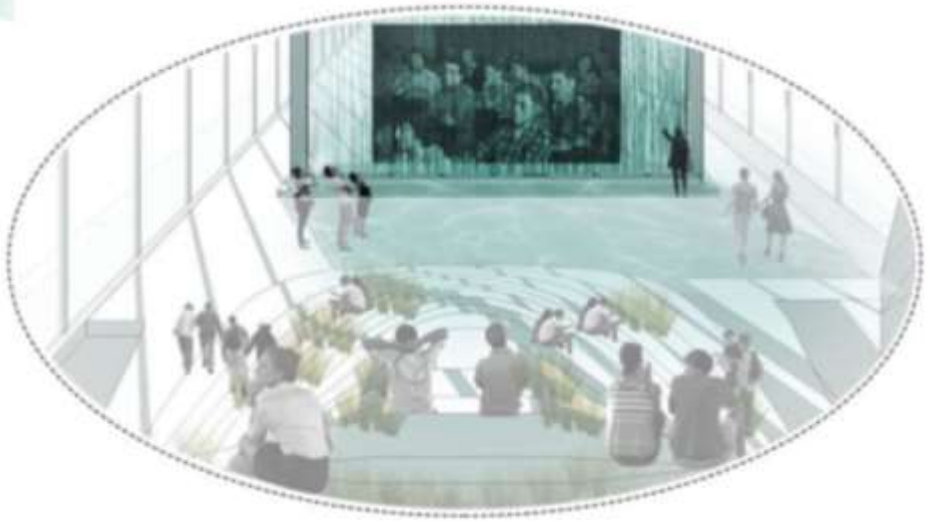
Water balcony & Terrace

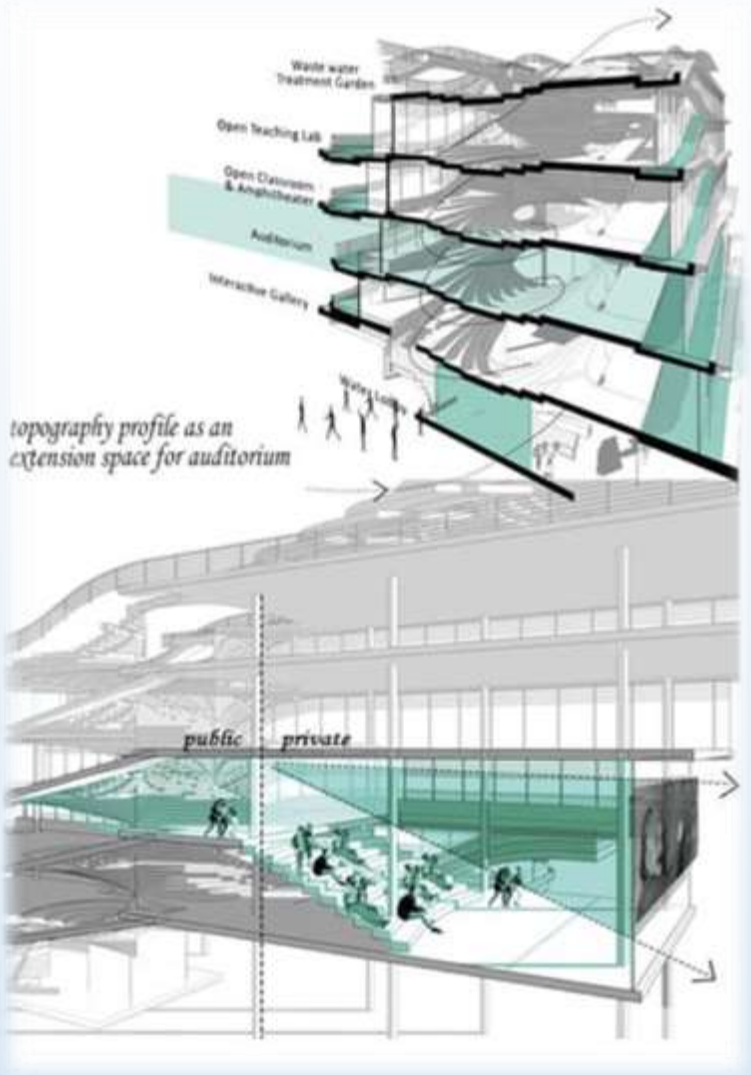


3.5.8 **Plan – 3d Details**









3.5.9 **Conclusion**

3.5.9.1 Advantages

- Takes into account the climate and the prevalent wind flow in the design process.
- Applying many sustainable and environmental friendly systems.
- Inviting the public to get to know the importance of water issues, water filtering and saving the environment.
- Use of natural materials as green and water inside and outside the building.

3.5.9.2 Disadvantages

- The design and the techniques have a high cost.

3.6 El **Humedal research facility**

3.6.1 **General Information**

The project is a private botany **research facility** in Valle de Bravo, Mexico. Its main goal is to develop natural products taken from the **forest** in a **sustainable** way.
It also pretends to show another approach to urban development and construction taking into consideration the natural surroundings.
The project is built from a crade to cradle stand point in terms of materials. Most materials are locally manufactured, natural, recycled or salvaged.
This project is 100% off grid in terms of **electricity**, **water** and **waste** management.

Project -5-

This example will be useful for:

- Research laboratory
- Sustainable concepts
- Filtration techniques

3.6.2 **Concepts**

The research complex is surrounded by an edible forest, organic orchard, and a man-made wetlands environment with several pools.
Raised on stilts and steel beams over the wetland pools, local pine and oak wood were used for the building's roofs and frames, while bricks made from local volcanic soil, were used for the walls.

Along with a laboratory for scientists to carry out their research, the main building of El Humedal contains a seed cellar for storing specimens, a wine cellar, a multipurpose workshop, and offices and bathrooms.

A supplementary building on the south side of the compound houses a maintenance warehouse and the greenhouse, with parking and the water treatment plants located underground.

To realize their eco-friendly design, TAAR looked to the architecture of the Masahisa people, a pre-hispanic culture living in Valle de Bravo.
"El Humedal uses two key Mazahua architectural elements for its design: wood structures in pitched roofs for rain water harvesting, and soil brick and stone walls to create thermal mass,".

3.6.3 El **Humedal research facility**

Project Features:
- Swage Water Treatment
- Rainwater Harvesting
- Photovoltaic Panels
- Thermosolar Water Heating
- Constructed Wetlands
- Compost Toilets
- Local Recycled & Salvaged Materials
- Bioclimatic Design
- Permaculture & Edible Forest Landscape
- Smart Low Consumption Showers

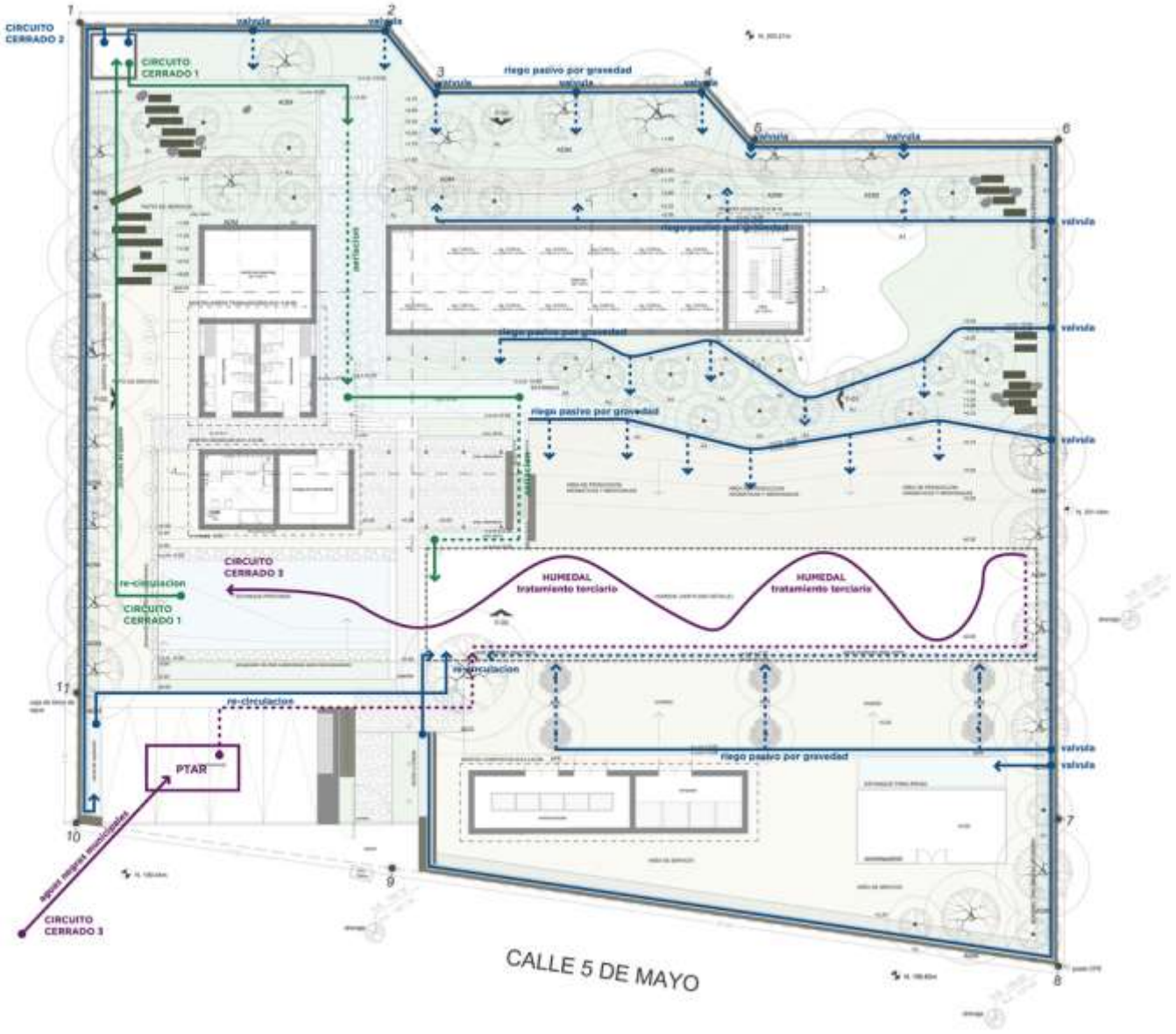
Figure: Exterior view showing the largest wetland within the project

3.6.4 El **Humedal research facility**

Ground Floor Level

First Floor Level

3.6.4 El **Humedal research facility**



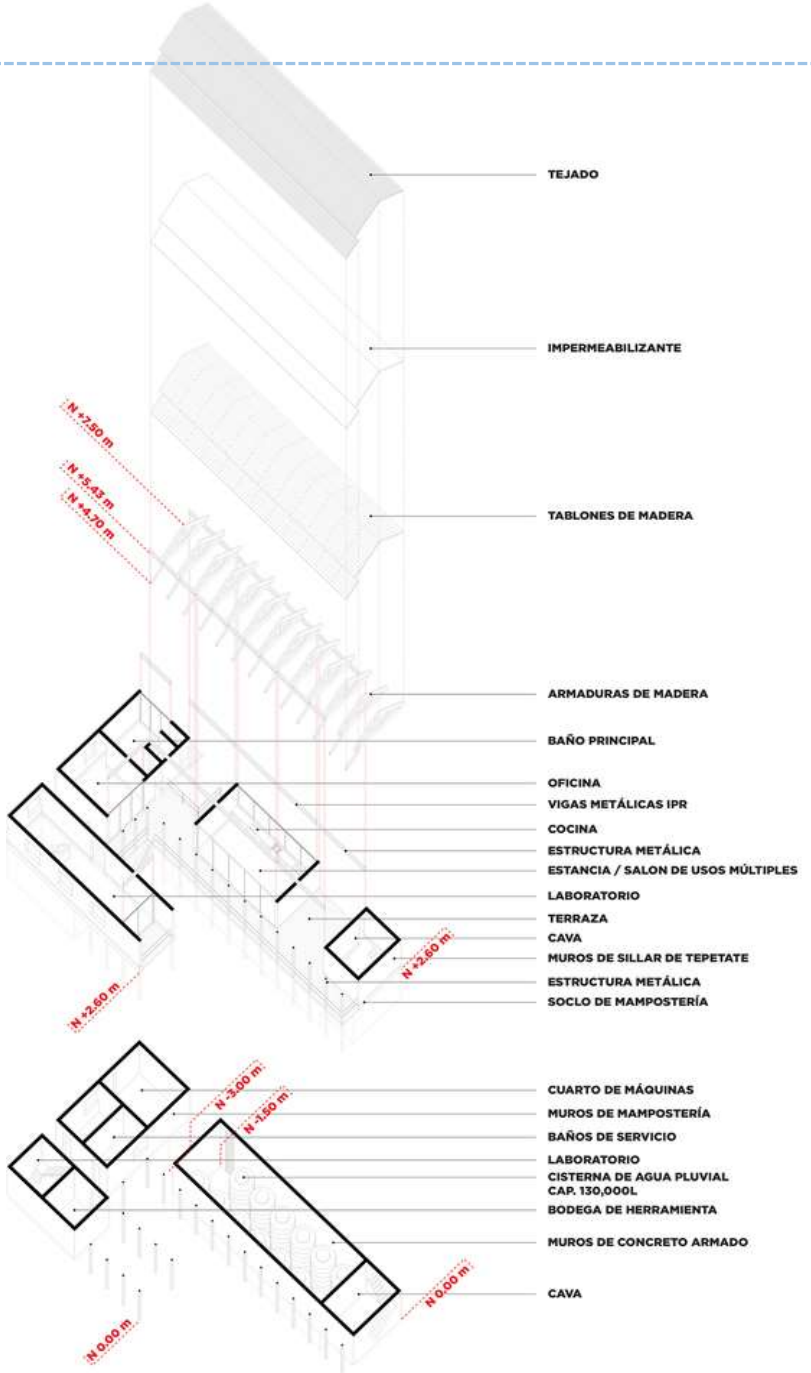
Water Path Floor Level

Basement

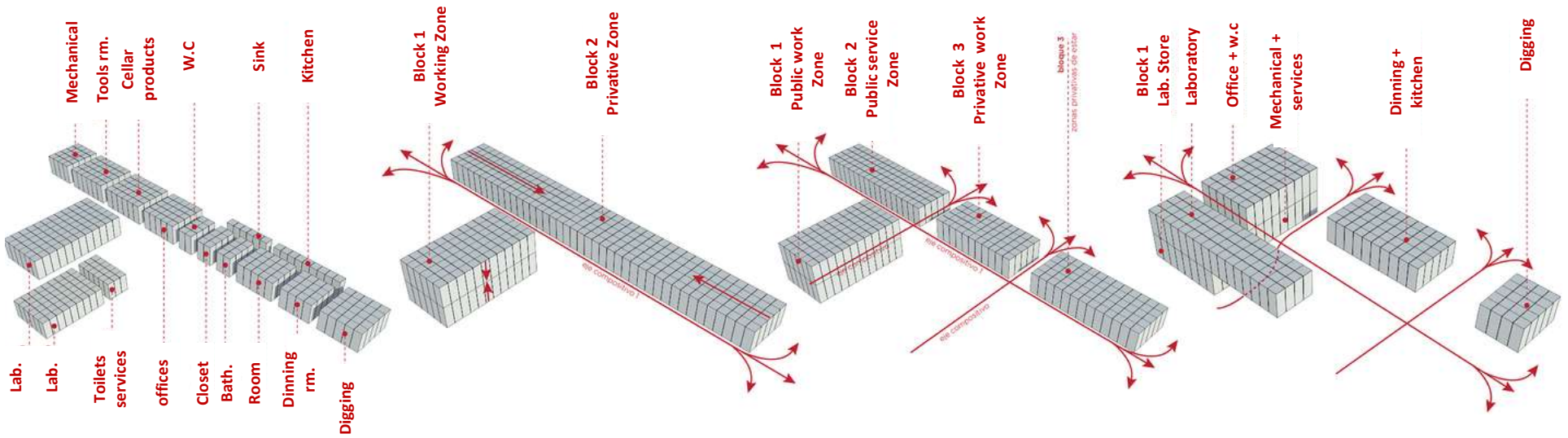
3.6 El **Humedal research facility**

3.6.5 **3D Plans**

Facilities	No. Of Spaces
Entrance	1
Public work space	1
Private work space	1
Public service space	1
Private service space	1
Laboratory	3
Laboratory store	1
Kitchen	2
Dinning area	2
Offices area	1
W.C	2
Toilet services + bath rm.	3
Sink	1
Digging	2
Cellar products	1
Tools rm.	1
Mechanical room + services	2
Wet lands	-

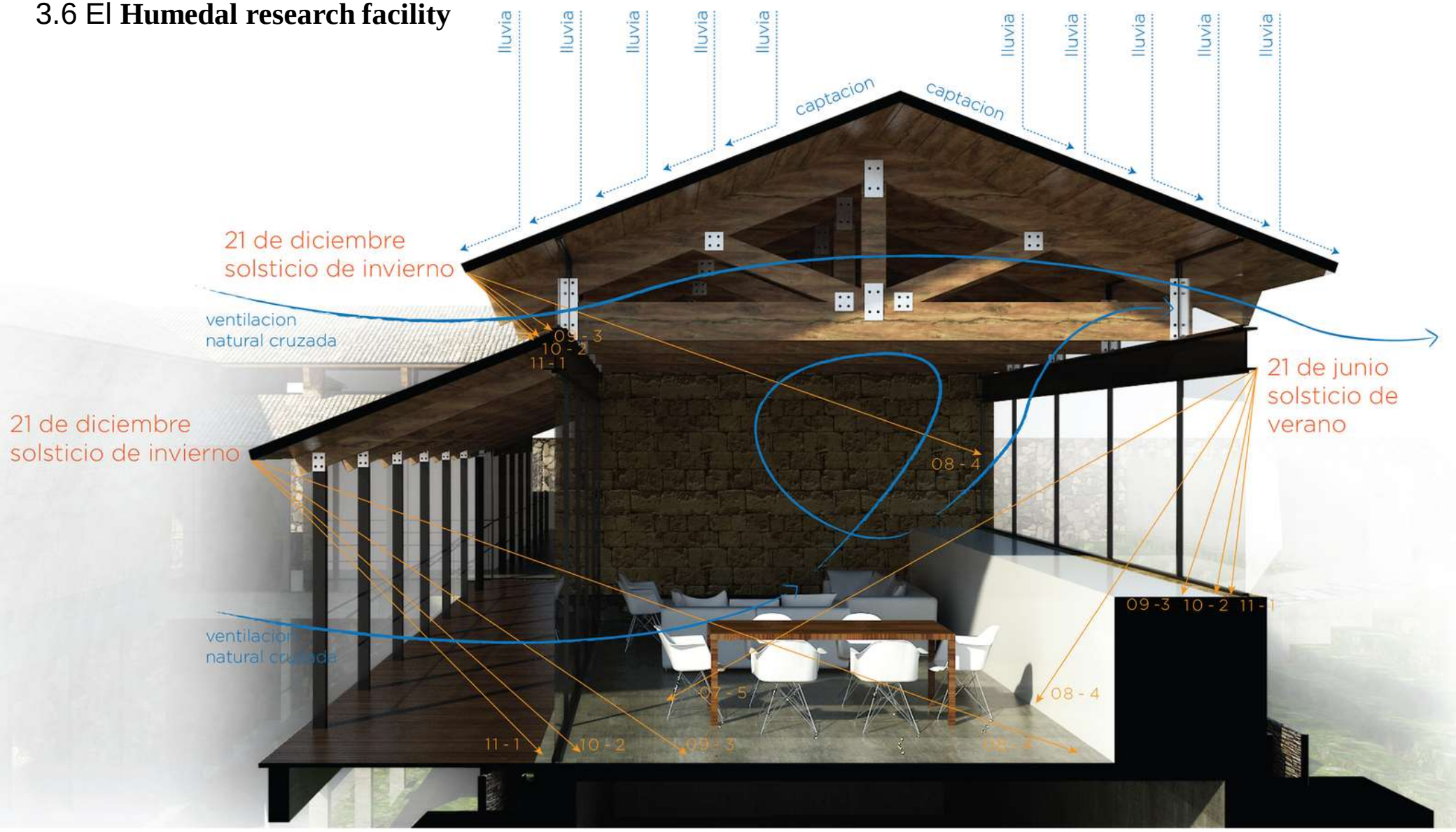


Development process of the architectural program



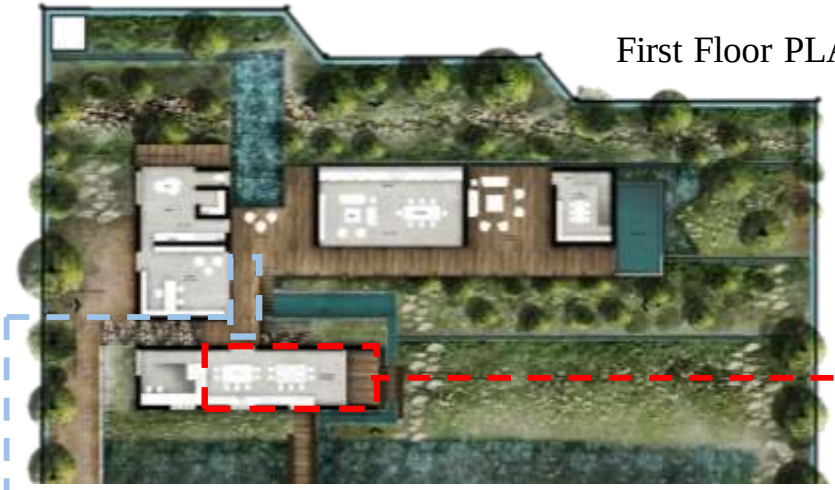
Cross Section

3.6 El **Humedal research facility**

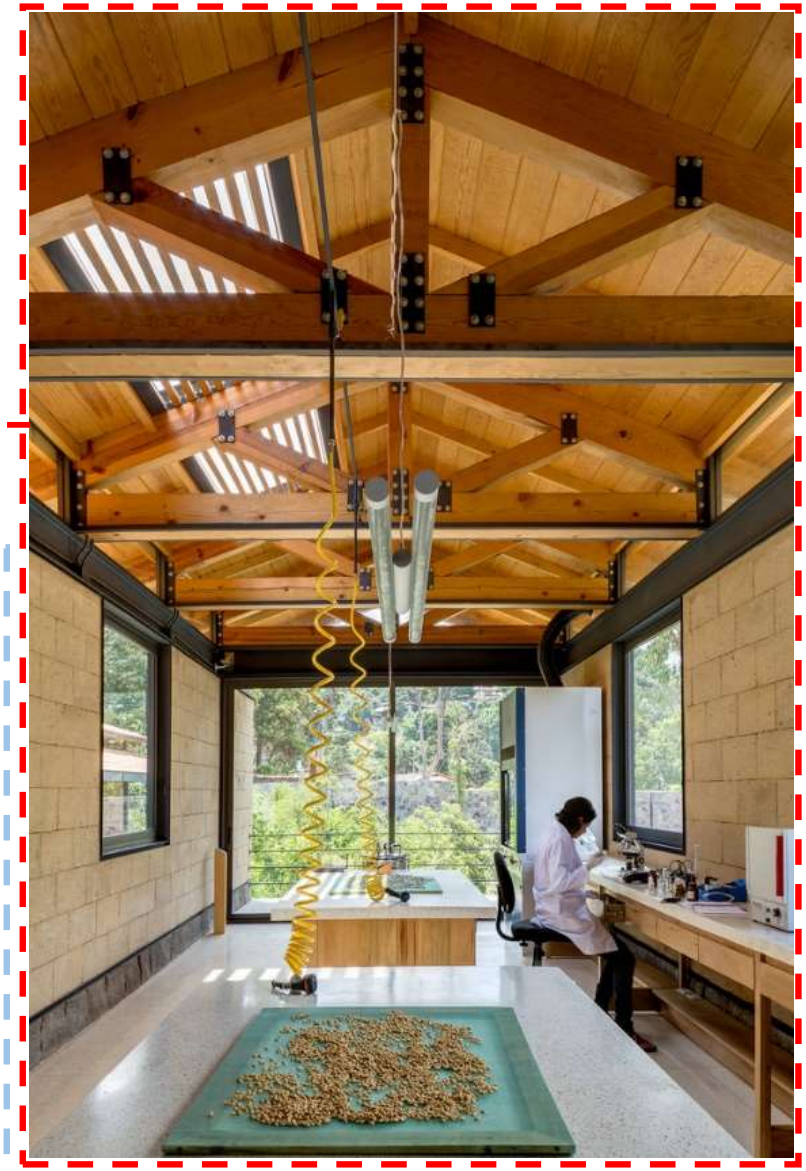


Climatic Analysis – Sective

3.6 El **Humedal research facility**

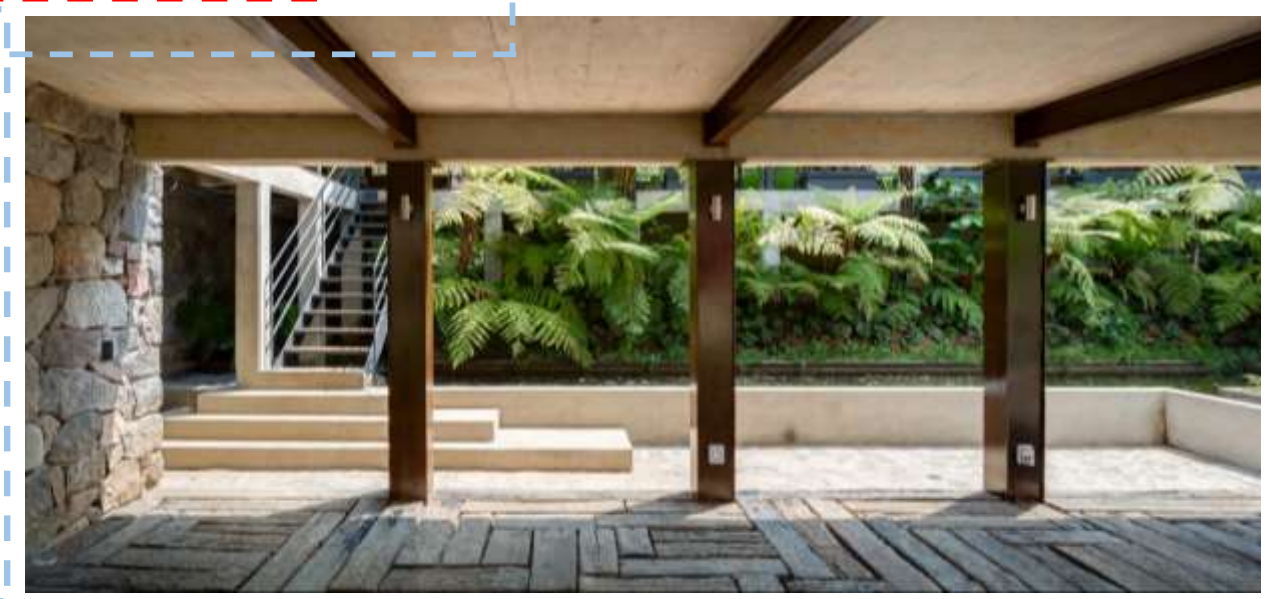


First Floor PLAN



3.6 El **Humedal research facility**

Ground Floor PLAN



3.6.6 **Conclusion**

3.6.6.1 **Advantages**

- Applying several sustainable concepts in the building design and the site as well
- The project is solving the surrounding area problems
- Making studies and tests on different levels to plants and natural resources as water.

3.6.6.2 **Disadvantages**

- The capacity of the project is small
- The form of the building is traditional with no creativity touch makes it look like many regular buildings.

3.7 Qandil Water Project – Local Project

3.7.1 **General Information**

This project is located in
It filters water and supply it to both Shaqlawa and Salahaddin Masif in northern of Erbil.

- The project contains all parts of water filtering steps as well as a number of laboratories serving the filtering part.

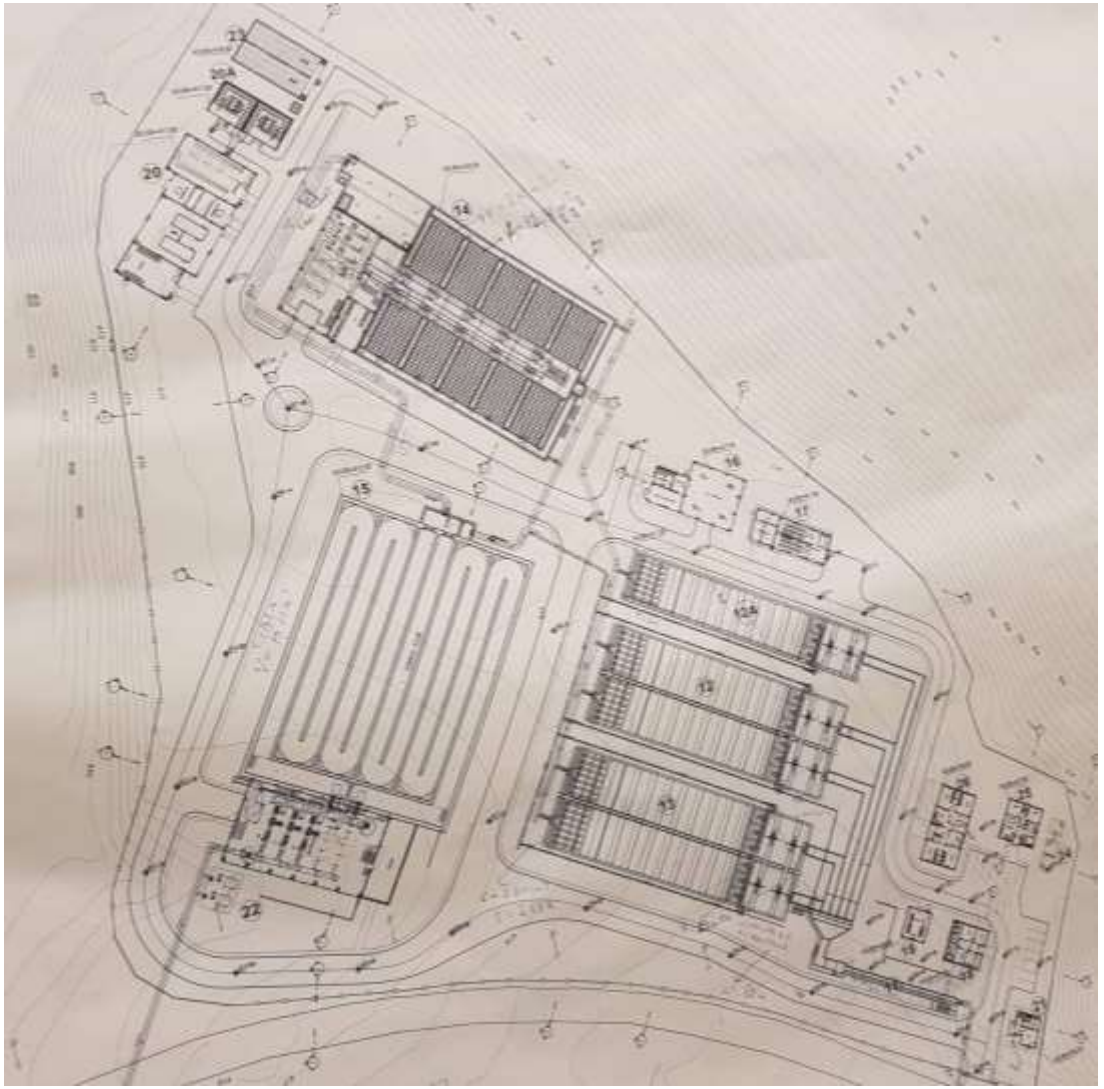
- Some electrical and mechanical buildings are supporting the whole project with the necessary needs.
- Small residential units are also available for project

Project -5-

This example will be useful for:

- Filtration techniques

3.7.2 **Ground Floor Plan**



3.7.3 Qandil Water Project – Interior Views

3.7.4 Qandil Water Project – Exterior Views

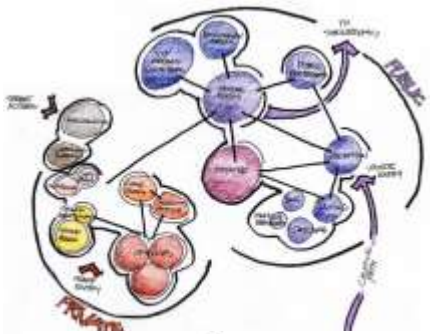


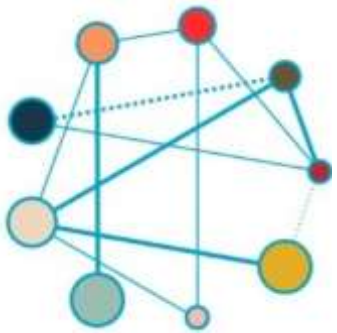


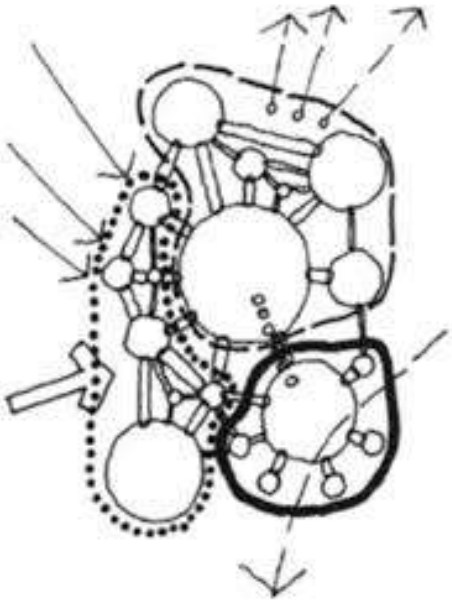

CHAPTER CONCLUSION
SIMILAR PROJECTS

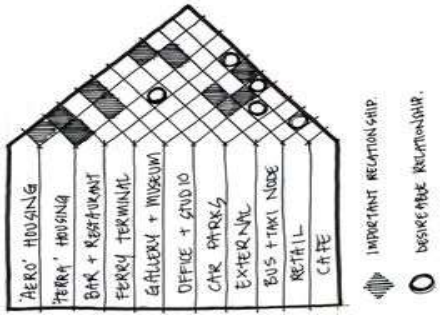
3.8 This chapter is of great importance to the design stage specially to the space program in chapter 5 providing a background for the basic parts of the project.

SPACE COMPONENTS & FUNCTINAL RELATIONS



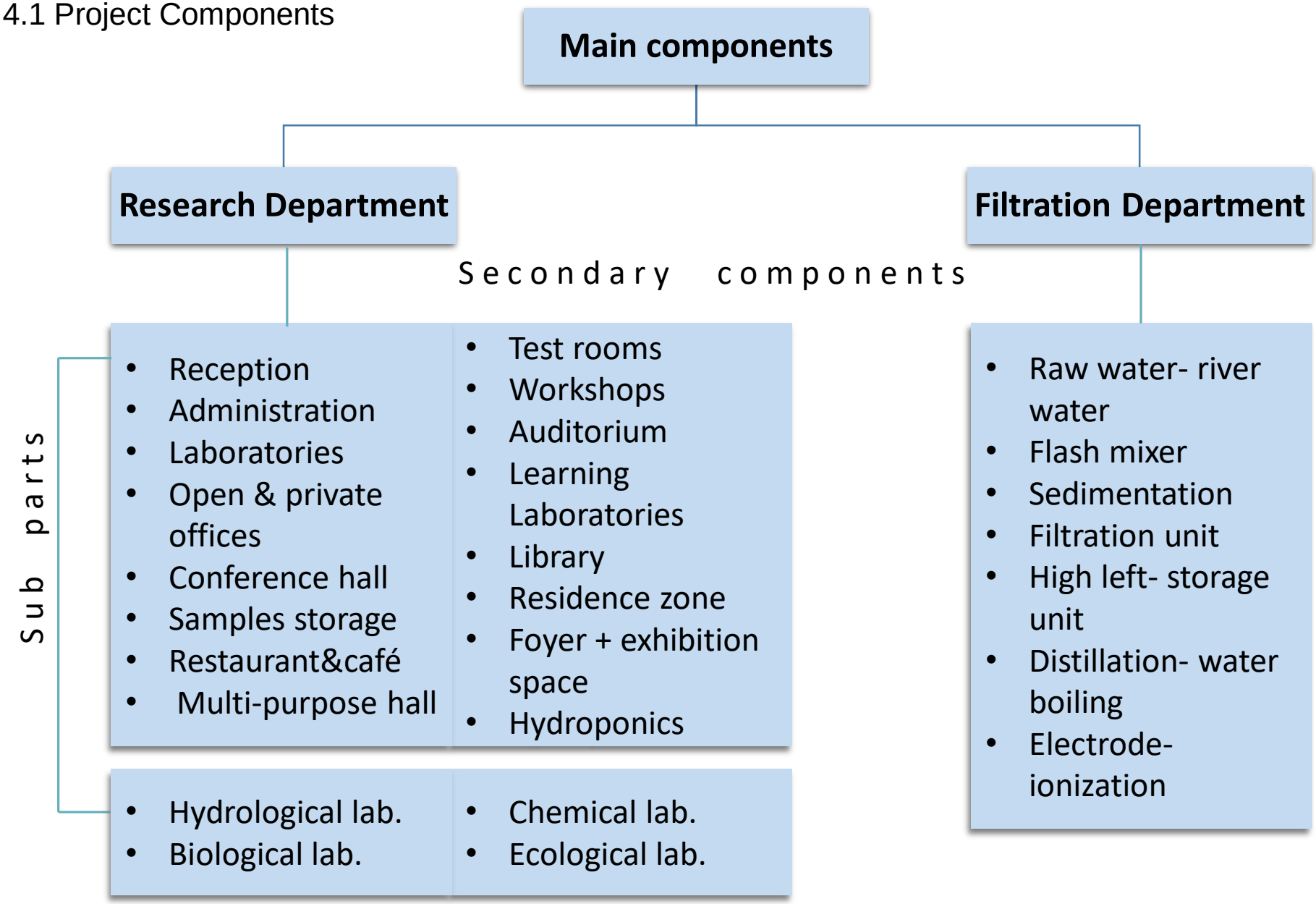






CONTENT

4.1 Project Components



4.2 Main Zones Components

Lobby Zone:
Lobby
Reception
Small café
Auditorium
Exhibition hall
Store
Multi purpose hall
Toilets

Research Laboratory Zone:
Lobby
Control rm.
Small café
Meeting rm.
Seminar hall
Store
Head of researchers
Research laboratories
Toilets

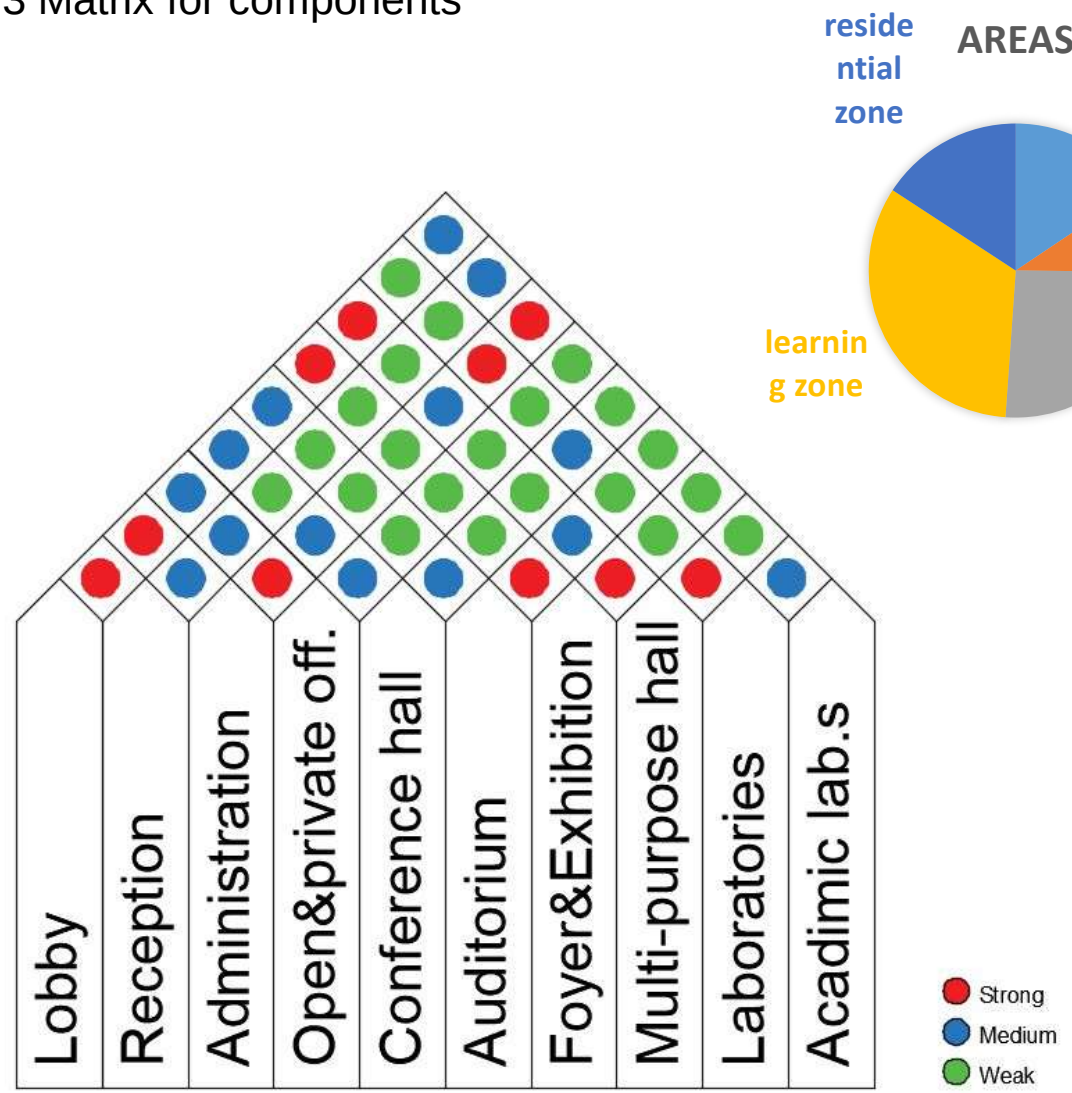
Residential Zone:
Lobby
Front desk
Restaurant
café
Shops
Fitness
Store
Toilets
Studio apartment
Family apartment

Administration Zone:
Manager rm.
Secretary rm.
Assistant rm.
Open offices
Close offices
Meeting room
Seminar hall
Archive
Store
Assembly area
Toilets

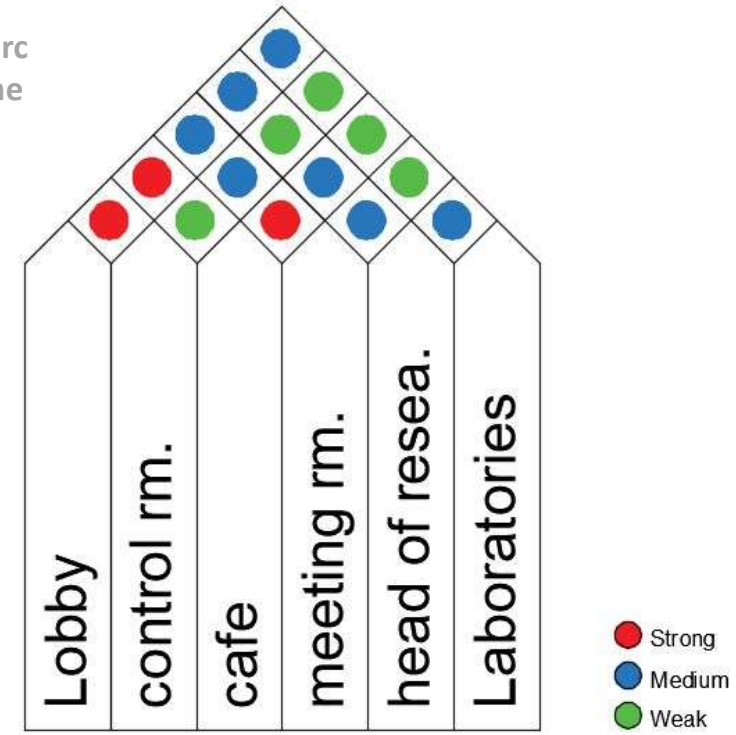
Learning Laboratory Zone:
Lobby + social area
Reception
Control rm.
café
archive
Conference hall
Store
Learning laboratories
Lecture halls
Toilets

Services and Outdoor Activity Zone:
Public parking
Residential parking
Wetlands
Loading dock
General storage
Fire control rm.
Mechanical services
Electrical services

4.3 Matrix for components

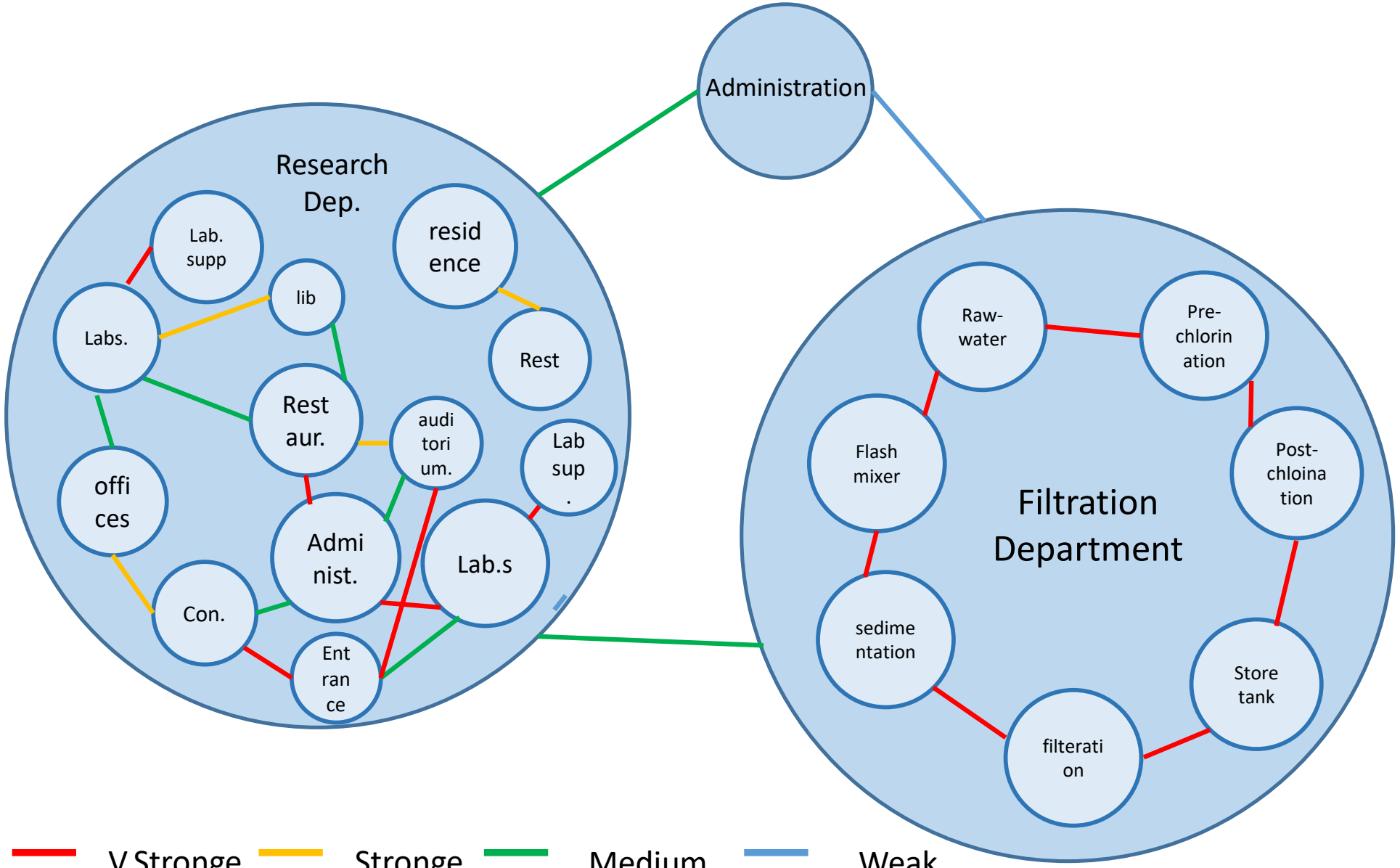


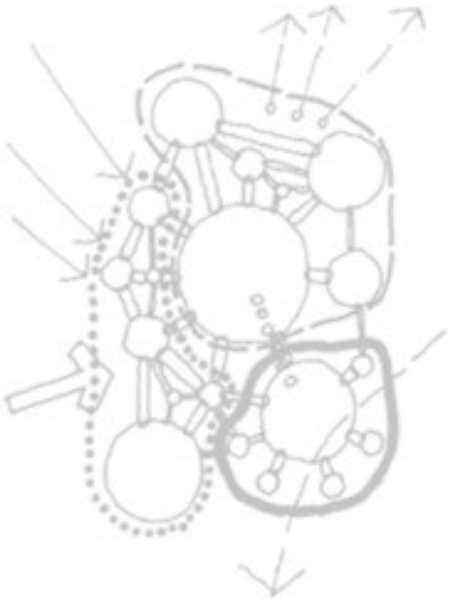
All Departments Matrix

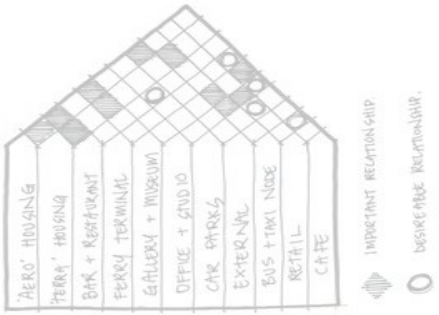


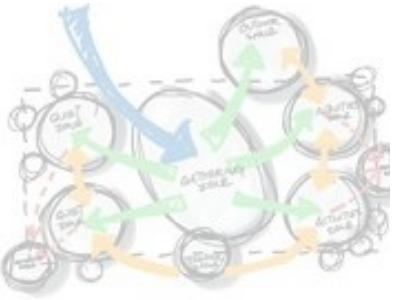
Research Department Matrix

4.4 Component Relationships





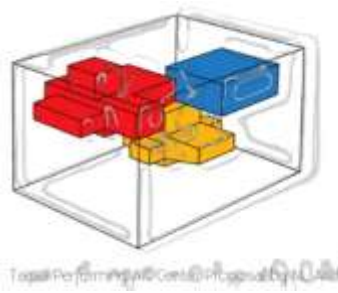


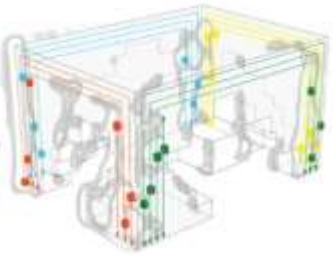


4.5 This chapter prepares a base for the next chapter space program through defining the functional relations between the spaces that will be identified in ch.5. also defines the spaces within zones to aid in the design stage.

CHAPTER CONCLUSION
SPACE COMPONENTS & FUNCTINAL RELATIONS

SPACE PROGRAMM





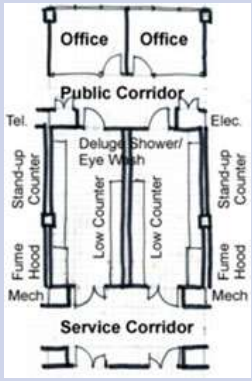
CONTENT

5.1 Laboratory Classification

5.1.1 Laboratory types

1- Dry Laboratory

2- Wet Laboratory

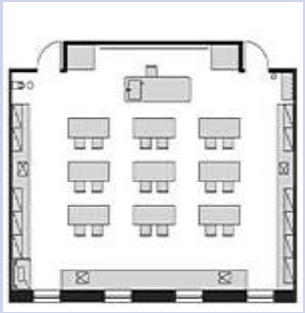
specifications	Dry Laboratory	Wet Laboratory
Plan		
location	Not necessary being separated	Separated from other facilities
Types	Computer labs. Engineering labs.	Biological labs. Chemical labs.
Design	Open or closed	Open or closed

5.1.2 Laboratory sectors

1- Academic Laboratory

2- Government Laboratory

3- Private Laboratory

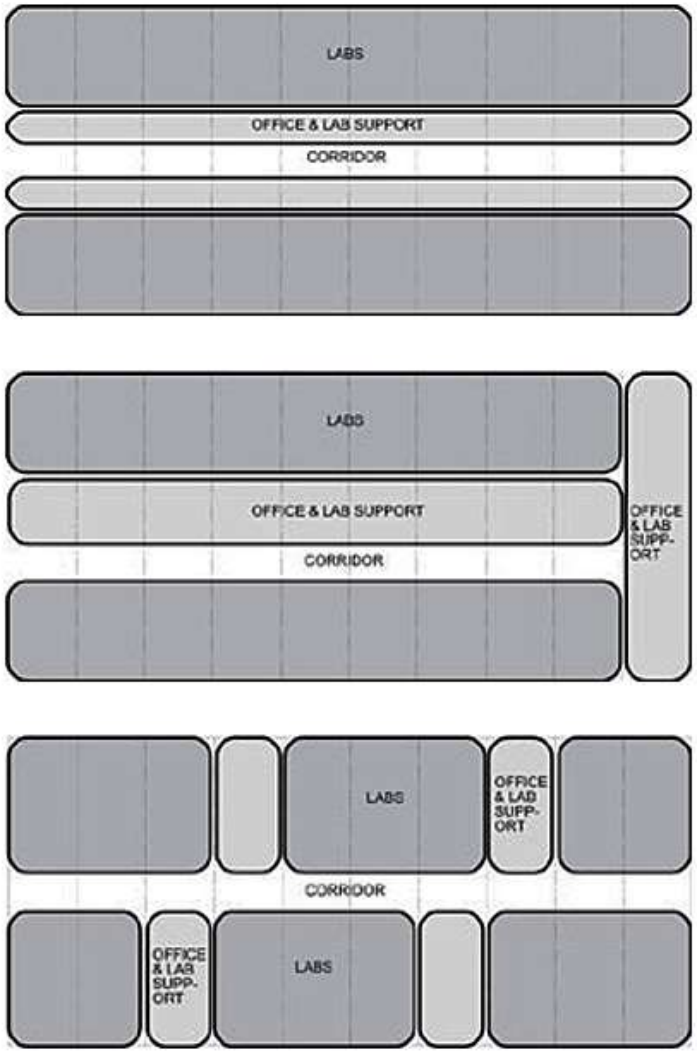
Specifications	Government Laboratory	Academic Laboratory
Plan		
location	In relation with other spaces	Not necessary to be close to other spaces
Content	Lab. Area, offices, test room	Studying area, practicing area
Design	Open or closed	closed for a group of students

- Only 2 types are used in my project

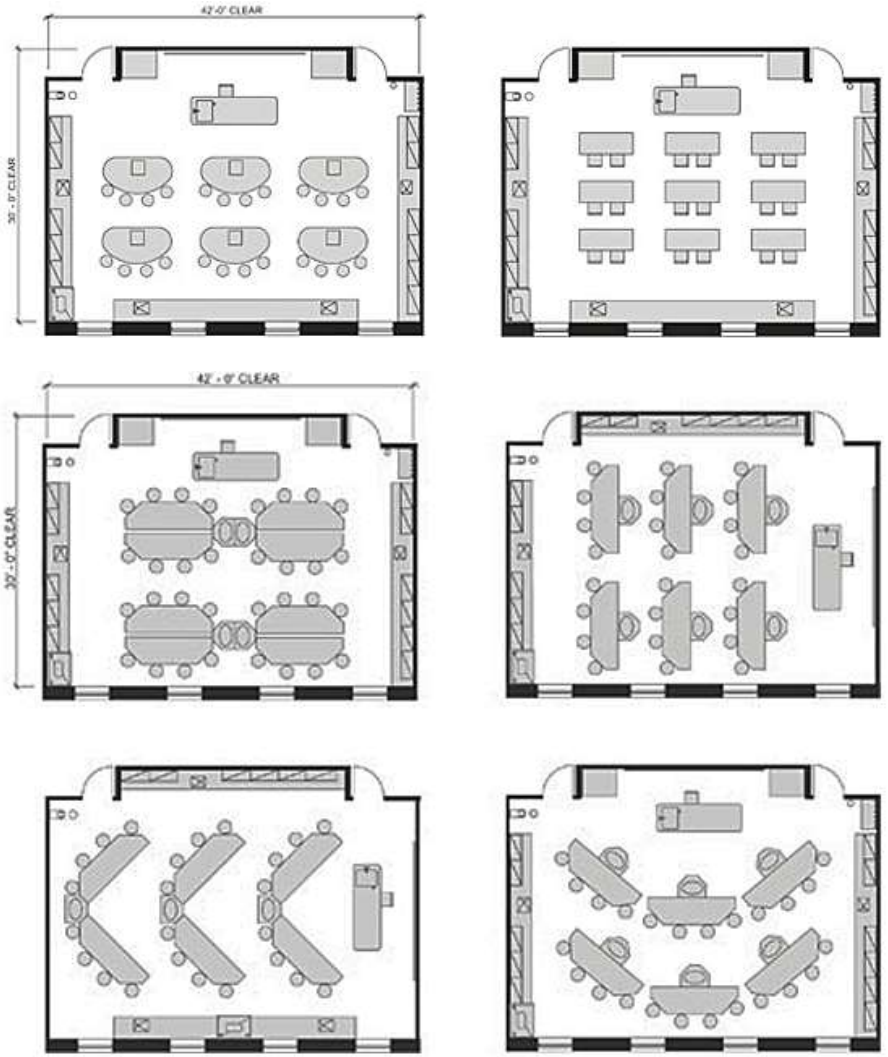
5.1 Laboratory Classification

5.1.3 Laboratory sectors

1- Government Laboratory space arrangement



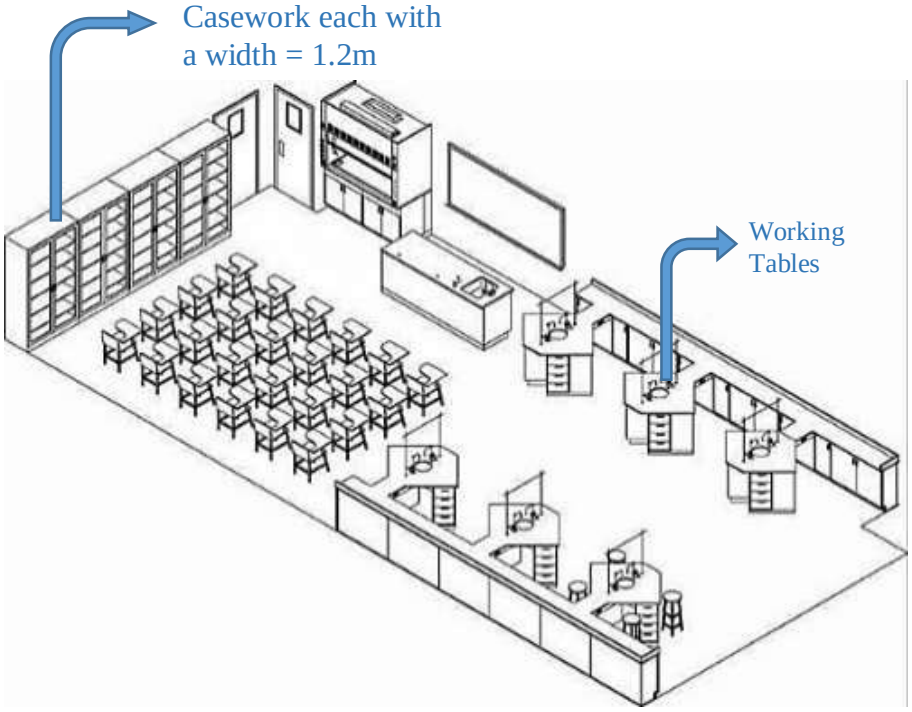
2- Academic Laboratory space arrangement



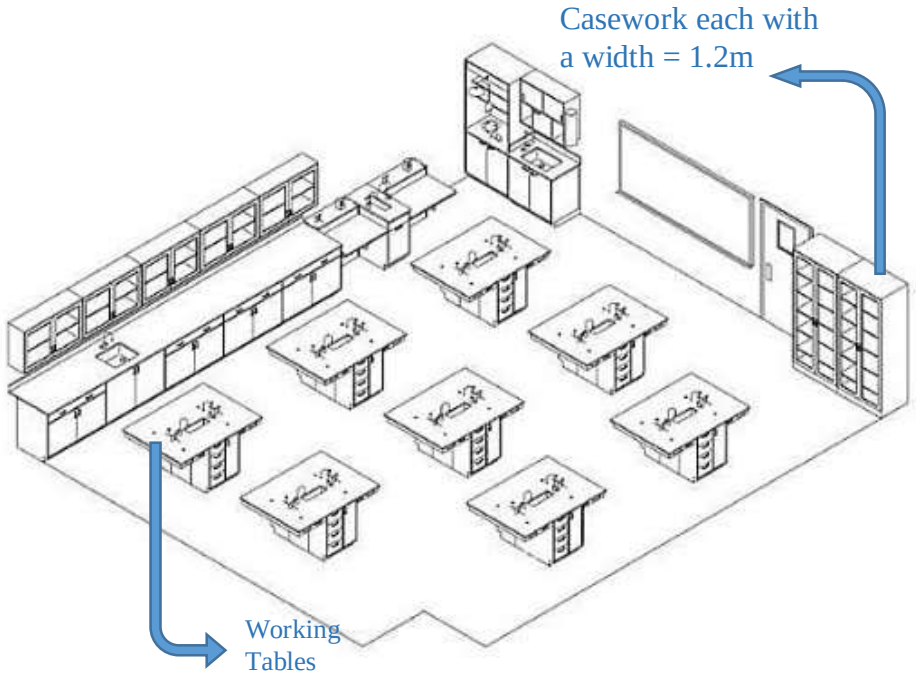
5.1 Laboratory Classification

5.1.3 Laboratory sectors

2- Academic Laboratory space arrangement



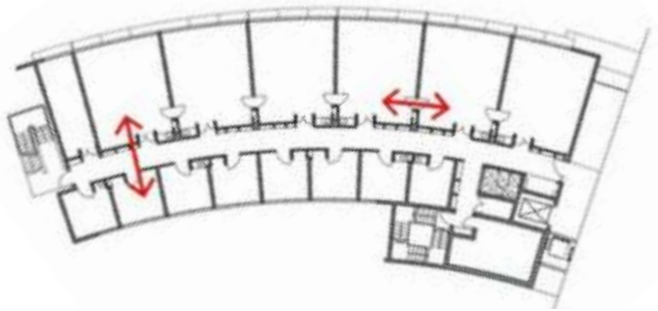
Lecture space is separated
from research space

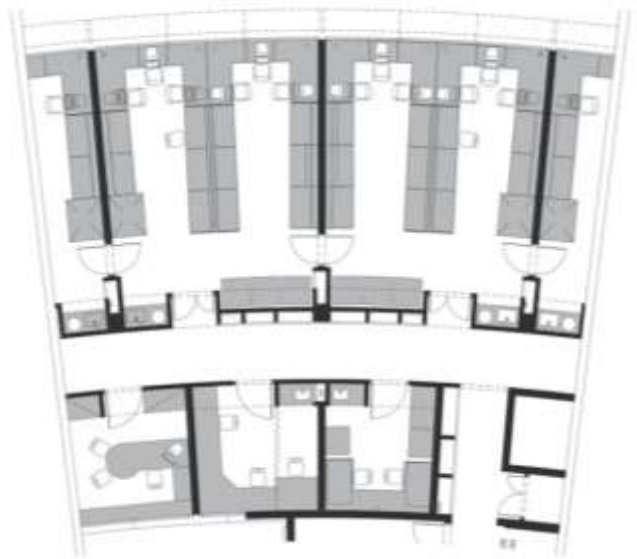


Lecture space is not separated
from research space

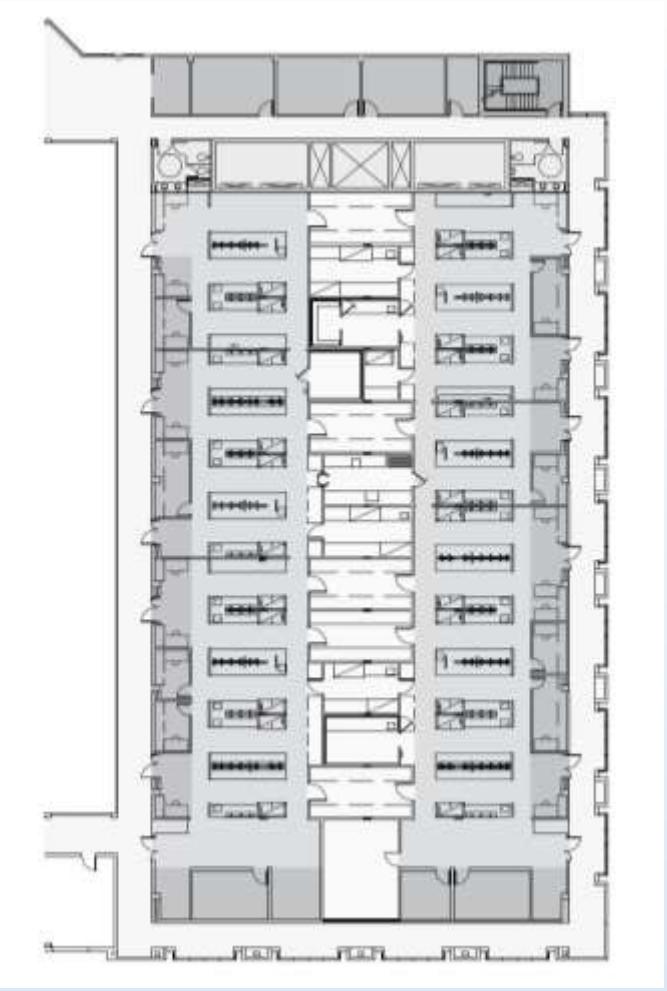
5.1 Laboratory Classification

5.1.3 Laboratory Building Layouts





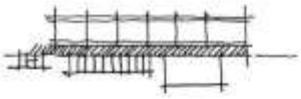
Curve Laboratory Layouts



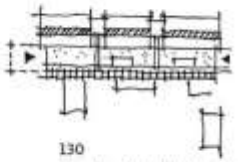
Straight Laboratory Layouts

5.1 Laboratory Classification

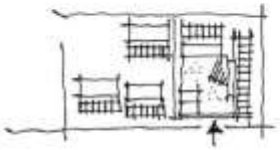
5.1.3 Laboratory Building Layouts



128
State Office
for Chemical Investigations

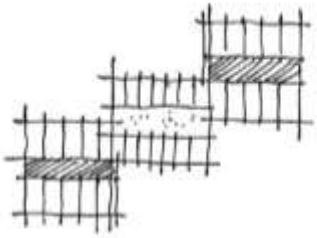


130
Max Planck Institute of Biophysics

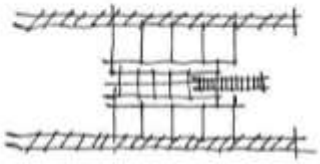


134
Fraunhofer Institute
for Manufacturing and Advanced Materials

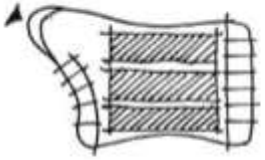
136
Center of Advanced European Studies
and Research (CAESAR)



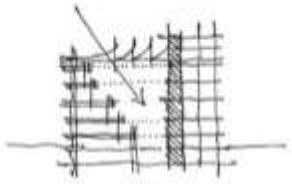
148
CIBA-Geigy Life Sciences Building



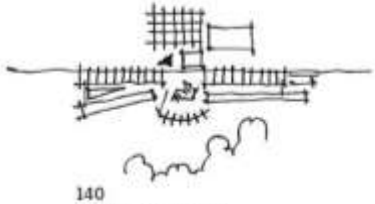
150
Centre for Human Drug Research



152
Laboratory Building
for Medical Genome Research

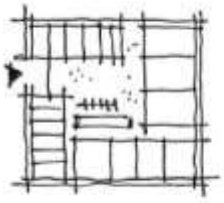


154
Sir Alexander Fleming Building,
Imperial College

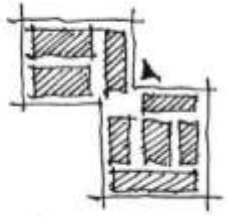


140
Fraunhofer Institute
for Applied Polymer Research

142
Pharmacological Research Building,
Boehringer Ingelheim Pharma KG



144
Centre for Energy and Technology



146
Molecular Sciences Building

5.1.3 Research Tools And Techniques Of Erbil Ifraz 2

Personal Visit

This Research Laboratory Project Is Based On Testing The Water Comes Form All The **Wells** In Erbil City.

Two main Laboratories are available within the project, those are mentioned below with the tests that are done inside each laboratory :

Chemical laboratory :

- Test 1 : Turbidity test
- Test 2 : Sulfate test – amount of SO4
- Test 3 : Flame photo meter – amount of NA + K
- Test 4 : PH number of the sample
- Test 5 : Turbidity of the sample
- Test 6 : EC of water – electrical conductivity
- Test 7 : Spectrophoto meter – UV
- Test 8 : Burette – hardness of water
- Test 9 : Titrette – amount of chlorine

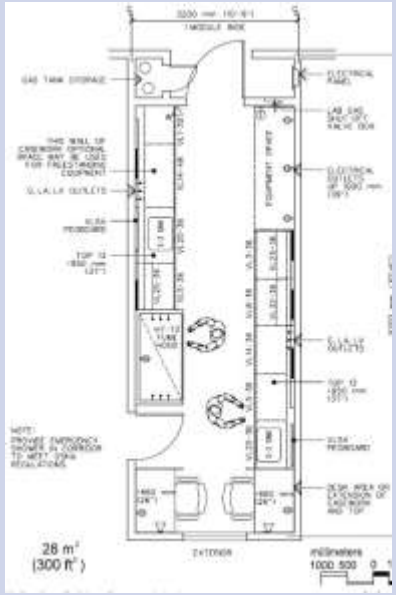
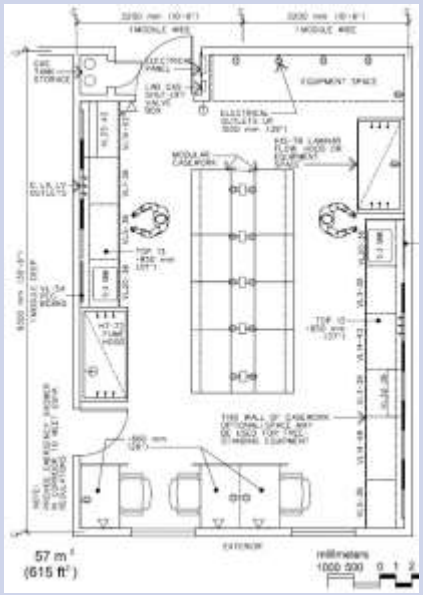
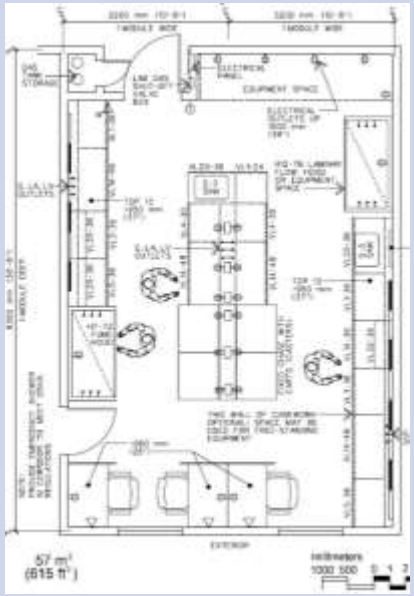
Biological laboratory :

- Test 1 : Incubator test – done at 37c’
- Test 2 : oven – done at 140 c’
- Test 3 : chlorine – determines the amount of chlorine needed to filter this type of water
- Test 4 : PH number of the sample
- Test 5 : Turbidity of the sample
- Test 6 : EC of water – electrical conductivity
- Test 7 : Jar test

Unit used : PPM

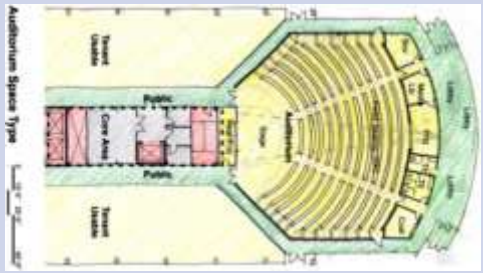
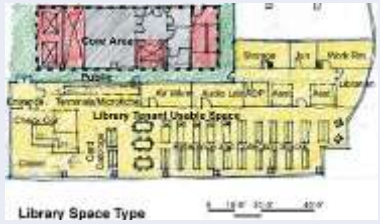
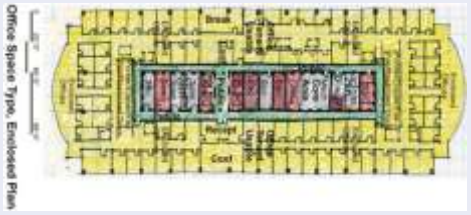
Each well get tested every TWO months

5.2 Laboratory Modules

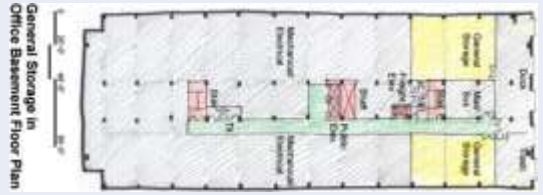
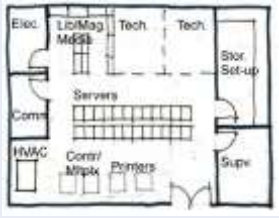
Standards	Single Module Laboratory	Double Module Laboratory 1	Single Module Laboratory 2	Single Module Laboratory 3
Area	28 sqm.	58 sqm.	58 sqm.	58 sqm.
Ceiling Height	Mini. 2.7 m	Mini. 2.7 m	Mini. 2.7 m	Mini. 2.7 m
No. of users	3	6	6	6
Wall Finish	gwb	gwb	gwb	gwb
Floor Finish	vct	vct	vct	vct
Dimensions	3.2m * 9.3m	6.4m * 9.3m	6.4m * 9.3m	6.4m * 9.3m
Plan				

- The second type will be used in my project.

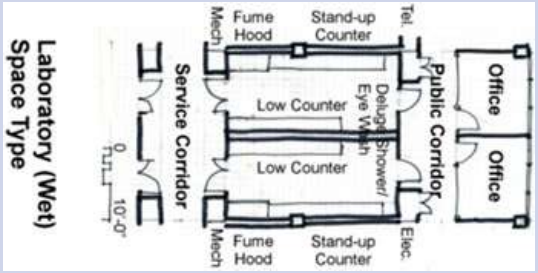
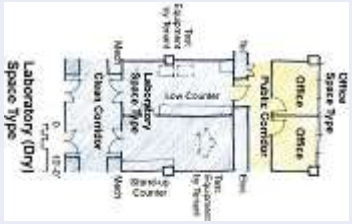
5.2 Spaces according to standards

Facility	L	W	Area sqm.	Space Attributes	Plan
Auditorium	-	-	700	Lobby - Coat check - main auditorium 300 per. – equi. Store - control room - male& female toilets	
Library	-	-	200	Check out – reference desk – reference stuck – collection stuck - Lounge seating – table seating – research computer terminals	
Open Offices	-	-	120	Reception station - Open large offices - open small offices - server room – document room	
Closed Offices	-	-	120	Reception station - Enclosed large offices – enclosed small offices - server room – document room	

5.2 Spaces according to standards

Facility	L	W	Area sqm.	Space Attributes	Plan
Loading Dock	-	-	As requires	Shipping and receiving docks – supervisor office	
General storage	-	-	As requires	Storing area close to (mechanical, electrical, trash, dock) services	
ADP main frame	-	-	120	Main frame room – control room – server room	
ADP PC	-	-	90	Supervisor office – server racks – controller racks - printer	

5.2 Spaces according to standards

Facility	L	W	Area sqm.	Space Attributes	Plan
Wet laboratory	6.4	9.3	28-58 Per lab.	Working area – offices – test room - storage	
Dry laboratory	6.4	9.3	28-58 Per lab.	Working area – offices – test room - storage	
Clinic / health unit	-	-	As requires		
Food service	-	-	170	Customer area – kitchen – employee area	

5.3 Space program

Lobby zone	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Lobby	60	2	120	1	120	Standard
Reception sitting	4	2.5	10	1	10	Standard + similar ex. 1,3
Control rm.	-	-	6	1	6	Similar ex. 1
Store			8	1	8	
Café	34	1.5	50	1	50	standard
Auditorium	150	1.1	165	1	428	Total+services
Exhibition hall	-	-	155	1	155	Similar ex. 1,3
Multi purpose hall	150	2	300	1	300	Standard
Male toilets	41(3units)	0.5	20	1	20	Standard
Female toilets	41(3units)	0.5	20	1	20	Standard
Total					**1,117**	

5.3 Space program

Auditorium	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Lobby	150	0.46	70	1	70	Standard
Foyer	150	0.3	45	1	45	Standard
Coat Check	-	-	15	1	15	Standard
Main auditorium stages	150	1.1	165	1	165	Standard
Stage	-	-	55	1	55	Standard
Control room	-	-	15	1	15	Standard
Equipment storage	-	-	15	1	15	Standard
Rear projection rm.	-	-	18	1	18	Standard
Male toilets	-	-	15	1	15	Standard
Female toilets	-	-	15	1	15	Standard
Total					428	
Exhibition hall			155		155	
Hall			155		155	Similar ex. 1,3
Total					**583**	

5.3 Space program

Administration zone	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Manager rm.	-	-	24	1	24	standard
Secretary rm.	-	-	20	1	20	standard
Assistant rm.	-	-	20	1	20	standard
Single close offices	1	10	10	3	30	standard
Open offices A	9	6.5	60	1	60	Similar ex. 3
Open offices B	14	6.5	90	1	90	Similar ex. 3
Meeting rm.	10	1.5	15	2	30	standard
Meeting rm.	20	1.5	30	1	30	standard
Seminar hall	20	2	40	2	80	standard
Archive	-	-	12	1	12	standard
Social area (Assembly space)	-	-	220	1	220	Similar ex. 3
Store	-	-	50	1	50	Similar ex.
Male toilets	20(2units)	0.5	10	1	10	Standard
Female toilets	20(2units)	0.5	10	1	10	Standard
Total					**683**	

- Standard no. of offices = 10% close offices + 90% open offices in modern office design
- no. + area of offices is average of similar projects
- Area of single close offices standard = 10 sqm/per.

5.3 Space program

Government Laboratory	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Ecological lab	6	9.5	58	1	158	Standard
Chemical lab	6	9.5	58	1	158	Standard
Organic geochemistry research lab	6	9.5	58	1	158	Standard
National water quality	6	9.5	58	1	158	Standard
Bacteriological lab	6	9.5	58	1	158	Standard
Physical lab	6	9.5	58	1	158	Standard
Biological lab	6	9.5	58	1	158	Standard
Microbiological lab	6	9.5	58	1	158	Standard
Total	48				**1,264**	

- According to double module standard no. of users = 6

All types-laboratory Support	Net Area (sqm.)	All types-laboratory Support	Net Area (sqm.)
Laboratory working area	58	Gas cylinder storage room	9
Cold procedure room	7.5	Acid storage room	9
Glass ware washing and sterilize room	38	Flammable storage room	9
Tissue culture laboratory	9	Ultralow freezer room	18.5

Total Area of one government laboratory

= **158** sqm

5.3 Space program

Research Laboratory Zone	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Entrance lobby	12	2	24	1	24	Standard
Control rm.	-	-	6	1	6	Similar ex. 1
Large Store	-	-	50	1	50	Similar ex.
Small café	12	1.5	18	1	18	Standard
Meeting rm.	20	1.5	30	3	90	Standard
Seminar hall	50	2	100	1	100	Standard
Head of researchers	-	-	24	1	24	Standard
Head assistant rm.	-	-	20	1	20	Standard
Staff rm.	6	5	30	8	240	Standard
Male toilets	30(2units)	0.5	15	1	15	Standard
Female toilets	30(2units)	0.5	15	1	15	Standard
Total					**602**	

5.3 Space program

Learning Laboratory	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
open lab A	20	3	60	2	120	Standard+similar ex.3
open lab B	20	3	60	2	120	Standard+similar ex.3
open lab C	20	3	60	2	120	Standard+similar ex.3
open lab D	20	3	60	2	120	Standard+similar ex.3
Lecture halls	40	1.5	60	4	240	Standard
Total	**160**				**720**	

- Standard no. of students in research laboratory = 20-24 in laboratory
- Open laboratory system merges more than 2 types of research
- In my project 8 types of research are divided to 4 open lab.s each eith 2 researching types.

5.3 Space program

Learning Laboratory Zone	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Lobby + social area	40	2	80	1	80	Standard-25% of users
Reception	2	2.5	5	1	5	Standard
Head of department	-	-	25	1	25	
Secretary rm.	-	-	20	1	20	
Head assistant rm.	-	-	20	1	20	
Control rm.	-	-	6	1	6	Similar ex. 1
Store	-	-	50	1	50	
Archive	-	-	12	1	12	Standard
Café	40	1.5	60	1	60	Standard
Conference hall	160	1.0	160	1	160	Standard+similar ex.
Lecturers rm.	2	10	20	2	40	Standard
Lecturers café+rest rm.	4	2.5	10	1	17	Standard(+7)
Male toilets	80(5units)	0.5	40	1	40	Standard
Female toilets	80(5units)	0.5	40	1	40	Standard
Library					**271**	**Notes**
Shelves space	80	2.5	200	1	200	Standard
Librarian’s office	1	10	10	1	10	Standard
Research computer terminal	1	2	2	8	16	Standard
Store rm.	-	-	30	1	30	Standard
Entrance + check out	-	-	15	1	15	Standard
Total					**1440**	

5.3 Space program

Residential zone	No. of users	M2/P	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	
Lobby	10	2	20	1	20	Standard
Front desk	2	2.5	5	1	5	Standard
Control rm.	-	-	6	1	6	Similar ex. 1
Restaurant	10	1.8	18	1	18	
Kitchen	-	-	8	1	8	25-45%of rest.
Café	10	1.5	15	1	15	Standard
shops	-	-	15	4	60	
Fitness	42	1.5	65	1	65	Standard
Studio app.	1	-	40	7	280	Standard
Family apartment	5	-	90	7	630	Standard
Total				**1107**		

Total area on the project	**6,987 + 25%**
Total area on the project	**8,734 sqm**

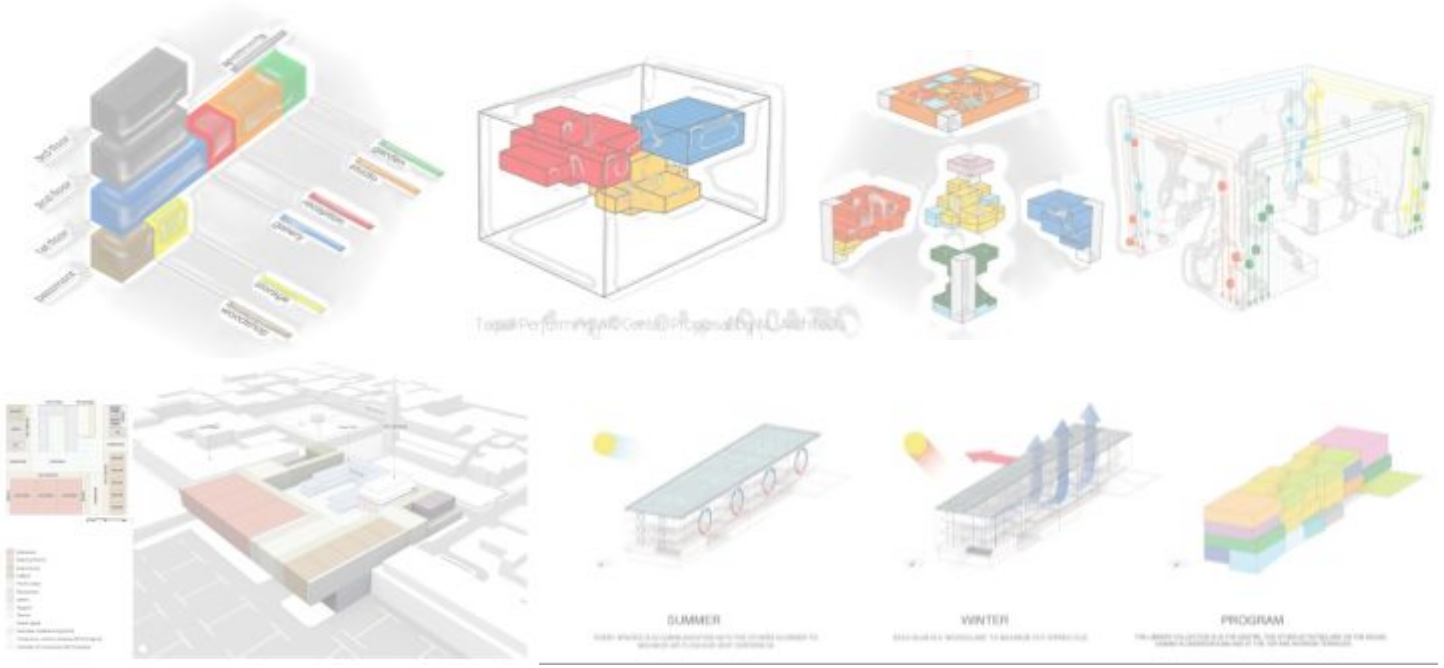
According to standards

- 25% of the total is the users of Lobby
- 25-35% of users is for the restaurant
- The area of apartments is according to the no. of beds

5.3 Space program

Services + Outdoor spaces	No. of users	M2/car	Net-Area (sqm.)	No. Of Spaces	Total N-Area (sqm.)	Notes
Public parking car	41	25	25	41	1025	
Public parking bus	14	84	84	15	1260	Bus = 14pers /bus
Residential parking	14	25	350	1	350	Standard + calculations
wetlands	-	-	-	-	As design requires	Similar ex.1,4,5
Loading dock	-	-	215	1	215	Similar ex. 3
Mechanical services	-	-	-	-	As design requires	
Electrical services	-	-	-	-	As design requires	
General storage	-	-	-	-	As design requires	
Fire control rm.	-	-	55	1	55	Similar ex. 3
Total					**+2905**	

Bus parking calculation: 160 student/14 pers per bus = 12 bus
50% of employees = 41/14 pers perr bus = 3 bus



CHAPTER CONCLUSION
SPACE PROGRAMM

5.4 This chapter provides all space requirements that are needed during project design, also provides the total area of the project which aids in estimating affairs that are needed within the construction stages.

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