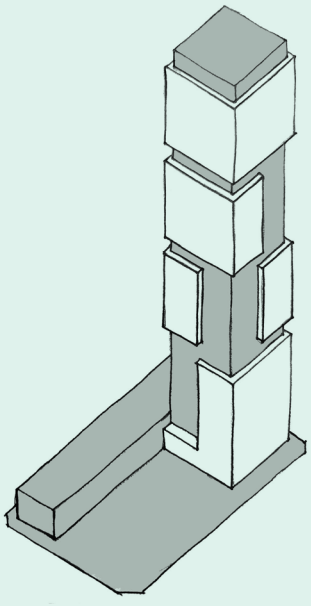


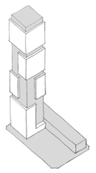
# FARMSCRAPER

MSc Building Architecture

Politecnico di Milano

Project Type - Multi-Use, Highrise.

Location - Central Business District, Singapore



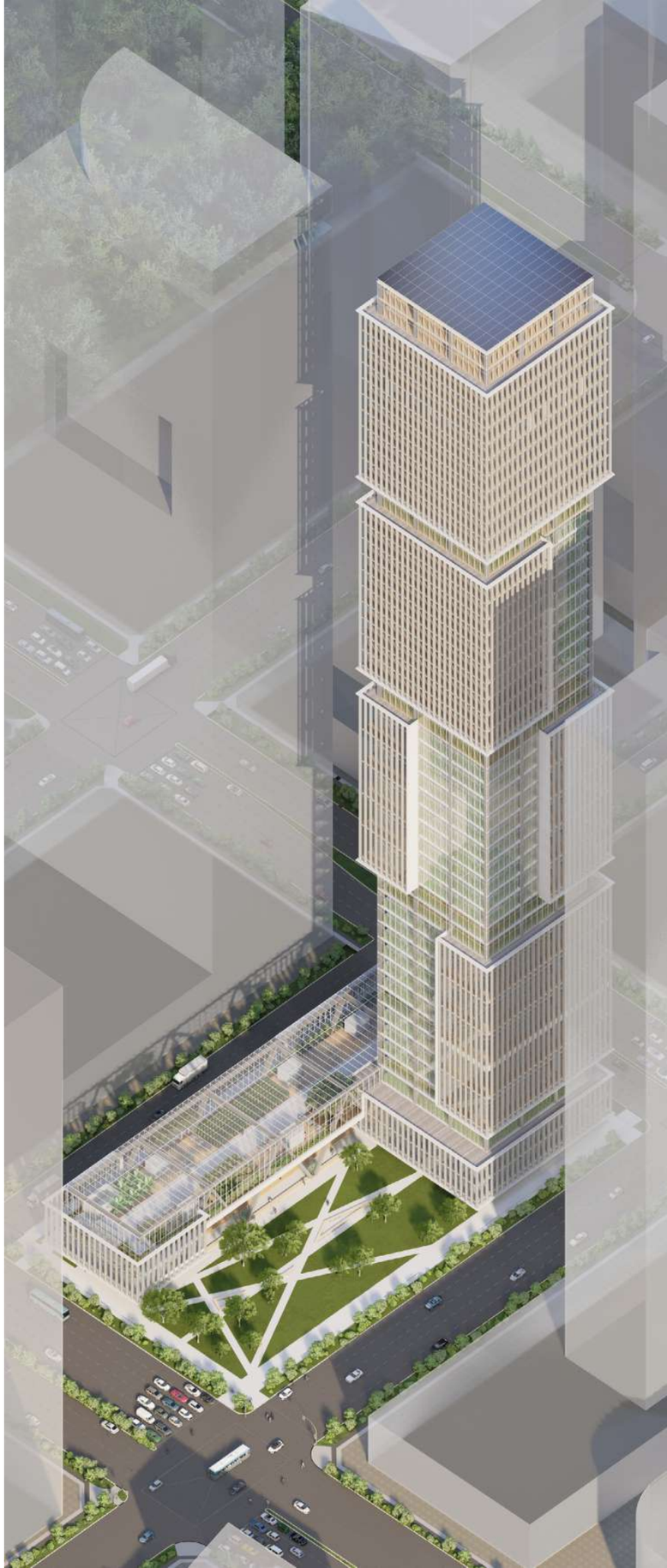
# ABOUT THE PROJECT

Due to rapid urbanization, Singapore is facing scarcity of land for traditional farming. As a result, the city depends on imported food supplies. Therefore, Singapore Food Agency has set the target for Singapore to be 30% self-sufficient in food production by 2030. The Singapore govt. wants to create a Food resilient future by exploring creative ways in locating farming activities in different parts of the city. Local example such as Sky Greens, who provides urban farming solutions, demonstrated how vertical farming can lead to higher yield of production with less resources.

The main purpose of the FARMSCRAPER (Tall building with integrated farming) is to bridge the gap between corporate office jobs and farming, while creating a sustainable architecture with reduced environmental impact. Separated by glass walls, the two different functions connect with each other and maintain transparency.

The design explores the creation of a new building typology - A unique way of combining urban agriculture, innovative technical solutions, and architecture to meet the demand for efficient food production within cities.

This thesis project was realized in collaborative effort by a group of three students at Politecnico di Milano.

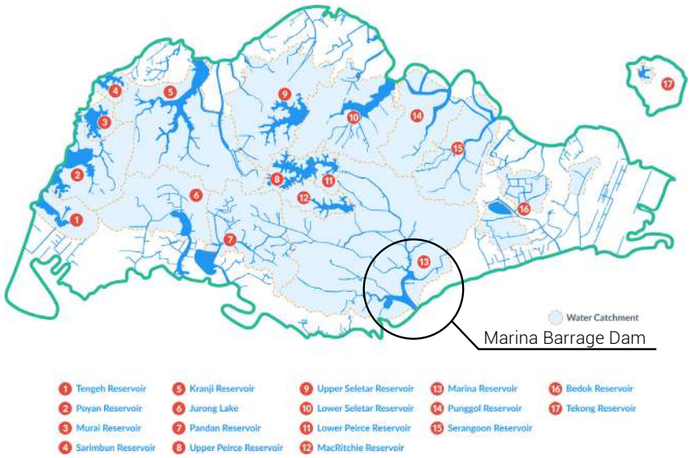


# URBAN DEVELOPMENT



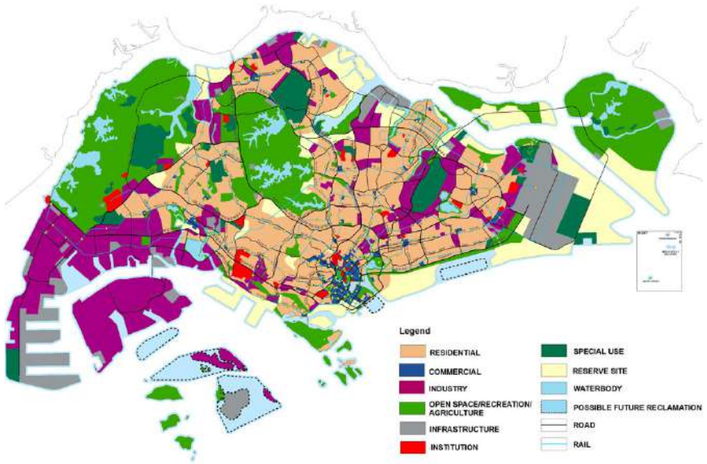

## LAND RECLAMATION

The Singaporean government has used land reclamation to supplement the country's commercial, residential, industrial, and governmental properties. Land reclamation in Singapore also allows for the preservation of local historic and cultural communities, as building pressures are reduced by the addition of reclaimed land. The ongoing land reclamation project has increased the land area of Singapore from 581.5 km2 in the 1960s to 721.5 km2.




## WATER CATCHMENTS

Marina Barrage is part of a comprehensive flood control scheme to alleviate flooding in low-lying areas of the city. Singapore faces a lack of clear water to support its growing population. Water has been derived from 4 sources, namely; importation from Malaysia, reclaiming used water ("NEWater"), desalination of sea water, rainwater collection..




## MASTERPLAN, 2021

With the government's initiative and investment from private entrepreneurs, numerous companies have been established for vertical farming inside the city. They run both intensive and extensive methods. All these buildings are solely dedicated to farming activities, where only official personnels are allowed to enter and work there. They have laboratory-like environment.

As the buildings the situated amidst the city, it is necessary to make the general public aware of these great inventions so that they can also learn and educate themselves.



# FARMING IN SINGAPORE




VISUAL REPRESENTATION OF FARMLAND ALLOCATIONS

## FOOD SHORTAGE & LACK OF LAND

Singapore is overpopulated with 5.8 million people in 2021.Around 90% of their food comes from overseas. Singapore produces around 22,458 tonnes of vegetables, while its population consumes 524,462 tonnes, making food scarcity an important issue. Singapore sets to accomplish the "30 By 30" goal of producing 30% of their food locally by 2030.

Only 1% of Singapore's land is being used for conventional farming - only around 2 square kilometers (200ha) of land is used for land-based food farms presently. This is due to the high cost & scarcity of land. Our project introduces vertical farming, consuming minimum land area, and yet contributing significantly to the production of food for domestic and commercial consumption.

Orchard Road, 1900

Orchard Road, 2021

Mid 1950's Greenery Farm

Skygreens Agro-tech Industries.

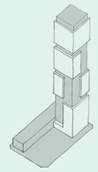
Family of Dairy Farmers

Current scenario

## REVIVAL OF FARMING ACTIVITIES

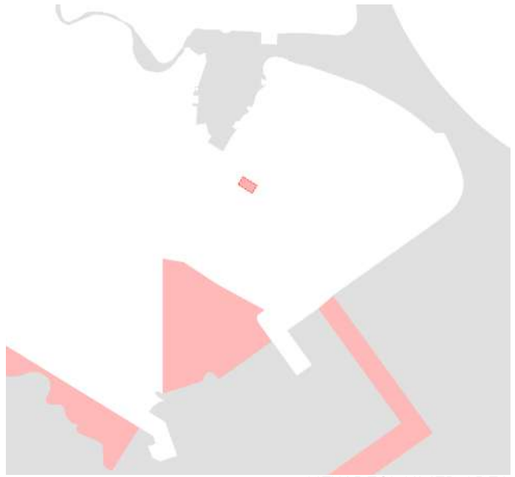
In the early 1900s, Singapore was renowned for its agriculture & farming business, served as an important source of income & lifestyle. Popular shopping areas used to be major districts for farmland as well. An example would be Orchard Road, which used to be a flower orchard. The rise of modernism & tech-industries has gradually shifted the agricultural activities of the city.

The current agricultural facilities function like chemical laboratories. They are highly efficient, but unwelcoming to non-professionals and general public. Our design aims to introduce modern Agro-tech techniques for efficient food production, yet maintaining the characteristic features that are unique to traditional farmlands. We want it to be a place where members of the public can re-engage in the rural farm life style The building will facilitate educational programs, boosting the level of awareness on the agricultural concern.



# CONTEXTUAL BACKGROUND

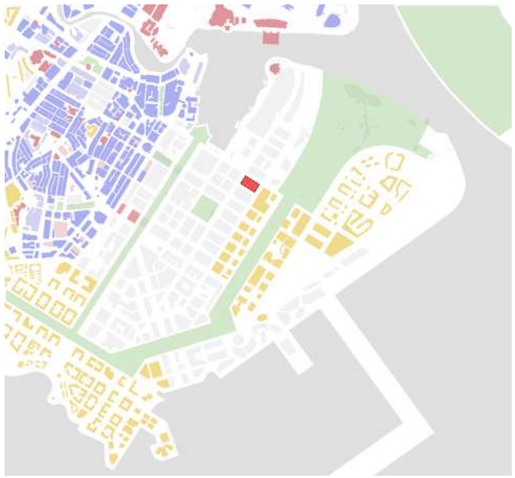
**SITE ANALYSIS**



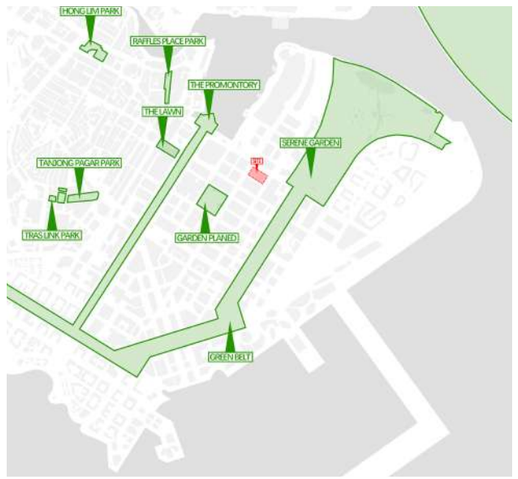
NEW RECLAIMED AREA

FIGURE-GROUND RELATION

ROADS AND DIRECTION



DESIGNATIONS




GREEN AREA

WALK DISTANCE





# FARMING IN SINGAPORE

Tangible produce

Intangible produce

Demands physical activity

Stationary activity

Inpresent activity

Can easily be remote

Active involvement of nature

Devoid of interaction with nature

Informal environment
Lack of hierarchy
Non-obligatory

Formal events
Presence of hierarchy
Obligatory activity

Interaction with wide range of people sharing the same interests.

Interaction with people concerned with the profession

Shared activity-involvement of family & friends

Only skilled personnels involved

Involves activities, releasing happiness chemicals, promoting well-being

Involves formal activities typically inducing stress

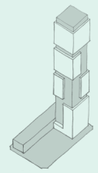
**REVIVAL OF FARMING ACTIVITIES**

The aim of our design is bridging the gap between boring, corporate "9-to-5" jobs, and the earthy, refreshing farming. Those regular office jobs can easily become monotonous as you are always sitting in one position in a small cubicle or just a closed room, disconnected from nature, with only interactions between people from the same field.

These small scale farming activities in the building, it opens doors to the country-side farmers who lost their jobs due to rapid urbanization. The building welcomes the general public as well to participate int the farming activities; learning how they work, how to grow their own fruits and vegetables, make room for socializing with people from all over the city from different ethnic and professional backgrounds.

When we are introducing new functions it naturally drives people to explore that, breaking away from the monotony of their regular life, blending the formal and the informal together, and experience something new and interesting.

It not only creates a break in the increasing numbers of commercial skyscrapers, but also give the multi-use towers a new meaning, contributing to the development of the city.



# MORPHOLOGICAL DEVELOPMENT

**CONTEXTUAL RESPONSE**


ROADS DEFINE MAIN ENTRANCE


RAMPS POSITION

GREEN BELT & BIKE PATH

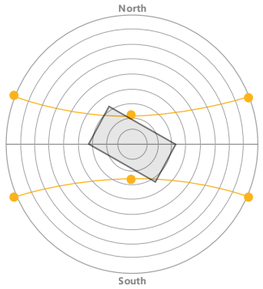

SHOP HOUSES

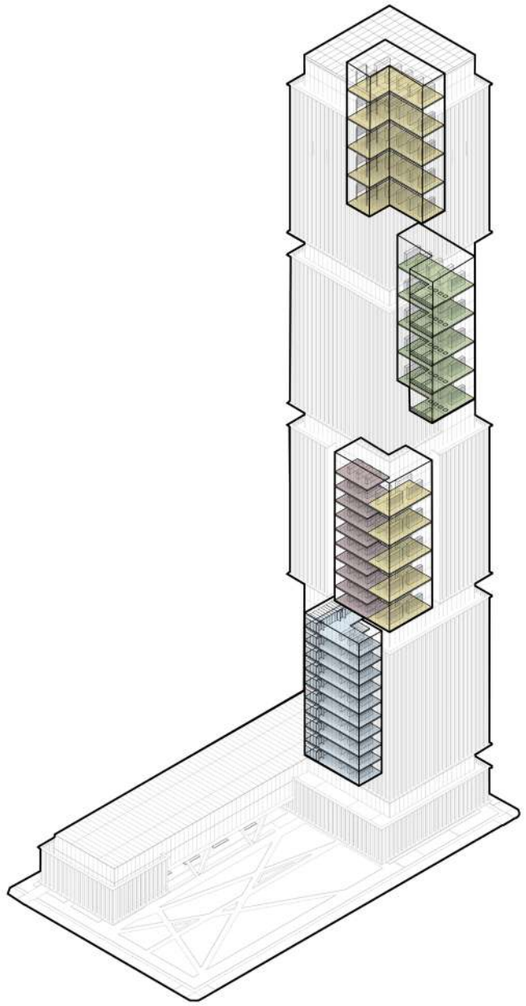

BLOCK POSITION


PODIUM POSITION

# HYDROPONIC SYSTEMS





## CROP FEATURES

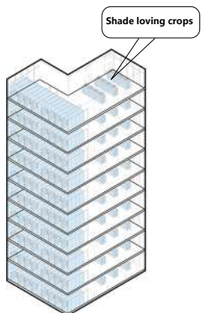
The selected crops can be divided into four categories according to their lighting properties. Sun loving crops need longer illumination time. Sun loving and shade tolerant crops can adapt to different light intensity. Shade tolerant crops prefer shorter daily hours or weaker light. Shade loving crops like to grow in no light or weak light.

**Type A (Block 1)** Farming Space is at lower level and lack sun shine, which is good for shade loving crops

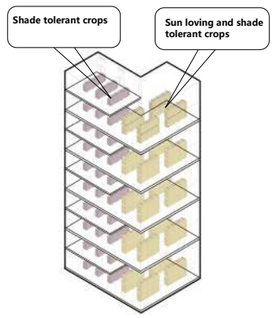
**Type B (Block 2)** Farming Space is at higher level of building. Half of the floors are cut off every other floor, so that the lower floor can get more sunshine. Thus, lower floor can grow Sun loving and shade tolerant crops, and upper floor can grow Shade tolerant crops by using artificial light.

**Type C (Block 3)** Farming Space are the same space with Type D, the difference is during different period. During summer time with enough sunshine, space is used to grow sun loving crops.

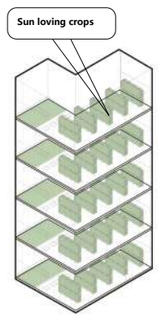
**Type D (Block 4)** Farming Space is used to sun loving and shade tolerant crops During winter time with not enough sunshine,



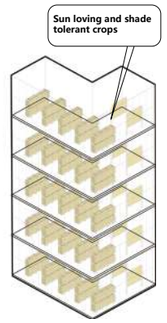

Type A (Block 1)




Type B (Block 2)




Type C (Block 3)




Type D (Block 4)





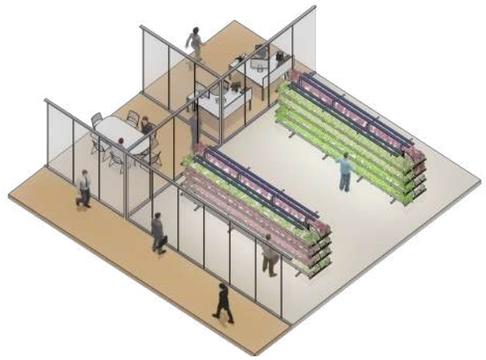
## FARMING SECTIONS

The building introduces three types of farming activity. In the podium, along with the market, there is extensive farming with soil beds, from which the fresh produce can be directly brought to the market kiosks to be sold instantly. The second type of farming includes both intensive and extensive farming, along with cafes and restaurants, are situated on the recreational floors. Lastly, the third type includes NFT hydroponic systems which are placed on the tower blocks, co-existing side by side with the offices.

### RECREATIONAL FLOOR

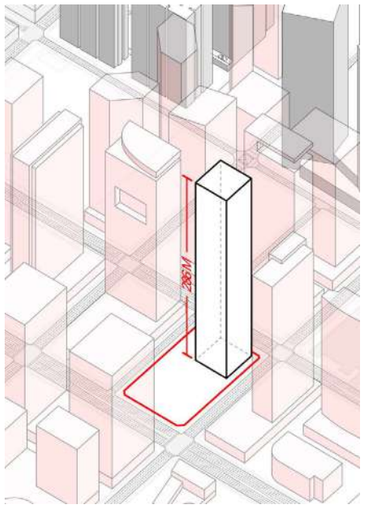
### MARKET

### OFFICE

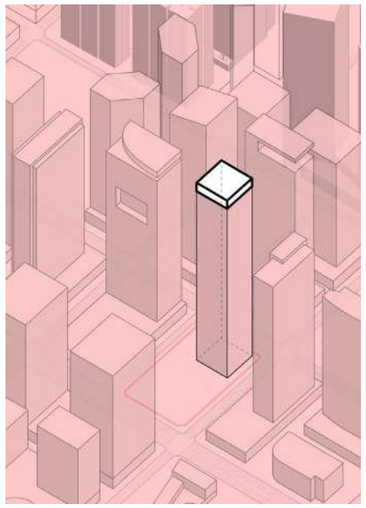


# MORPHOLOGICAL DEVELOPMENT

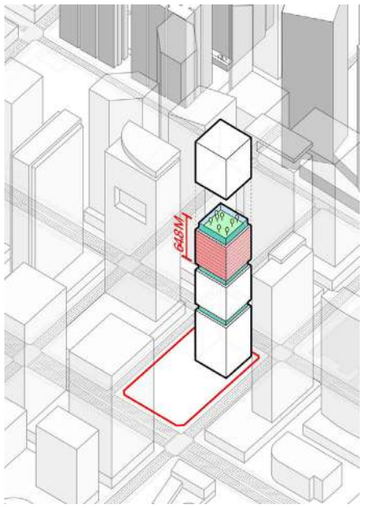
## VOLUMETRIC FORMATION



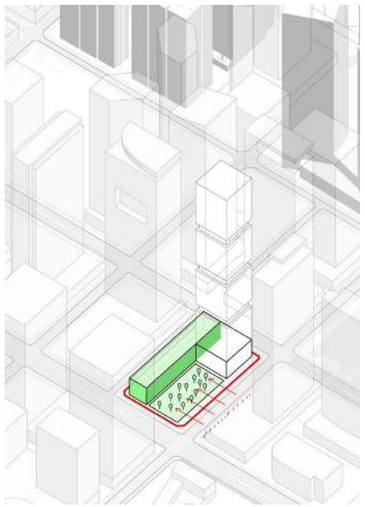

The height of our building strictly respects the average height of surrounding buildings and the floor area ratio stipulated by the government: 1.3.



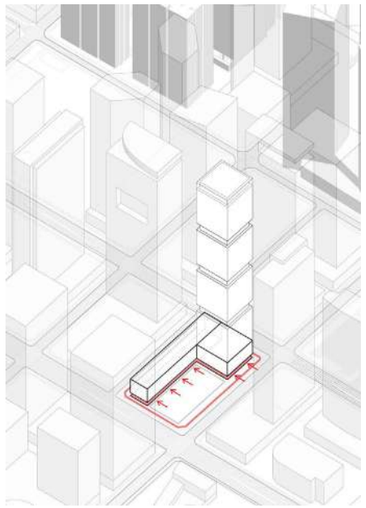
The building is crowned with a public observatory at the top, so the dominance in height allows for better experience. This reiterates the attention to public welfare and accessibility in the building.



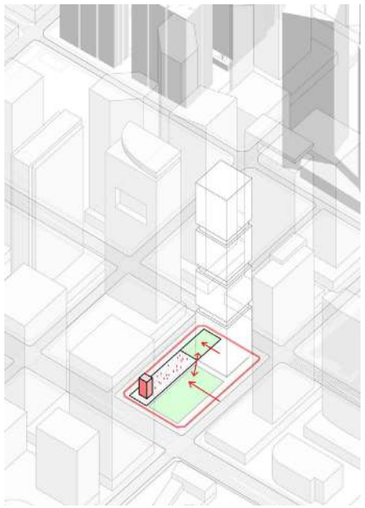

The building is split vertically in certain parts to allow for proximity to the recreational spaces which host common functions, shared between the two major demographic users of the building.



We use a whole promenade with planting behavior to attract people to come and explore. The green space in front of the tower as a buffer area for the promenade, which also echoes the diagonal of the marina bay park.

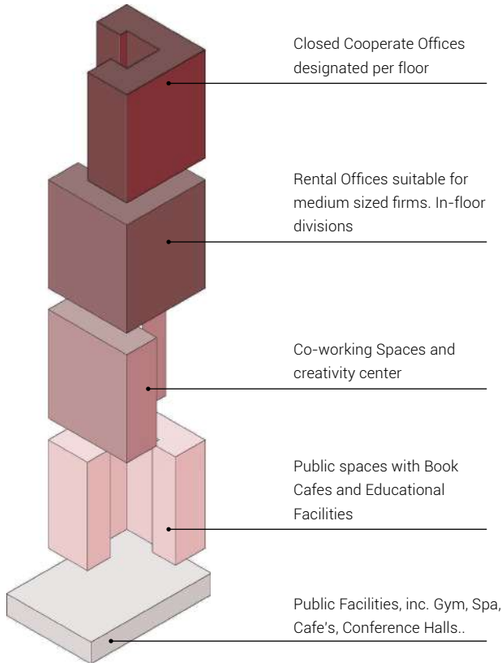


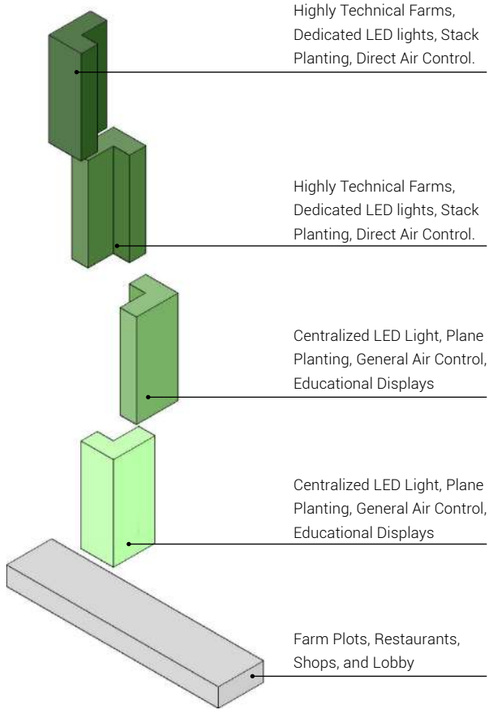
The platform has been designed to allow free flow of public movement across and through the site, as well as underneath the building, enhancing the ease of access and blurring the boundaries.



This is done in reference to the common Singaporean architectural morphology, which consists of shops, entrances and interactive spaces at the bottom of the building, thus connecting the building with the city.








**Office Blocks** - Singapore's contemporary modern culture consists of a combination of Asian and European cultures, Singapore has been dubbed as a country where “East meets West”, or “Gateway to Asia”

This level of diversity requires that our design responds to the work needs of a wide range of demographics, from the most formal to informal work spaces. Each block of offices will have its unique ambient.

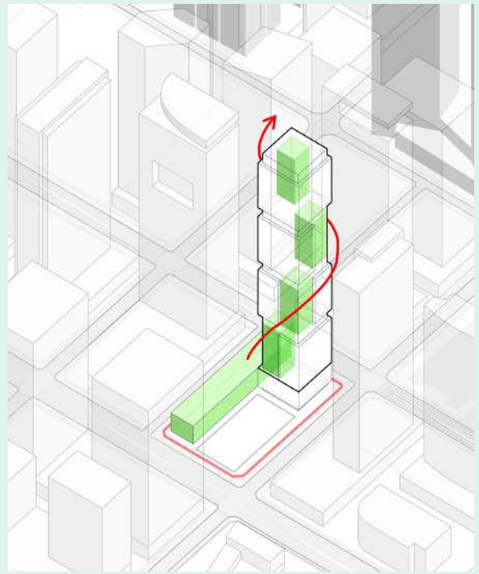
**Farm Blocks** - The high level of biodiversity also translate to a wide range of interest in food crops and farming methodologies. Planters could consider these agricultural activities a vocation, a hobby, or simply a way to socialize and connect with other people. In addition different crops require sunlight from different directions Hence the -farming blocks have been segmented and oriented to satisfy these varying needs.

**1st Farm Block** - The first farm block is connected with the podium to form a coherent visual experience: when walking in the Qunfang greenhouse, you can look up and see the indoor farm of the first block.

**2nd Farm Block** - Looking at the site from the park, the visibility of the distant buildings is shifted upward by 30° due to the occlusion of trees. So people can see the second farm block from about 60 meters.

**3rd Farm Block -** Walking along the walkway of Marina Bay, here you can get a full view of the skyscrapers: 4 equally divided blocks and the same comfortable viewing angle: the height of the third farm block that can be touched by the 30-degree elevation angle: 200 meters up and down.

**4th Farm Block** -The fourth farm block faces the surrounding buildings of similar height and improving the relationship between the buildings by view reaction and the vertical farm for attracting people to come to check the farm activity of our building.



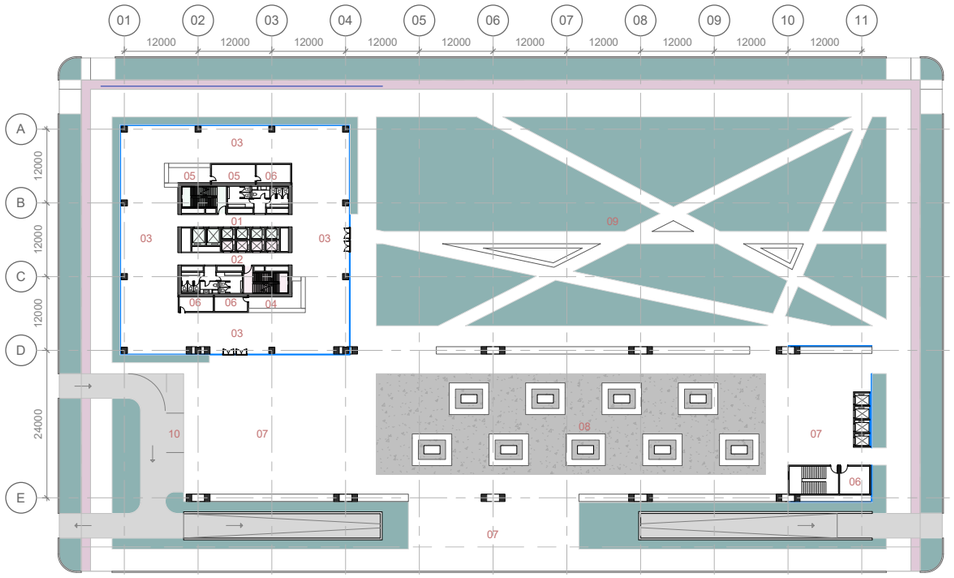
# PLANS, SECTIONS & ELEVATIONS

## FLOOR PLANS


01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - INFO POINT
05 - STORAGE
06 - FARM STORAGE
07 - MEP ROOM
08 - VAN PARKING
09 - CAR PARKING
10 - DROP-OFF POINT

0 10 20 30 50m

**Level -1**




01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - INFO POINT
05 - CAFE
06 - STORAGE
07 - ENTRANCE PLAZA
08 - BIO MARKET
09 - PUBLIC PARK
10 - DROP-OFF POINT

0 10 20 30 50m

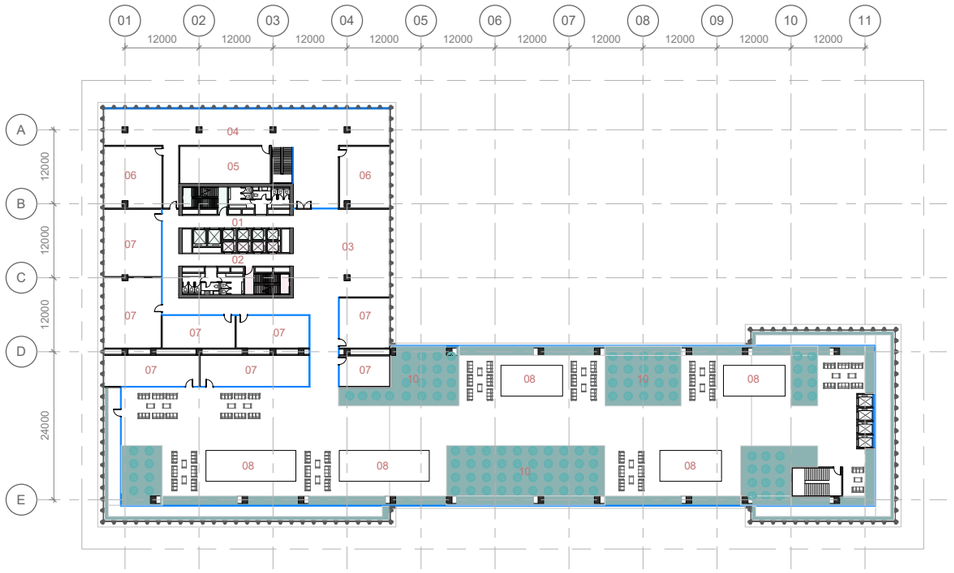
**Level 0**

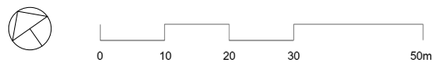


**MASTER PLAN**

# PLANS, SECTIONS & ELEVATIONS

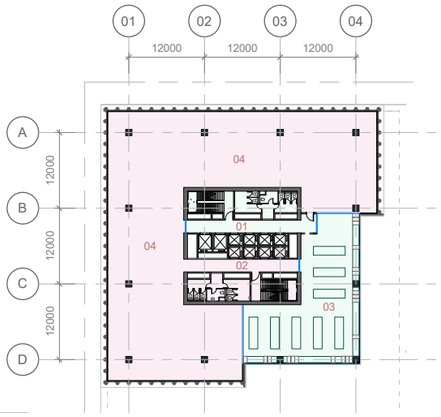
## FLOOR PLANS




01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - GYM
05 - MEN LOCKERS & WASHROOMS
06 - SPA ROOMS
07 - SHOP
08 - RESTAURANT
10 - INTENSIVE VEGETATION

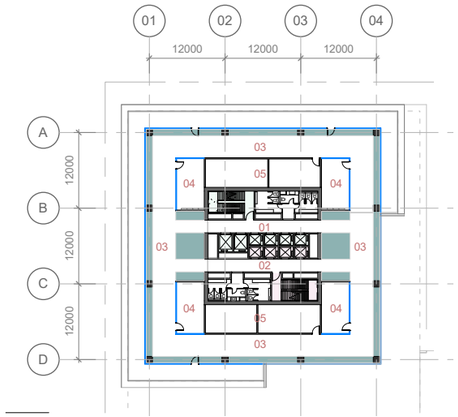
**Level 2**




**TYPICAL BLOCK 01**
Open Floor Plan Co-working public spaces with Educational Displays, and greenery

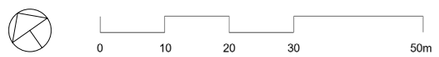
01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE

**Level 5 - TB 01**




01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - CAFE / RESTAURANT
05 - MEP ROOM
06 - INDOOR TERRACE
07 - OUTDOOR TERRACE

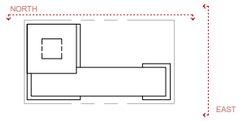
**Level 15 - TR**

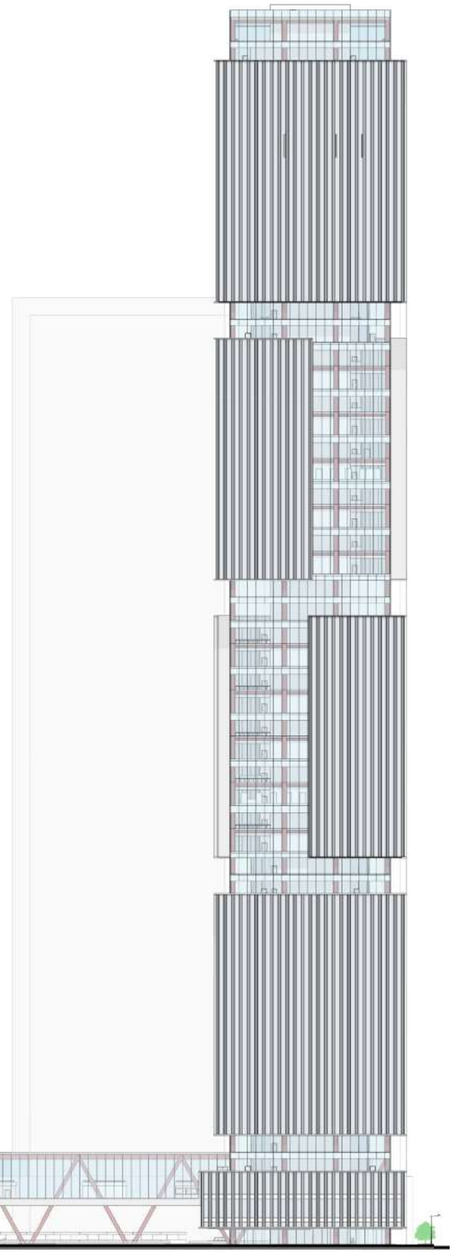




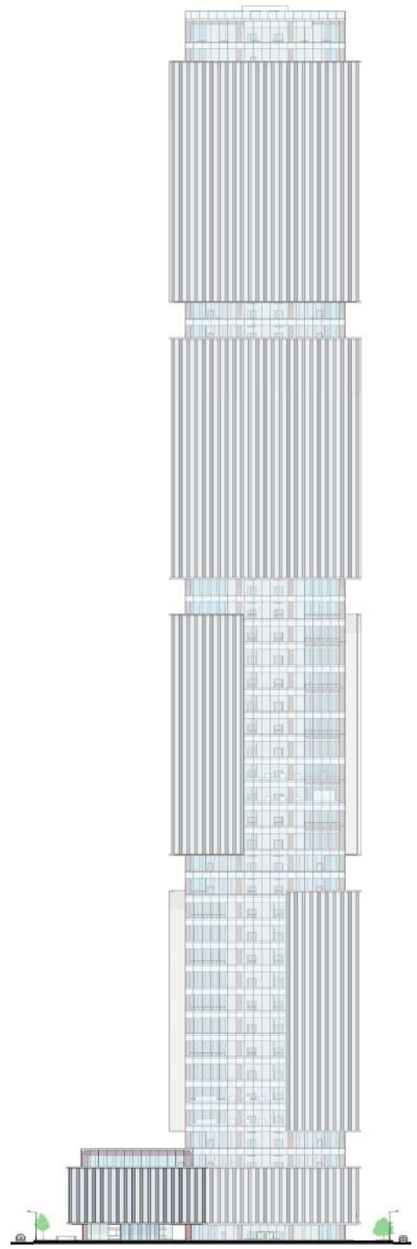



## ELEVATIONS



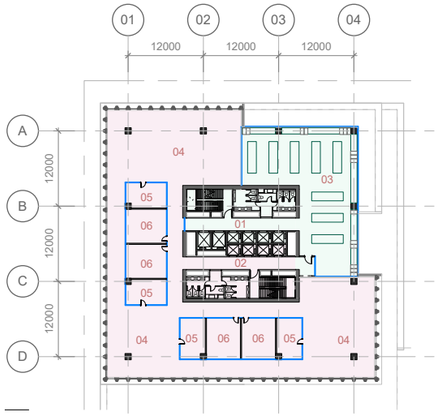
**NORTH ELEVATION**



**EAST ELEVATION**

# PLANS, SECTIONS & ELEVATIONS

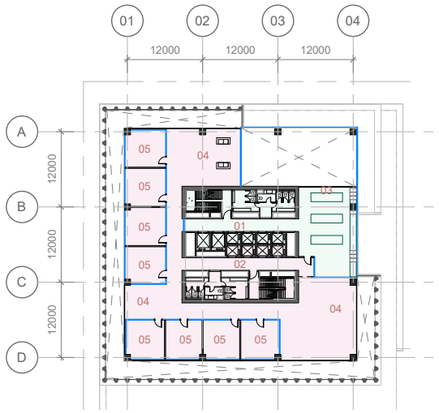
## FLOOR PLANS




**TYPICAL BLOCK 02**
Work hubs integrated in Open Floor Plan Co-working public spaces suited for short term retails, studios, artisans, and start-ups

01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE
05 - WORK CUBICLES
06 - MEETING ROOM

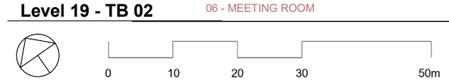
**Level 19 - TB 02**

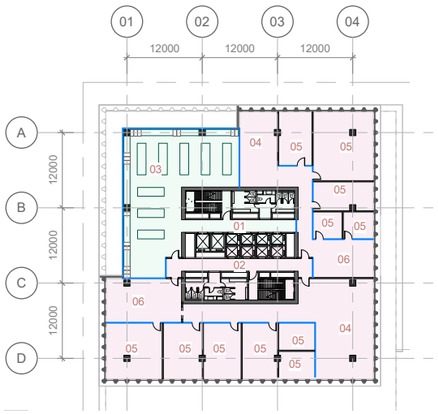



**TYPICAL BLOCK 02**
Work hubs integrated in Open Floor Plan Co-working public spaces suited for short term retails, studios, artisans, and start-ups

01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE
05 - CLOSED WORKSPACE

**Level 20 - TB 02 MZ**

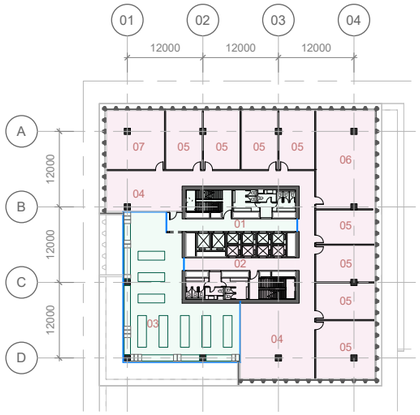



**TYPICAL BLOCK 03**
In-floor cooperate unit divisions, suited for long term purposes, and open to individual office fit-out works

01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE
05 - CLOSED WORKSPACE
06 - RECEPTION AREA

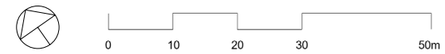
**Level 33 - TB 03**



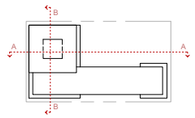

**TYPICAL BLOCK 04**
Single private cooperate units designate per floor

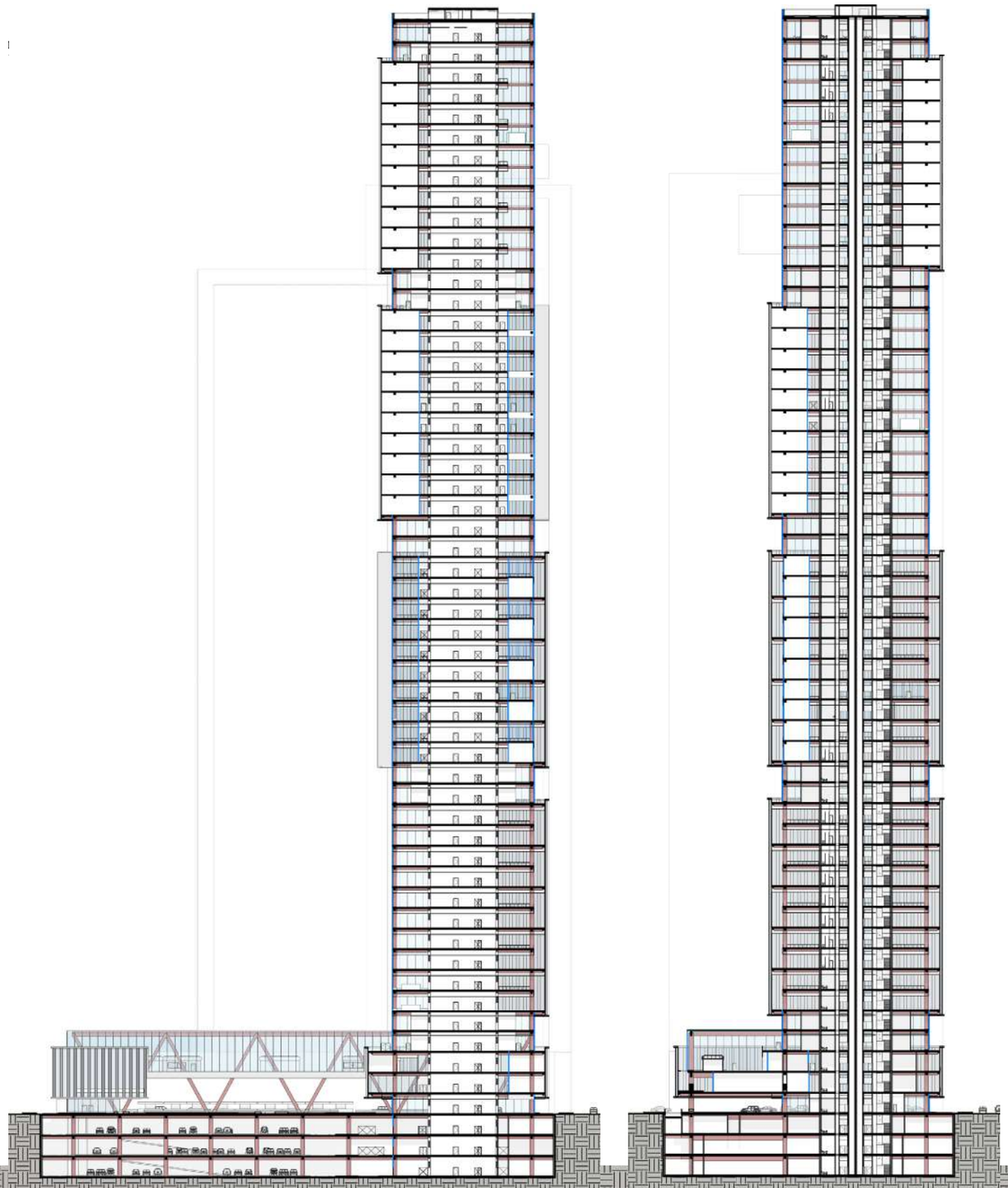
01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE
05 - CLOSED WORKSPACE
06 - RECEPTION AREA
07 - BREAK ROOM

**Level 47 - TB 04**



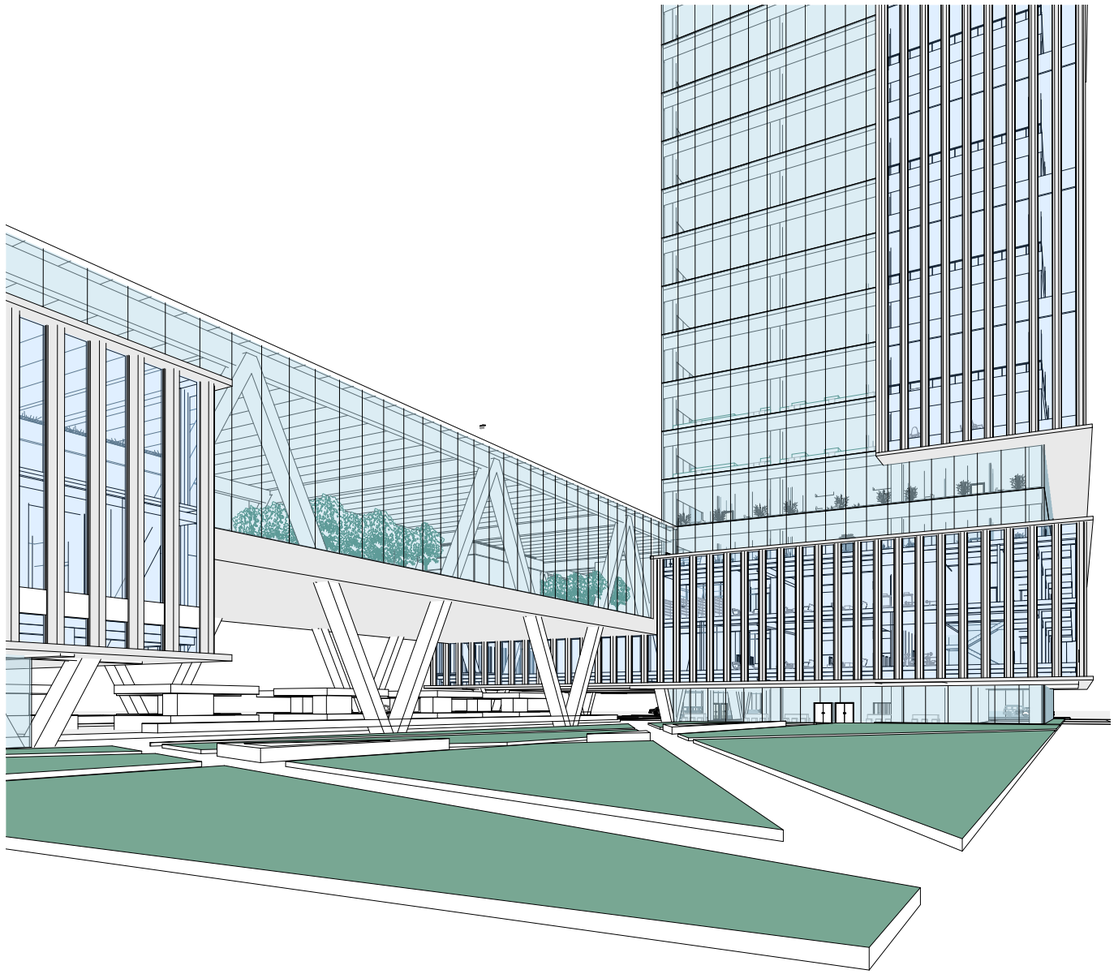
## SECTIONS



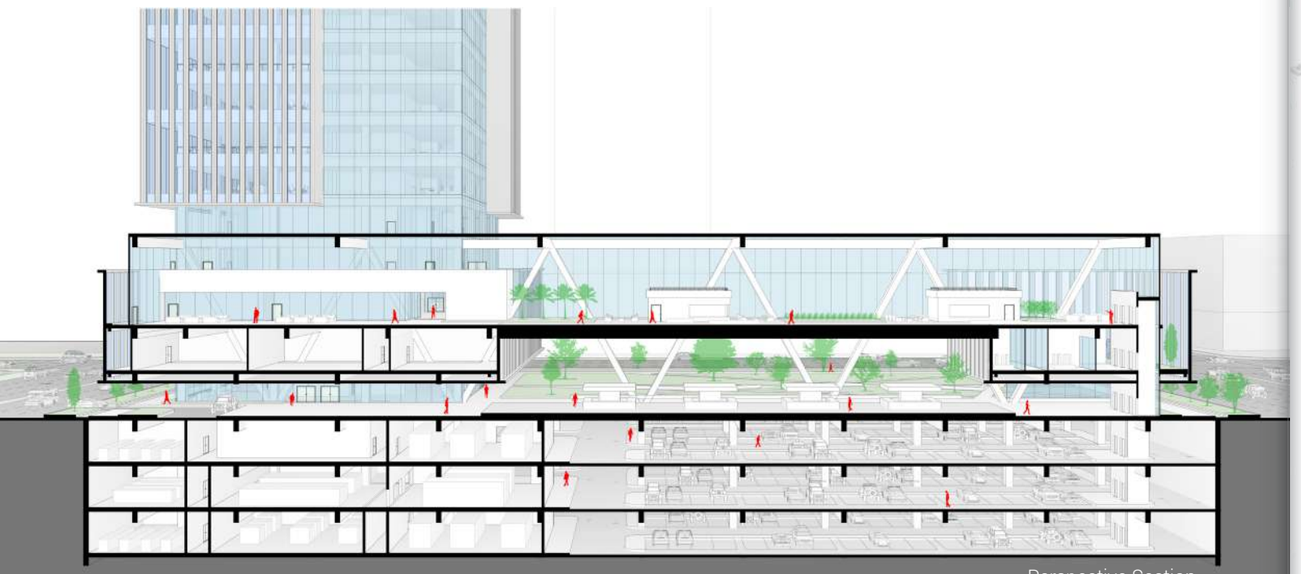



SECTION A-A

SECTION B-B



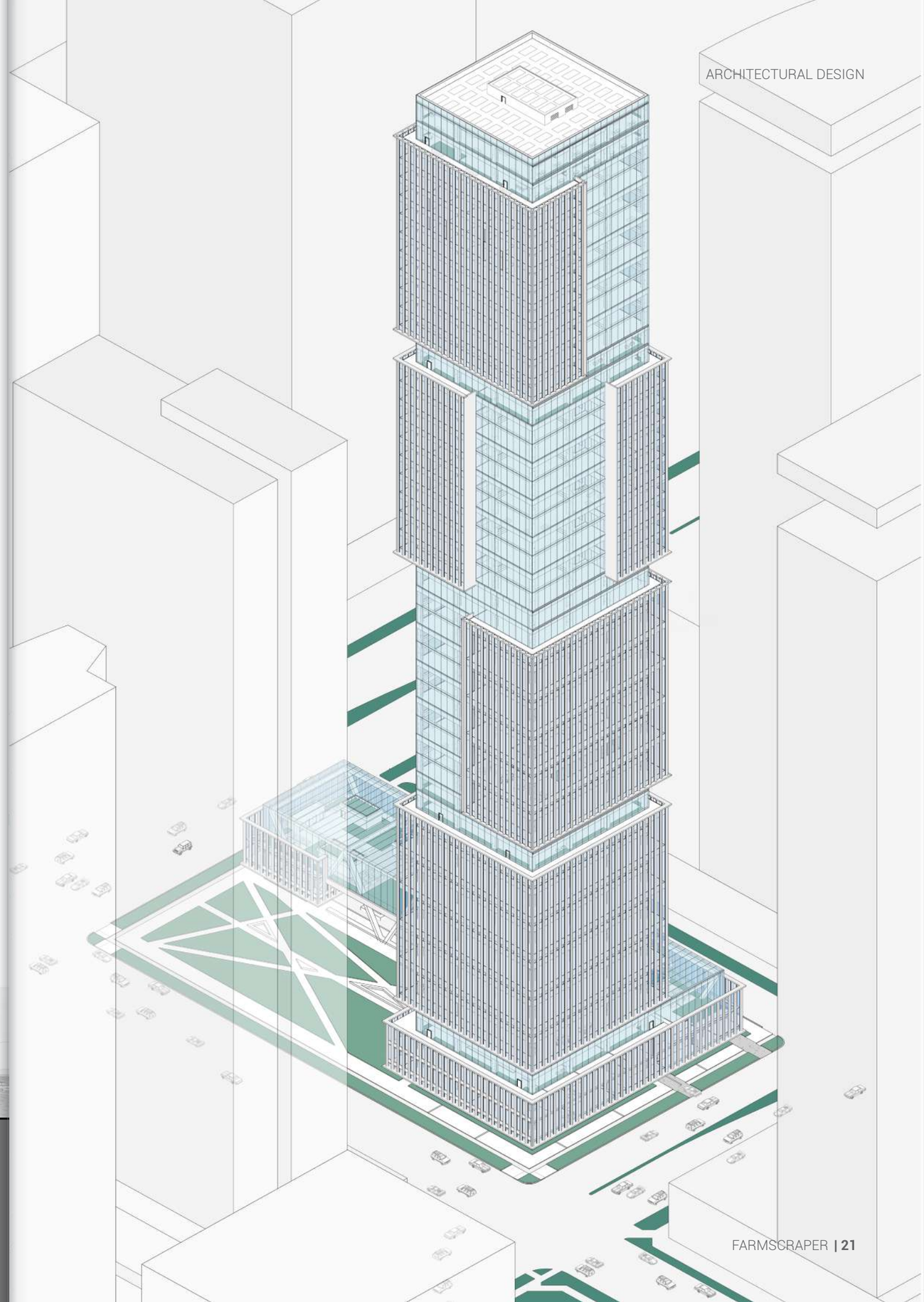
Public Plaza



Perspective Section







Hydroponic Farms

Open Plan Offices

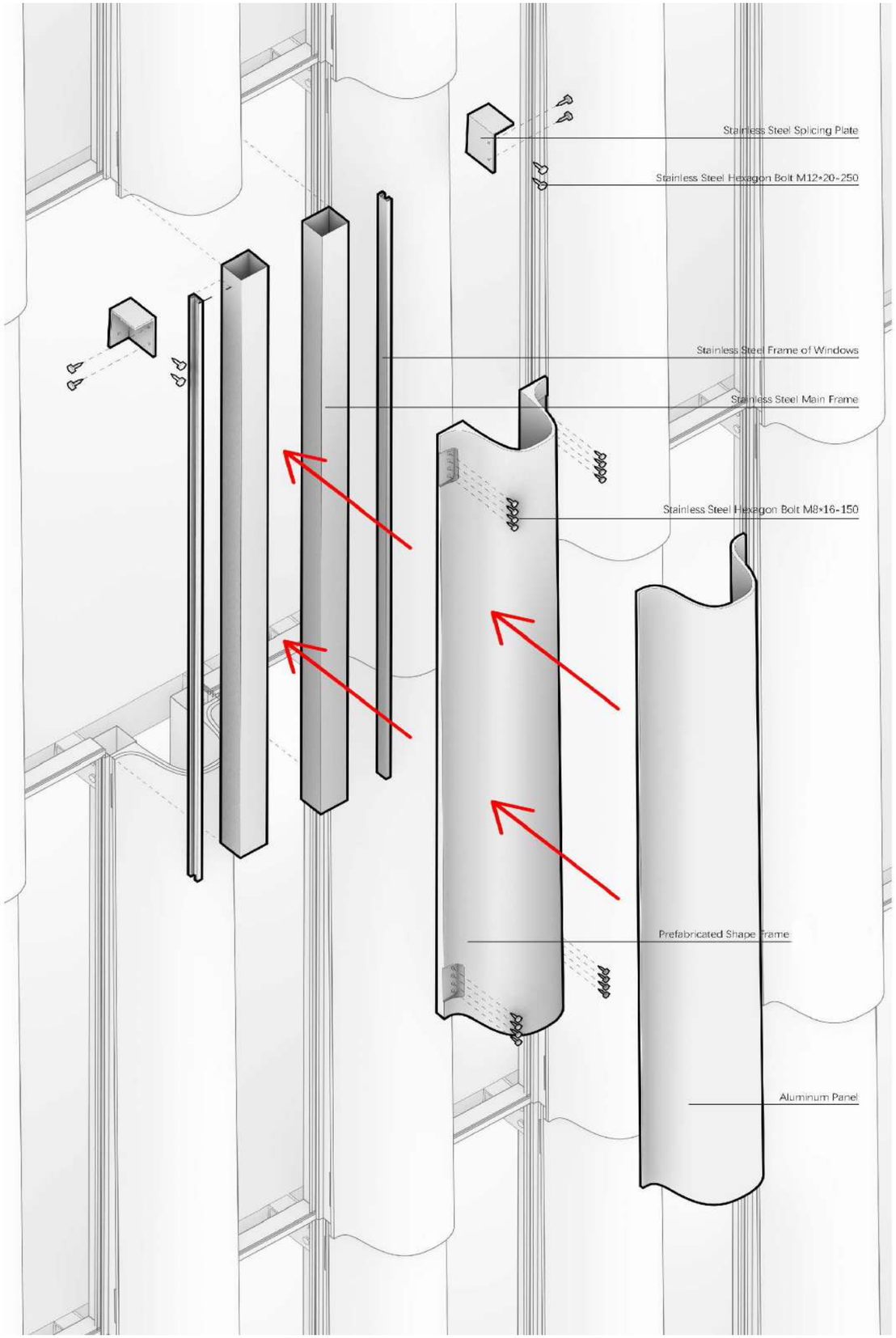


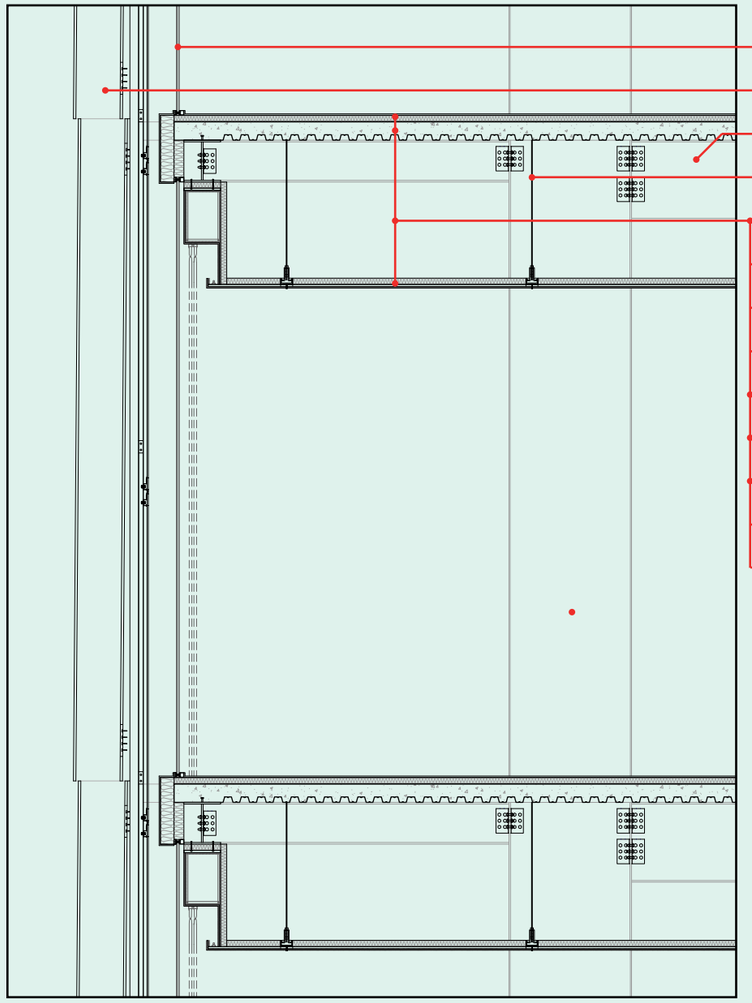

Open Market in Plaza

Green House Market

# CONSTRUCTION DETAIL

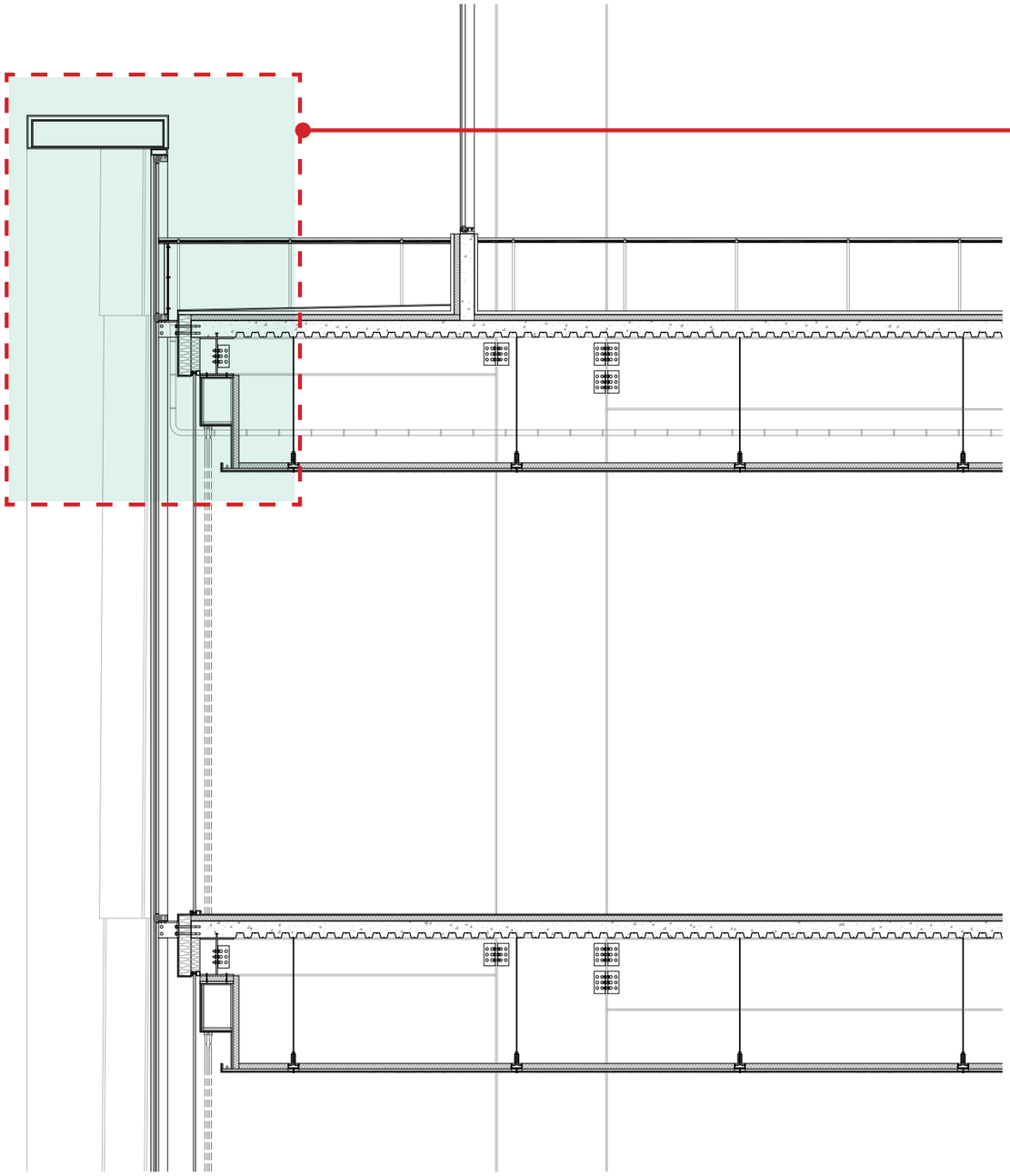
**DETAIL SECTION 1-50**



# CONSTRUCTION DETAIL

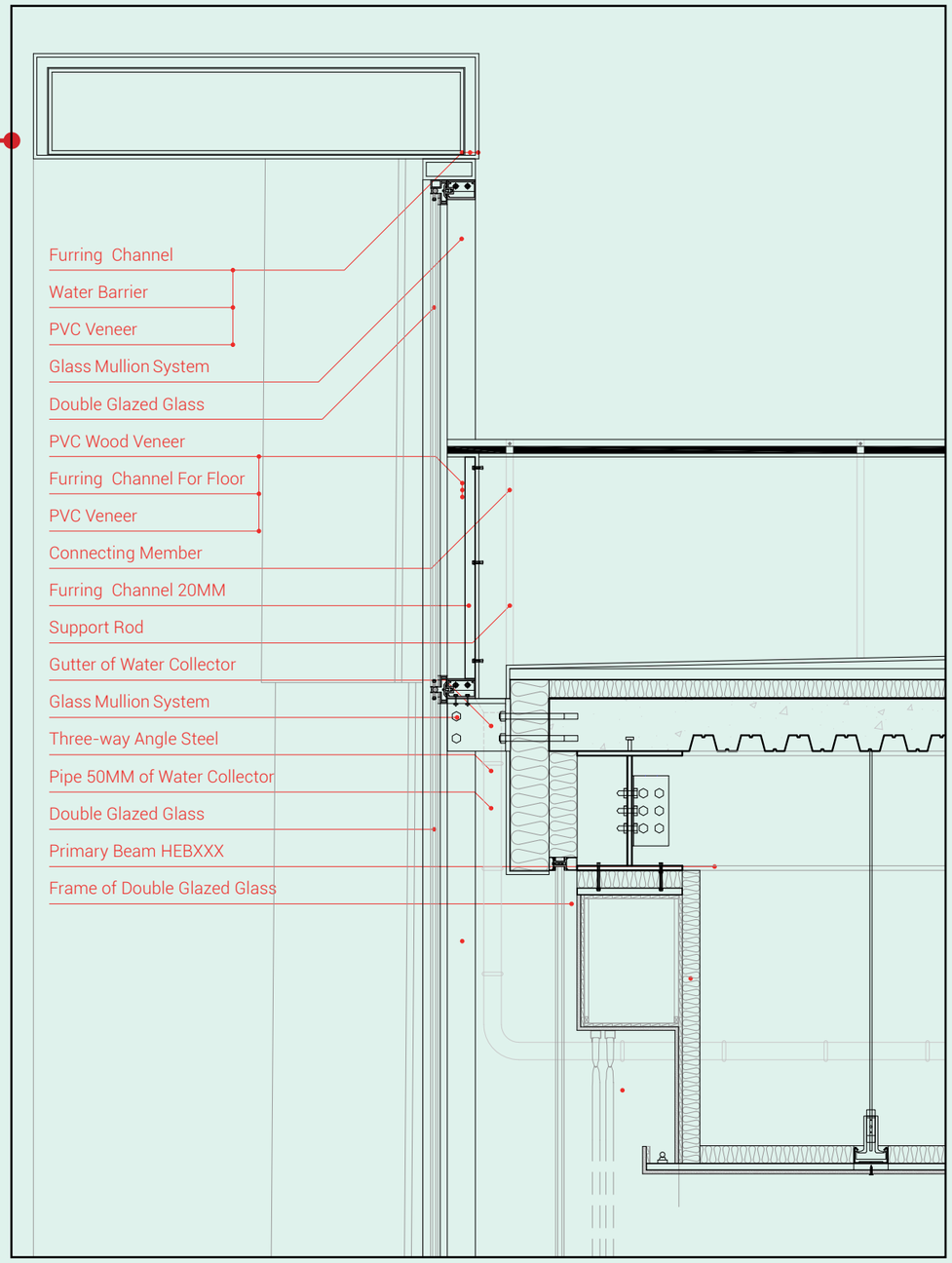
**DETAIL SECTION 1-50**

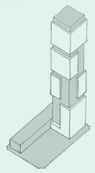






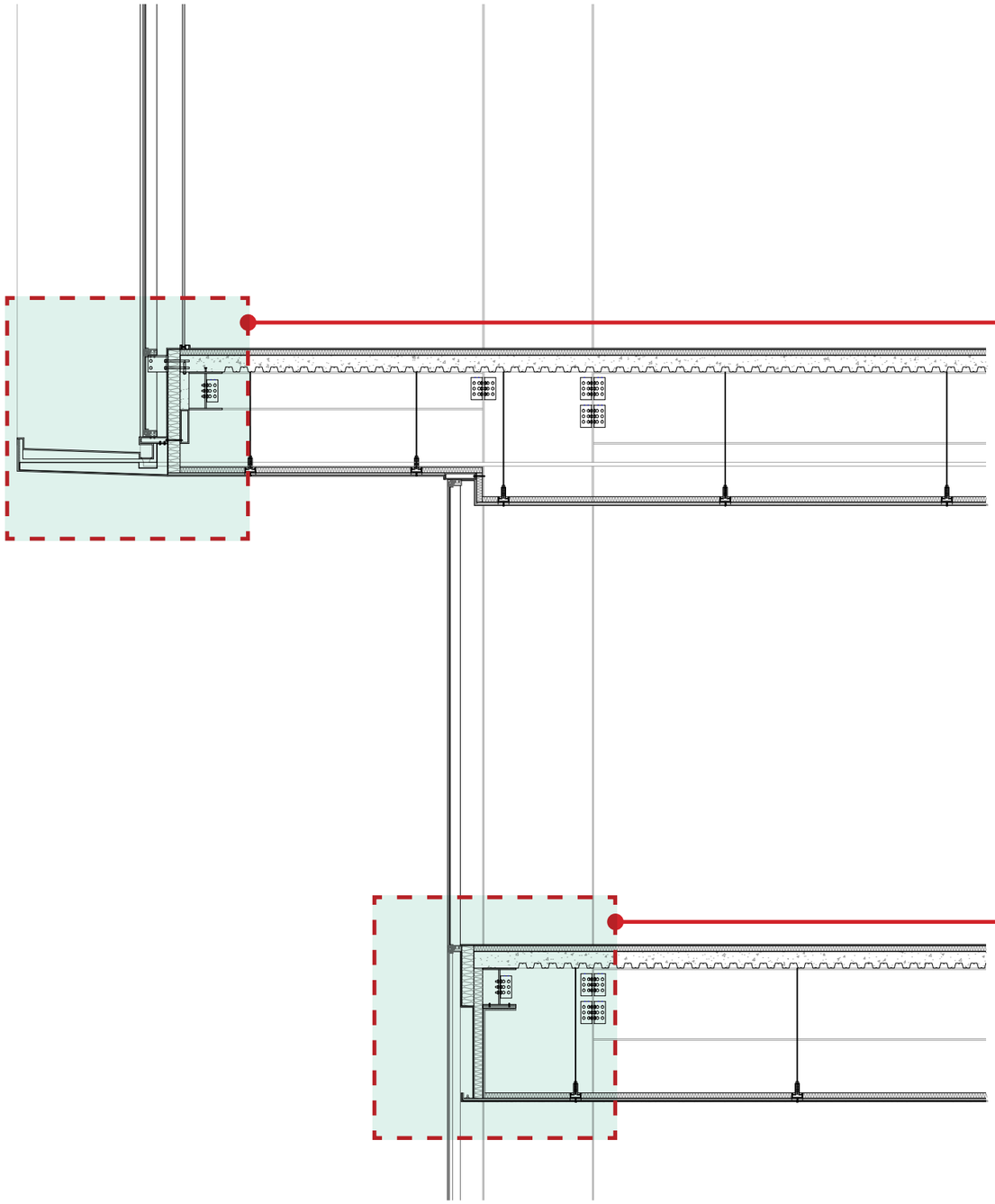
**DETAIL SECTION 1-15**



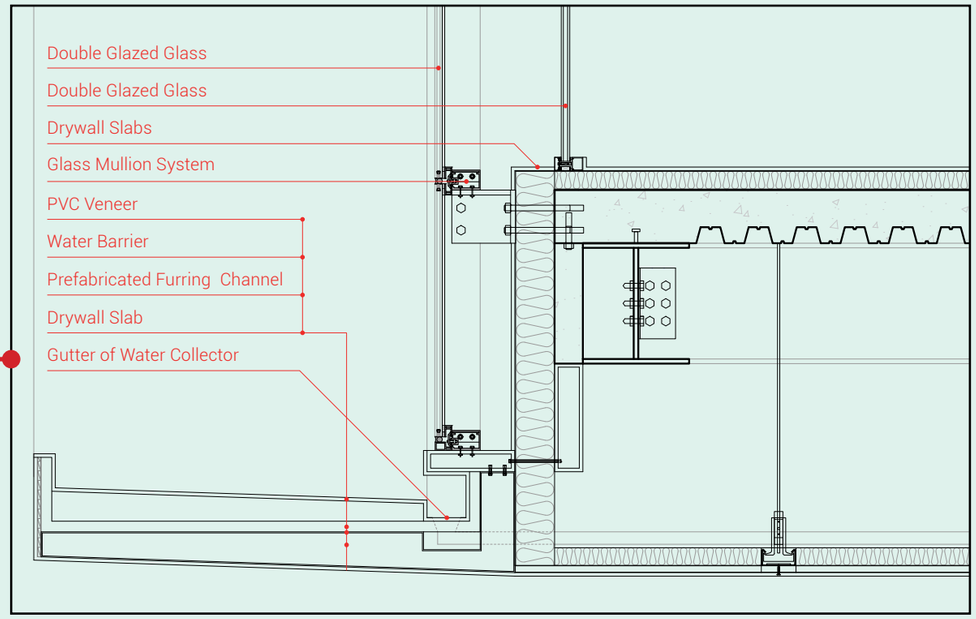
# CONSTRUCTION DETAIL

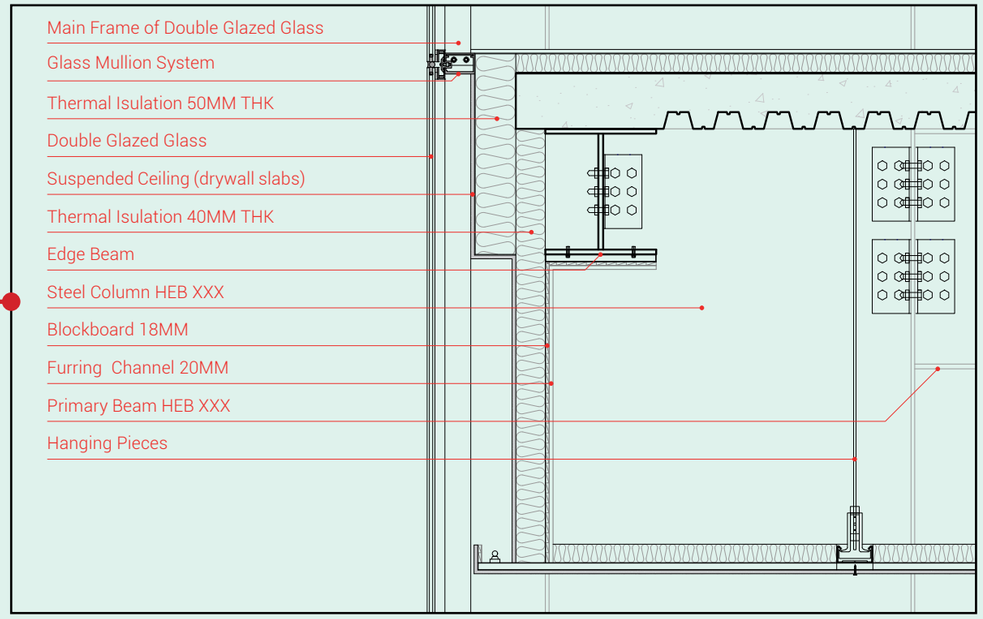
**DETAIL SECTION 1-50**

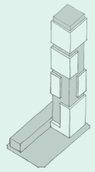




**DETAIL SECTION 1-15**



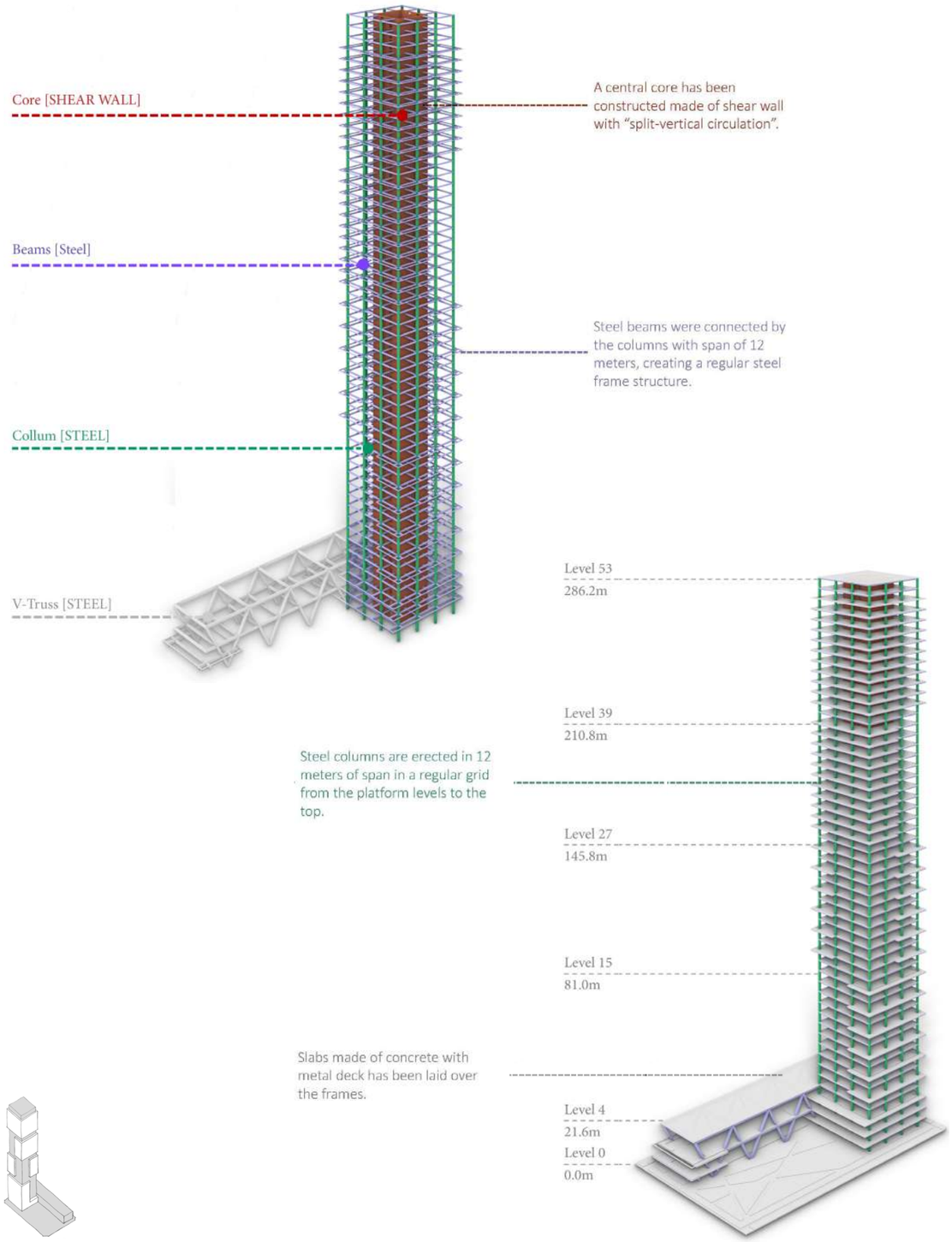



# STRUCTURAL SCHEME

## 3D BEHAVIOUR

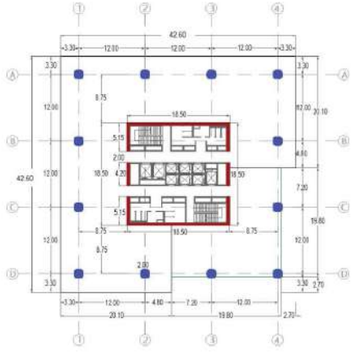
The structure of the tower is made up of regular steel column-beam frame with a central core made up of shear walls. For the typical floor beams, HE 650B has been used for principal beams and HE 340B is used for the secondary beams. For the pillars, King-cross column section of 2 HEB 1000 x 494 has been chosen.



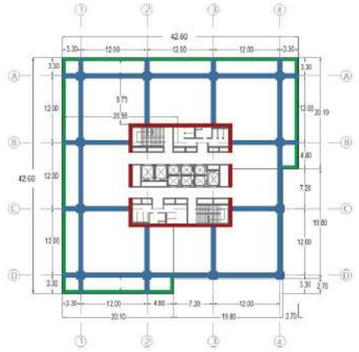




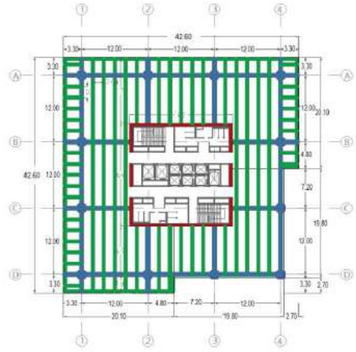

## TYPICAL FLOOR PLAN



COLUMN LAYOUT

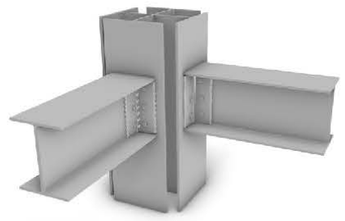


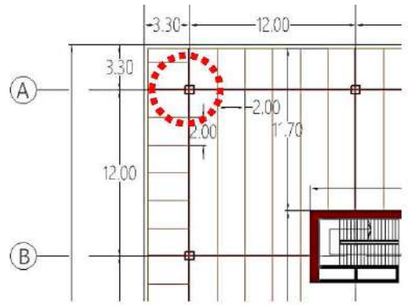
PRIMARY BEAM LAYOUT



SECONDARY BEAM LAYOUT

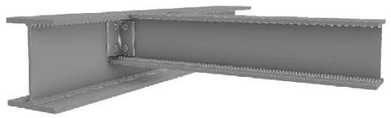
## PRIMARY BEAM TO COLUMN

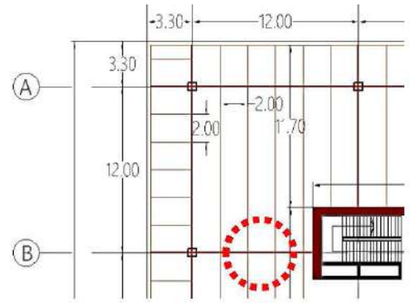





**Clip Angle Joint**- The primary beams are connected to the king-cross column by angles with bolts.

## PRIMARY BEAM TO SECONDARY BEAM

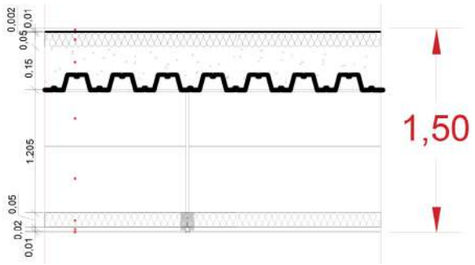





**Clip Angle Joint**- The connection between the two beams is made through onee or two angles.
"Clip Angle"joint is used when the secondary beam is perpendicular to the main beam.

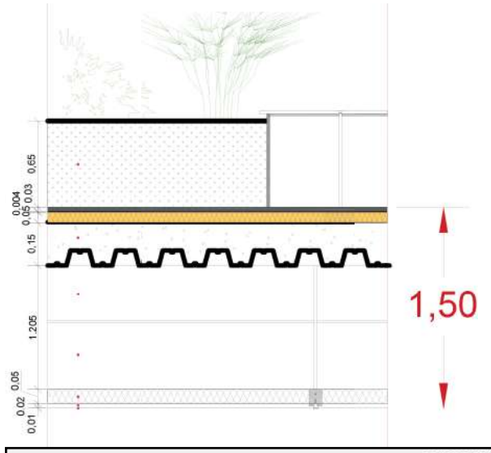
# SLAB DETAIL AND LOADING

## TYPICAL FLOOR SLAB




- FLOORING..... 10 mm
- GEO-TEXTILE FELT..... 2 mm
- THERMAL INSULATION..... 50 mm
- VAPOUR BARRIER..... 3 mm
- METAL DECK + CONCRETE COVER..... 150 mm
- SPACE FOR STRUCTURE & MEP.....1205 mm
- ACOUSTIC INSULATION.....50 mm
- SUPPORTING STEEL PROFILE.....20 mm
- SUSPENDED CEILING (drywall slabs).....10 mm

| TYPICAL FLOOR SLAB DETAIL | | | | | |
|---|---|---|---|---|---|
| Material | Height (mm) | Height (m) | Width (m) | Length (m) | Total Weight of the Material (kN/m2) |
| Flooring | 10 | 0.01 | 1 | 1 | 0.15 |
| Geo-textile Felt | 2 | 0.002 | 1 | 1 | 0.002 |
| Thermal Insulation | 50 | 0.05 | 1 | 1 | 0.25 |
| Vapor Barrier | 3 | 0.003 | 1 | 1 | 0 |
| Metal Deck + Concrete Cover | 150 | 0.15 | 1 | 1 | 2.5 |
| MEP | 1205 | 1.205 | 1 | 1 | 0 |
| Ceiling Construction (acoustic insulation + supporting steel profile + dry wall slab) | 80 | 0.08 | 1 | 1 | 0.3 |
| | | | | **TOTAL WEIGHT [ DEAD LOAD]** | **3.20** |




- VEGETATION..... -
- EARTH SUBSTRATE.....650 mm
- DRAINAGE LAYER..... 30 mm
- GEO-TEXTILE FELT..... 2 mm
- WATER INSULATION..... 3 mm
- THERMAL INSULATION..... 50 mm
- VAPOR BARRIER..... 3 mm
- METAL DECK + CONCRETE COVER..... 150 mm
- SPACE FOR STRUCTURE & MEP.....1205 mm
- ACOUSTIC INSULATION.....50 mm
- SUPPORTING STEEL PROFILE.....20 mm
- SUSPENDED CEILING (drywall slabs).....10 mm

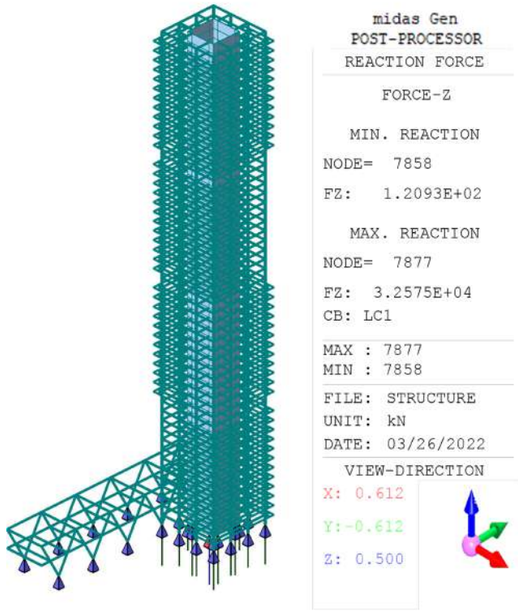
| RECREATIONAL FLOOR SLAB DETAIL | | | | | |
|---|---|---|---|---|---|
| Material | Height (mm) | Height (m) | Width (m) | Length (m) | Total Weight of the Material (kN/m2) |
| Vegetation | *varying | * | 1 | 1 | 6.25 |
| Earth Substrate | 650 | 0.65 | 1 | 1 | |
| Drainage Layer | 30 | 0.03 | 1 | 1 | 0.18 |
| Geo-textile Felt | 2 | 0.002 | 1 | 1 | 0 |
| Water Insulation | 3 | 0.003 | 1 | 1 | 0 |
| Thermal Insulation | 50 | 0.05 | 1 | 1 | 0.25 |
| Vapor Barrier | 3 | 0.003 | 1 | 1 | 0 |
| Metal Deck + Concrete Cover | 150 | 0.15 | 1 | 1 | 2.5 |
| MEP | 1205 | 1.205 | 1 | 1 | 0 |
| Ceiling Construction (acoustic insulation + supporting steel profile + dry wall slab) | 80 | 0.08 | 1 | 1 | 0.3 |
| | | | | **TOTAL WEIGHT** | **9.48** |



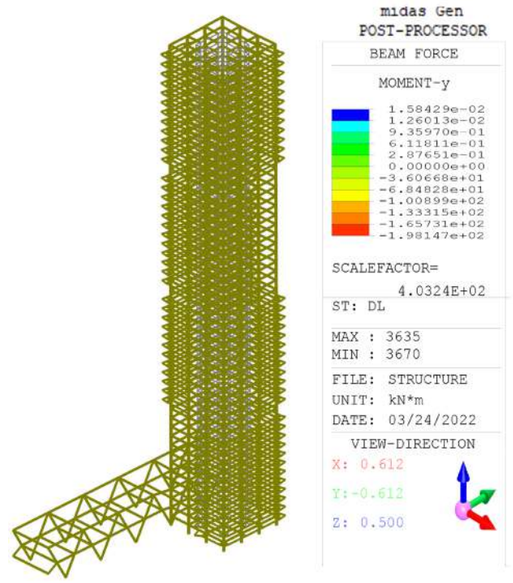


# STRUCTURAL ANALYSIS

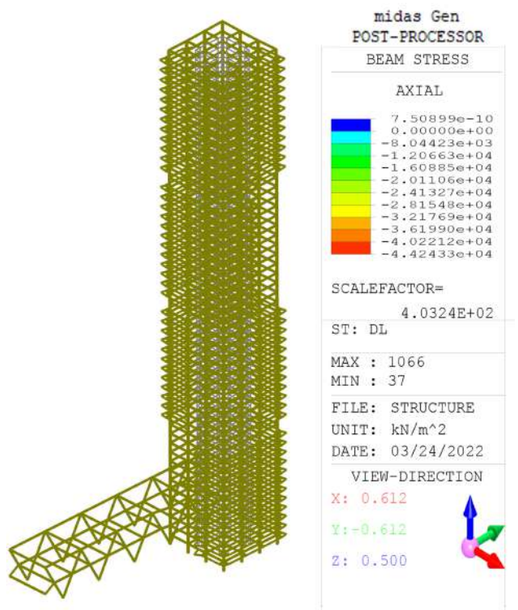
## MIDAS SIMULATION



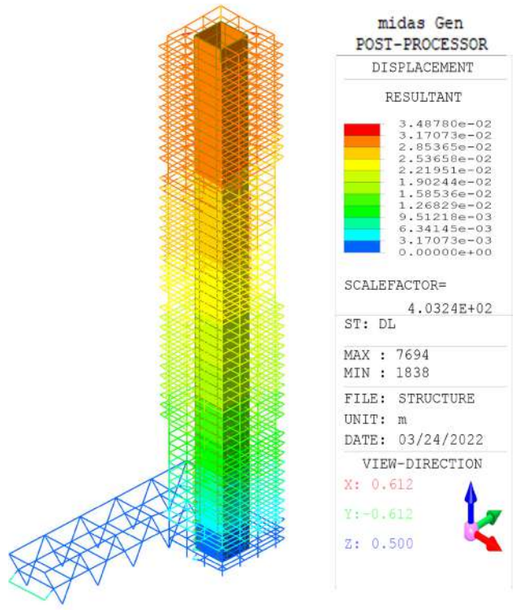

REACTION FORCE [Fmax = 32575 kN]




BEAM BENDING MOMENT [Mmax = 0.0158 kN.m]



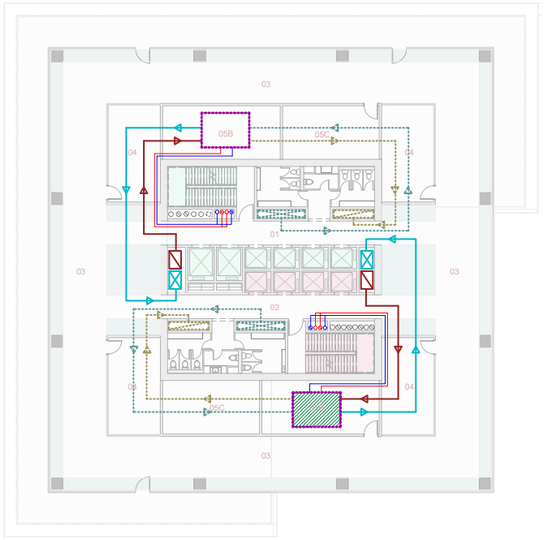

AXIAL LOAD [Fmax = 0.0158 kN/m2]




DISPLACEMENT ANALYSIS [Dmax = 0.0348 m]

# HVAC SYSTEMS

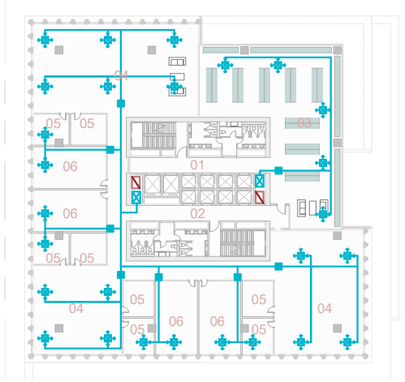
## DISTRIBUTION




LEVEL 15 - TR HVAC SERVICE FLOOR

- HWS RISER
- HWS DOWNER
- HWS PIPE LINE
- CHWS RISER
- CHWS DOWNER
- CHWS PIPELINE
- SUPPLY AIR DUCT
- RETURN AIR DUCT
- AIR EXHAUSTION DUCT
- SUPPLY AIR RISER
- RETURN AIR RISER
- AIR COLLECTION SHAFT
- AIR EXHAUSTION SHAFT
- AIR HANDING UNIT
- AIR HANDING UNIT (FARMING)

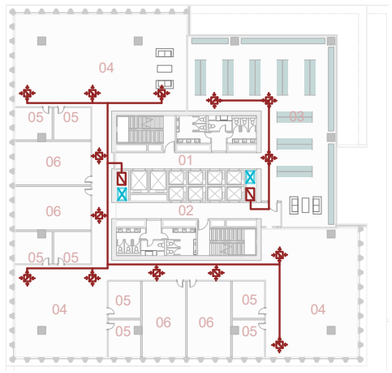
01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - CAFE / RESTAURANT
05 - MEP ROOM
A - BOOSTER PUMP ROOM
B - AHU ROOM
C - ELECTRICAL PANEL ROOM
06 - INDOOR TERRACE
07 - OUTDOOR TERRACE




LEVEL 19 - TB 02 HVAC AIR RETURN

- RETURN RISER
- RETURN GRILLS
- RETURN AIR DUCT

01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE
05 - WORK CUBICLES
06 - MEETING ROOM




LEVEL 19 - TB 02 HVAC AIR SUPPLY

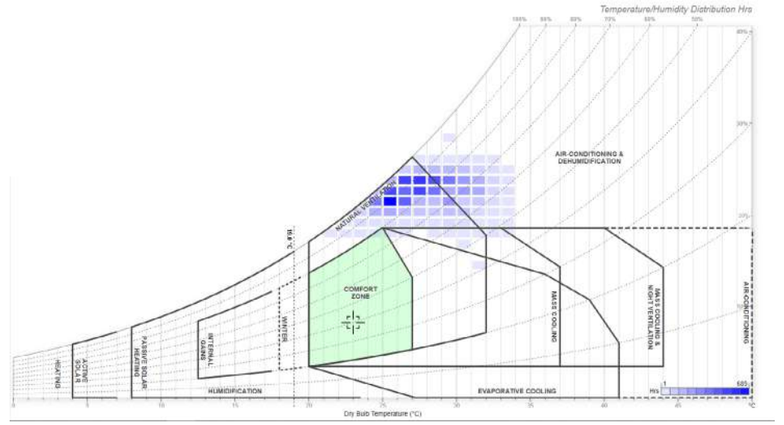
- SUPPLY RISER
- TERMINAL DIFFUSER
- SUPPLY AIR DUCT
- VAV UNIT

01 - FARM LOBBY
02 - OFFICE LOBBY
03 - FARMING AREA
04 - OPEN PLAN WORKSPACE
05 - WORK CUBICLES
06 - MEETING ROOM

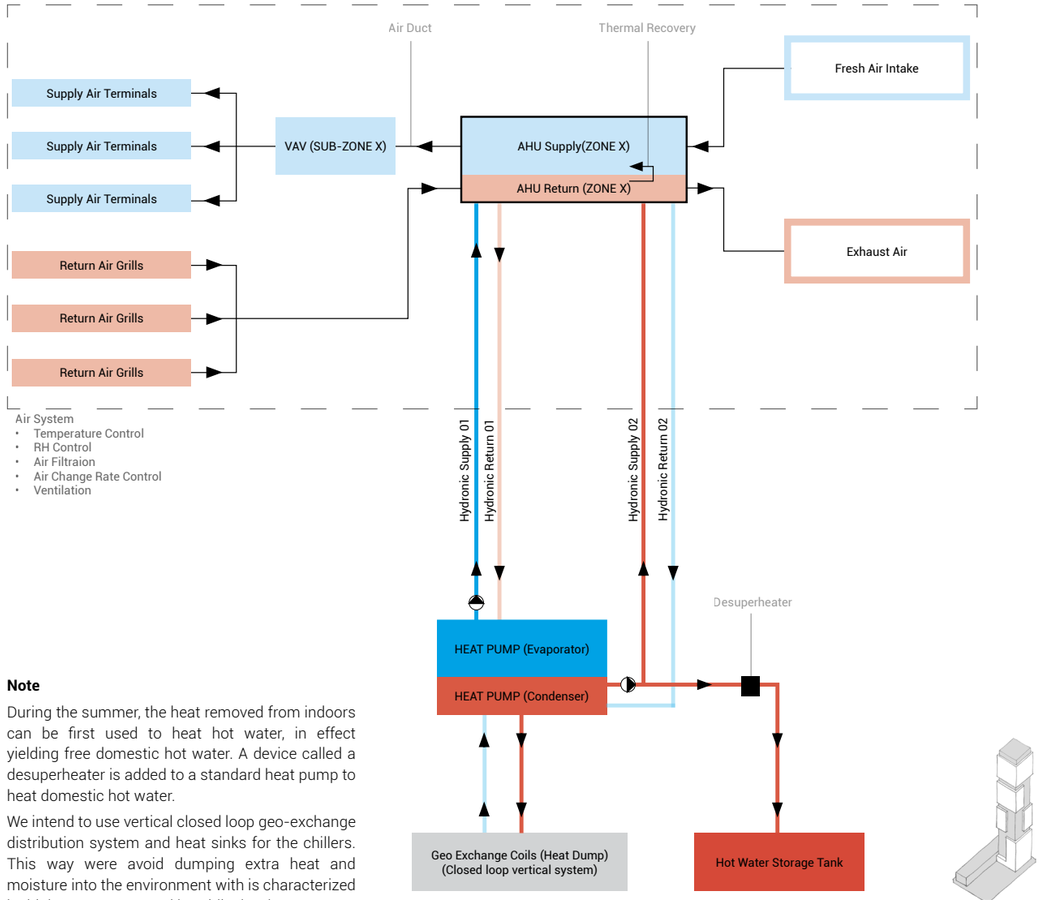




## PSYCHROMETRIC CHART



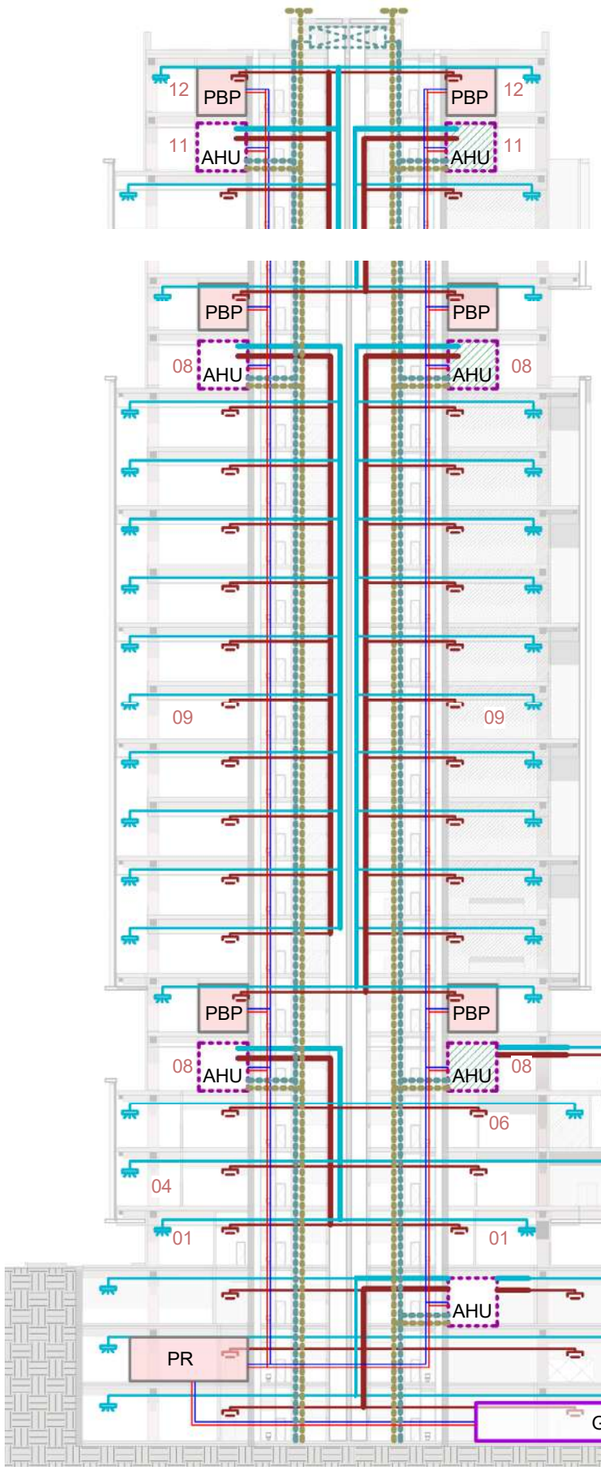

## HVAC SCHEME DIAGRAM




**Note**

During the summer, the heat removed from indoors can be first used to heat hot water, in effect yielding free domestic hot water. A device called a desuperheater is added to a standard heat pump to heat domestic hot water.

We intend to use vertical closed loop geo-exchange distribution system and heat sinks for the chillers. This way were avoid dumping extra heat and moisture into the environment with is characterized by high temperature and humidity levels.




01 - ENTRANCE LOBBY
02 - MEP ROOMS
- EQUIPMENT STORAGE
- CAR PARKING
03 - OPEN MARKET
04 - GYM & SPA
05 - CONFERENCE ROOMS
06 - SHOPS
07 - GREEN HOUSE PLAFORM
08 - RECREATIONAL FLOOR
09 - OFFICE
10 - INDOOR FARMING
11 - RESTAURANT
12 - PUBLIC OBSERVATORY

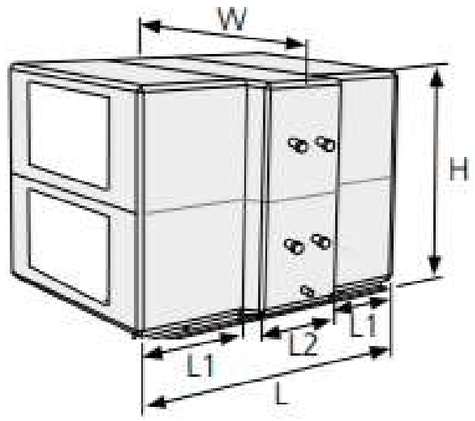
- HYDRONIC LINES
- SUPPLY AIR DUCT
- RETURN AIR DUCT
- AIR COLLECTION SHAFT
- AIR EXHAUSTION SHAFT
- AIR HANDLING UNIT
- AIR HANGLING UNIT (FARMING)
- PR — PUMP ROOM
- PBP — PRESSURE BOOSTER PUMP
- GSHP — GROUND SOURCE HEAT PUMP

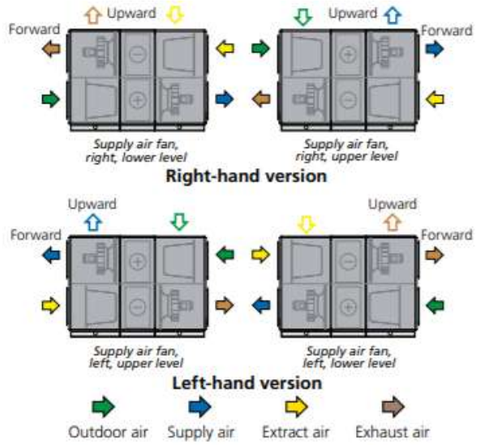
## SECTION HVAC DISTRIBUTION





## DUCT & PLANT SIZING




| AHU | | |
|---|---|---|
| Ventilation Loads (m3/h) | AHU Count Load per Unit AHU (m3/h) | |
| 300,084 | 11 | 27280.4 |
| | | |
| AHU Type | SWEGON - SILVER C CX (With coil heat exchanger) | |

Compact air handling unit SILVER C is an air handling unit where the vital functional components (fans, filters, heat exchangers) are integrated on site in the same casing. This provides quick and simple installation.

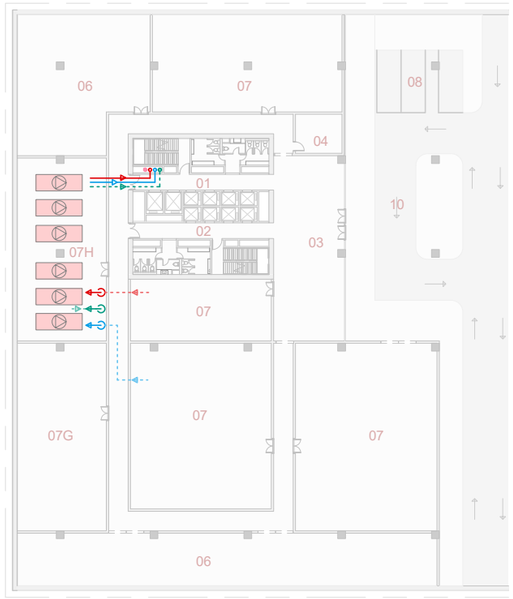
The SILVER_C_CX is a complete, one-piece air handling unit with coil heat exchangers, The coil heat exchanger is supplied in empty condition from the factory.

| SUPPLY DUCT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Qsensible (W) | m air (kg/s) | Airflow rate (m³/s) | c p,air | T air,amb,sp | T air,in | Air speed (m/s) | Cross section (m²) | Cross section of required duct (AHU Count - 11 units)(m²) |
| 0 | 100 | 83.4 | 1000 | 28 | 28.0 | 5 | 16.67 | 1.5 |
| | | | | | | | | |
| Supply Duct Size | | | | | | | | 1.0m X 1.5m |

| SILVER C CX | L | | L1 | | L2 | | W | H | | Min. | | ≤ SFP_2.0/200 Pa | | Max. | | Max. Ecodesign | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mm | kg | mm | kg | mm | kg | mm | mm | mm | m³/s | m³/h | m³/s | m³/h | m³/s | m³/h | m³/s | m³/h |
| 35 | 2719 | 1410-1524 | 948 | - | - | 766 | 2190 | 2085 | 1400x600 | 0.50 | 1800 | 3.78 | 13608 | 3.90 | 14040 | 3.88 | 13970 |
| 40 | 2719 | 1460-1574 | 948 | - | - | 766 | 2190 | 2085 | 1400x600 | 0.75 | 2700 | 3.90 | 14040 | 3.90 | 14040 | 3.90 | 14040 |
| 50 | 2956 | 1887-2011 | 1050 | - | - | 1007 | 2518 | 2353 | 1600x800 | 1.00 | 3600 | 5.00 | 18000 | 5.00 | 18000 | 5.00 | 18000 |
| 60 | 2956 | 1967-2091 | 1050 | - | - | 1007 | 2518 | 2353 | 1600x800 | 1.00 | 3600 | 5.95 | 21420 | 6.50 | 23400 | 6.02 | 21670 |
| 70 | 3454 | 2797-2949 | 1275 | - | - | 1317 | 2837 | 2740 | 1800x1000 | 1.50 | 5400 | 7.30 | 26280 | 7.50 | 27000 | 7.48 | 26930 |
| 80 | 3454 | 2897-3173 | 1275 | - | - | 1317 | 2837 | 2740 | 1800x1000 | 1.50 | 5400 | 8.00 | 28800 | 9.50 | 34200 | 7.86 | 28300 |
| 100 | 3396 | 4374-4734 | - | 1183-1363 | 1144 | - | 3540 | 3440 | 2400x1200 | 1.50 | 5400 | 11.00 | 39600 | 11.00 | 39600 | 11.00 | 39600 |
| 120 | 3396 | 4580-5002 | - | 1286-1597 | 1144 | - | 3540 | 3440 | 2400x1200 | 2.50 | 9000 | 11.70 | 42120 | 14.00 | 50400 | 12.68 | 45650 |

# WATER SUPPLY

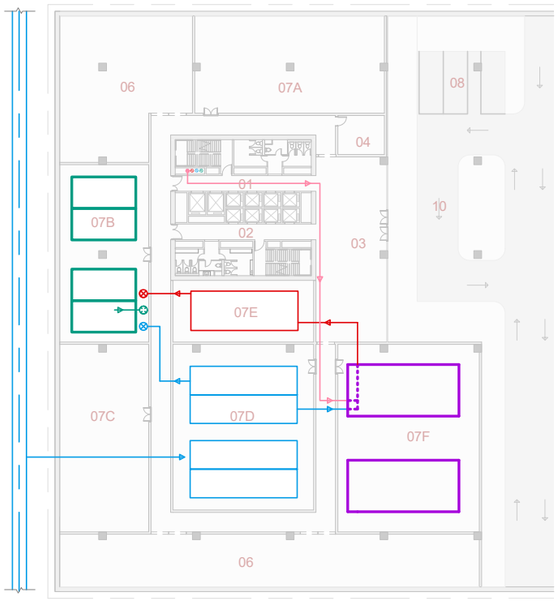
## SERVICE FLOORS




- HW RECIRCULATION DOWNER
- HW RISER
- COLD WATER RISER
- AUXILIARY WATER RISER
- PIPE RISE
- PIPE DROP
- HOT WATER LINES
- COLD WATER LINES
- AUXILIARY WATER LINES
- PUMP ROOM

01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - INFO POINT
05 - STORAGE
06 - FARM STORAGE
07 - MEP ROOM
A - WATER TREATMENT PLANT
B - AUXILIARY WATER TANK
C - FIRE WATER TANK
D - MAIN WATER TANK
E - HOT WATER TANK
F - HEAT PUMP
G - WATER FILTRATION ROOM
H - PUMP ROOM
08 - VAN PARKING
09 - CAR PARKING
10 - DROP-OFF POINT

**LEVEL -2 - PHE SUPPLY**



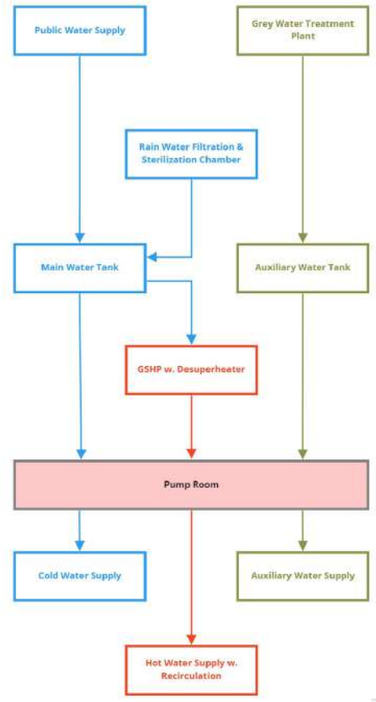

- HW RECIRCULATION DOWNER
- PIPE RISE
- PIPE DROP
- HW RECIRCULATION LINE
- HOT WATER LINES
- COLD WATER LINES
- AUXILIARY WATER LINES
- PUBLIC WATER SUPPLY
- HOT WATER TANK
- MAIN WATER TANK
- AUXILIARY WATER TANK
- HEAT PUMP (CONDENSER COIL + DESUPERHEATER)

01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - INFO POINT
05 - STORAGE
06 - FARM STORAGE
07 - MEP ROOM
A - WATER TREATMENT PLANT
B - AUXILIARY WATER TANK
C - FIRE WATER TANK
D - MAIN WATER TANK
E - HOT WATER TANK
F - HEAT PUMP
G - WATER FILTRATION ROOM
H - PUMP ROOM
08 - VAN PARKING
09 - CAR PARKING
10 - DROP-OFF POINT

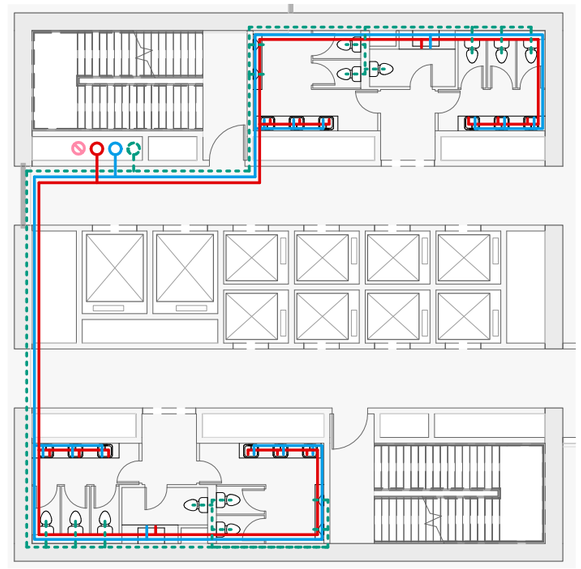
**LEVEL -3 - PHE SUPPLY**








## SUPPLY SCHEME




## TYPICAL WATER SUPPLY PLAN

## GENERAL CALCULATIONS

| Cold Water Supply | | | | | |
|---|---|---|---|---|---|
| | Units | Loading Units | Max. LU | Pipe Size (da x s)(mm) | Pipe Size (di)(mm) |
| Washbasin | 14 | 1 | 14 | 26 X 3 | 20 |
| Total Units | 14 | 1 | 14 | **26 X 3** | **20** |

| Hot Water Supply | | | | | |
|---|---|---|---|---|---|
| | Units | Loading Units | Max. LU | Pipe Size (da x s)(mm) | Pipe Size (di)(mm) |
| Washbasin | 14 | 1 | 14 | 26 X 3 | 20 |
| Total Units | 14 | 1 | 14 | **26 X 3** | **20** |

| Auxiliary Water Supply | | | | | |
|---|---|---|---|---|---|
| | Units | Loading Units | Max. LU | Pipe Size (da x s)(mm) | Pipe Size (di)(mm) |
| WC | 12 | 1 | 12 | 26 X 3 | 20 |
| Urinals | 4 | 3 | 12 | 26 X 3 | 20 |
| Total Units | 16 | 4 | 24 | **32 X 3** | **26** |

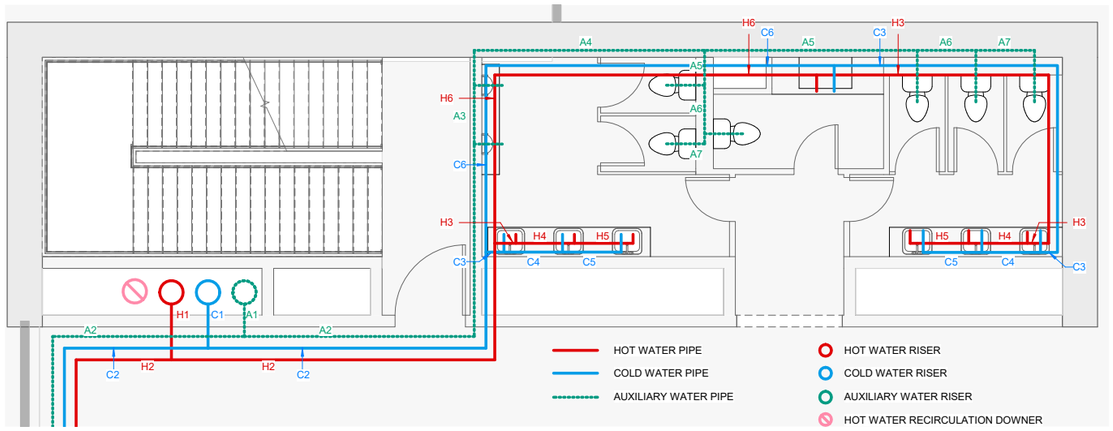
# WATER SUPPLY

## PIPE SIZING

| Pipe No. | Pipe Material | Pipe Size (da x s)(mm) |
|---|---|---|
| **Hot Water** | | |
| Main Pipe | Stainless steel (Ni – Cr) | 26 X 3 |
| H1 | Stainless steel (Ni – Cr) | 26 X 3 |
| H2 | Stainless steel (Ni – Cr) | 20 X 2.5 |
| H3 | Stainless steel (Ni – Cr) | 16 X 2 |
| H4 | Stainless steel (Ni – Cr) | 16 X 2 |
| H5 | Stainless steel (Ni – Cr) | 16 X 2 |
| H6 | Stainless steel (Ni – Cr) | 16 X 2 |

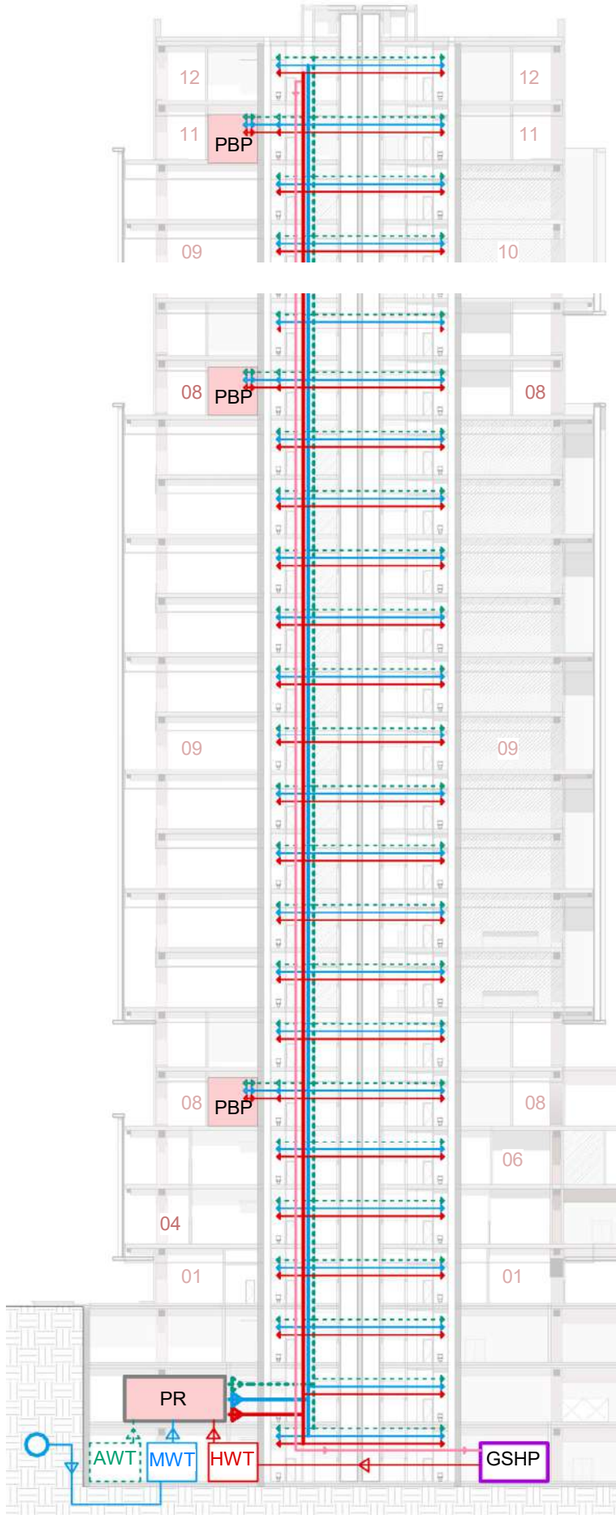
| Pipe No. | Pipe Material | Pipe Size (da x s)(mm) |
|---|---|---|
| **Cold Water** | | |
| Main Pipe | Stainless steel (Ni – Cr) | 26 X 3 |
| C1 | Stainless steel (Ni – Cr) | 26 X 3 |
| C2 | Stainless steel (Ni – Cr) | 20 X 2.5 |
| C3 | Stainless steel (Ni – Cr) | 16 X 2 |
| C4 | Stainless steel (Ni – Cr) | 16 X 2 |
| C5 | Stainless steel (Ni – Cr) | 16 X 2 |
| C6 | Stainless steel (Ni – Cr) | 16 X 2 |

| Pipe No. | Pipe Material | Pipe Size (da x s)(mm) |
|---|---|---|
| **Auxiliaray Water Supply** | | |
| Main Pipe | Stainless steel (Ni – Cr) | 32 X 3 |
| A1 | Stainless steel (Ni – Cr) | 32 X 3 |
| A2 | Stainless steel (Ni – Cr) | 26 X 3 |
| A3 | Stainless steel (Ni – Cr) | 20 x 2.5 |
| A4 | Stainless steel (Ni – Cr) | 18 x 2 |
| A5 | Stainless steel (Ni – Cr) | 16 X 2 |
| A6 | Stainless steel (Ni – Cr) | 16 X 2 |
| A7 | Stainless steel (Ni – Cr) | 16 X 2 |







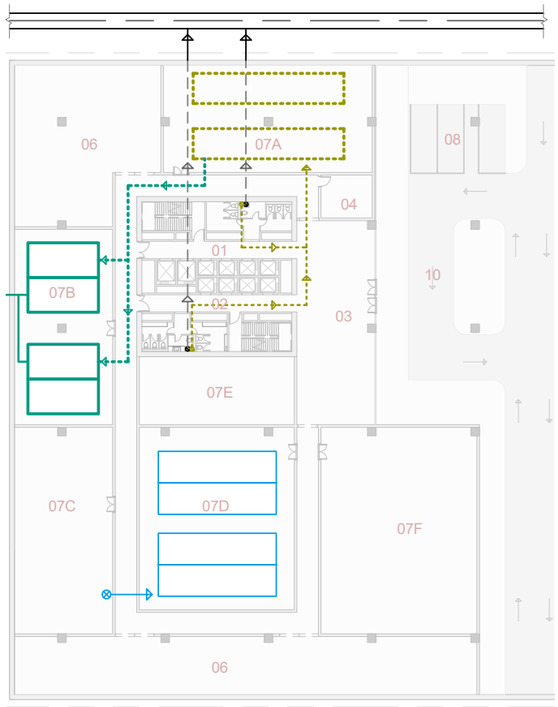

01 - ENTRANCE LOBBY
02 - MEP ROOMS
- EQUIPMENT STORAGE
- CAR PARKING
03 - OPEN MARKET
04 - GYM & SPA
05 - CONFERENCE ROOMS
06 - SHOPS
07 - GREEN HOUSE PLAFORM
08 - RECREATIONAL FLOOR
09 - OFFICE
10 - INDOOR FARMING
11 - RESTAURANT
12 - PUBLIC OBSERVATORY

PUBLIC WATER SUPPLY
HOT WATER RECIRCULATION DOWNER
HOT WATER SUPPLY
COLD WATER SUPPLY
AUXILIARY WATER SUPPLY
HWT HOT WATER TANK
MWT MAIN WATER TANK
AWT AUXILIARY WATER TANK
GSHP GROUND SOURCE HEAT PUMP
PR PUMP ROOM
PBP PRESSURE BOOSTER PUMP

**SECTION WATER SUPPLY**

# DRAINAGE

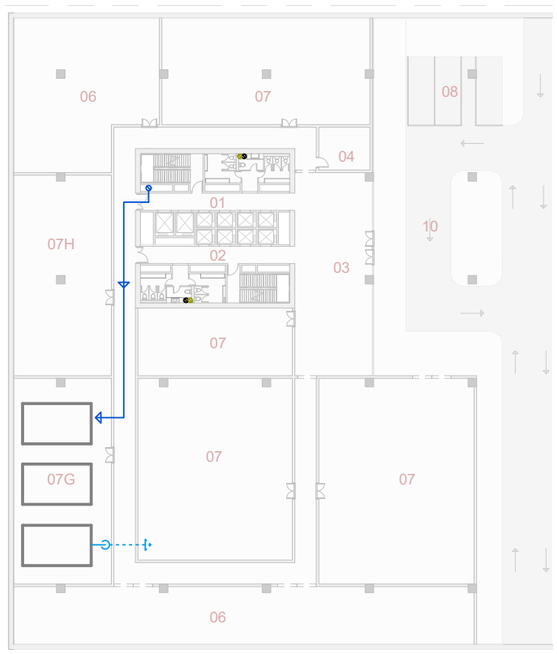
## SERVICE FLOORS




- GREY WATER DOWNER
- BLACK WATER DOWNER
- PIPE RISE
- PIPE DROP
- GREY WATER LINES
- BLACK WATER LINES
- AUXILIARY WATER LINES
- COLD WATER LINES
- WATER TREATMENT PLANT
- MUNICIPAL SEWAGE LINES
- AUXILIARY WATER TANK
- MAIN WATER TANK

01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - INFO POINT
05 - STORAGE
06 - FARM STORAGE
07 - MEP ROOM
A - WATER TREATMENT PLANT
B - AUXILIARY WATER TANK
C - FIRE WATER TANK
D - MAIN WATER TANK
E - HOT WATER TANK
F - HEAT PUMP
G - WATER FILTRATION ROOM
H - PUMP ROOM
08 - VAN PARKING
09 - CAR PARKING
10 - DROP-OFF POINT

### LEVEL -3 - PHE DRAINAGE



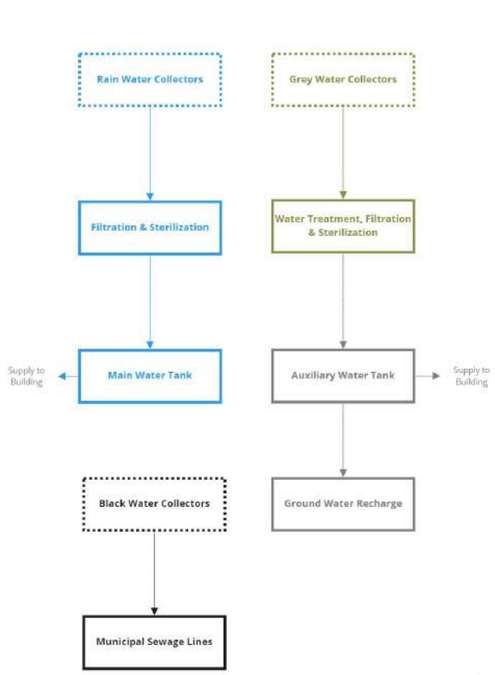

- RAIN WATER DOWNER
- GREY WATER DOWNER
- BLACK WATER DOWNER
- PIPE RISE
- PIPE DROP
- RAIN WATER LINES
- COLD WATER LINES
- WATER FILTRATION & STERILIZATION

01 - FARM CORE
02 - OFFICE CORE
03 - LOBBY
04 - INFO POINT
05 - STORAGE
06 - FARM STORAGE
07 - MEP ROOM
A - WATER TREATMENT PLANT
B - AUXILIARY WATER TANK
C - FIRE WATER TANK
D - MAIN WATER TANK
E - HOT WATER TANK
F - HEAT PUMP
G - WATER FILTRATION ROOM
H - PUMP ROOM
08 - VAN PARKING
09 - CAR PARKING
10 - DROP-OFF POINT

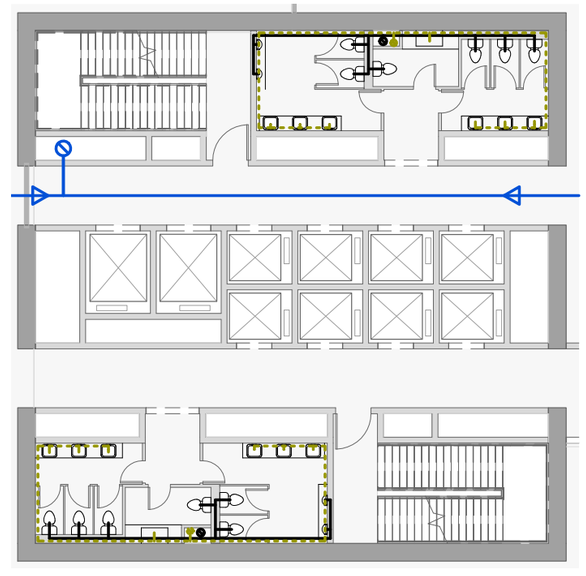
### LEVEL -2 - PHE DRAINAGE








### DRAINAGE SCHEME




### LEVEL 19- TB 02 PHE DRAINAGE

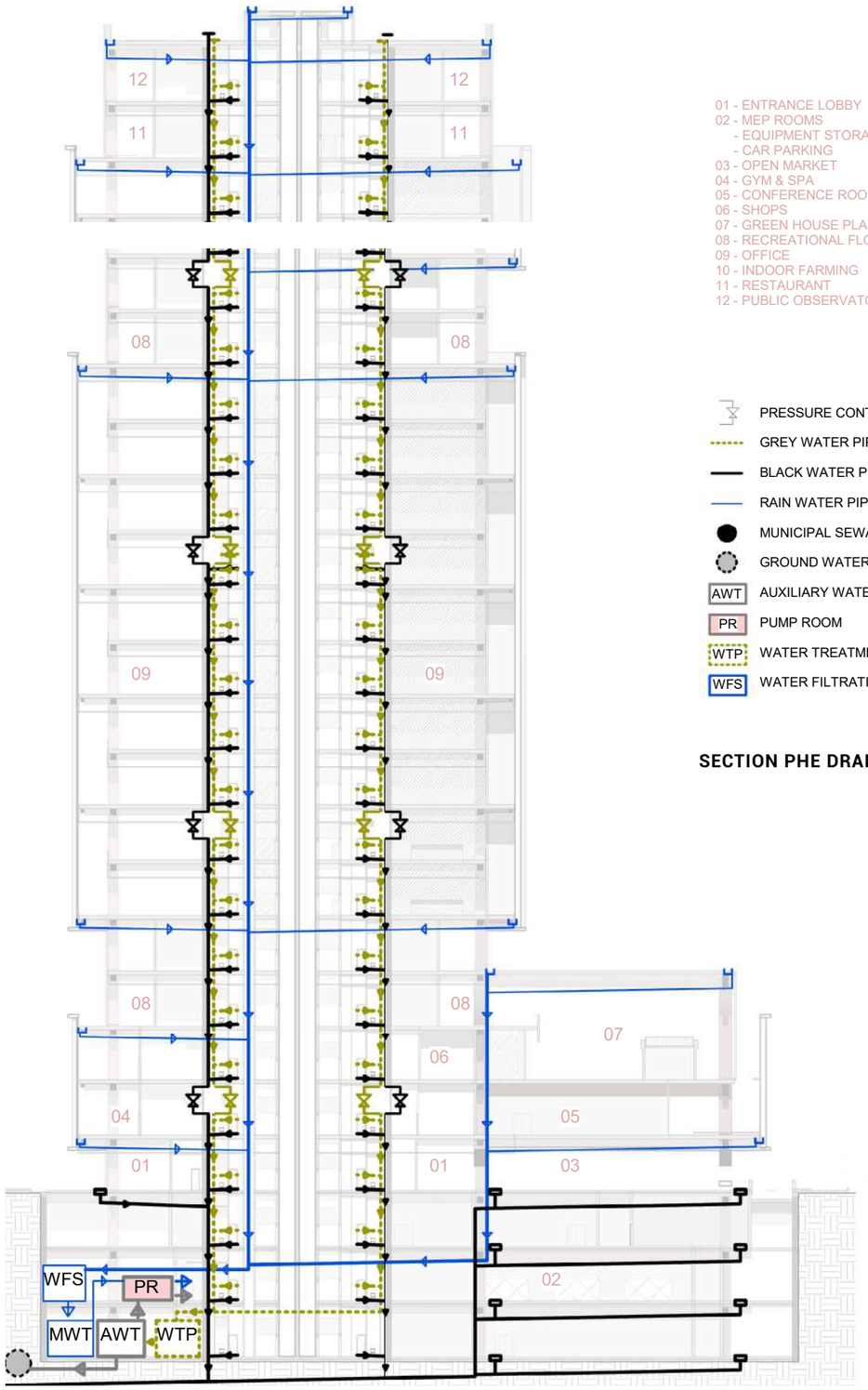
### GENERAL CALCULATIONS

| Grey Water - Drainage | | | | | |
|---|---|---|---|---|---|
| | Units | Discharge Units | Max. DU | Frequency factor | Qmax |
| Washbasin | 7 | 0.3 | 2.1 | 0.5 | 0.72 |
| Total Units | 7 | 0.3 | 2.1 | 0.5 | 0.72 |
| DN | | | | | DN 50 |

| Black Water - Drainage | | | | | |
|---|---|---|---|---|---|
| | Units | Discharge Units | Max. DU | Frequency factor | Qmax |
| WC | 6 | 2 | 12 | 0.5 | 1.73 |
| Total Units | 6 | 2 | 12 | 0.5 | 1.73 |
| DN | | | | | DN 70 |

# DRAINAGE

## SERVICE FLOORS




01 - ENTRANCE LOBBY
02 - MEP ROOMS
- EQUIPMENT STORAGE
- CAR PARKING
03 - OPEN MARKET
04 - GYM & SPA
05 - CONFERENCE ROOMS
06 - SHOPS
07 - GREEN HOUSE PLAFORM
08 - RECREATIONAL FLOOR
09 - OFFICE
10 - INDOOR FARMING
11 - RESTAURANT
12 - PUBLIC OBSERVATORY

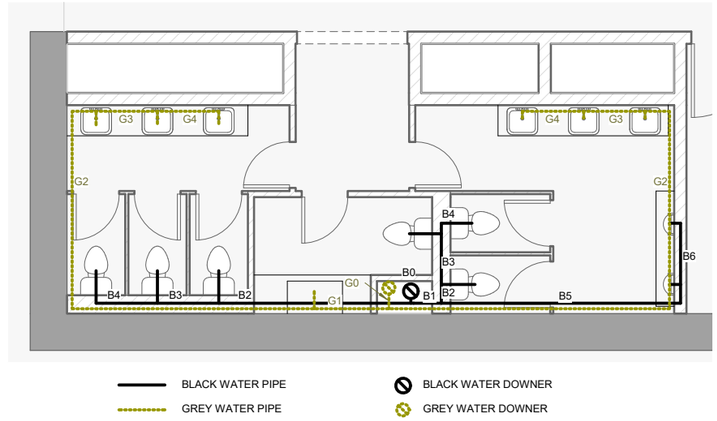
- PRESSURE CONTROL VALVES
- GREY WATER PIPELINES
- BLACK WATER PIPELINES
- RAIN WATER PIPELINES
- MUNICIPAL SEWAGE LINES
- GROUND WATER RECHARGE
- AWT — AUXILIARY WATER TANK
- PR — PUMP ROOM
- WTP — WATER TREATMENT PLANT
- WFS — WATER FILTRATION AND STERILIZATION

**SECTION PHE DRAINAGE**





## PIPE SIZING




- BLACK WATER PIPE
- GREY WATER PIPE
- BLACK WATER DOWNER
- GREY WATER DOWNER

**TYPICAL BLOCK PHE DRAINAGE**

| Pipe No. | Pipe Material | Pipe Size |
|---|---|---|
| **Grey Water** | | |
| Main Gray Water Pipe | PVC | DN 50 |
| G0 | PVC | DN 50 |
| G1 | PVC | DN 50 |
| G2 | PVC | DN 40 |
| G3 | PVC | DN 30 |
| G4 | PVC | DN 30 |

**Grey Water Downer Stacking Sequence**

Level 52 - 46 - DN 100
Level 45 - 36 - DN 150
Level 35 - 25 - DN 200
Level 24 - 01 - DN 250
Level 00 - -3 - DN 300

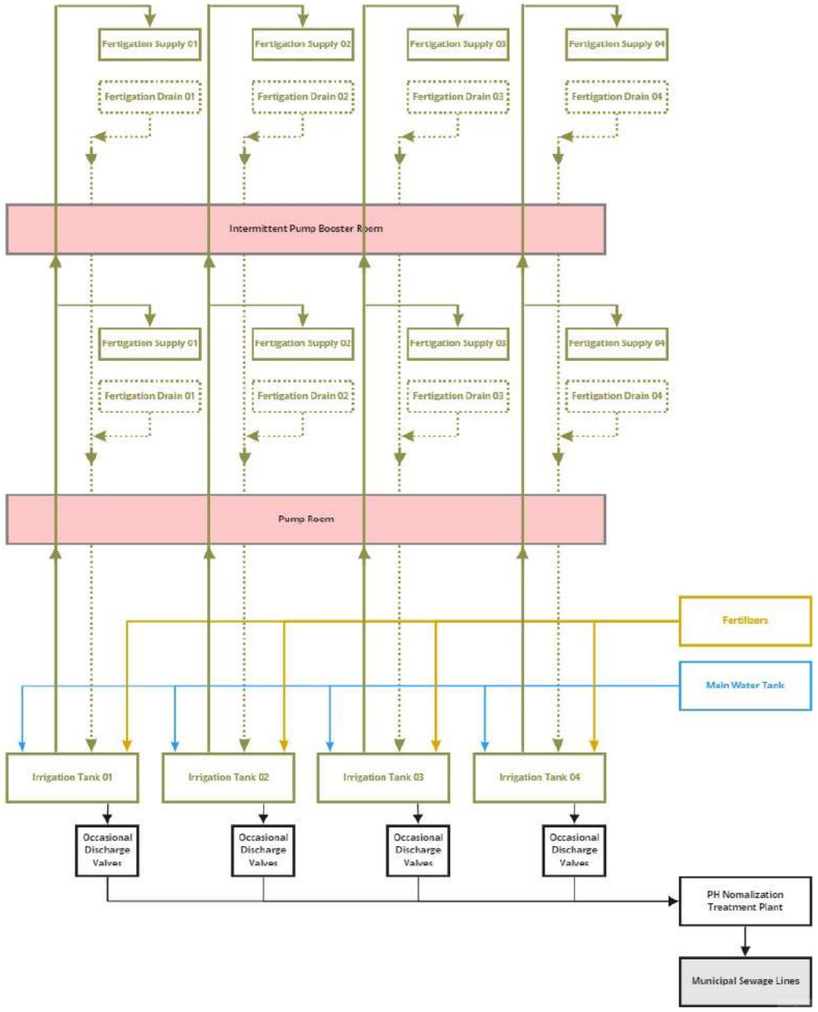
| Pipe No. | Pipe Material | Pipe Size |
|---|---|---|
| **Black Water** | | |
| Main Black Water Pipe | PVC | DN 70 |
| B0 | PVC | DN 70 |
| B1 | PVC | DN 60 |
| B2 | PVC | DN 60 |
| B3 | PVC | DN 50 |
| B4 | PVC | DN 50 |
| B5 | PVC | DN 40 |
| B6 | PVC | DN 30 |

**Grey Water Downer Stacking Sequence**

Level 52 - 50 - DN 100
Level 49 - 46 - DN 150
Level 45 - 41 - DN 200
Level 40 - 32 - DN 250
Level 31 - -3 - DN 300

# FERTIGATION

## SCHEMATIC DIAGRAM




## WHY HYDROPONICS?

- No need for soil (less structural loads)
- No pests
- No erosion / nutrient loss
- Used Indoor
- High yield
- Recycled water / nutrients

## PRE-REQUISITES

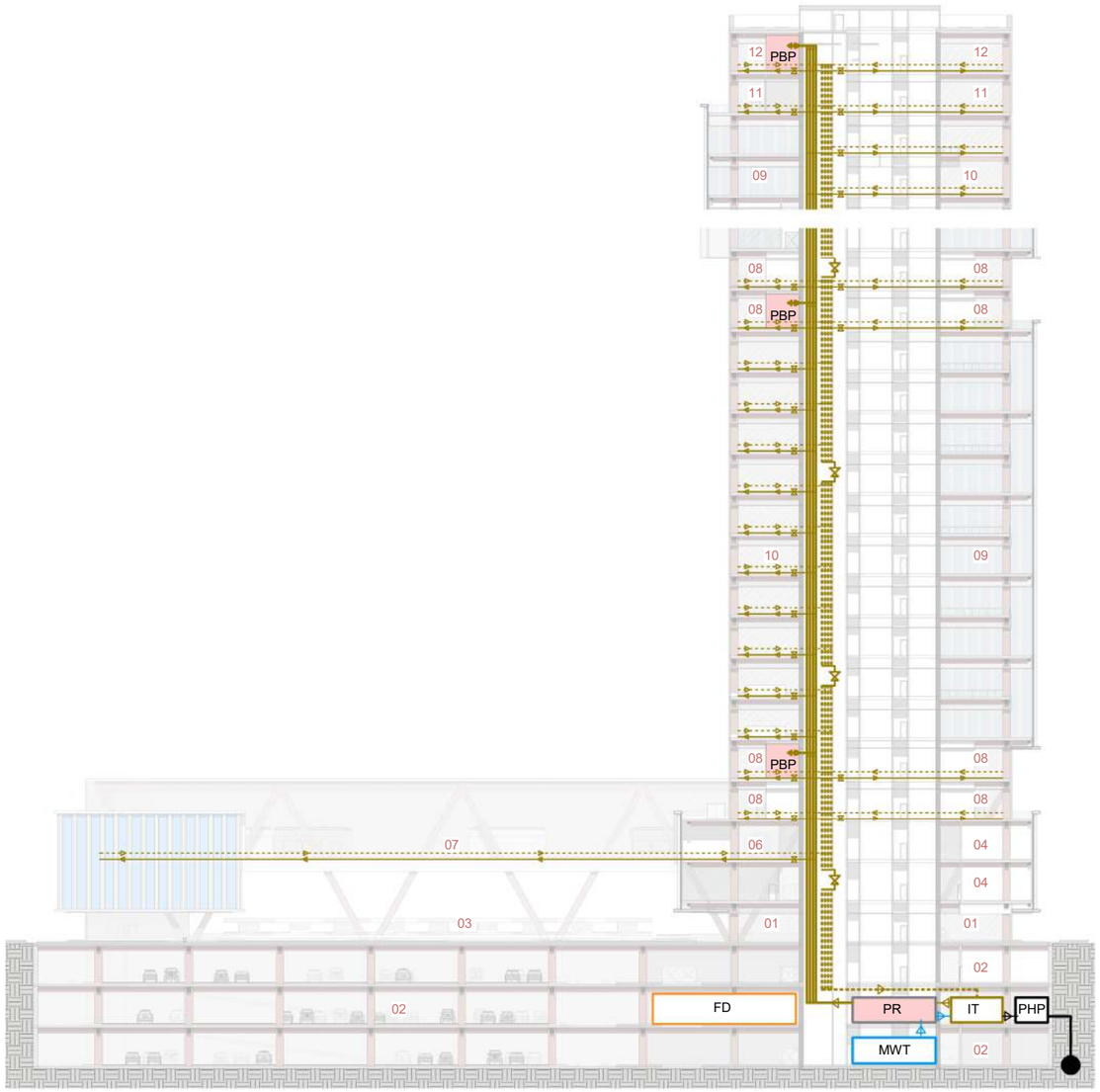
Four Irrigation Tanks are provided, with valves controls on every floor, allowing for substantial variability in the resulting composition of the nutrients supplied. Hydroponic crops require more technology and precision than a conventional ones. Some of these systems include:

- Conductivity meters
- pH meters
- Lighting
- Air Control





## SECTION - DISTRIBUTION ROUTE




FLOW VALVE
PRESSURE CONTROL VALVE
IRRIGATION RISER
IRRIGATION DOWNER
IRRIGATION SUPPLY LINES
IRRIGATION RETURN LINES
PR PUMP ROOM

PBP PRESSURE BOOSTER PUMP
IRRIGATION TANKS
MAIN WATER TANK
PH TREATMENT PLANT
FERTILIZER DEPOT
MUNICIPAL SEWAGE LINE

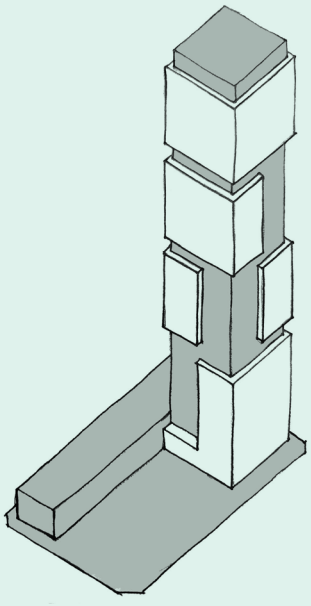
01 - ENTRANCE LOBBY
02 - MEP ROOMS
- EQUIPMENT STORAGE
- CAR PARKING
03 - OPEN MARKET
04 - GYM & SPA
05 - CONFERENCE ROOMS
06 - SHOPS
07 - GREEN HOUSE PLAFORM
08 - RECREATIONAL FLOOR
09 - OFFICE
10 - INDOOR FARMING
11 - RESTAURANT
12 - PUBLIC OBSERVATORY





RECREATIONAL AREAS

PUBLIC PODIUM - GREEN HOUSE MARKET



# FARMSCRAPER

MSc Building Architecture

Politecnico di Milano

Project Type - Multi-Use, Highrise.

Location - Central Business District, Singapore