An- Najah National University

Faculty of Engineering & Information Technology

Building Engineering Department

Graduation Project II

An Integrated Redesign of Al-Wafa'a Elderly Home in Nablus City

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Ismail Al Jabi

30/12/2021

Under Supervision of:

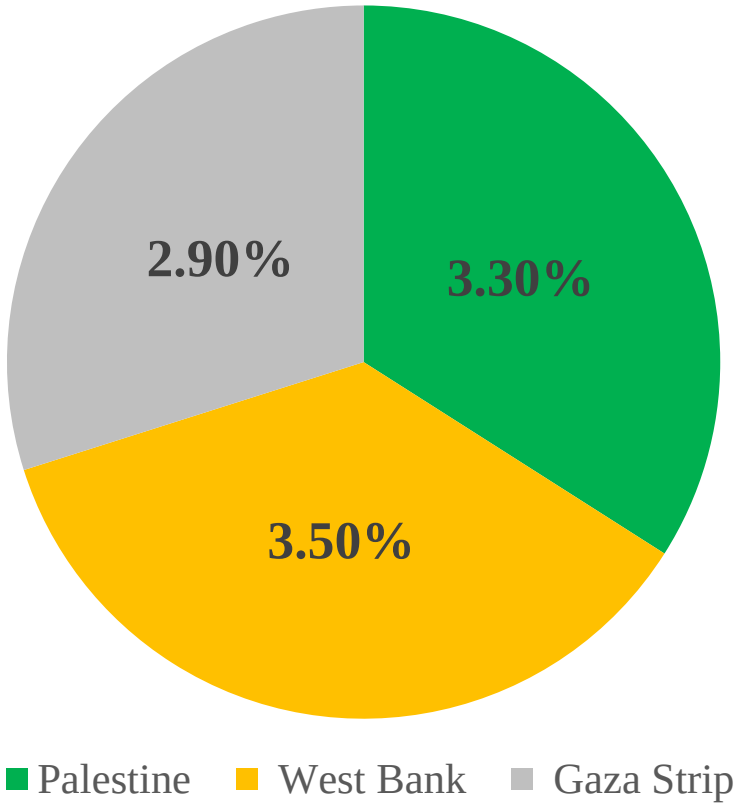
Eng.Haitham Sawalha

Contents:

Introduction

Introduction:

Percentage of elderly people whose age above 65 years.



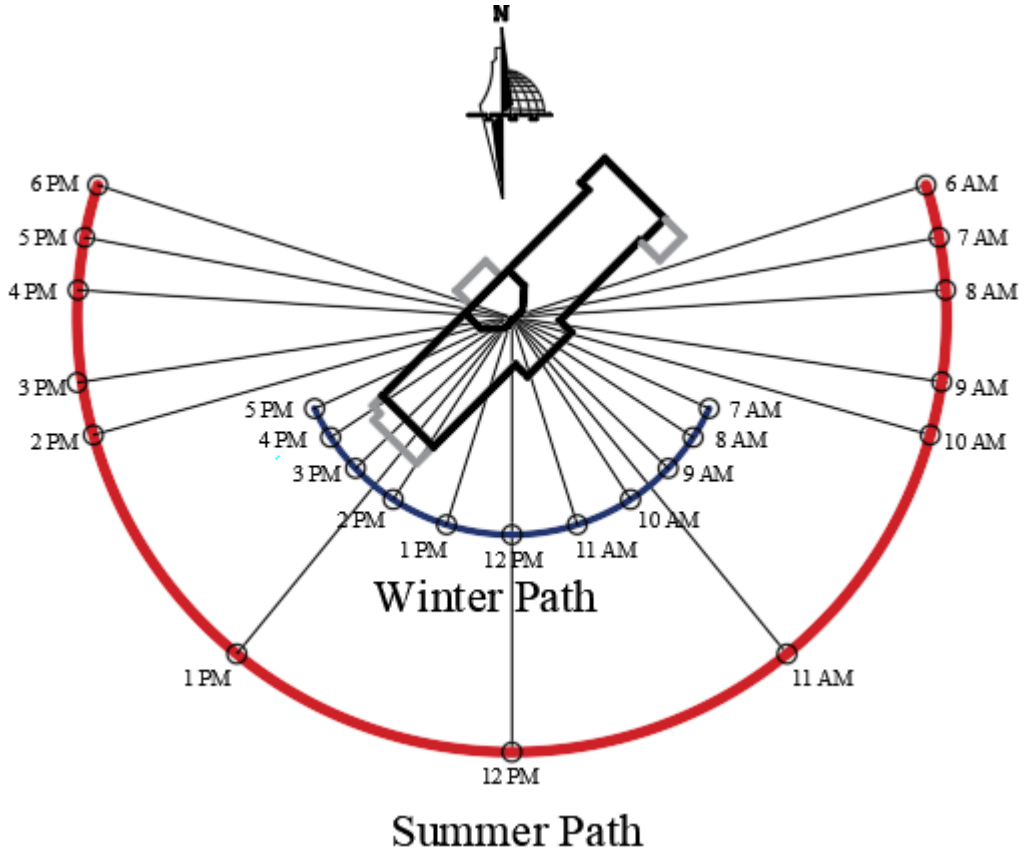
Introduction:

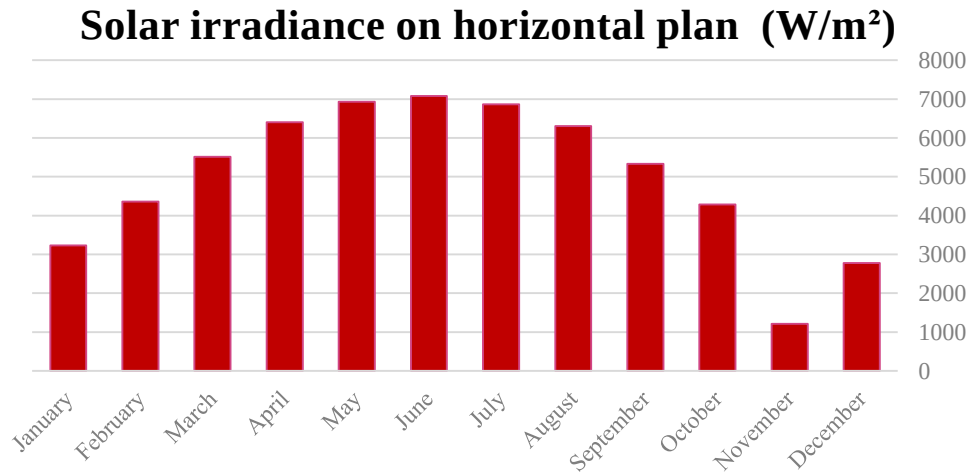
Site analysis

❑ Location:

- ❑Aerial distance to the earliest elderly home → 2.5 km
- Aerial distance to Nablus city center → 1.85 km
- ❑Aerial distance to the earliest police station→ 1.63 km
- ❑Aerial distance to the earliest fire station→ 1.56 km
- ❑Aerial distance to the earliest health center → 1.10 km

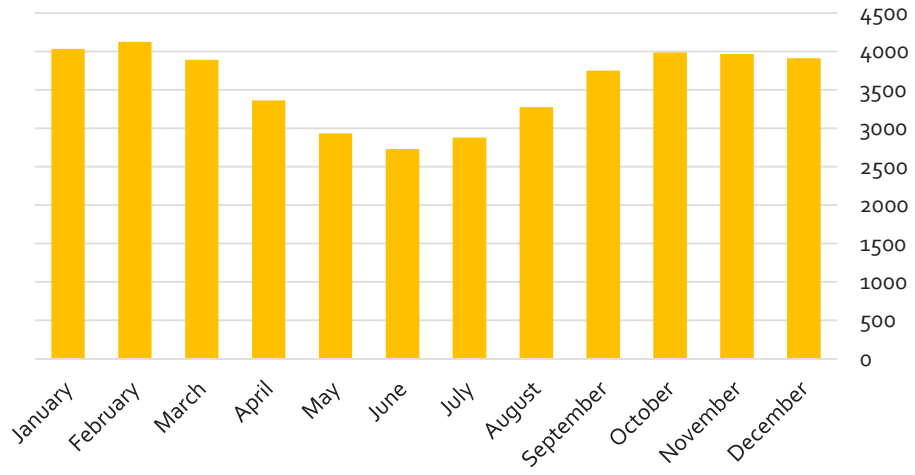
❑ Sun path:


N
6 PM
5 PM
4 PM
3 PM
2 PM
1 PM
12 PM
11 AM
10 AM
9 AM
8 AM
7 AM
6 AM
Winter Path
Summer Path

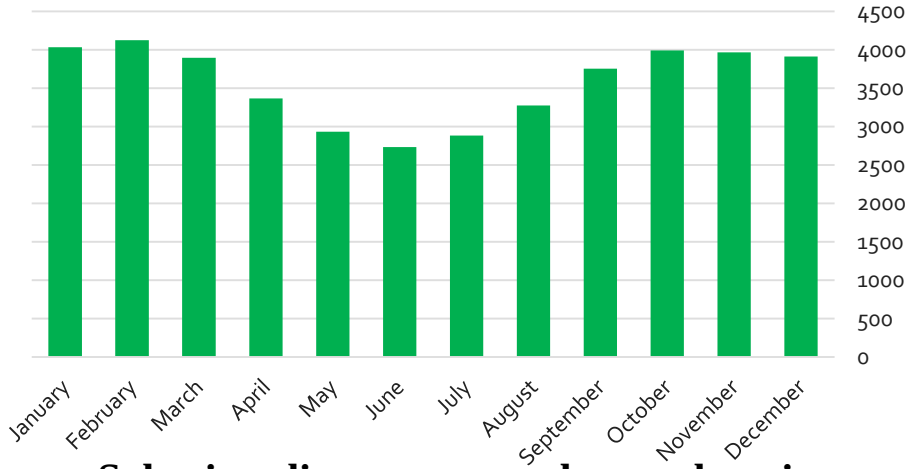

Solar irradiance on horizontal plan (W/m²)
8000
7000
6000
5000
4000
3000
2000
1000
0
January
February
March
April
May
June
July
August
September
October
November
December

❑ Solar irradiance:

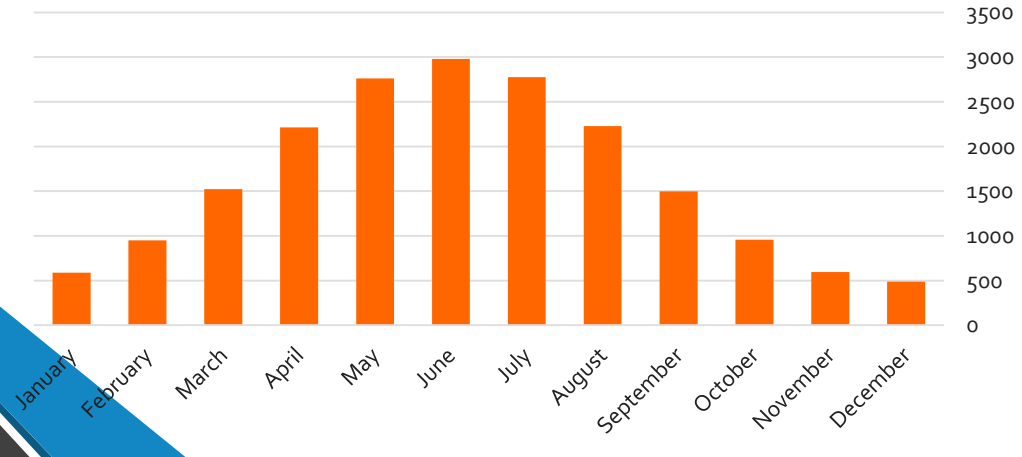
Solar irradiance on southeast elevations (kW.h/m².day)



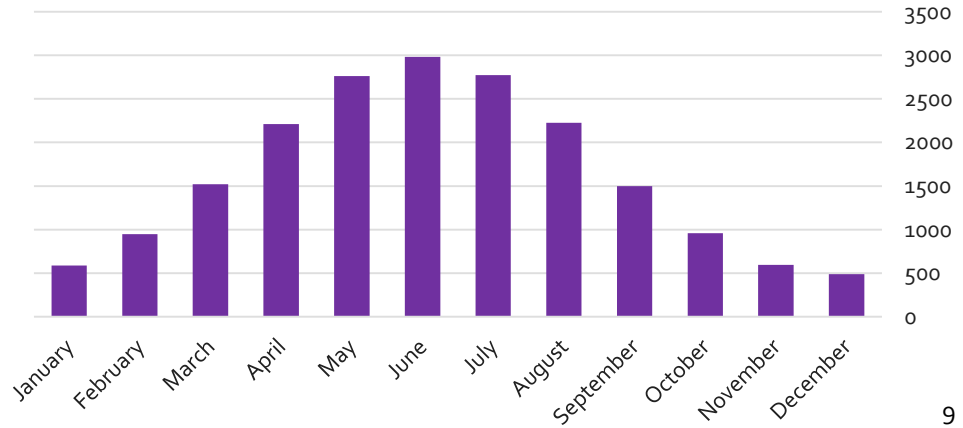
Solar irradiance on southeast elevations (kW.h/m².day)



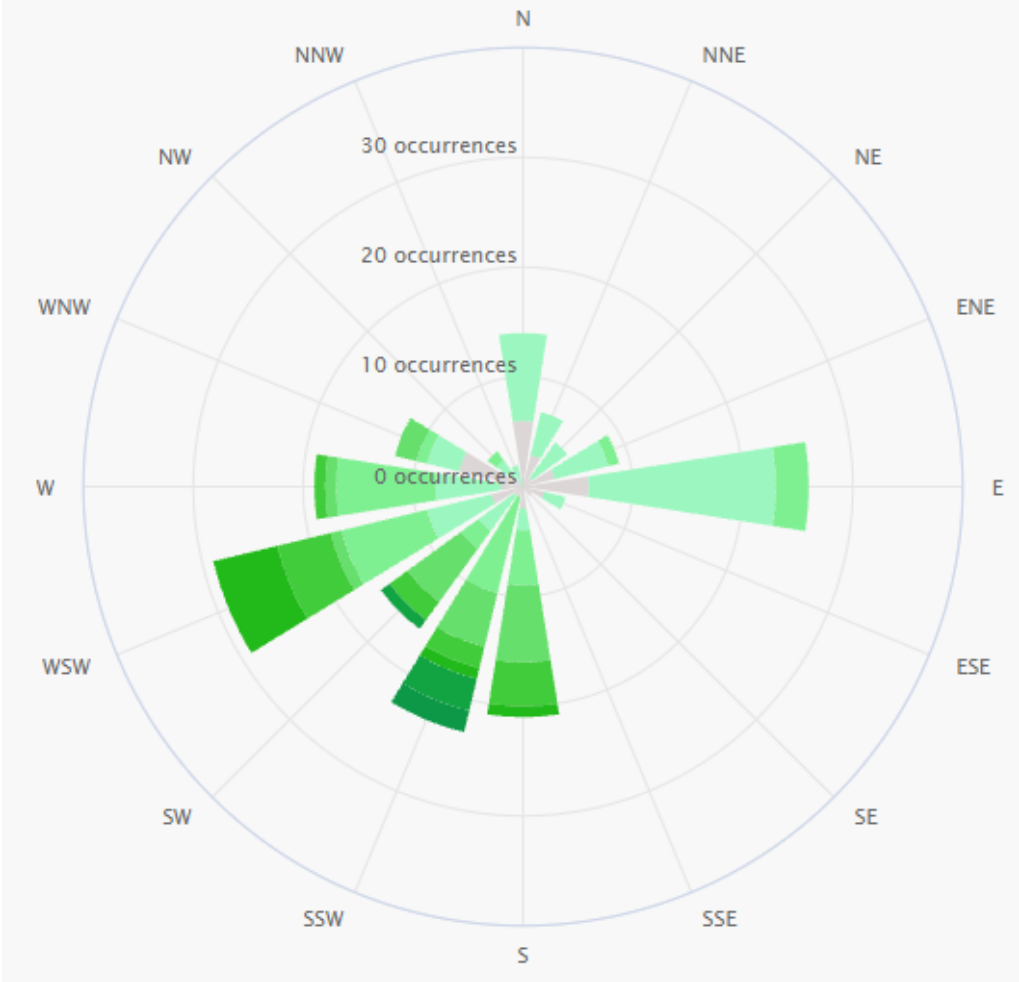
Solar irradiance on northeast elevations (kW.h/m².day)

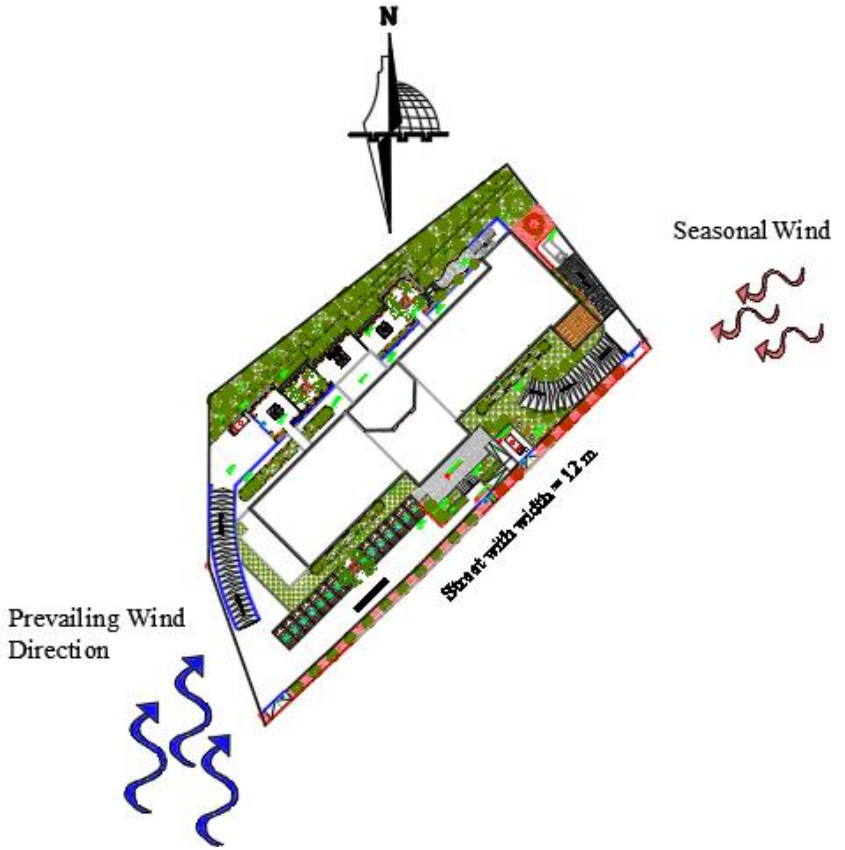


Solar irradianace on northwest elevations (kW.h/m² .day)

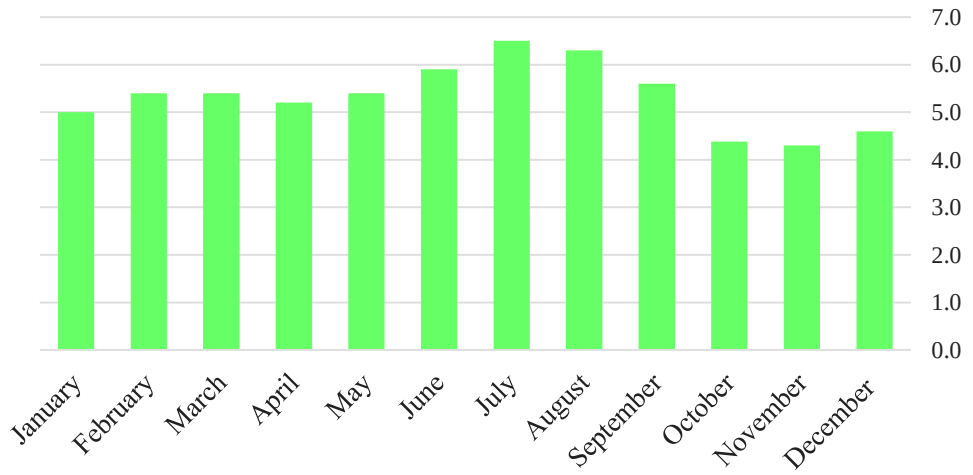


❑ Wind analysis:





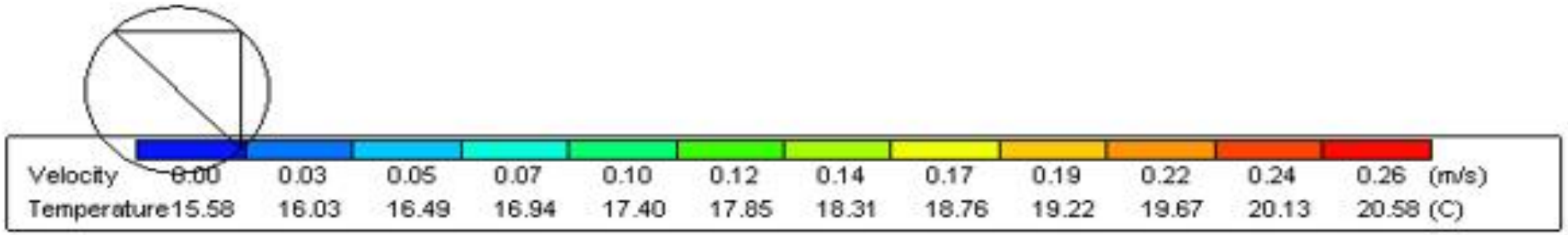
Average Monthly Wind Speed (km/hr)



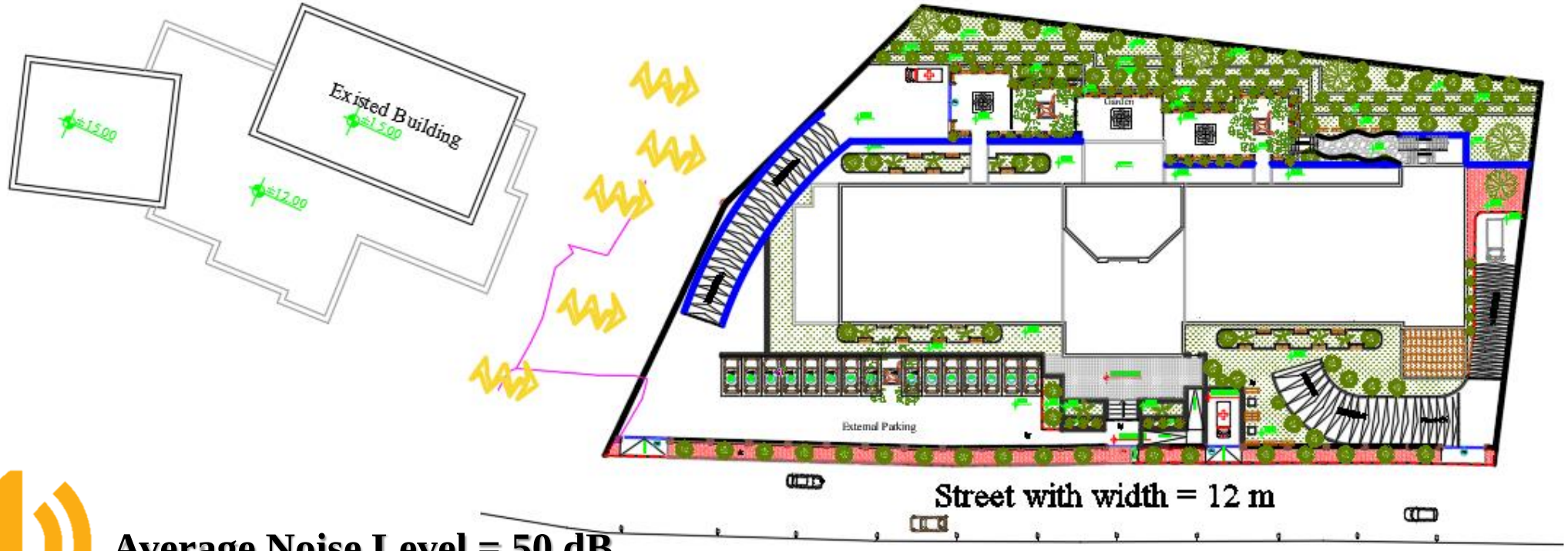
❑ External CFD:

Velocity	0.00	0.55	1.09	1.64	2.18	2.73	3.27	3.82	4.37	4.91	5.46	6.00 (m/s)
Pressure	-16.98	-14.55	-12.12	-9.69	-7.26	-4.83	-2.40	0.03	2.46	4.89	7.32	9.75 (Pa)

❑ Internal CFD:



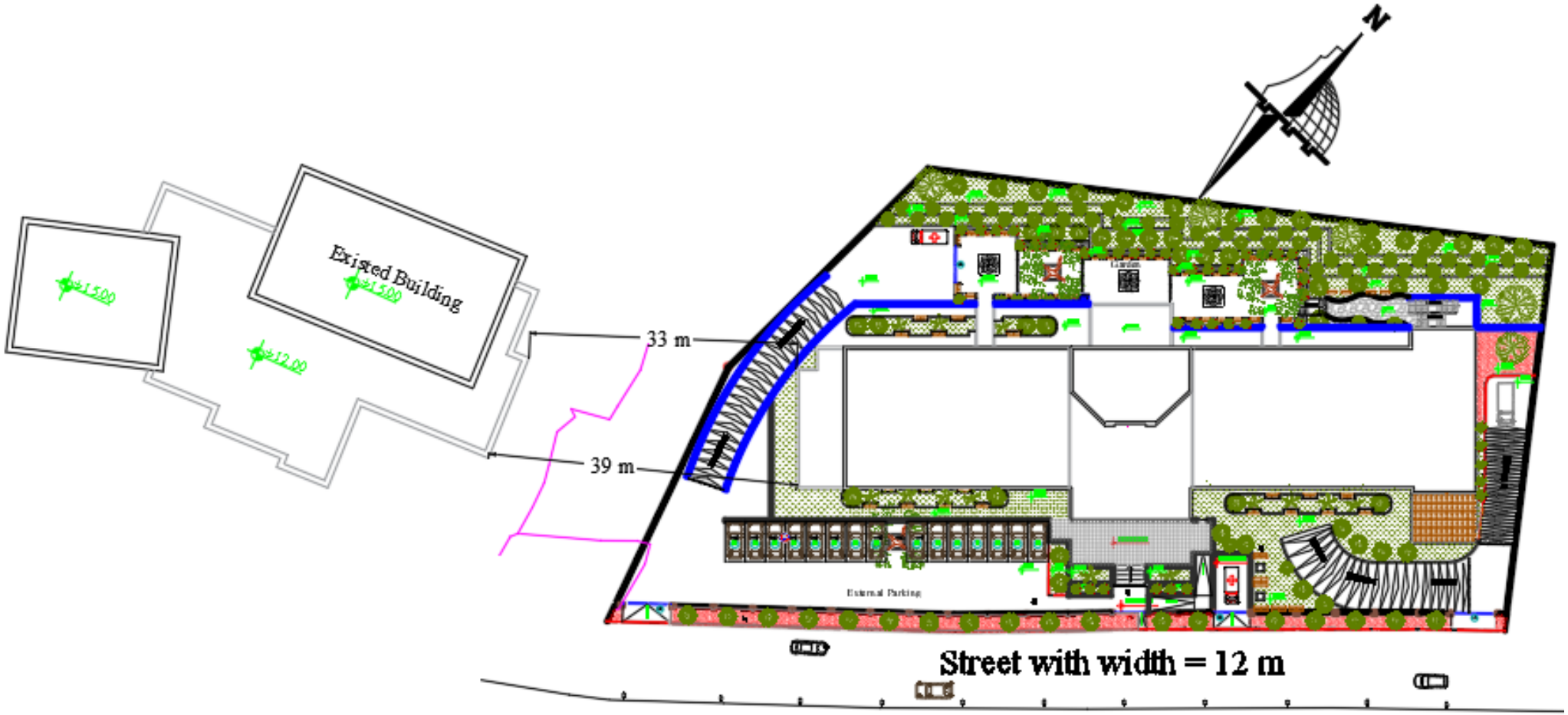
❑ Noise analysis:



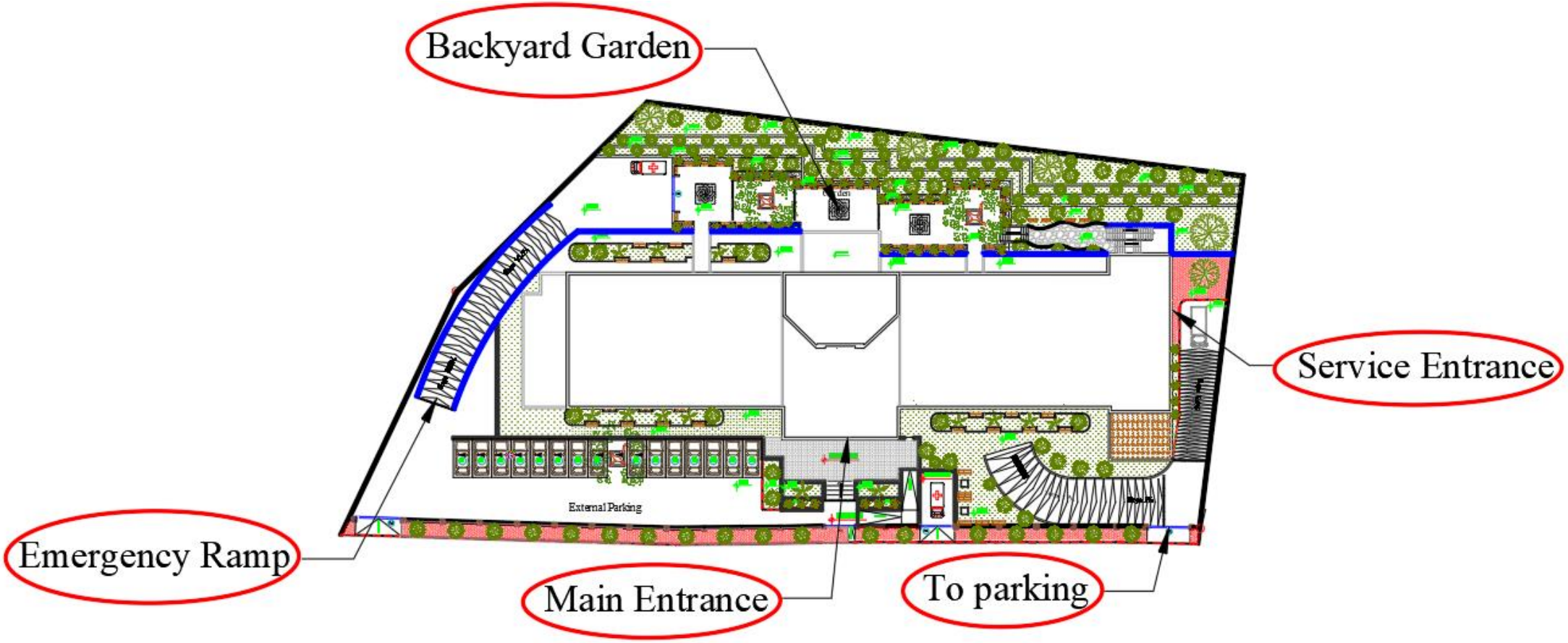
Average Noise Level = 50 dB

❑ Surrounding buildings and streets:

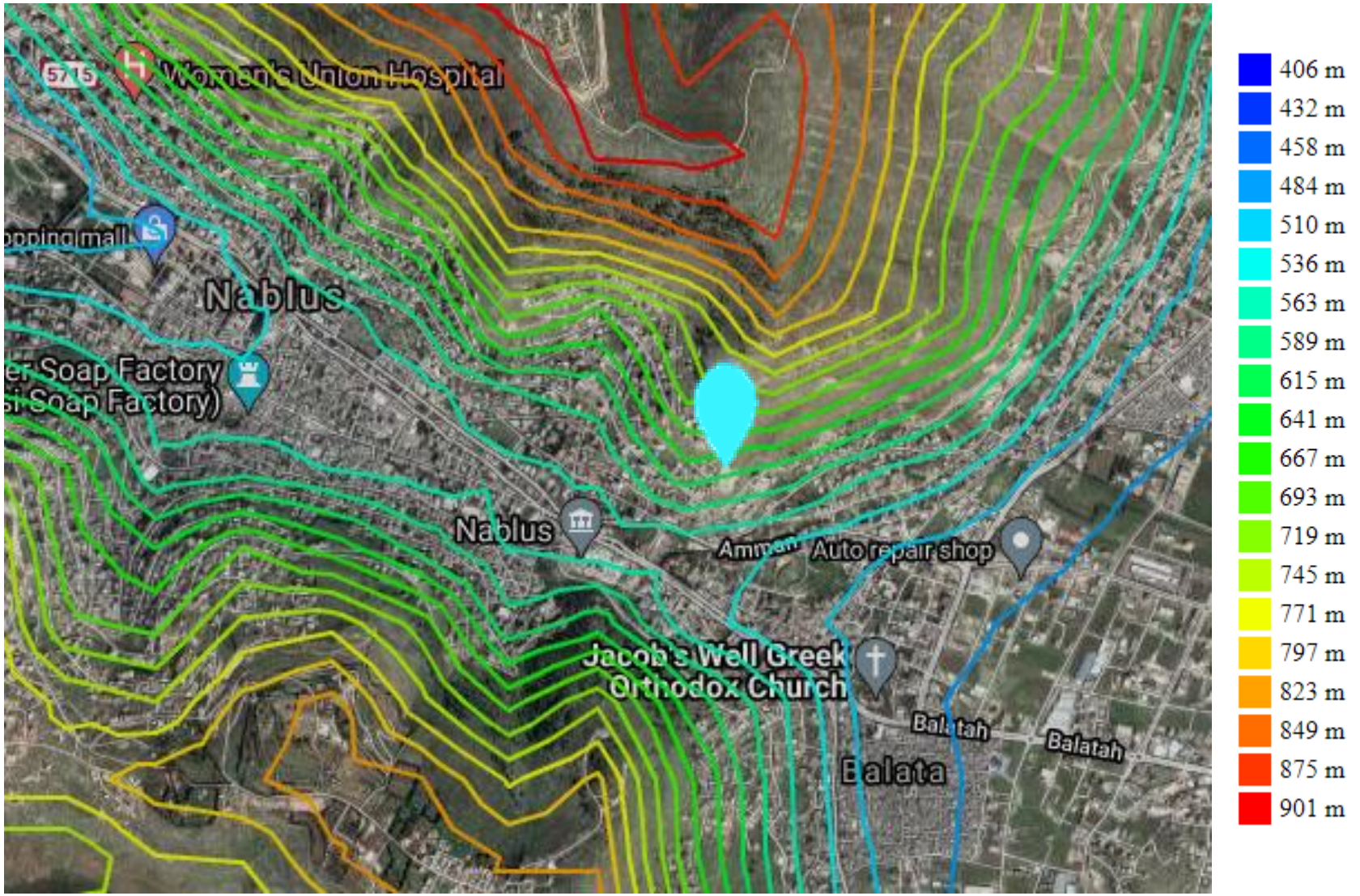
❑ Surrounding buildings and streets:



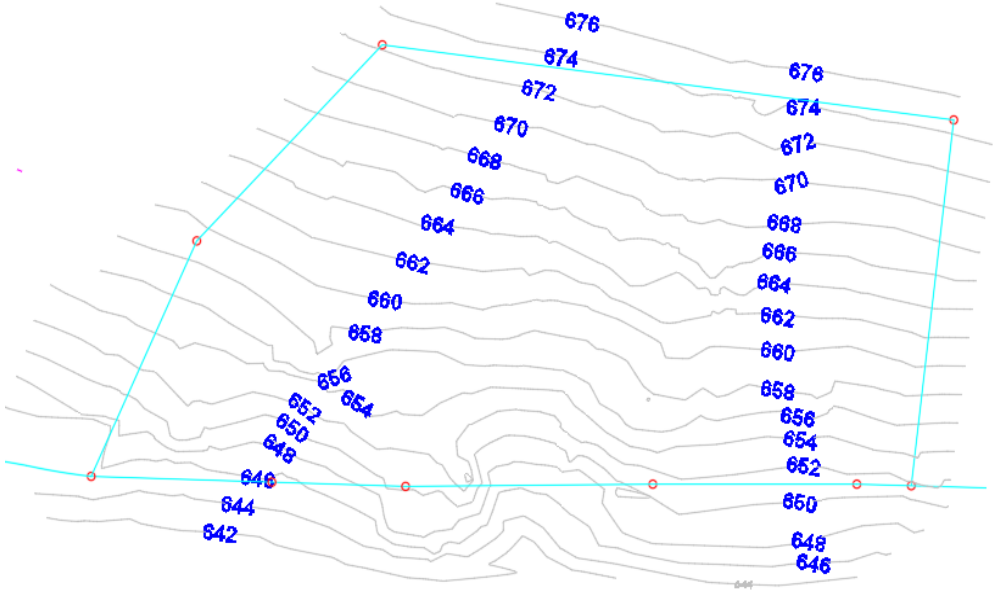
❑ Main axes and entrances:

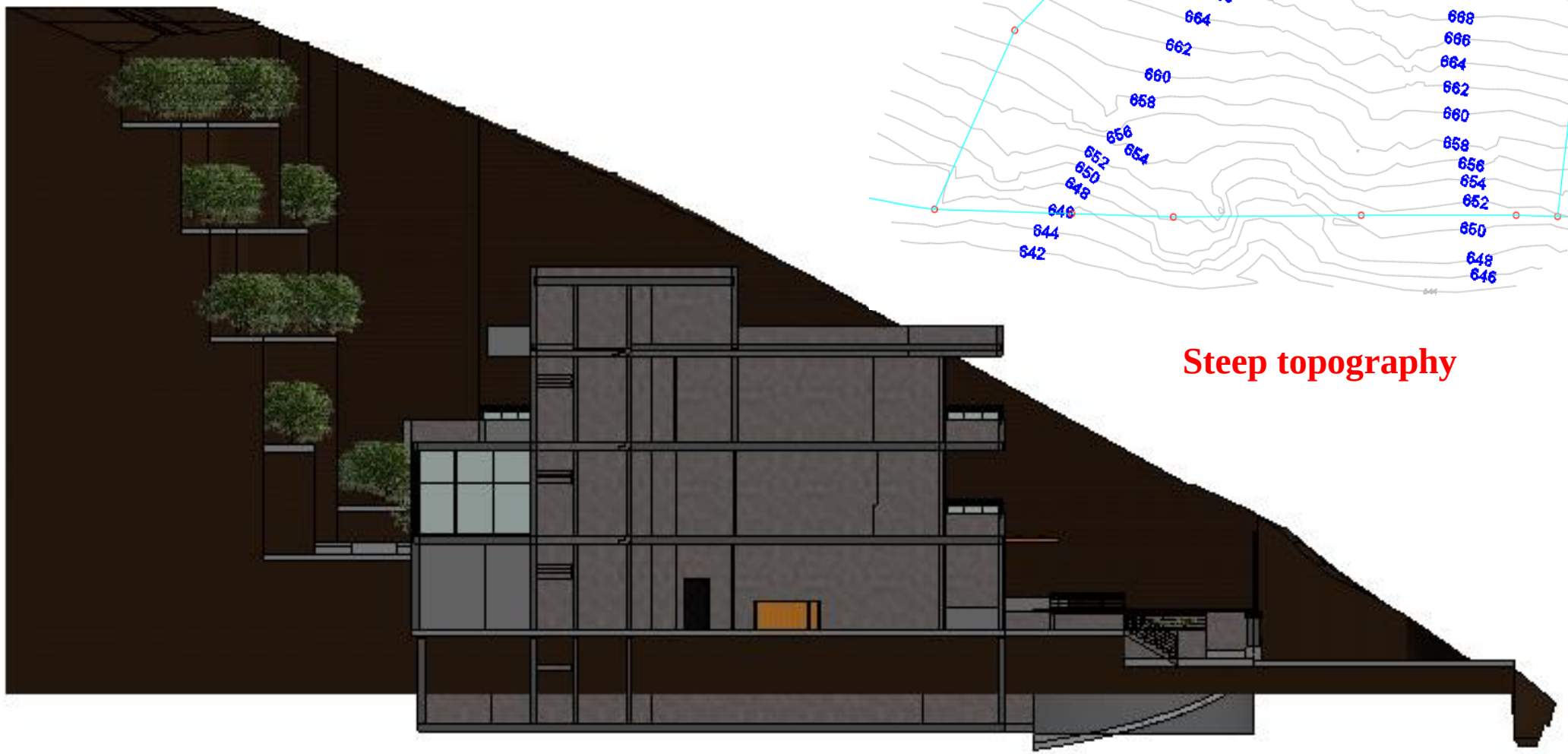


❑ Topography:


Nablus
Nablus
Auto repair shop
Jacob's Well Greek Orthodox Church
Balata
Balatah
Balatah
406 m
432 m
458 m
484 m
510 m
536 m
563 m
589 m
615 m
641 m
667 m
693 m
719 m
745 m
771 m
797 m
823 m
849 m
875 m
901 m

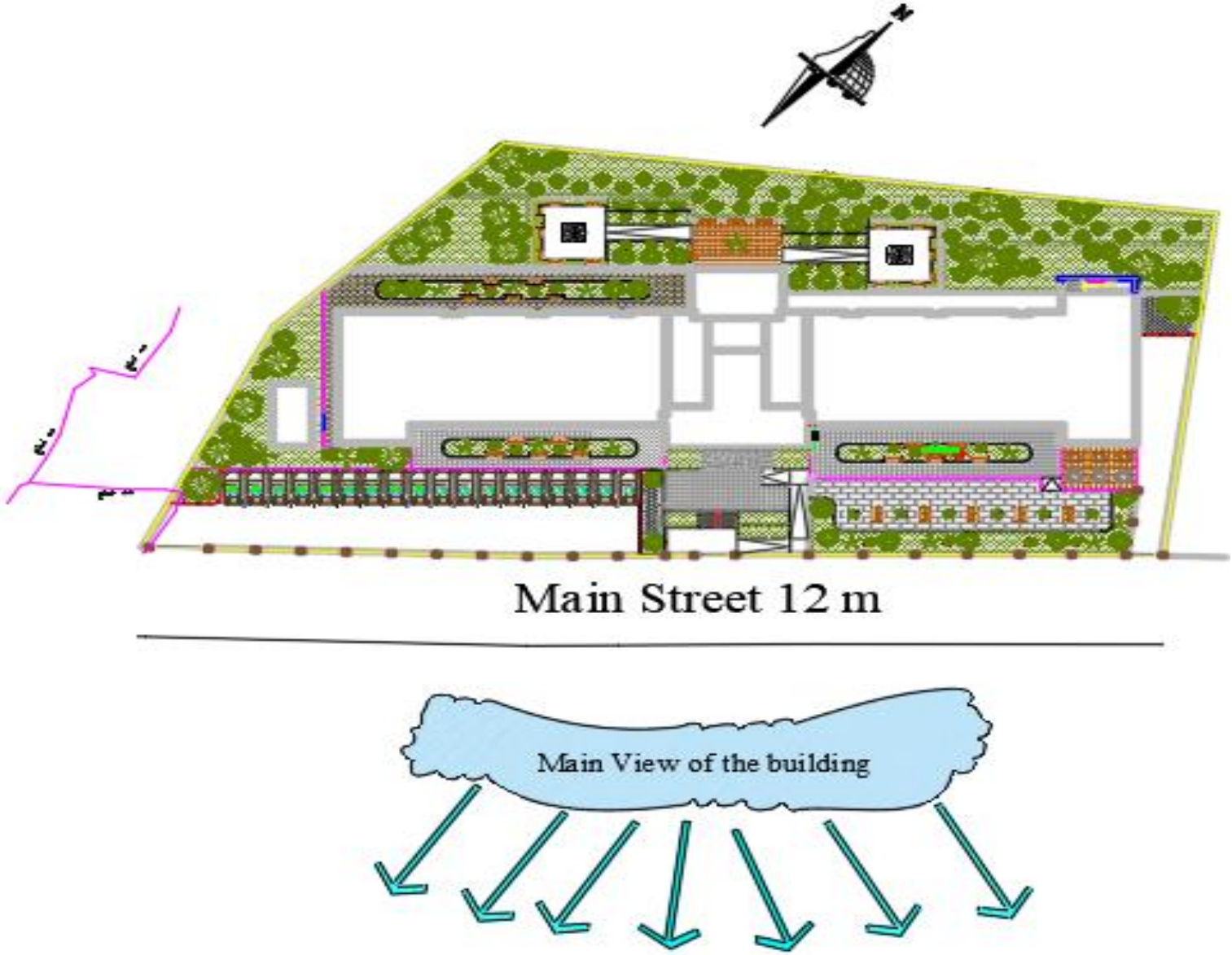
❑ Topography:



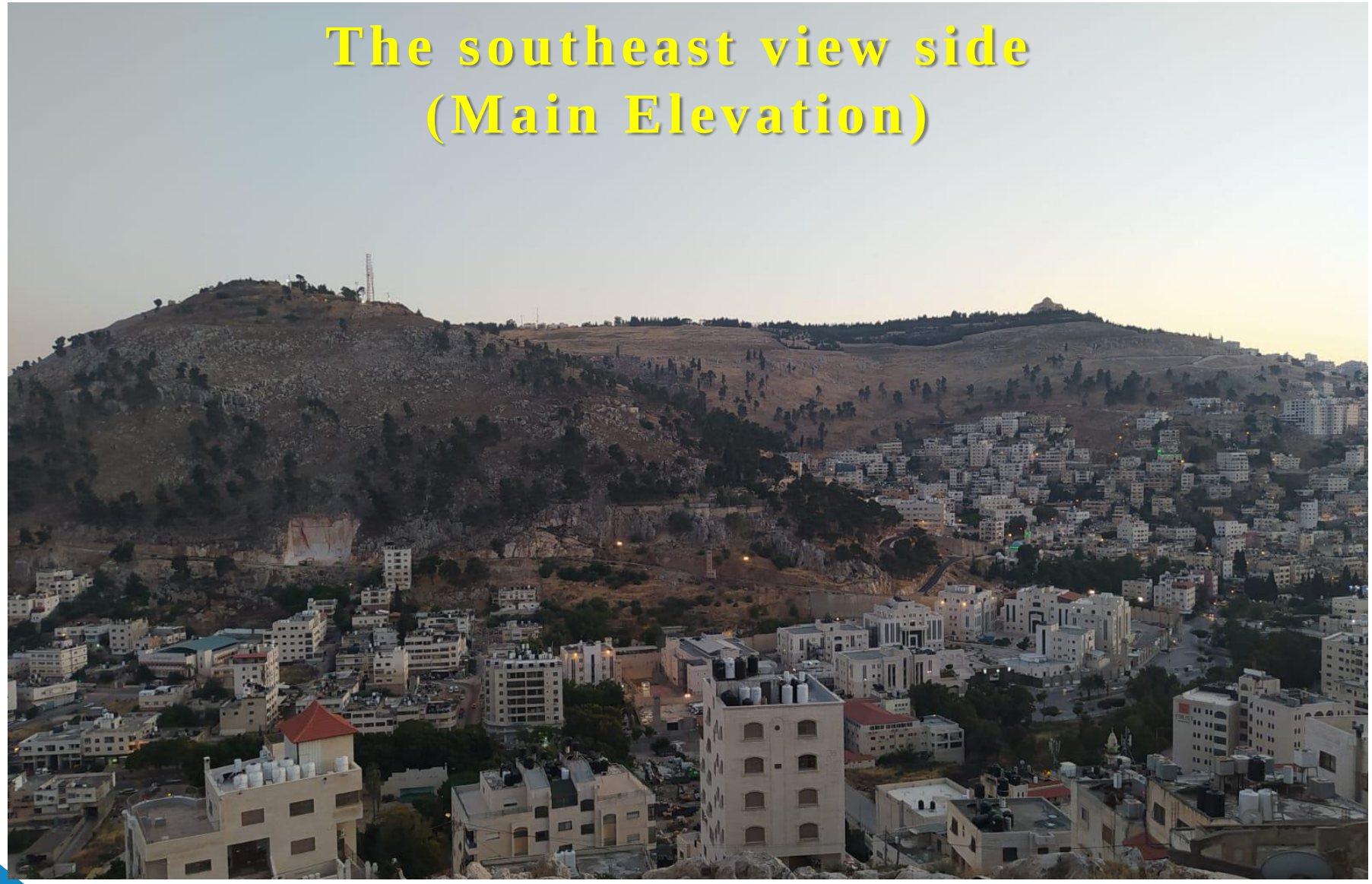


Steep topography

❑ Views:



❑ Views:

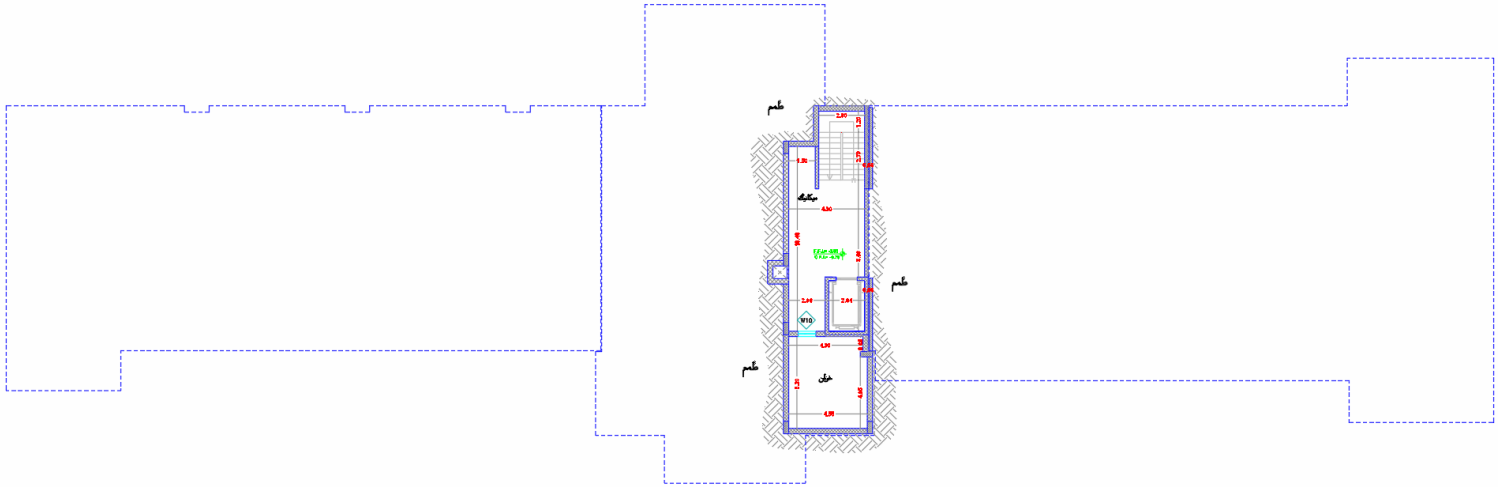


❑ Views:

Architectural aspects

Architectural modifications:

Before:



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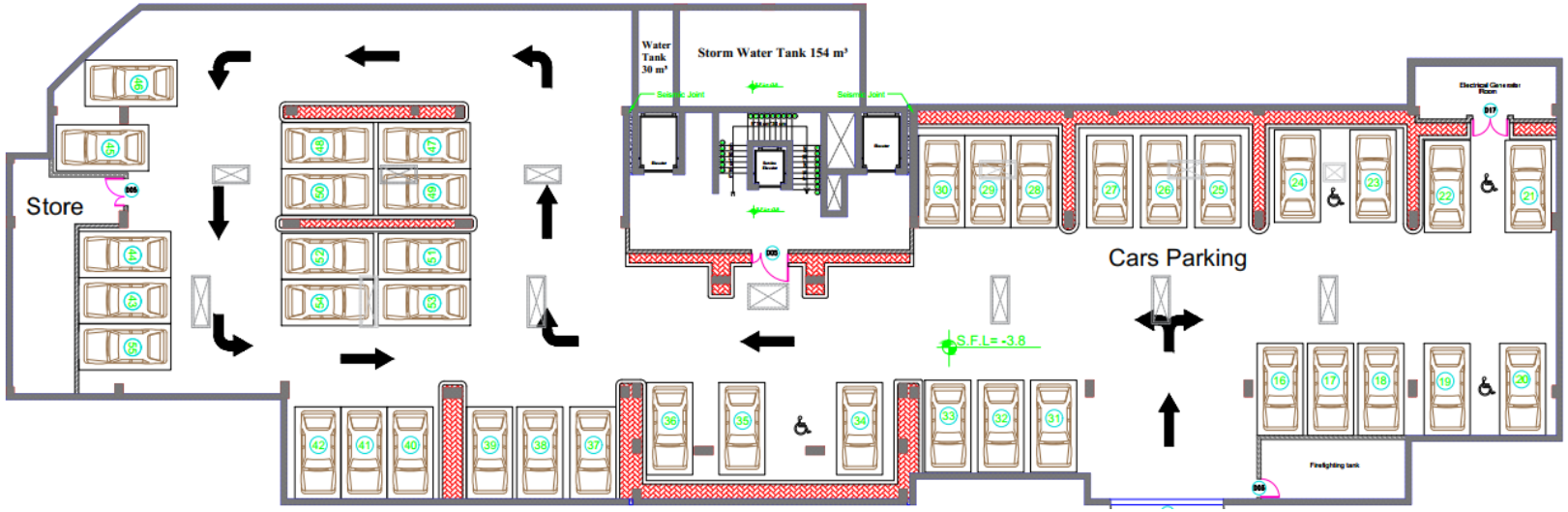
Basement Plan

After:



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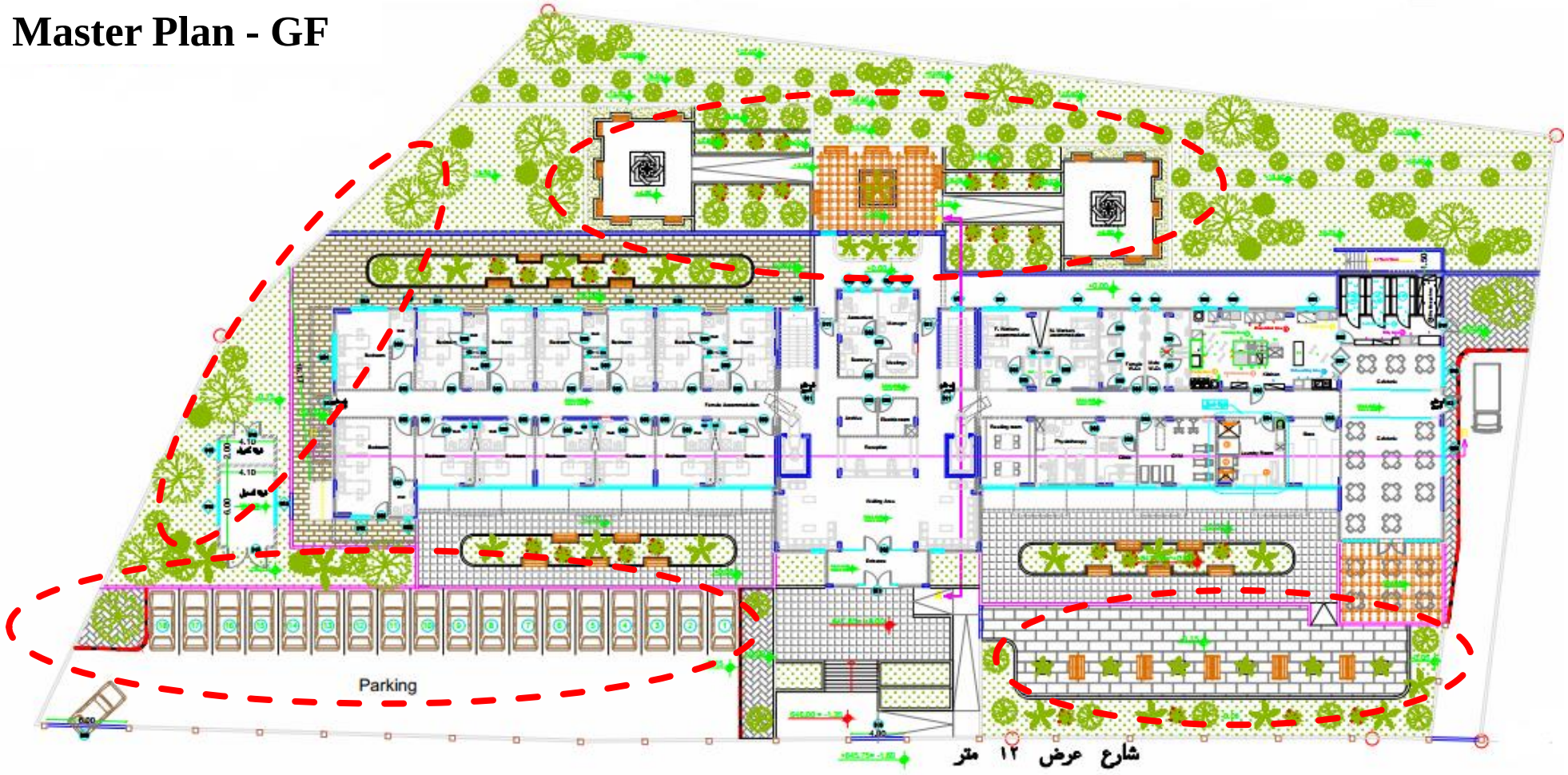
Architectural modifications:

Before:

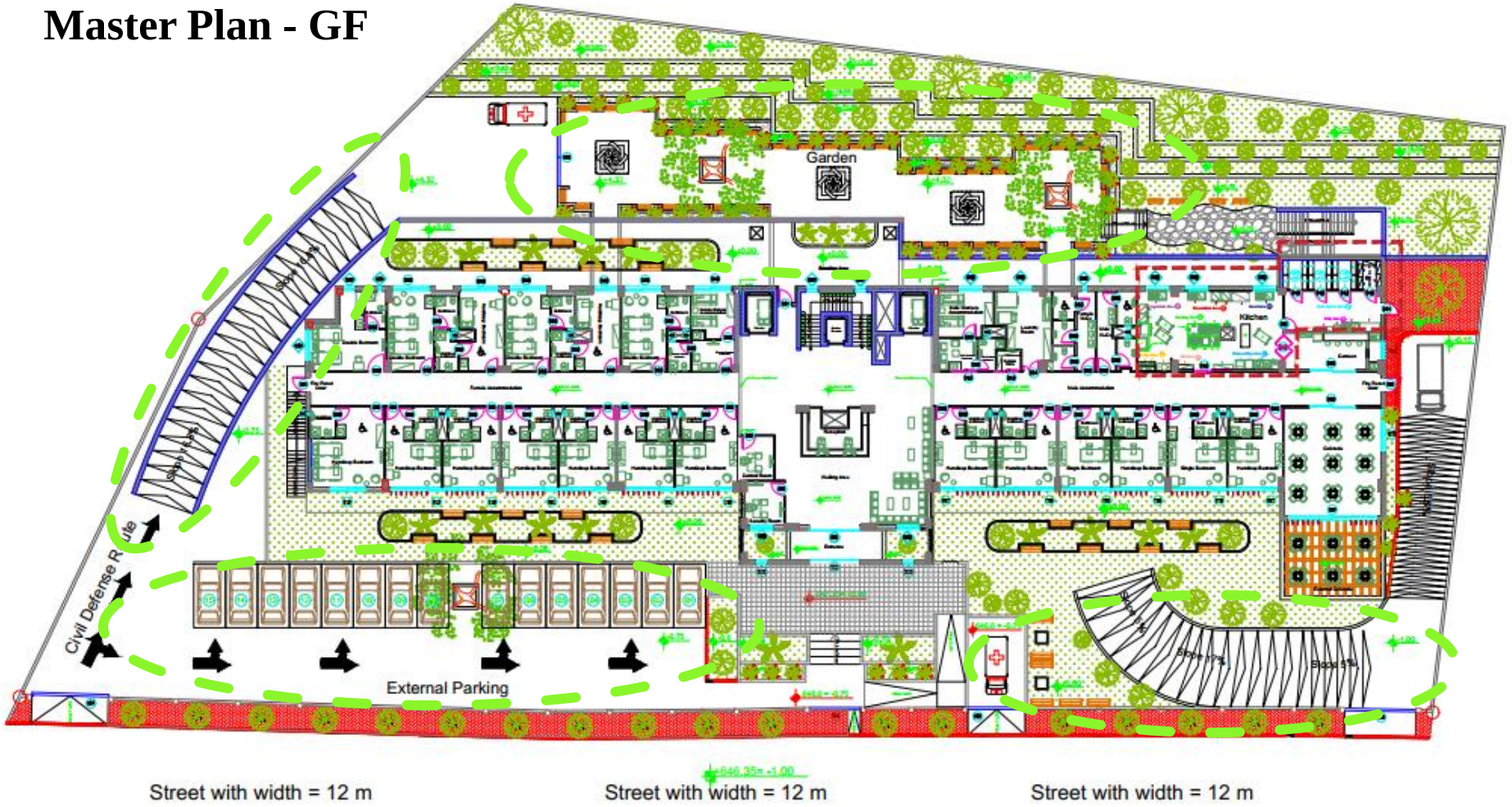
Master Plan - GF



Architectural modifications:

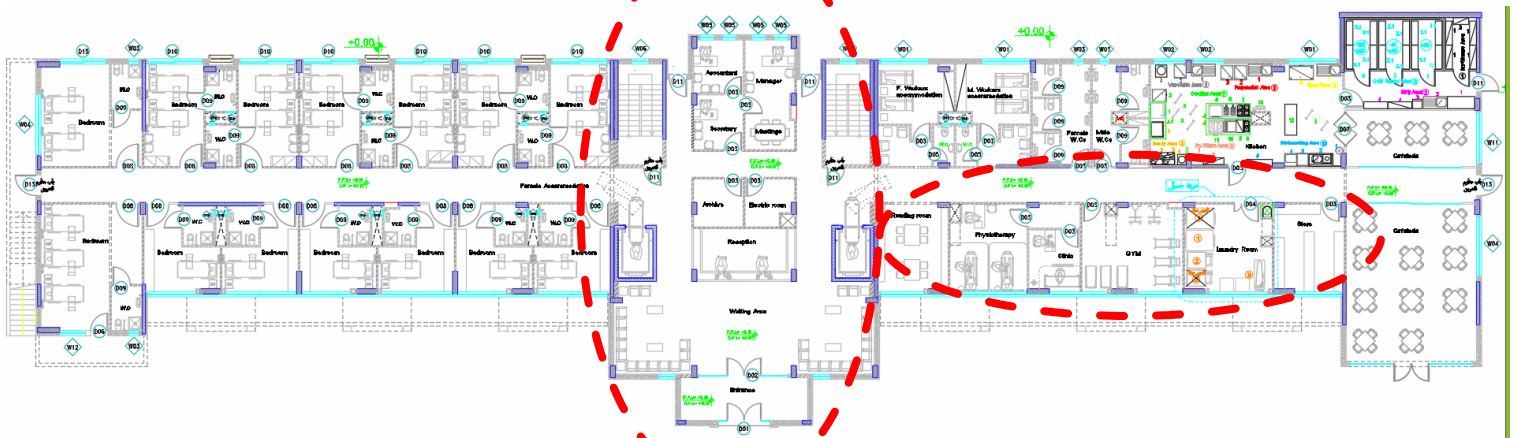
After:

Master Plan - GF



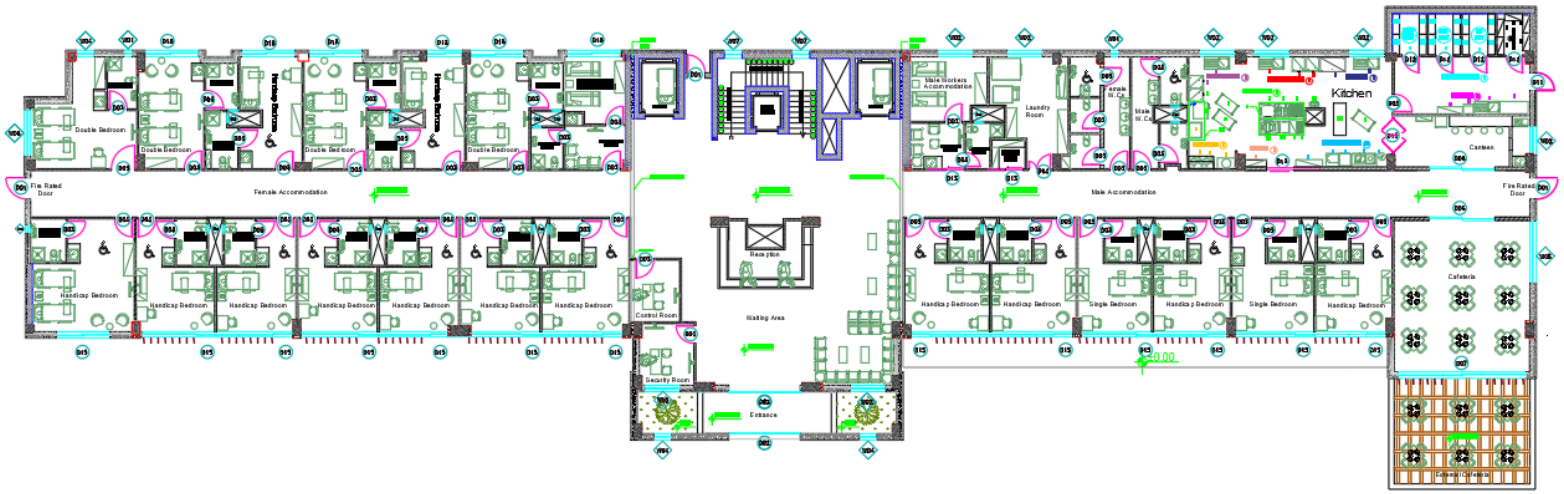
Architectural modifications:

Before:



Ground Floor Plan

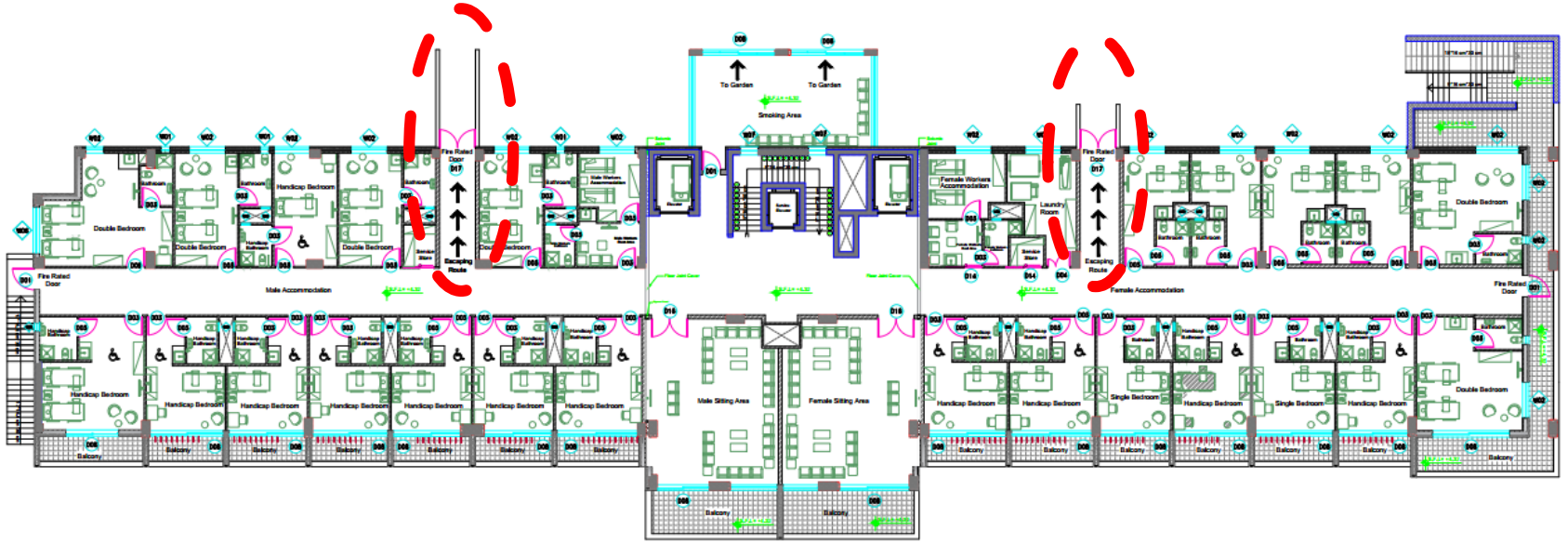
After:



Before:

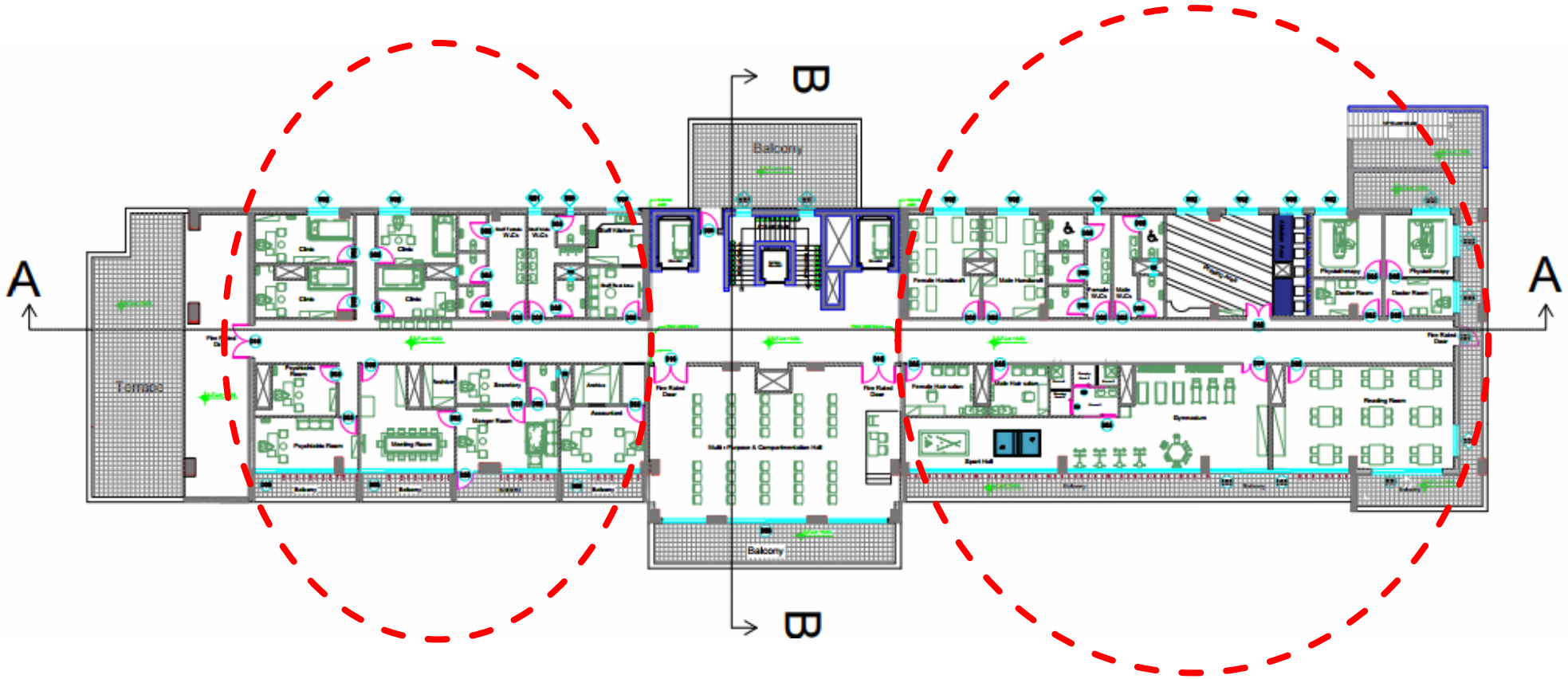
First Floor Plan

After:

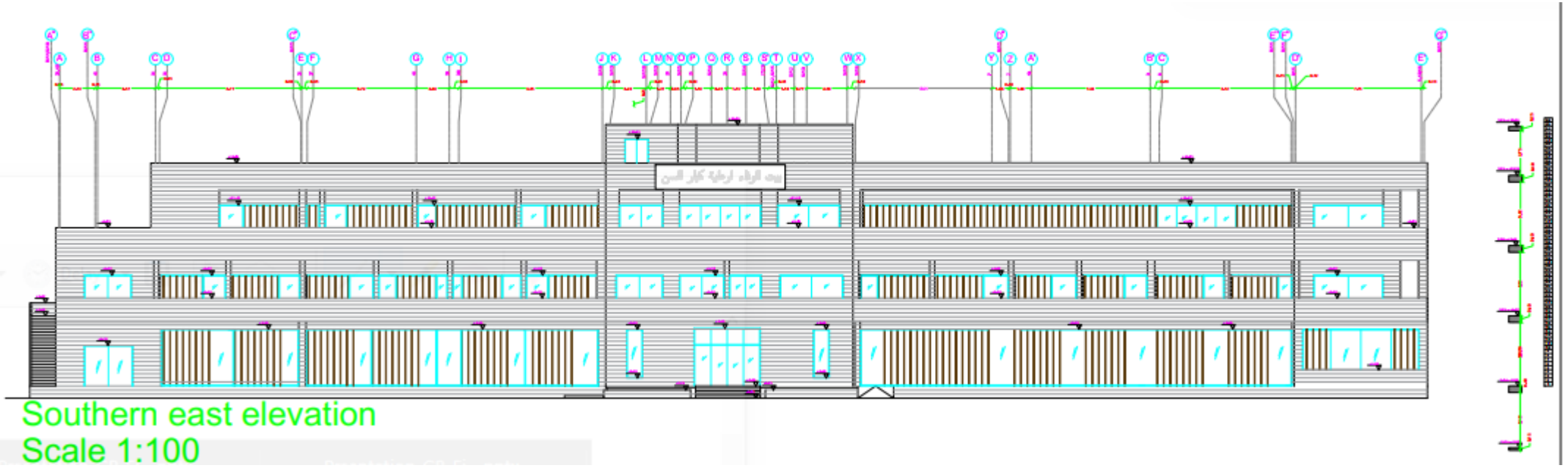


New:

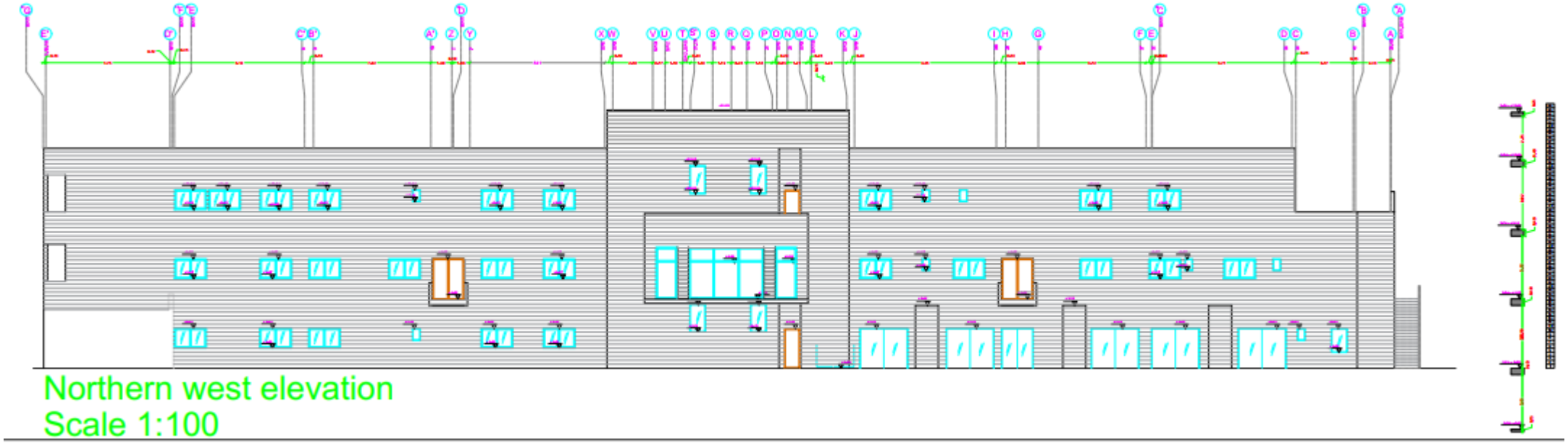
Second Floor Plan



Southern east Elevation

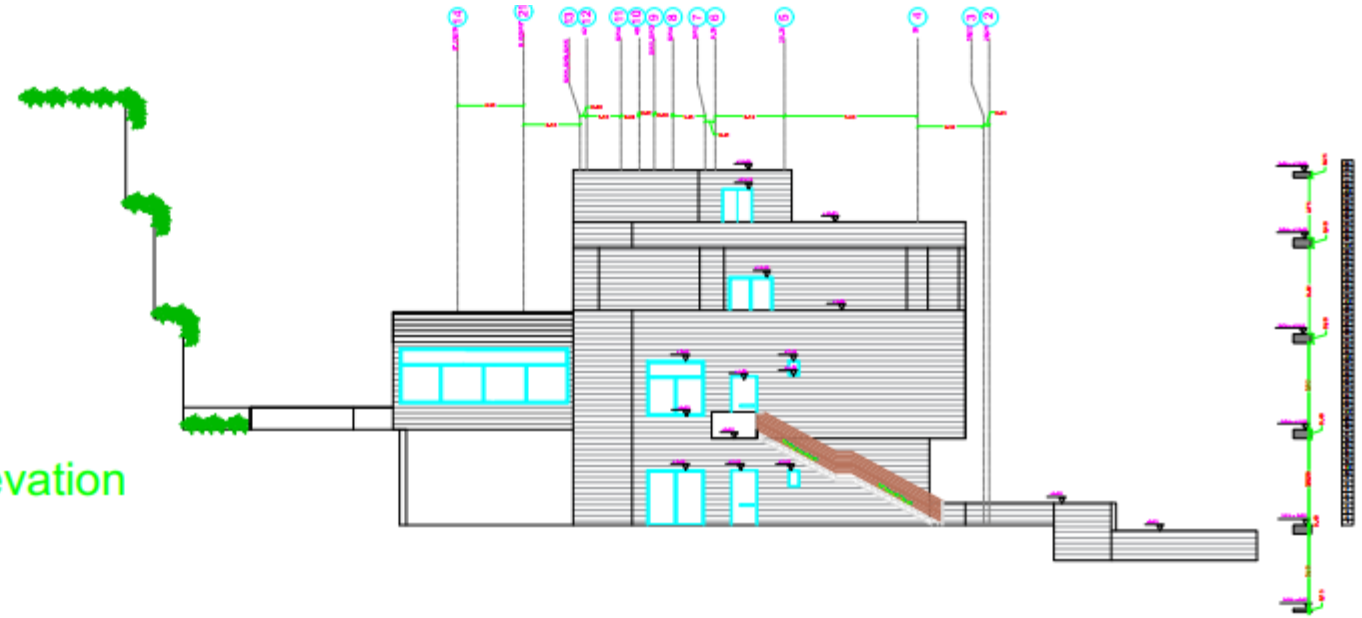


Northern west Elevation



Northern east Elevation

Southern west Elevation

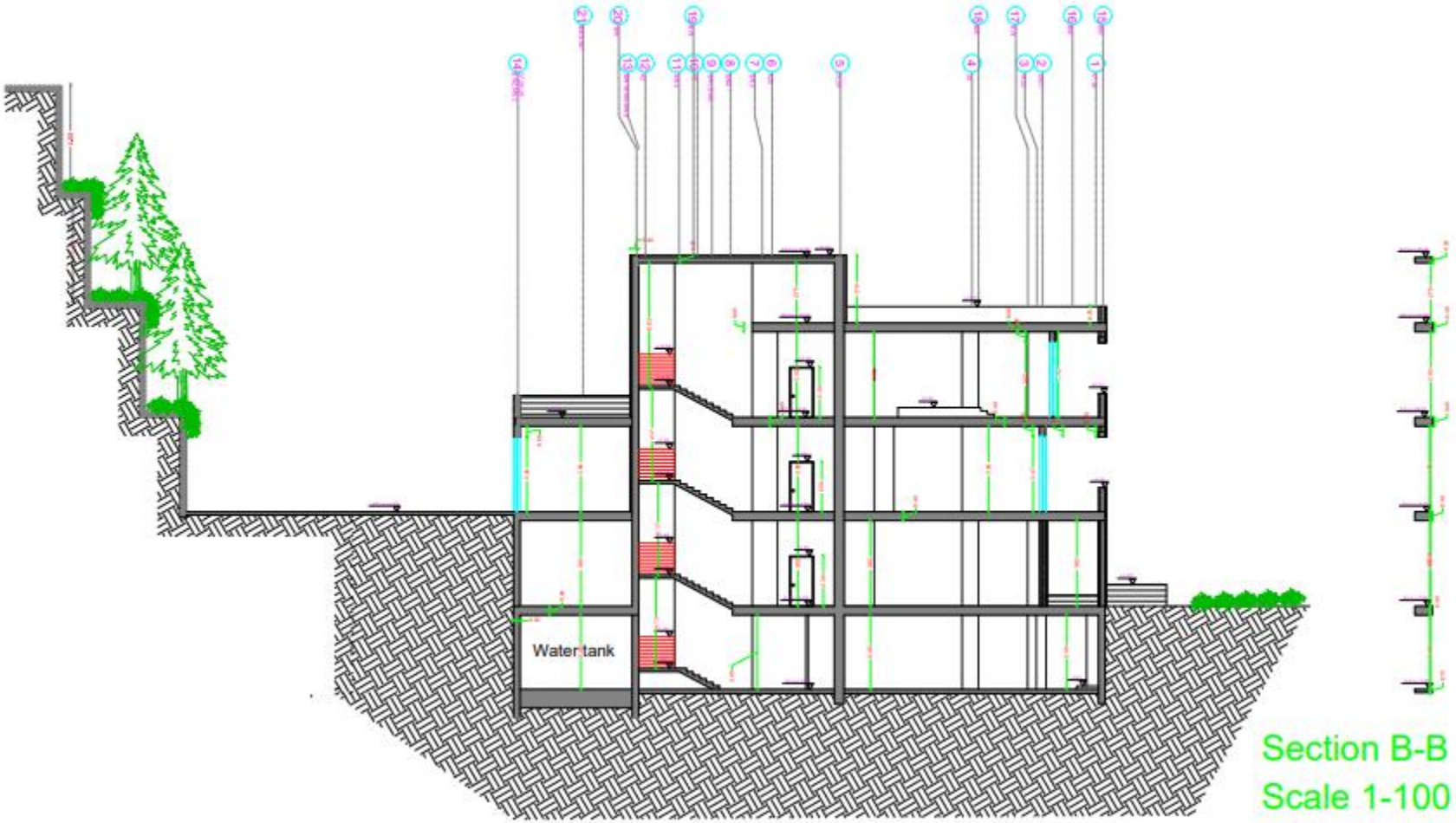


Southern west elevation
Scale 1:100

Section A-A:

Section A-A
Scale 1-100

Section B-B:

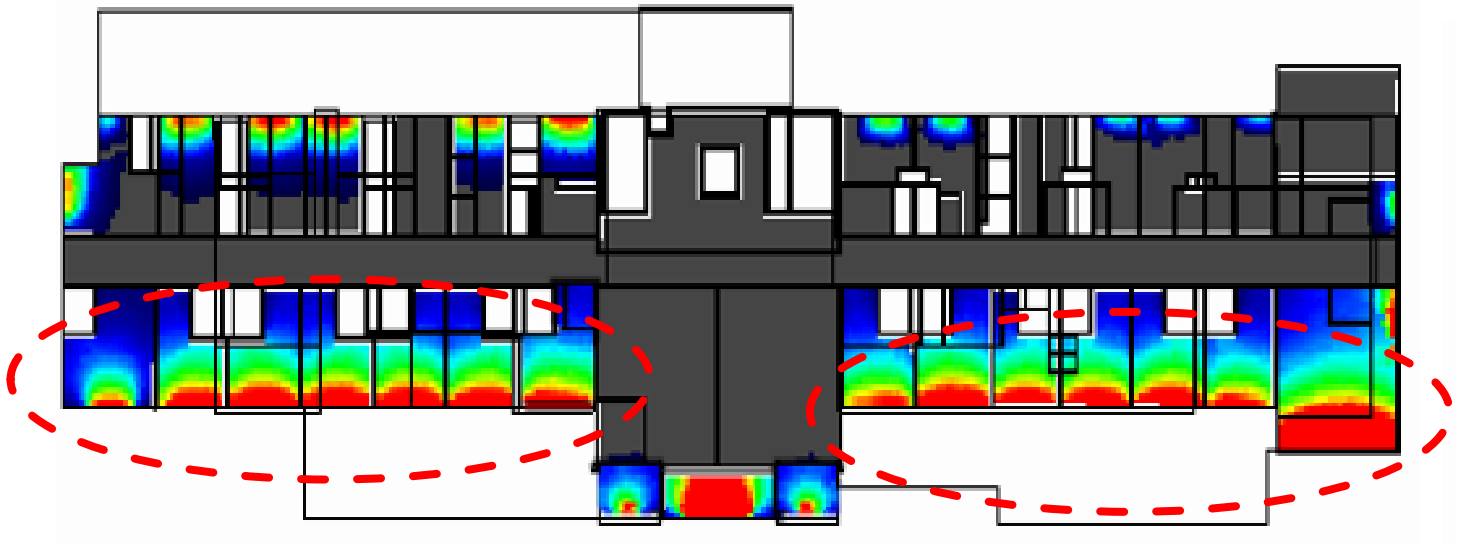


Environmental aspects

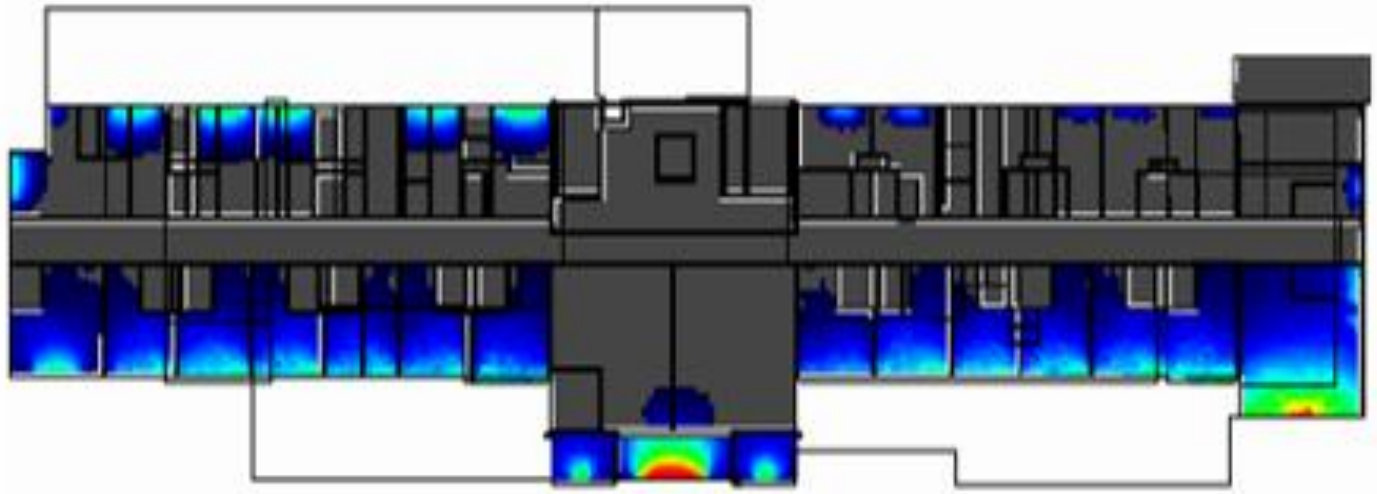
❑ Daylight Factor Analysis:

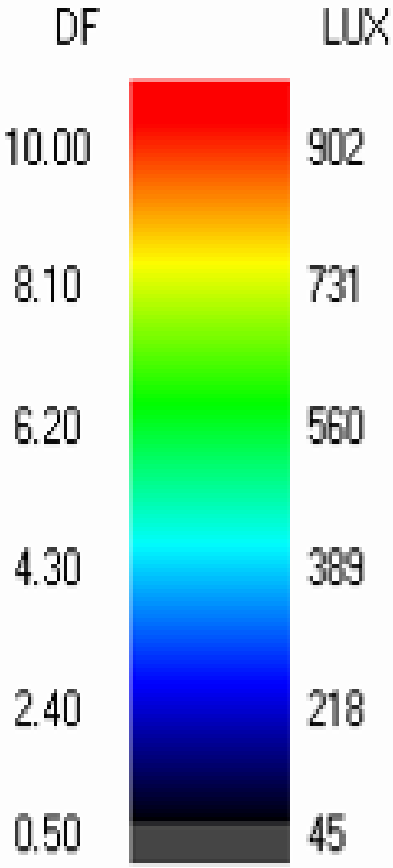
Ground Floor

Before:



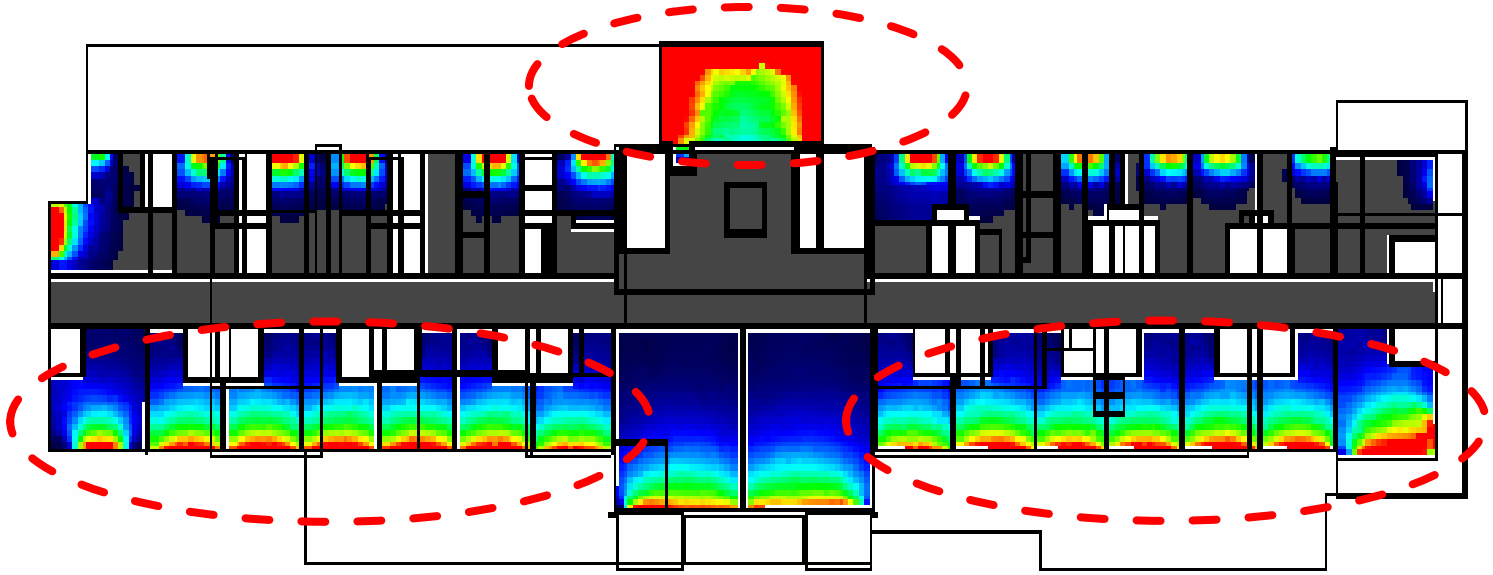
After:



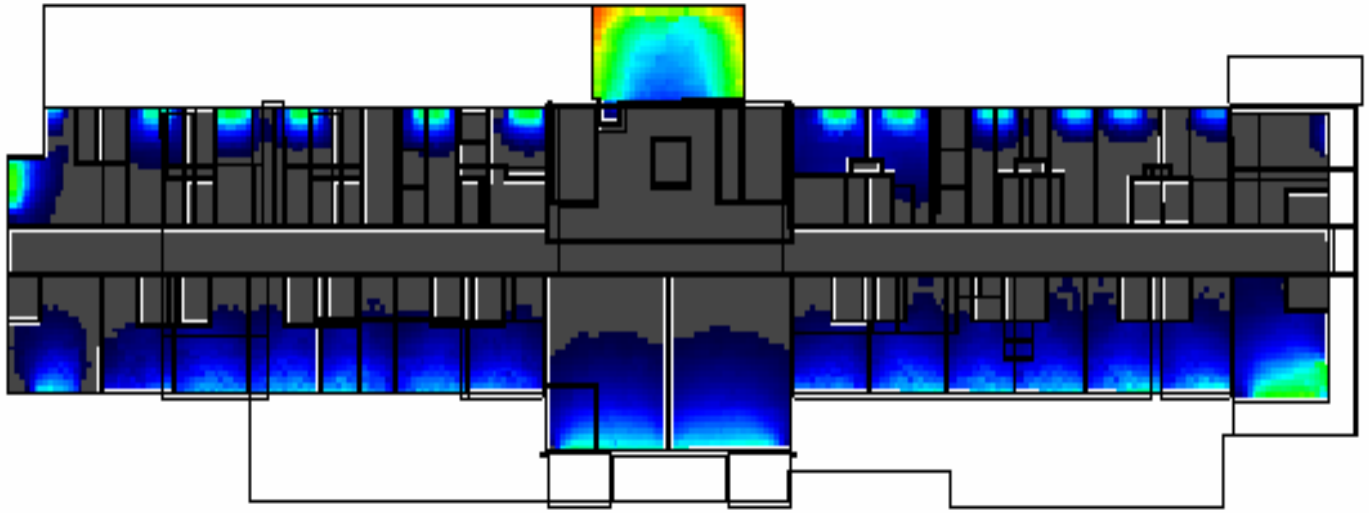


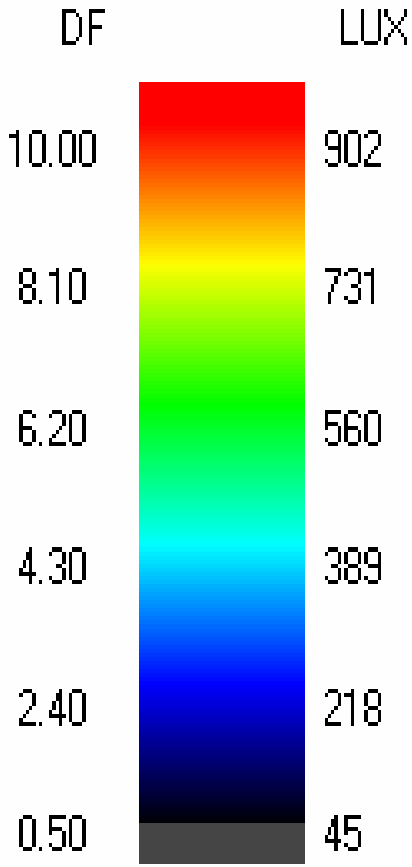
First Floor

Before:



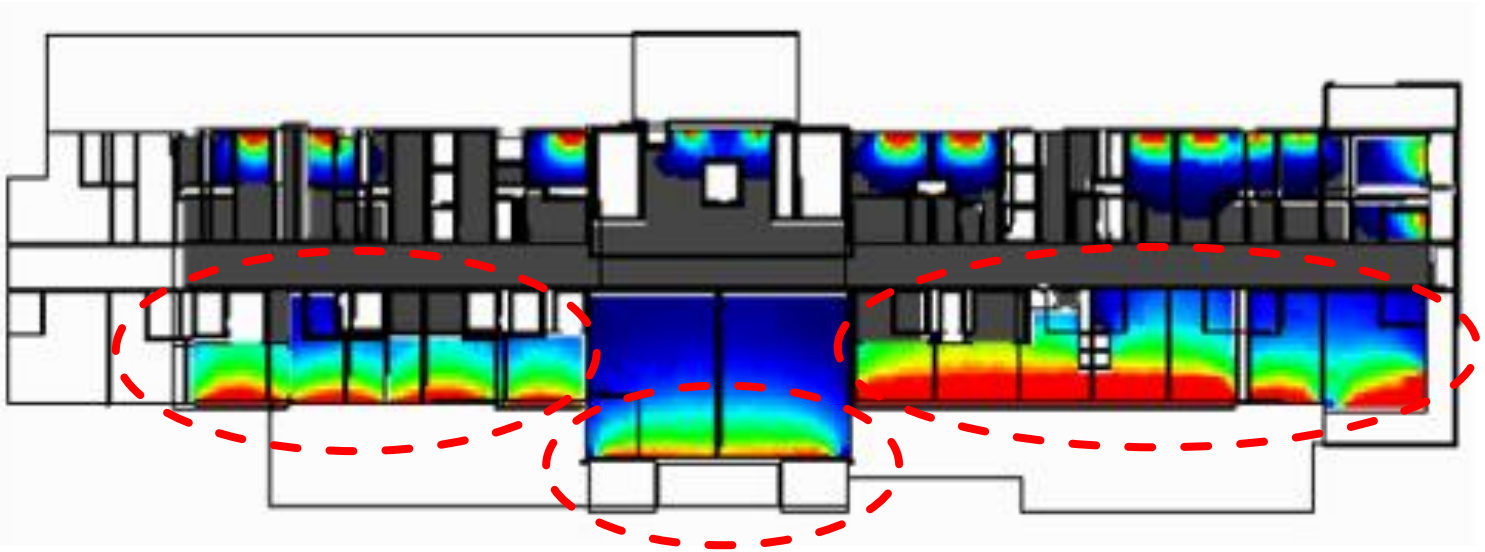
After:



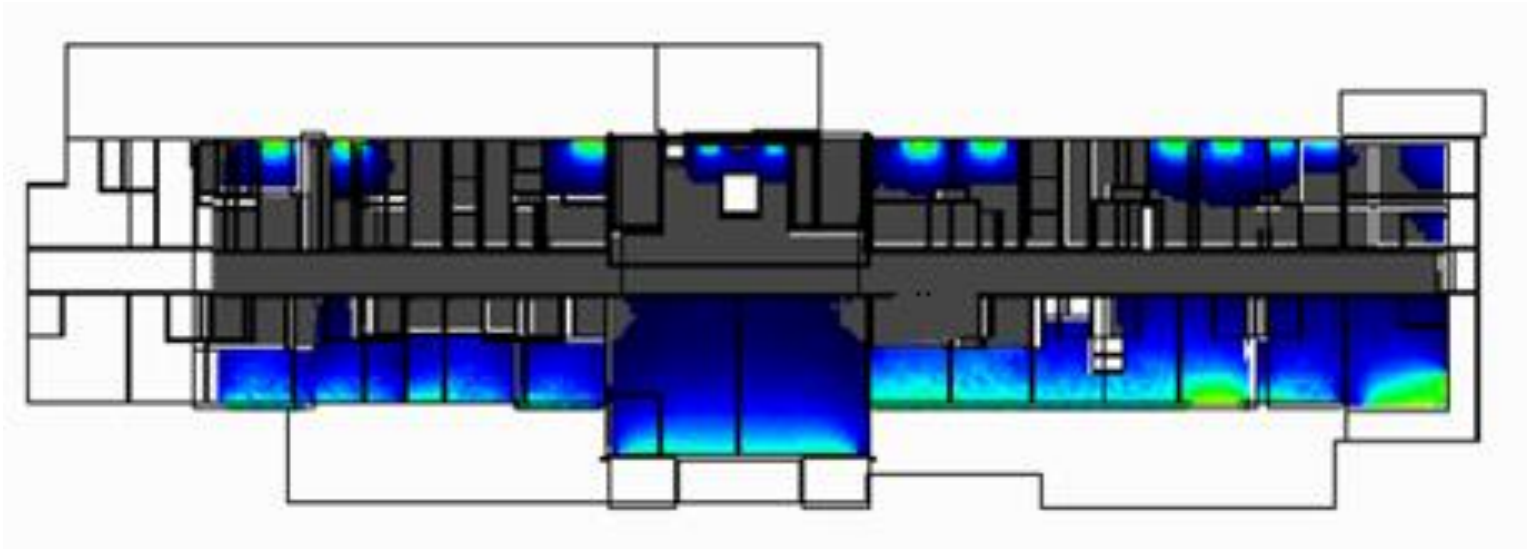


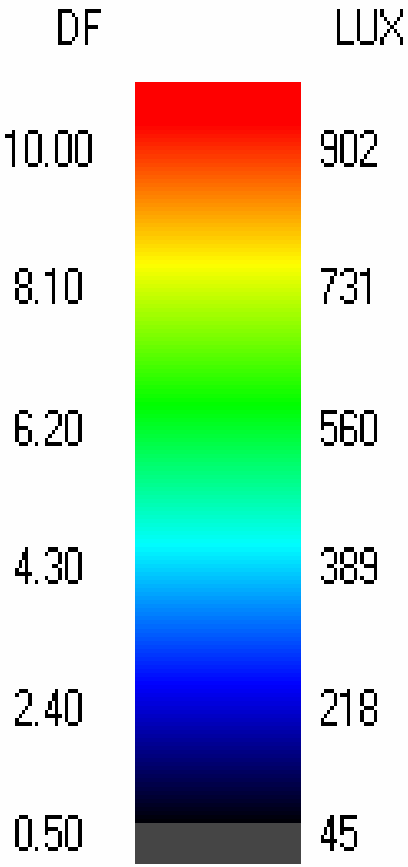
Second Floor

Before:



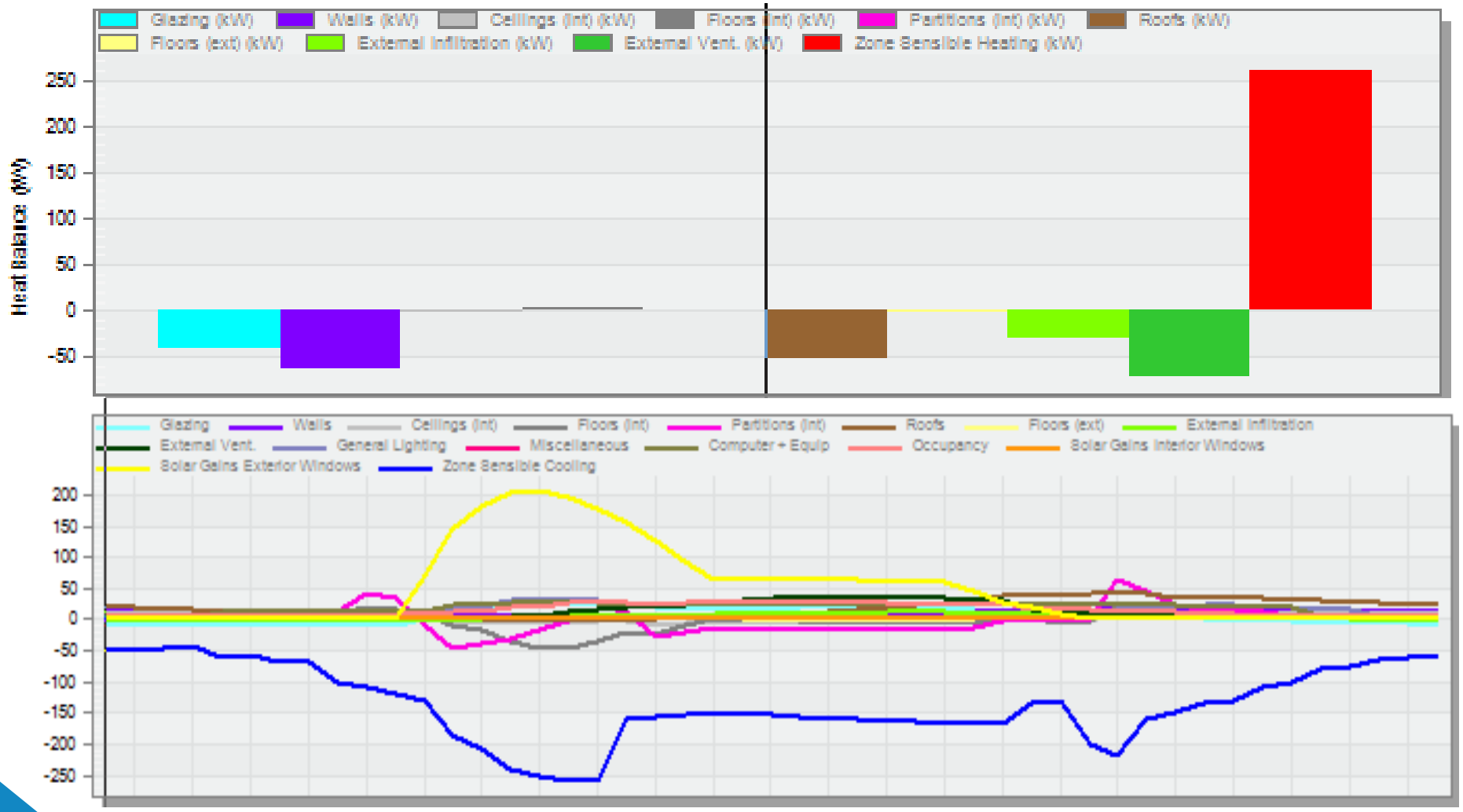
After:





❑ Heating and Cooling Loads:

Before thermal and shading modification:



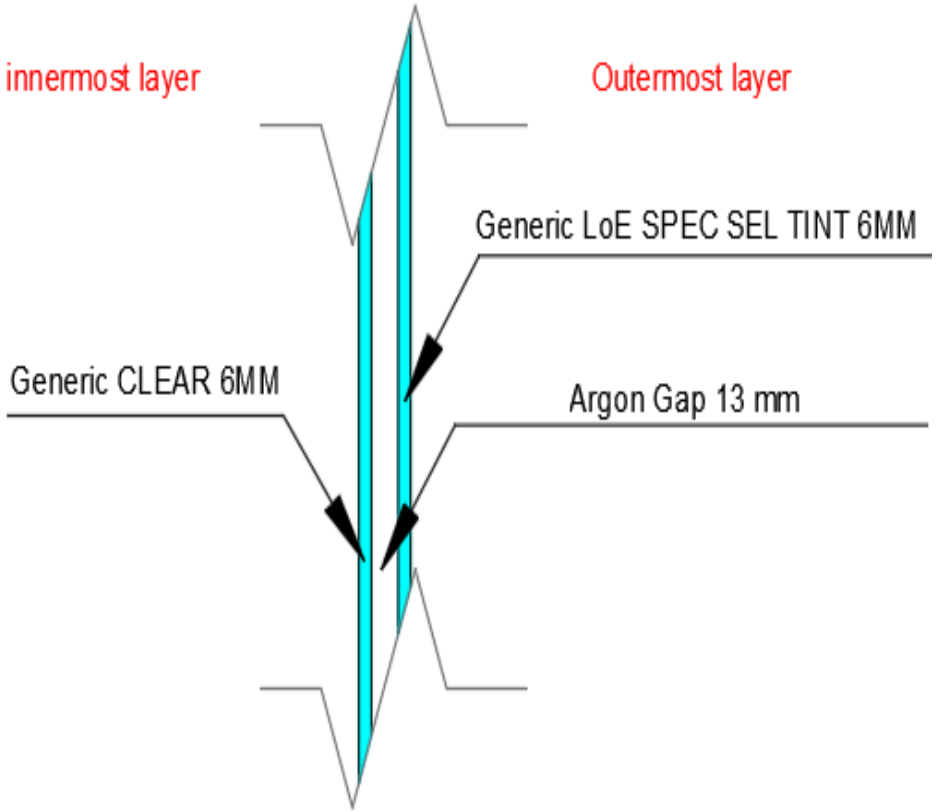
❑ Heating and Cooling Loads:

Thermal modification on exterior wall:

Inner surface	
Convective heat transfer coefficient (W/m2-K)	2.152
Radiative heat transfer coefficient (W/m2-K)	5.540
Surface resistance (m2-K/W)	0.130
Outer surface	
Convective heat transfer coefficient (W/m2-K)	19.870
Radiative heat transfer coefficient (W/m2-K)	5.130
Surface resistance (m2-K/W)	0.040
No Bridging	
U-Value surface to surface (W/m2-K)	0.410
R-Value (m2-K/W)	2.607
U-Value (W/m2-K)	**0.384**
With Bridging (BS EN ISO 6946)	
Thickness (m)	0.3600
Km - Internal heat capacity (KJ/m2-K)	99.4560
Upper resistance limit (m2-K/W)	2.607
Lower resistance limit (m2-K/W)	2.607
U-Value surface to surface (W/m2-K)	0.410
R-Value (m2-K/W)	2.607
U-Value (W/m2-K)	**0.384**

❑ Heating and Cooling Loads:

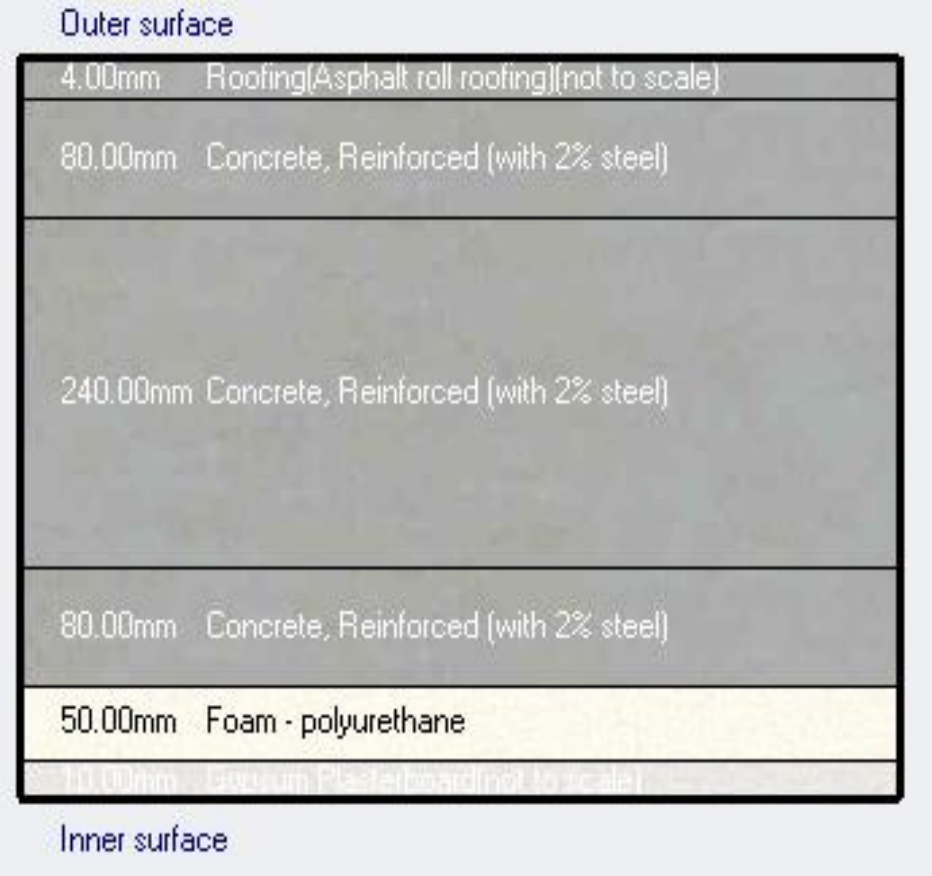
Thermal modification on glazing area:



Calculated Values	
Total solar transmission (SHGC)	0.282
Direct solar transmission	0.208
Light transmission	0.408
U-value (ISO 10292/ EN 673) (W/m2-K)	1.148
U-Value (W/m2-K)	**1.338**

❑ Heating and Cooling Loads:

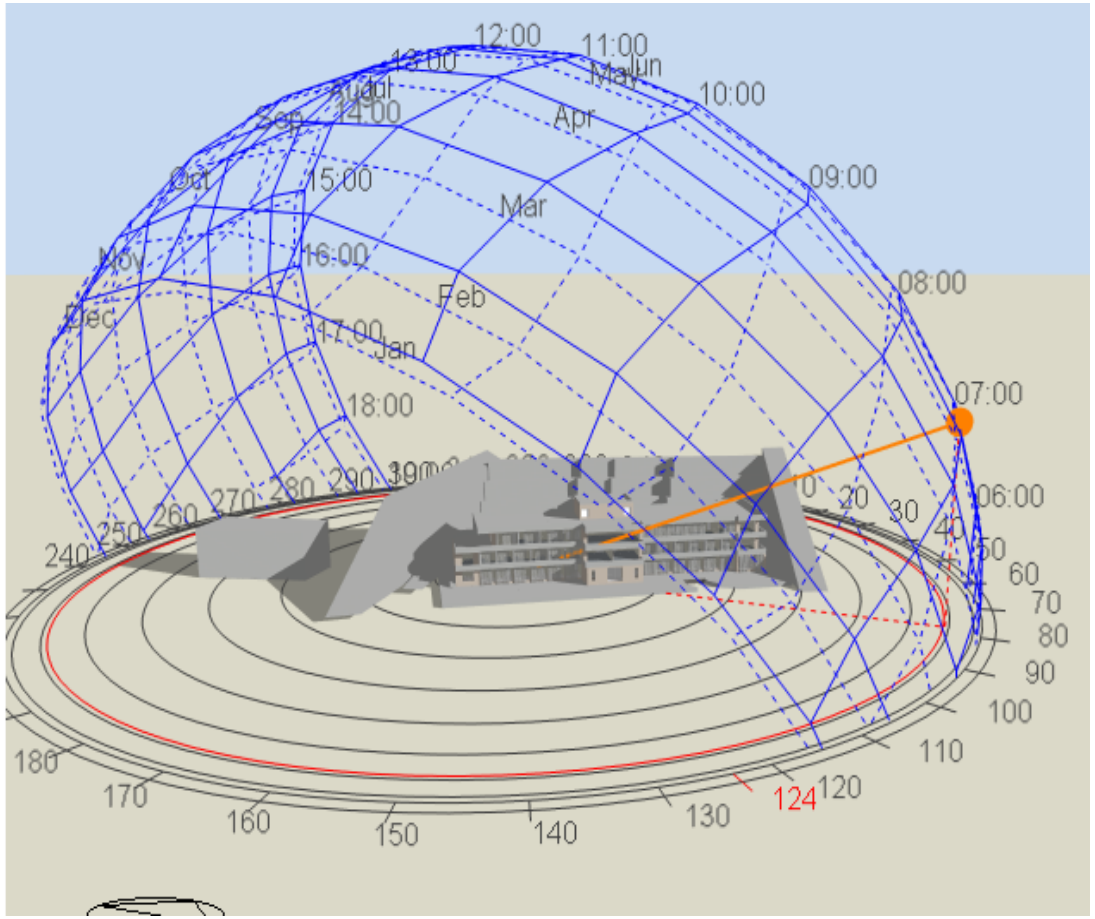
Thermal modification on external floor:

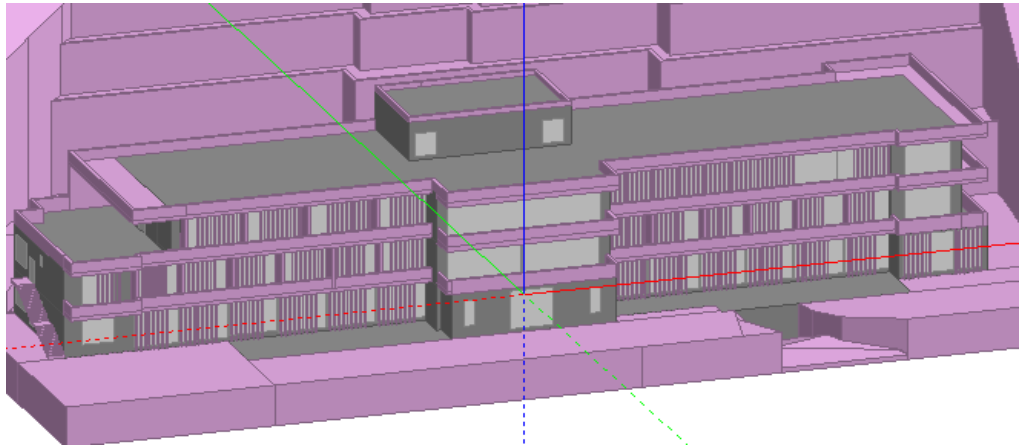


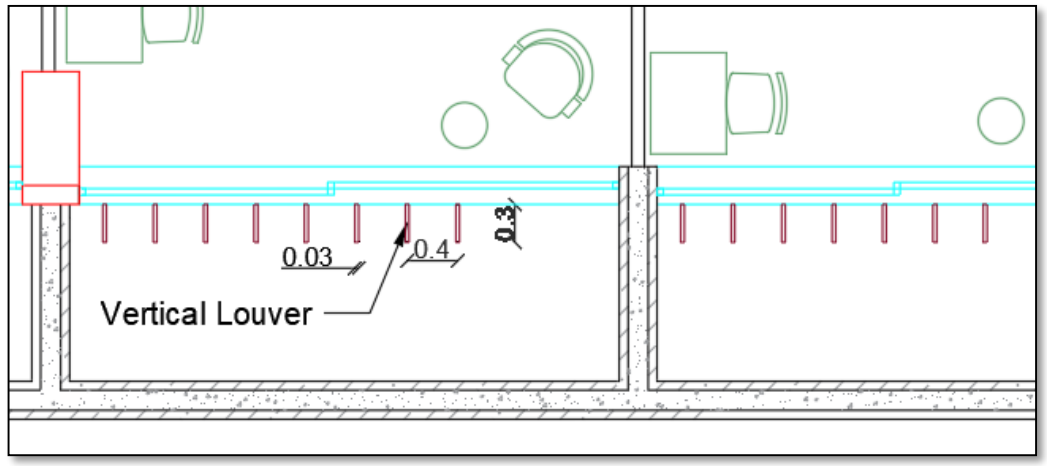
Inner surface	
Convective heat transfer coefficient (W/m2-K)	4.460
Radiative heat transfer coefficient (W/m2-K)	5.540
Surface resistance (m2-K/W)	0.100
Outer surface	
Convective heat transfer coefficient (W/m2-K)	19.870
Radiative heat transfer coefficient (W/m2-K)	5.130
Surface resistance (m2-K/W)	0.040
No Bridging	
U-Value surface to surface (W/m2-K)	0.497
R-Value (m2-K/W)	2.153
U-Value (W/m2-K)	**0.465**
With Bridging (BS EN ISO 6946)	
Thickness (m)	0.4640
Km - Internal heat capacity (KJ/m2-K)	107.2050
Upper resistance limit (m2-K/W)	2.193
Lower resistance limit (m2-K/W)	2.183
U-Value surface to surface (W/m2-K)	0.488
R-Value (m2-K/W)	2.188
U-Value (W/m2-K)	**0.457**

❑ Heating and Cooling Loads:

Shading modification (Vertical louvers):

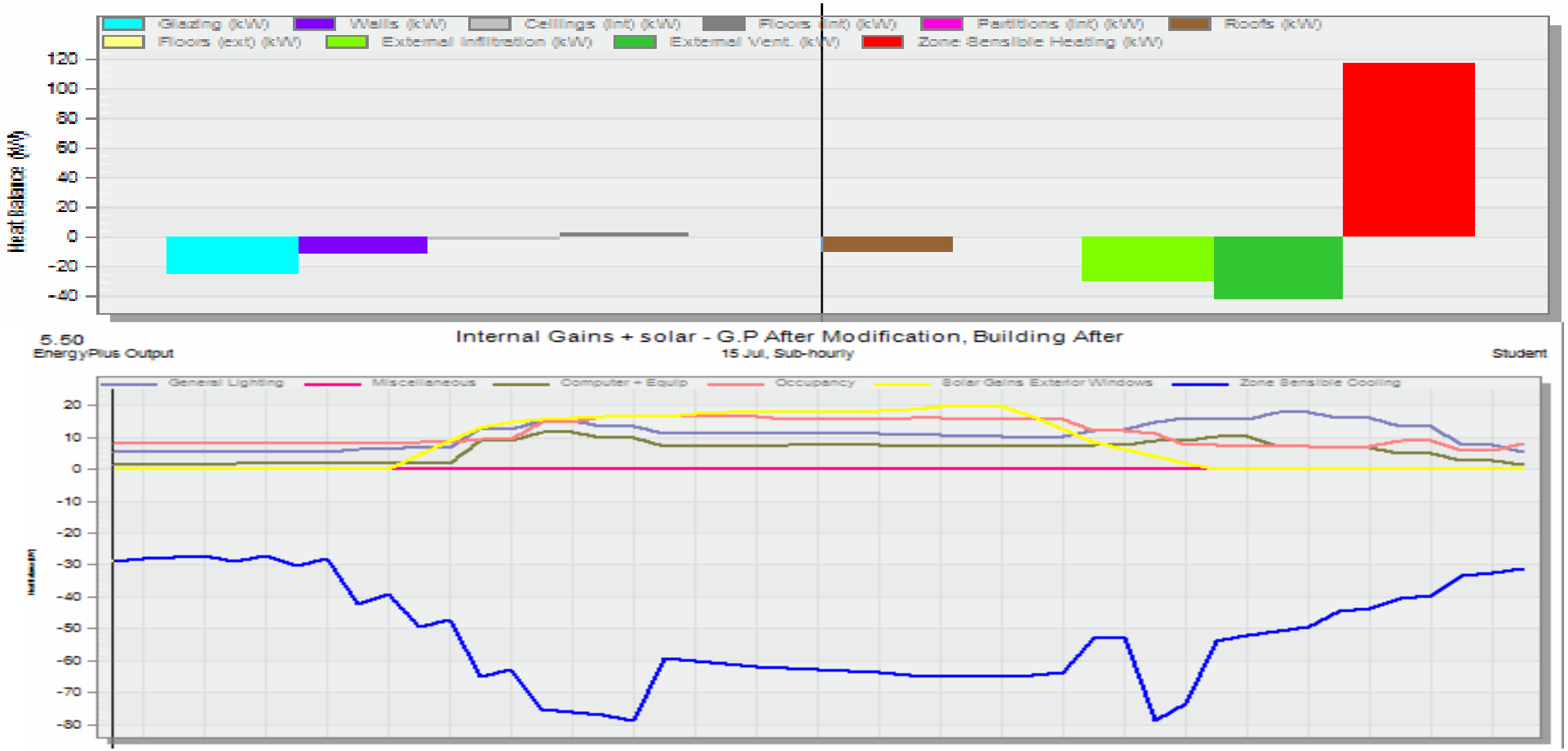






❑ Heating and Cooling Loads:

After thermal and shading modification:



The values of design cooling and heating load per floor area (W/m^2) for the spaces lie between (35-80) W/m^2 with an average of 42.2 W/m^2.

❑ Site and source energy:

Comparison between our building and baseline building:

Design Builder:

Site and Source Energy

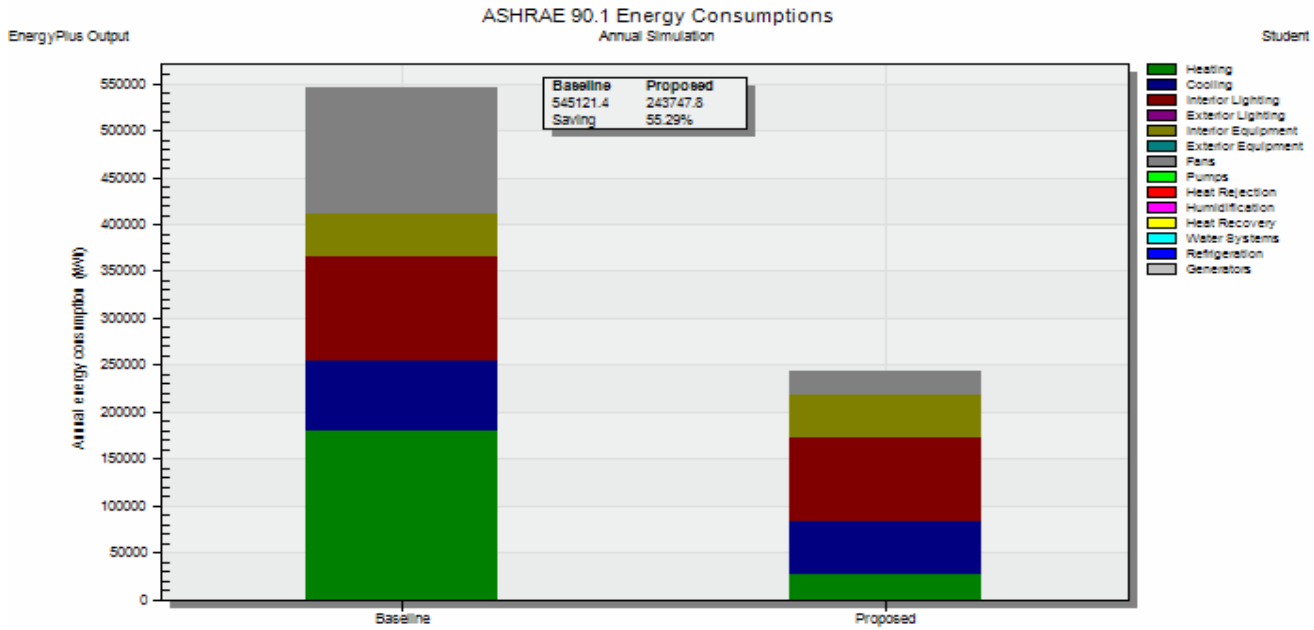
	Total Energy [kWh]	Energy Per Total Building Area [kWh/m2]	Energy Per Conditioned Building Area [kWh/m2]
Total Site Energy	361913.96	117.77	117.77
Net Site Energy	361913.96	117.77	117.77

Baseline building:

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI kBtu/ft²	Site EUI kBtu/ft²	Site Annual kWh/m²	Reference Data Source - Peer Group Comparison
Lodging/Residential	Barracks*		114.9	73.9	232.8	
	Hotel*		162.1	73.4	231.2	
	Multifamily Housing*		127.9	78.8	248.2	
	Prison/Incarceration		169.9	93.2	293.6	
	Residence Hall/Dormitory*		114.9	73.9	232.9	
	Senior Care Community*		243.2	125.7	396.0	
	Single Family Home		N/A	N/A	N/A	
	Other - Lodging/Residential		155.5	73.4	231.2	

❑ Site and source energy:

Comparison between our building and baseline building:

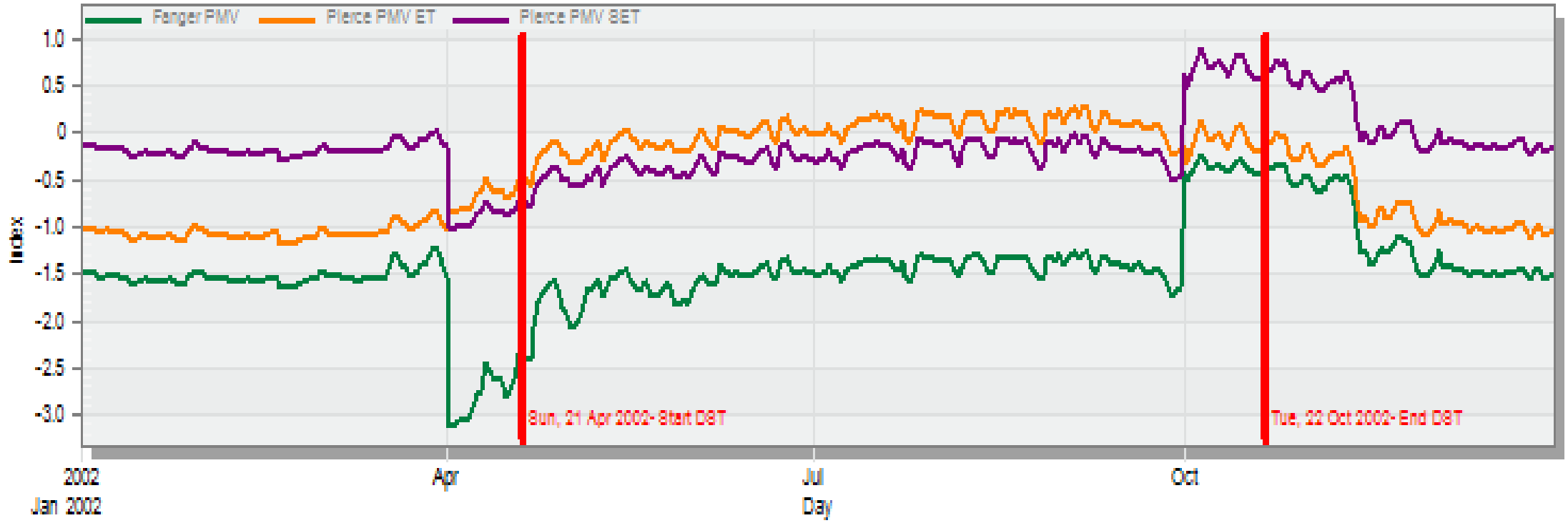


	Baseline	Proposed
Heating	180276.80	27199.18
Cooling	73222.02	55673.01
Interior Lighting	112610.82	89487.82
Exterior Lighting	0.00	0.00
Interior Equipment	45365.13	45365.13
Exterior Equipment	0.00	0.00
Fans	133646.64	26022.62
Pumps	0.00	0.00
Heat Rejection	0.00	0.00
Humidification	0.00	0.00
Heat Recovery	0.00	0.00
Water Systems	0.00	0.00
Refrigeration	0.00	0.00
Generators	0.00	0.00

Total energy saving of 55.29%.

❑ Thermal comfort:

PMV Index graph:



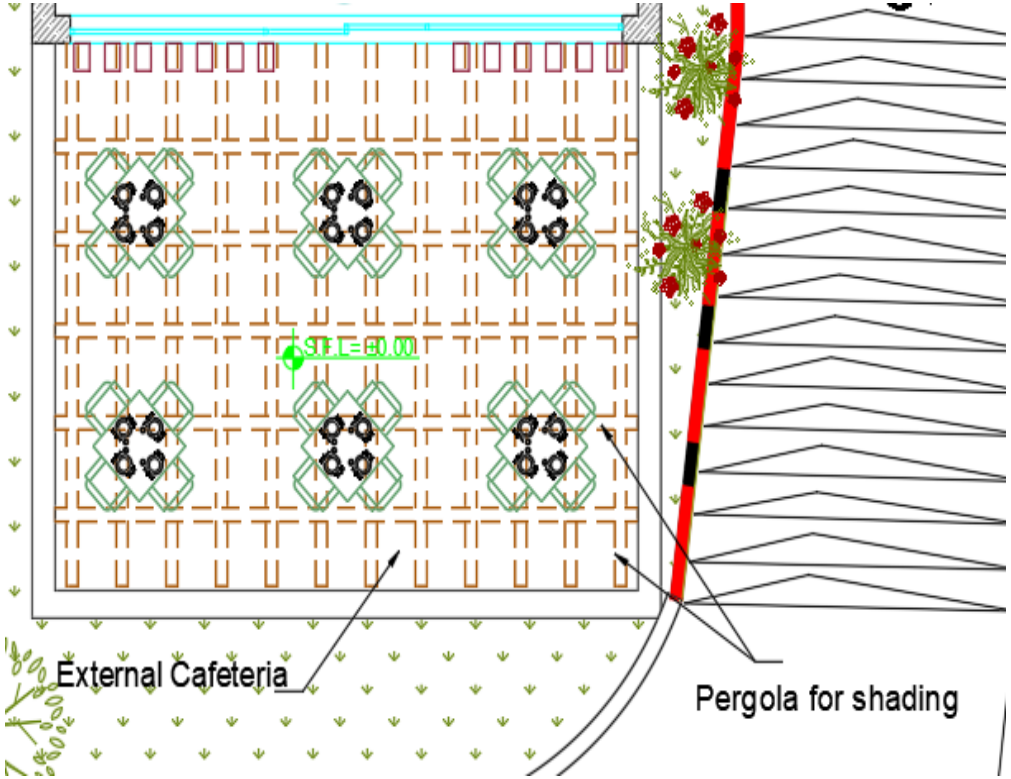
The values of the PMV index are in the range between (-1,1) which indicates that the comfort condition is good in the building.

❑ Shading Systems:

Natural Shading:

Garden and green areas

Artificial Shading:

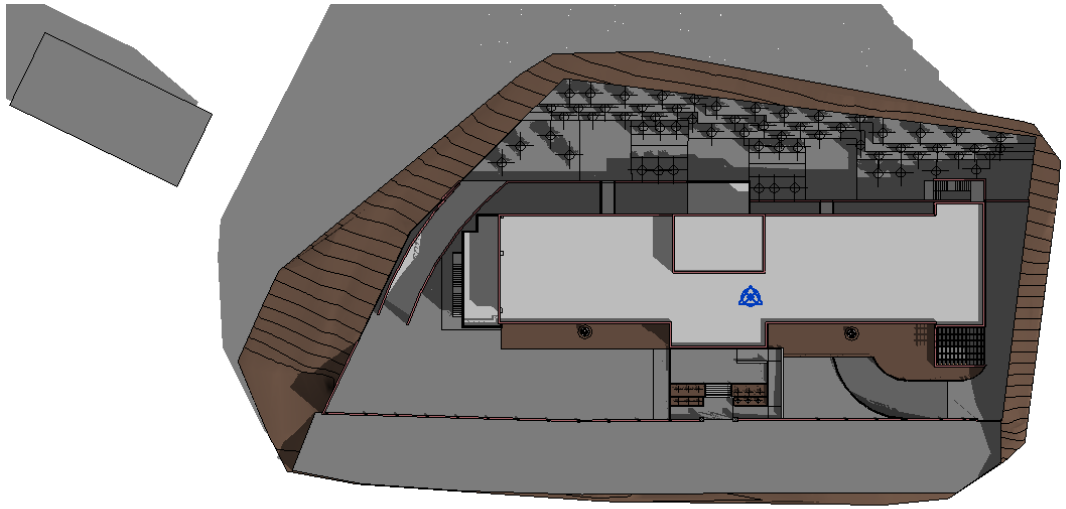


External Cafeteria

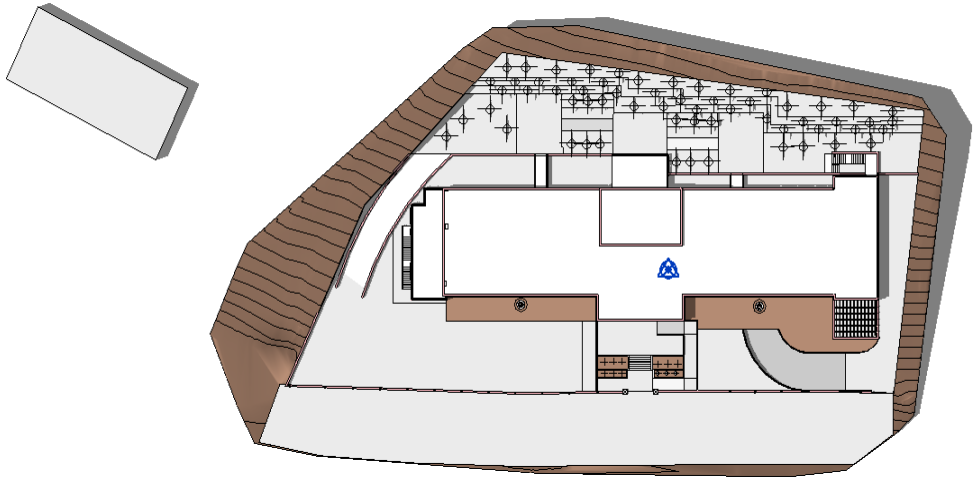
❑ Shadowing and Overshadowing Analysis:

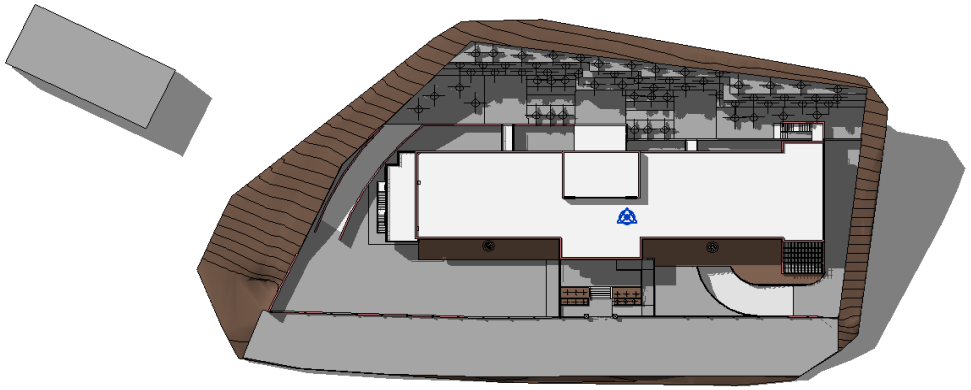
In Summer solstice (21/6/2021):

- **At 8:00 AM:**



- **At 12:00 PM:**



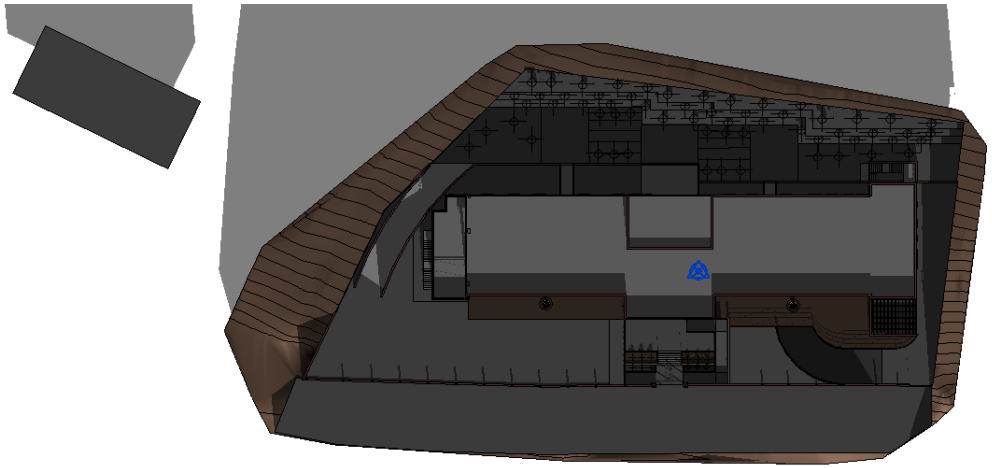


At 2:00 PM:

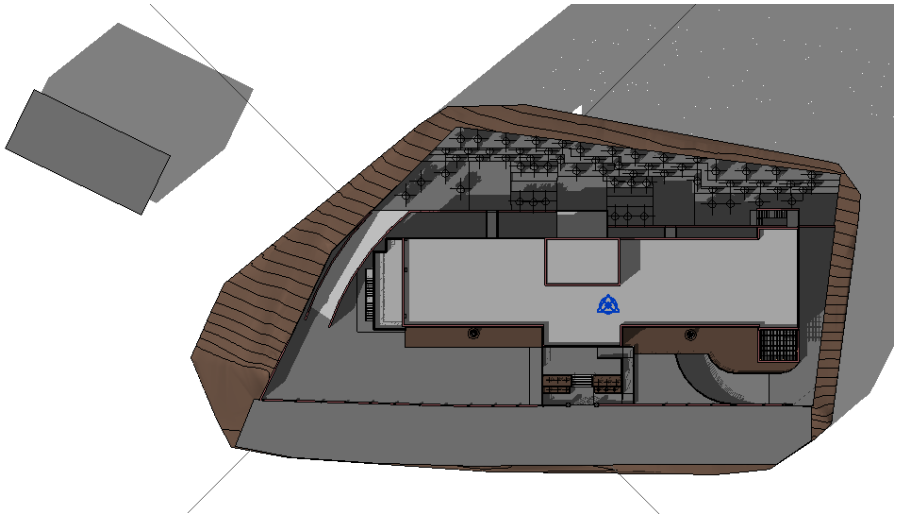
❑ Shadowing and Overshadowing Analysis:

In Winter solstice (21/6/2021):

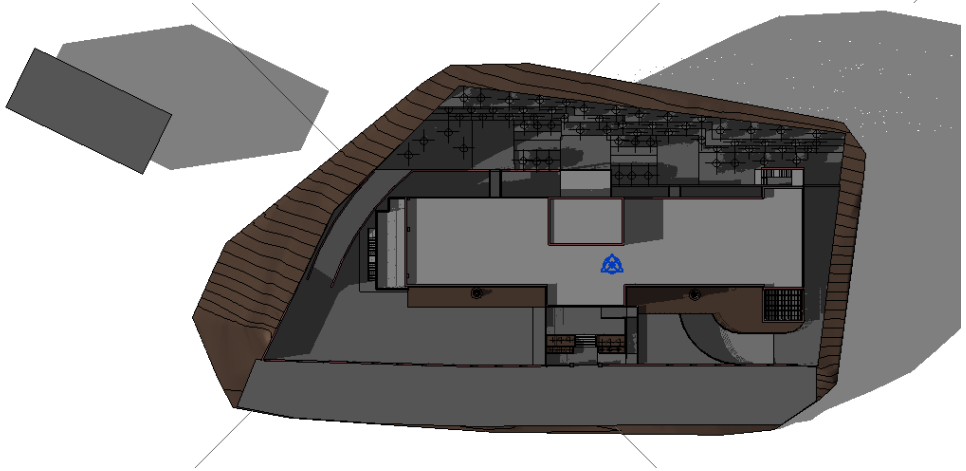
- **At 8:00 AM:**



- **At 12:00 PM:**



- **At 2:00 PM:**



Structural aspects

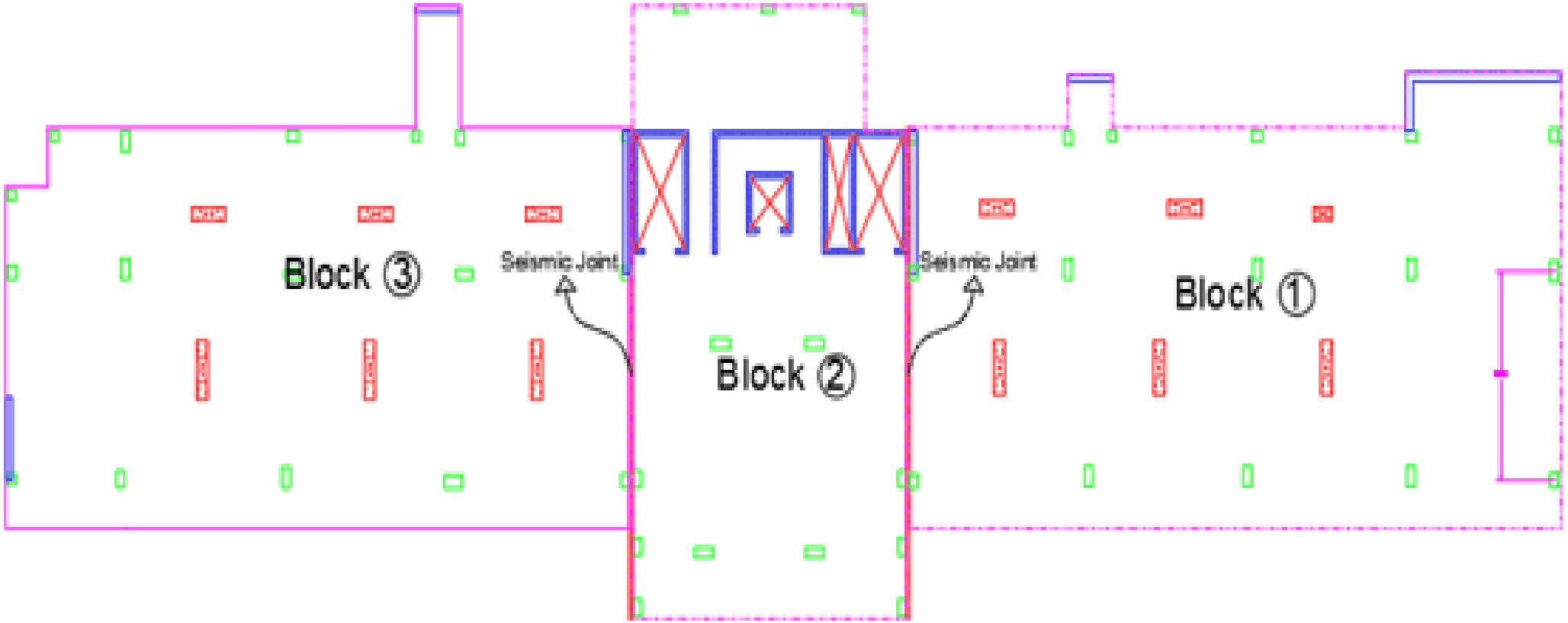
❑ Designing Data:

Designing Materials and loads:

Structural Component	Compressive Strength (f'c)	Unit weight (γ)
Columns and footings Slabs, beams, shear wall and basement wall	24 Mpa	25 kN/m^3

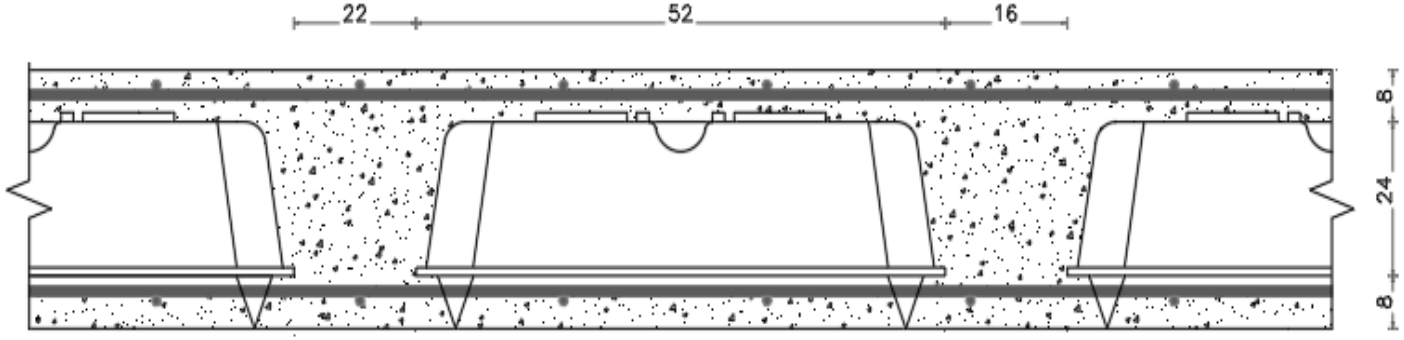
Specifications	Yield Stress (Fy)	Modulus of Elasticity (E)	Unit weight (γ)
Reinforcement Steel	420 Mpa	200 Gpa	78.5 kN/m^3

Load type	Unit Weight
Super Imposed dead load	4 kN/m^2
Live load	3 kN/m^2
Exterior perimeter wall	21 kN/m


Block ③
Seismic Joint
Block ②
Seismic Joint
Block ①

Structural System:

Structural System	Thickness of Slab	Height of U-Boot
Two –way voided with edge drop beams	40 cm	24 cm



Advantages of using U-Boot system:

- Great architectural freedom and large spans.
- Reduction of slab thickness.
- Reduction in the overall weight of structure.

Block NO. 1:

Beams:

Beam Section	Width	Depth
Main Drop Beam 1	600	850
Main Drop Beam 2	700	850
Edge Hidden beam	500	400
Shaft Beam	300	400

Columns:

Column section	Length of column (m)	Width of Column (m)
C1	0.45	0.4
C2	0.5	0.4
C3	0.6	0.45
C4	0.65	0.45
C5	0.9	0.45

Block NO. 2:

Beams:

Beam Section	Width	Depth
Main Drop Beam	500	850
Edge Hidden beam	600	400
Edge Hidden beam	500	400
Inverted beam	200	800
Shaft Beam	300	400

Columns:

Column section	Length of column (m)	Width of Column (m)
C1	0.7	0.3
C2	0.75	0.45
C3	1	0.45

Block NO. 3:

Beams:

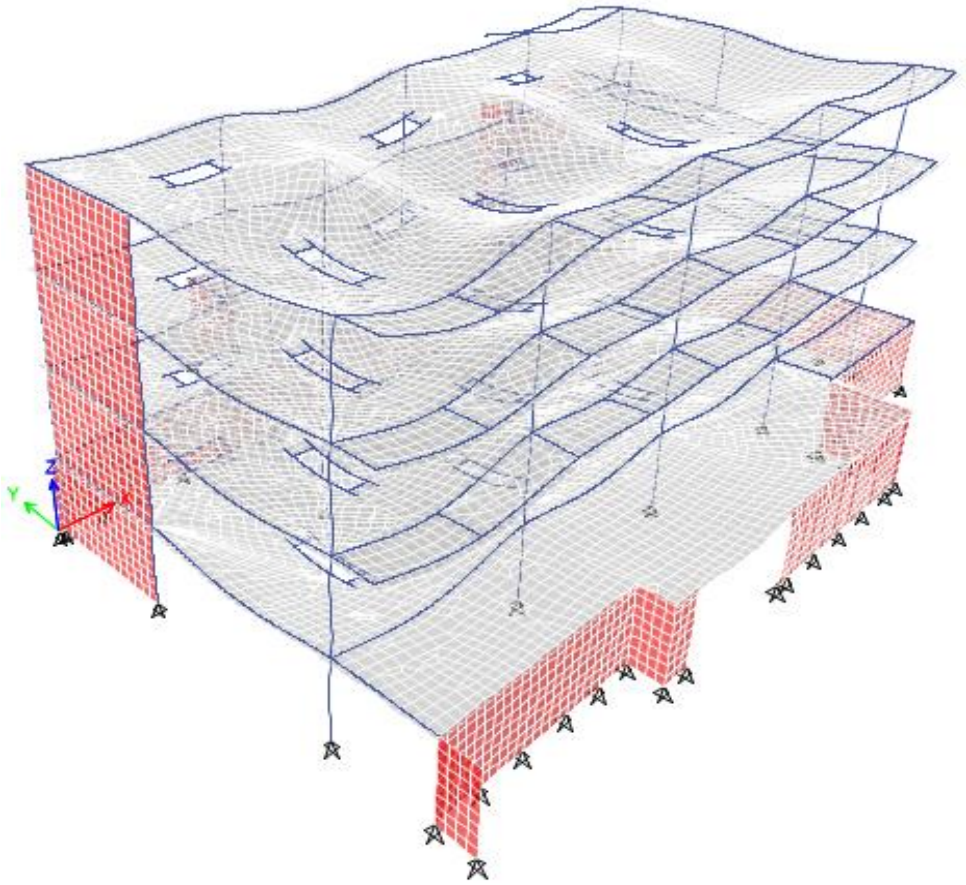
Beam Section	Width	Depth
Main Drop Beam	700	850
Edge Hidden beam	500	850
Edge Hidden beam	600	400
Edge Hidden beam	500	400
Shaft Beam	300	400

Columns:

Column section	Length of column (m)	Width of Column (m)
C1	0.45	0.4
C2	0.6	0.45
C3	0.75	0.45
C4	0.9	0.45
C5	1	0.55

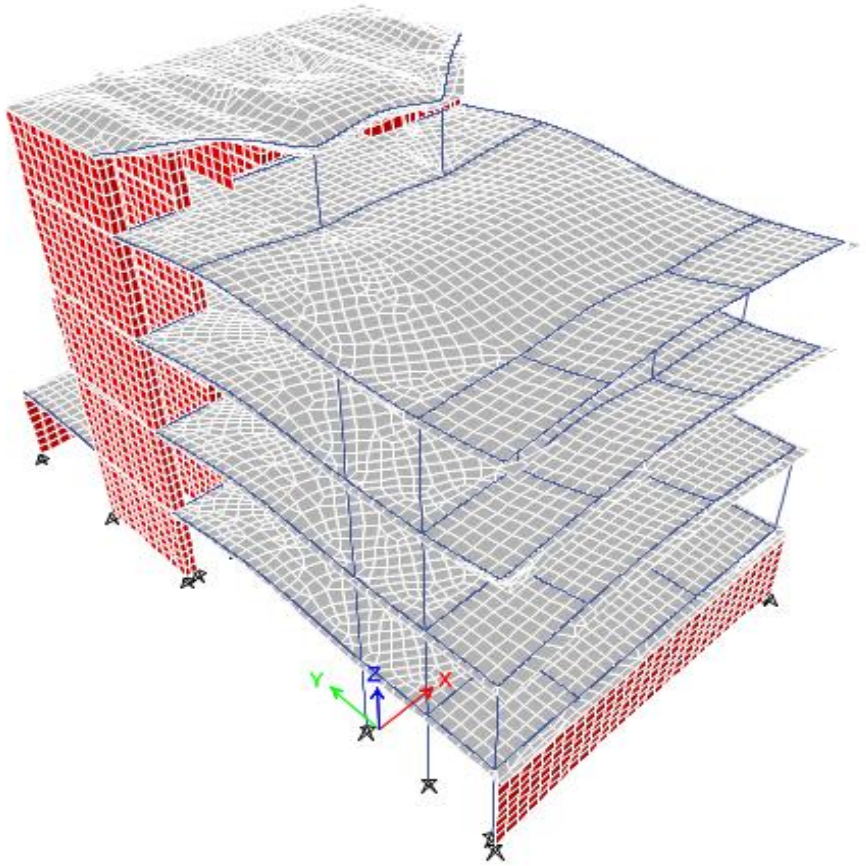
Block NO. 1:

Compatibility Check:



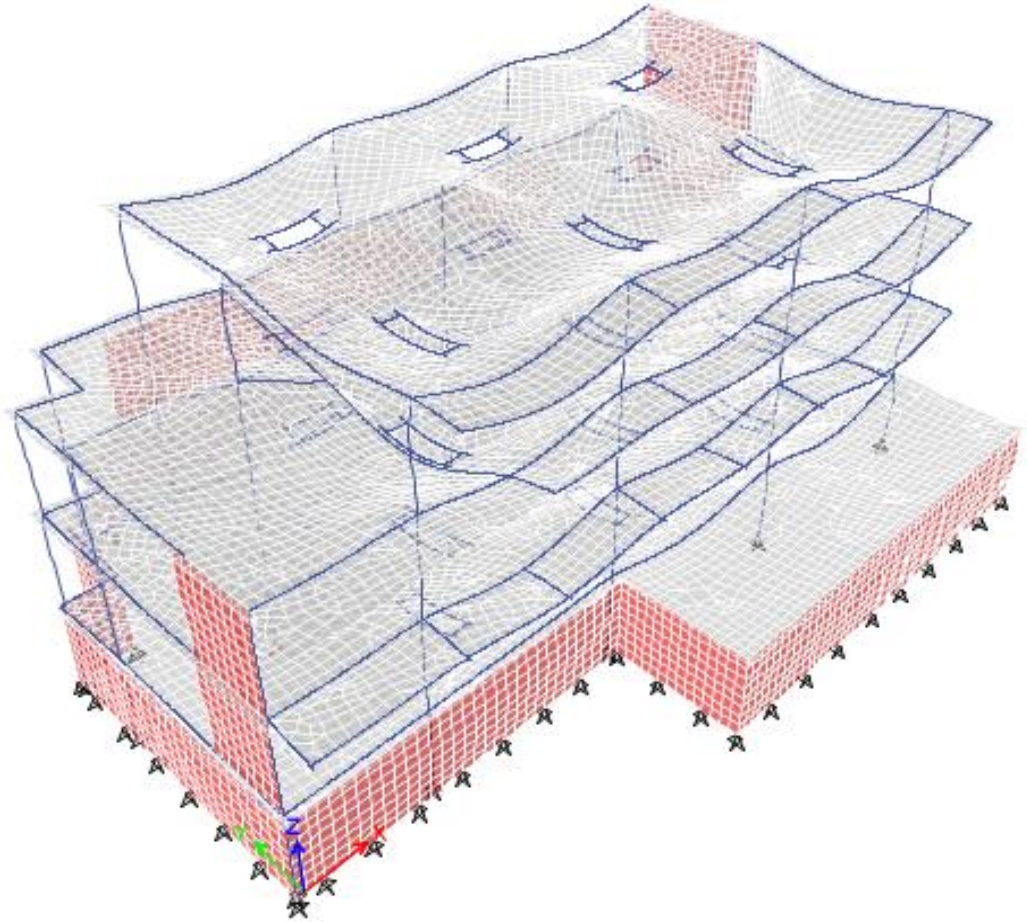
Block NO. 2:

Compatibility Check:



Block NO. 3:

Compatibility Check:



Equilibrium Check:

Block no.	Load	ETABS	Manual	Error percentage	Allowable limit	check status
1	Dead	27053.67	27287.8195	0.86 %	5%	Ok
	Live	7917.17	8058.81	1.7 %	5%	Ok
	Super Imposed	16379.16	16808.83	2.6 %	5%	Ok
2	Dead	18883.49	18969.167	0.453%	5%	Ok
	Live	3842.0369	3842.03	≈ 0.0%	5%	Ok
	Super Imposed	9286.95	9229.4	0.619%	5%	Ok
3	Dead	18883.49	18969.167	0.453%	5%	Ok
	Live	3842.0369	3842.03	≈ 0.0%	5%	Ok
	Super Imposed	9286.95	9229.4	0.619%	5%	Ok

Slab Layout:

Stress-Strain Check:

Summery for all blocks:

Structural element	Block no.	ETABS	Manual	Error percentage	allowable limit	check status
C1	1	123.38	133.2	7.9 %	15%	Ok
C3	1	401.7	367.2	8.5%	15%	Ok
C5	1	890.15	808.8	9.1%	15%	Ok
Frame	1	511.3	438.68	14.2%%	15%	Ok
Column Strip	1	378.3	329	13.01%	15%	Ok
C2	2	30.14	28.5	5.4%	15%	Ok
C1	2	90.01	80.4	10.6%	15%	Ok
C1	3	148	139.5	5.7%	15%	Ok
Edge Beam	2	22.45	24	6.9%	15%	Ok
Frame	3	455.56	439.93	3.4%	15%	Ok
Column Strip	3	413.45	392.94	4.96%	15%	Ok

Other Designing Checks:

Summery for block no.1:

Check Name	ETABs results	Allowable limit	Check status
Immediate deflection of slab	7.15 mm	23.9 mm	Ok
Long-term deflection of slab	31.2 mm	35.9 mm	Ok
Immediate deflection of Beam	1.43 mm	28.63 mm	Ok
Long-term deflection of beam	8.31 mm	42.93 mm	Ok
Shear capacity of slab	Vu ≤ 230 *kN/m*	*ØVc=230.6 kN/m*	Ok
Punching Shear factor	≤ 0.9	1	Ok
Check doubly for beam	Mu =596.20 kN.m	$ØM_n$ =1497.84 kN.m	Ok

Other Designing Checks:

Summery for block no.2:

Check Name	ETABs results	Allowable limit	Check status
Immediate deflection of slab	3.6 mm	25.69 mm	Ok
Long-term deflection of slab	10.2 mm	13.2 mm	Ok
Immediate deflection of Beam	0.955 mm	28 mm	Ok
Long-term deflection of beam	5.535 mm	42 mm	Ok
Shear capacity of slab	Vu ≤ 230 *kN/m*	*ØVc=230.6 kN/m*	Ok
Punching Shear factor	≤ 0.486	1	Ok
Check doubly for beam	Mu =347.23 kN.m	$ØM_n$ =1497.84 kN.m	Ok

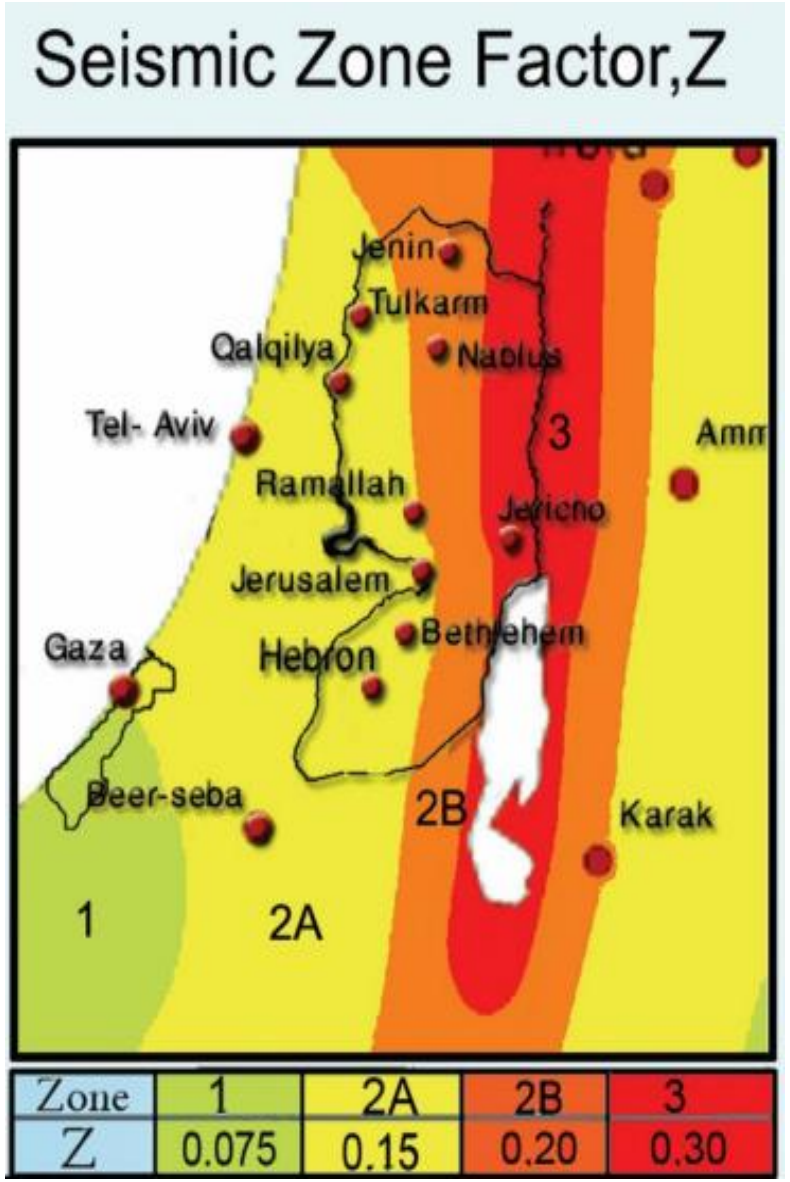
Other Designing Checks:

Summery for block no.3:

Check Name	ETABs results	Allowable limit	Check status
Immediate deflection of slab	6.4 mm	25 mm	Ok
Long-term deflection of slab	37.2 mm	37.5 mm	Ok
Immediate deflection of Beam	1.424 mm	25 mm	Ok
Long-term deflection of beam	8.69 mm	37.5 mm	Ok
Shear capacity of slab	Vu ≤ 230 *kN/m*	*ØVc=230.6 kN/m*	Ok
Punching Shear factor	≤ 0.891	1	Ok
Check doubly for beam	Mu =881.28 kN.m	$ØM_n$ =1497.84 kN.m	Ok

❑ Seismic Data:

- **The used seismic code is UBC 97**
- **The seismic zone factor (Z)=0.2**
- **The soil profile type is Sc.**
- **Seismic coefficient factor (Cv) =0.32**
- **Seismic coefficient factor (Ca) =0.24**
- **The ductility factor (R) =5.5**
- **The importance factor (I) = 1**
- **The adopted used method is Response spectrum.**



Seismic Checks:

Summery for block no.1:

Check Name	ETABs results	Allowable limit/Manual limit.	Check status
Period check	0.518 sec.	< 0.566 sec	Ok
Modal participating ratio	96.4%	> 90%	Ok
Base shear	$V_{base\ shear}$ =4946.55 kN.	$V_{base\ shear} \leq V_{max}$ =4946.55 kN.	Ok
Drift check	ΔM_X=57.2	ΔM_{All} =86.4	Ok
P-Delta effect	θ_x =0.0007	≤ 0.1	Ok

Seismic Checks:

Summery for block no.2:

Check Name	ETABs results	Allowable limit/Manual limit.	Check status
Period check	0.55 sec	< 0.566 sec	Ok
Modal participating ratio	93.07%	> 90%	Ok
Base shear	$V_{base\ shear}$ =3177.91 kN.	$V_{base\ shear} \leq V_{max}$ =3177.92 kN.	Ok
Drift check	ΔM_X=25.9	ΔM_{All} =75	Ok
P-Delta effect	θ_x =0.00187	≤ 0.1	Ok

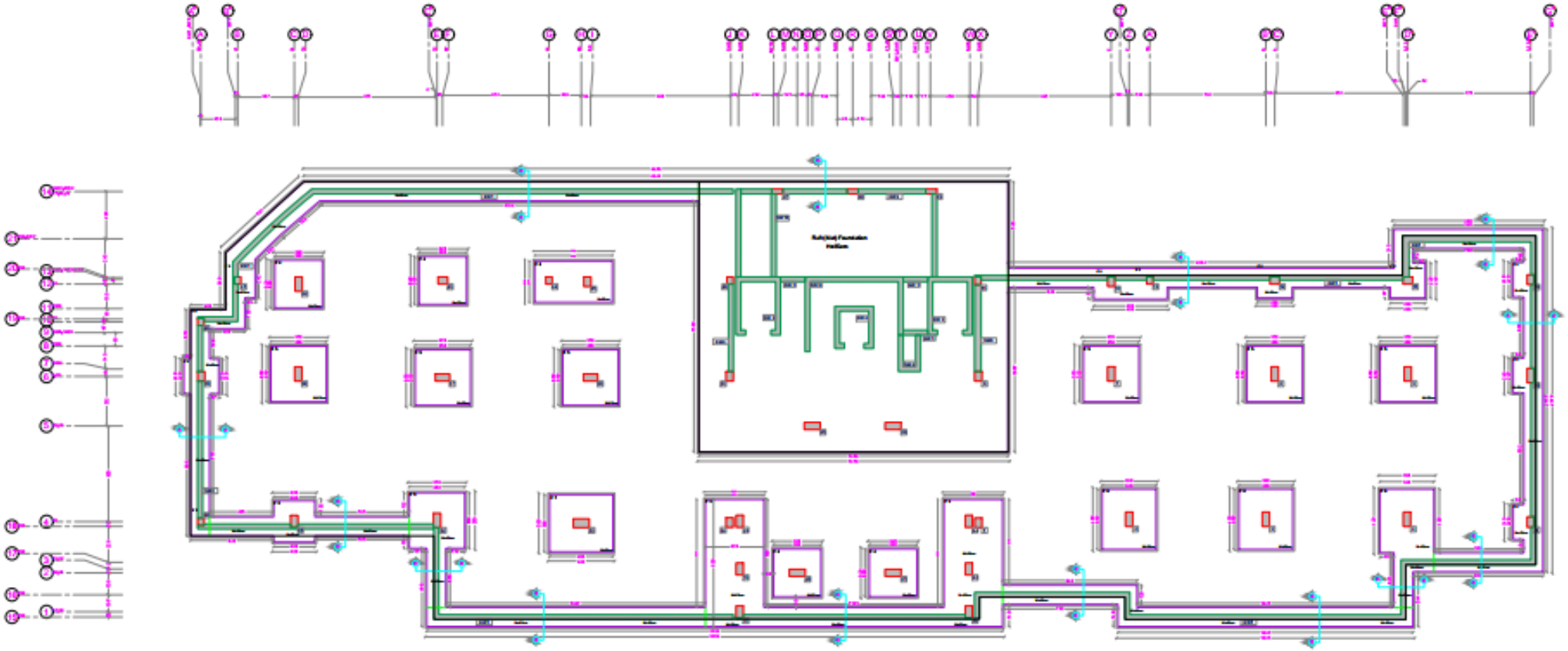
Seismic Checks:

Summery for block no.3:

Check Name	ETABs results	Allowable limit/Manual limit.	Check status
Period check	0.565 sec.	< 0.566 sec	Ok
Modal participating ratio	92.7%	> 90%	Ok
Base shear	$V_{base\ shear}$ =4570.46 kN.	$V_{base\ shear} \leq V_{max}$ =4570.47kN.	Ok
Drift check	ΔM_X=64.7	ΔM_{All} =86.4	Ok
P-Delta effect	θ_x =0.0289	$\leq$ 0.1	Ok

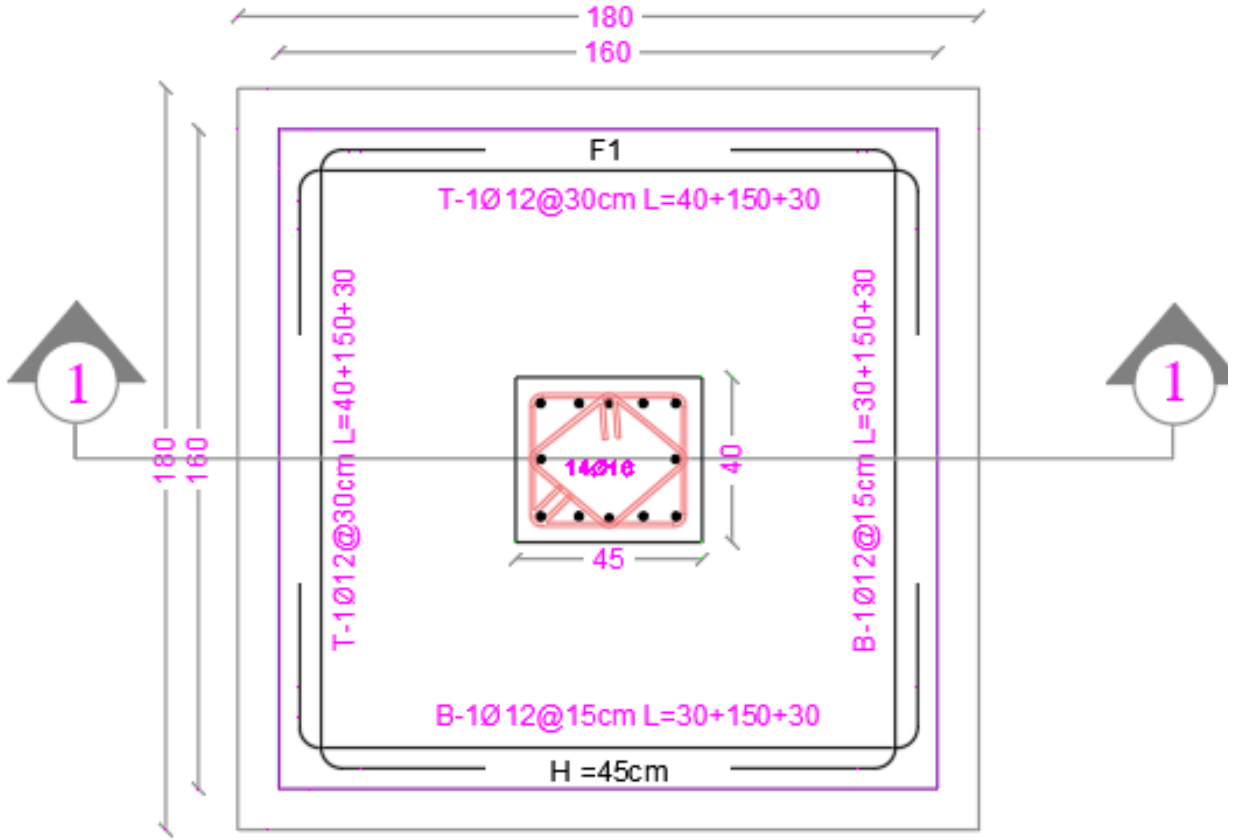
Structural detailing:

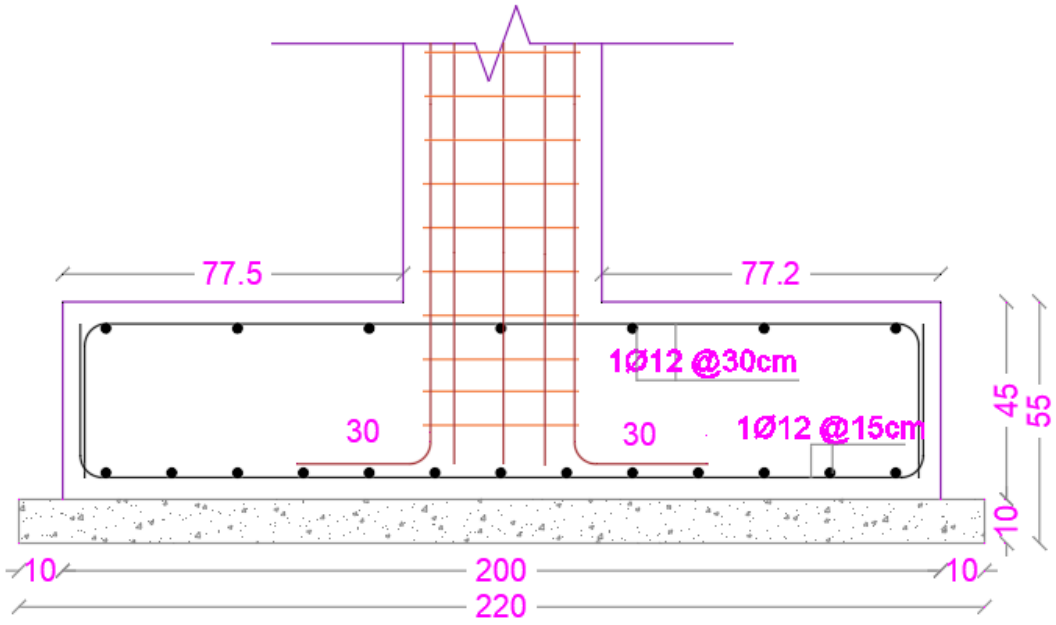
Footing layout:



Structural detailing:

Footing details:

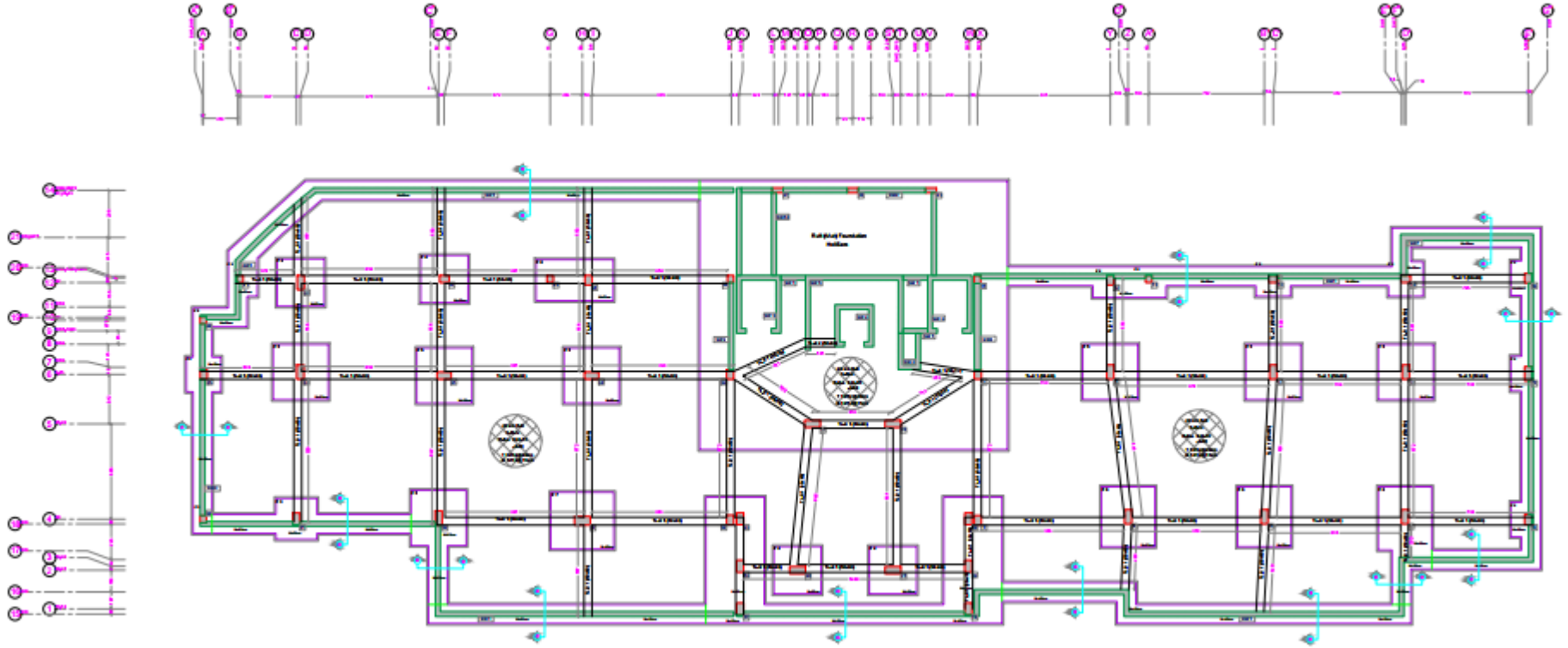




Section 1-1

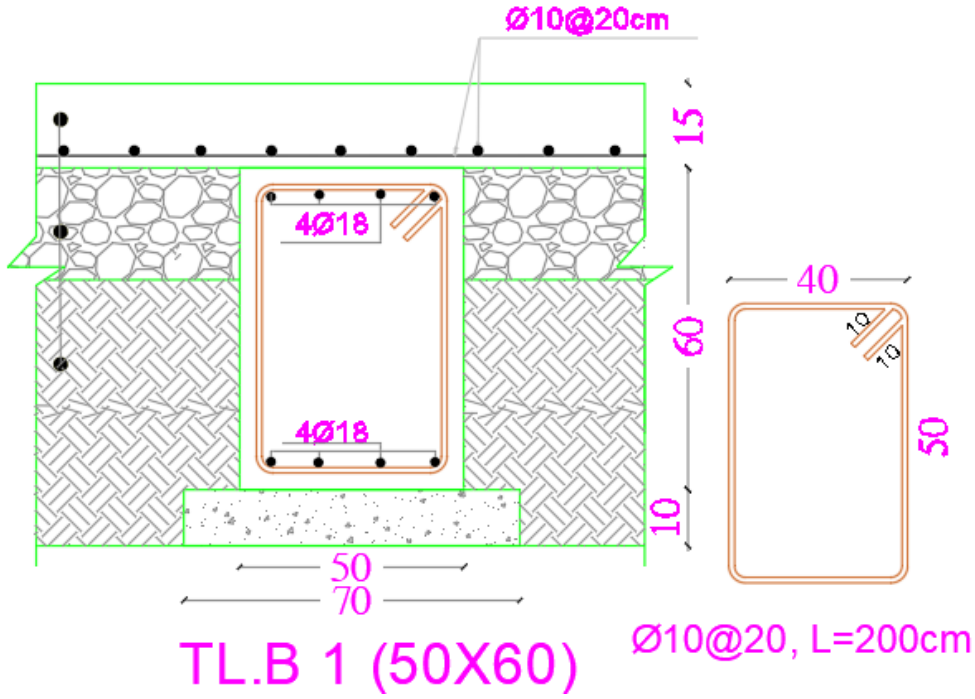
Structural detailing:

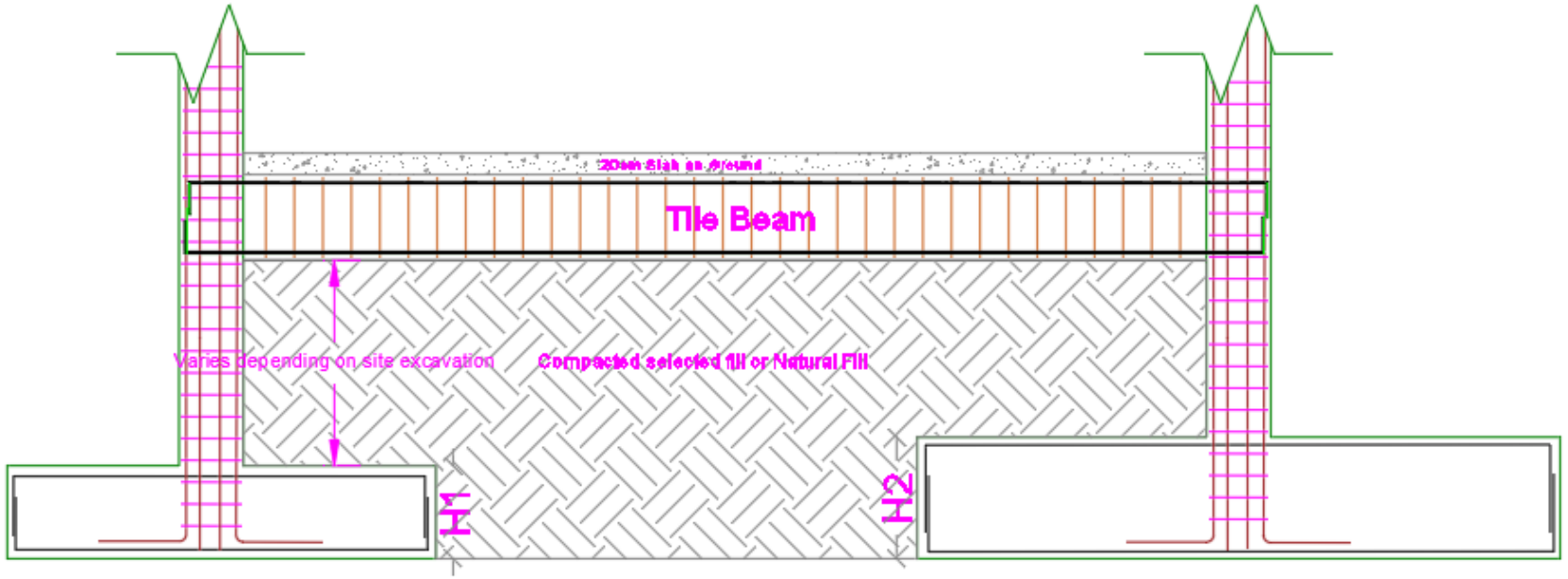
Tie-beams layout:



Structural detailing:

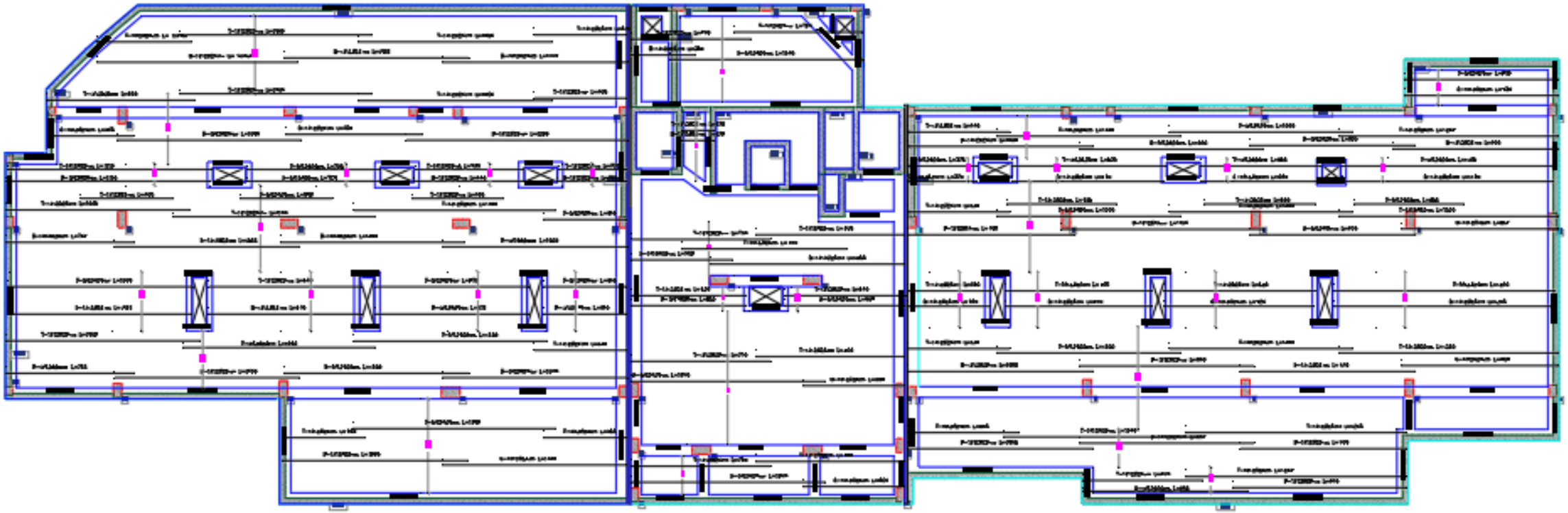
Tie-beam details:





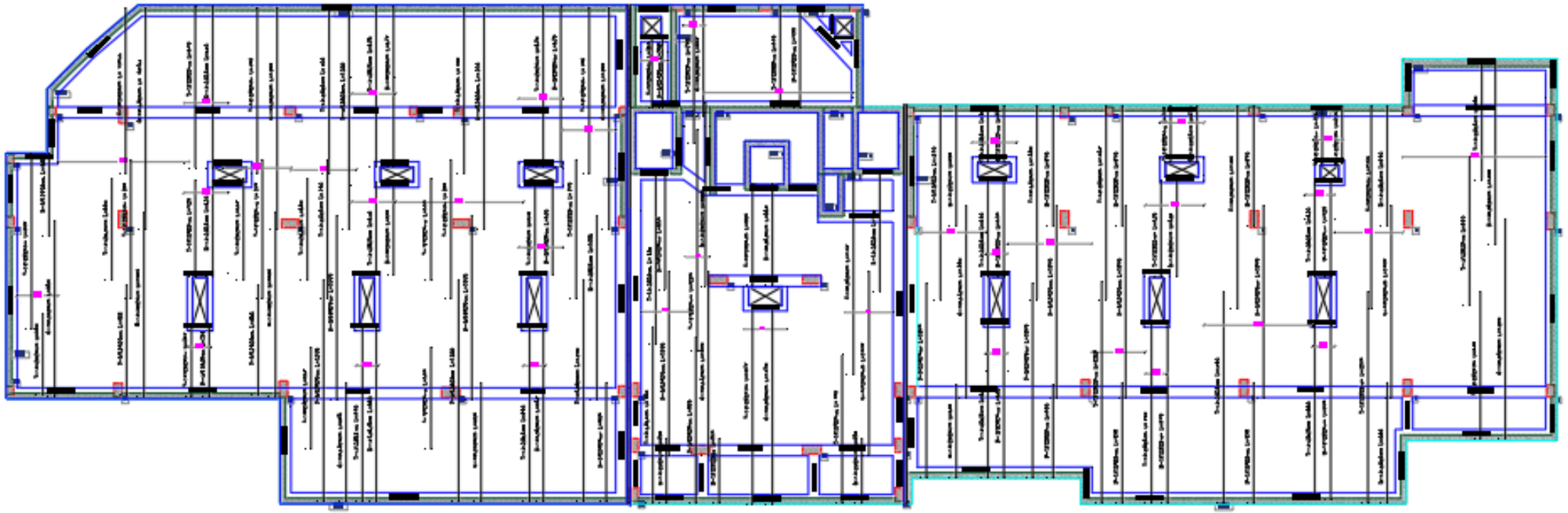
Structural detailing:

Slab reinforcement in x-direction:



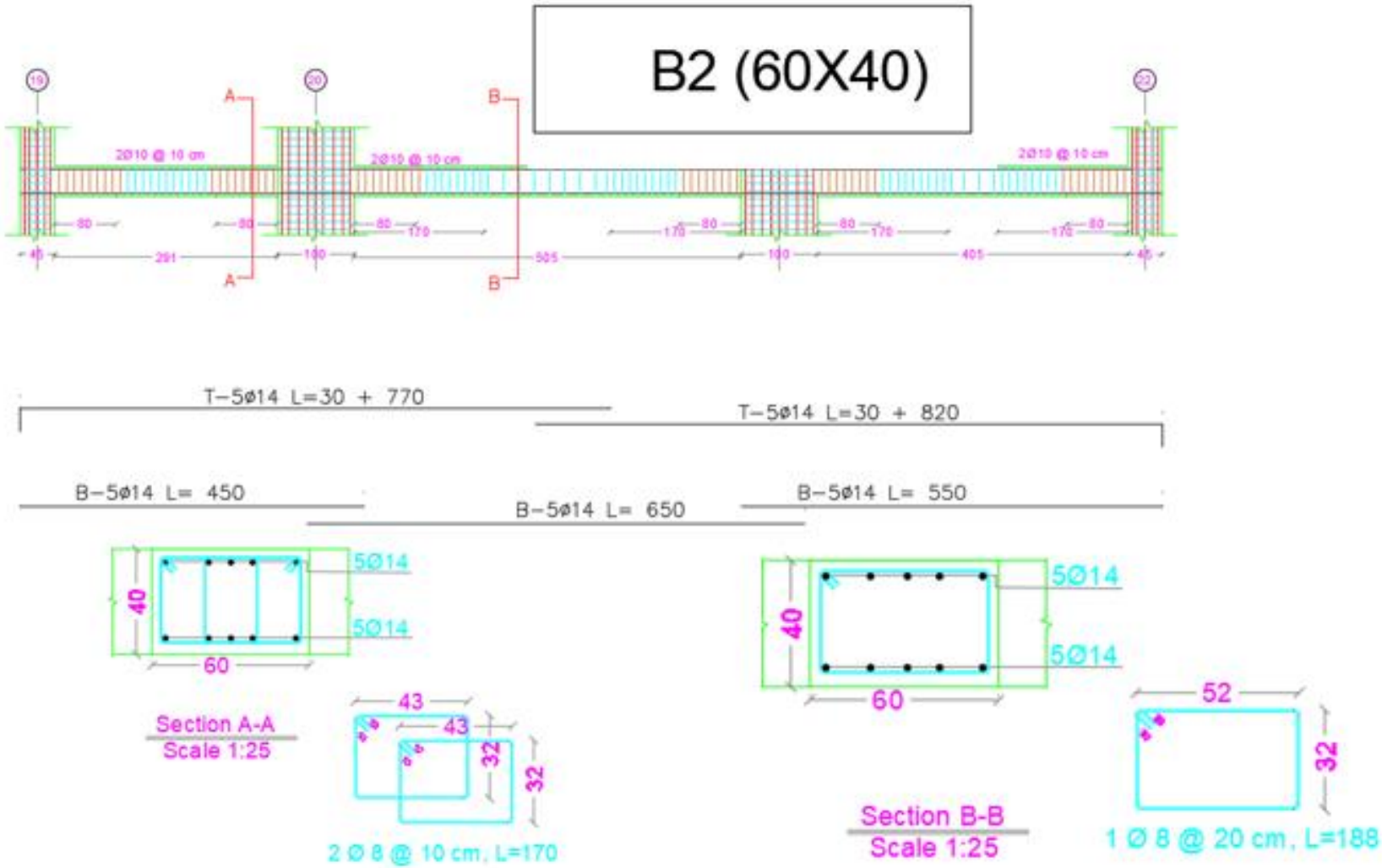
Structural detailing:

Slab reinforcement in y-direction:



Structural detailing:

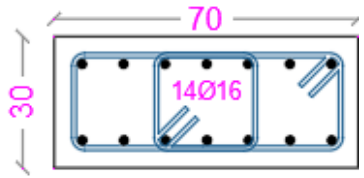
Beam Details:

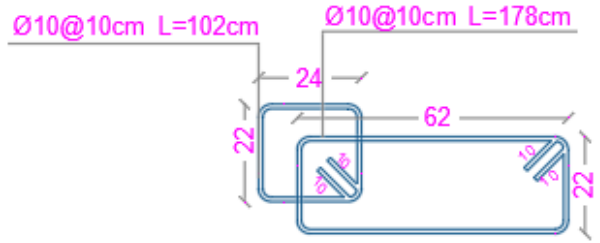


Structural detailing:

Column Details:

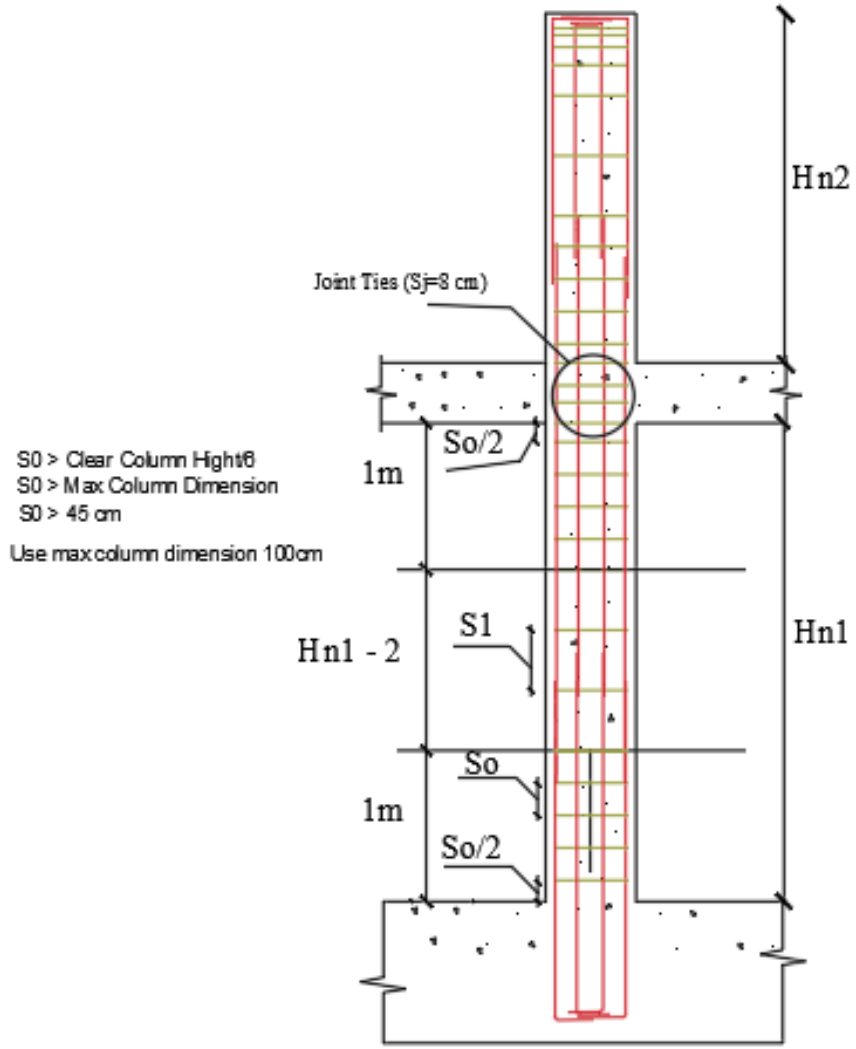
C 1





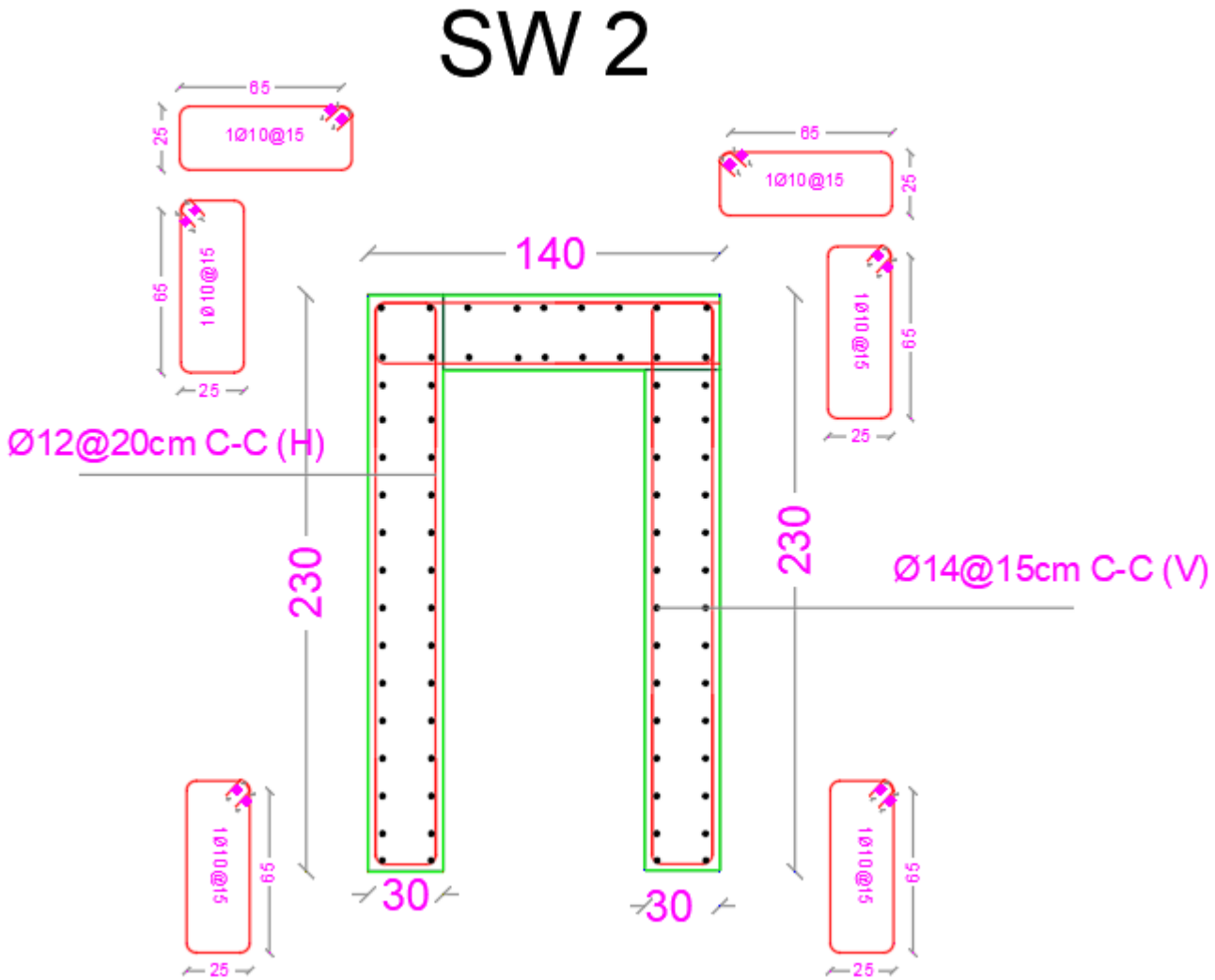
Ø10@10cm (At End)
Ø10@15cm (At Middle)

General Detailed Drawing of Columns reinforcment:



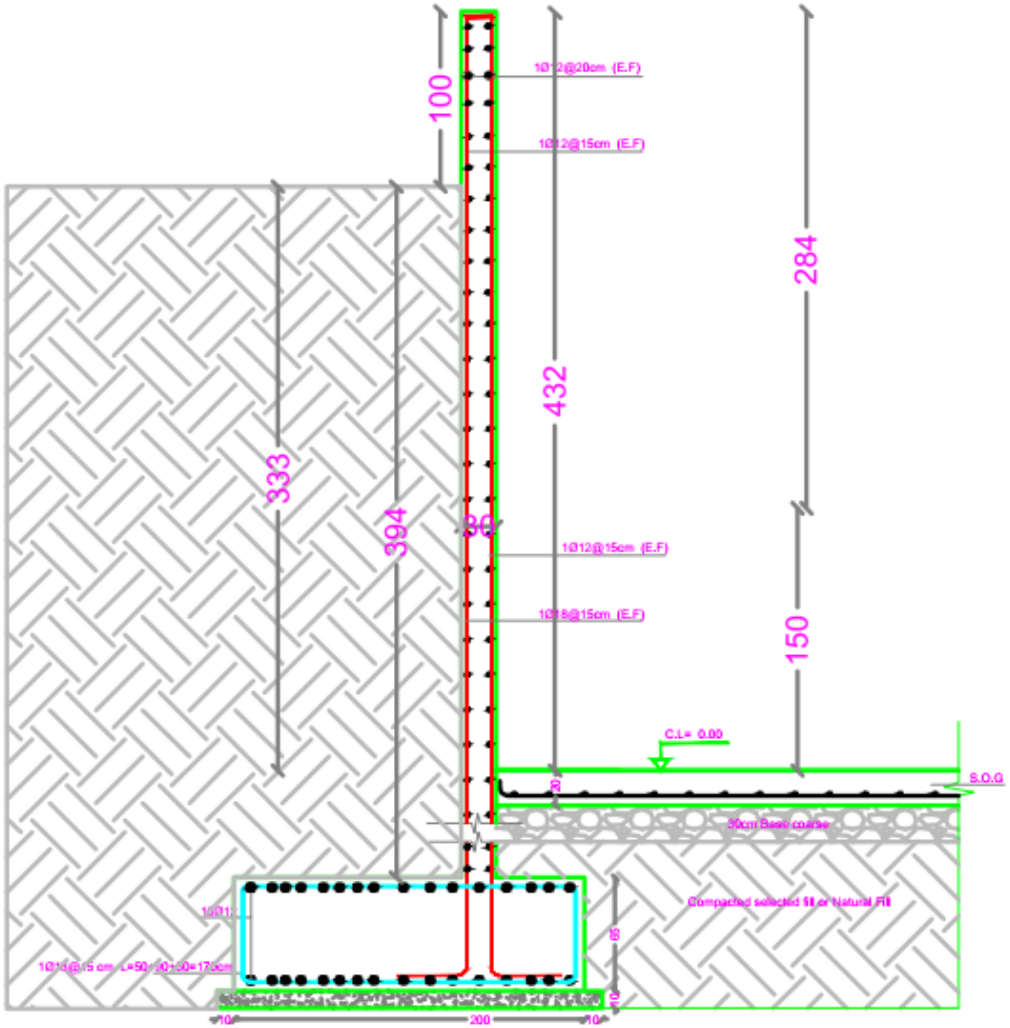
Structural detailing:

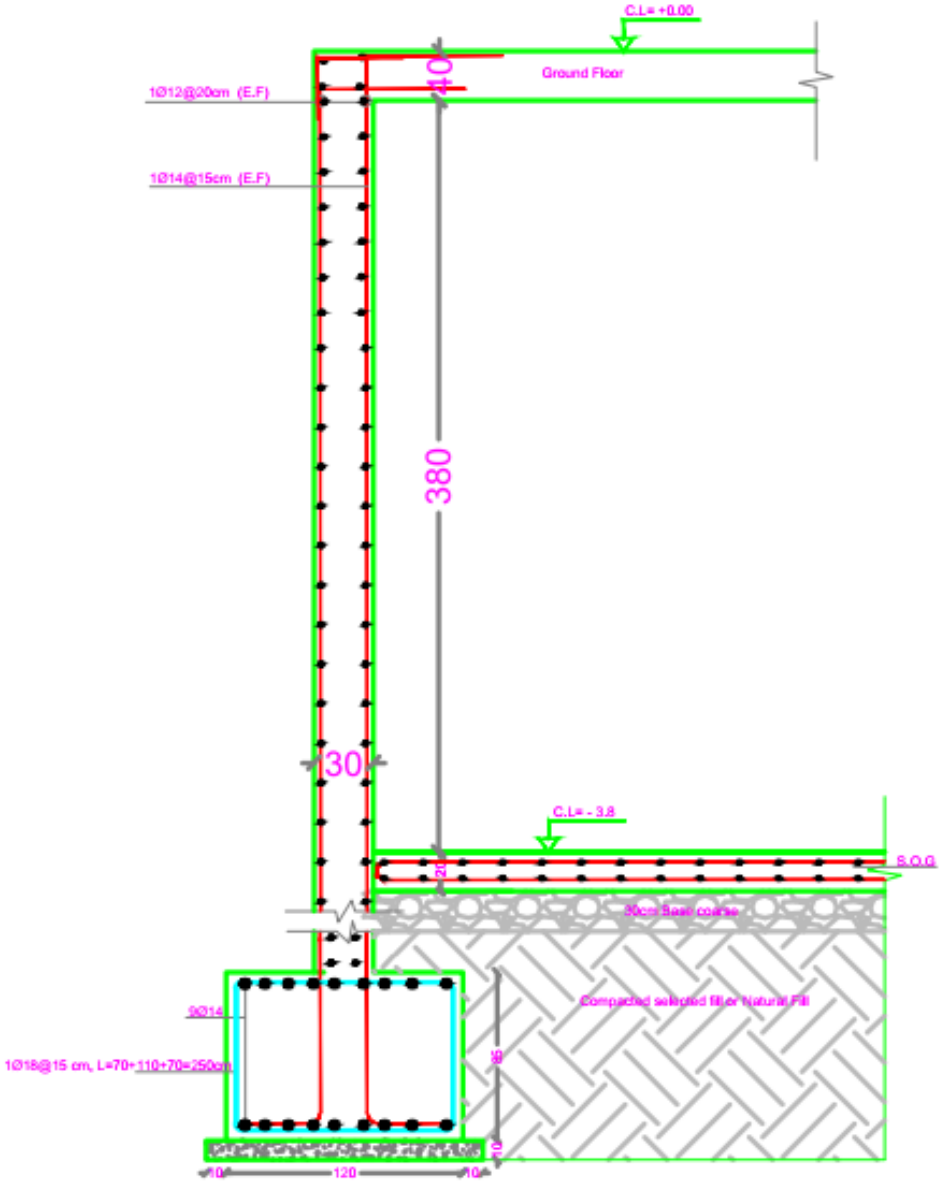
Shear wall Details:



Structural detailing:

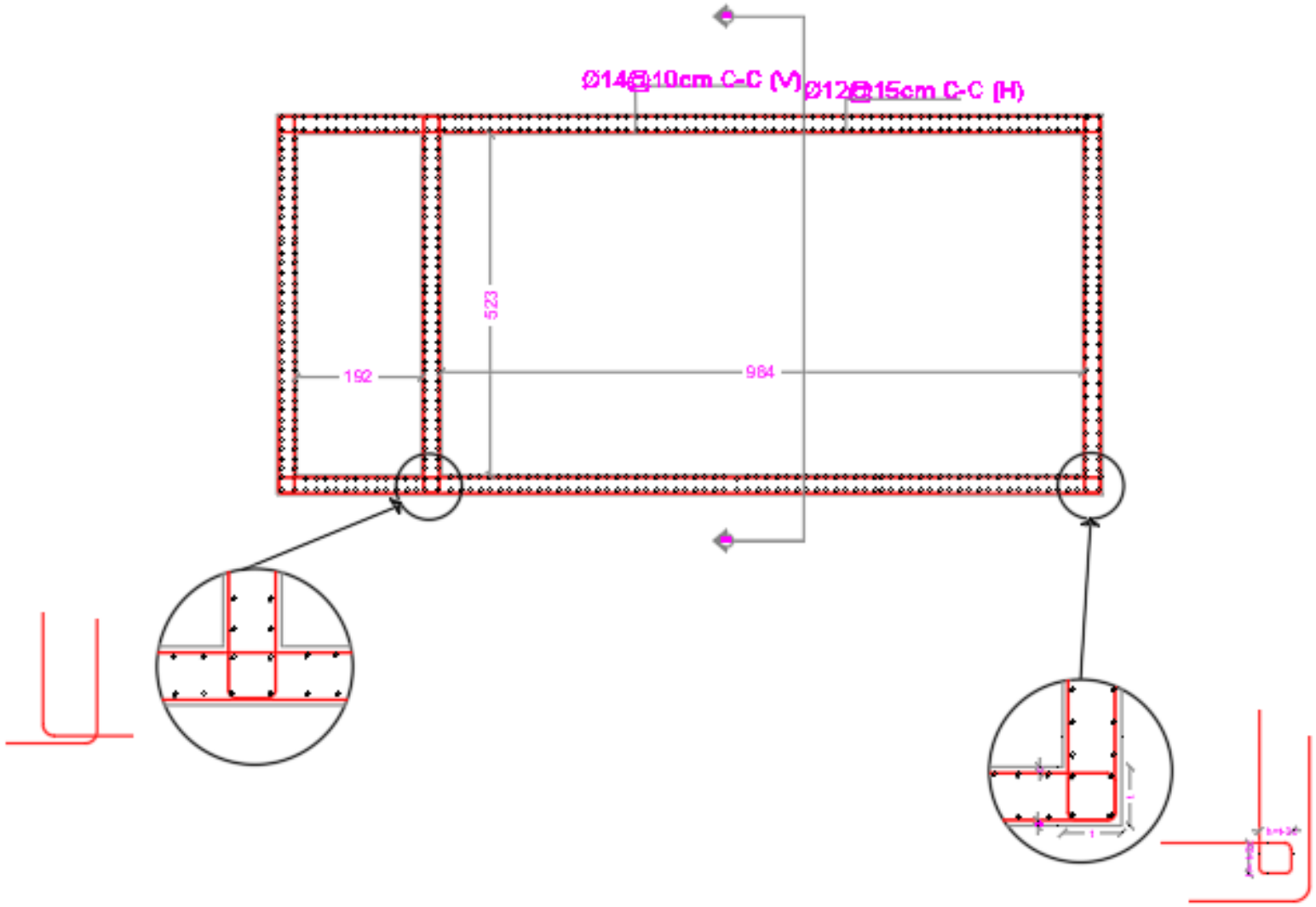
Retaining & Basement Details:





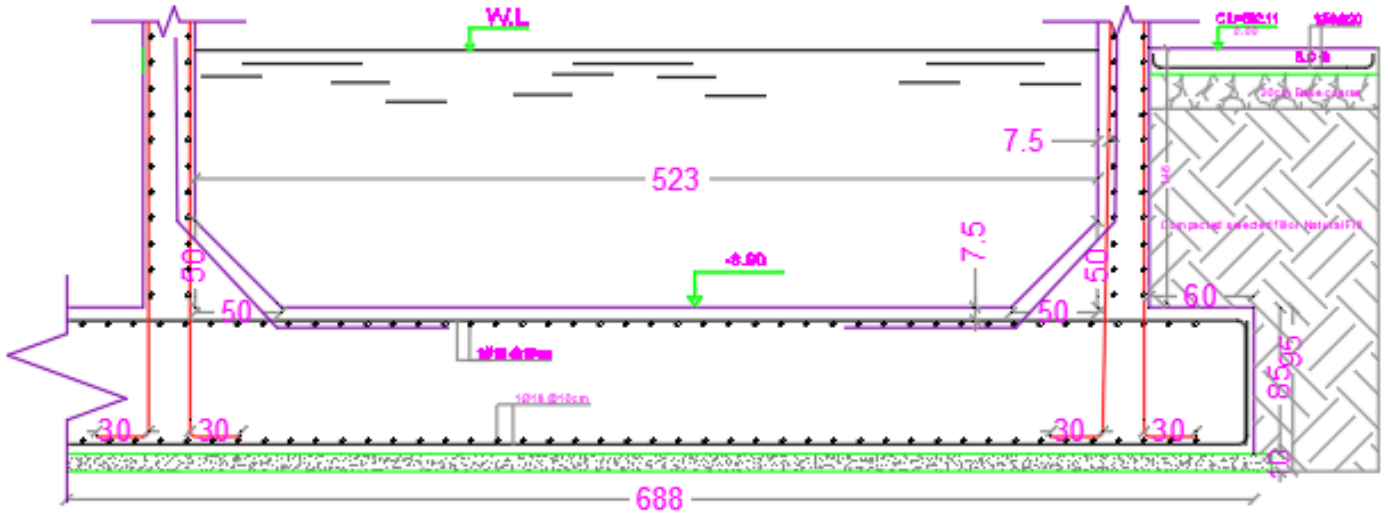
Structural detailing:

Water tank Details:

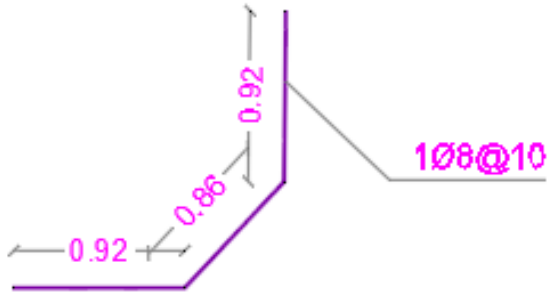


Structural detailing:

Water tank Details:

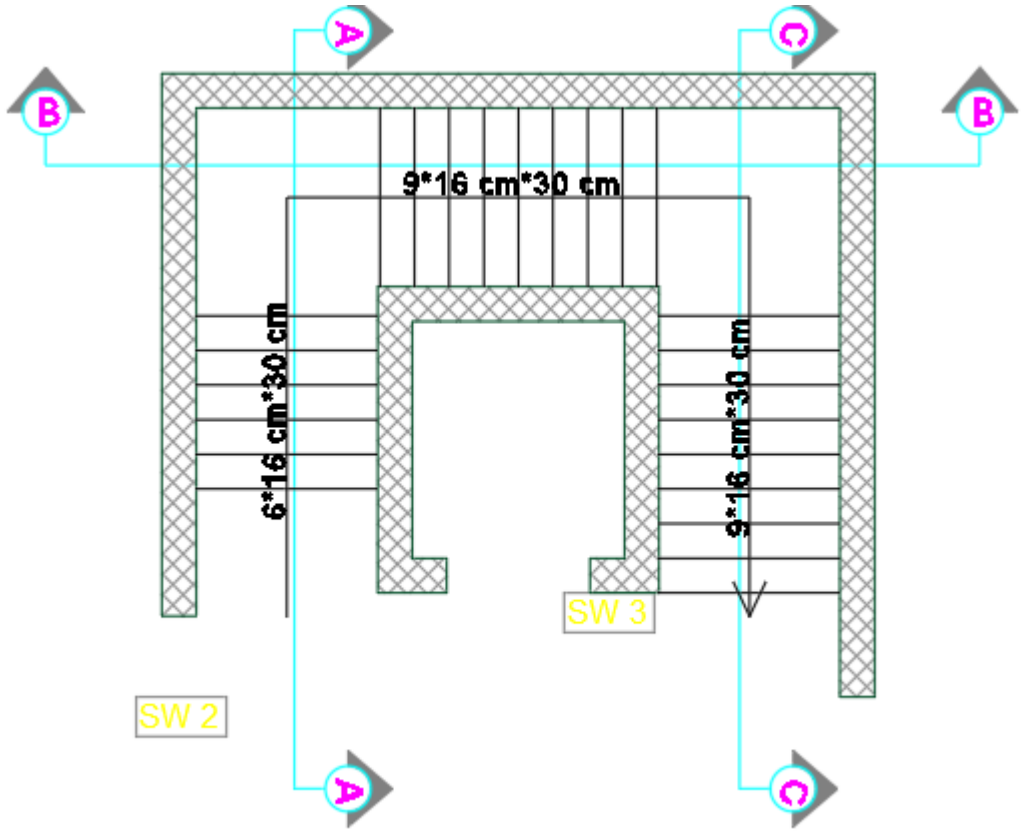


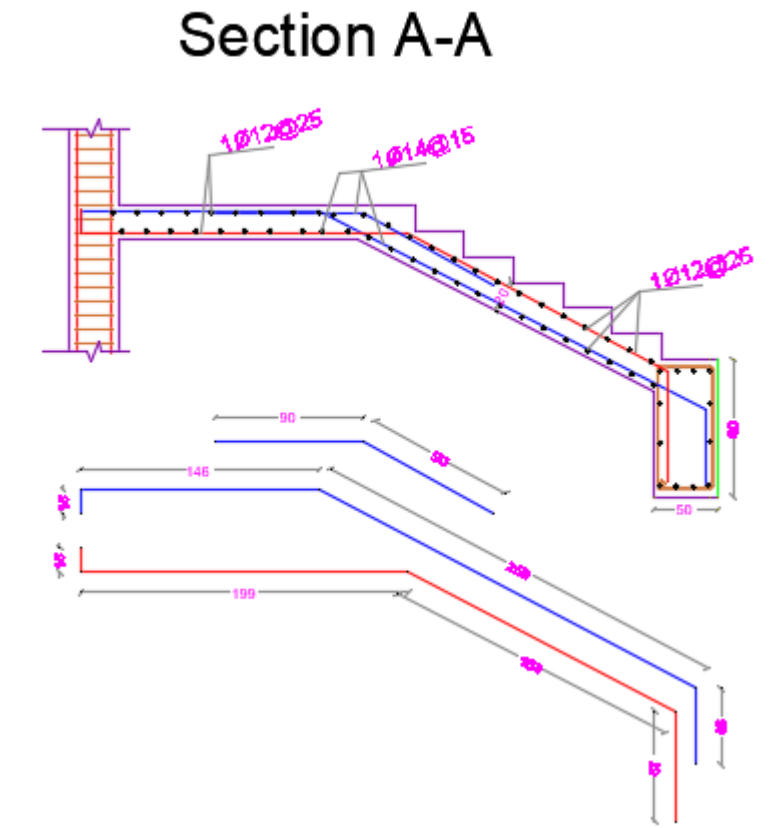
Section A-A



Structural detailing:

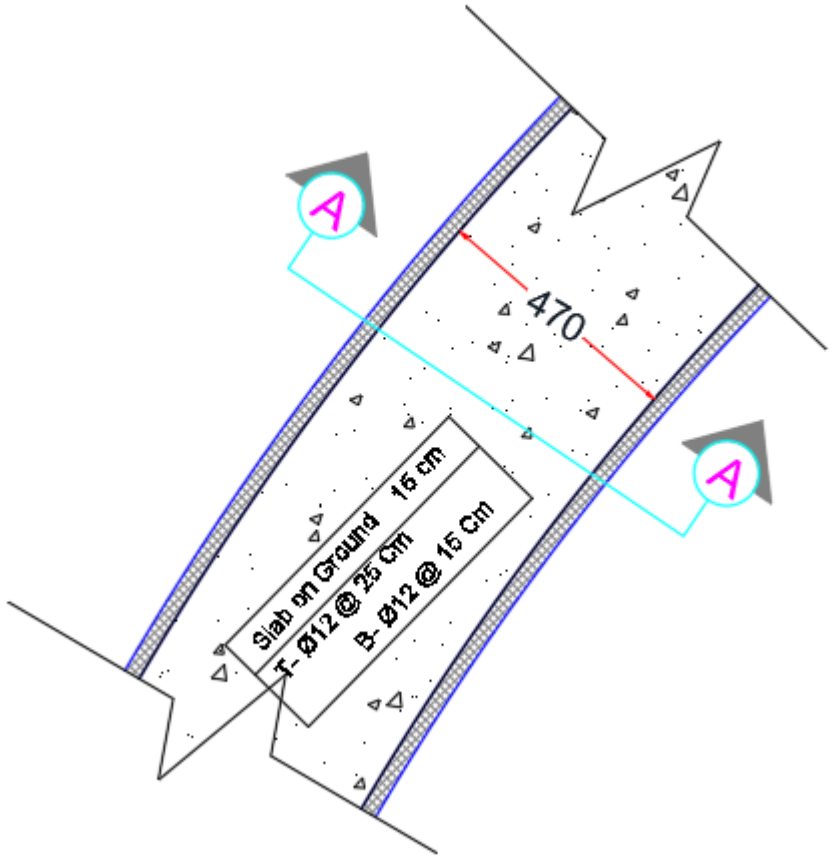
Stairs Details:

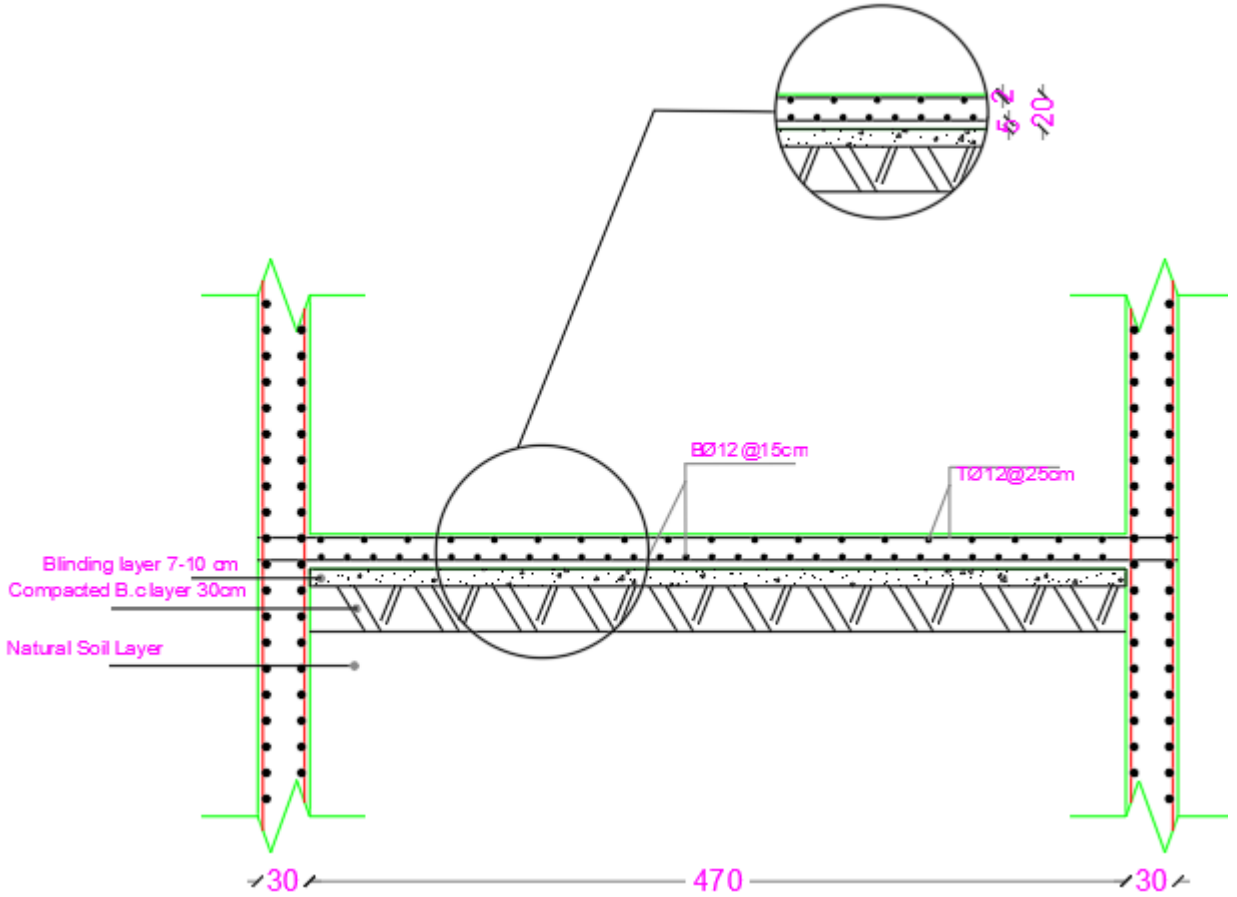




Structural detailing:

Ramp Details:



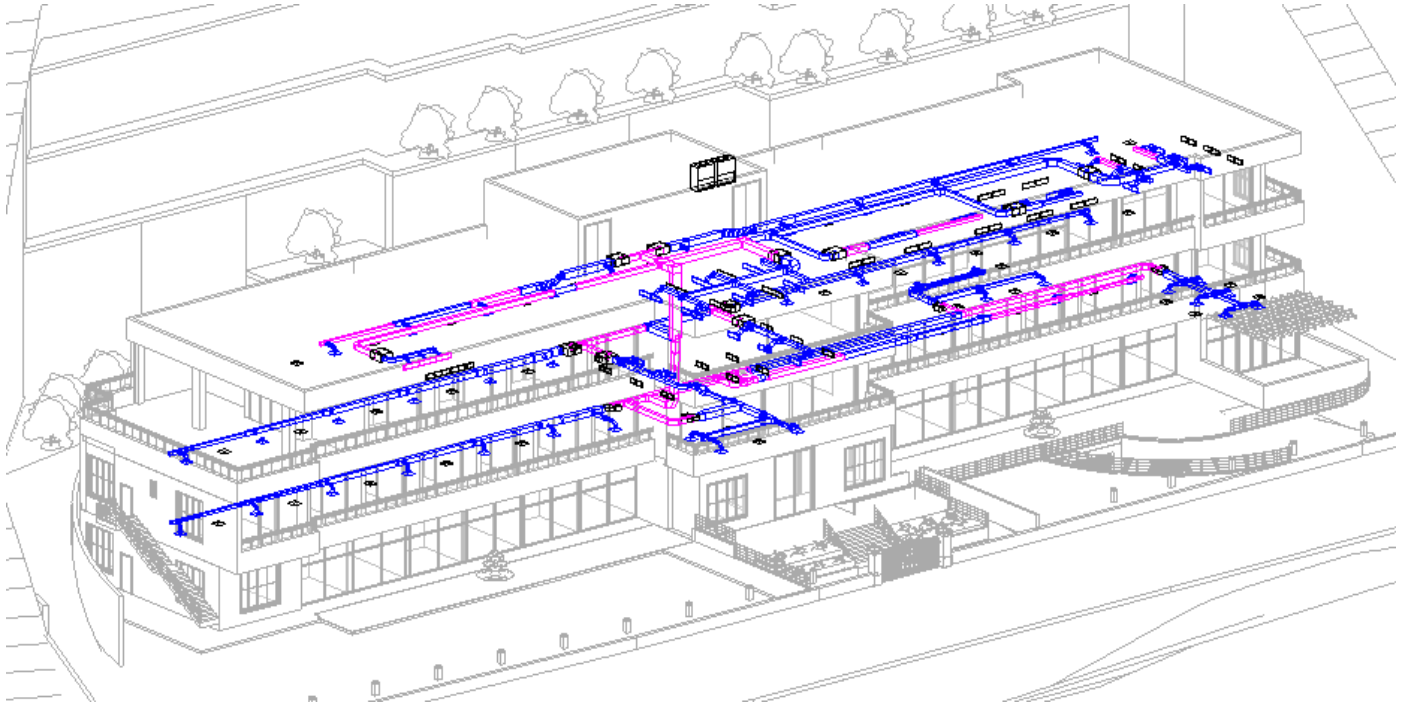


Electro-Mechanical aspects

❑ HVAC Design:

Heating and Cooling loads:

Total heating and cooling load in the building	
The peak cooling load for the building	139 kW
The peak heating load for the building	129 kW



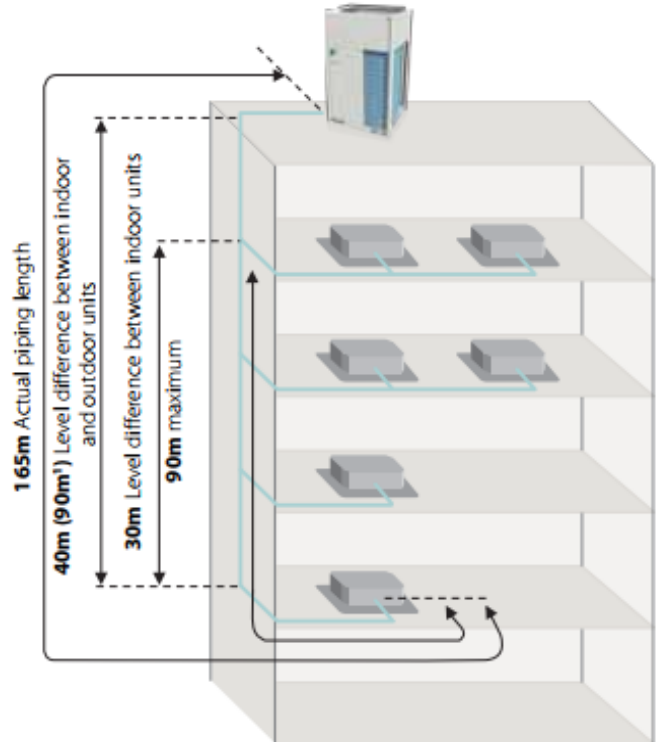
❑ HVAC Design:

Outdoor unit:

- The used HVAC system is VRF.

- The used indoor system for bedrooms and offices is split unit.

- The indoor unit used for halls and waiting and circulation areas is fan coils with diffusers.



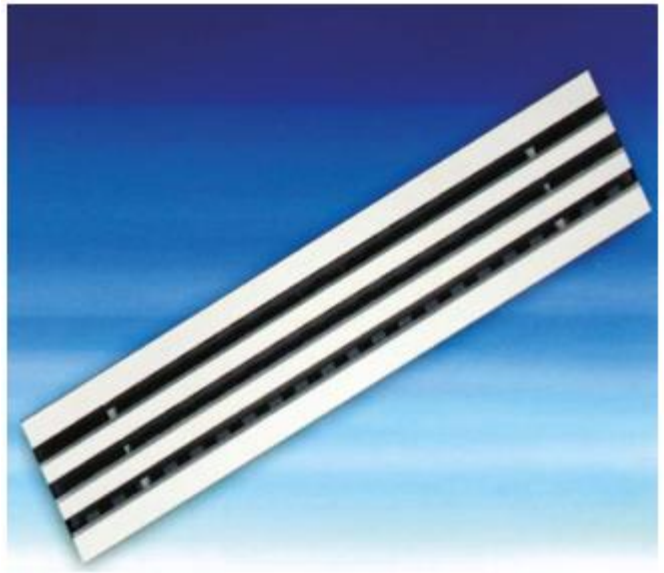
❑ HVAC Design:

Indoor unit:

FXDQ-A — Slim concealed ceiling unit

FXDQ15-32A

BRC1E52A/B BRC4C65



FXAQ-P — Wall mounted unit

FXAQ15-32P

BRC1E52A/B BRC7E63

Diffusers 22

Louvred Face Diffusers

DTR Tile Replacement

Introduction

The DTR is a Direct Tile Replacement overall size 595 x 595 mm.
Available in neck sizes of 225 and 300 mm. Horizontal air supply in four directions, also suitable for exhaust.
Installation flush to the ceiling, low unit height.
Removable front panel enables cleaning of the diffuser and ductwork.

Product Description

DTR Direct Tile Replacement

Features

- Lightweight construction

Finishes

PPG9010 (RAL 9010 Gloss - 80% Gloss White)
PPM9010 (RAL 9010 Matt - 20% Gloss White)
PPM9006 (RAL 9006 Matt - 30% Gloss Silver)
Other colours available on request

Sizes

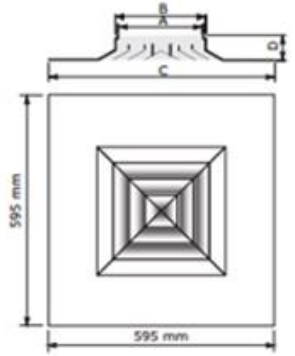
DTR Overall size 595 x 595 mm.
Available in neck sizes of 225 and 300 mm.

Std. Size mm	A	B	C	D
225 X 225	209	221	595	45
300 X 300	284	294	595	45

Order Example

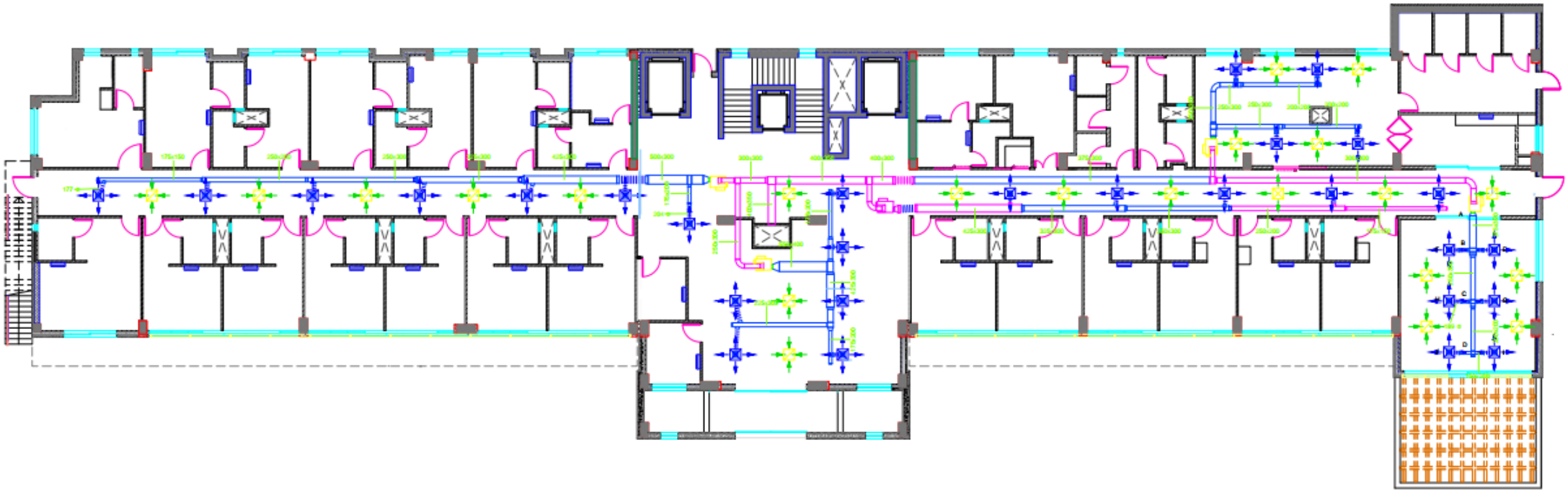
DTR/300/300/PPM9010/OBSS

Type
Duct width
Duct height
Finish
Damper



❑ HVAC Design:

Sample of design:



❑ HVAC Design:

Duct sound insulation:

❑ Acoustics Design:

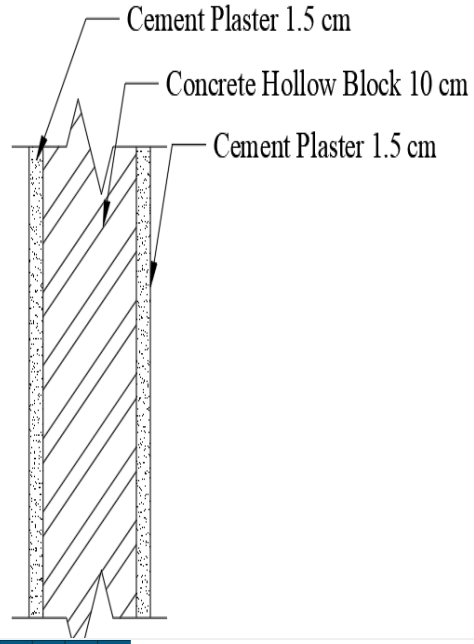
Acoustic Considerations:

Space	Reverberation Time (RT_{60})	Sound Pressure Level (SPL)	Noise Criteria (NC)	Sound Transmission Index (STI)
Bedroom	0.4-0.6	30-35	20-25	≥ 0.6
Prayer room	0.8-1.2	50-65	20-25	≥ 0.6
Meeting room	0.6-1.4	30-35	30-40	≥ 0.6
General office	0.4-0.6	40-45	30-40	≥ 0.6
Reading room	0.5-0.9	25-30	20-25	> 0.7
Gymnasium and sport hall	< 2	< 85	35-45	> 0.45
Cafeteria	< 1	45-55	40-50	> 0.45
Multi-purpose hall	1.4-1.9	45-50	35-40	≥ 0.45

❑ Acoustics Design:

Acoustic insulation:

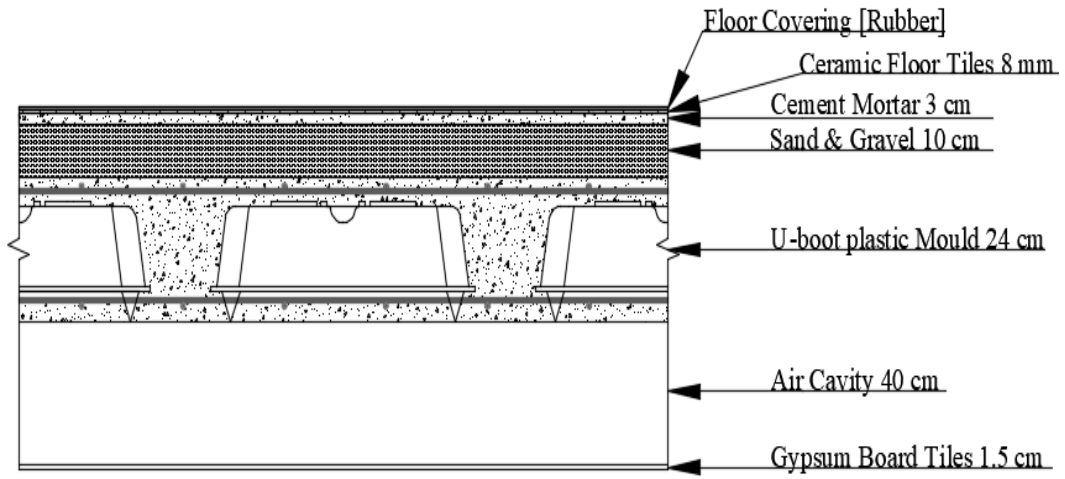
Partition between		Recommended Sound Transmission Class (STC)	Design Sound Transmission Class (STC)
Bedroom	Bedroom	50 dB	50 dB
Bedroom	corridor	42 dB	42dB.
Bedroom	Outdoor	30 dB	37 dB
Reading room	Gymnasium	60 dB	60 dB



❑ Acoustics Design:

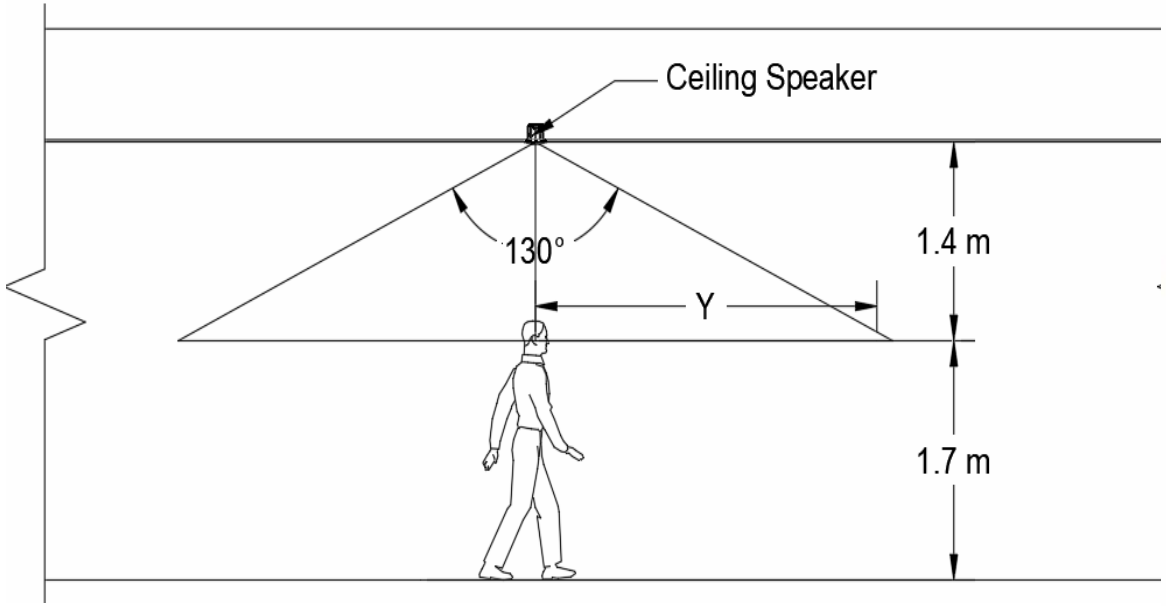
Acoustic insulation:

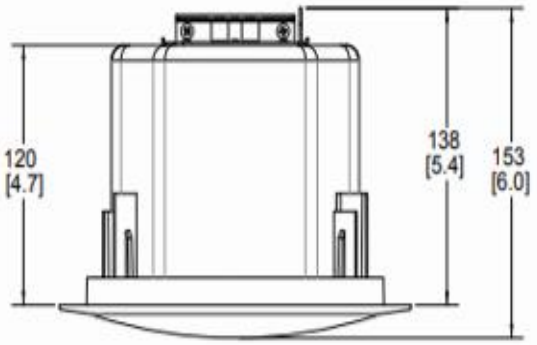
Slab between		Recommended Impact insulation class (IIC)	Design Impact insulation class (IIC)
Bedroom	Bedroom	52 dB	75 dB
Bedroom	Gymnasium	>65 dB	75 dB



❑ Acoustics Design:

Electro-acoustic design :





Specifications:

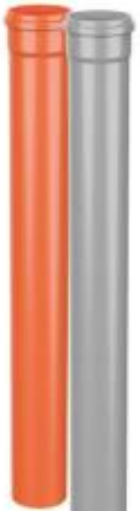
System	
Frequency Range (-10 dB)[1]	68 Hz – 17 kHz
Frequency Response (±3 dB)[1]	95 Hz – 15 kHz
Power Capacity (at low-Z)[2]	40W Continuous Program Power 20W Continuous Pink Noise
Nominal Sensitivity[3]	84 dB
Nominal Coverage Angle[3]	130° conical coverage
Directivity Factor (Q)[3]	9.8
Directivity Index (DI)[3]	7.4 dB
Rated Maximum SPL	97 dB @ 1 m (3.3 ft) average, 103 dB peak
Nominal Impedance	8 ohms (in direct/bypass 8Ω setting)
Transformer Taps	15 W, 7.5 W, 3.8 W @ 70V and 100V (& 1.9 W @ 70V only)
Transducers	
Full-Range Driver	76 mm (3 inch) with polypropylene cone, butyl rubber surround, Kapton™ voice coil former, high-temperature voice coil, aluminum coupling ring for low distortion and HF extension
Enclosure	
Input Connector	Removable locking 4-pin connector with screw-down terminals; max wire size 12 AWG (2.5 mm²)

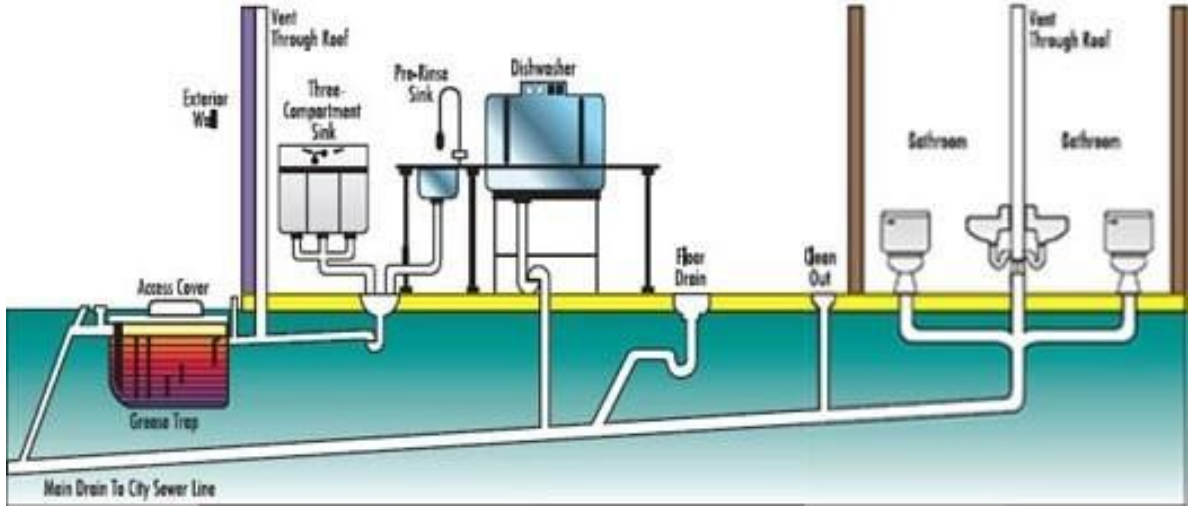
Connector Wiring	Pin 1 = + In Pin 2 = - In Pin 3 = + Loop Thru Pin 4 = - Loop Thru
Strain Reliefs	Strain relief for two cables or two flex conduits via coupled clamping mechanism
Materials	ABS baffle with UL94-V0 and UL94-5VB flame class fire rating; zinc-plated steel backcan
Safety Agency	UL1480, UL2043, NFPA90 & NFPA70; S7232/UL listed, suitable for use in air handling spaces, signaling speaker; transformer UL registered per UL1876; ROHS, C-tick N108, CE compliant; baffle meets UL94-V0 and UL94-5VB flammability rating; in accordance with IEC60849/EN60849 systems
Dimensions	196 mm diameter x 138 mm depth from back of baffle (7.7 in diameter x 5.4 in depth)
Ceiling Cutout Size	Circular cutout with 170 mm (6.7 in) diameter (cardboard cutout template included)
Ceiling Thickness Range	Up to 35 mm (1.4 in) with stock dogears; MTC-TCD thick-ceiling dogears available for up to 55 mm (2.2 in) ceiling thicknesses
Safety Seismic Attachment	One point, top surface
Net Weight	1.6 kg (3.5 lbs, one speaker)
Shipping Weight	6.7 kg (14.7 lbs, pair in master carton)

Drainage System:

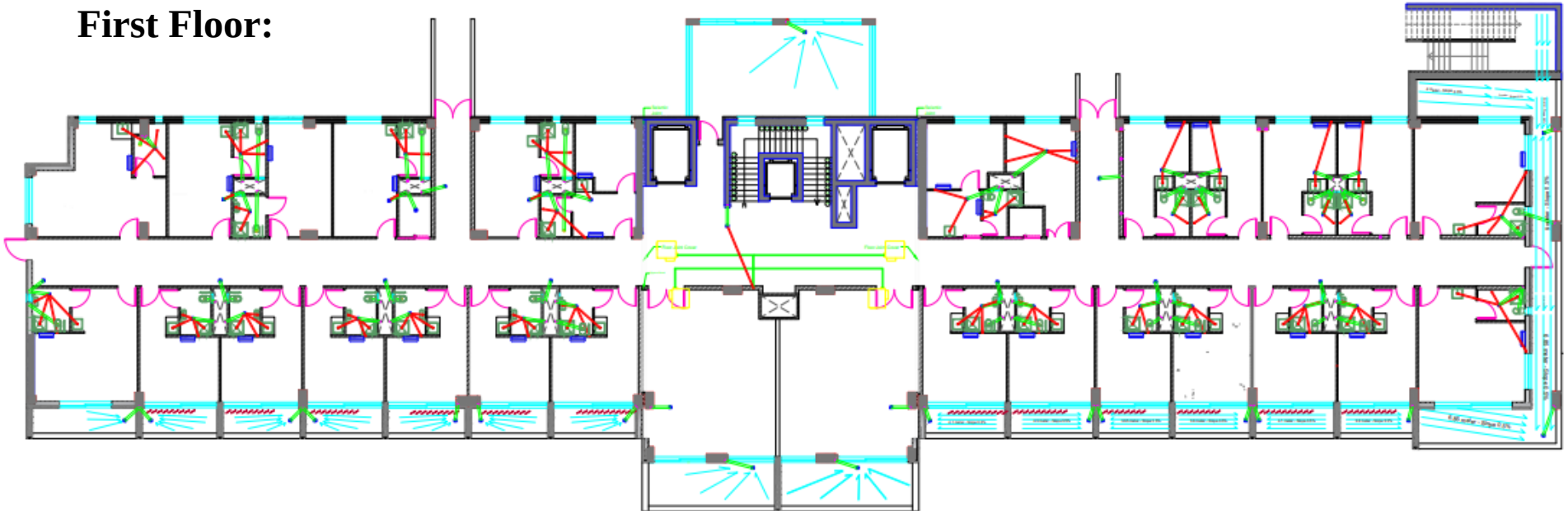
Drainage piping systems design assumptions		
Type of pipe	**Diameter (inch)**	**The slope of the Pipe (%)**
Slab embedded horizontal Sewer	4"	1%
Above slab horizontal sewer	2"	2%
HVAC sewer	1 ½"	1%
Vertical stack	4"	0%
Vertical vent	4"	0%
Suspended horizontal sewers in basement ceiling	4"	1%
	6"	
	8"	
Main horizontal sewer to the manhole	8"	1%

U-PVC DRAIN & SEWER PIPE						SN-2
CODE	ITEM NAME	SIZE		LENGTH	TYPE	COLOR
		Inch	mm	m		
04-0027	Pipe	2	50	4	–	White
04-0037	Pipe	3	75	4	–	White
04-0046	Pipe	4	110	3	Light	Gray
04-0047	Pipe	4	110	4	Light	Gray
04-0051	Nipple	4	110	0.5	E	White
04-0053	Nipple	4	110	1	E	White
04-0057	Pipe	4	110	4	E	White
04-0066	Pipe	6	160	3	–	Gray
04-0067	Pipe	6	160	4	–	Gray
04-0076	Pipe	8	200	3	–	Gray
04-0077	Pipe	8	200	4	–	Gray

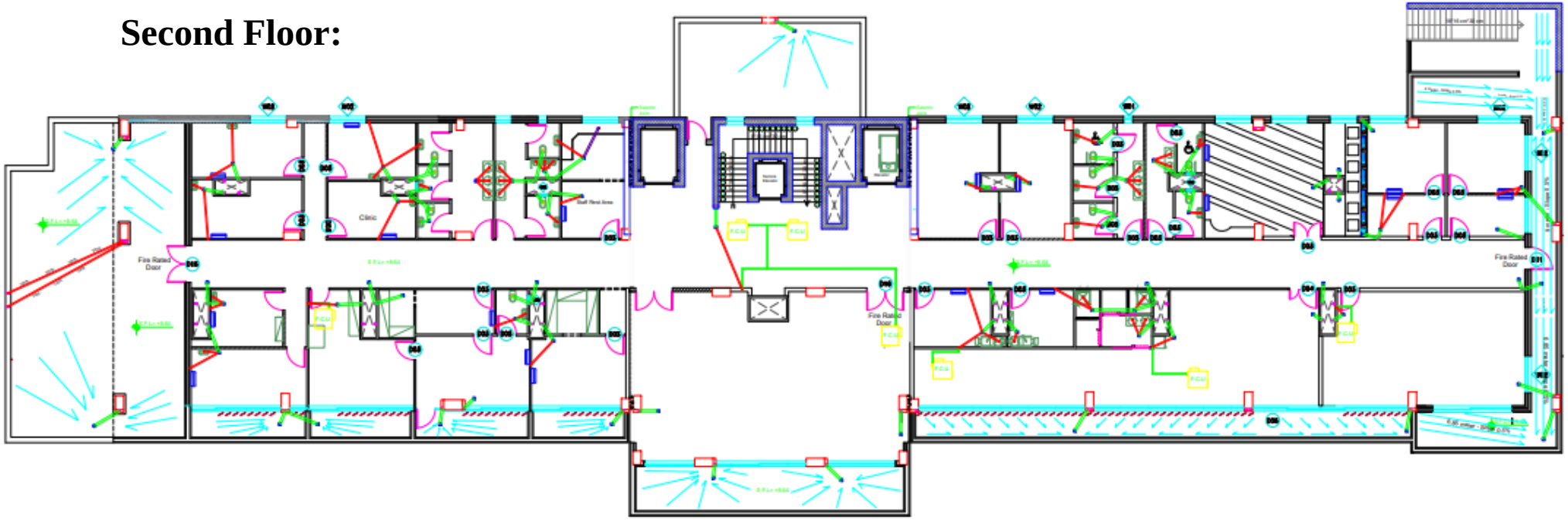


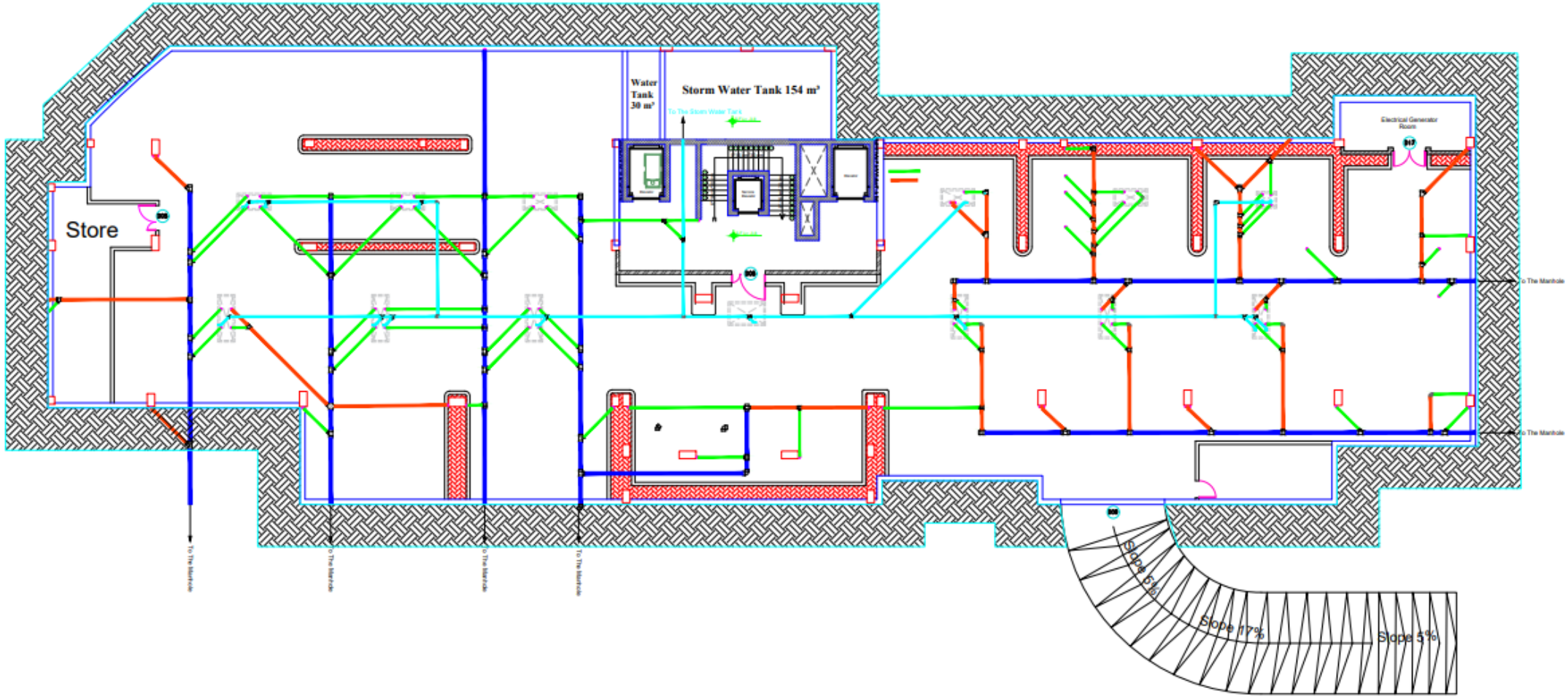


First Floor:

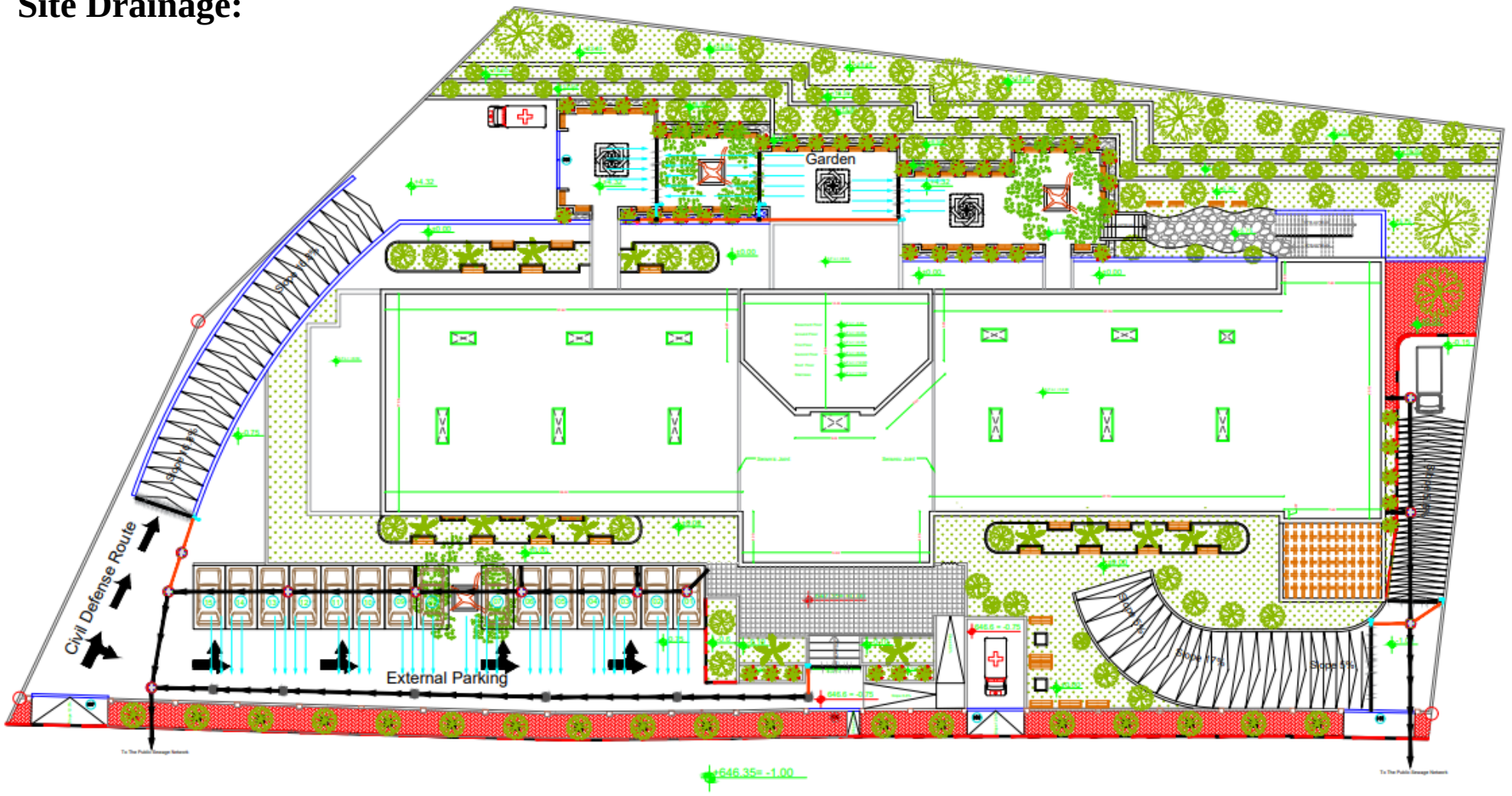


Second Floor:



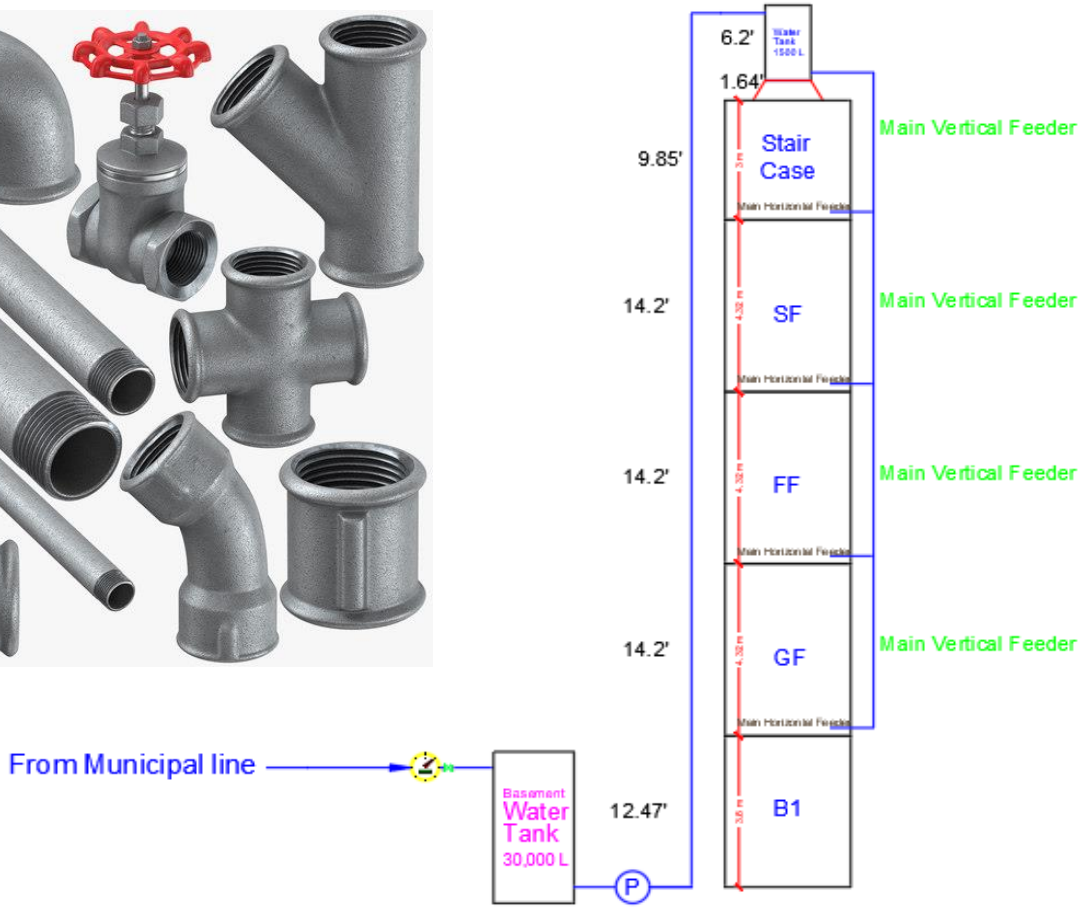

Water Tank 30 m³
Storm Water Tank 154 m³
Store
Electrical Generator Room
Slope 5%
Slope 17%
Slope 5%

Site Drainage:

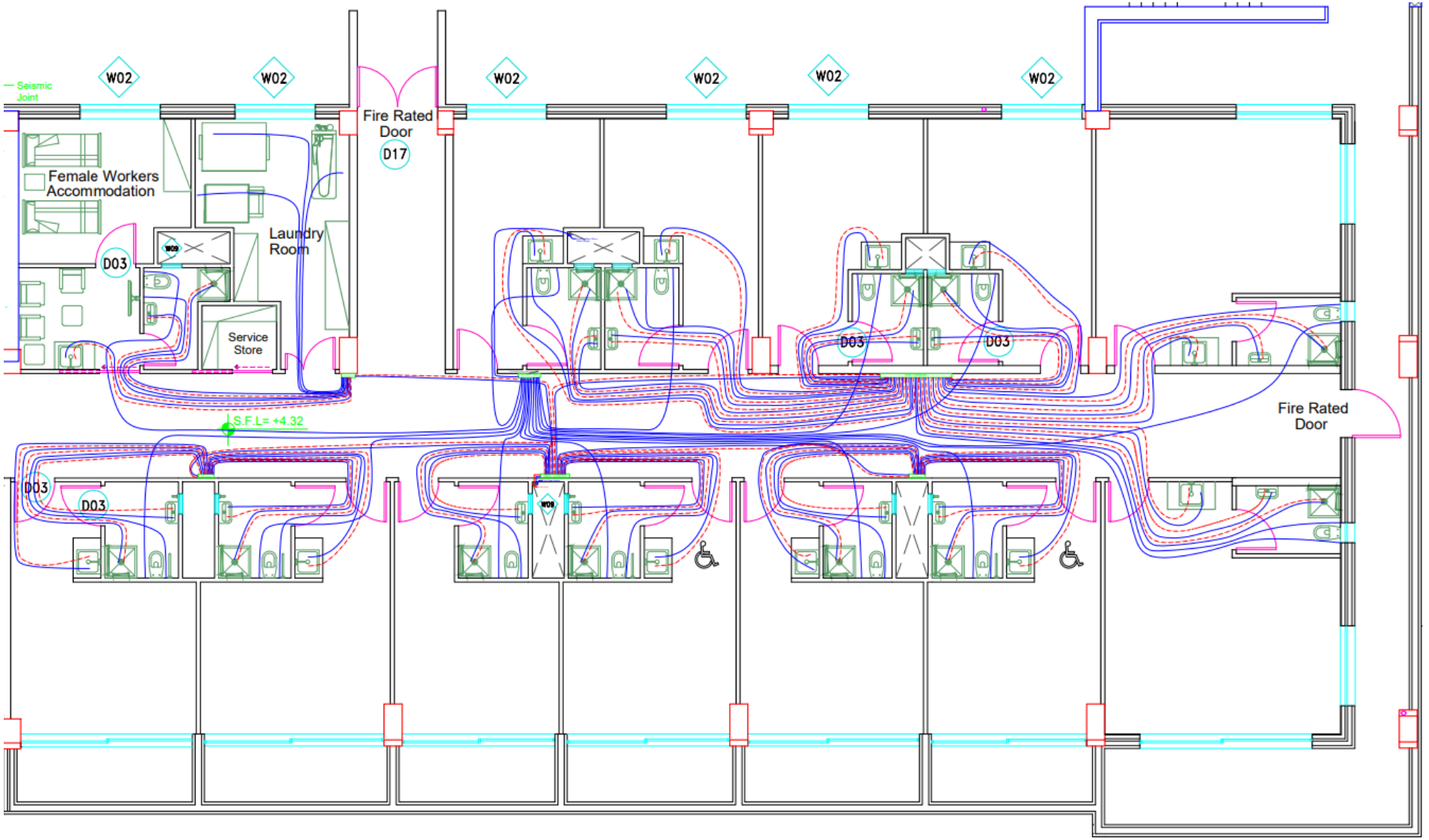


Water Supply System:

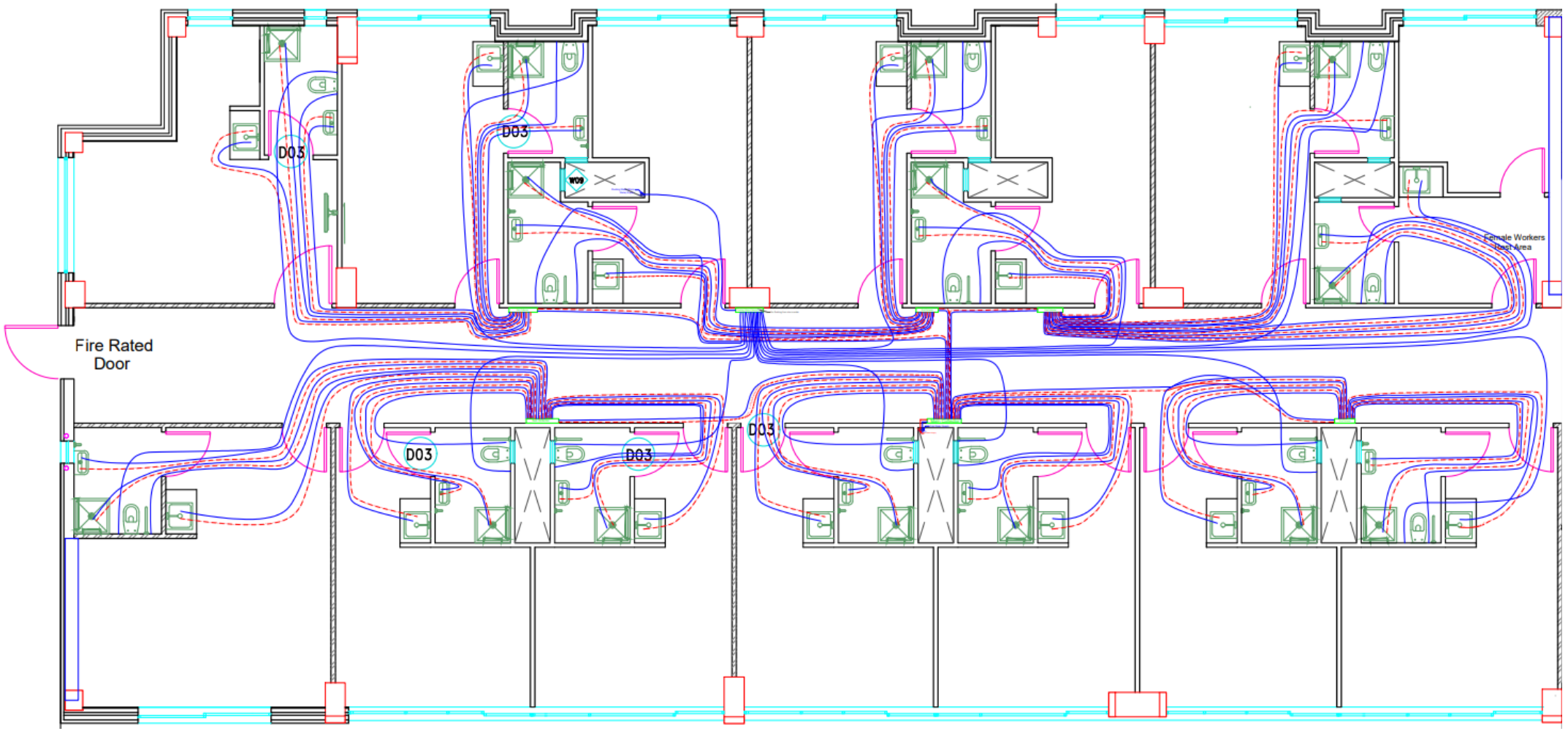
Line	Vertical	Horizontal	Branch	Critical Sub-branch
Diameter	2 ½"	1 ½"	1 ¼"	½"
Loss (psi)	7.552	0.024	0.88	0.42



First Floor – Right Side:

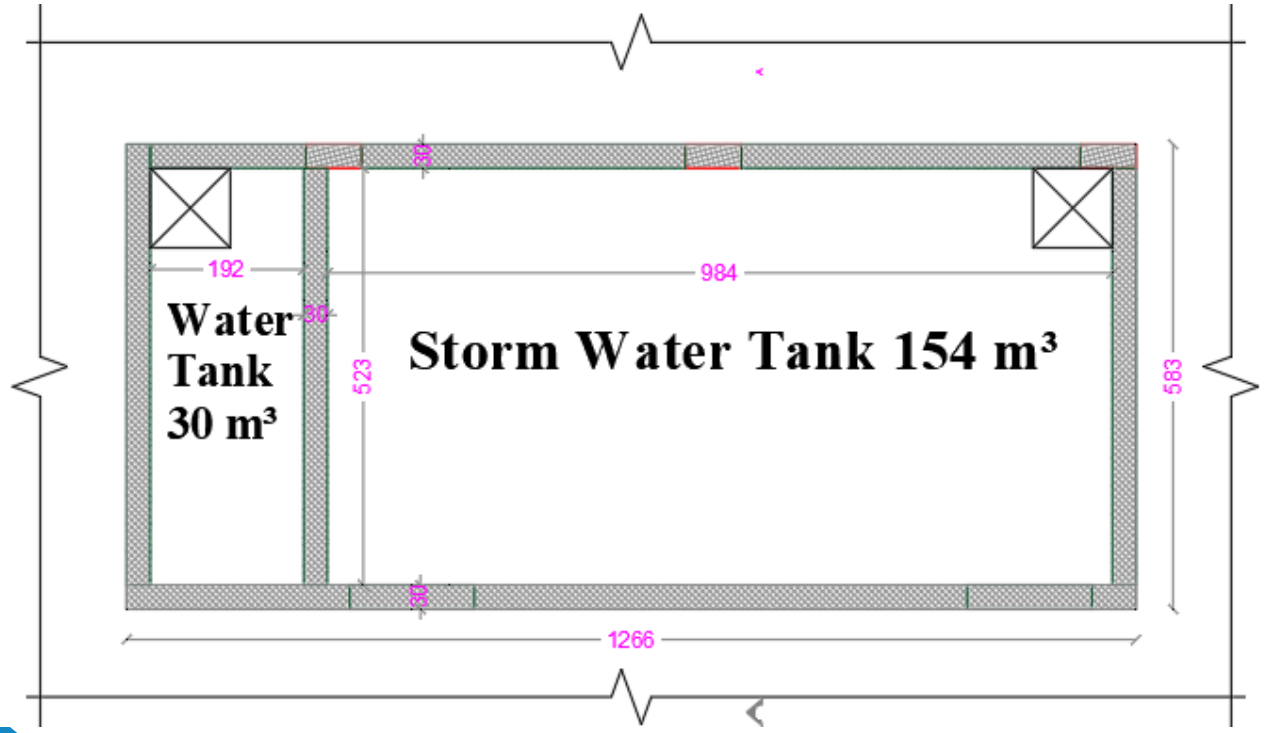


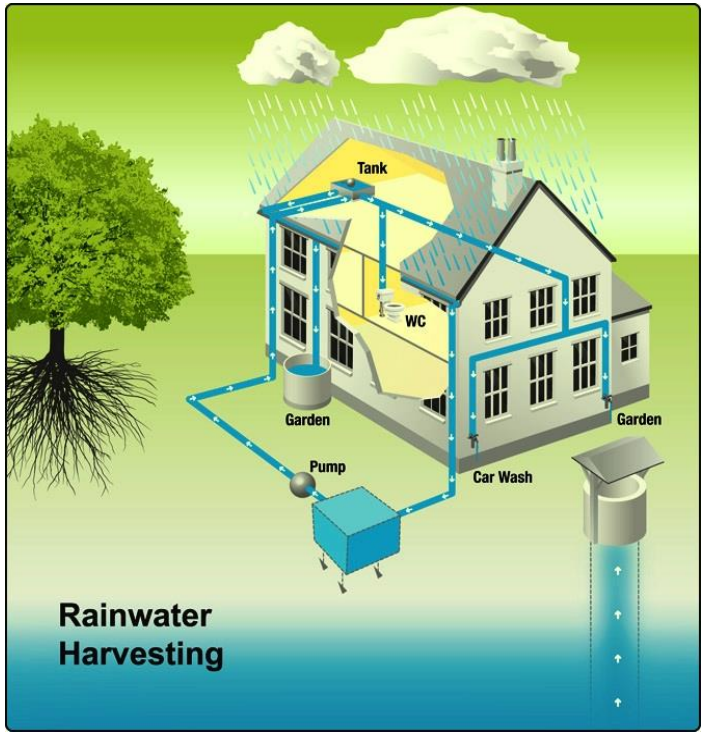
Ground Floor – Left Side:



Green Storm Water Harvesting:

- The average annual precipitation in Nablus is 660 mm
- The available roof surface area for stormwater drainage = 1400 m^2.
- The volume of the storm water tank = 154 m^3.
- It used for toilet flushing.

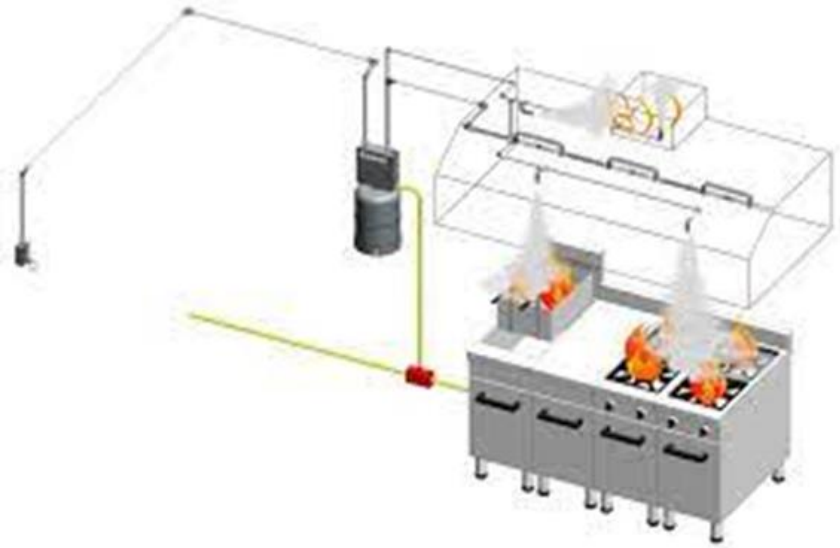




Fire Fighting System

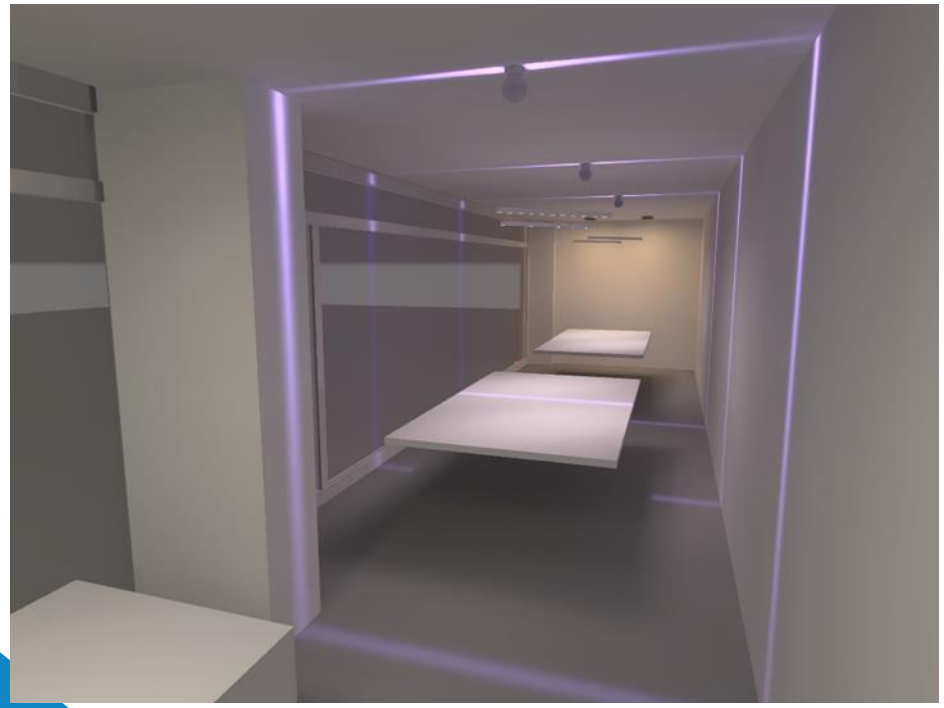
Fire Suppression
Sprinkler
Fire Extinguisher
Fire Hose
Hood Suppression

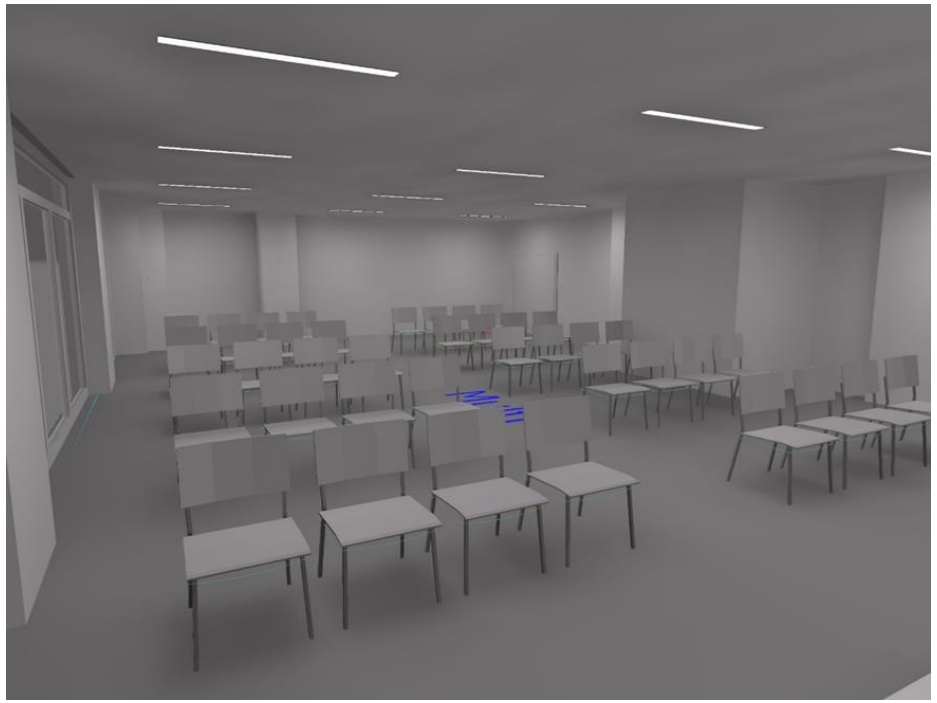
Fire Prevention
Smoke Detector
Heat Detector
Call Point
Alarm Bell
Exit Sign



Artificial lighting design:

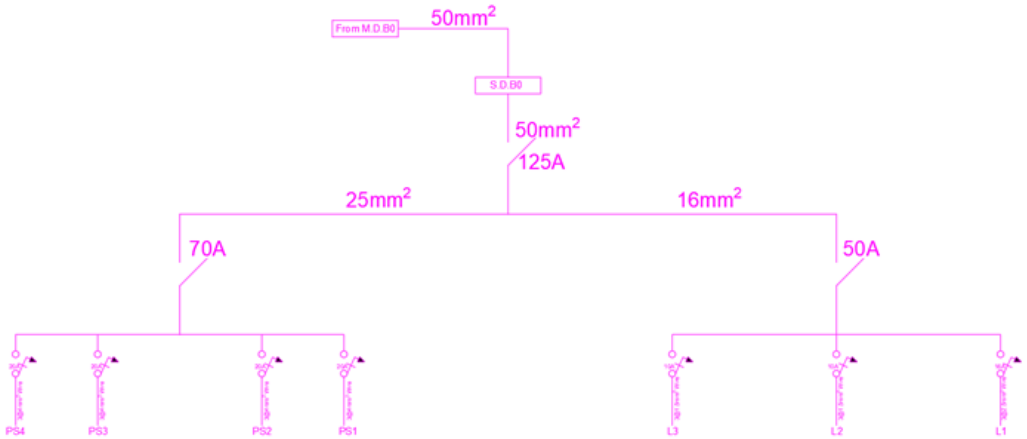
Types of Artificial lighting
General
Accent
Task
Decorative





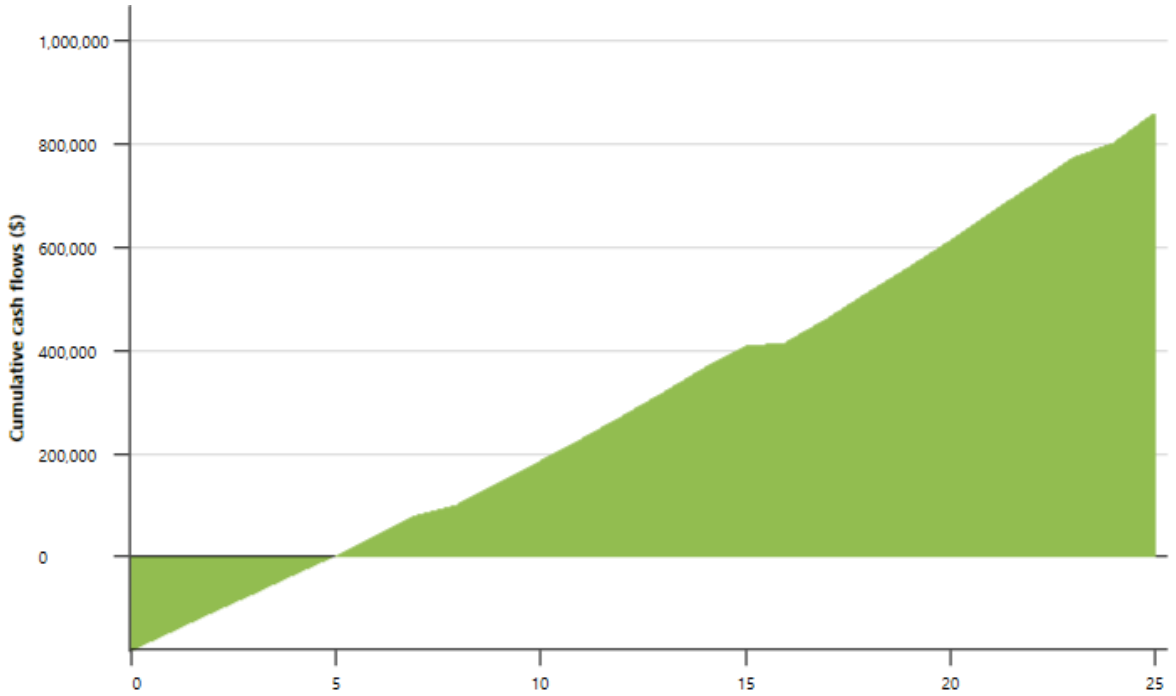
Power design:

Power/day	Nominal Power
141.3 kW	50 kW x 3

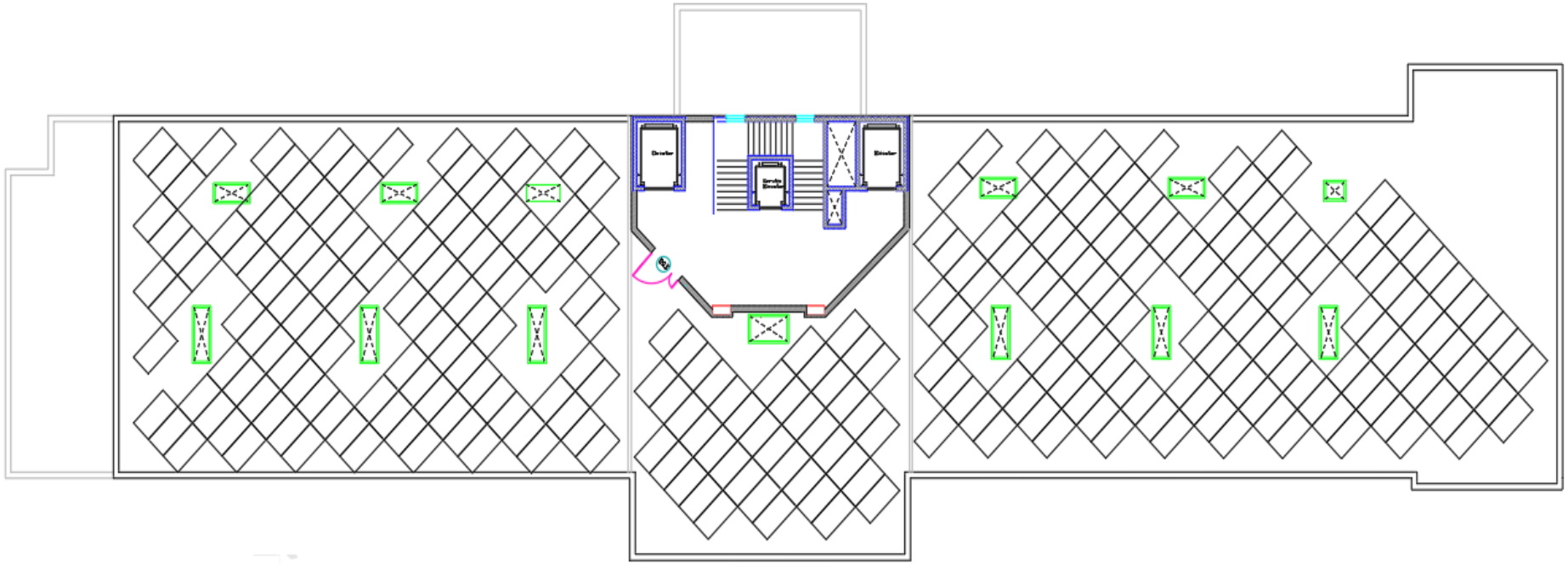


Photovoltaic design:

Annual Site Energy	Produced Energy	Percentage of Saving
361.9 MWh/year	251.4 MWh/year	69.4 %

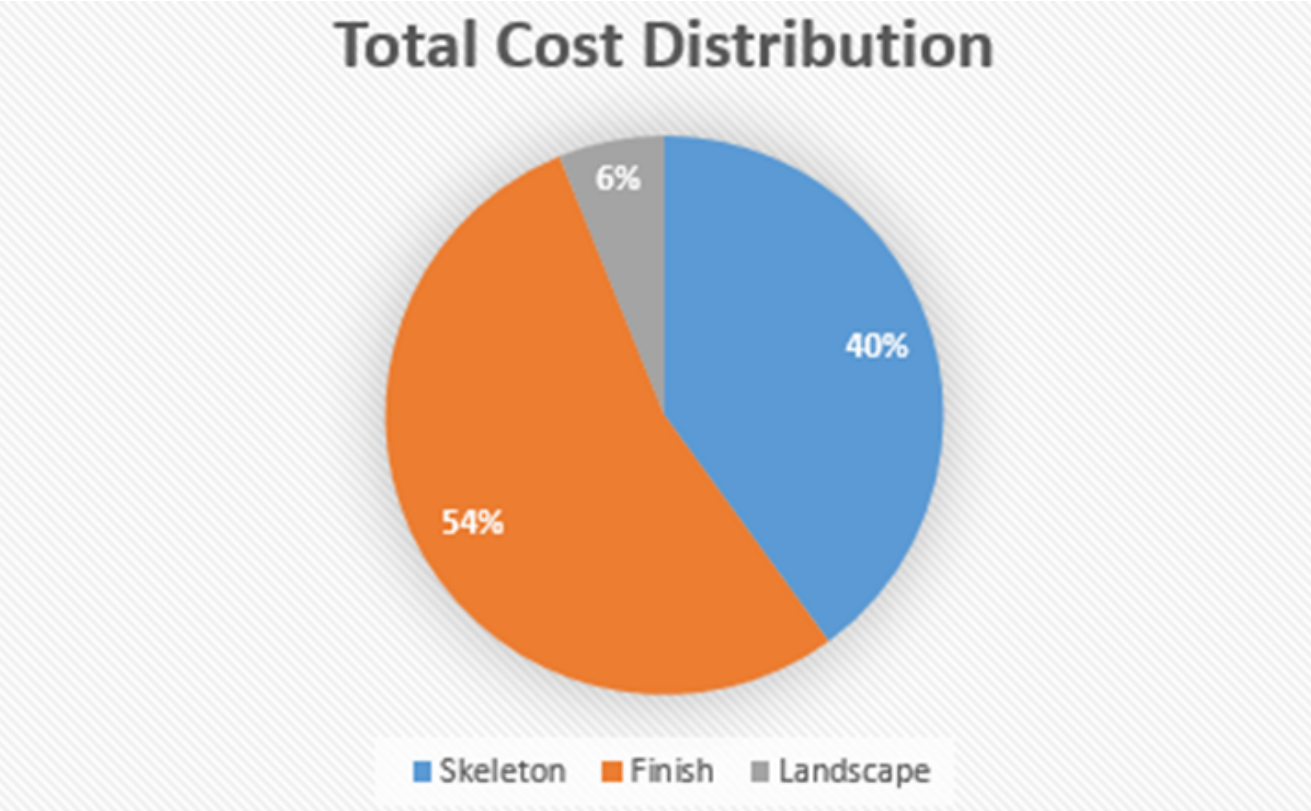


Photovoltaic design:



Quantity surveying and cost estimate

Total Cost Distribution:



The total cost of the project ≈ 20.1 Million NIS.

The unit cost of the project ≈ 4000 NIS/m^2.


Thank you for
listening!