An-Najah National University
Faculty of Engineering &
Information Technology
Building Engineering Department

Integrated Re-design of the Ayesh Office Building in Ramallah/Al-Bireh

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Supervised by:
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2021/2022

Graduation Project Team

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- Afnan Badran

- Nada Jalghoum

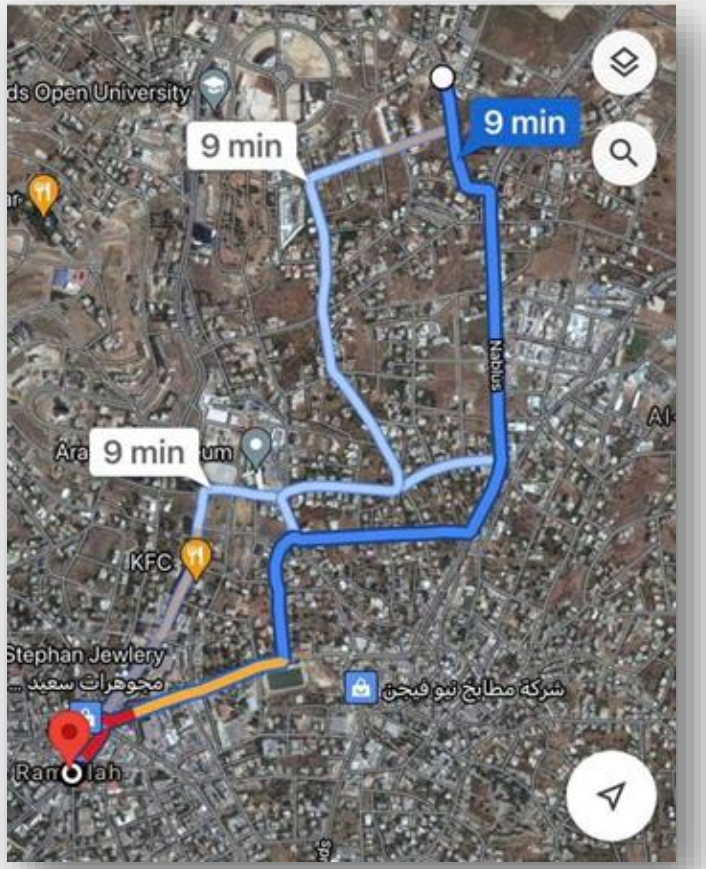
- Wala Rabaya

Project Outline

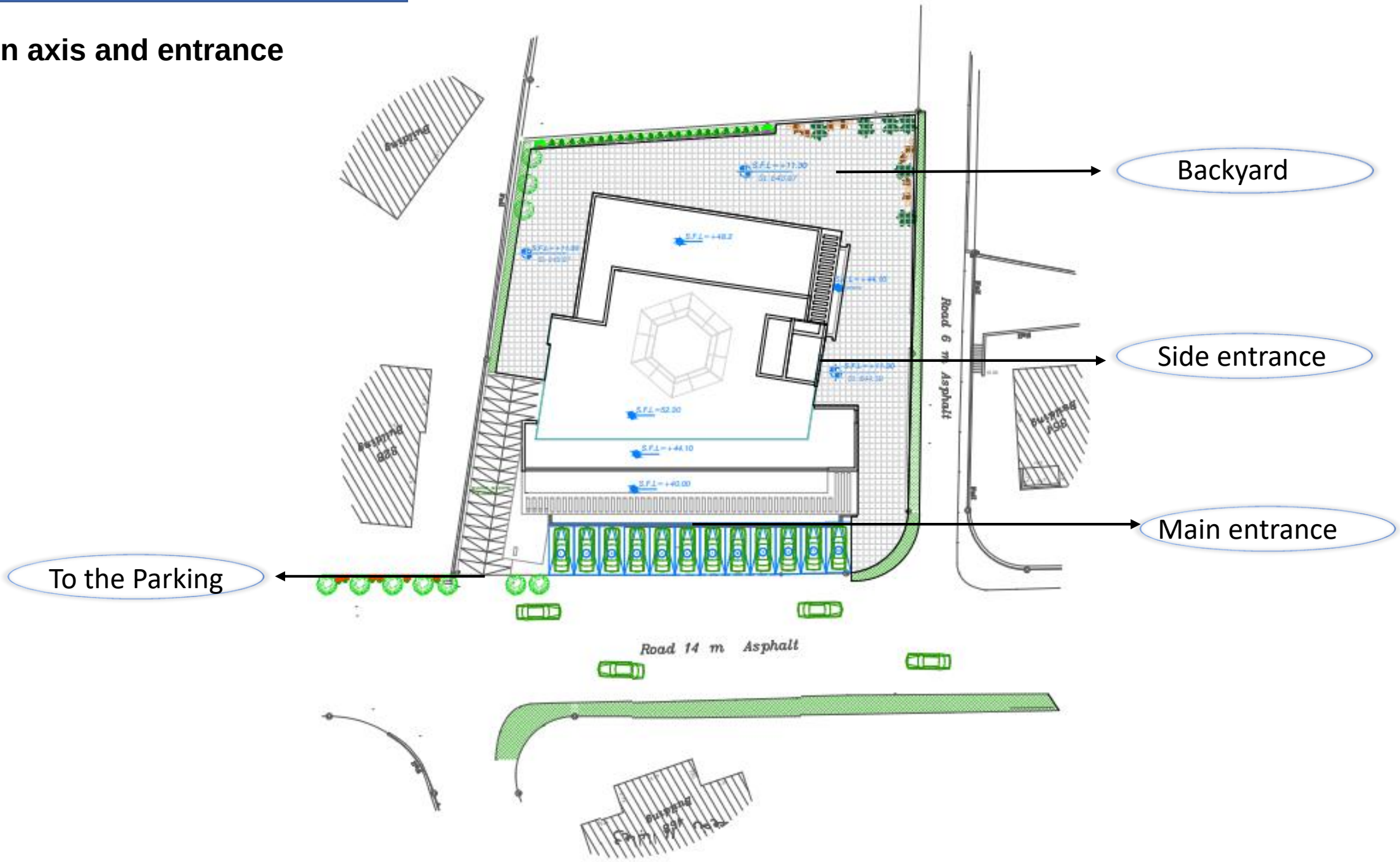
Site Analysis

Location

The building is located in Ramallah, Al-Bireh on a land area of 1864 meter square .



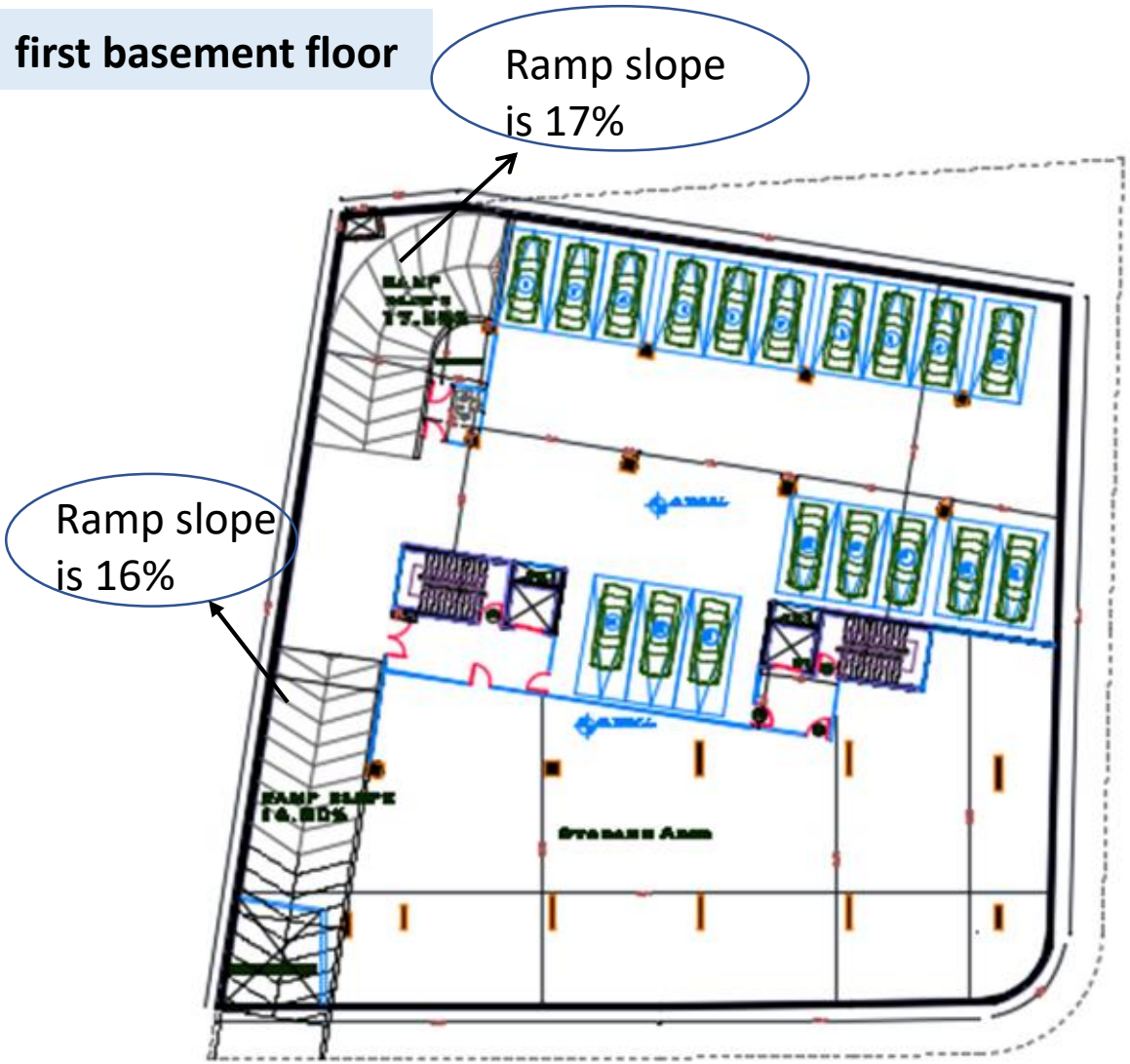
Main axis and entrance



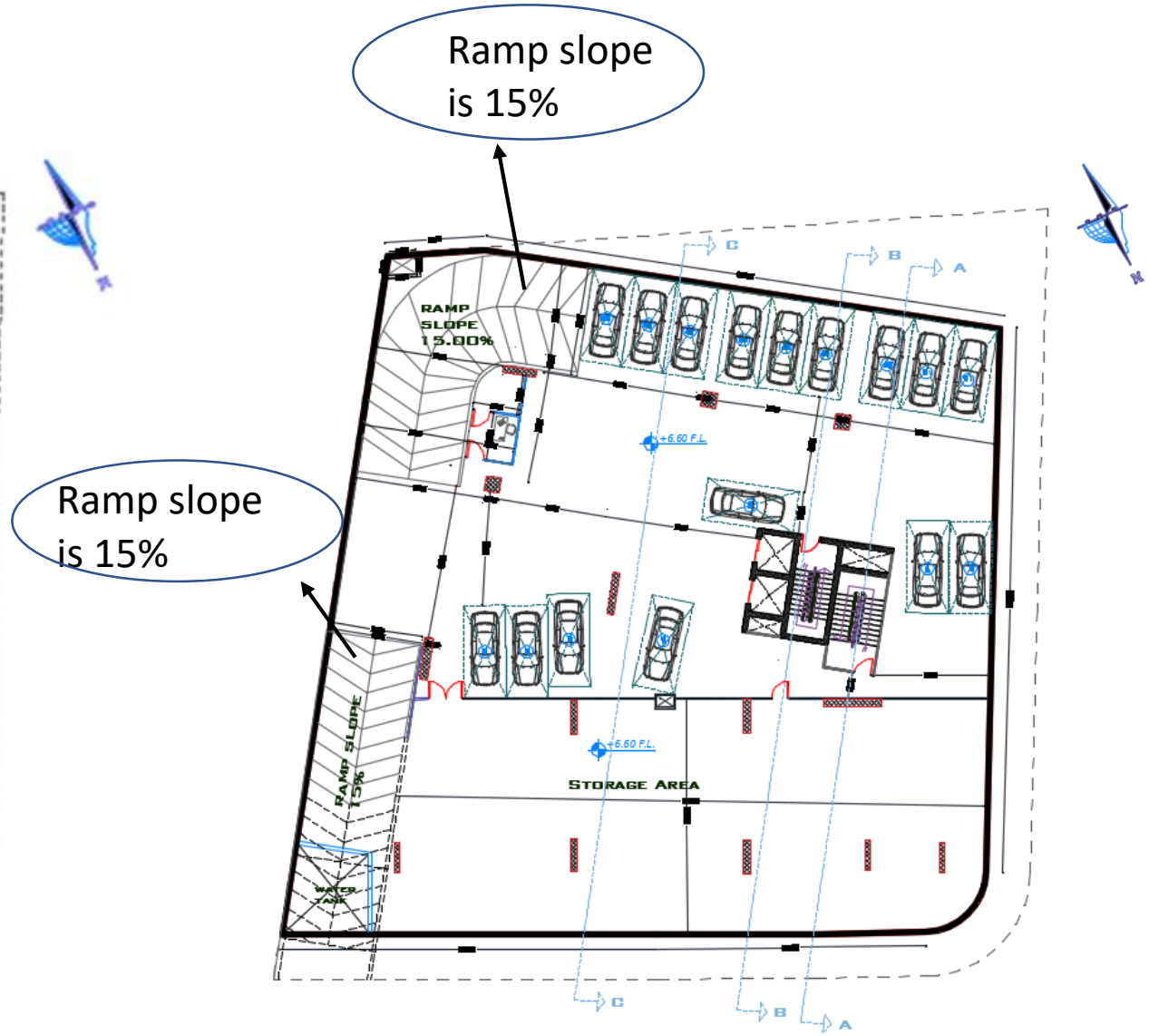
Architectural Aspect

Architectural modifications:

first basement floor

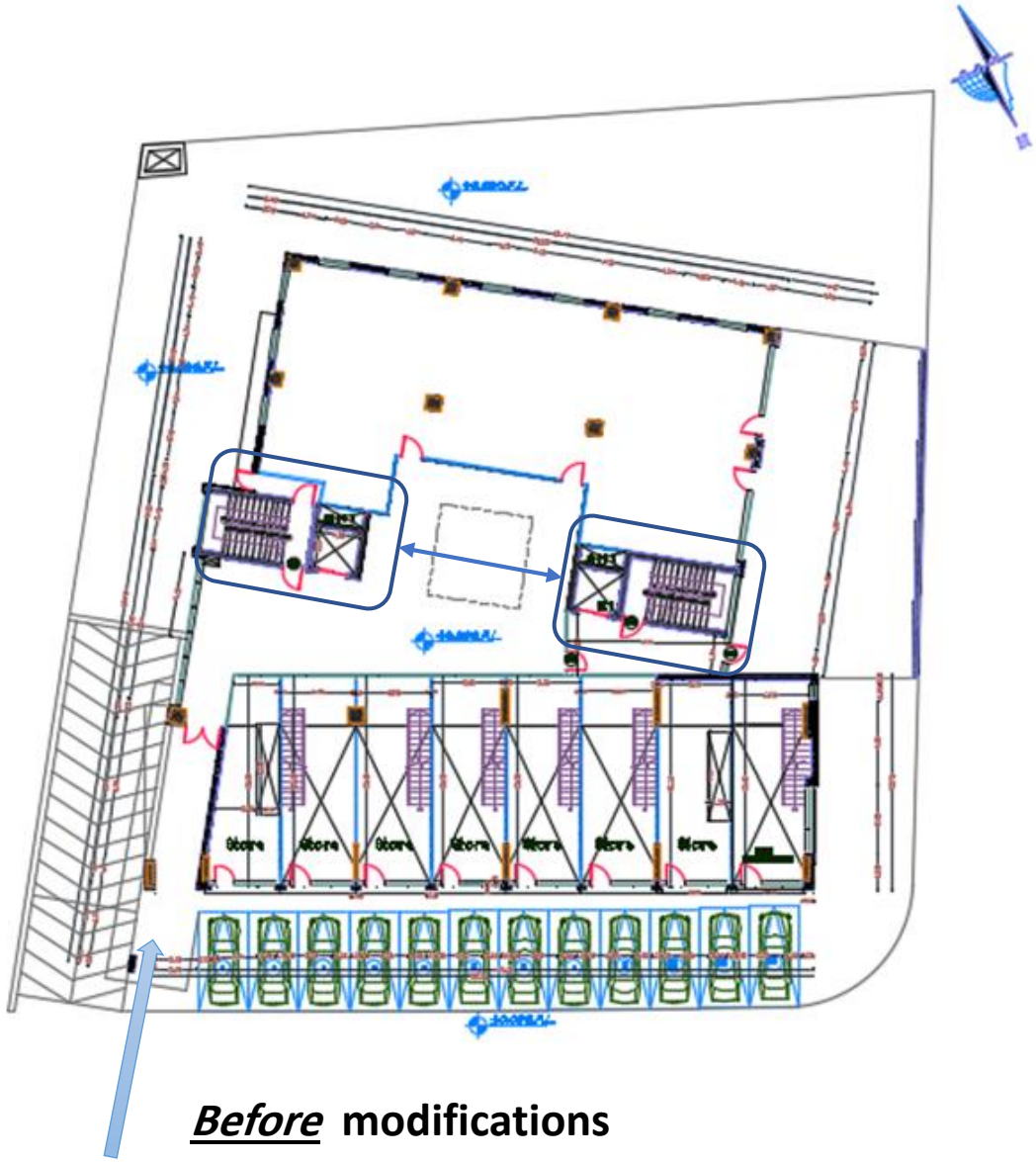


Before **modifications**

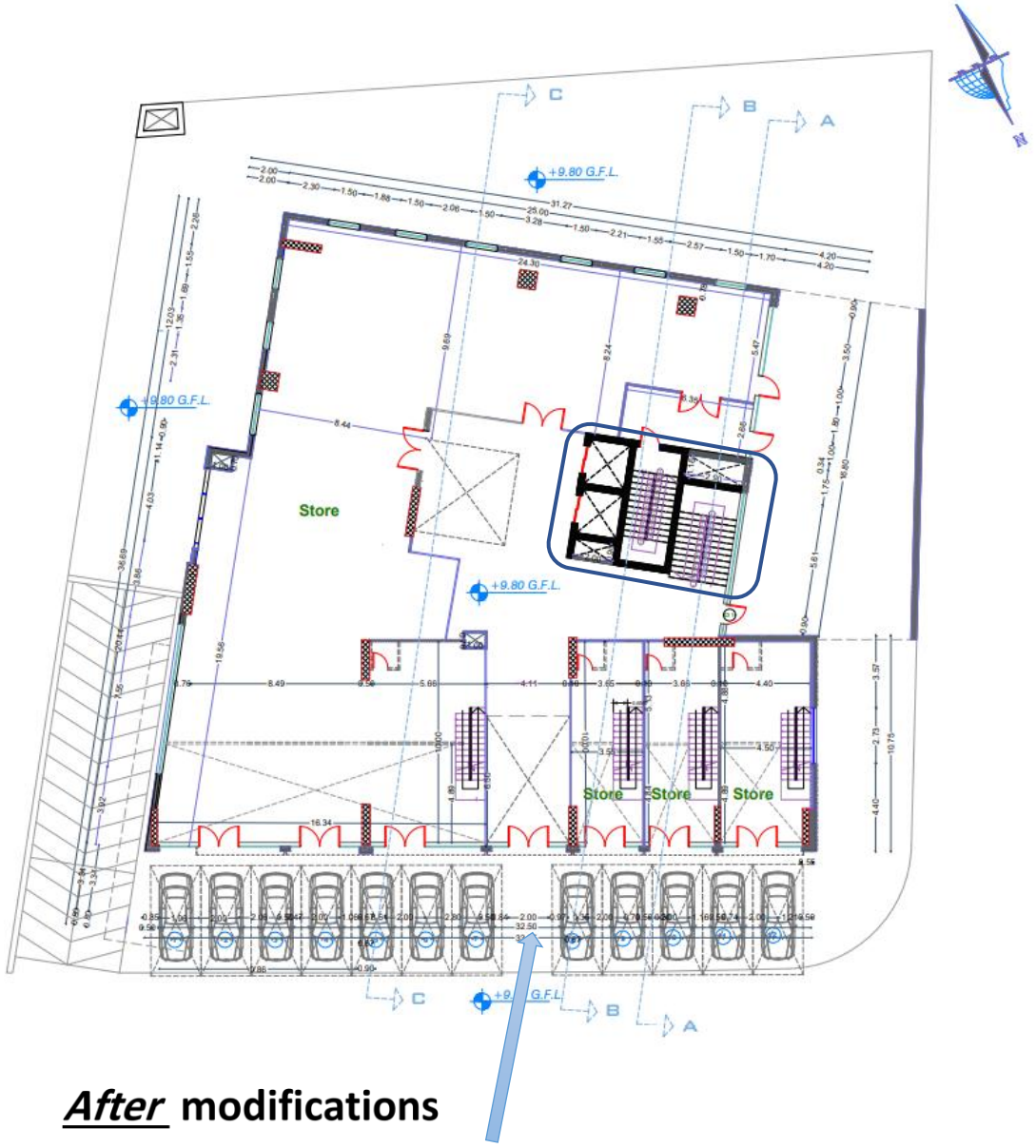


After **modifications**

Ground floor



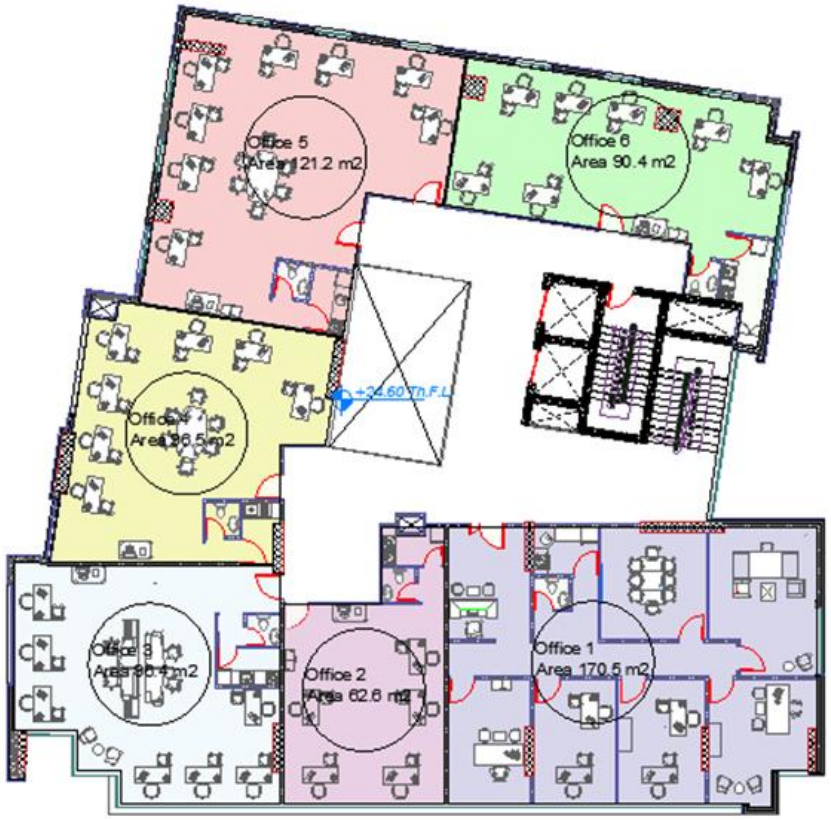
Before **modifications**



After **modifications**

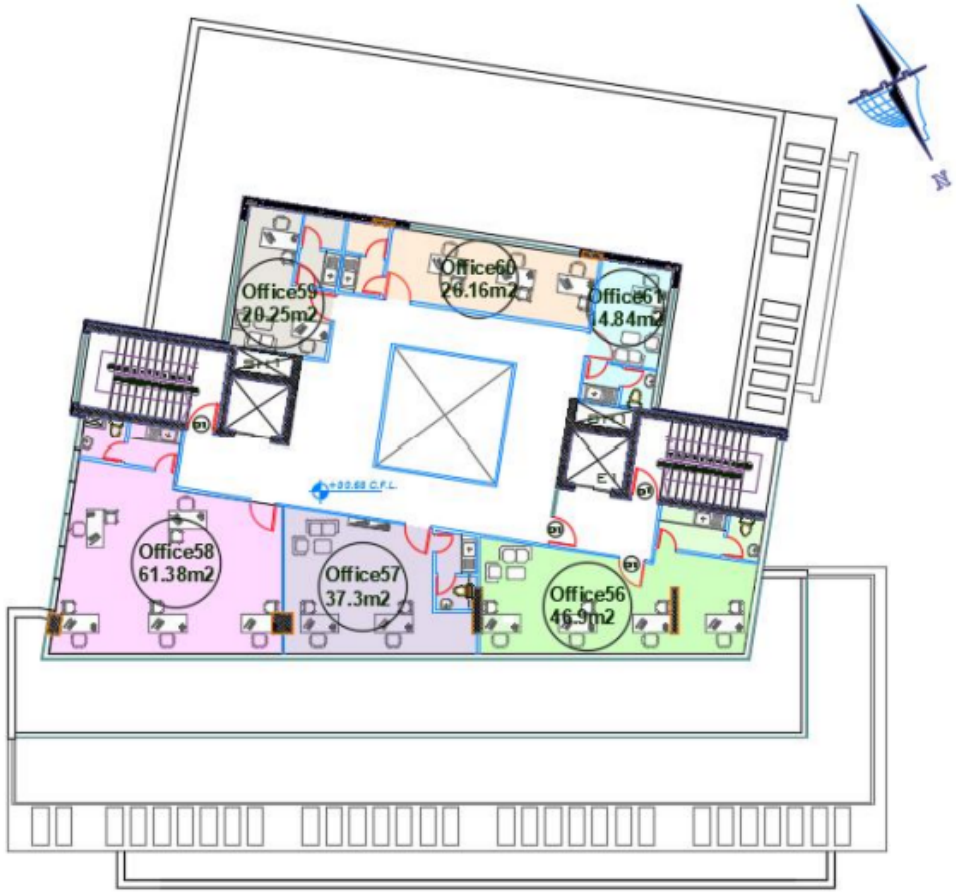
Offices floor

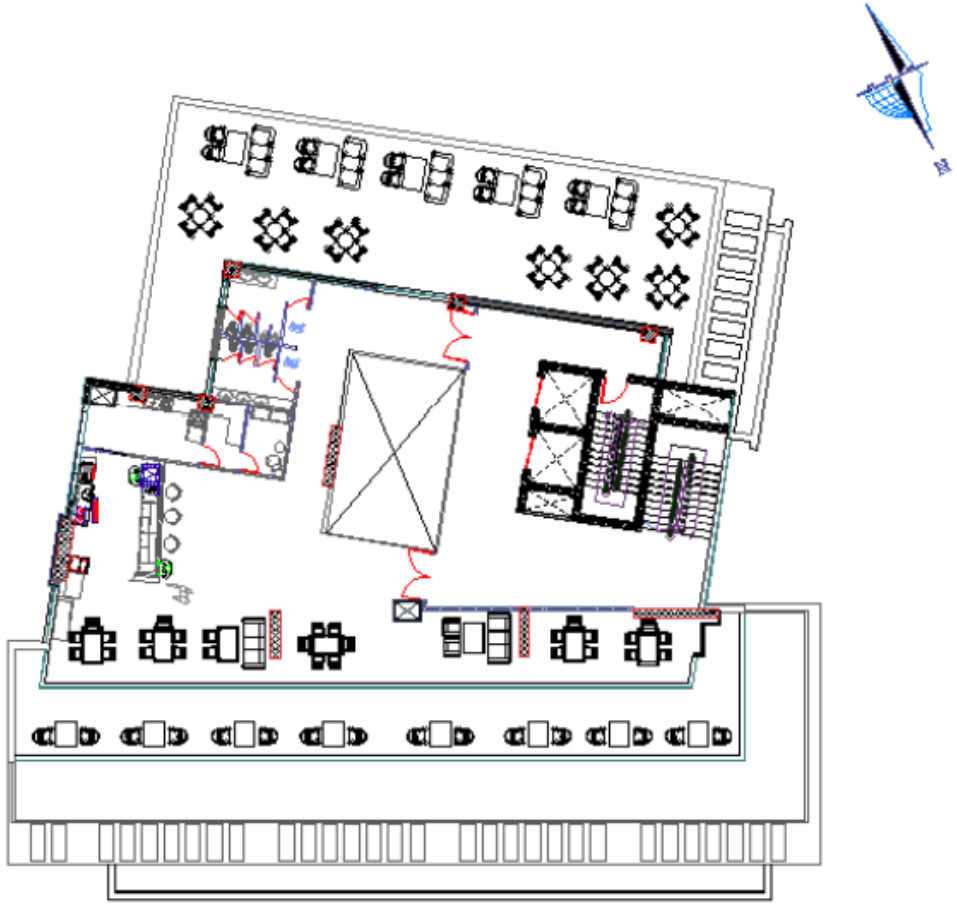
Before **modifications**



After **modifications**

Roof floor

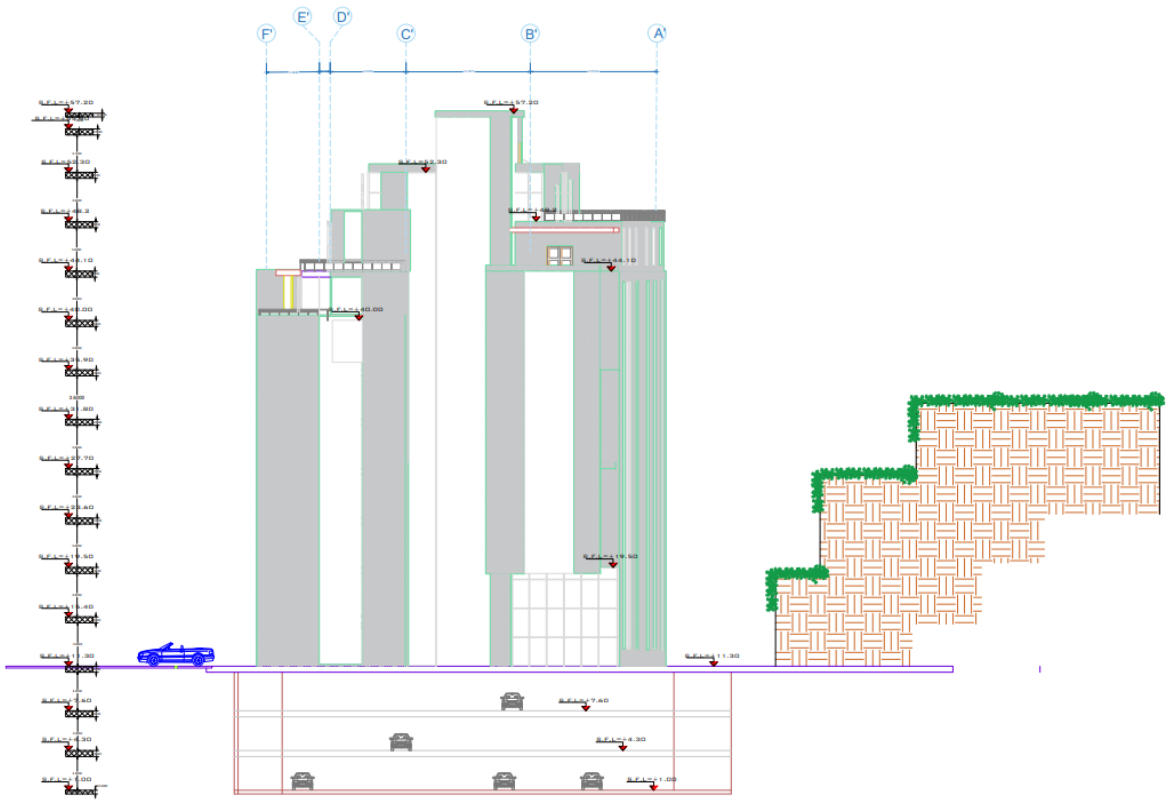




Before **modifications**

After **modifications**

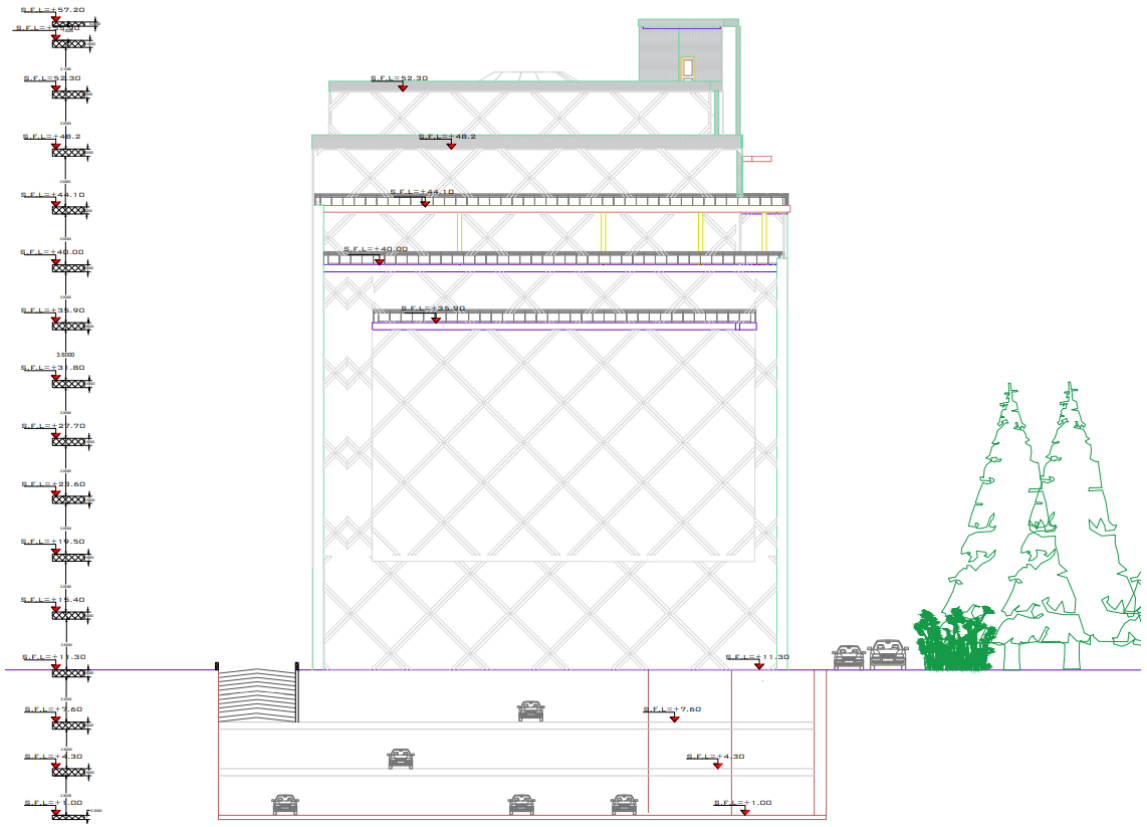
Elevations



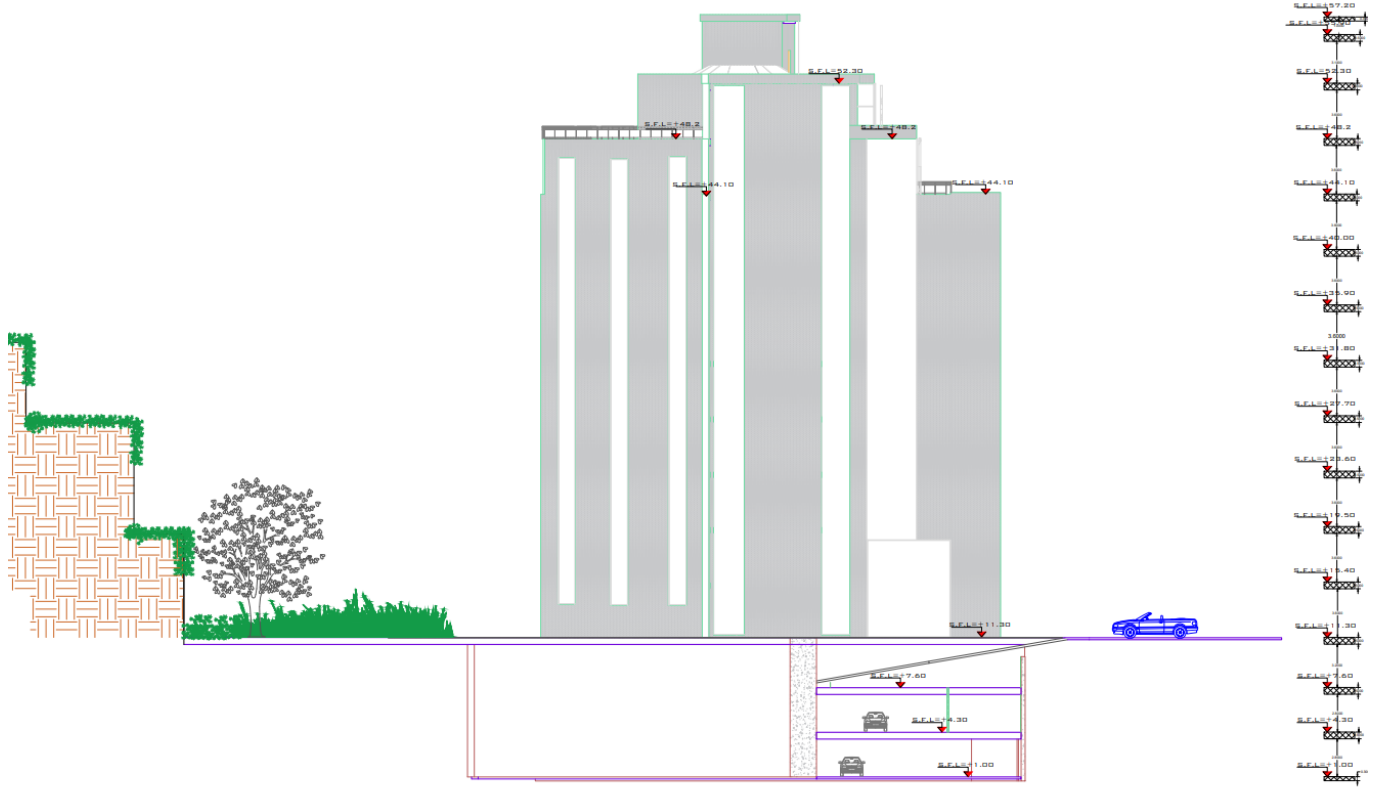
North –East Elevation

South-East Elevation

Elevations

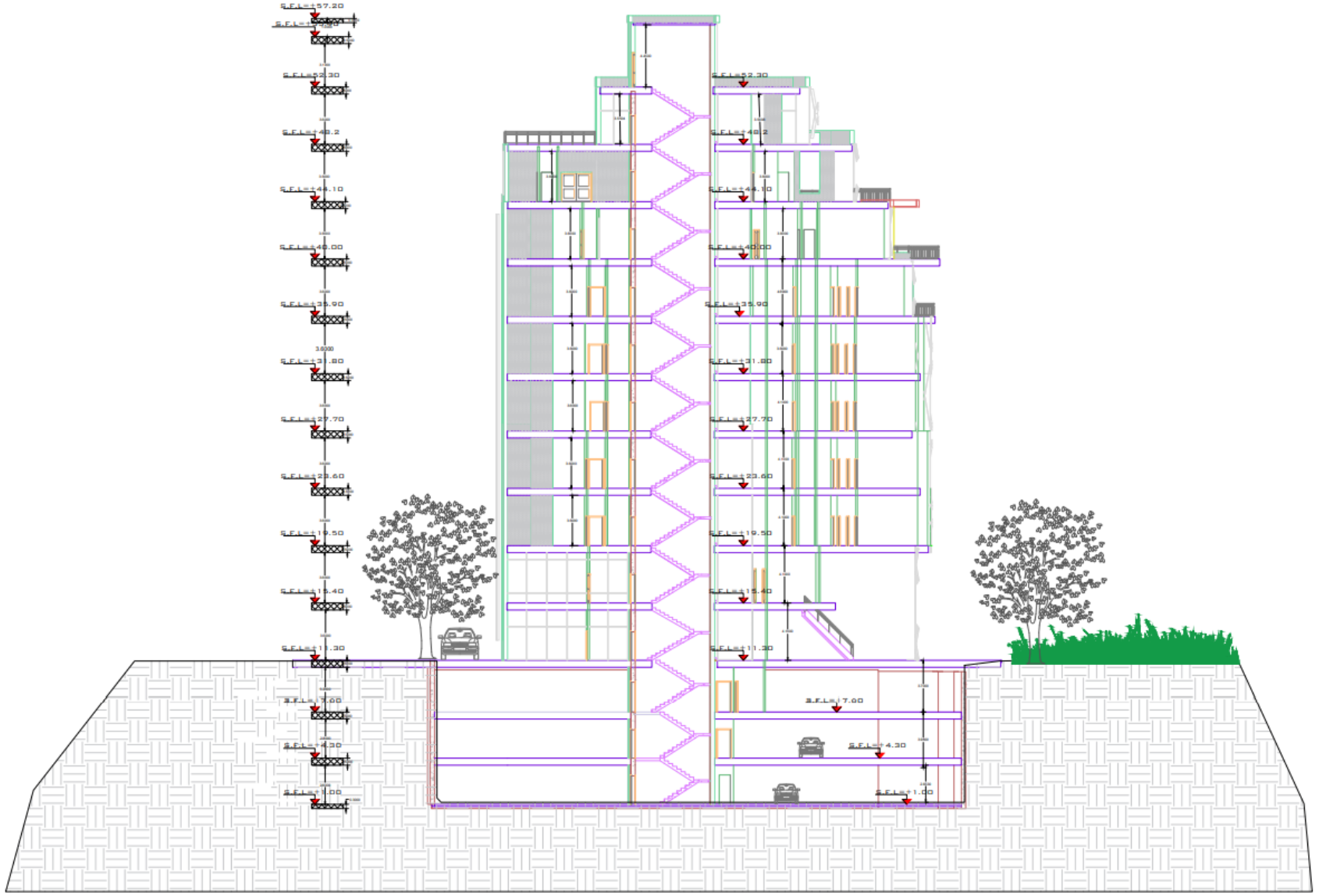


North-West Elevation



South-West Elevation

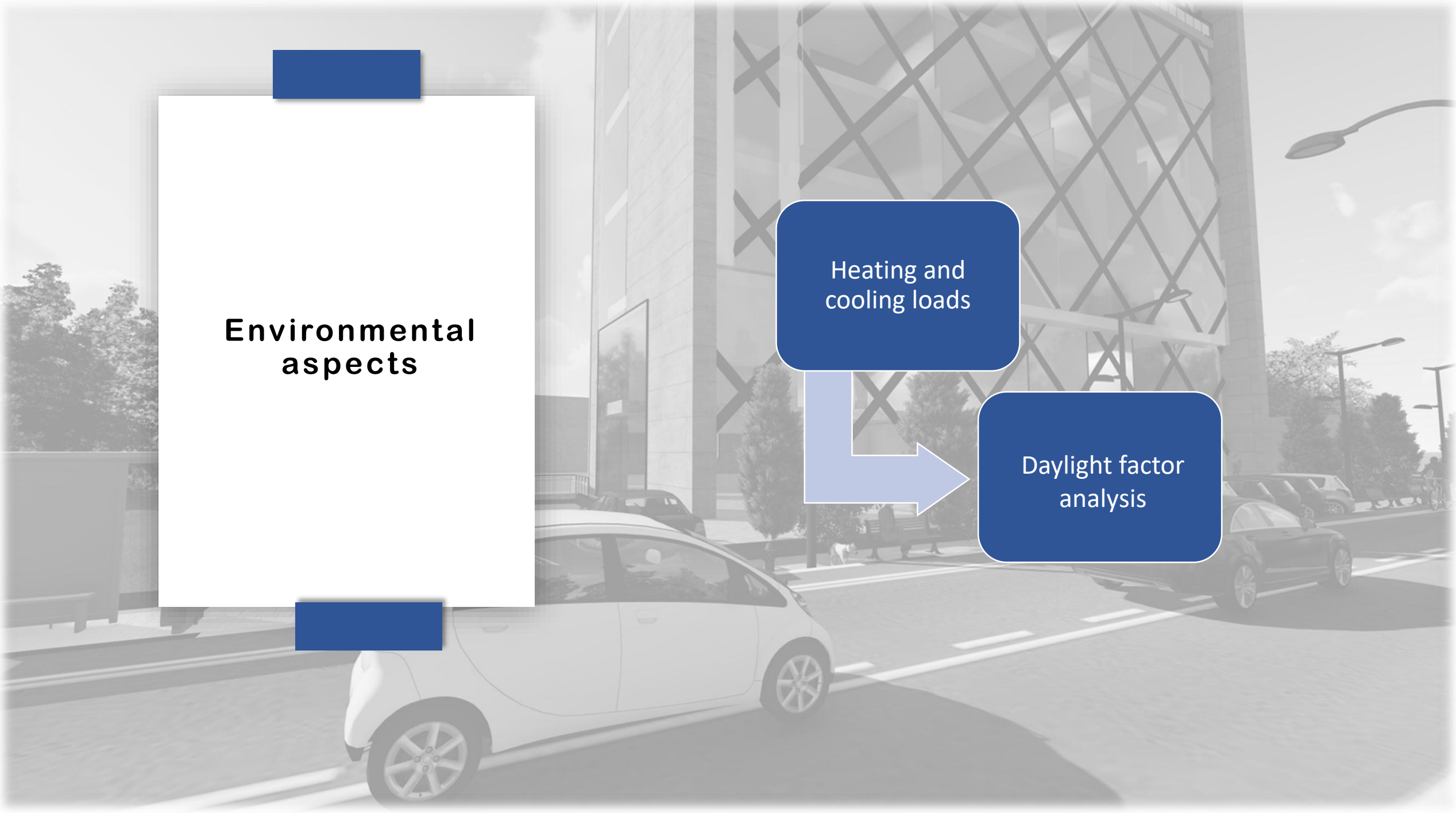
Sections



Section B-B

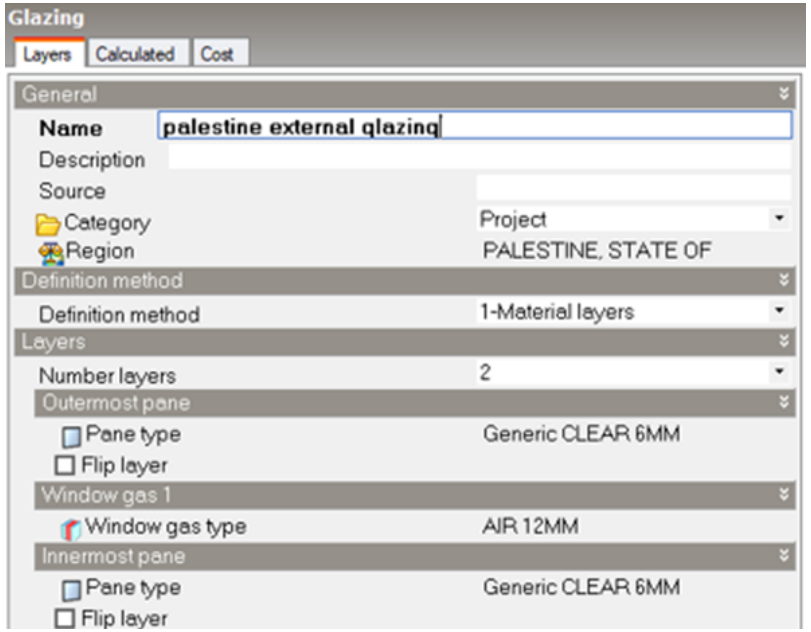
Section C-C

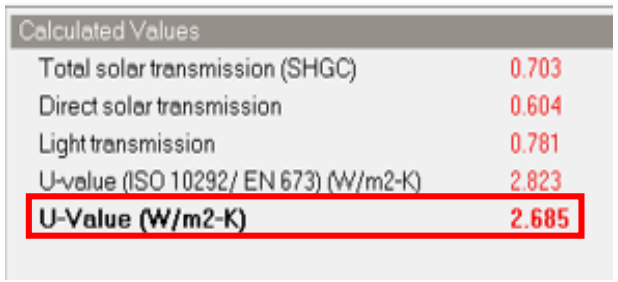
Environmental aspects

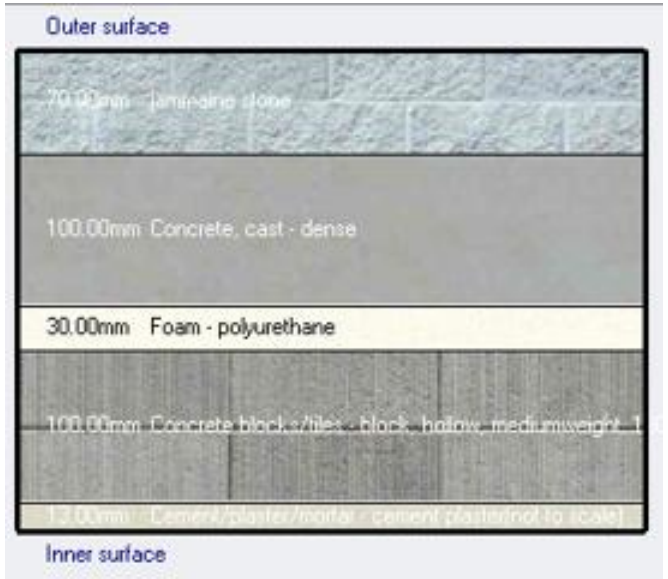


Heating and cooling loads

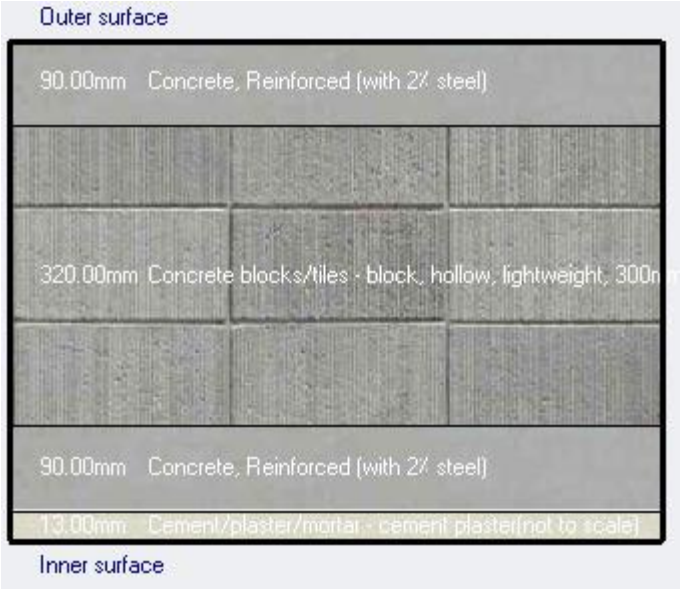
Base case







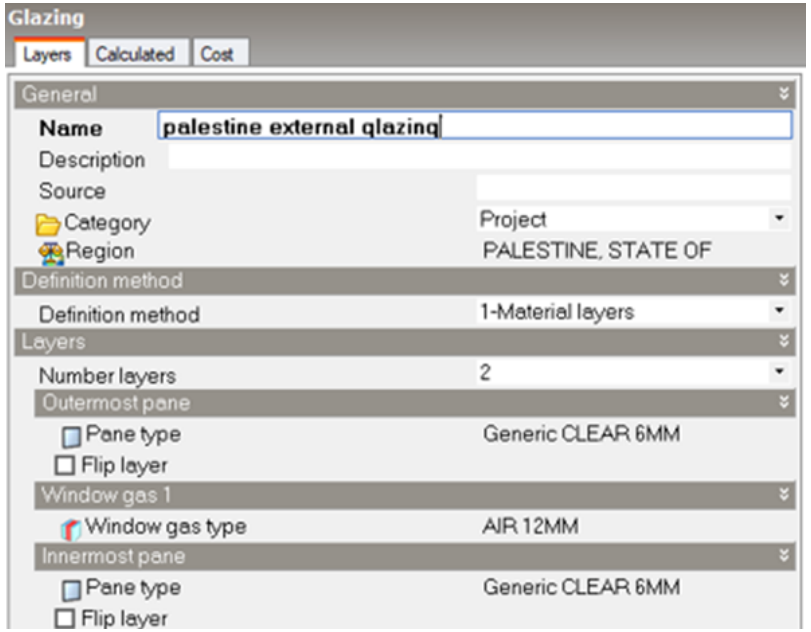
The U-value of the external walls in the base case is 0.664 W/m^2.k

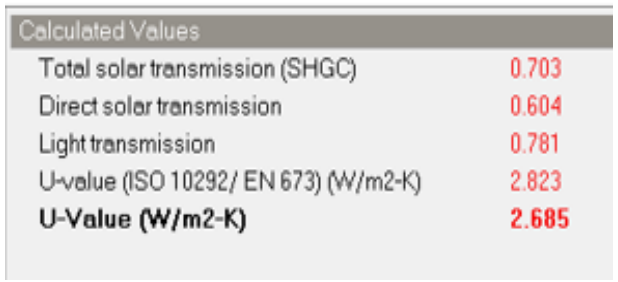


The U-value of the roof slab in the base case is 2.127 W/m^2.k

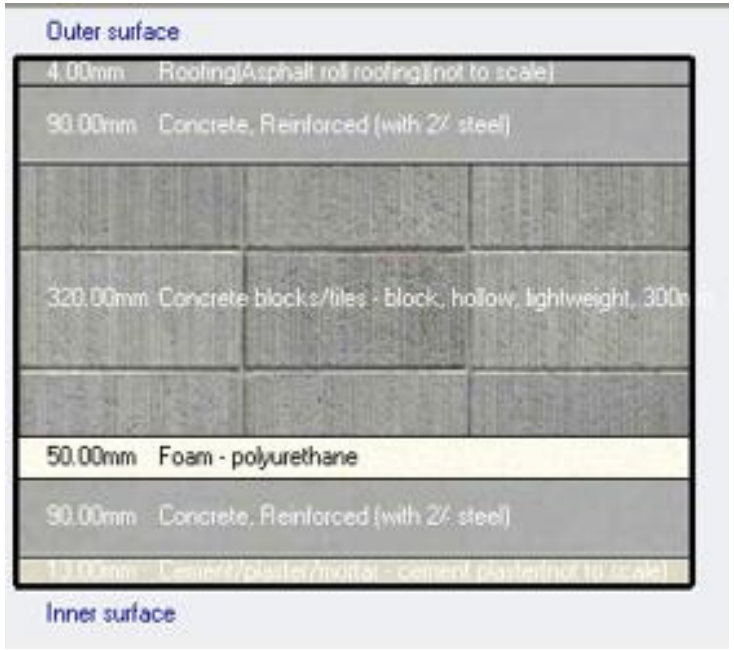
Heating and cooling loads

scenario # 1





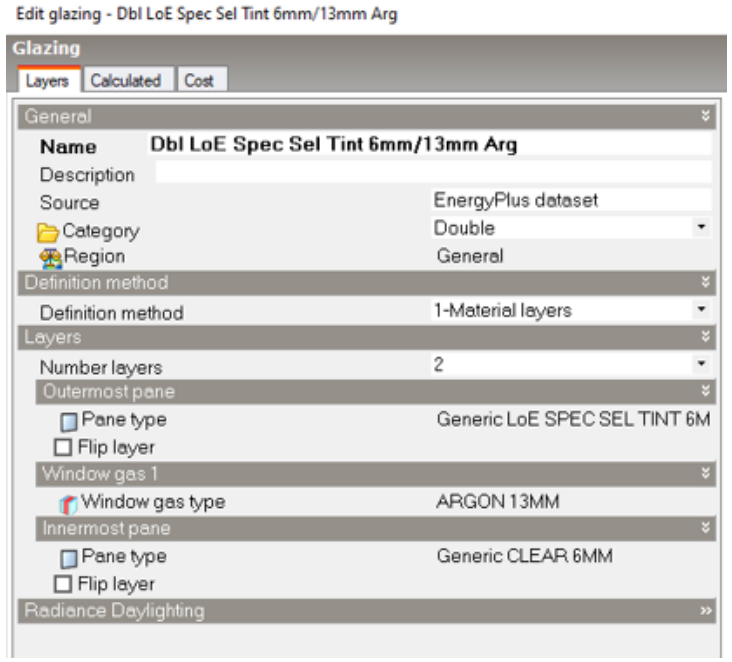
The U-value of the external walls in the first case is 0.388 W/m2.k.

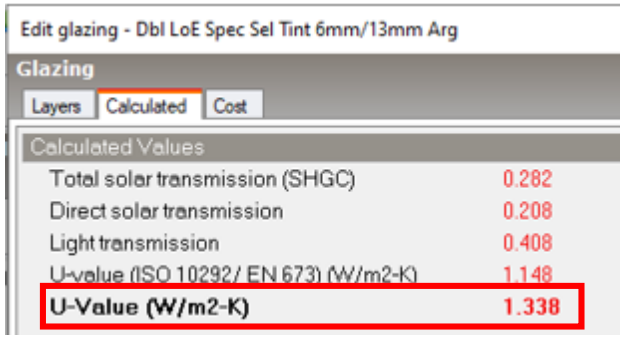


The U-value of the roof in the first case is 0.435 W/m^2.k.

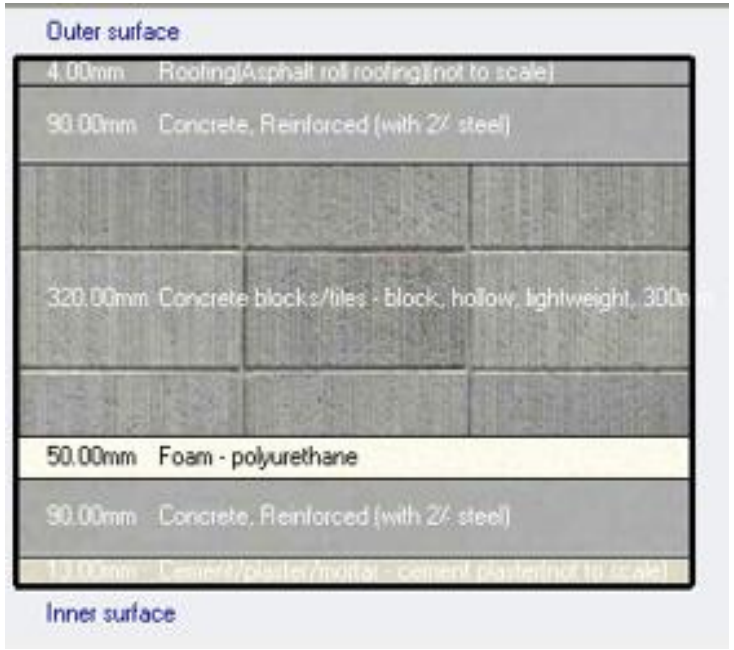
Heating and cooling loads

scenario # 2





The U-value of the external walls in the first case is 0.388 W/m2.k.

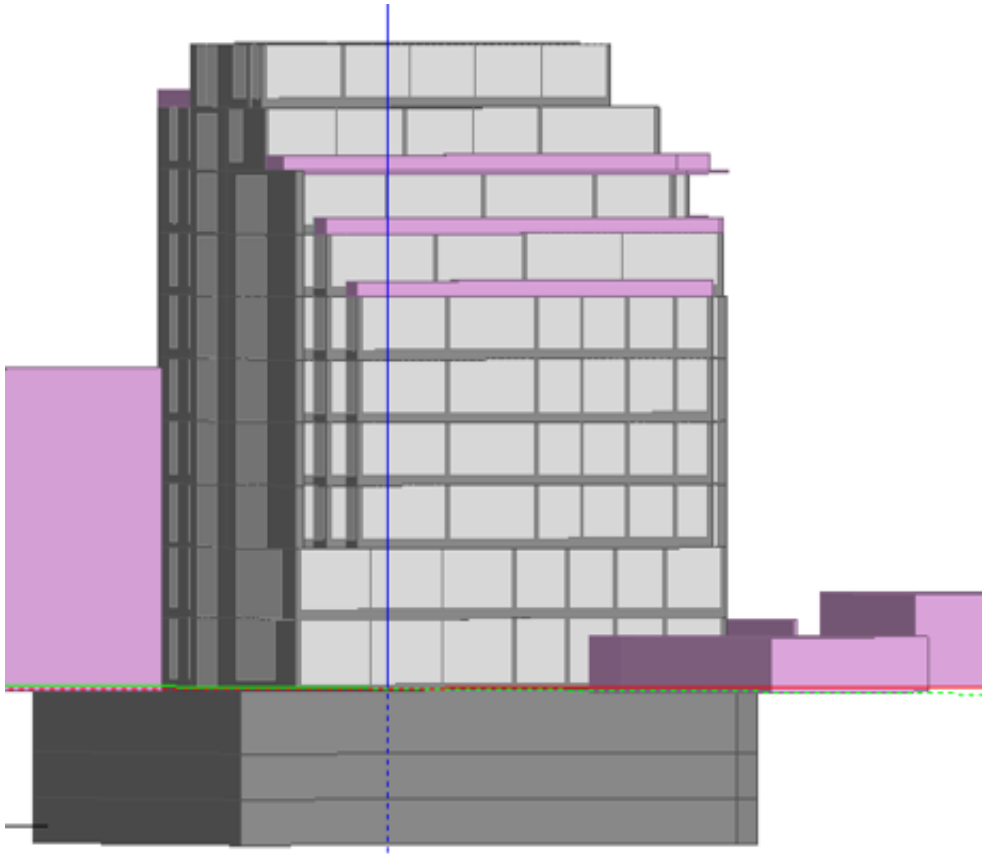


The U-value of the roof in the first case is 0.435 W/m^2.k.

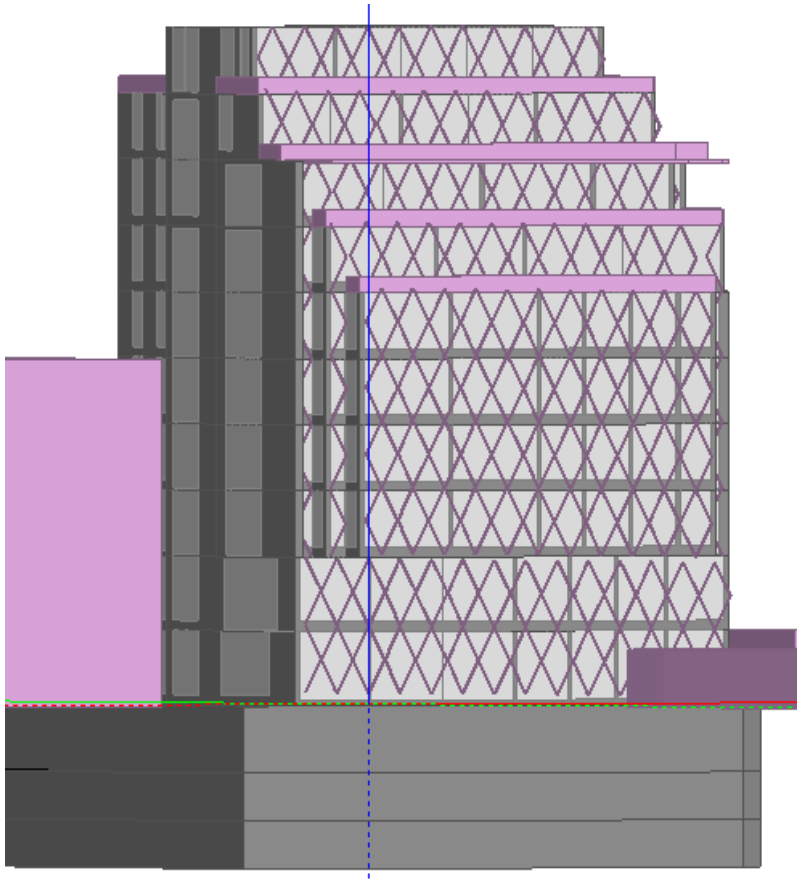
Heating and cooling loads

scenario # 3

In addition to the modifications in the second scenario, the front façade was modified by adding CNC panels as a shading system



Before **modifications**



After **modifications**

Heating and cooling loads

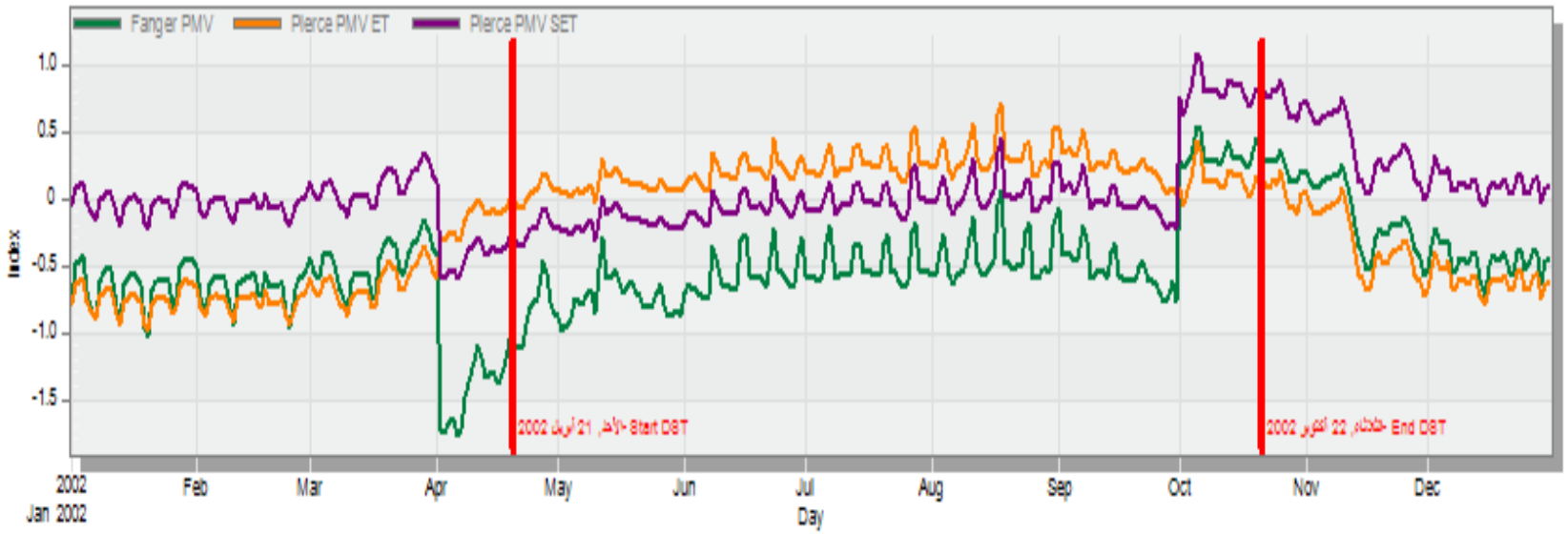
A summary of the cases that we have suggested to get less consumption

The cases	Total Cooling load (kW)	Total Heating load (kW)	Total consumption (kWh/m2)
The base case	443.18	367.64	136.51
Scenario # 1	410.75	292.38	129.11
Scenario # 2	270.72	225.59	92.72
Scenario # 3	254.41	224.3	89.48

We chose Scenario number 3 (placing a CNC on the front façade and using insulating materials for walls and roof and double low-E tint glazing).

Thermal comfort

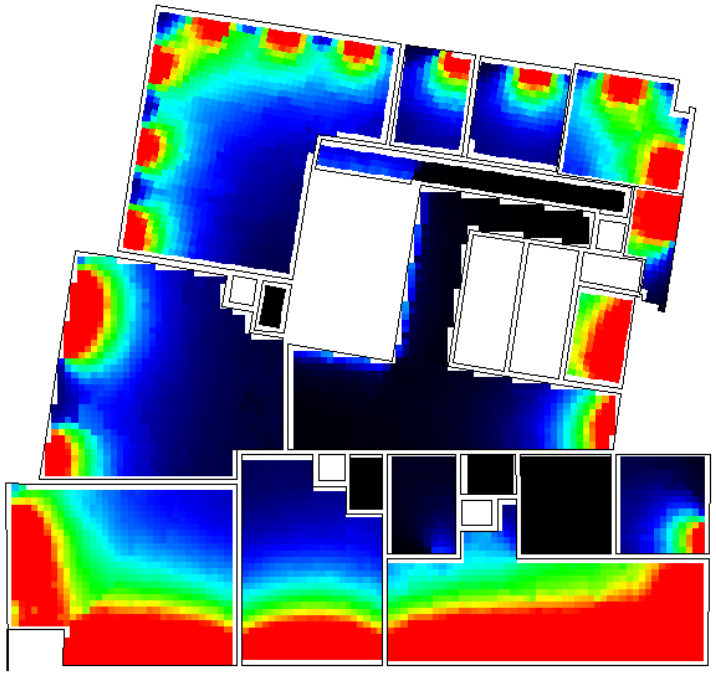
- **Thermal comfort graph**



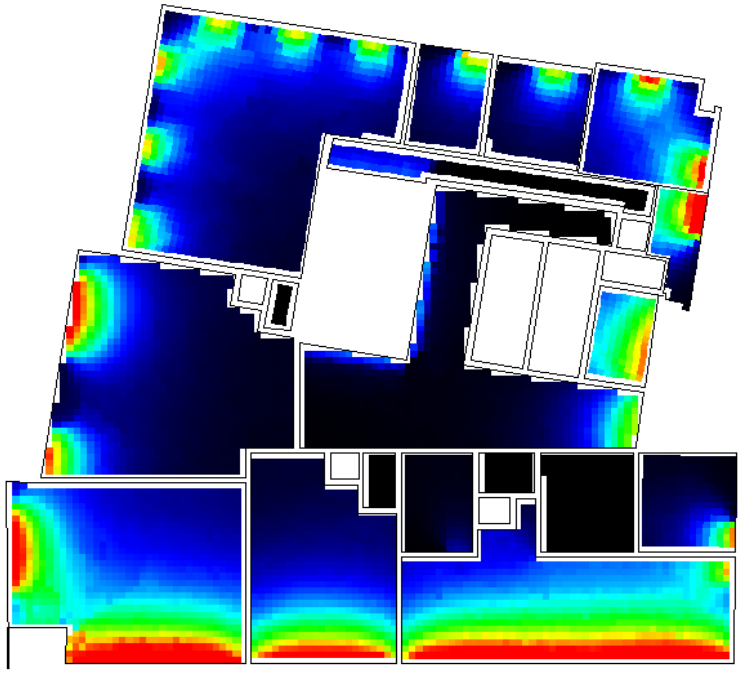
- **The PMV index according to Price two-nod between -1 – 1**

Daylight factor Analysis

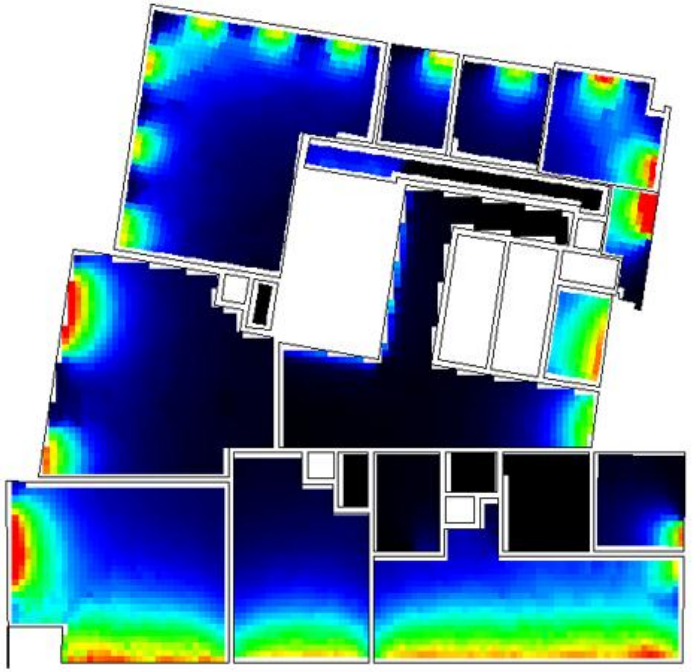
FOR FIFTH FLOOR



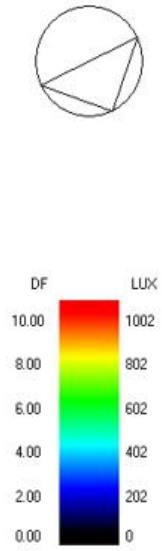
Before Modification



After glass modification



After adding the CNC panels



Structural Aspect

❑ Materials

- Concrete with compressive strength of 28 MPa (B350) and 36 MPa(B450)
- Steel rebar with yielding strength of 420 MPa

❑ Codes

- ACI 318-14
- Seismic design UBC 97
- ASCE for load design

❑ The parameters for seismic analysis

1. • Mass source: 100% for dead laods and SID , 25% for live laods.
2. • Seismic zone : The faculty is located in Ramallah city Therefore, the seismic zone is 2A and the Z value is equal to 0.15
3. • Soil profile: The soil type is rock so the soil profile is Sc
4. • Force Reduction Factor R = 4.5 (Bearing wall system - shear wall)
5. • Importance Factor I = 1
6. • Acceleration-Dependent Seismic Coefficient Ca = 0.18
7. • Velocity-Dependent Seismic Coefficient Cv = 0.25
8. • Response spectrum scale factor = $\frac{I*g}{R}$ = 2179.26

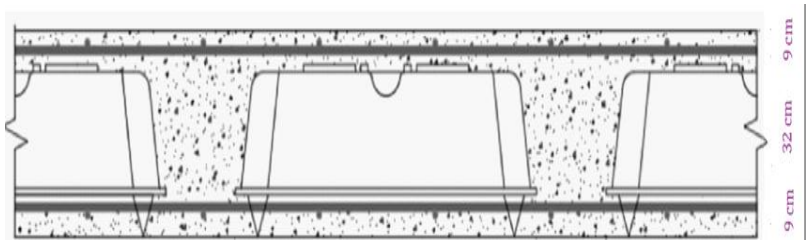
❑ Loads

- Live load = 5 kN/m^2
- SID load = 4 kN/m^2
- Exterior perimeter walls=21kN/m^2
  1.5 kN/m^2

❑ Design elements

❑ Concrete

- Slabs: The structural system used for the slabs is a two-way voided slab with U-Boot Beton and the beams are hidden; with a thickness of 50cm.



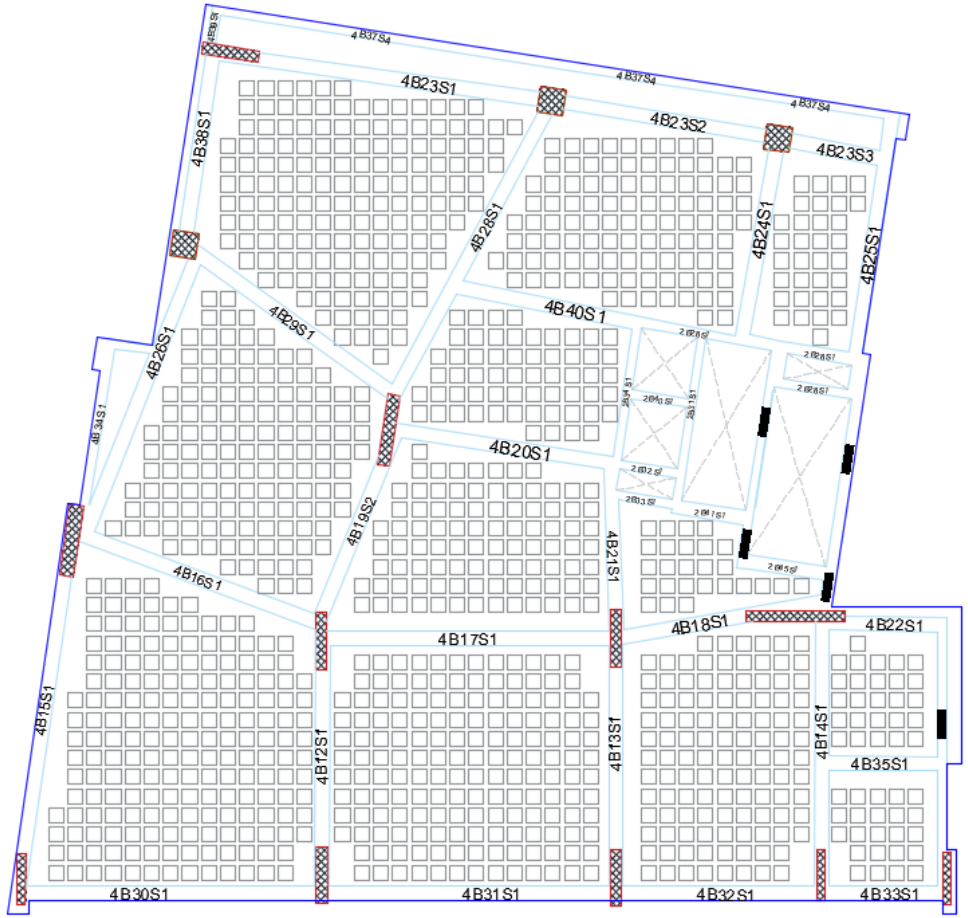
Advantages of using the U-Boot system:

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

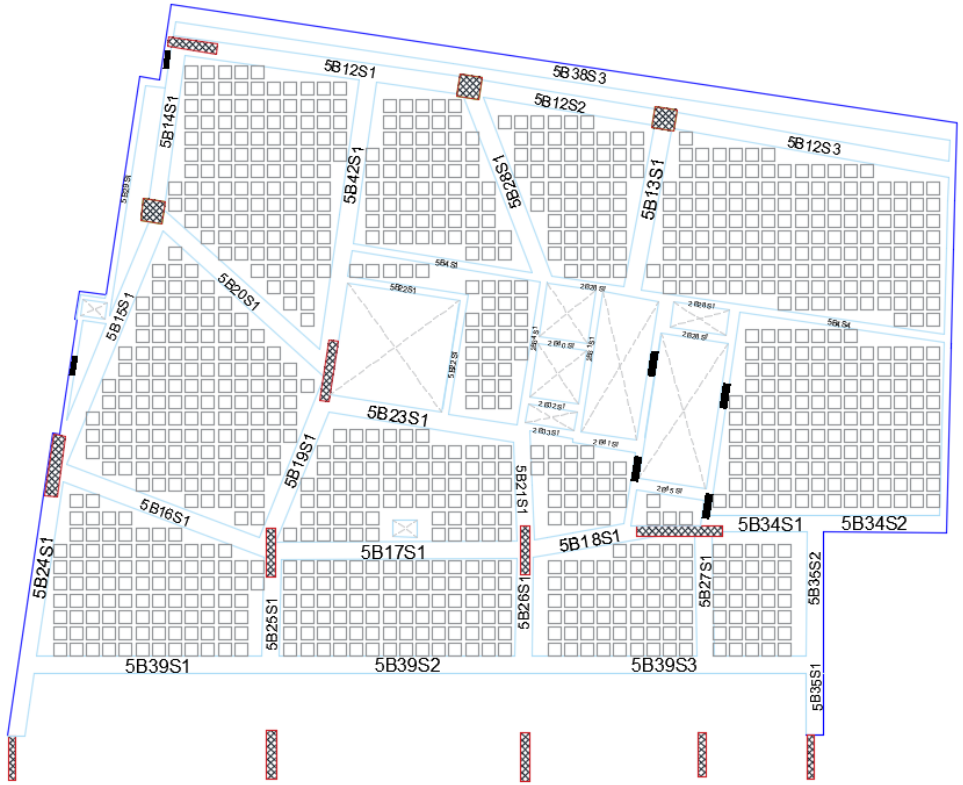
- Columns: we have two groups of cross section in columns
  - {0.9*0.9} cm
  - {0.6*0.6} cm

- Shear wall: three groups of the shear wall section were used:
  - S.W.1 {0.3*3.5}m
  - S.W. 2 {0.3*2}m
  - S.W. 3 {0.4*2.5}m

- U-Boot distribution on Plans



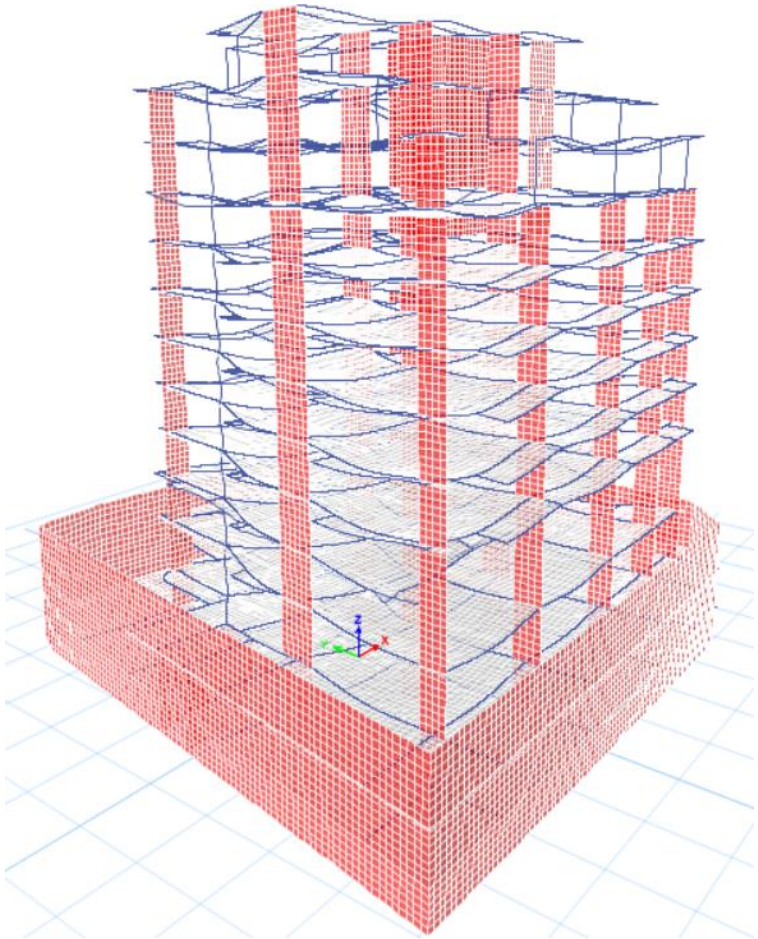
Ground floor



Mezzanine floor

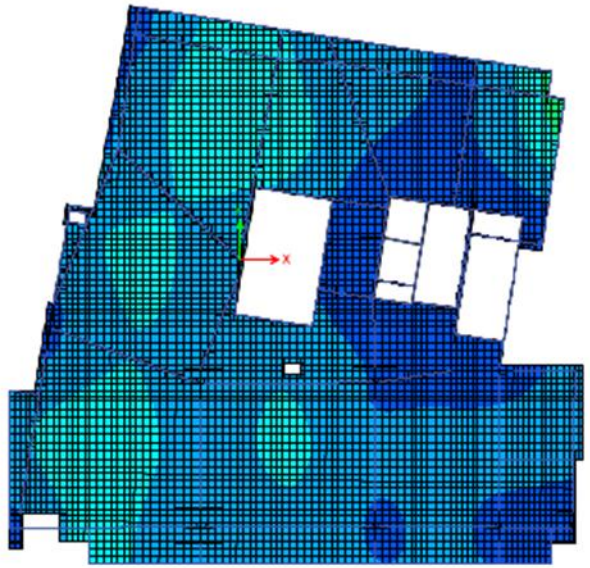
❑ Design check:

❑ Compatibility check:



❑ Deflection check:

From the ETABS program defection equals 36mm and the limitation equals 50. So the check is OK!



❑ Equilibrium check:

Loads	ETABS (KN)	Manual (KN)	Error%	
Dead	166886.2	167359.7	0.28288	<5% OK!
Live	46609.98	46601.437	0.018	
SID	55067.54	55014.34	0.026	

❑ Stress-strain check:

Structural elements	ETABS (KN)	Manual (KN)	Error%	
Corner column	1652.60	1656	0.206	<15% OK!
Edge column	2443.7	2752	12.6	
Interior column	*271.3*	*300*	10.57	

Frame			Column strip			
Manual	ETABS	%Error	Manual	ETABS	%Error	<15% OK!
918.7	840	9.369048	808.69	736.8	9.757058	
272.813	240	13.67208	162.813	146.3	11.28708	

❑ Seismic design checks

1. Base shear checks

	T (SEC)	V Manual (KN)	V ETABS (KN)	Error %	Old Scale factor	NEW Scale factor
TX	1.2	10170.34	10139.10	0	2179.26	2185.974
TY	1.2	10170.34	10139.10	0	2179.26	2185.974

- shear results from ETABS are greater than manual calculations, so the base shear check is ok

2.Period check

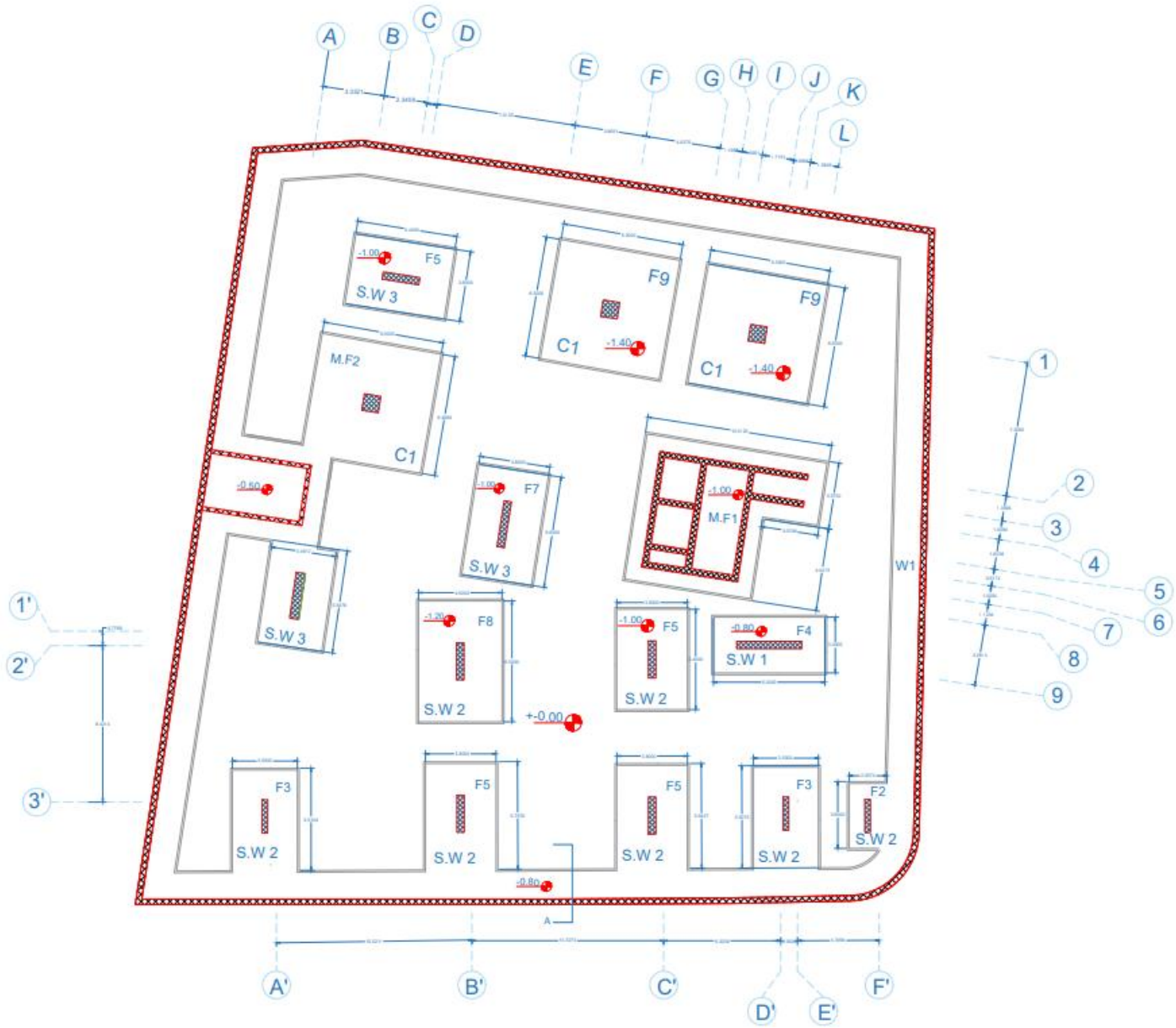
- Time period from mode 1 (Tx) = 0.742 sec < 1.69 sec, the check is ok.
- Time period from mode 2 (Ty) = 1.37sec < 1.69 sec, the check is ok.

3. Drift check

Story	Hight	Dis X	Dis y	Drift X	Drift Y	Dalta X	Dalta Y	Dalta Limit
0	0	0	0					
1	2600	0.128	0.147	0.128	0.147	0.4032	0.46305	52
2	3200	0.78	0.929	0.652	0.782	2.0538	2.4633	64
3	4000	3.25	3.3	2.47	2.371	7.7805	7.46865	80
4	3600	6.2	6.3	2.95	3	9.2925	9.45	72
5	3600	8.8	10.4	2.6	4.1	8.19	12.915	72
6	3600	13.7	14.2	4.9	3.8	15.435	11.97	72
7	3600	18	18.9	4.3	4.7	13.545	14.805	72
8	3600	22.3	23.2	4.3	4.3	13.545	13.545	72
9	3600	26.6	27.9	4.3	4.7	13.545	14.805	72
10	3600	30.8	33.1	4.2	5.2	13.23	16.38	72
11	3600	34.8	34.6	4	1.5	12.6	4.725	72
12	3600	39.1	38.6	4.3	4	13.545	12.6	72
13	3600	43.4	41.1	4.3	2.5	13.545	7.875	72

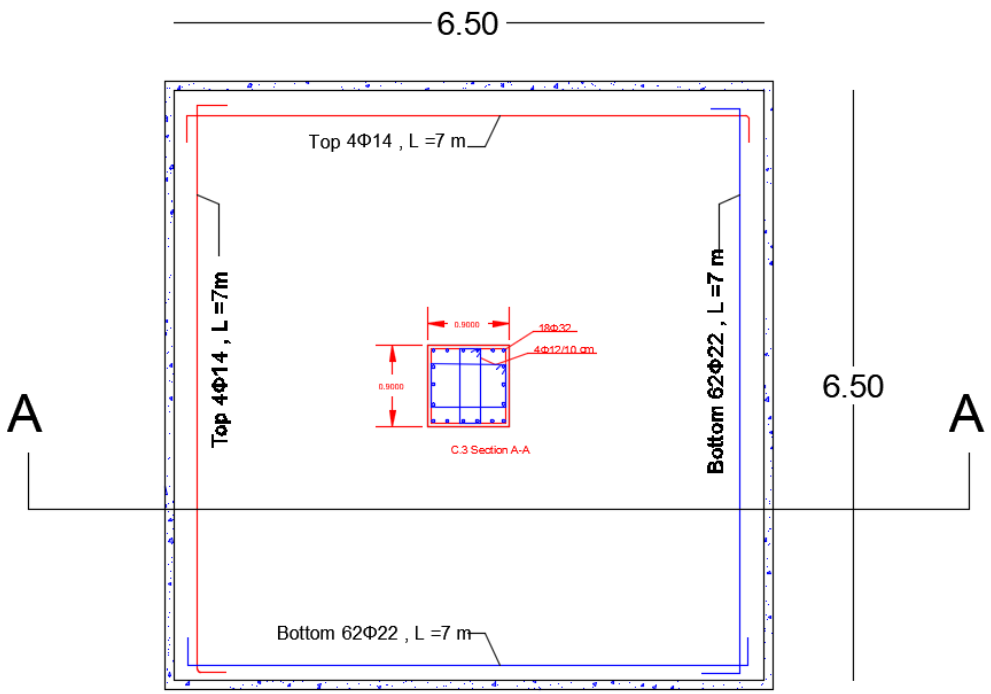
- All drifts in floors < Delta Limits; so the check is ok.

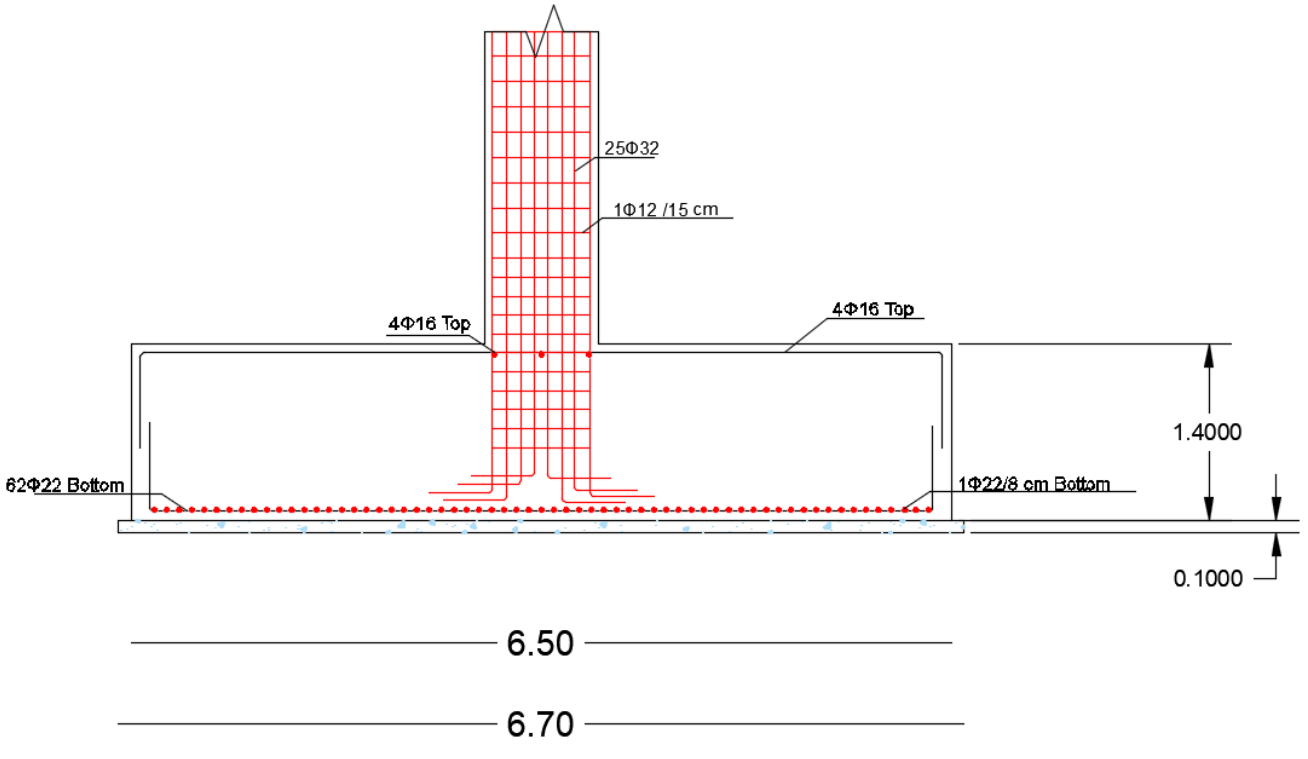
- Details for the structural element:
  - Footing layout:



❑ Footing details

Column footing 9 :

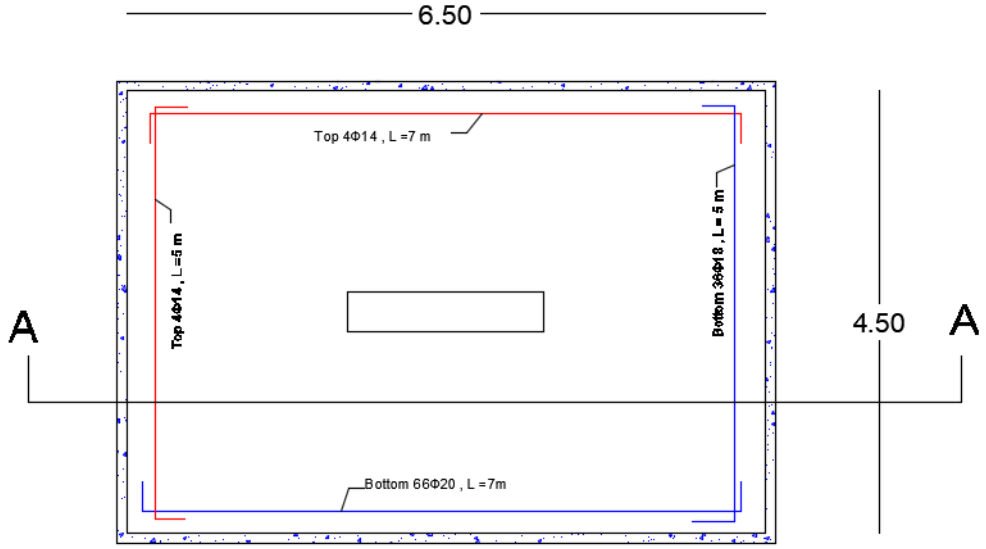


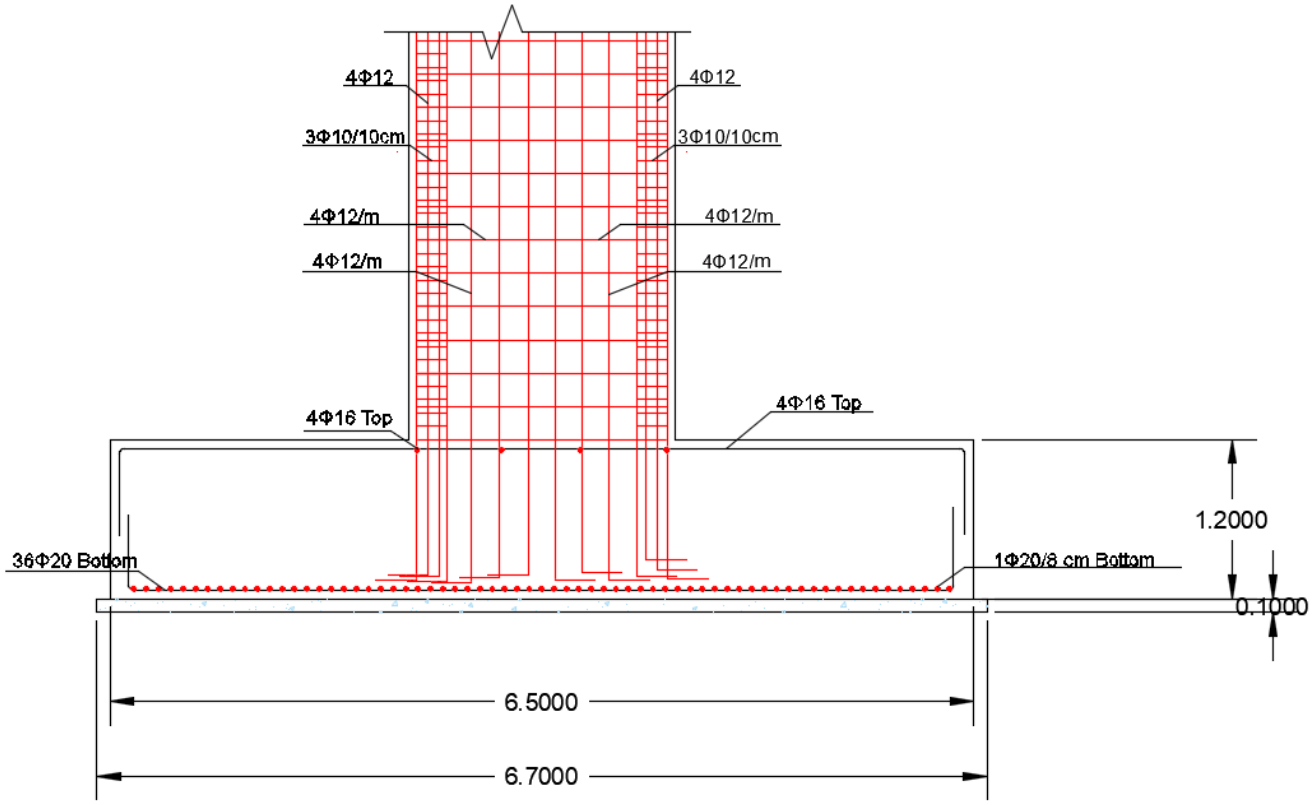


Section A-A

❑ Footing details

Shear wall footing 8 ：

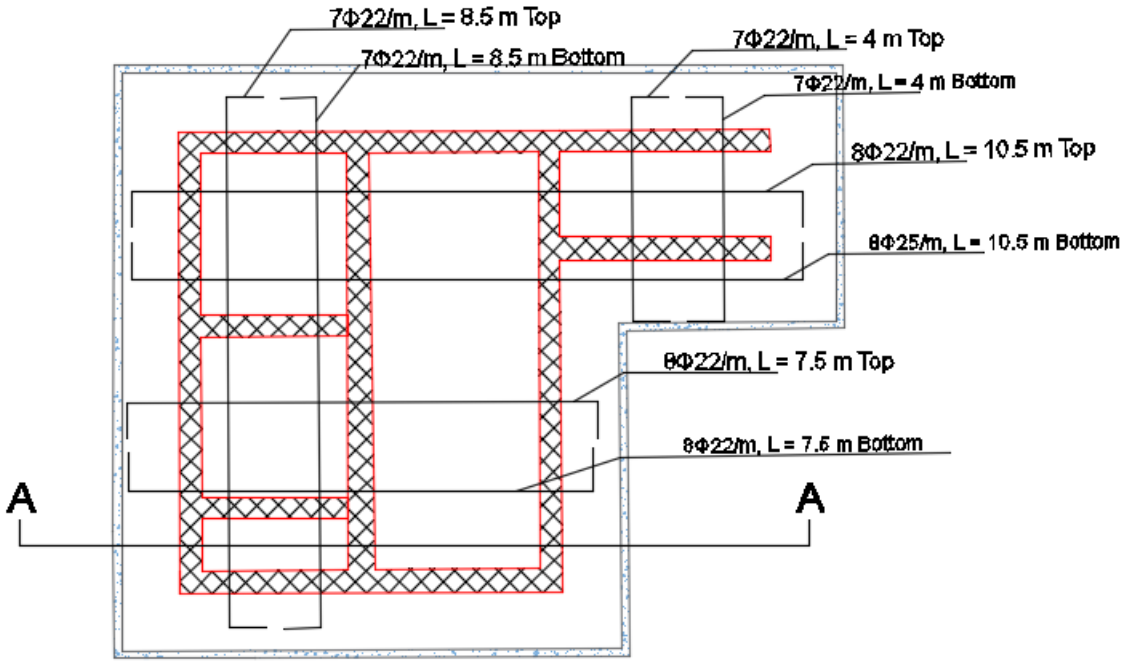


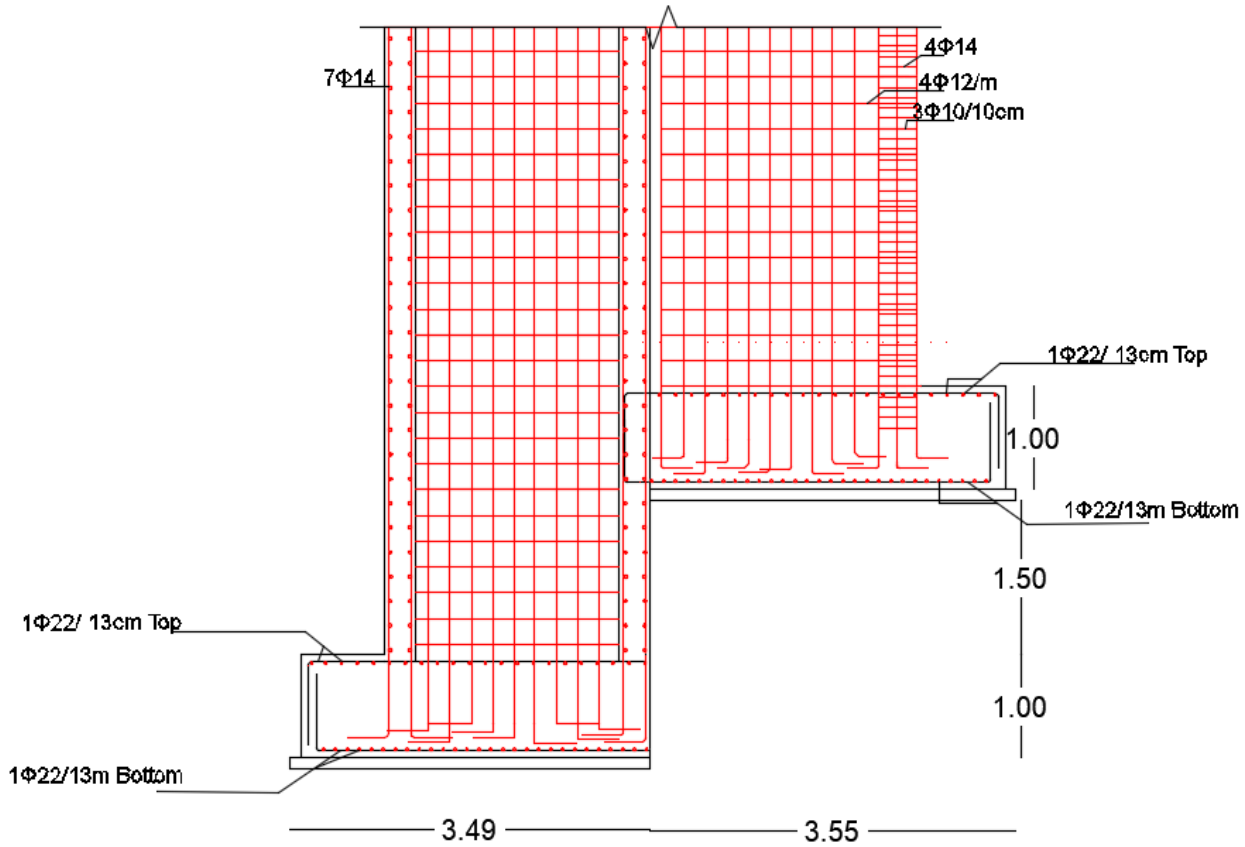


Section A-A

❑ Footing details

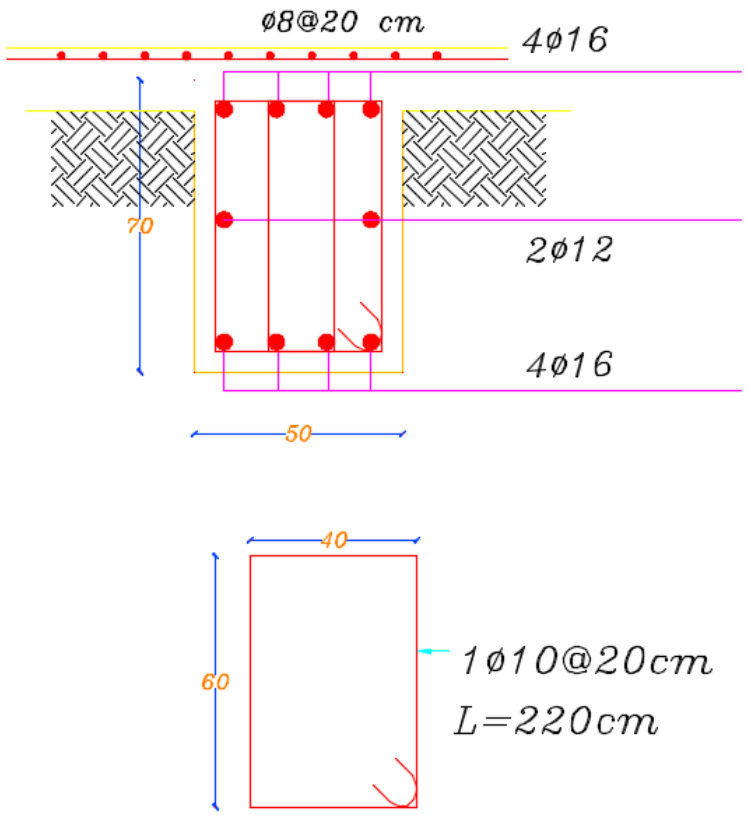
Mat Footing :

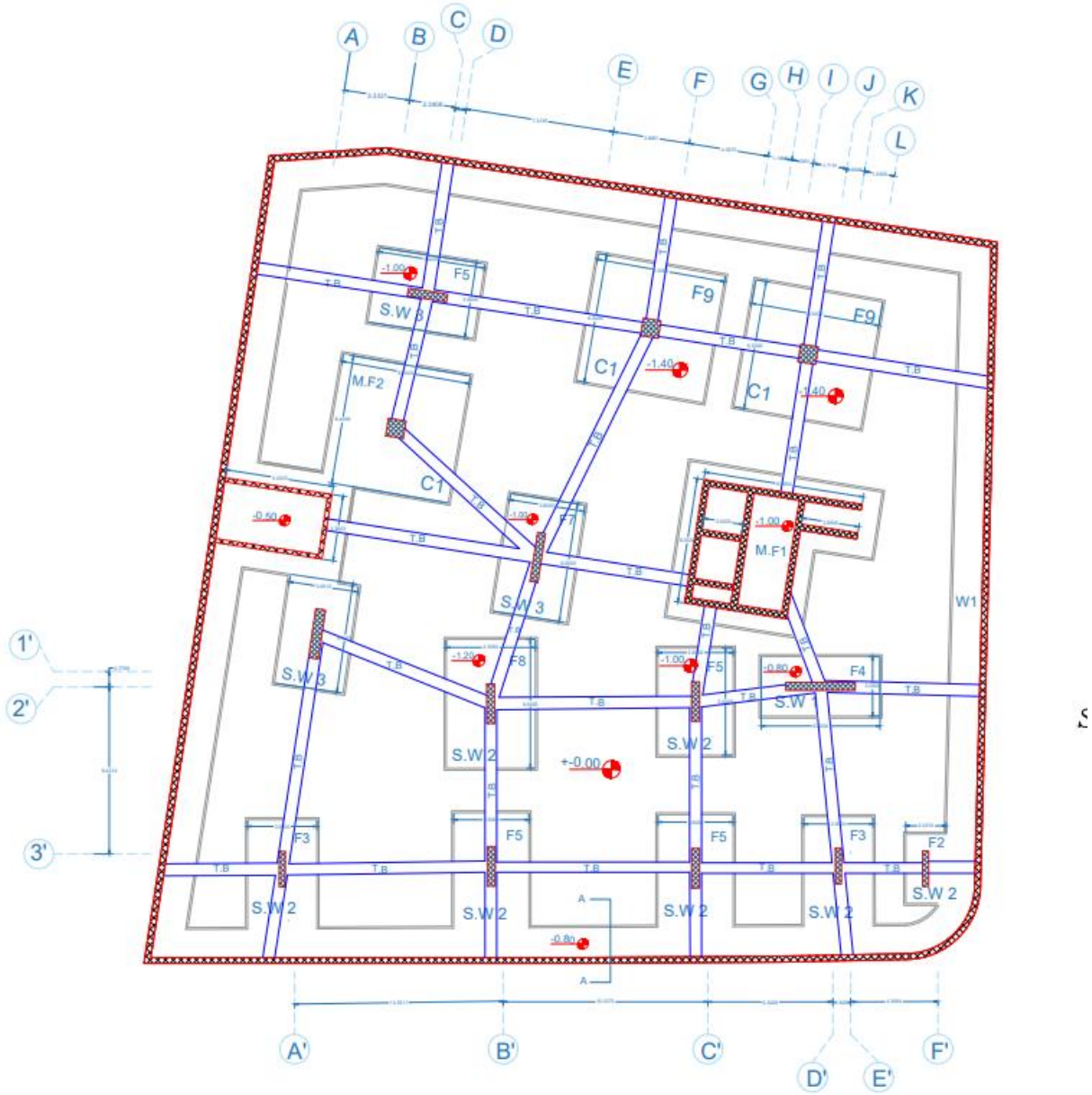




Section A-A

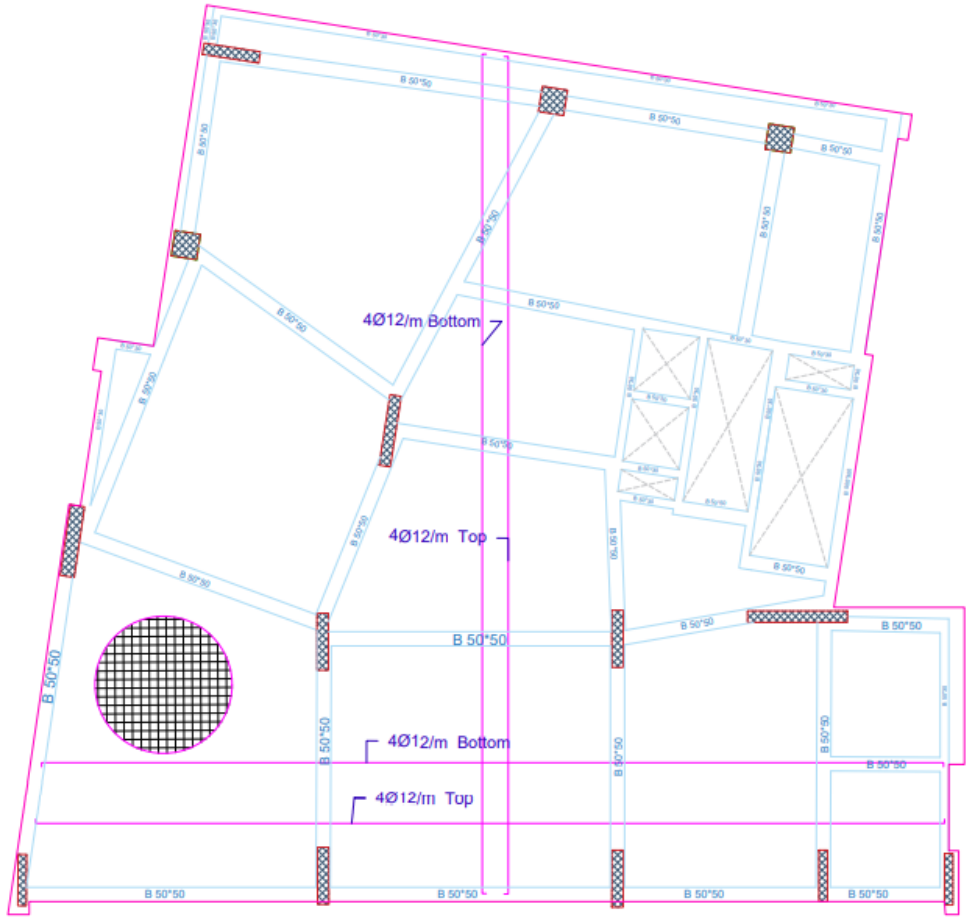
❑ Tie-beams layout



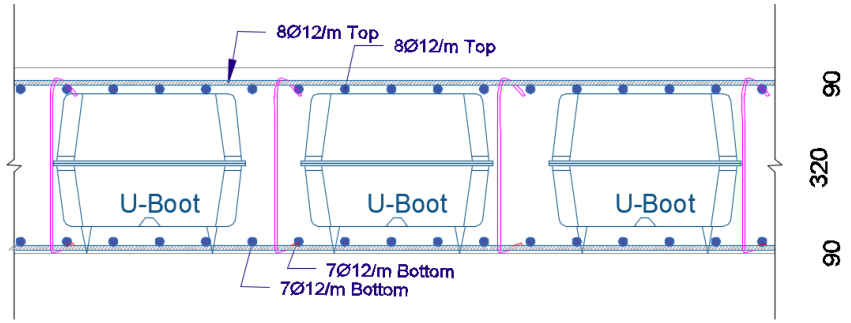


❑ Details for the structural element:

❑ Slab details:

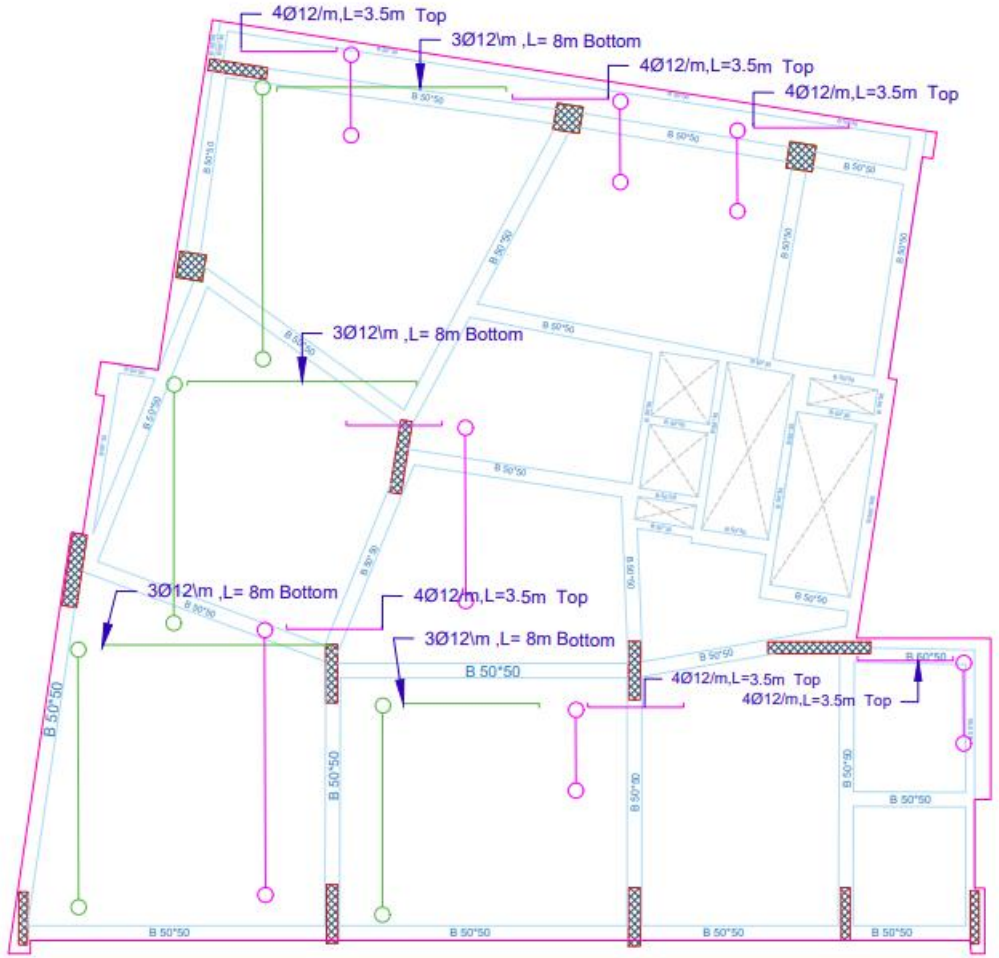


Ground floor –General X-Y Direction

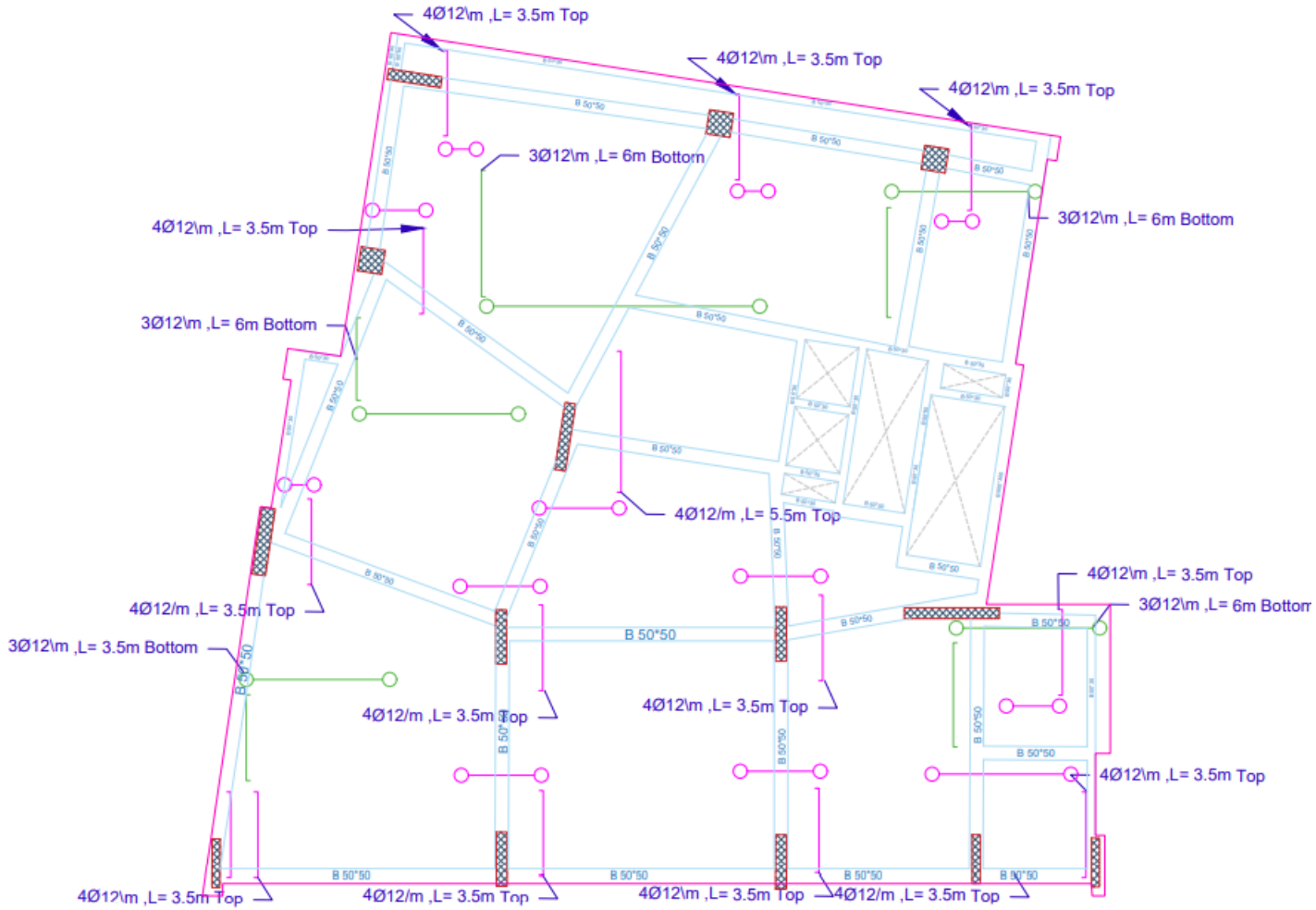


U-BOOT slab

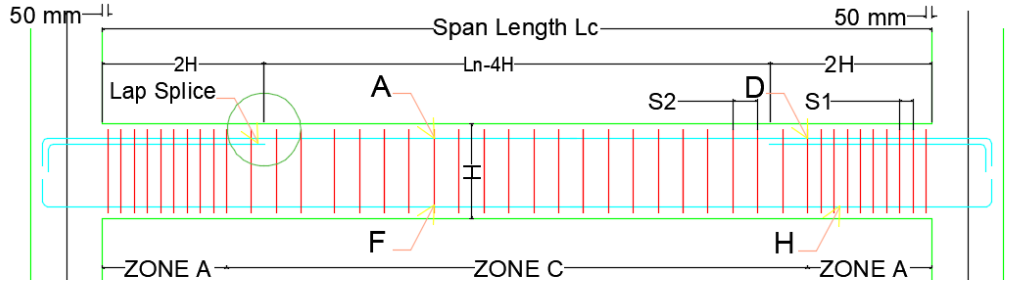
❑ Additional Slab reinforcement in x-direction:

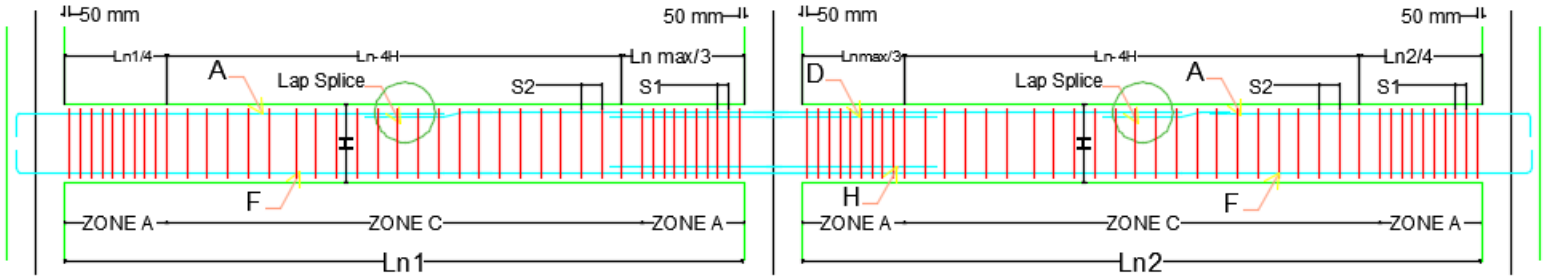


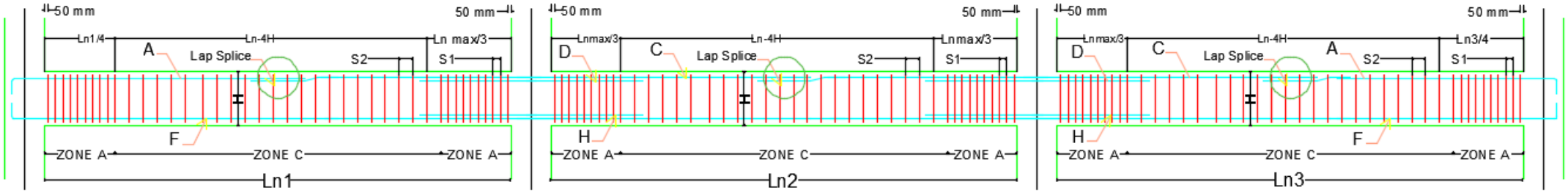
❑ Additional Slab reinforcement in Y-direction:



❑ Beam Details:







General Detailing For Beams:

❑ Beam Details:

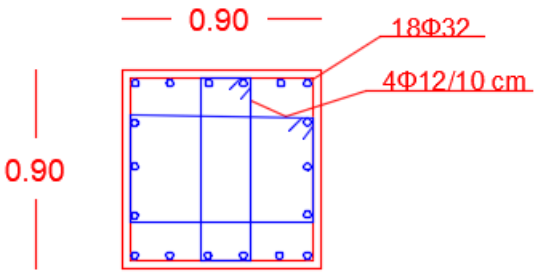
Beam ID	Span No.	Span Length (Lc)	Section Size		Longitudinal Bars					L1	L2	Stirrups		Typical Elevations
			Width	Depth	A	C	D	F	H			ZONE A	ZONE C	
4B30	1	5.517 m	0.500 m	0.500 m	6-12	-	-	7-12	-	1.379 m	-	3-10	21-10	ELEVATION 2S
	2	3.428 m	0.500 m	0.500 m	5-12	2-14	-	4-14	2-12	0.857 m	0.857 m	3-10	12-10	ELEVATION 2S
4B31	1	9.876 m	0.500 m	0.500 m	7-12	4-12	3-12	7-12	-	2.469 m	2.469 m	3-10	41-10	ELEVATION 1S
4B32	1	6.804 m	0.500 m	0.500 m	7-12	2-14	-	4-14	-	1.701 m	-	3-10	27-10	ELEVATION 1S
4B33	1	3.558 m	0.500 m	0.500 m	2-14	2-14	-	4-14	-	-	-	3-10	12-10	ELEVATION 1S
4B35	1	3.964 m	0.500 m	0.500 m	2-14	2-14	-	4-14	-	-	-	3-10	14-10	ELEVATION 1S
4B16	1	8.234 m	0.500 m	0.500 m	7-12	4-12	3-12	7-12	-	2.058 m	2.058 m	3-10	33-10	ELEVATION 1S
4B17	1	9.399 m	0.500 m	0.500 m	7-12	4-12	3-12	7-12	-	2.350 m	2.350 m	3-10	39-10	ELEVATION 1S
4B18	1	4.123 m	0.500 m	0.500 m	2-14	2-12	1-12	4-14	-	-	1.031 m	3-10	15-10	ELEVATION 1S
4B22	1	3.134 m	0.500 m	0.500 m	10-14	4-12	3-12	9-12	1-12	0.784 m	0.784 m	6-10	19-10	ELEVATION 1S
4B20	1	7.398 m	0.500 m	0.500 m	5-12	4-12	4-12	6-12	-	1.850 m	1.850 m	3-10	30-10	ELEVATION 1S

❑ Beam Details:

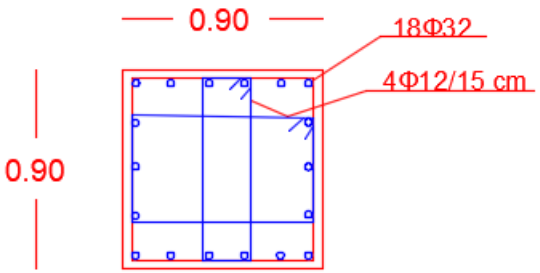
Beam ID	Span No.		Section Size		Longitudinal Bars							Stirrups		
		Span Length (Lc)	Width	Depth	A	C	D	F	H	L1	L2	ZONE A	ZONE C	Typical Elevations
4B29	1	8.428 m	0.500 m	0.500 m	6-12	9-12	8-12	8-12	-	2.107 m	2.107 m	6-10	37-10	ELEVATION 1S
4B40	1	6.612 m	0.500 m	0.500 m	6-12	8-12	8-12	4-14	3-12	1.653 m	1.653 m	5-10	26-10	ELEVATION 1S
4B23	1	9.942 m	0.500 m	0.500 m	7-14	-	-	9-12	-	2.486 m	-	5-10	41-10	ELEVATION 3S
	2	7.139 m	0.500 m	0.500 m	-	4-12	4-12	4-14	-	-	1.785 m	3-10	30-10	ELEVATION 3S
	3	3.638 m	0.500 m	0.500 m	2-14	4-12	4-12	4-14	-	-	0.909 m	3-10	15-10	ELEVATION 3S
4B37	1	3.278 m	0.300 m	0.500 m	2-14	-	-	4-14	-	-	-	3-10	11-10	ELEVATION 3S
	2	8.910 m	0.300 m	0.500 m	-	2-12	2-12	4-14	-	-	2.227 m	3-10	36-10	ELEVATION 3S
	3	7.985 m	0.300 m	0.500 m	-	3-12	2-12	4-14	-	-	1.996 m	3-10	32-10	ELEVATION 3S
	4	3.873 m	0.300 m	0.500 m	2-14	3-12	2-12	4-14	-	-	0.968 m	3-10	14-10	ELEVATION 3S
4B15	1	9.547 m	0.500 m	0.500 m	7-14	8-12	7-12	9-12	-	2.387 m	2.387 m	3-10	39-10	ELEVATION 1S
4B26	1	8.885 m	0.500 m	0.500 m	7-12	5-12	5-12	10-12	-	2.221 m	2.221 m	3-10	39-10	ELEVATION 1S
4B34	1	5.859 m	0.300 m	0.500 m	5-12	2-14	-	4-14	-	1.465 m	-	3-10	23-10	ELEVATION 1S
4B38	1	5.984 m	0.500 m	0.500 m	5-12	2-12	2-12	5-14	-	1.496 m	1.496 m	3-10	25-10	ELEVATION 1S
4B39	1	1.624 m	0.300 m	0.500 m	2-14	2-14	-	4-14	-	-	-	3-10	3-10	ELEVATION 1S

❑ Column Details:

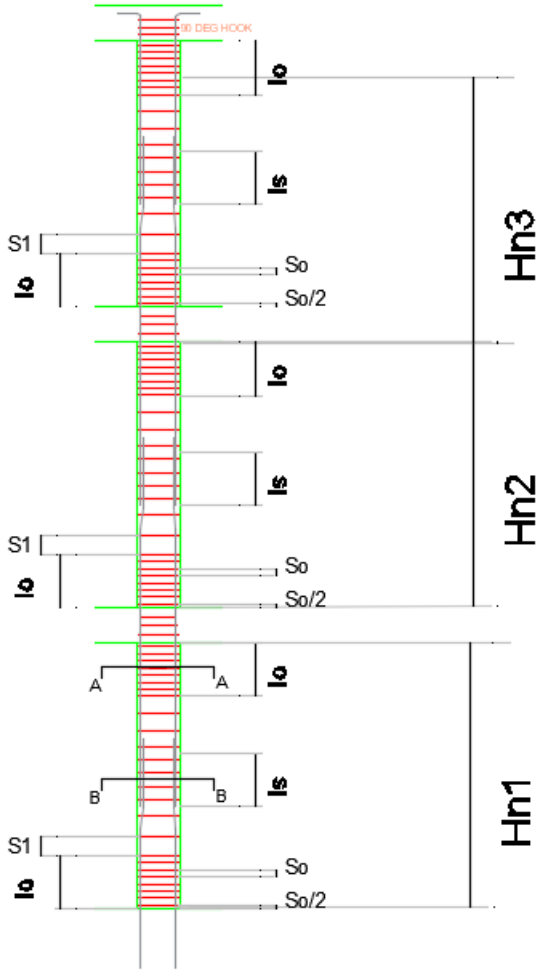
Column	StoryNO.	Length	Width	Longitudinal Rebar	Lap splice	bc	Stirrups used at support	Stirrups used at Middle	So	S1	Lo
		m	m		mm	mm			mm	mm	mm
C1	1,2	0.9	0.9	25Φ32	1600	820	4Φ12/10 cm	4Φ12 /15 cm	100	150	900
C2	1,2,3	0.9	0.9	23Φ32	1600	820	4Φ12/10 cm	4Φ12 / 15 cm	100	150	900
C3	1,2	0.9	0.9	18Φ32	1600	820	4Φ12/10 cm	4Φ12 / 15 cm	100	150	900
C4	11	0.6	0.6	15Φ18	1000	520	3Φ12/10 cm	3Φ12 / 15 cm	100	150	600
C1	3 to12	0.9	0.9	17Φ25	800	820	4Φ12/10 cm	4Φ12 / 15 cm	100	150	900
C2	4 to12	0.9	0.9	17Φ25	800	820	4Φ12/10 cm	4Φ12 / 15 cm	100	150	900
C3	3 to12	0.9	0.9	17Φ25	800	820	4Φ12/10 cm	4Φ12 / 15 cm	100	150	900



C.3 Section A-A

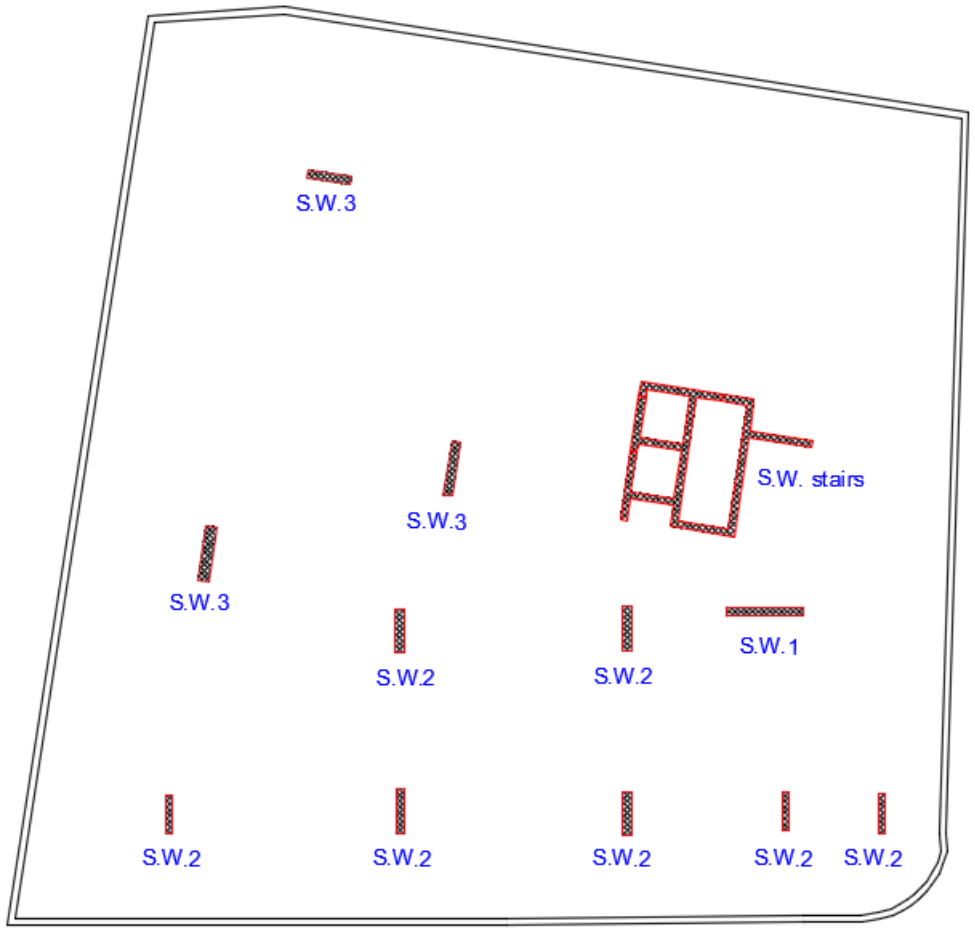


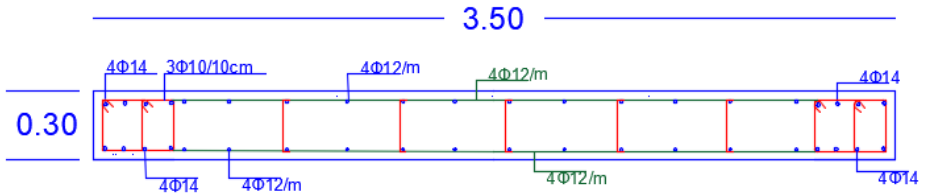
C.3 Section B-B



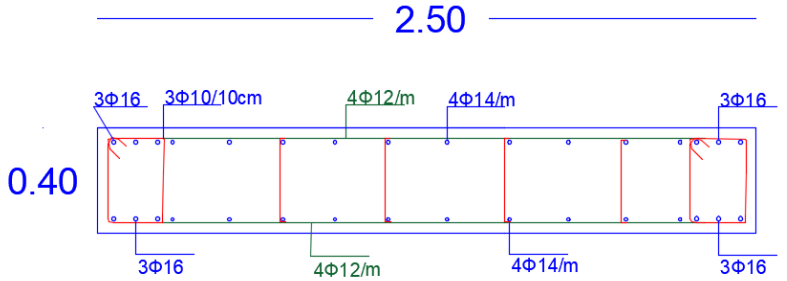
❑ Shear wall Details:

❑ Shear wall layout

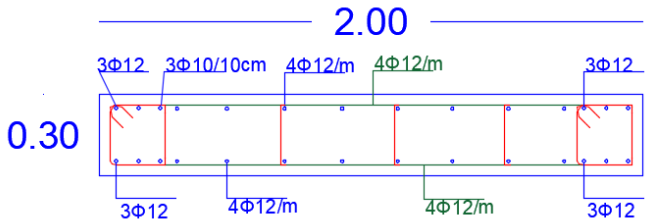




S.W. 1



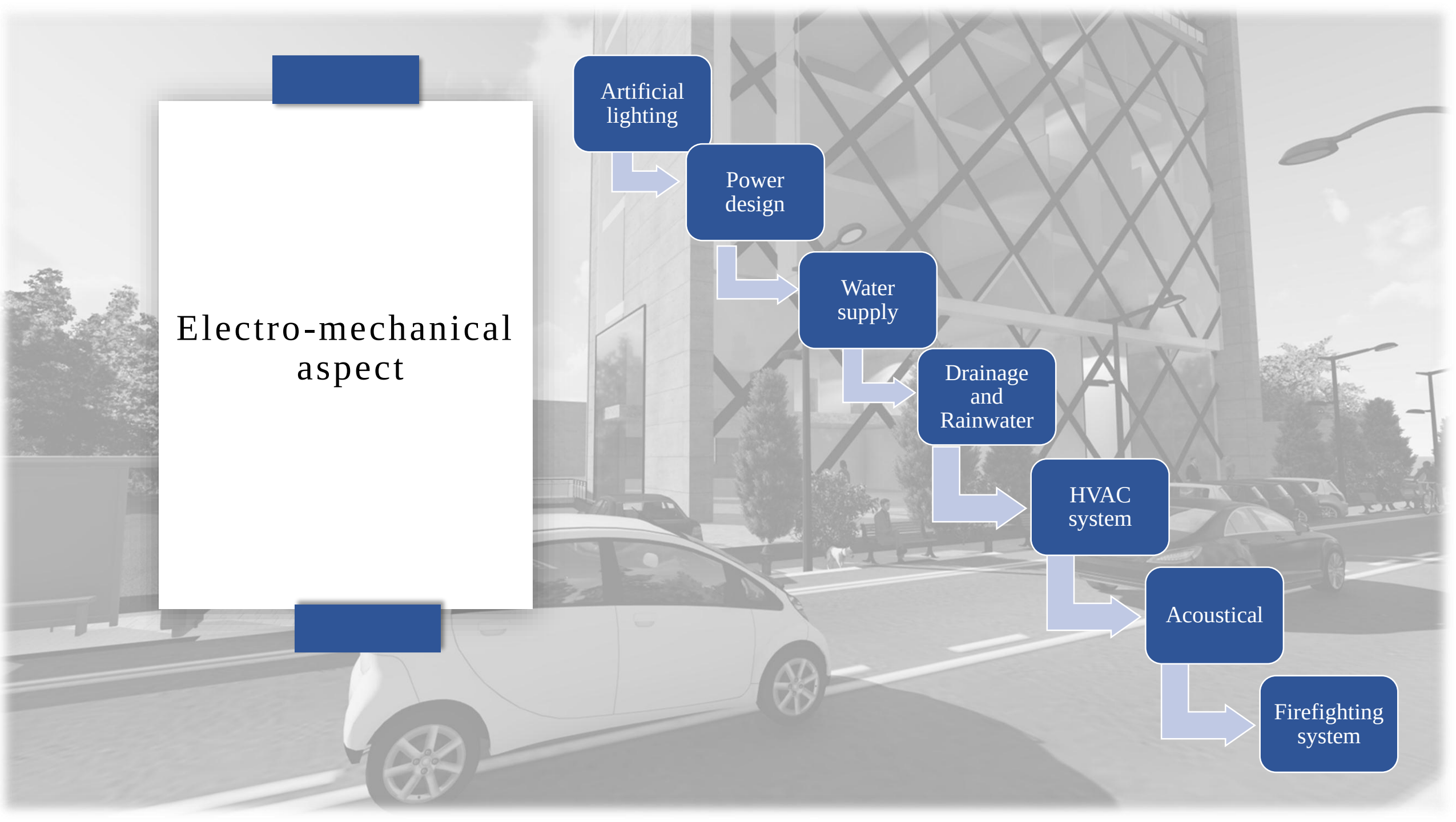
S.W. 2



S.W. 3

Electro–mechanic Aspect

Electro-mechanical aspect

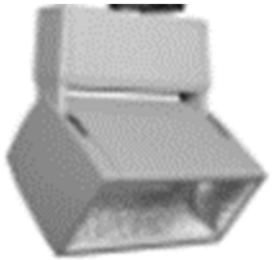


Artificial light

Artificial light

- Shops

Luminaries used:



Clothes shop

Furniture shop

Artificial light

- Reception
  Luminaries used:

activity	illuminance	uniformity	glare	Pass/fail
Reception room	385lux	0.64	22	pass

Artificial light

- Meeting room

  Luminaries used:

activity	illuminance	uniformity	glare	Pass/fail
Meeting room	500	0.62	>10	pass

Artificial light

- Manager room and mini office

  Luminaries used:




Activity	illuminance	uniformity	glare	Pass/fail
Manager room	502	0.81	17	pass
Mini office	545	0.9	17.5	pass

- Manager room and mini office

Artificial light

- Café

  Luminaries used:

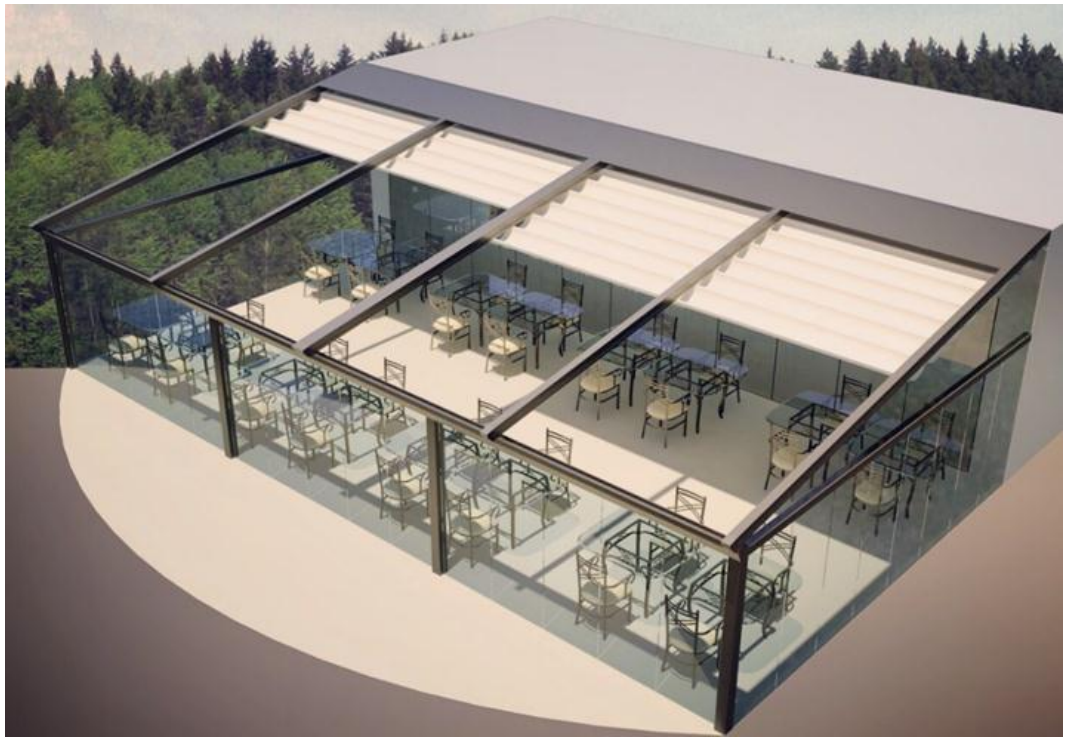




Activity	illuminance	uniformity	glare	Pass/fail
Dining room	183lux	0.62	-	pass

Indoor seating area

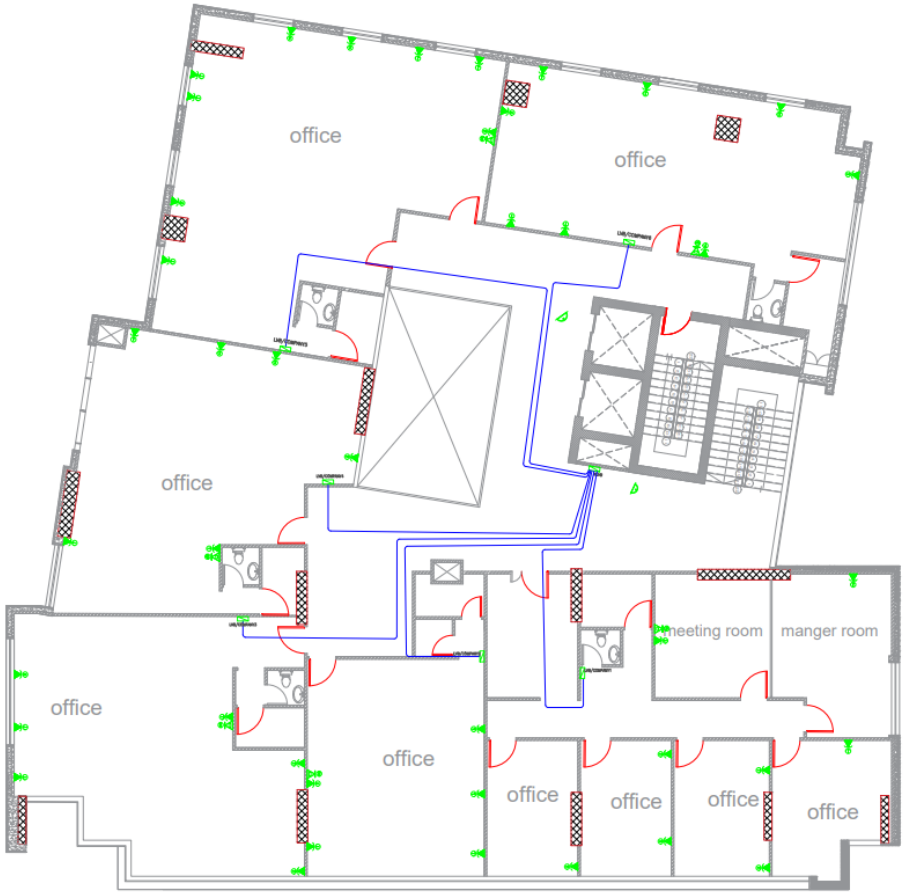
outdoor seating area



Power design

Sockets


+24.60 Th.F.L

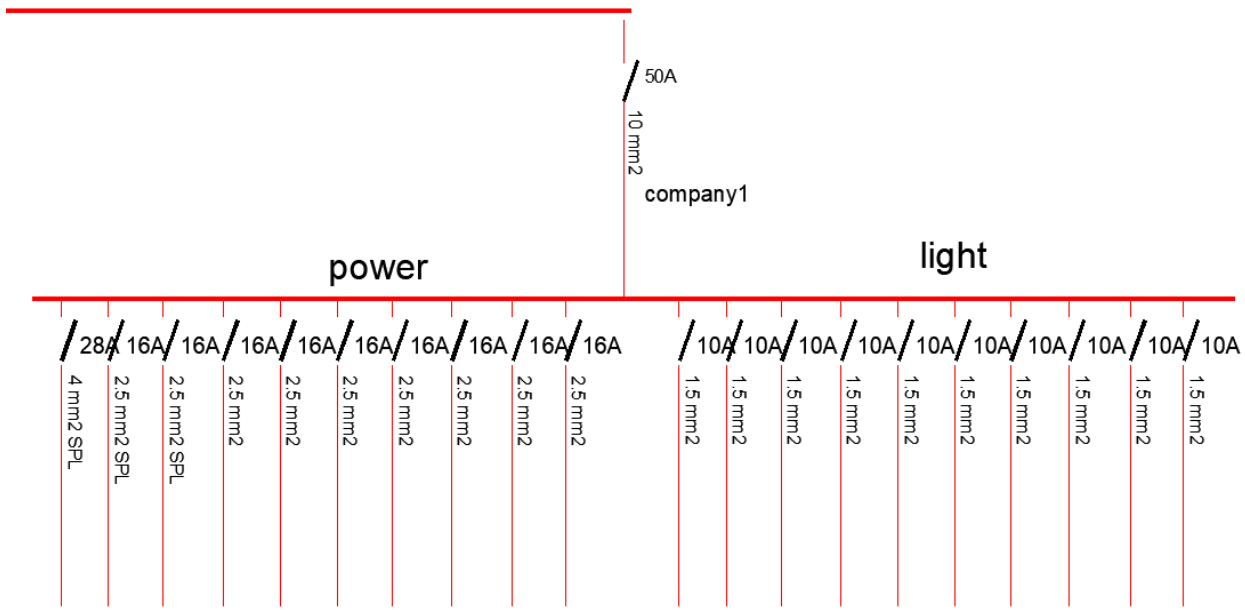

office
office
office
office
meeting room
manger room
office
office
office
office
office
office

Calculation of power

distribution board per company								
distribution board	power of lighting (watt)	normal power of socket (watt)	special power of socket (watt)	total power (watt)	I load (Amp)	I CB (Amp)	I cable (Amp)	Cross-section area (mm^2)
company 1	822.9	1826	4350	5556.12	28	32.3	37.1	10
company 2	347.3	1426	4350	5055.64	25.5	29.4	33.8	10
company 3	521.3	1826	4350	5314.84	26.8	30.9	35.5	10
company 4	413.3	1826	4350	5228.44	26.4	30.4	34.9	10
company 5	629.3	2026	4350	5461.24	27.6	31.7	36.5	10
company 6	437.3	1826	4350	5247.64	26.5	30.45	35	10

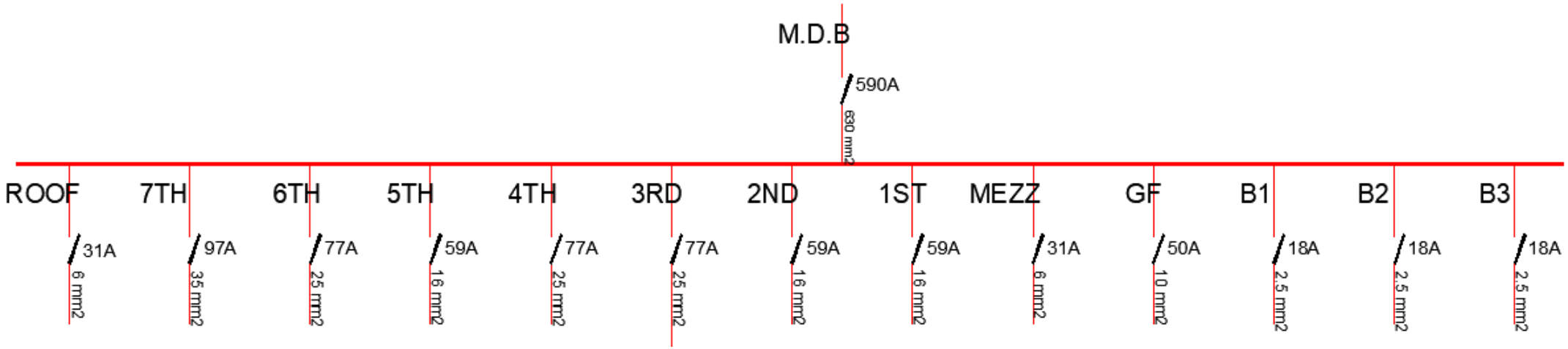
distribution board per store								
distribution board	power of lighting (watt)	normal power of socket (watt)	special power of socket (watt)	total power (watt)	I load (Amp)	I CB (Amp)	I cable (Amp)	Cross-section area (mm^2)
store 1	1516.8	370	2500	3824.44	19.3	22.2	25.5	4
store 2	1516.8	370	2500	3824.44	19.3	22.2	25.5	4
store 3	1516.8	370	2500	3824.44	19.3	22.2	25.5	4
store 4	3570.8	388	2500	5473.04	27.6	31.8	36.6	10

distribution board of café								
distribution board	power of lighting (watt)	normal power of socket (watt)	special power of socket (watt)	total power (watt)	I load (Amp)	I CB (Amp)	I cable (Amp)	Cross-section area (mm^2)
coffee	1845.42	645	8820	10489.84	52.97	60.9	70	25



Main distribution board

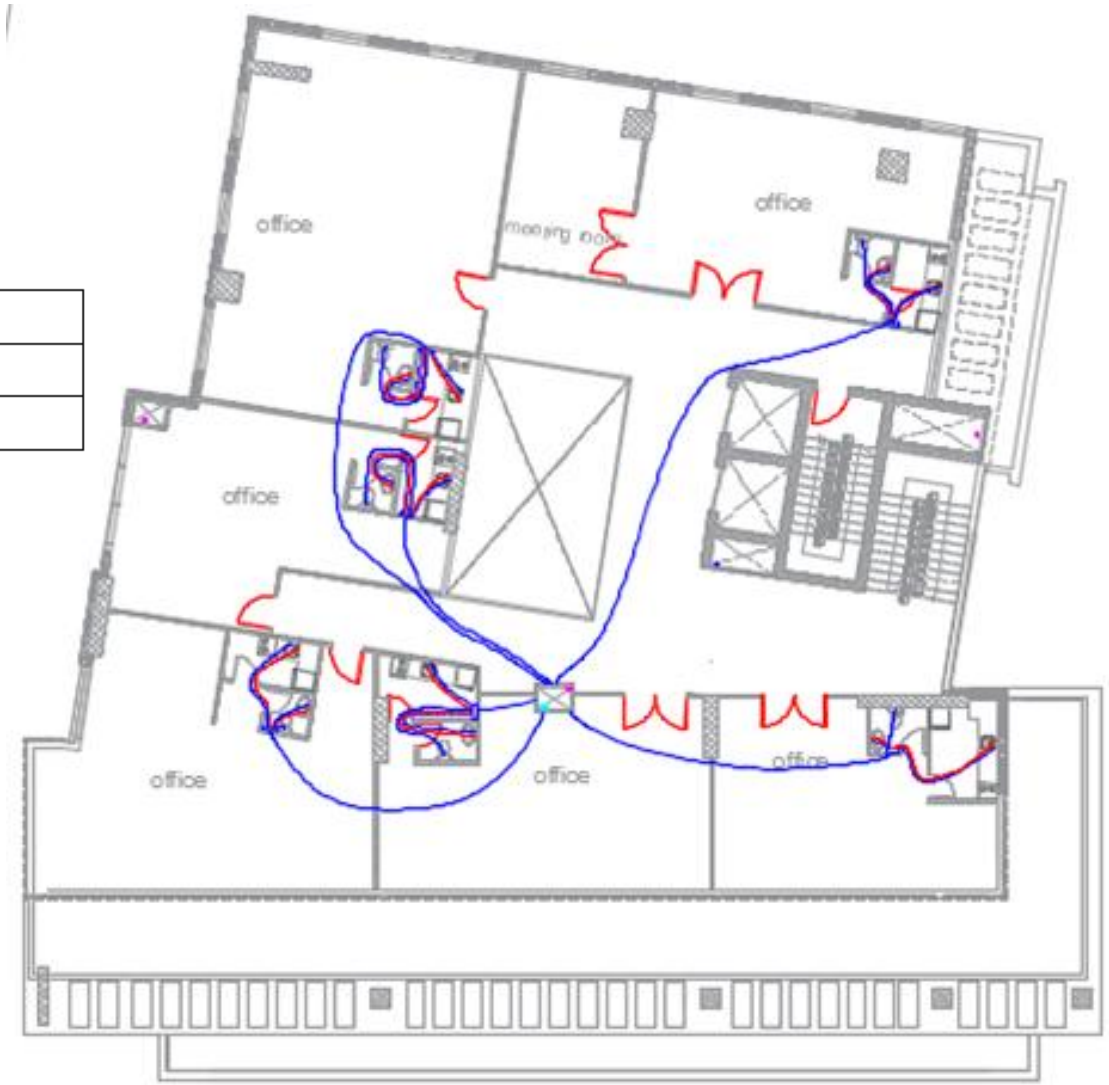
main distribution board for building								
build	total lighting power (watt)	total normal socket power (watt)	total special socket power (watt)	total power (watt)	I load (Amp)	I CB (Amp)	I cable (Amp)	Cross-section area (mm^2)
	99267.94	130682	370840	244729.5	413.14	475.1	546.4	630mm



Water supply

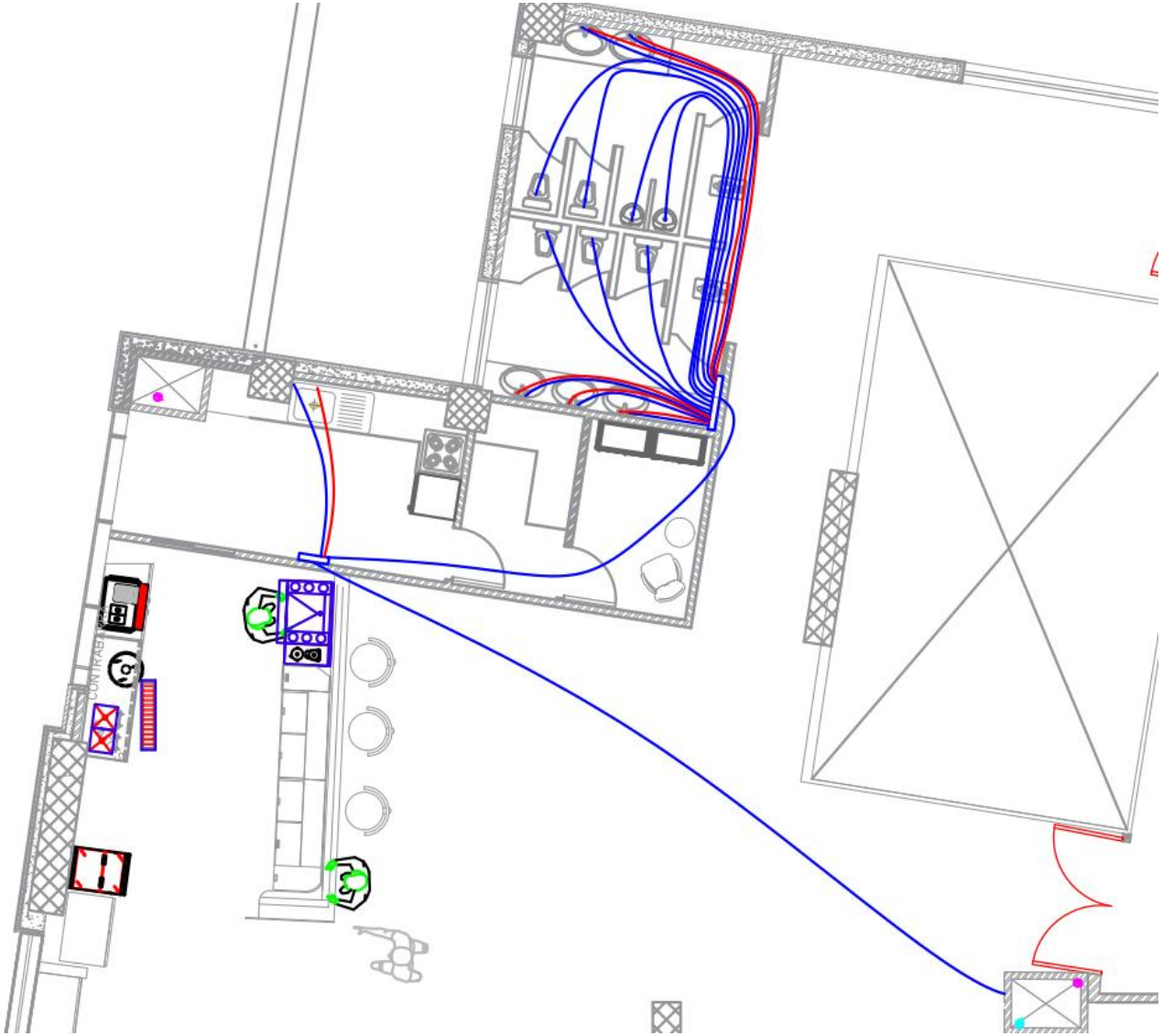
water supply

Type of pipes	vertical	horizontal	meter	branch
Diameter	2”	¾”	¾”	¾”
loss	5.6	4.25	1.75	0.3



water supply

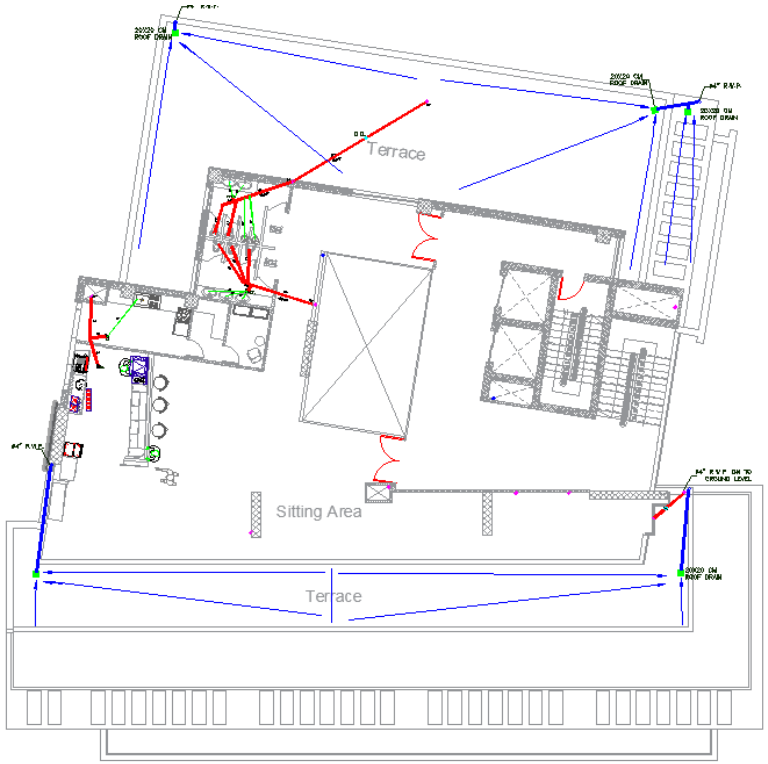
- Plan of Café

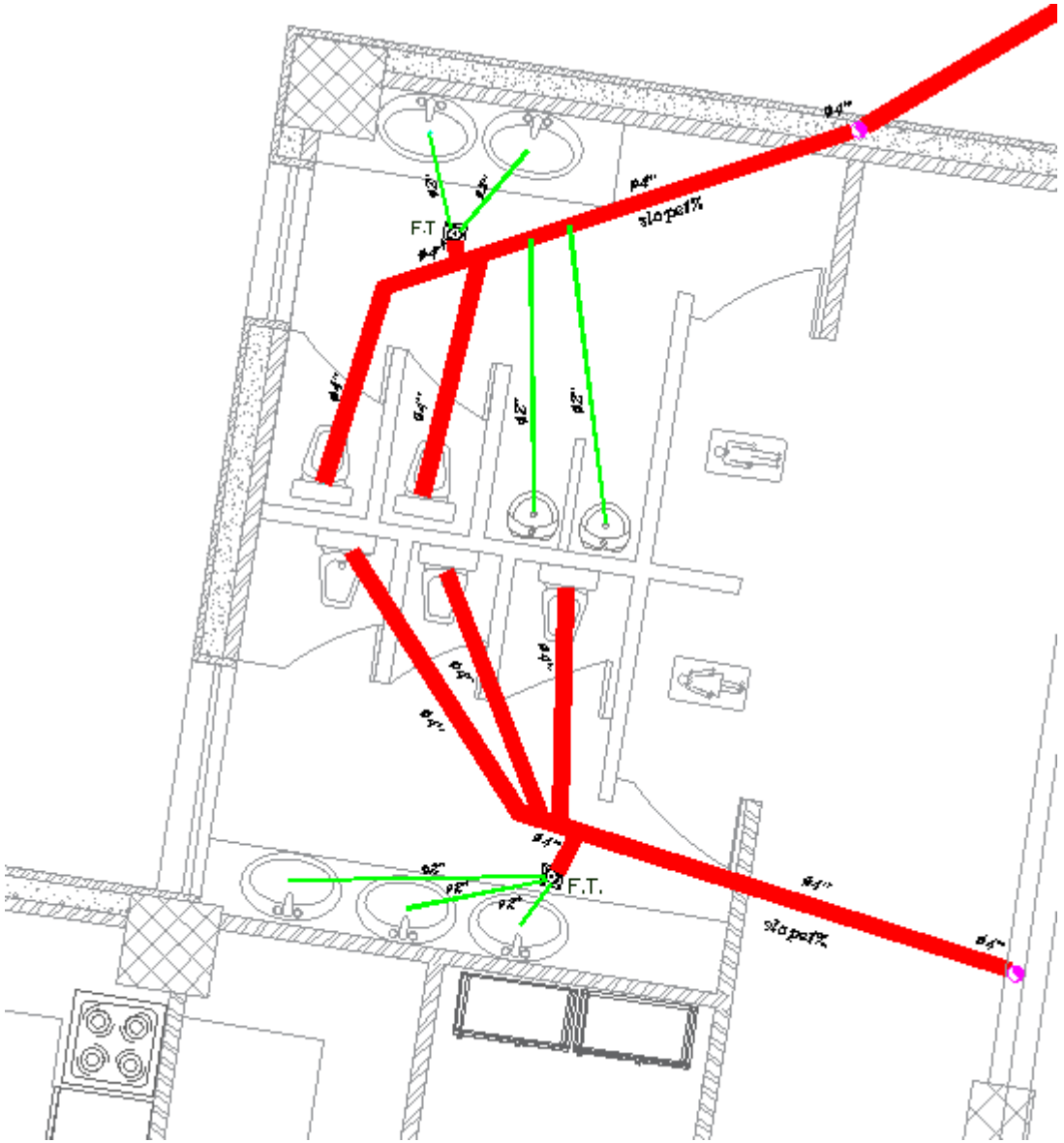


Drainage and Rainwater

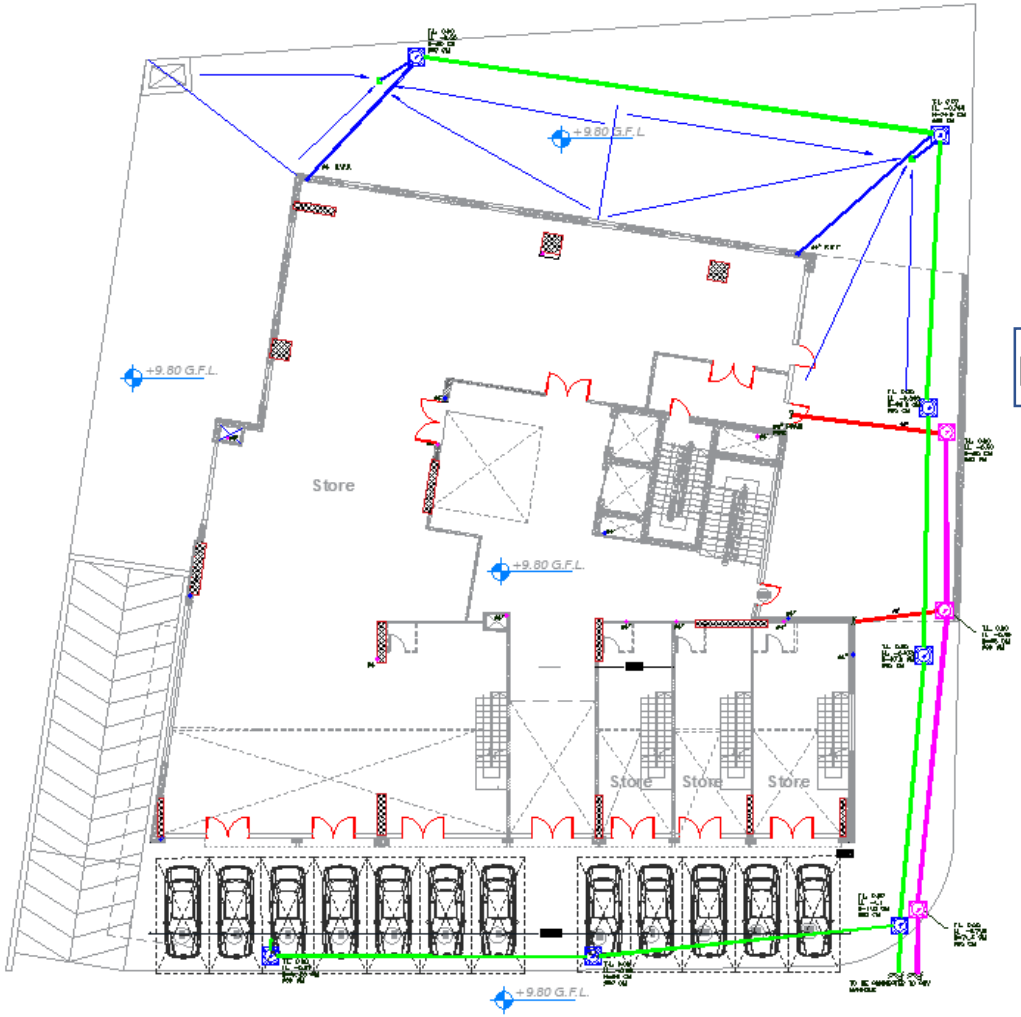
Drainage system

Pipe type	Diameter (inch)	Slope (%)	Material Pipe type
Horizontal Branch	2”	2%	PVC
Horizontal swear	4”	1%	PVC
Vertical Stack	4”	0%	PVC
Vertical Vent	4”	0%	PVC
Horizontal drain	6”	1%	PVC



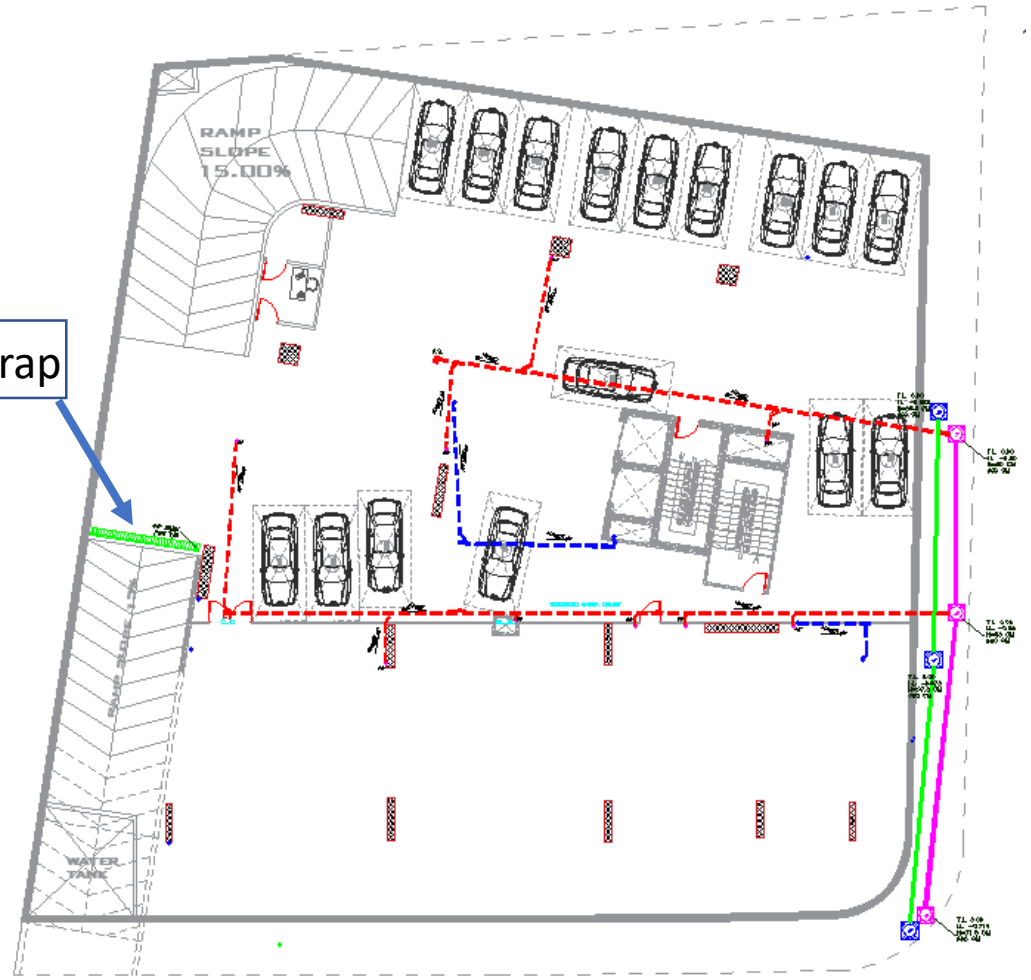


Drainage system



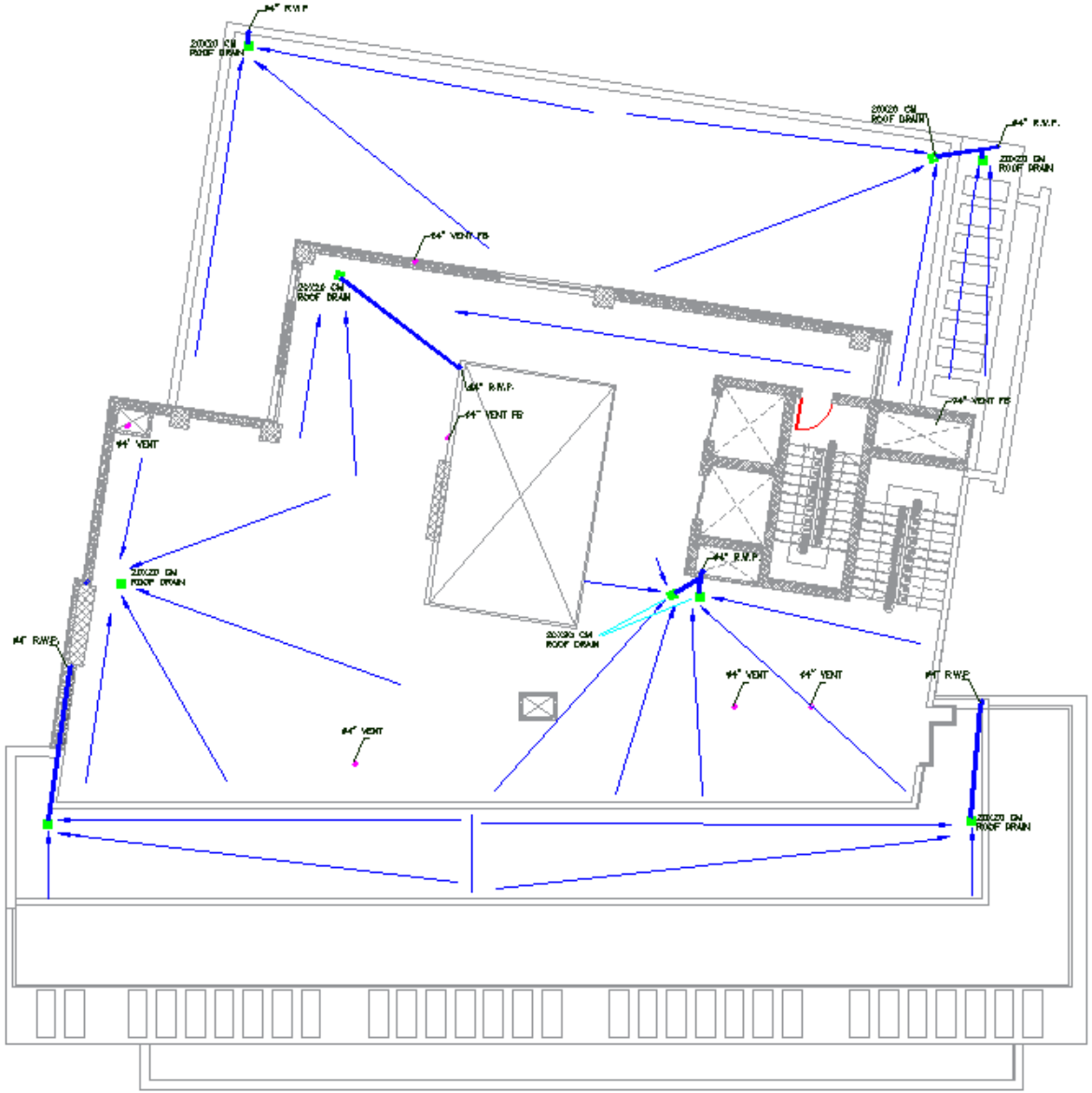
Ground Floor plan

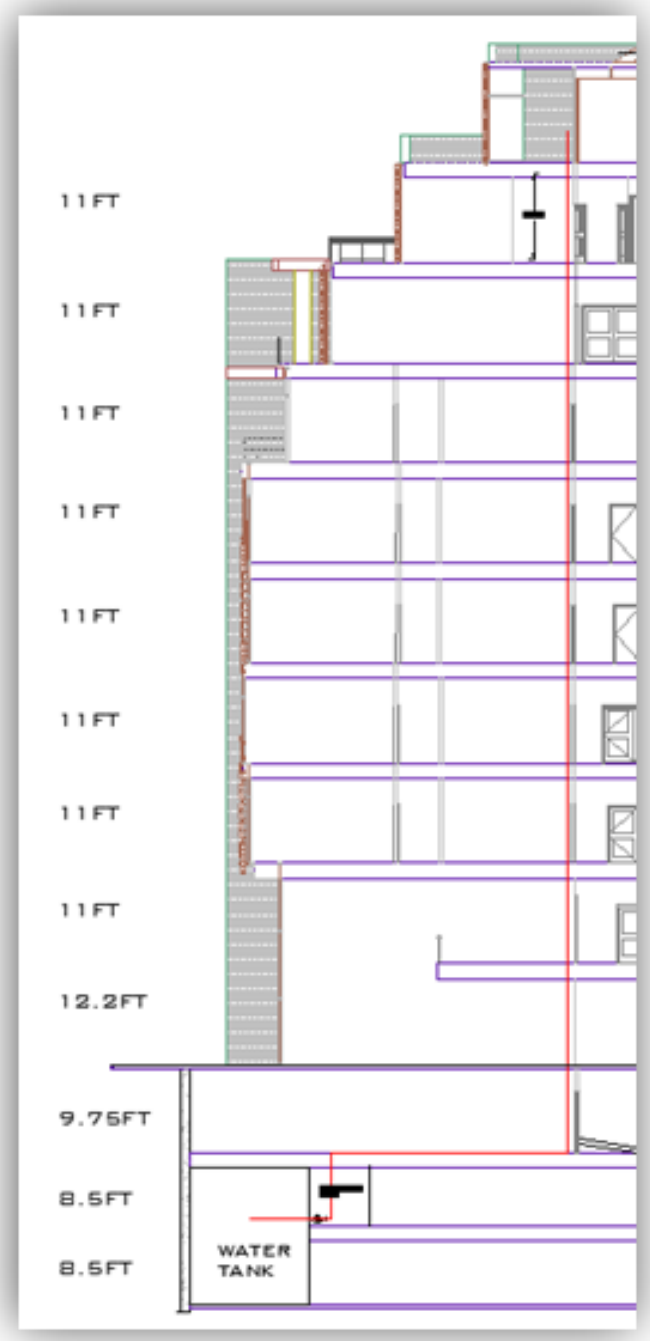
Ramp water trap



First basement plan

Rainwater




11FT
11FT
11FT
11FT
11FT
11FT
11FT
11FT
12.2FT
9.75FT
8.5FT
8.5FT
WATER TANK

HVAC system design

Thermal comfort

VRF outdoor unit
From daikin company

Split unit
From fujitsu company

Fan coil
From daikin company

Cassette unit
From daikin company

HVAC design for the ground floor

VRF- Cassette unit

VRF- Split unit

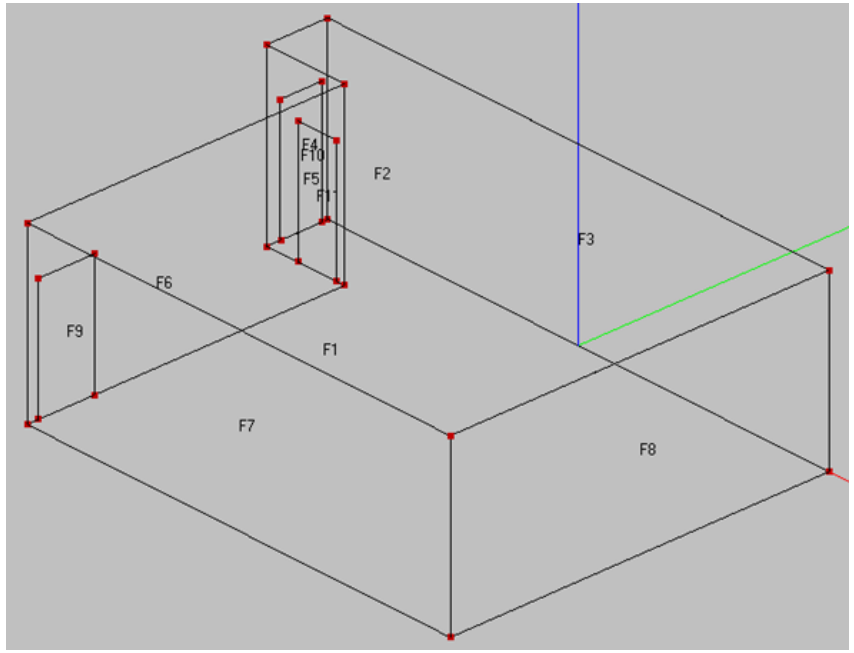
HVAC design for the third floor

VRF- Fan coil

Acoustical design

Acoustical design for the office

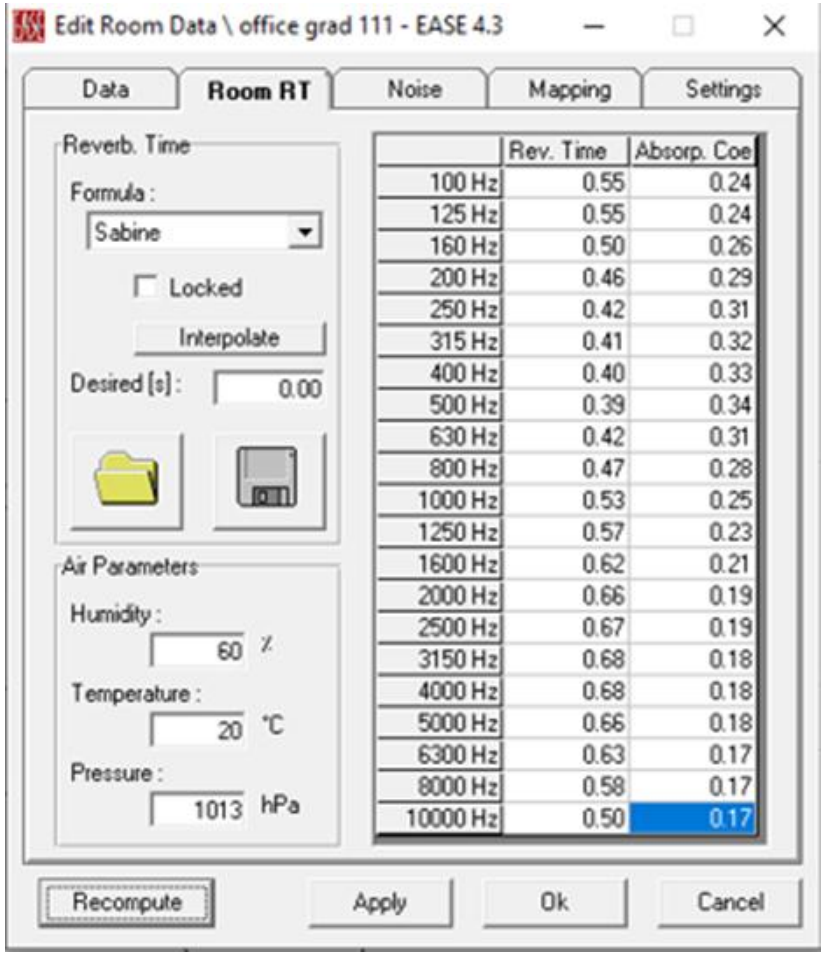
office model on EASE program



finished material for office elements

Element	Finish material
door	hollow door
ceiling	perforated panel
floor	tiles
wall	plaster
wall	glass

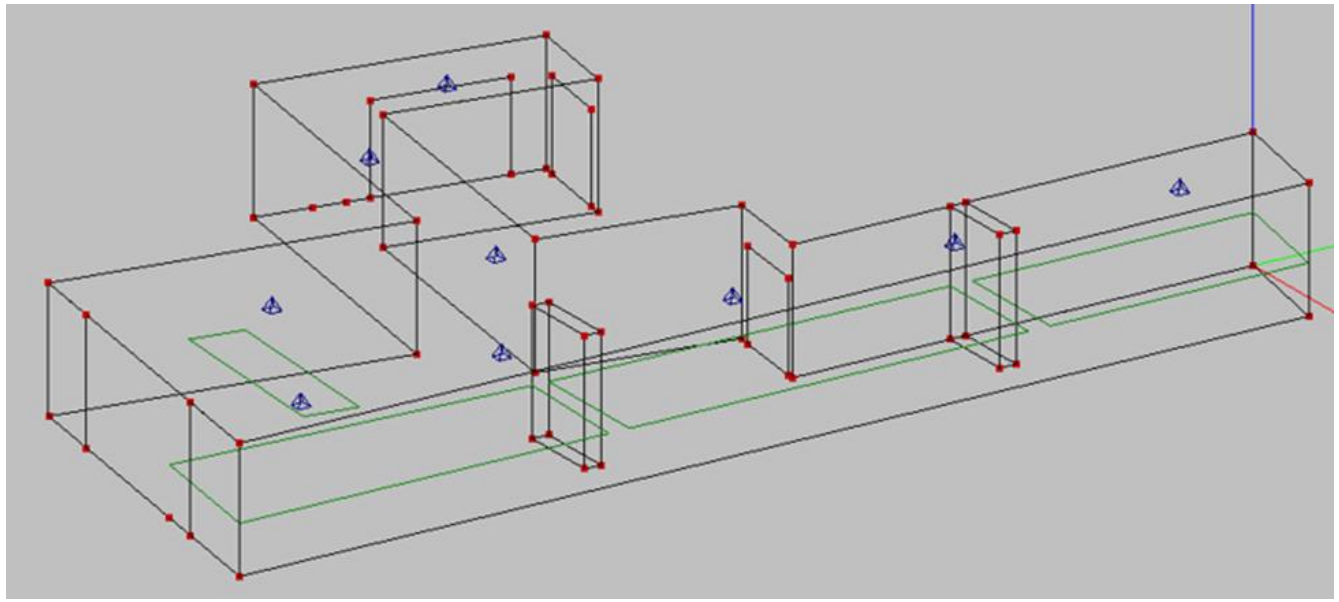
The reverberation time for the office according to Sabine



- All values are within the standard (0.4–0.7) seconds.

Acoustical design for the cafe

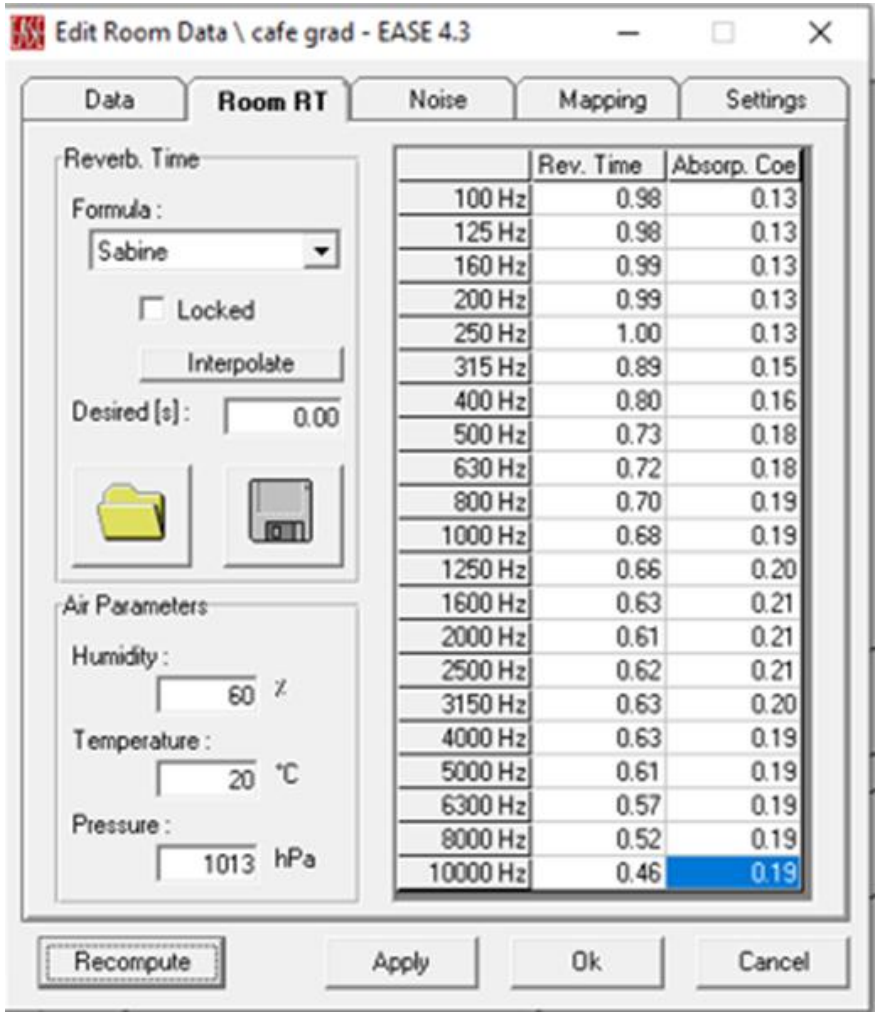
cafe model on EASE program



finished material for the café elements

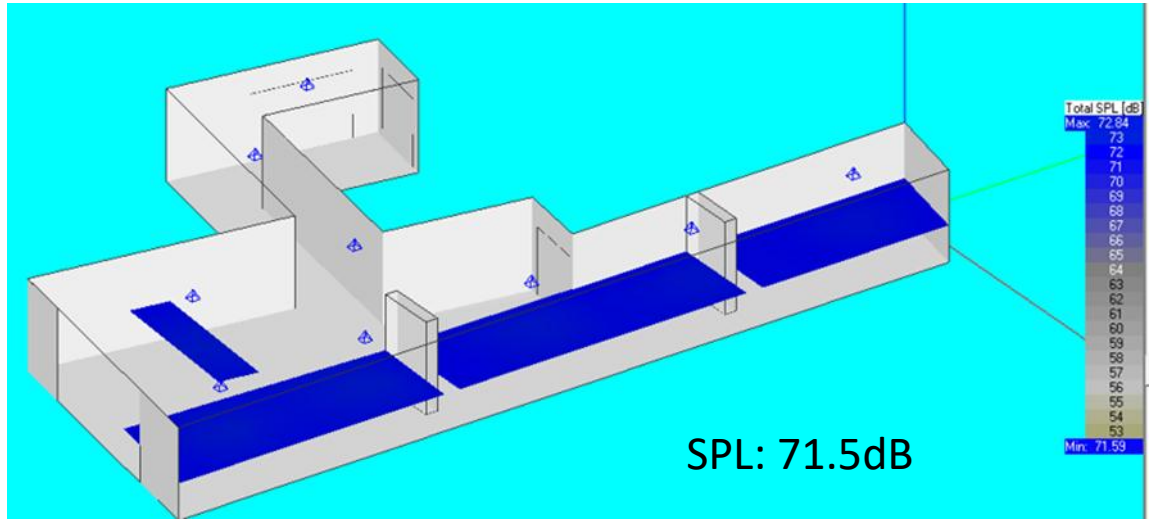
Element	Finish material
door	hollow door
window	glass
ceiling	gpsum
floor	tiles
wall	plaster
wall	glass

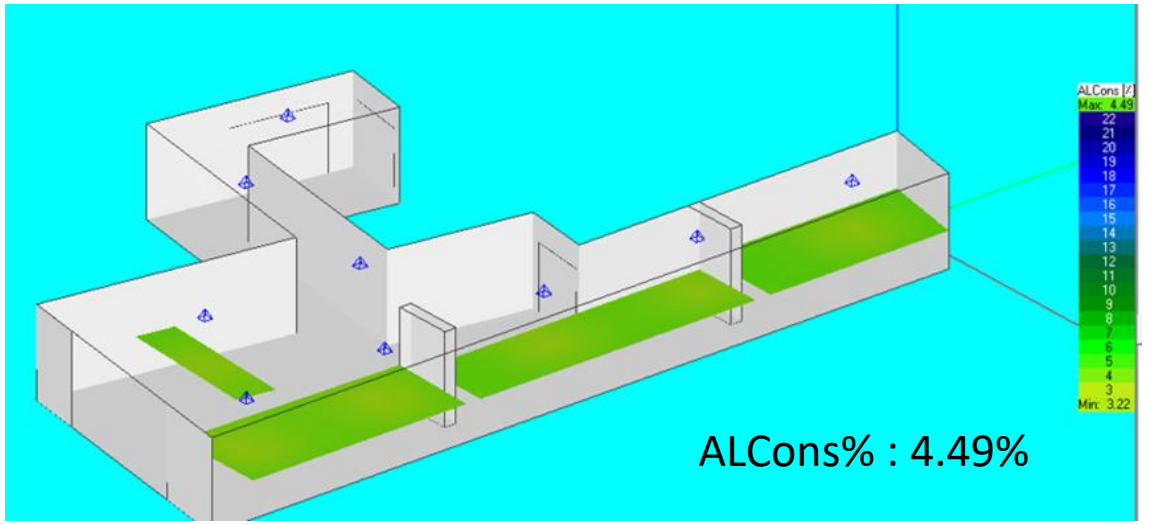
The reverberation time for the café according to Sabine

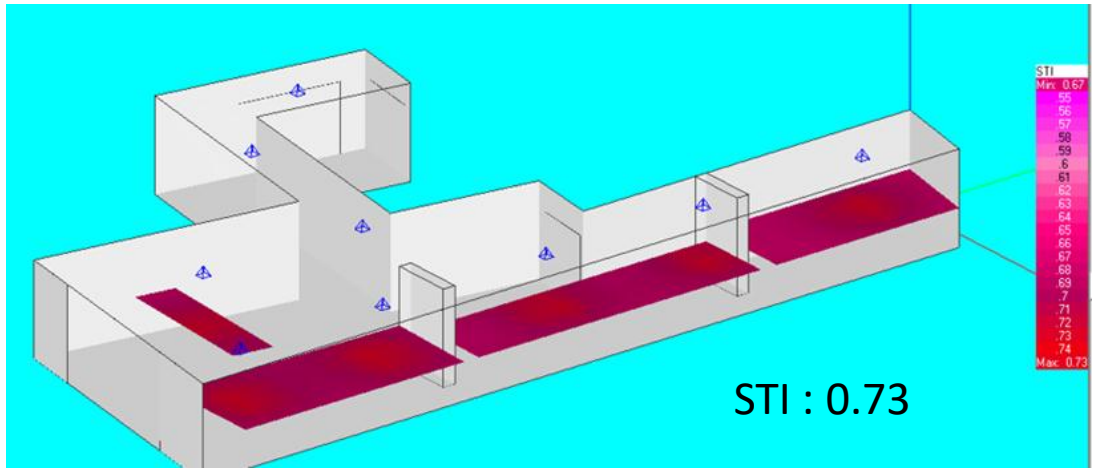


- most values are within the standard (0.6–1) seconds.

Acoustical design for the cafe

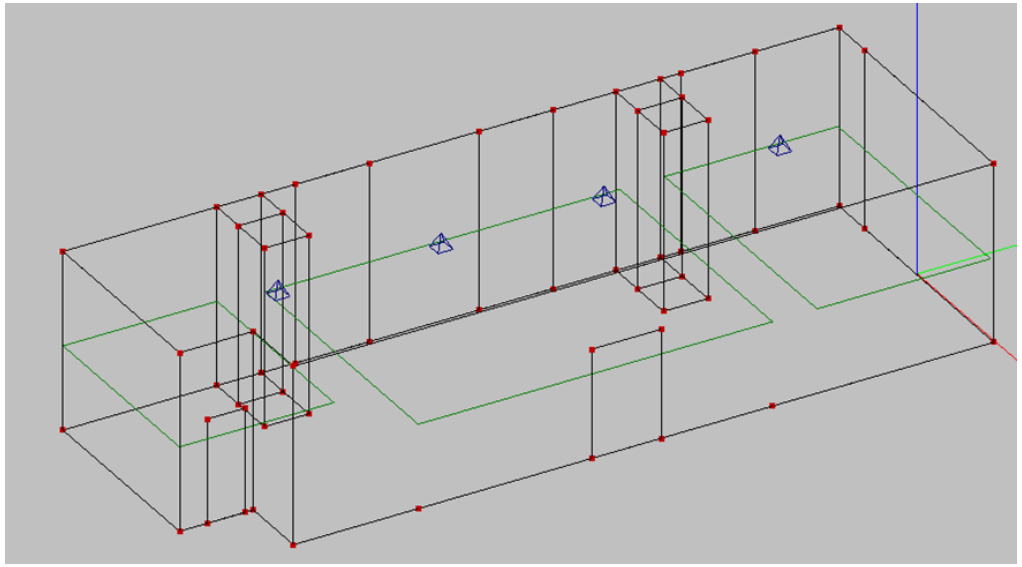






Acoustical design for the store

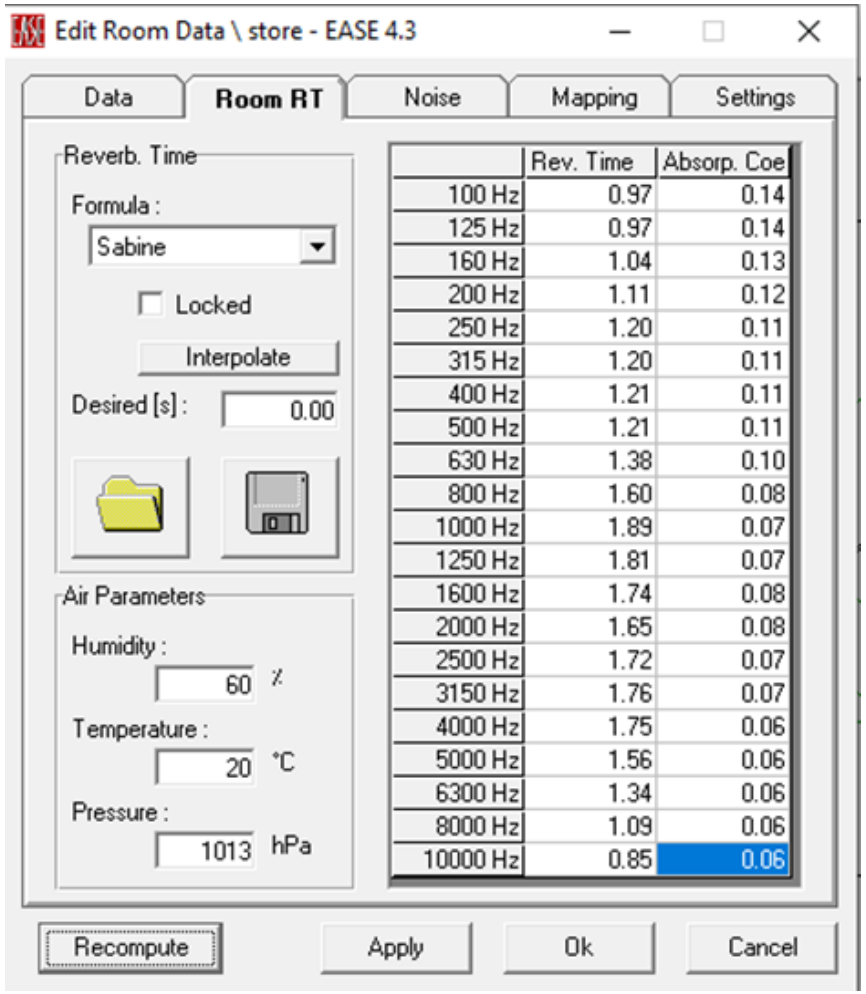
store model on EASE program



finished material for store elements

Element	Finish material
door	glass
door	hollow door
ceiling	gypsum
floor	tiles
wall	plaster
columns	gypsum
window	glass

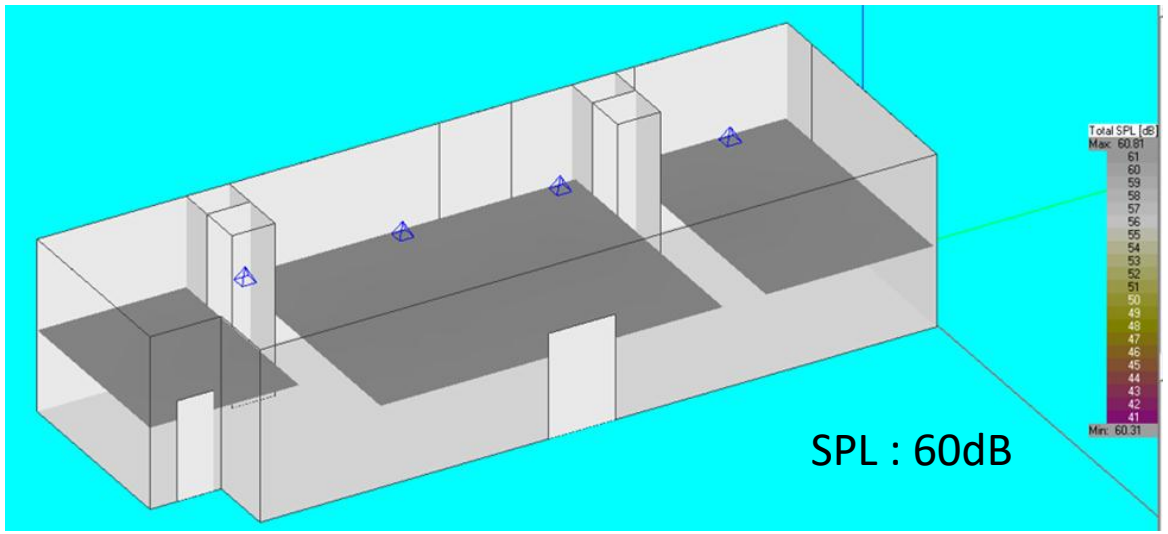
The reverberation time for the store according to Sabine

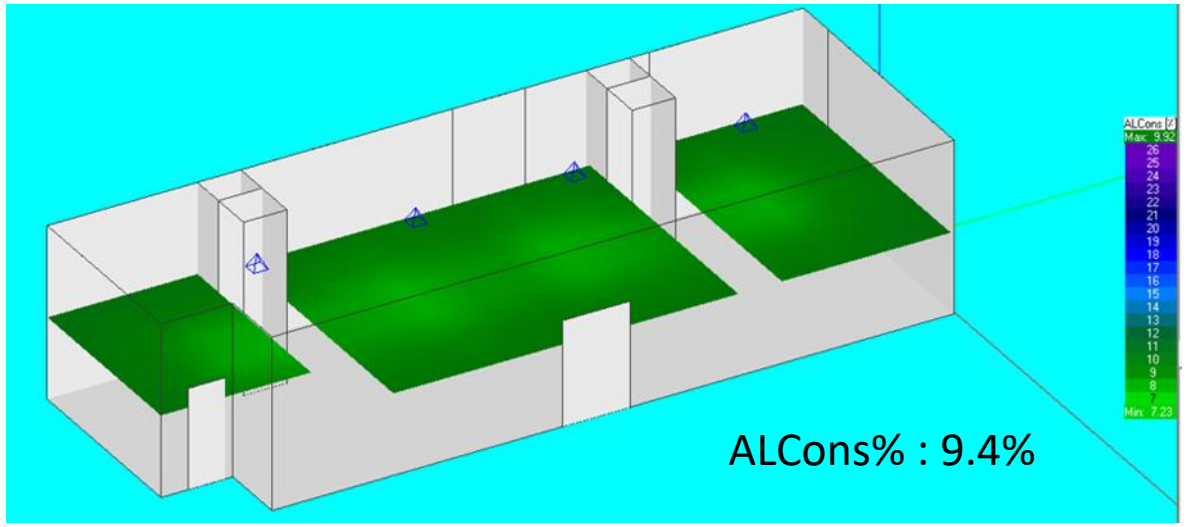


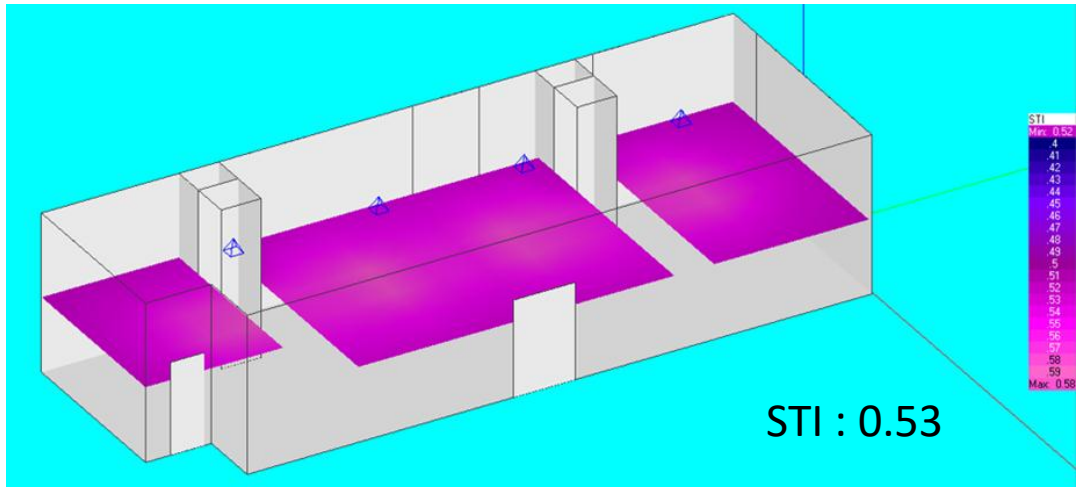
	Rev. Time	Absorp. Coe
100 Hz	0.97	0.14
125 Hz	0.97	0.14
160 Hz	1.04	0.13
200 Hz	1.11	0.12
250 Hz	1.20	0.11
315 Hz	1.20	0.11
400 Hz	1.21	0.11
500 Hz	1.21	0.11
630 Hz	1.38	0.10
800 Hz	1.60	0.08
1000 Hz	1.89	0.07
1250 Hz	1.81	0.07
1600 Hz	1.74	0.08
2000 Hz	1.65	0.08
2500 Hz	1.72	0.07
3150 Hz	1.76	0.07
4000 Hz	1.75	0.06
5000 Hz	1.56	0.06
6300 Hz	1.34	0.06
8000 Hz	1.09	0.06
10000 Hz	0.85	0.06

- most values are within the standard (1–1.6) seconds.

Acoustical design for the store







Fire alarm and firefighting system

Fire alarm and firefighting system

Fire alarm and firefighting system	
SYMBOL	DESCRIPTION
	Fire Hose station
	Fire extinguisher
	Water Sprinkler
HD	Heat detector
PS	Smoke sensor
	Manual alarm
S	External siren with flasher
	Water sprinkler
	Fire rout
	Fire rout

- The evacuation plan for the third floor

Fire alarm and firefighting system

- The fire emergency signs distribution in the third floor

Fire alarm and firefighting system

- The detector distribution in the third floor

Fire alarm and firefighting system

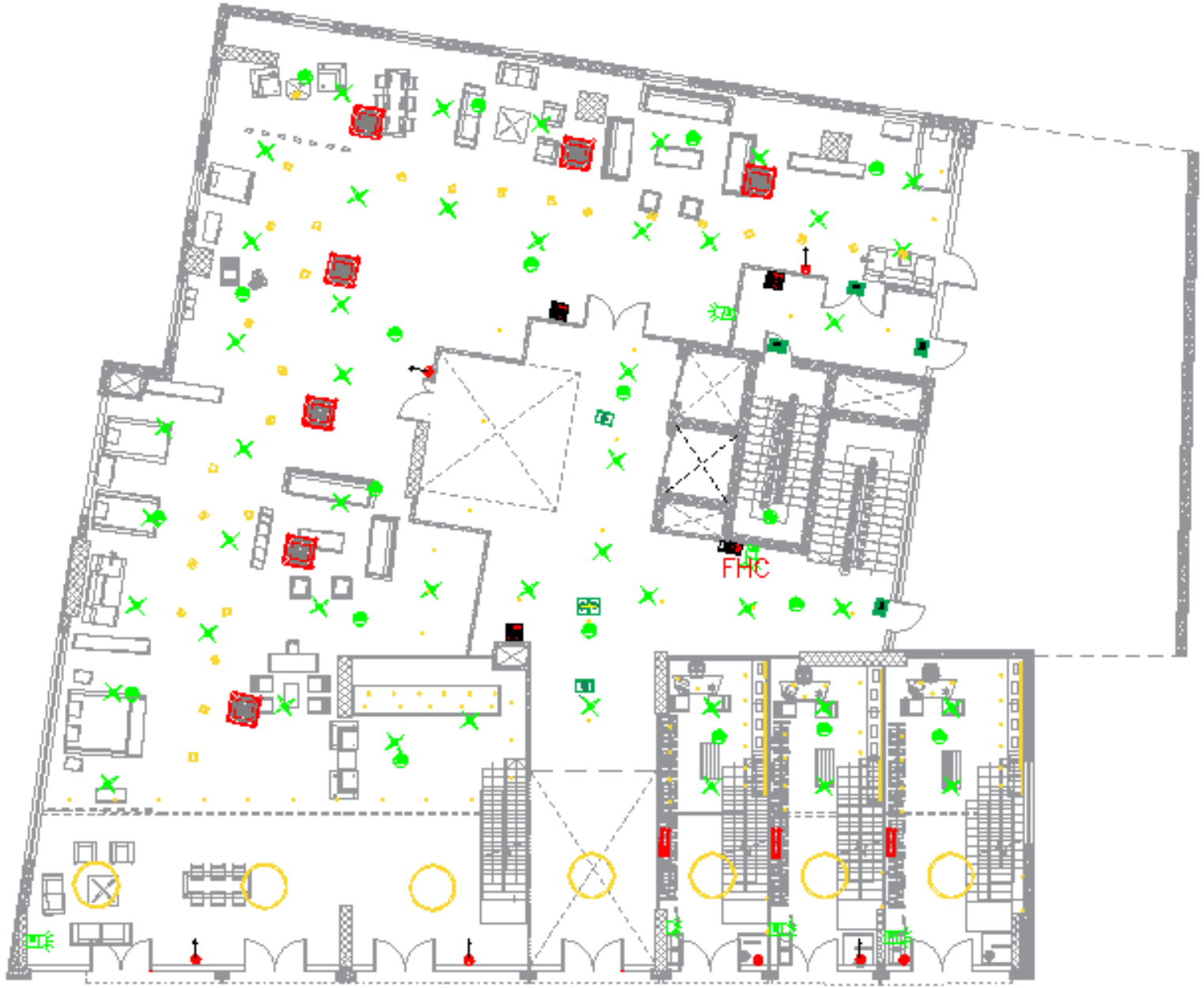
- fire extinguisher and hose station distribution in the third floor

Fire alarm and firefighting system

- The sprinklers distribution in the third floor

- The size of the pipes connected to the sprinklers on the third floor

Integrated plan of ground floor



Quantity Surveying & Cost Estimate

Quantity surveying

- Earthwork : 804245 NIS
- Super structure : 6540324 NIS
- Finishes : 4850091 NIS
- External work: 6206560 NIS
- Safety : 232470 NIS
- HVAC : 1627000 NIS
- Mechanical : 480000 NIS
- Electrical : 470000 NIS

Quantity surveying

Total cost : 21,900,000 NIS

Cost/ meter square :1780 NIS/m^2


Thanx!