OUR BEACON

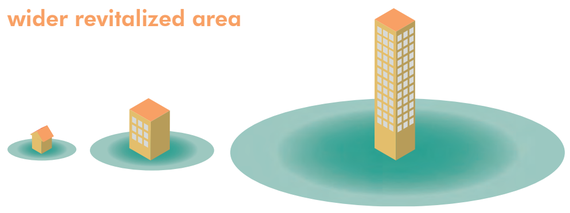
Affordable housing allows for a healthy economy while enjoying decent dwelling. It revitalises and maintains neighbourhoods by increasing security, business, integration and providing families with a sustainable lifestyle.

Yet housing is not just housing anymore! While the change started years prior, the beginning of the decade demonstrated that a home is not just for living. It is the place for learning, working, exercising, a scenario for socializing and community-building. It is this how the idea of this project arises. An amount of square footage -which would otherwise be used for activities that benefit from social engagement- is taken from each apartment and placed in semi-common areas called “shared-ownership spaces”. It is here where owners can encounter each other without relinquishing ownership of areas, space, functions or even momentaneous privacy. Encouraged by the diversity and the love for art and culture of Toronto, the program of these areas is knit to rentable public places that call for dancing, fitness, film-making, cooking and language-learning.

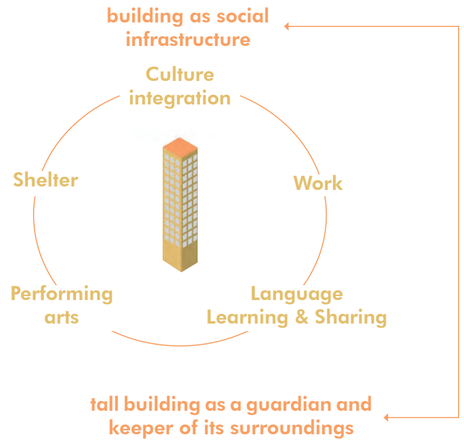
ANALYSIS

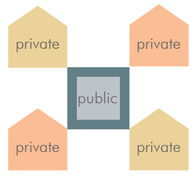
AFFORDABLE HOUSING/ TALL BUILDING

wider market effect
=
wider revitalized area

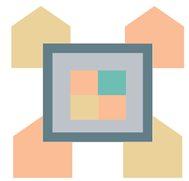


Extents of effect in the revitalization of areas and market effect





Traditional Programatic Separation



new
shared
ownership

New Programatic Integration

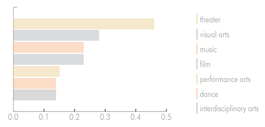
TORONTO'S SOCIAL QUALITIES

70% attend/participate/ donate to arts and culture

46% Torontonians speak other than English/French

93% more artists than other Canadian cities

yet ~50% struggle with affordable housing



3rd

most important entertainment&media in North America

Toronto's popula-

3 million in 2016

3.5 million
in 2030

Dependants in 2030

from 55 per 100
to 64 per 100

People living alone

16% of over 15 year-old

23% of seniors (>64)

Minorities

52% of population

Single parent households

33% of families
most female parents

Toronto's language

English and French

44% have a different mother tongue

26% do NOT speak English/French at home

Immigrants

47% of population

Marital status

54% married/co-living

30% single

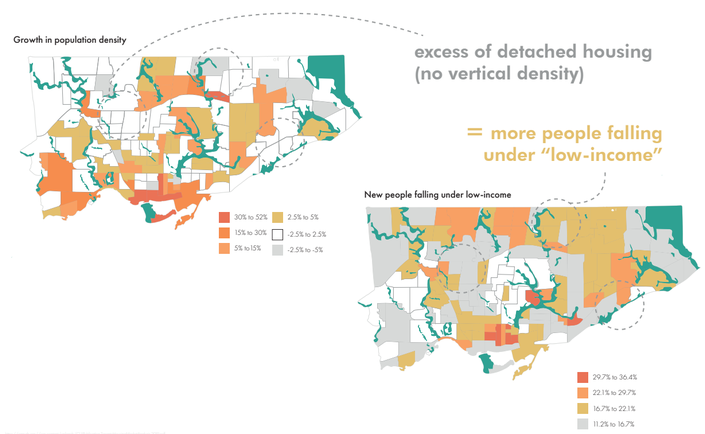
16% divoced/widowed

2018:median individual income for over 16s

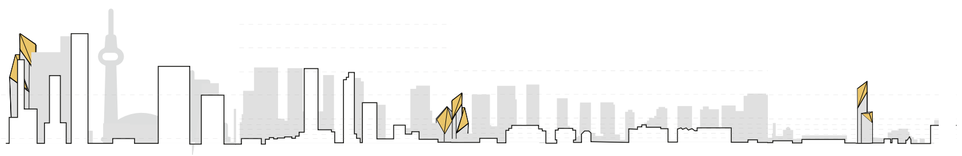
$ 36,400

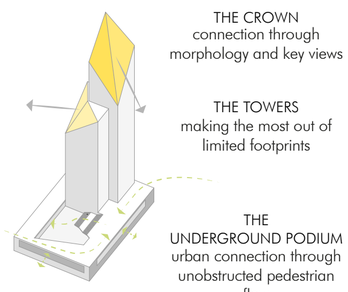
https://www.toronto.ca/wp-content/uploads/2019/11/99b4-TOHealthCheck_2019Chapter1.pdf
tatistics Canada. Table 11-10-0239-01 Income of individuals by age group, sex and income source, Canada, provinces and selected census metropolitan areas

Toronto 2020s: fear of homelessness overcomes fear of economic unhealthiness



CONCEPT

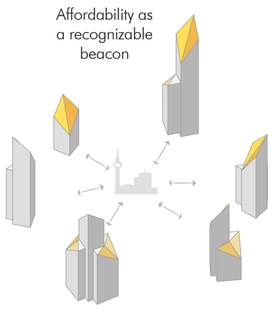


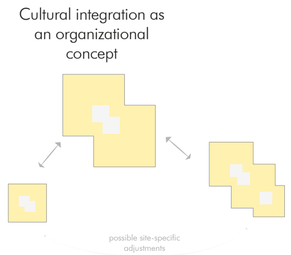


THE CROWN
connection through morphology and key views

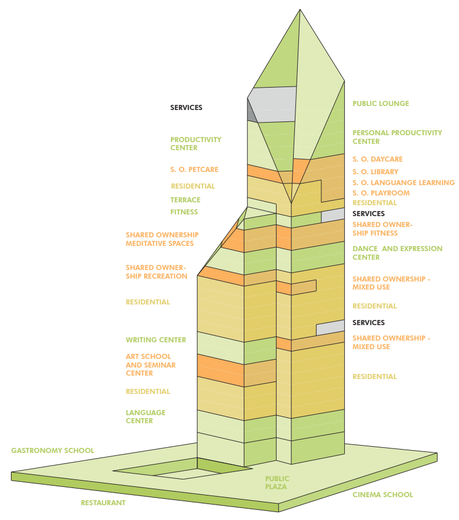
THE TOWERS
making the most out of limited footprints

THE
UNDERGROUND PODIUM
urban connection through unobstructed pedestrian flow

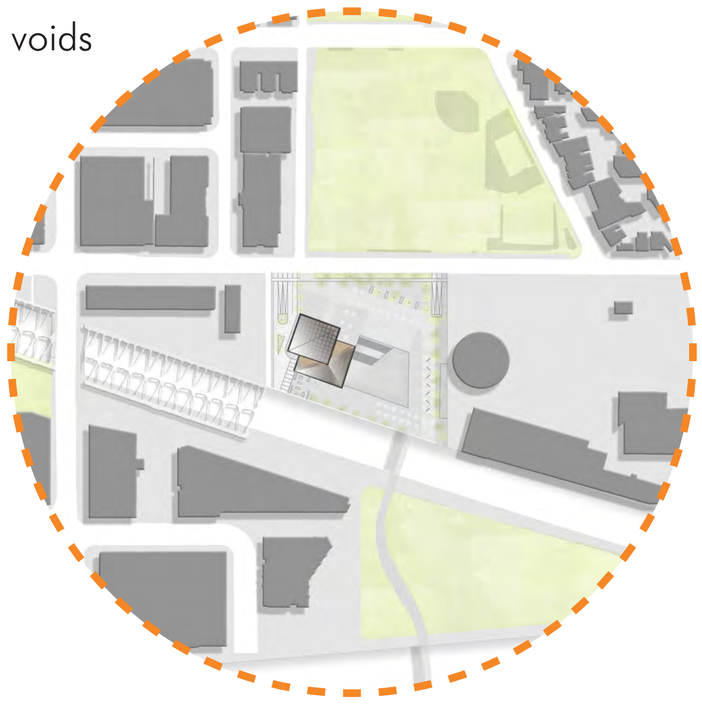


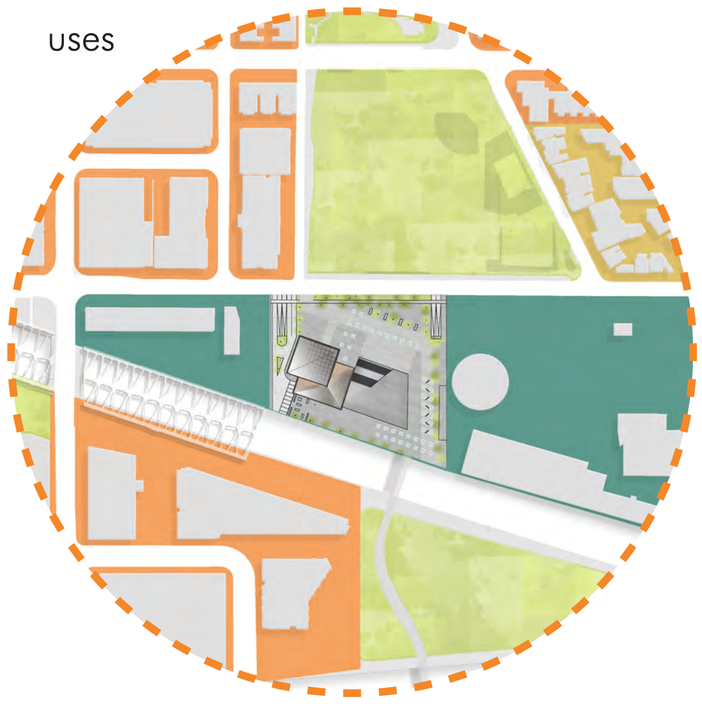


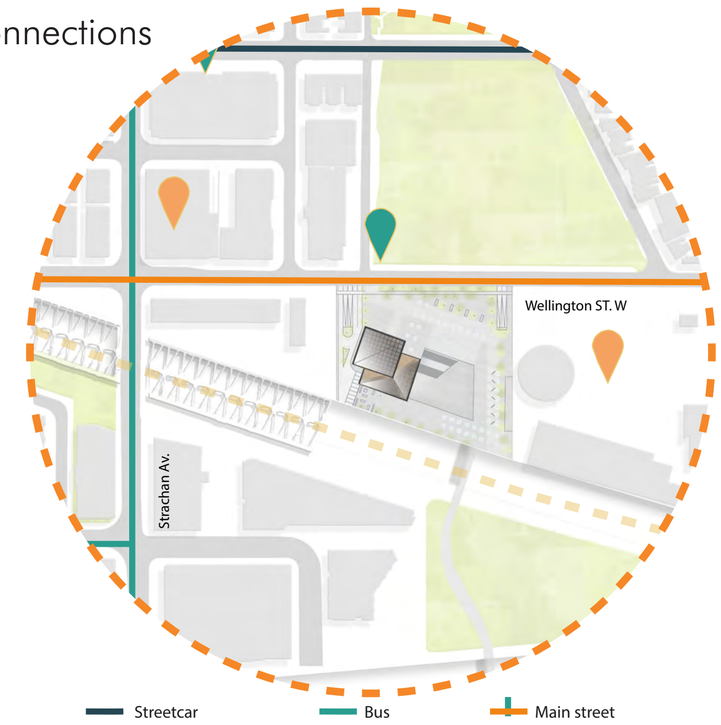
PROGRAM



OUR SITE







Mix Used Area
Apartment neighbourhoods
Regeneration areas
Parks

Streetcar
Bus
Main street
Bike station
Parking
Train line

POLITECNICO MILANO 1863

MSC BUILDING ARCHITECTURE THESIS

PROFESSORS:
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CORRADO PECORA
GIOVANNI DOTELLI
FRANCESCO ROMANO
MARCO IMPERADORI

STUDENTS:
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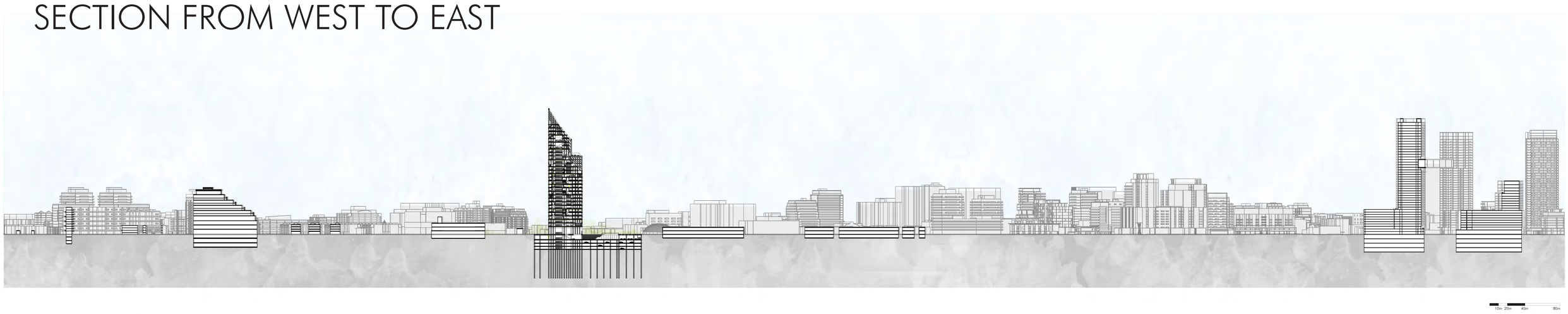
DIANA MARISOL NARVAEZ 10704376

OUR BEACON:
TORONTO AFFORDABLE HOUSING

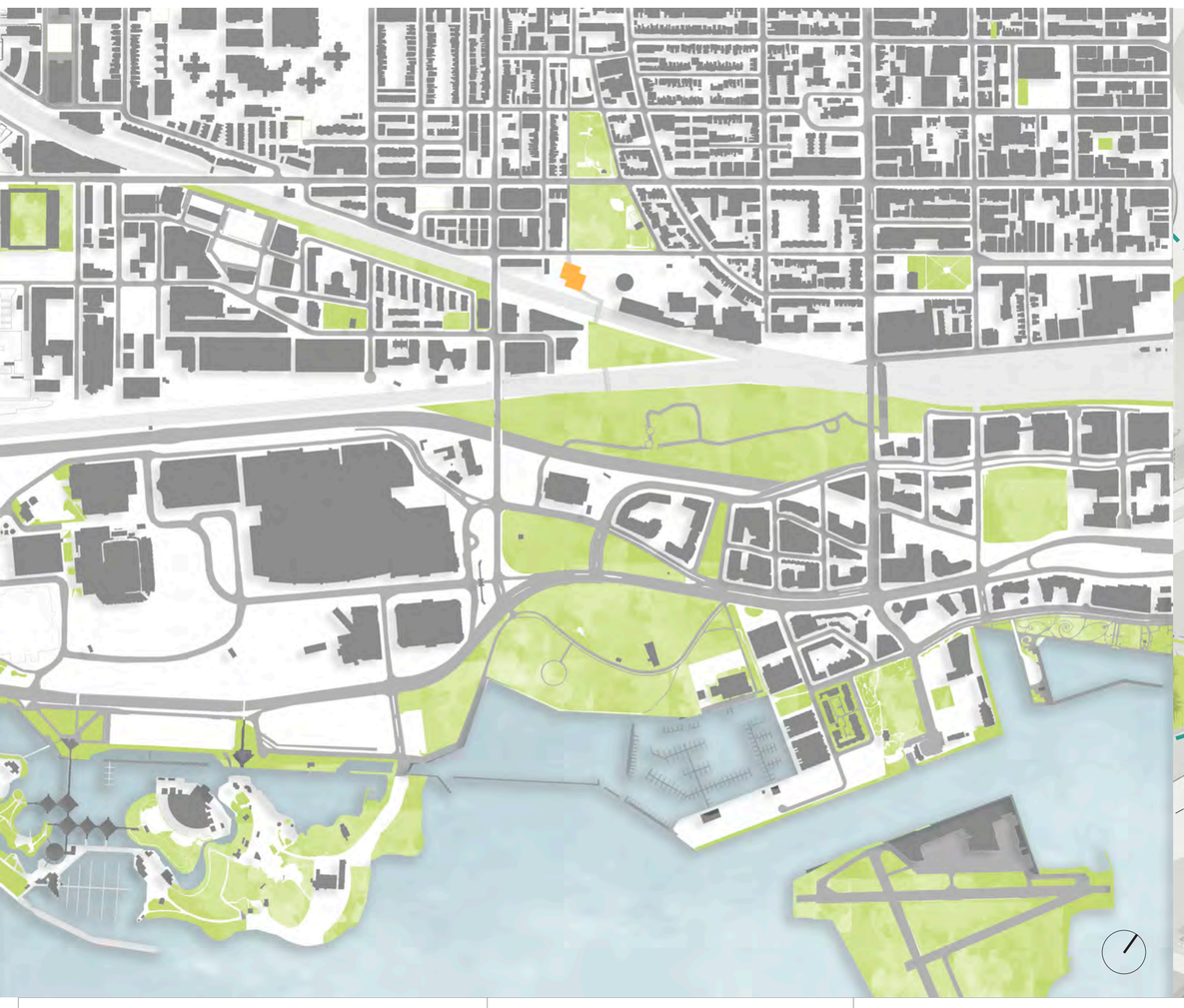
SITE

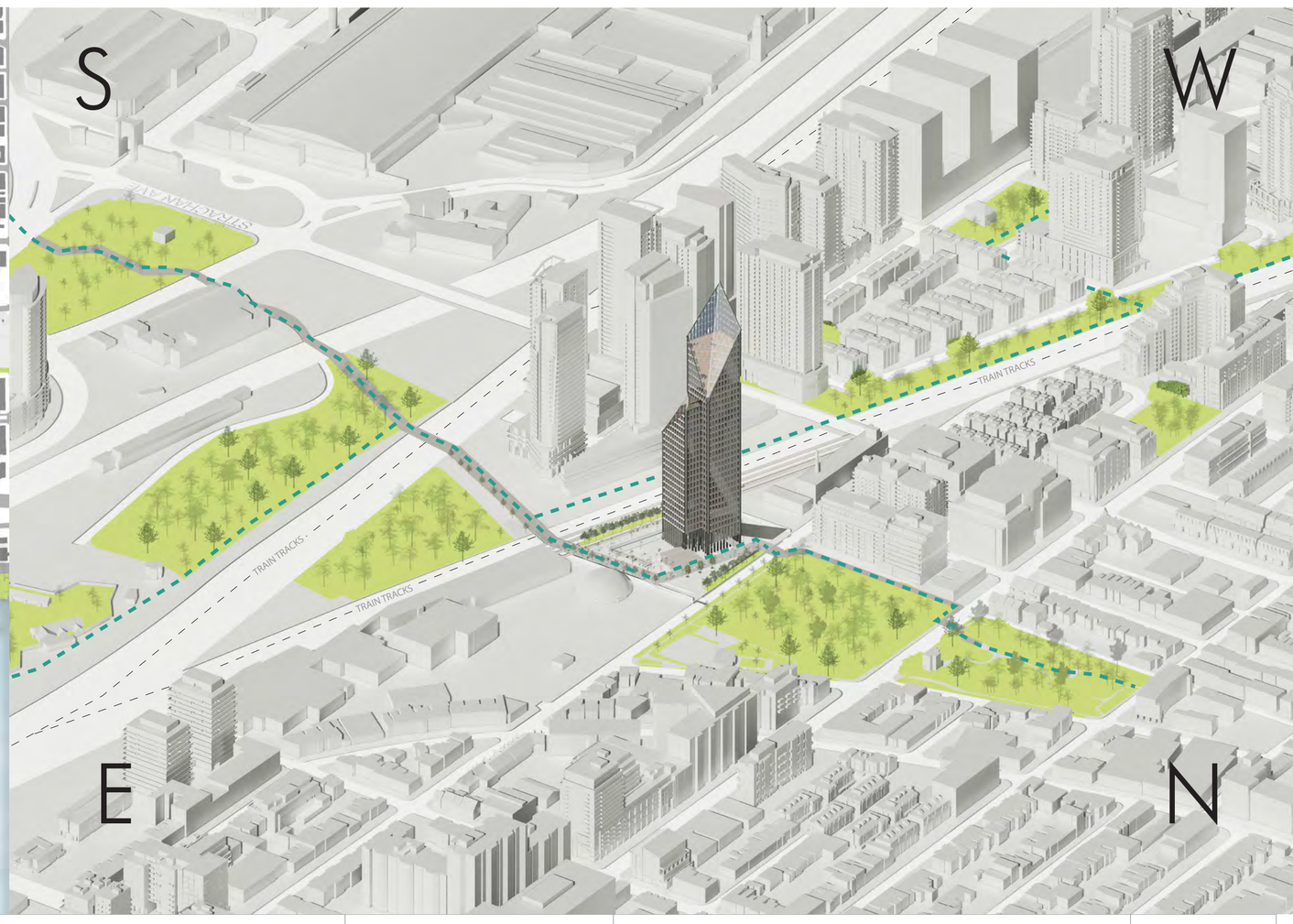
ELEVATION FROM WEST TO EAST

SECTION FROM WEST TO EAST



SECTION FROM SOUTH TO NORTH





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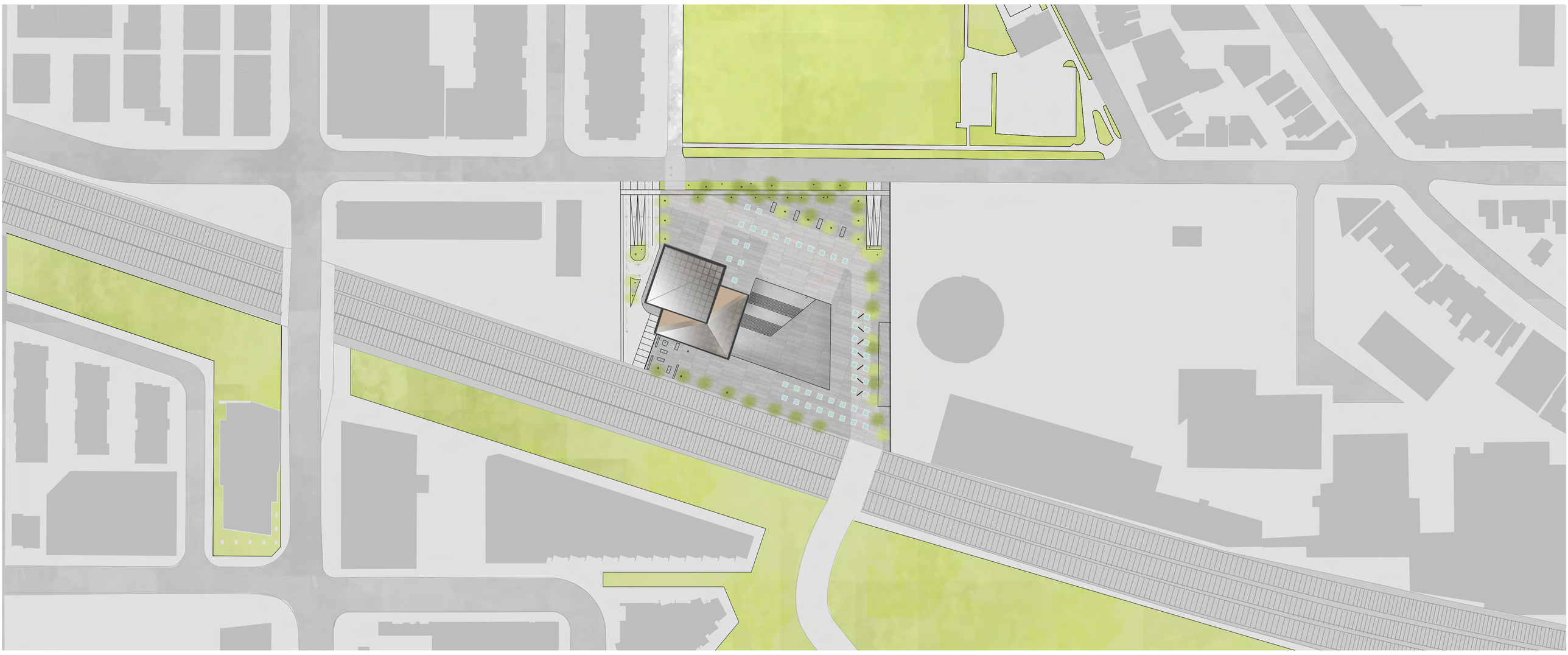
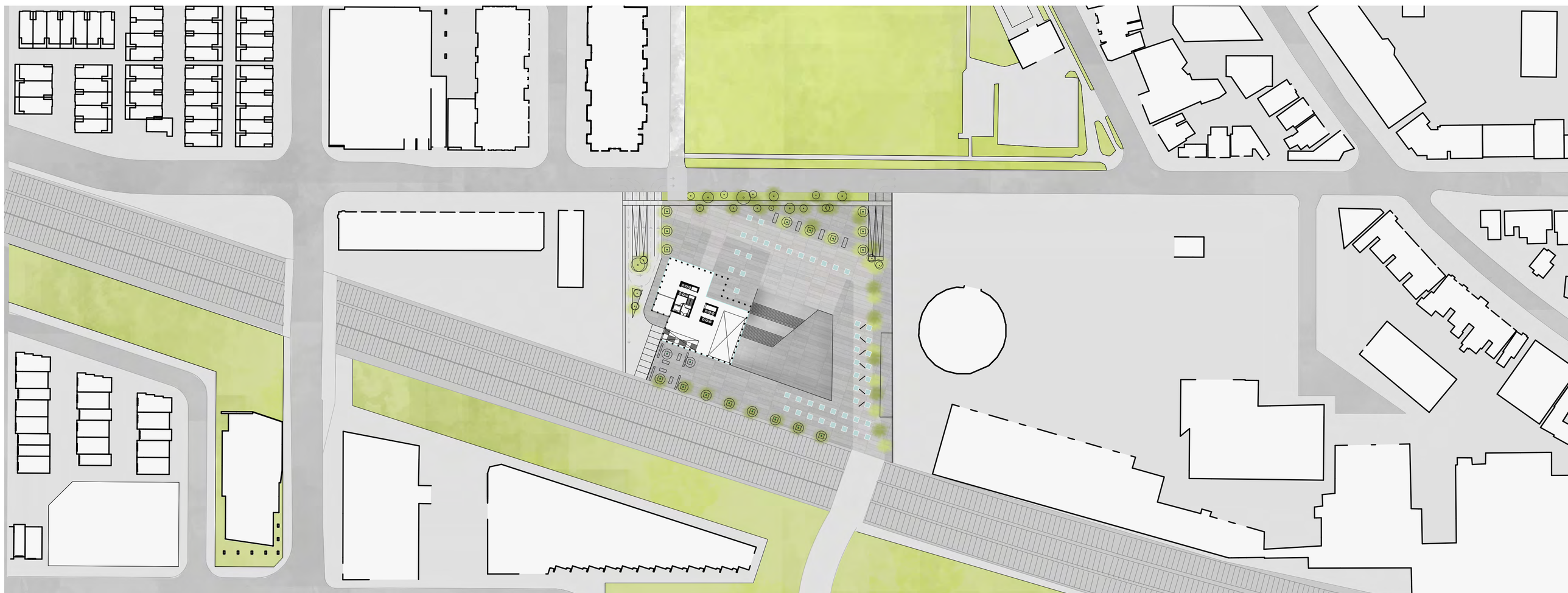
SITE

SITE PLAN



GROUND FLOOR



VIEW FROM PLAZA

POLITECNICO
MILANO 1863

MSC BUILDING ARCHITECTURE
THESIS

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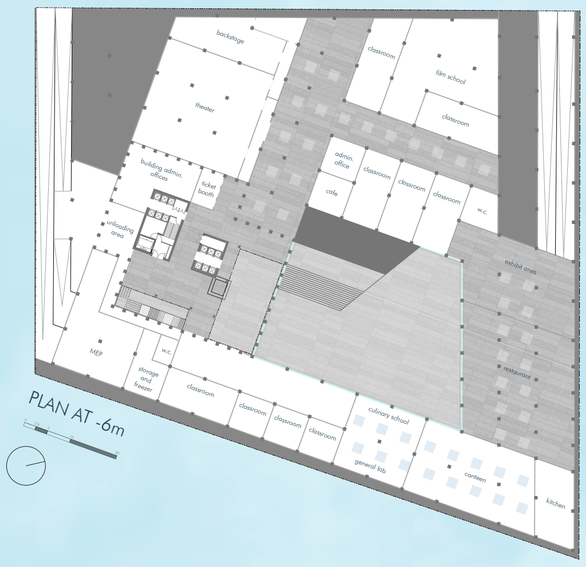
OUR BEACON:
TORONTO AFFORDABLE
HOUSING

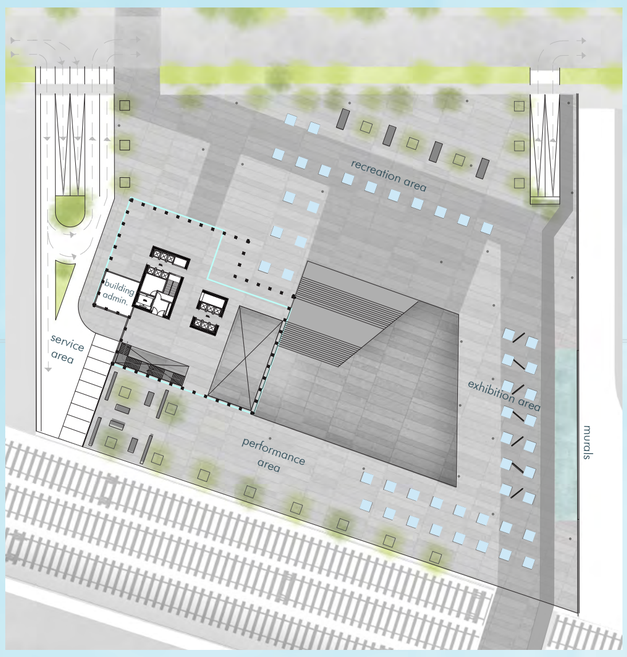
0 50 100 200

SECTION AND PUBLIC PLAZA PLANS

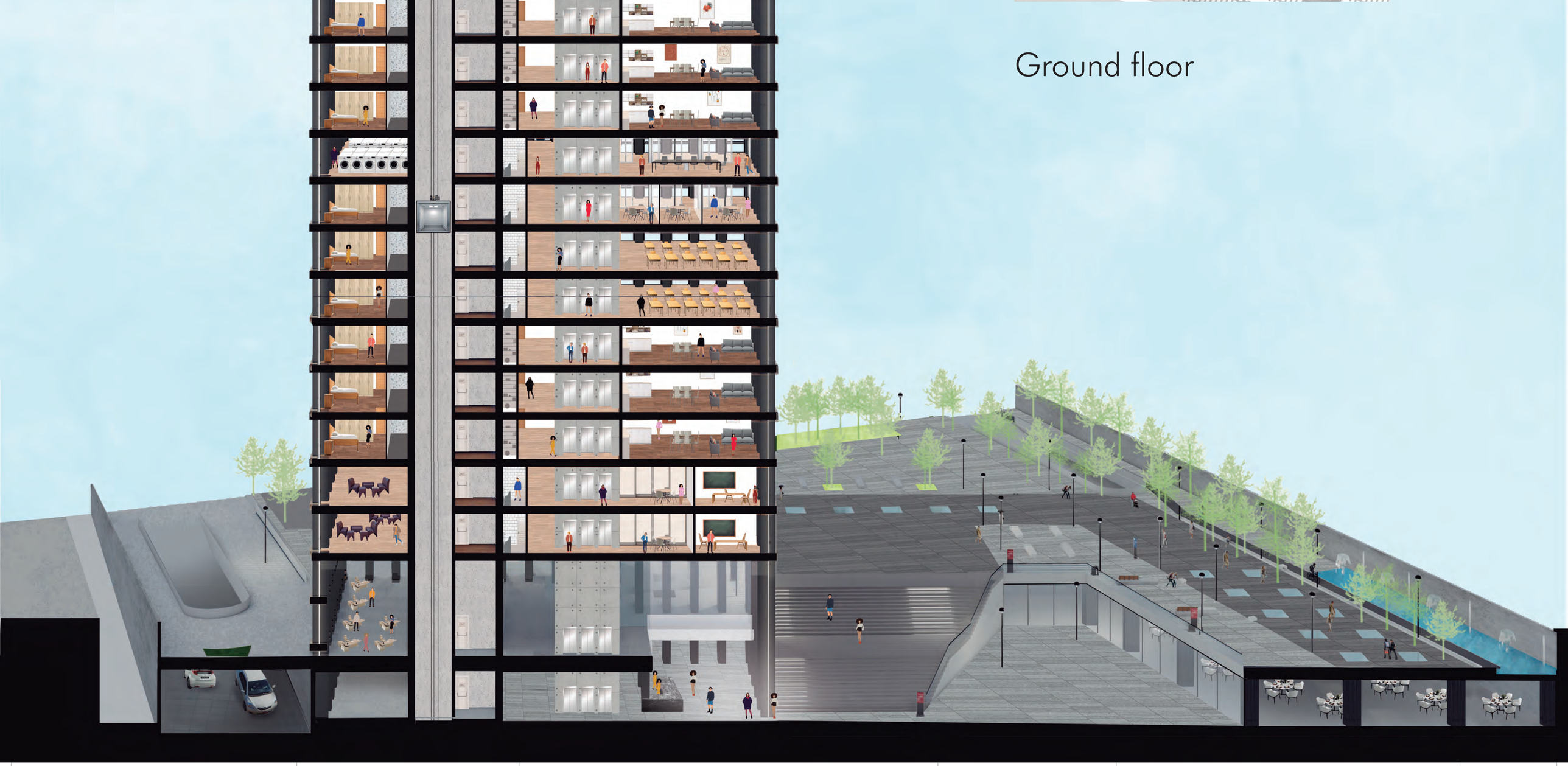
NORTH-SOUTH SECTION



Underground floor



Ground floor



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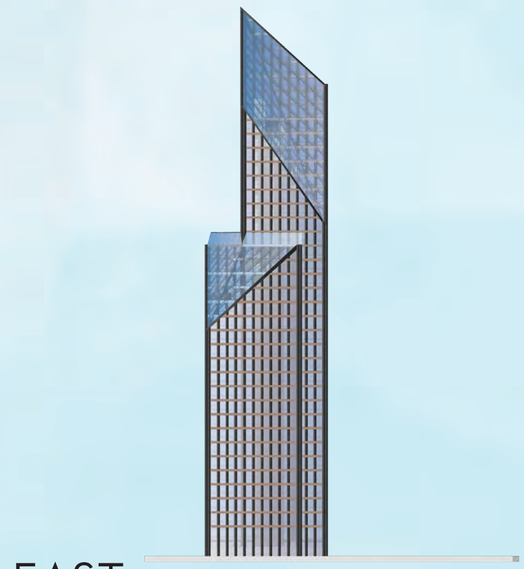
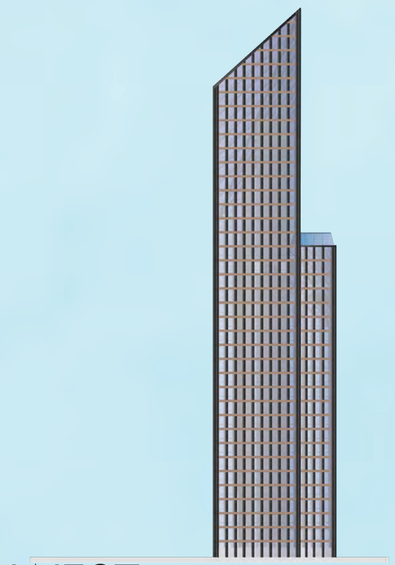
TORONTO AFFORDABLE HOUSING

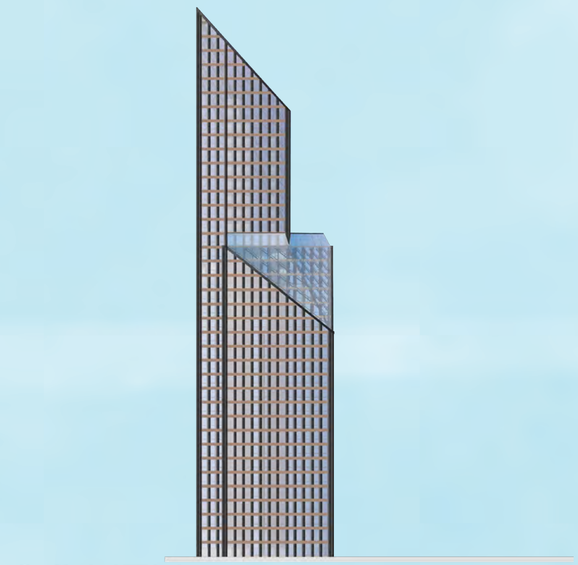
0 1 5 10 20

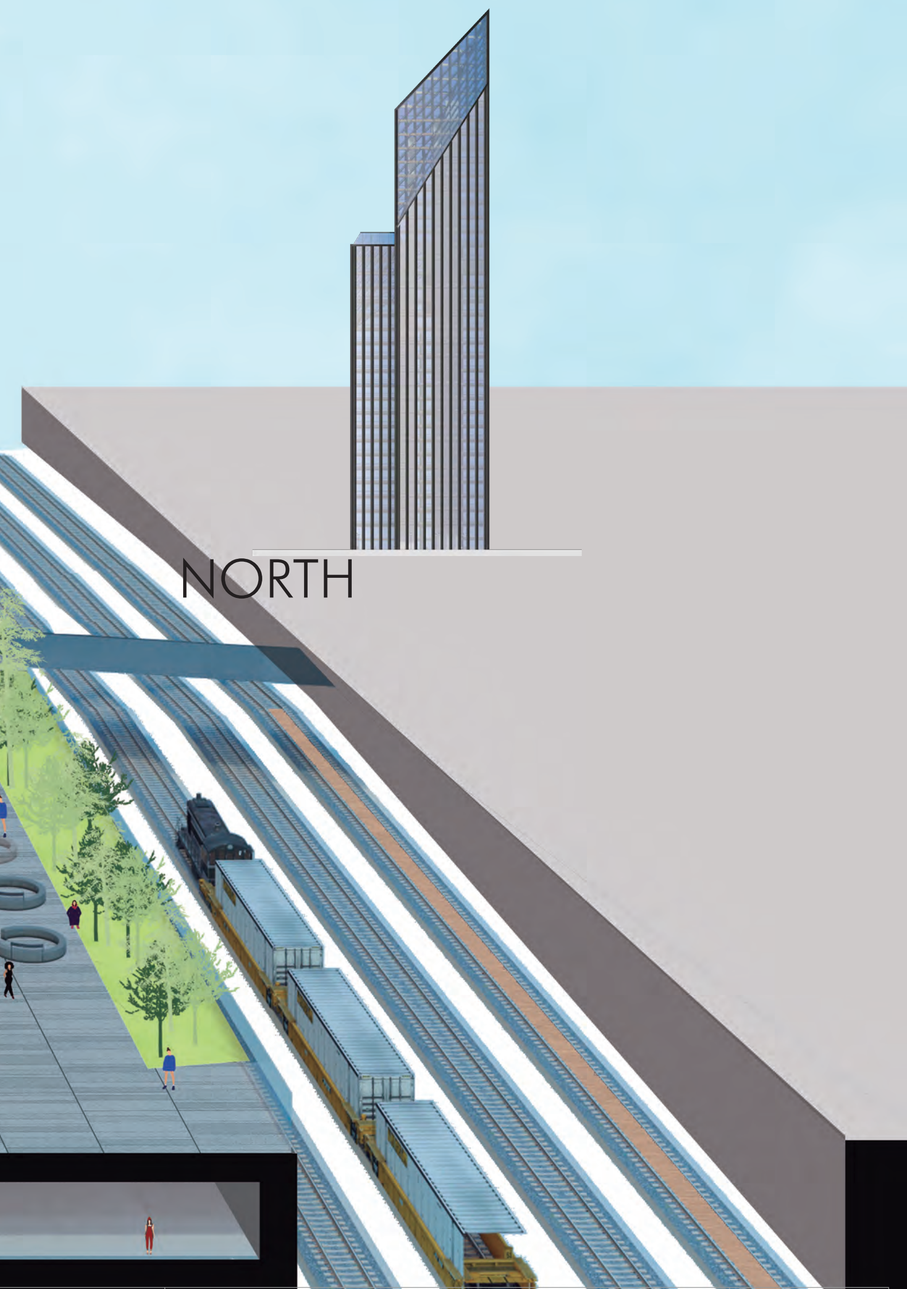
SECTION AND ELEVATIONS

WEST-EAST SECTION









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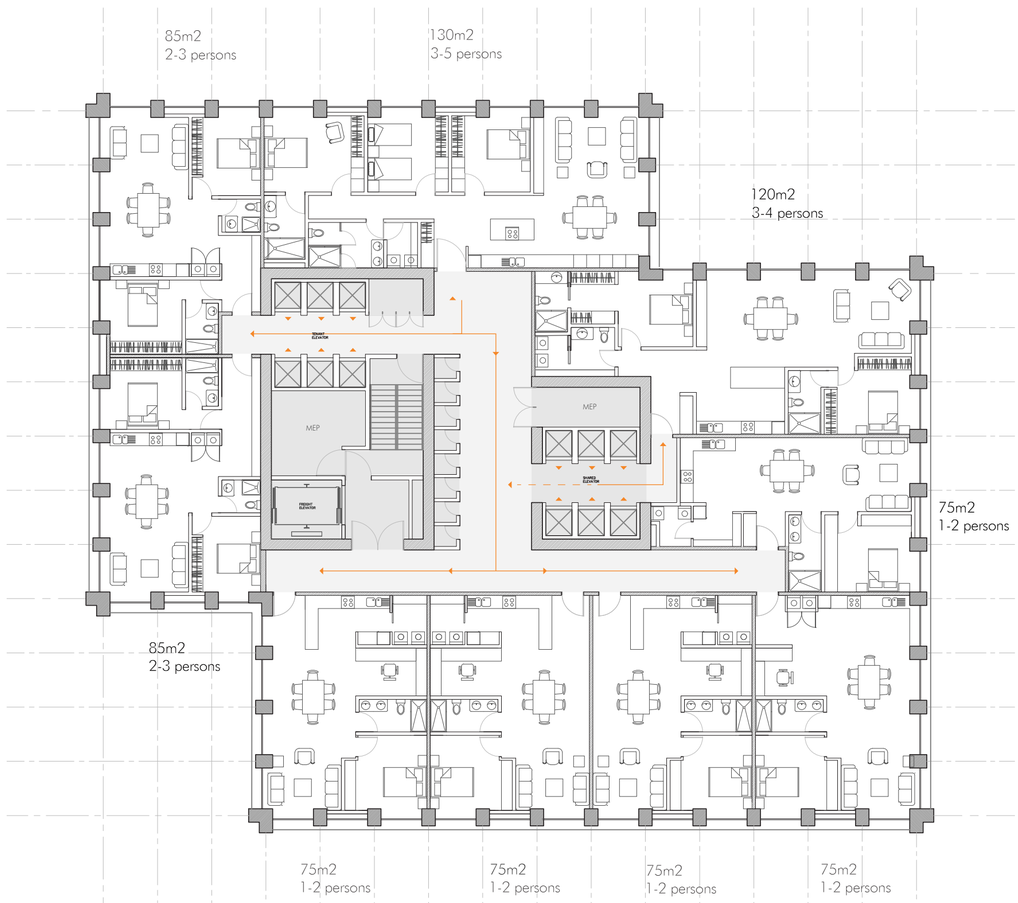
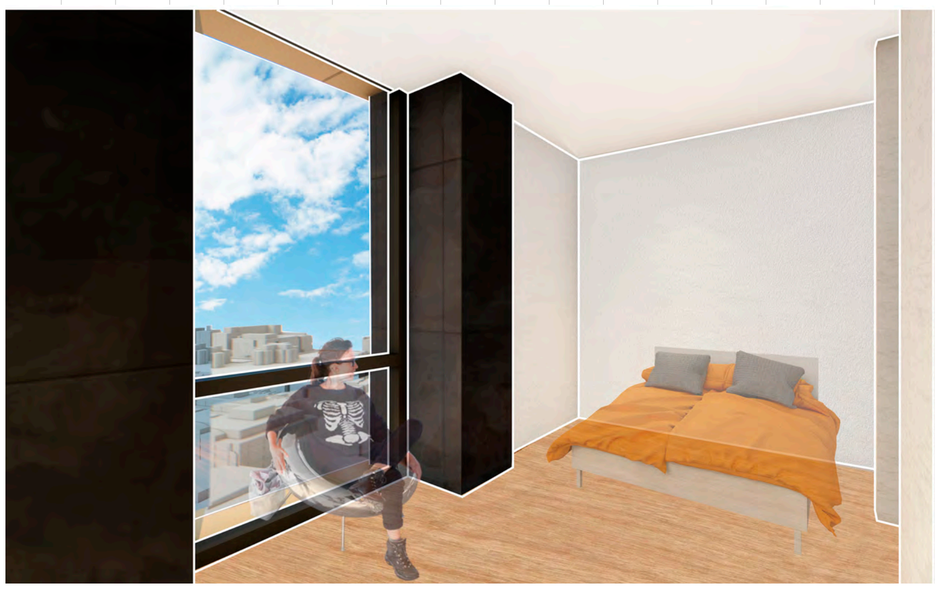
HOUSING

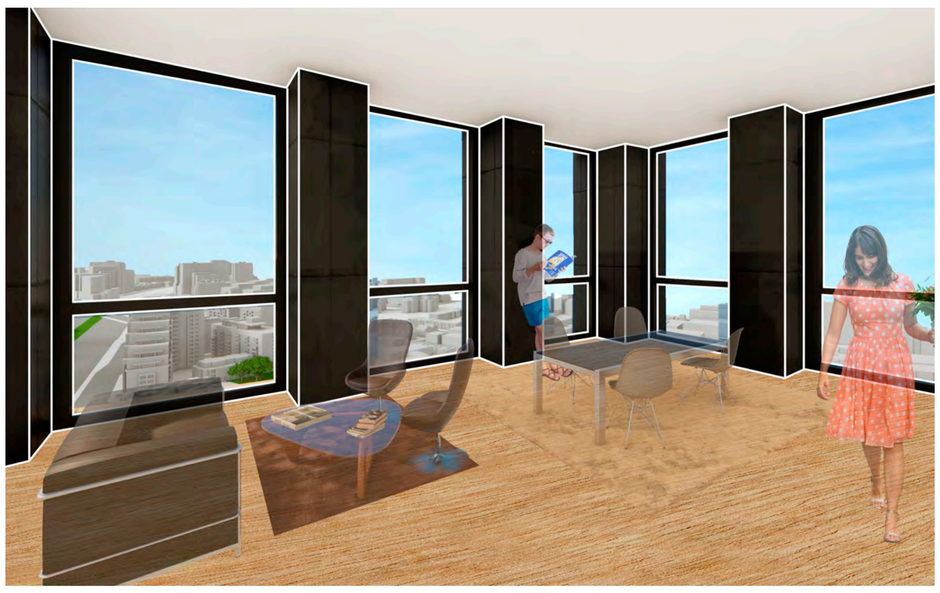
0 1 5 10 20

PLANS

RESIDENTIAL

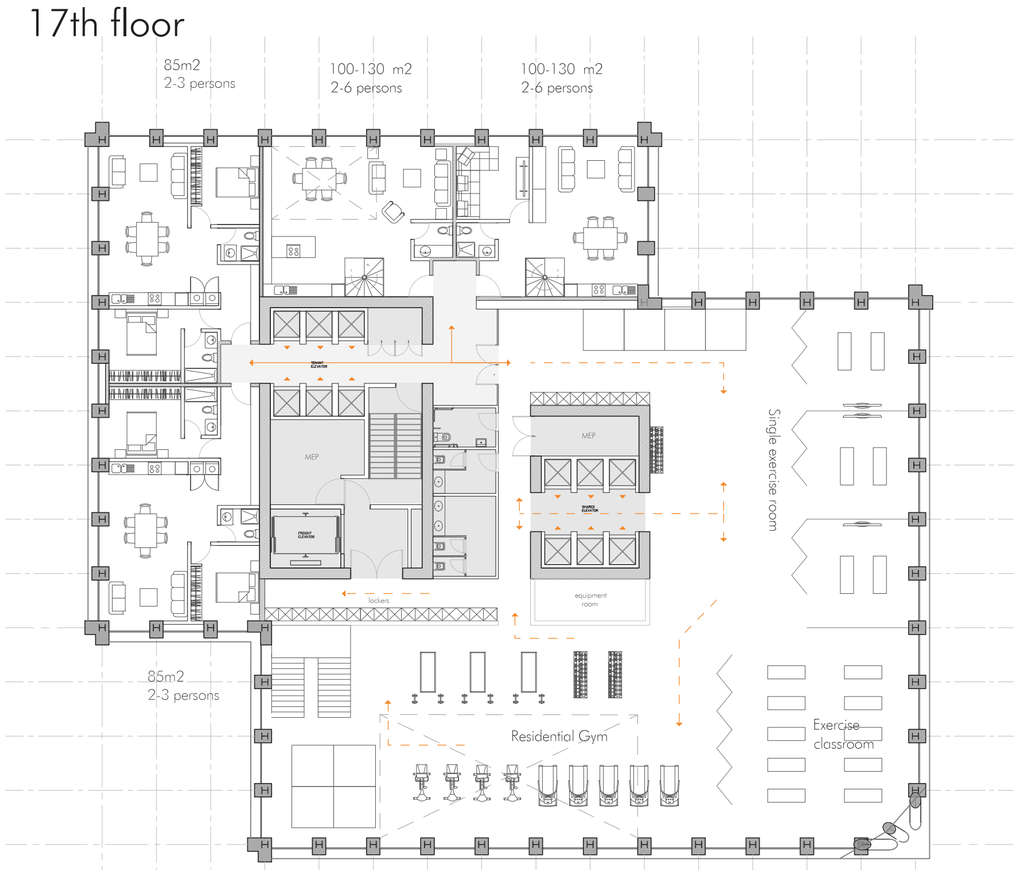




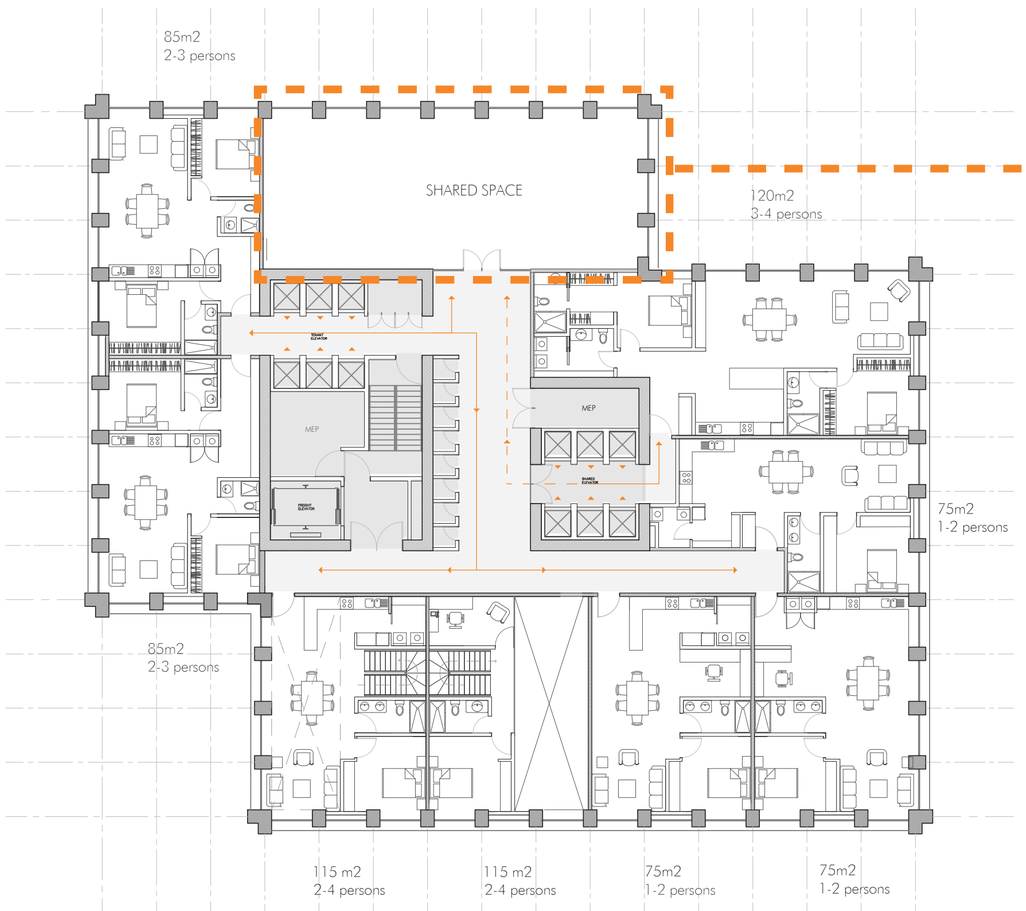


RESIDENTIAL/ GYM

17th floor



RESIDENTIAL/ SHARED SPACES

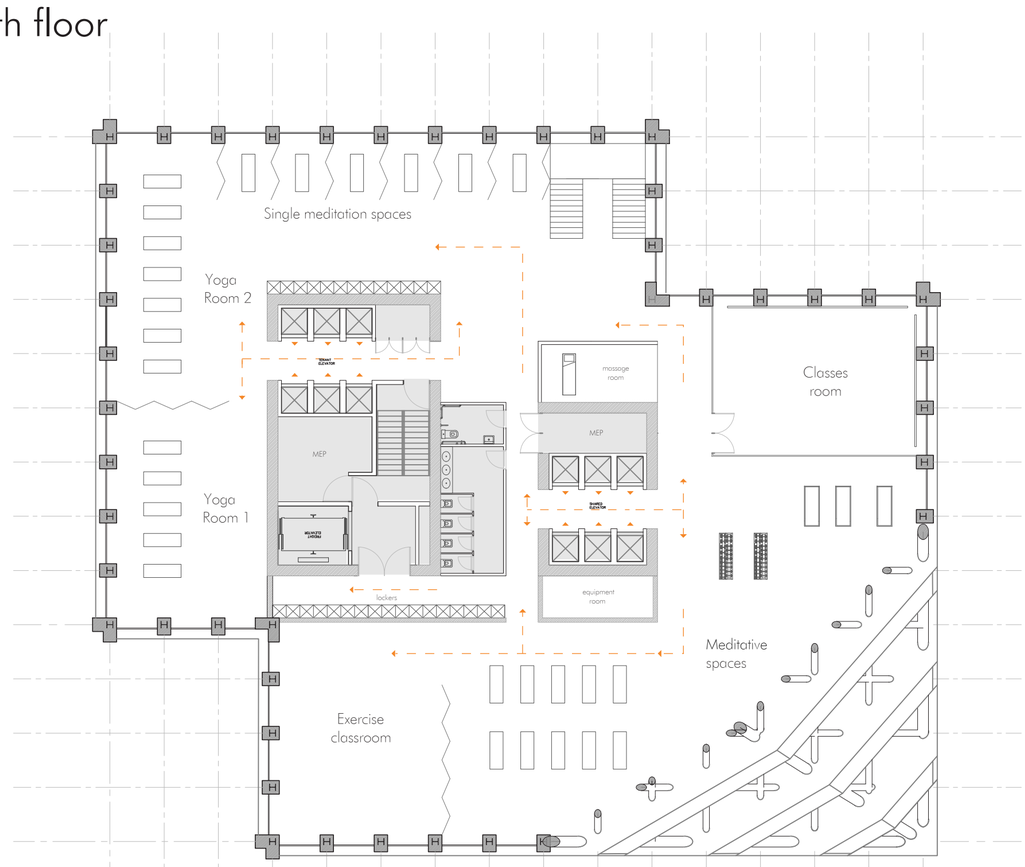


Possible configurations

PLANS

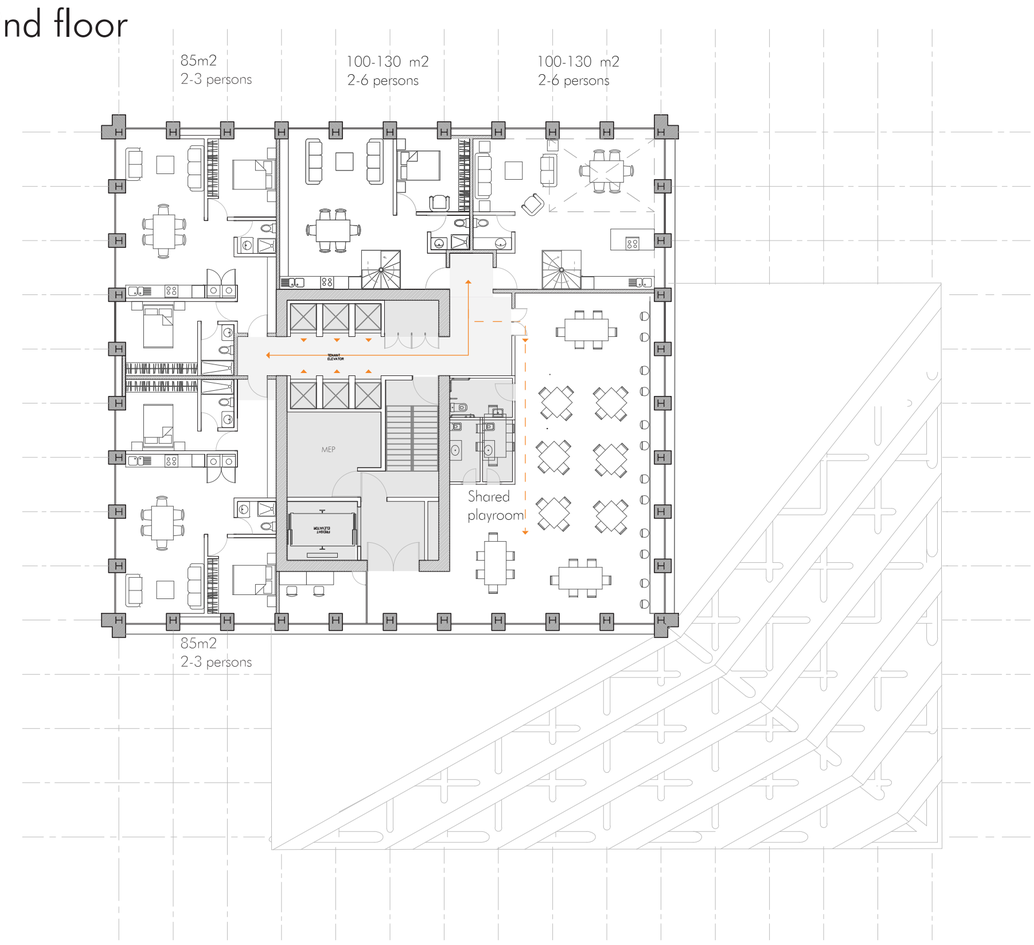
MEDITATIVE SPACES

19th floor



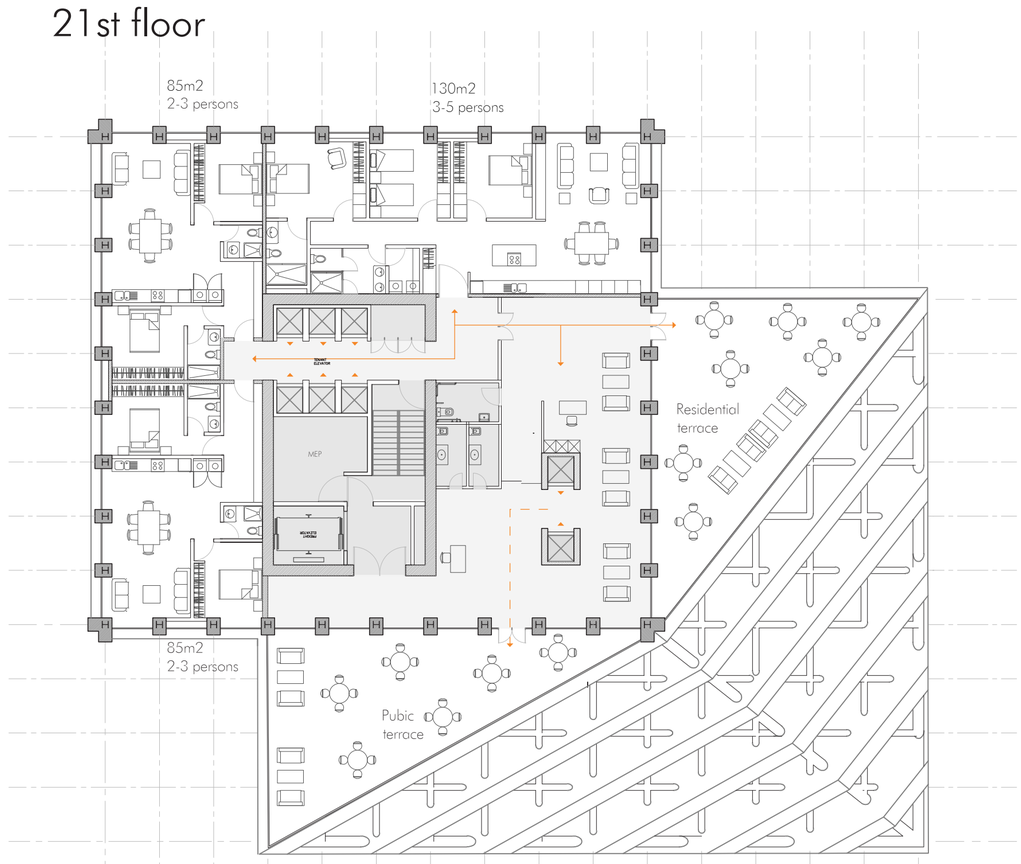
PLAYROOM

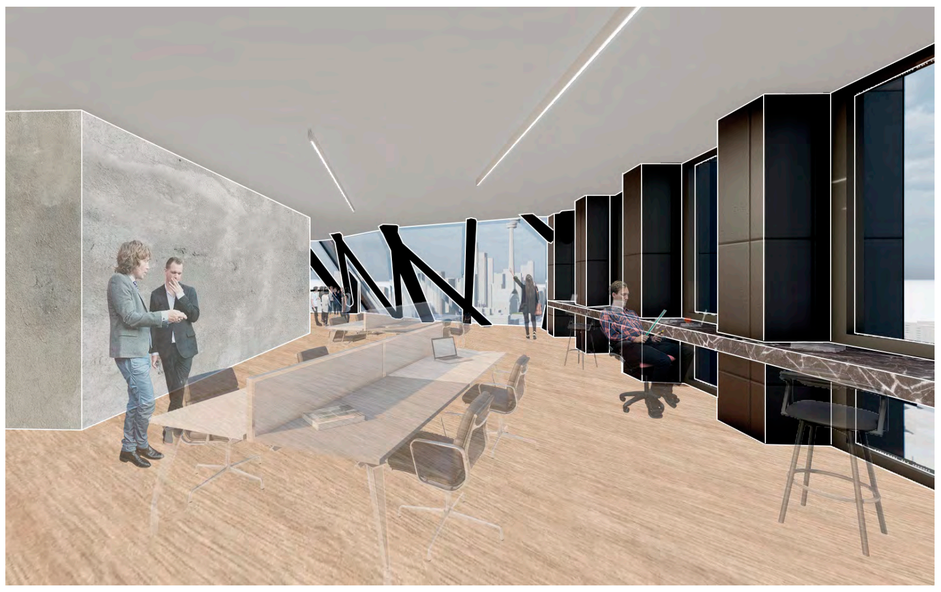
22nd floor



TERRACES

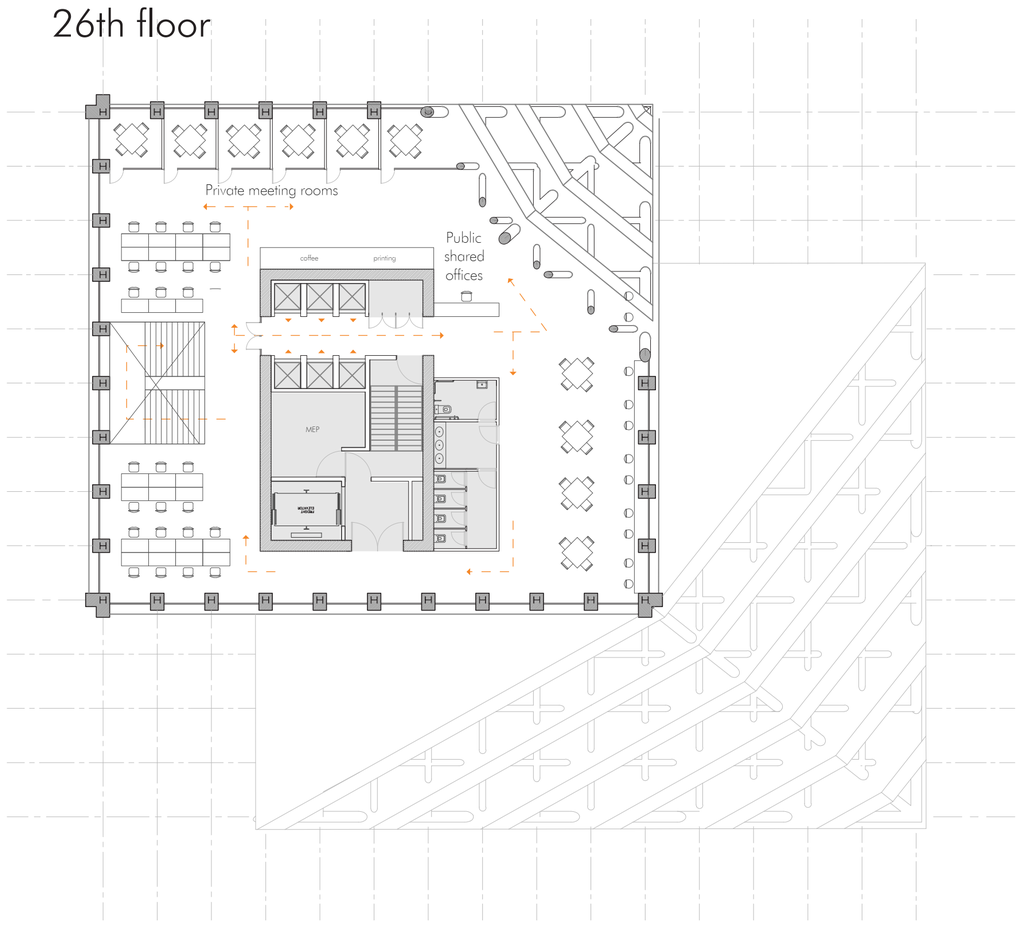
21st floor





PRODUCTIVITY SPACES

26th floor



POLITECNICO
MILANO 1863

MSC BUILDING ARCHITECTURE
THESIS

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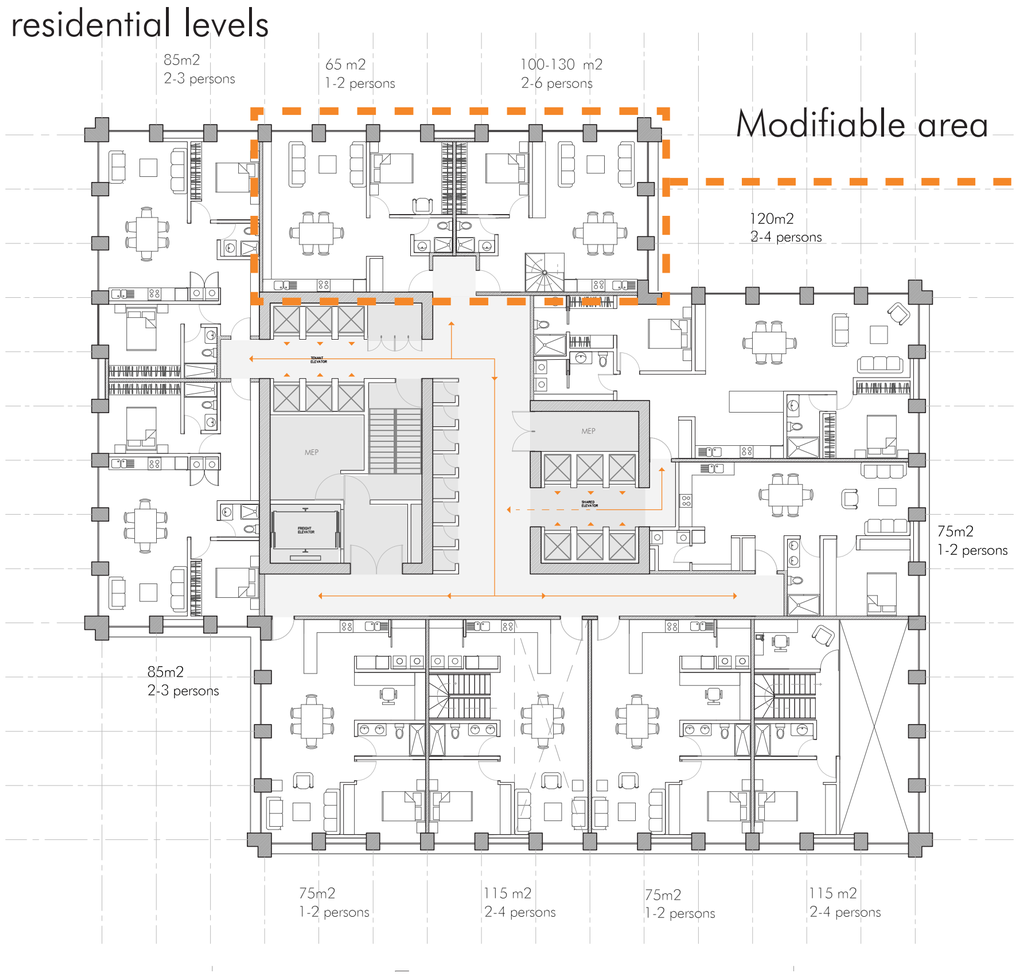
OUR BEACON:
TORONTO AFFORDABLE
HOUSING

1m 5m 10m

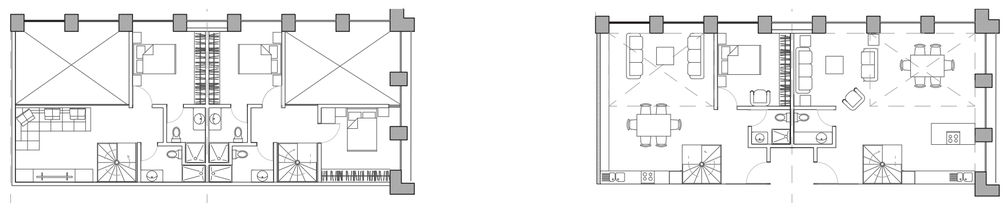
DOUBLE HEIGHT APPARTMENTS

POSSIBLE FLOOR VARIATIONS

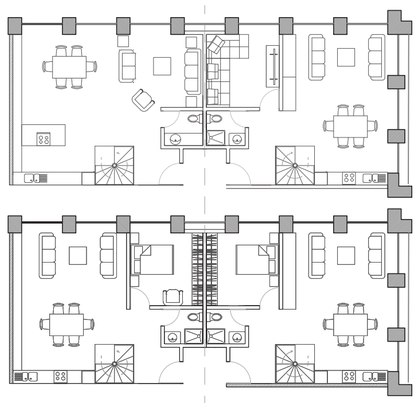
Possible in all residential levels



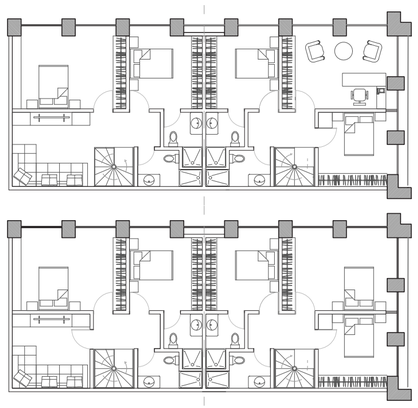
Double height configuration

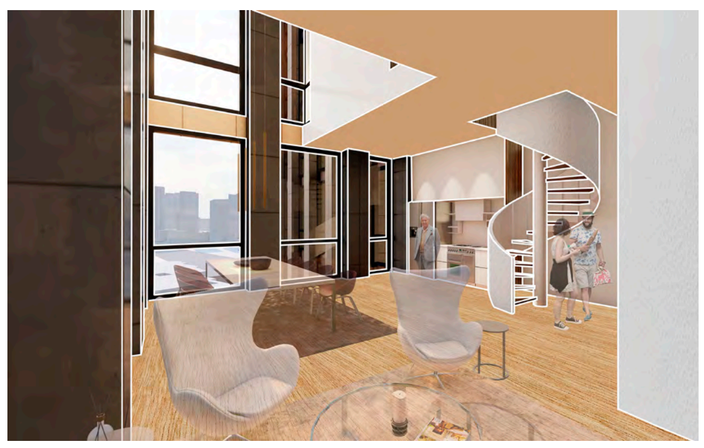


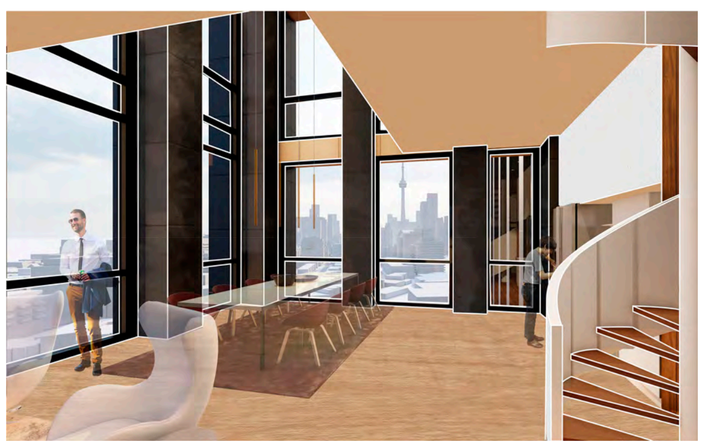
Lower floor configurations



Upper floor configurations

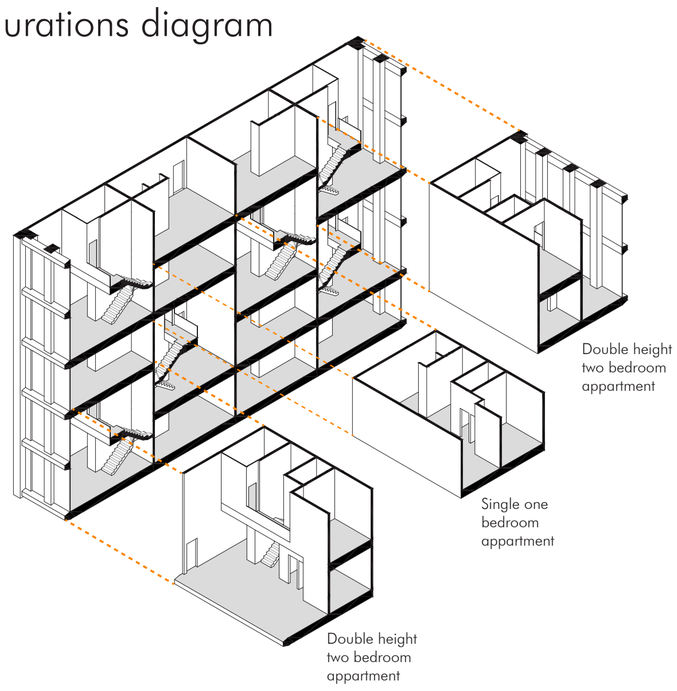






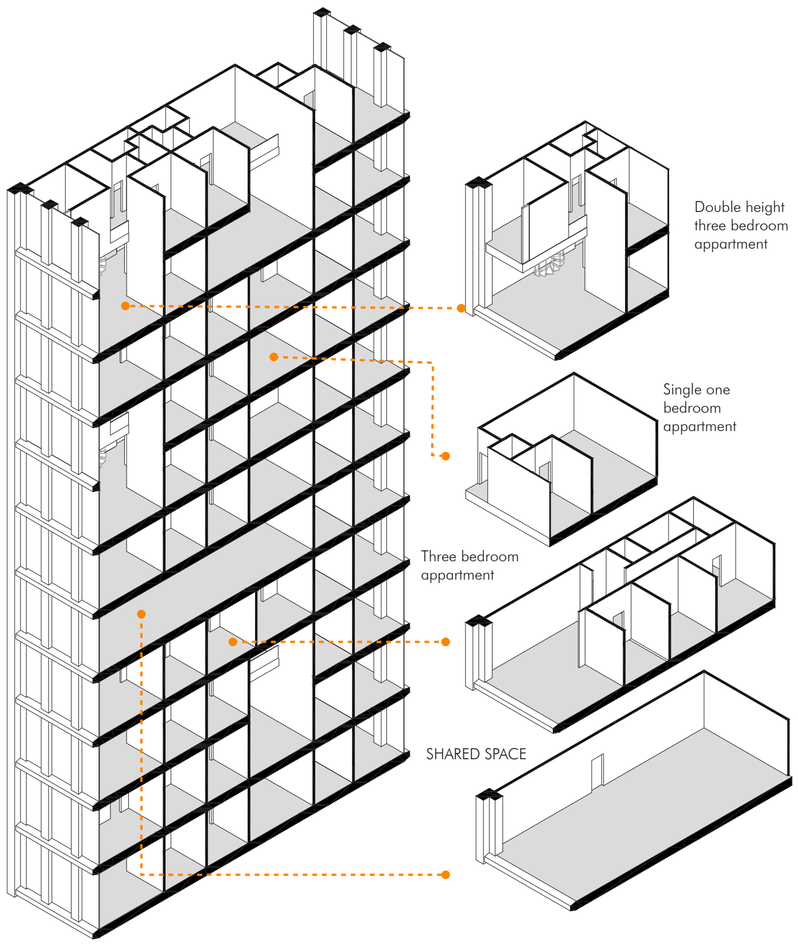
Interior views

Configurations diagram



Interior views

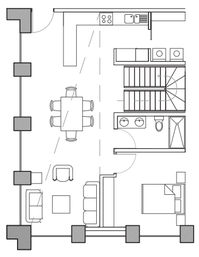
Configurations diagram



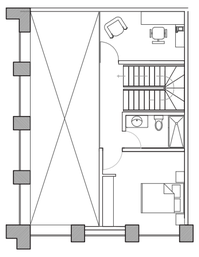
Possible in all residential levels below floor 18th

Modifiable area

Lower floor configurations



Upper floor configurations



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1m 5m 10m

MATERIALS

SUSTAINABILITY PRINCIPLES

PASSIVE

FACADE SHADING

SMART ORIENTATION

TRIPLE GLAZED WINDOWS

USE OF RECYCLED INSULATION

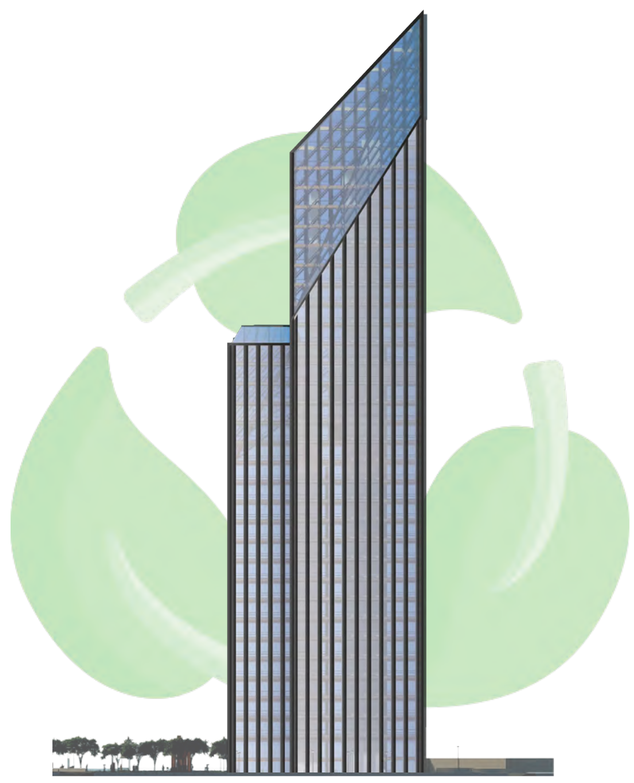
ENERGY STAR APPLIANCES

ENERGY SAVING SPACES

RECYCLABLE SLAB FORMWORK

RECYCLABLE FACADE MATERIALS

NATURAL LIGHT AT THE UNDERGROUND LEVEL



ACTIVE

WASTE WATER TREATMENT AND REUSE

ENERGY STAR APPLIANCES

BMS CONTROL

EFFICIENT WASTE MANAGEMENT STRATEGY

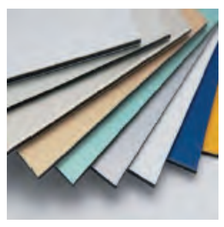
USE OF PHOTOVOLTAIC ENERGY

MATERIAL PALETTE

TRANSPARENT PHOTOVOLTAIC GLASS

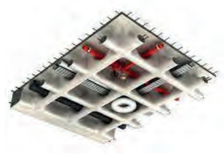
20 km from site

ALUMINUM COMPOSITE PANELS



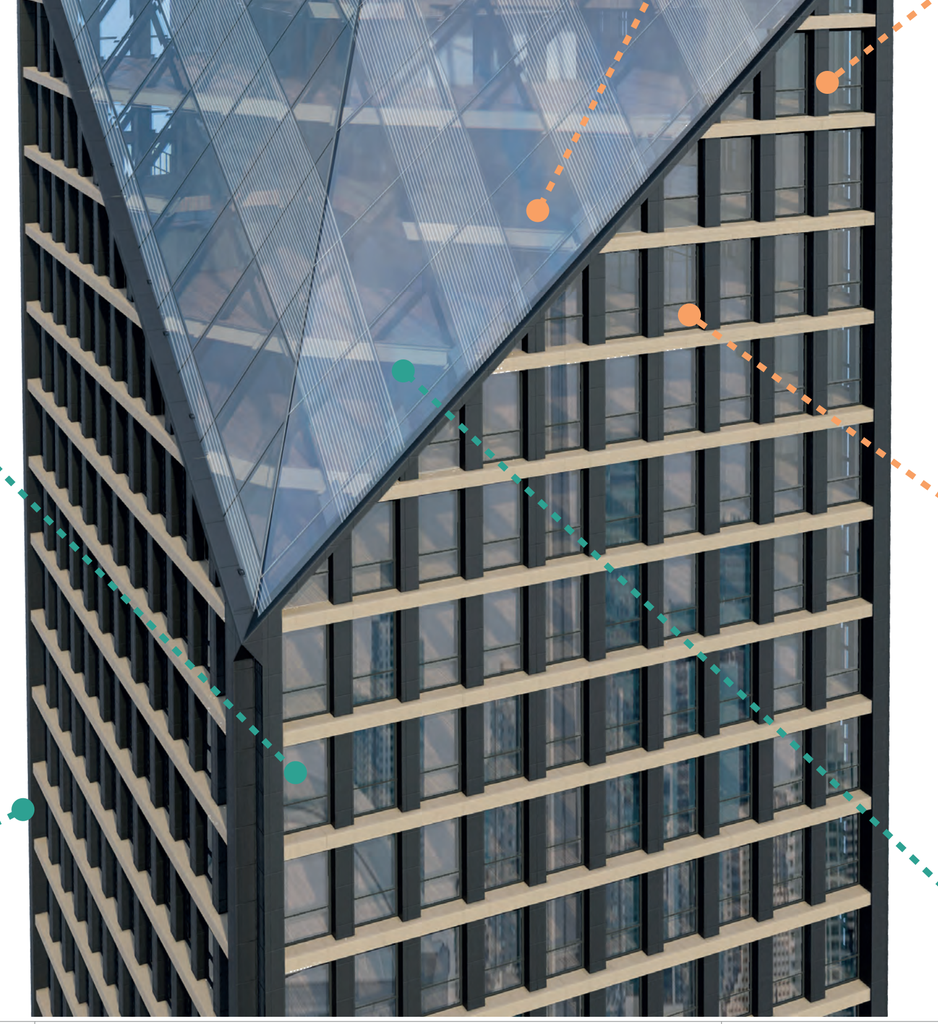
10 km from site

CONCRETE WAFFLE SLAB

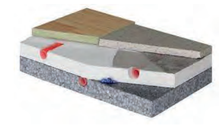


SUSTAIBABLE CONCRETE

5 km from site



UNDERFLOOR HEATING SYSTEM

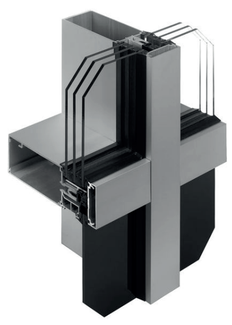


11 km from site (local partner)

MINERAL WOOL INSULATION

20 km from site

TRIPLE PANE GLASS



15 km from site

SUSTAIBABLE STEEL

17 km from site

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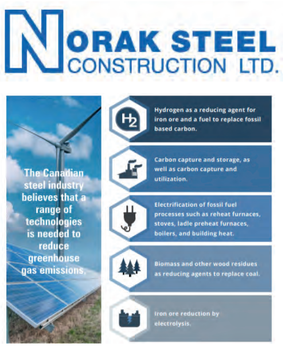
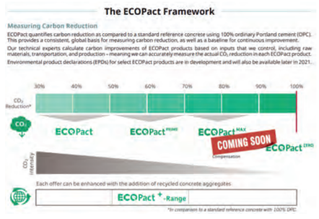
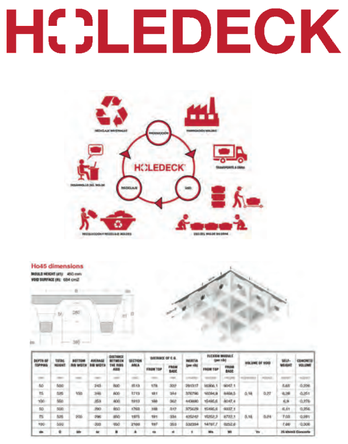
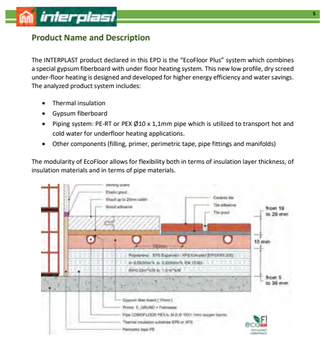
MATERIAL PROPERTIES/ PRODUCERS

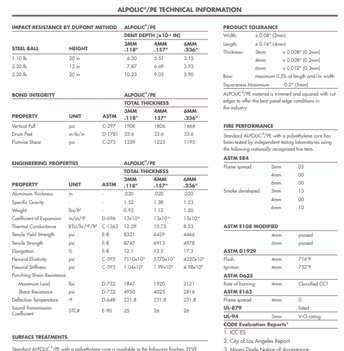
Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-02087
Publication date:	2021-03-19
Valid until:	2026-03-18
Scope of the EPD®	Global

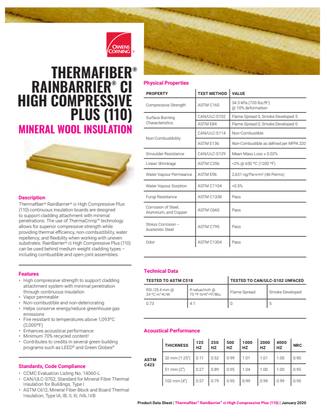








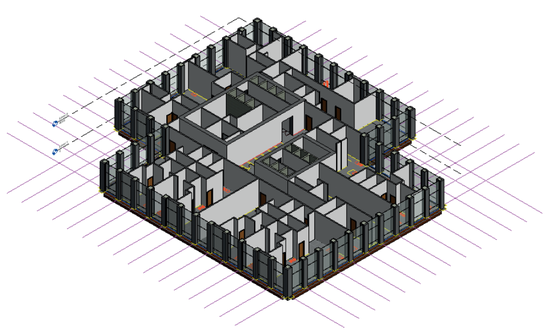




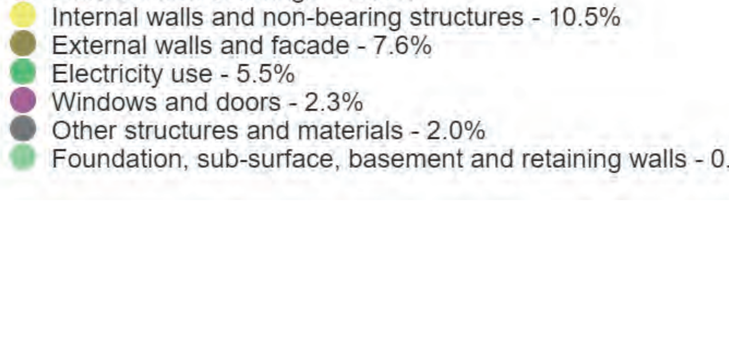
ONE CLICK LCA
LIFE CYCLE ASSESSMENT

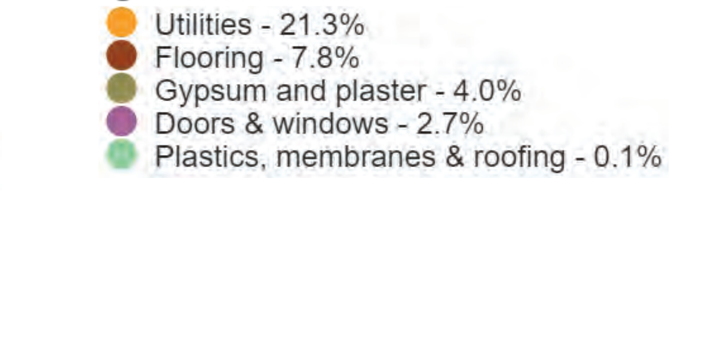
INVENTORY BY FLOOR

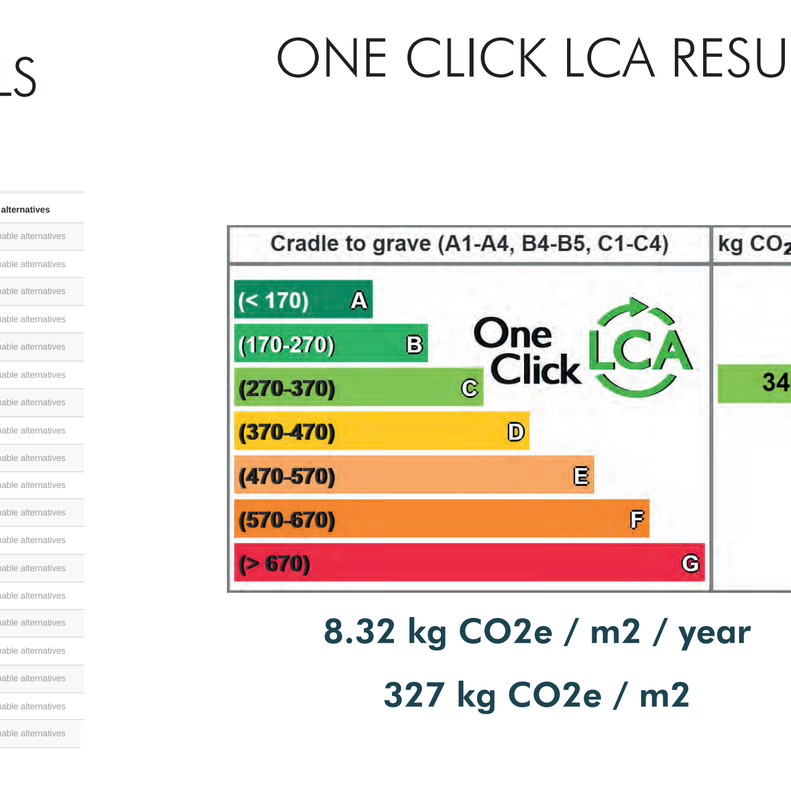
	COUNT	M2	M3
Doors	92		
Door	74		
Main Door	18		
Aluminum 6061			
Single emergency door	6		
Double emergency door	1		
Cast-in-place concrete			166.27
Concrete slab topping		1050	36.75
Damp-proofing floor		1050	
Gypsum Wall Board interior		5111	96.55
Light gauge steel framing, thermal air layer		1923	
Light gauge steel furring		1504	
physical material (floor)		1050	472.5
Polyethylene film membrane		1504	
Precast concrete (substitute with Comfloor)		1050	237.3
Rigid foam insulation board		1564	105.98
Soda Lime Glass		391	
Steel 345 Mpa (Alum, Composite)		602	
Vinyl Composition Tile		1050	
Wood framing, insulated /st. studs		1281	126.68
LED	75		
Ductwork (to be adjusted) in kg	2575		

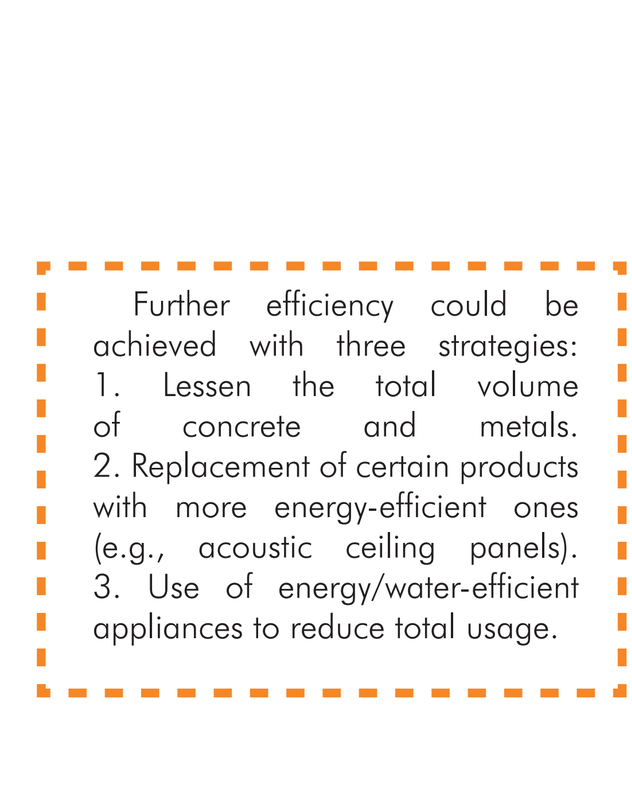


EMBODIED CARBON AND CLASSIFICATIONS









MOST CONTRIBUTING MATERIALS (GLOBAL WARMING)

No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)	Sustainable alternatives
1.	Ready-mix concrete, high-strength, generic	99 tons CO_2e	37.0 %	Show sustainable alternatives
2.	Aluminum composite panel, curtain walling/facade, mineral filled	43 tons CO_2e	16.2 %	Show sustainable alternatives
3.	Triple pane insulated glass unit (IGU) with two spacer	33 tons CO_2e	12.4 %	Show sustainable alternatives
4.	Galvanized steel profiles, furrings (F-section)	28 tons CO_2e	10.6 %	Show sustainable alternatives
5.	Gypsum plaster board, regular, generic	15 tons CO_2e	5.6 %	Show sustainable alternatives
6.	Reinforcement steel (rebar), generic	15 tons CO_2e	5.5 %	Show sustainable alternatives
7.	Luxury vinyl floor tile	11 tons CO_2e	4.0 %	Show sustainable alternatives
8.	Glass wool acoustic ceiling panel	6.2 tons CO_2e	2.3 %	Show sustainable alternatives
9.	Wooden door, with wooden frame	4.5 tons CO_2e	1.7 %	Show sustainable alternatives
10.	Pre-insulated round ductwork system for HVAC	4 tons CO_2e	1.5 %	Show sustainable alternatives
11.	LED office lighting	2.5 tons CO_2e	0.9 %	Show sustainable alternatives
12.	Ready-mix concrete, normal-strength, generic	1.7 tons CO_2e	0.6 %	Show sustainable alternatives
13.	Glass wool insulation panels, unfaced, generic	1.4 tons CO_2e	0.5 %	Show sustainable alternatives
14.	Steel door with polystyrene core, per unit	1.1 tons CO_2e	0.4 %	Show sustainable alternatives
15.	Diffuser, HVAC, French average	0.91 tons CO_2e	0.3 %	Show sustainable alternatives
16.	Reinforcement steel (rebar), generic	0.59 tons CO_2e	0.2 %	Show sustainable alternatives
17.	Damp insulation PA	0.25 tons CO_2e	0.1 %	Show sustainable alternatives
18.	Deep foundation concrete piles	kg CO_2e	0.0 %	Show sustainable alternatives
	Emergency exit light	26 kg CO_2e	0.0 %	Show sustainable alternatives

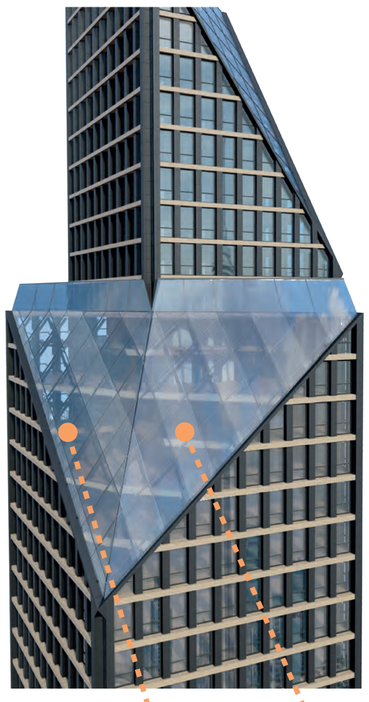
ONE CLICK LCA RESULT

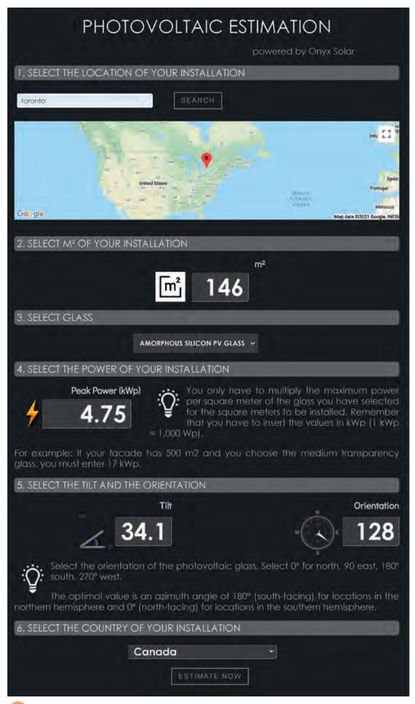
8.32 kg CO2e / m2 / year

327 kg CO2e / m2

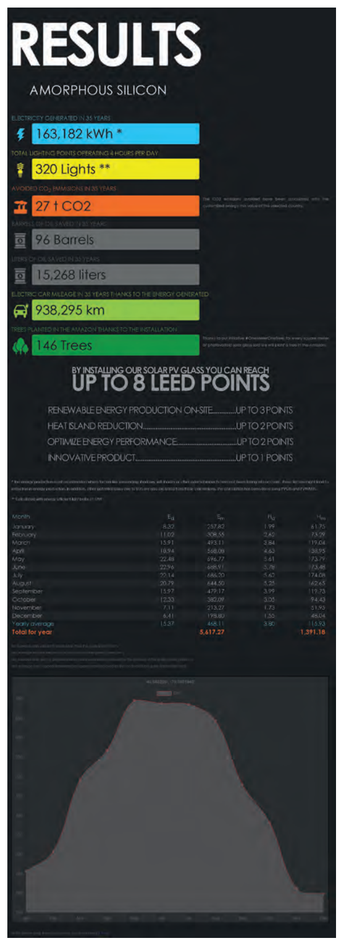
Further efficiency could be achieved with three strategies:
1. Lessen the total volume of concrete and metals.
2. Replacement of certain products with more energy-efficient ones (e.g., acoustic ceiling panels).
3. Use of energy/water-efficient appliances to reduce total usage.

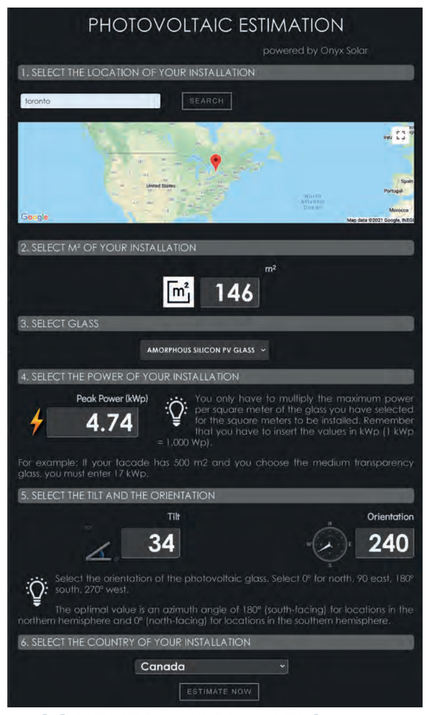
PV PANEL POTENTIAL
ACCORDING TO MANUFACTURER'S PARTNER



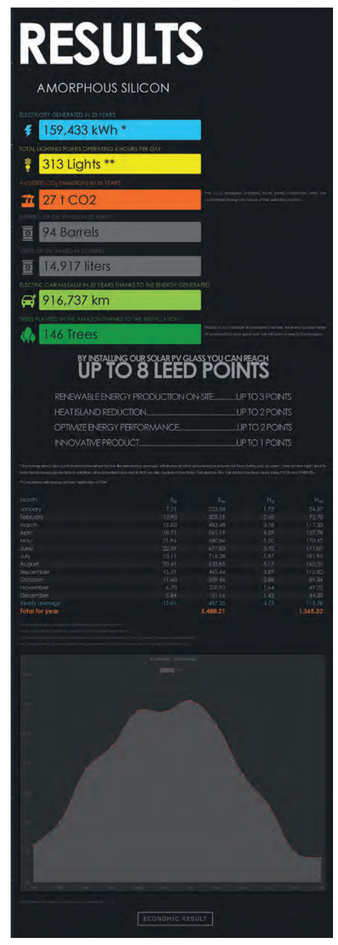


EASTERN PV PANELS



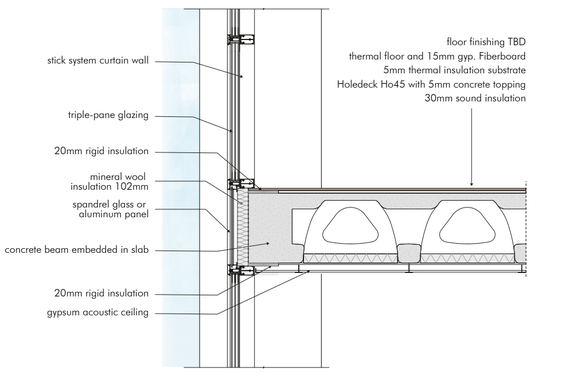


SOUTHERN PV PANELS

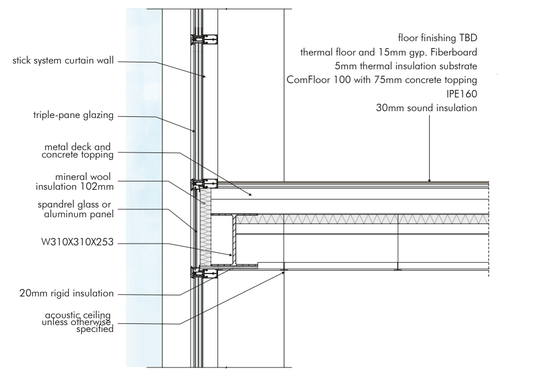


TRANSPARENT
PHOTOVOLTAIC
GLASS

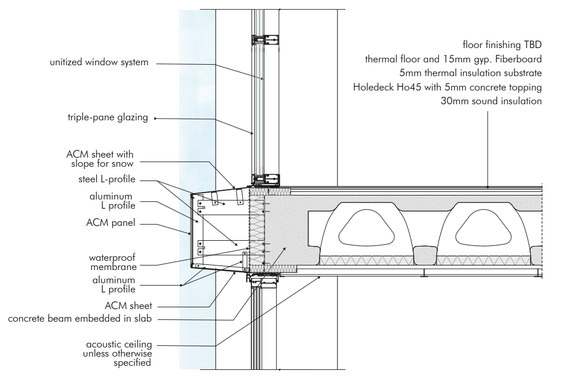
CONSTRUCTIVE DETAILS
SLAB DETAILS



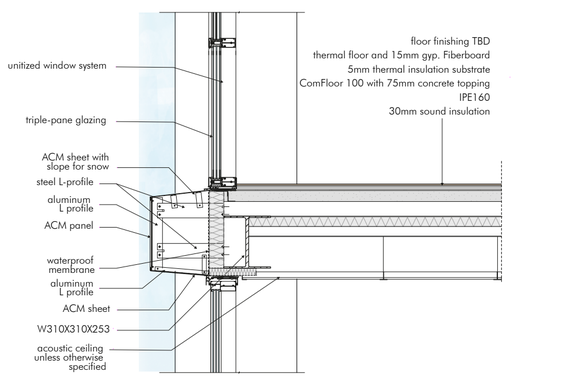
CONCRETE SLAB - NORTH FACADE



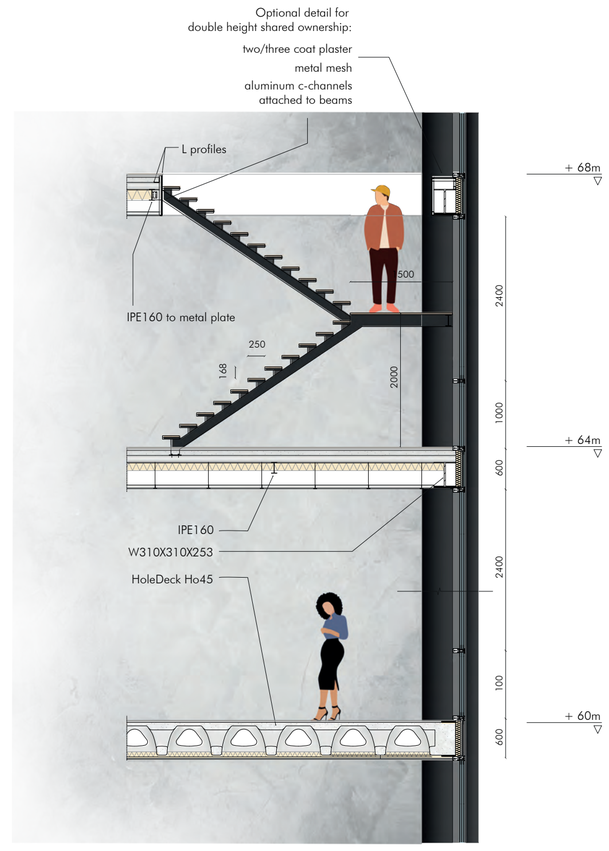
COMPOSITE SLAB - NORTH FACADE



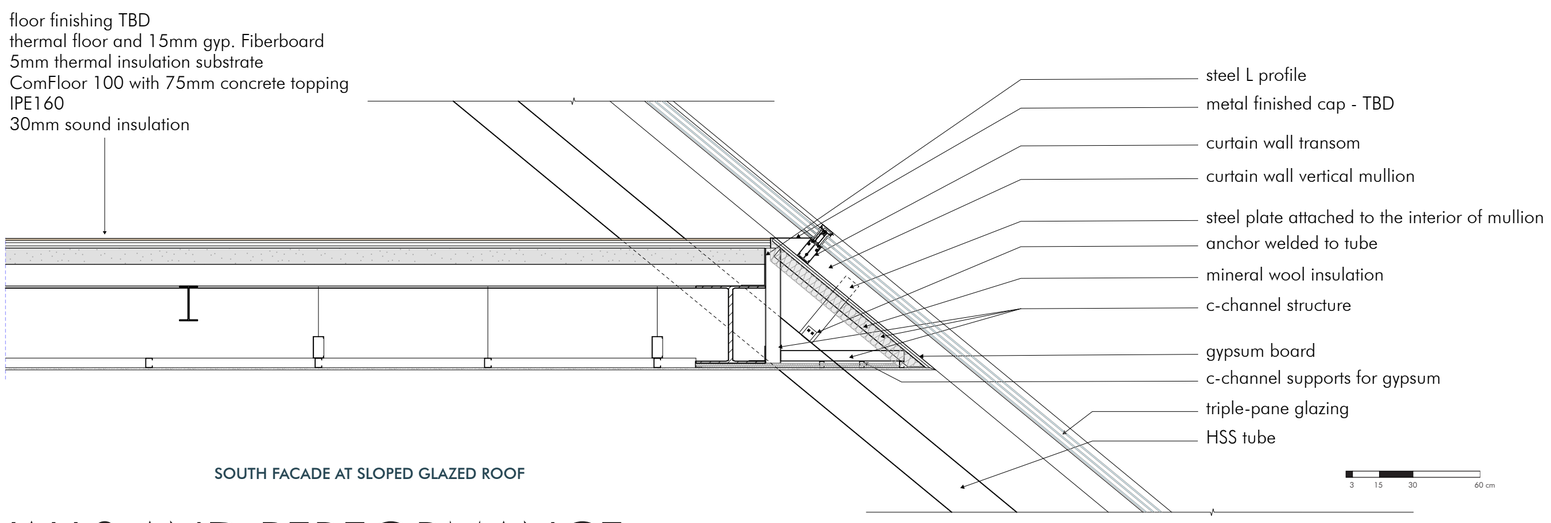
CONCRETE SLAB - TYPICAL



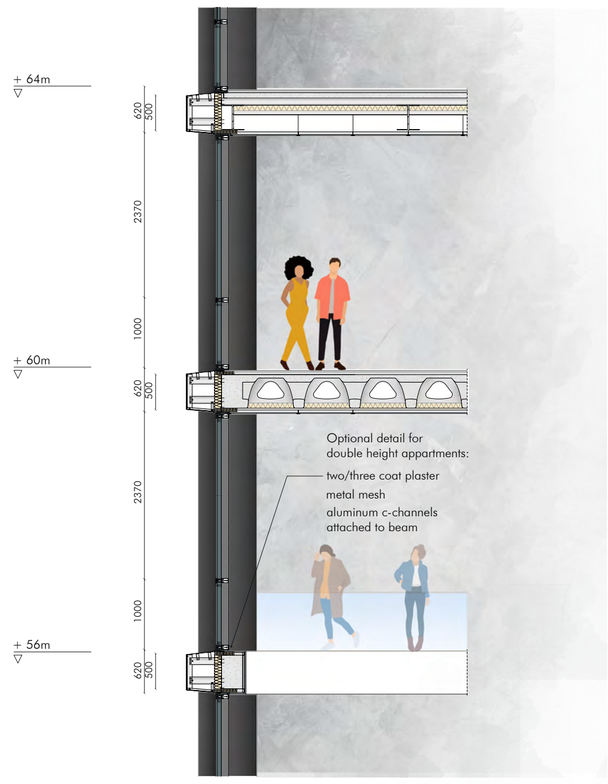
COMPOSITE SLAB - TYPICAL



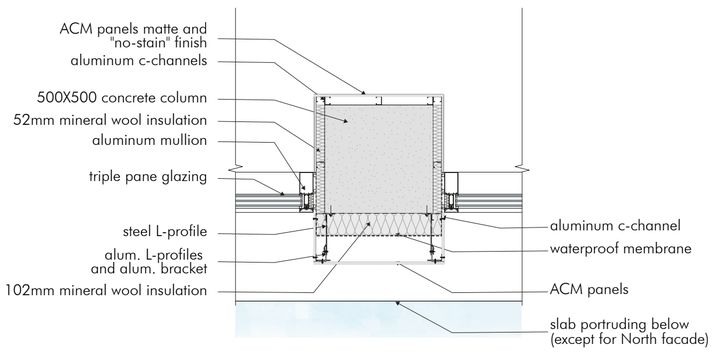
GLAZING DETAILS



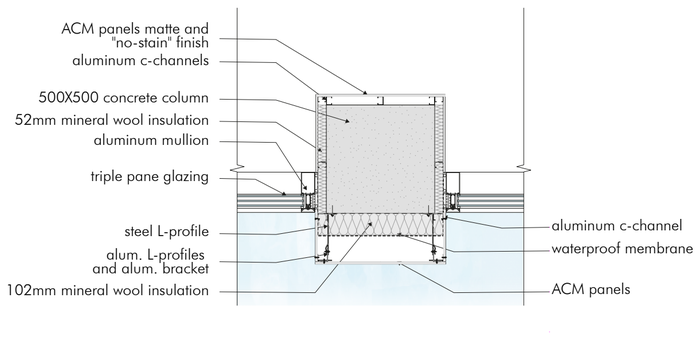
SOUTH FACADE AT SLOPED GLAZED ROOF



WALLS AND PERFORMANCE



TYPICAL CONCRETE COLUMN



TYPICAL CONCRETE COLUMN AT NORTH FACADE

MATERIAL	THICK.	R VALUE	U VALUE
int. ACM	8mm	0.10758	9.29508
concrete	600mm	1.81818	0.55
R17.2 insulation	102mm	3.03351	0.32965
air cavity	89mm	0.17637	5.67
ext. ACM	8mm	0.10758	9.29508
TOTAL		5.2432	**0.1907**
MIN/MAX ZONE 5		3.26	**0.307**

MATERIAL	U VALUE
triple pane glass	1
MAX ZONE 5	**1.4**
KAWNEER 7500W curtain wall	1.2
MAX ZONE 5	**1.4**

POLITECNICO MILANO 1863

MSC BUILDING ARCHITECTURE THESIS

PROFESSORS:
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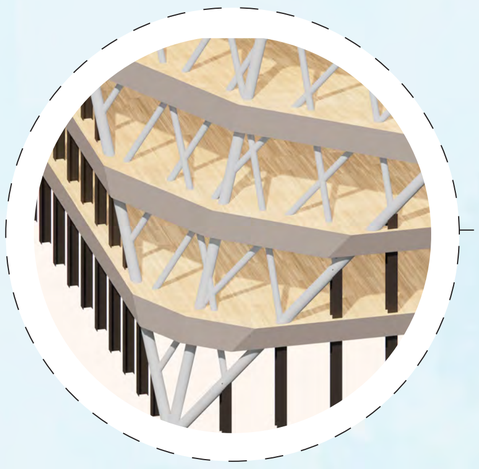
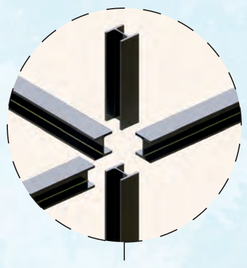
OUR BEACON:
TORONTO AFFORDABLE
HOUSING

STRUCTURE

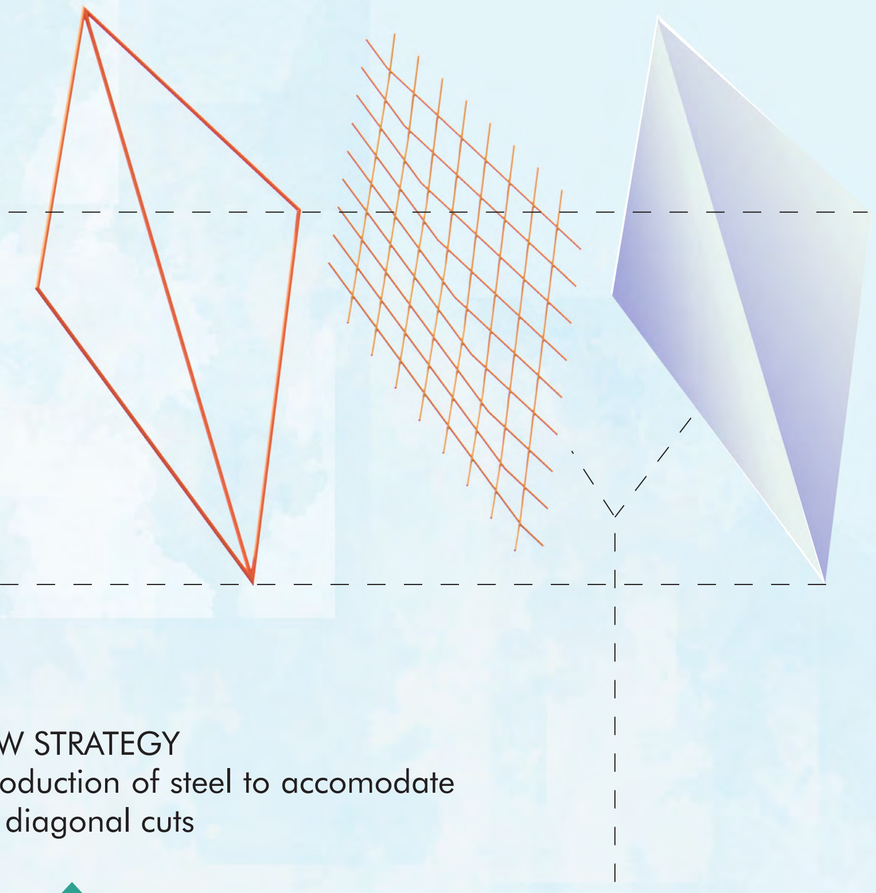


INNOVATION
Sustainable steel from Norten Steel - LEED certified producer that studies the use of hydrogen instead of CO2



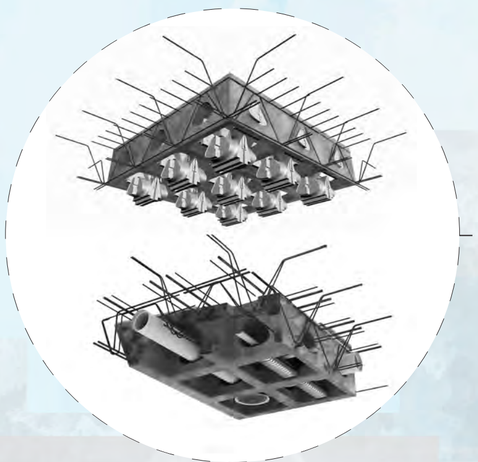
Canadian W310x253 to avoid doube sections in beams and same section in columns for geometry

~32cm diam. ~50cm diam.



NEW STRATEGY
Introduction of steel to accomodate the diagonal cuts

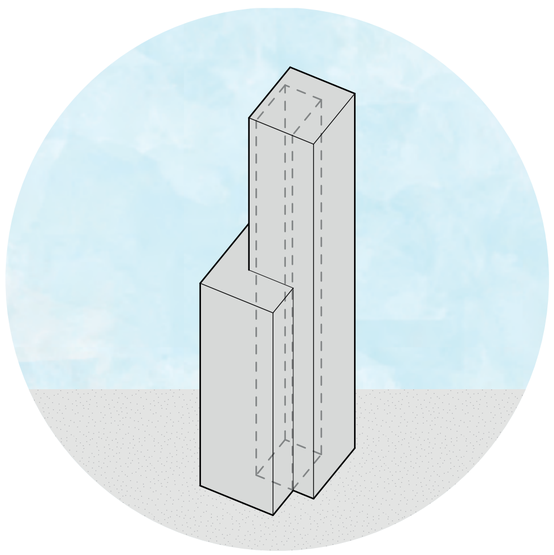
INNOVATION
Orthogonal grid for the diamonds allows for easier installation of triple pane glazing for better thermal performance



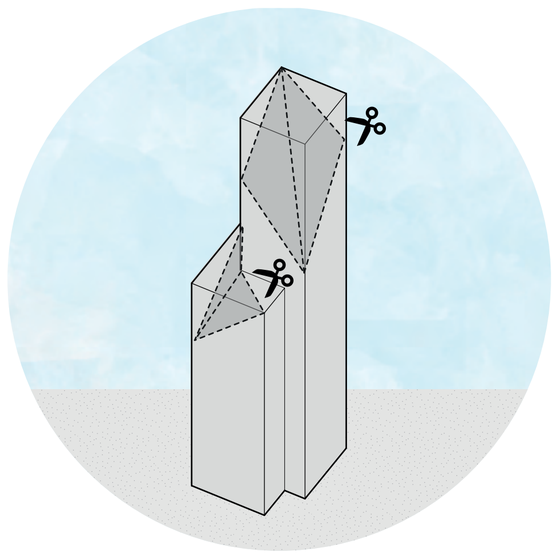
INNOVATION
Holedeck Ho45 allows for maximum span with a shallower slab and less concrete

TRADITIONAL STRATEGY
Concrete column , beam and core construction

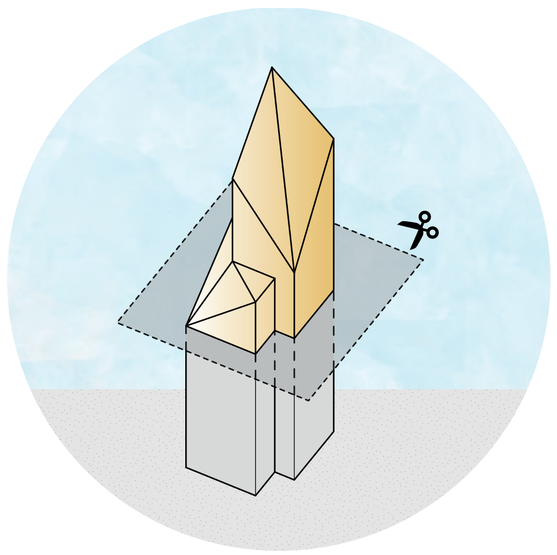
STRUCTURAL CONCEPT



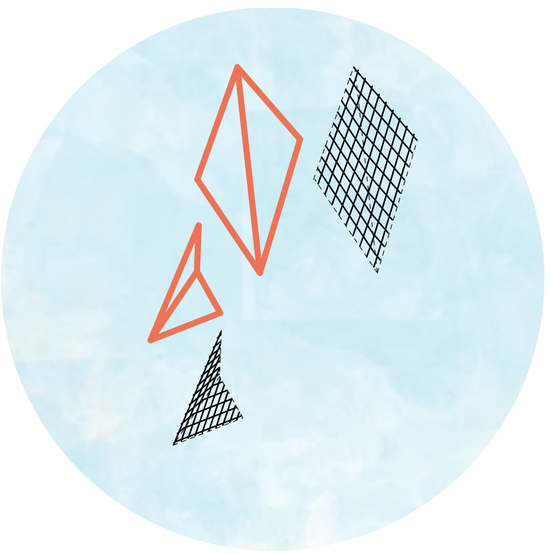
TRADITIONAL BUILDING



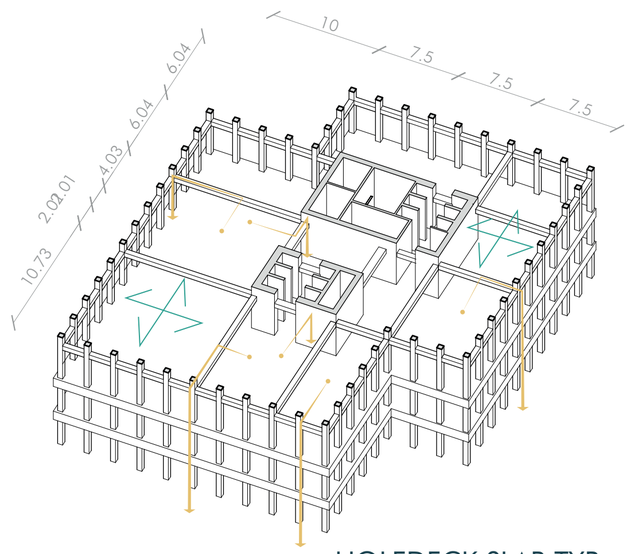
NEW GEOMETRY



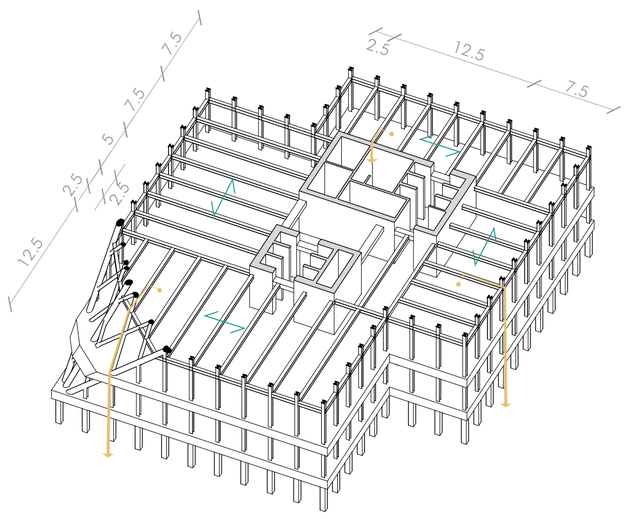
NEW STRATEGY FOR TOP



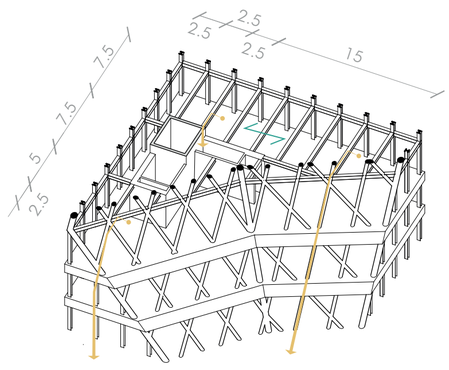
NEW STRATEGY FOR DIAMONDS



HOLEDECK SLAB TYP.

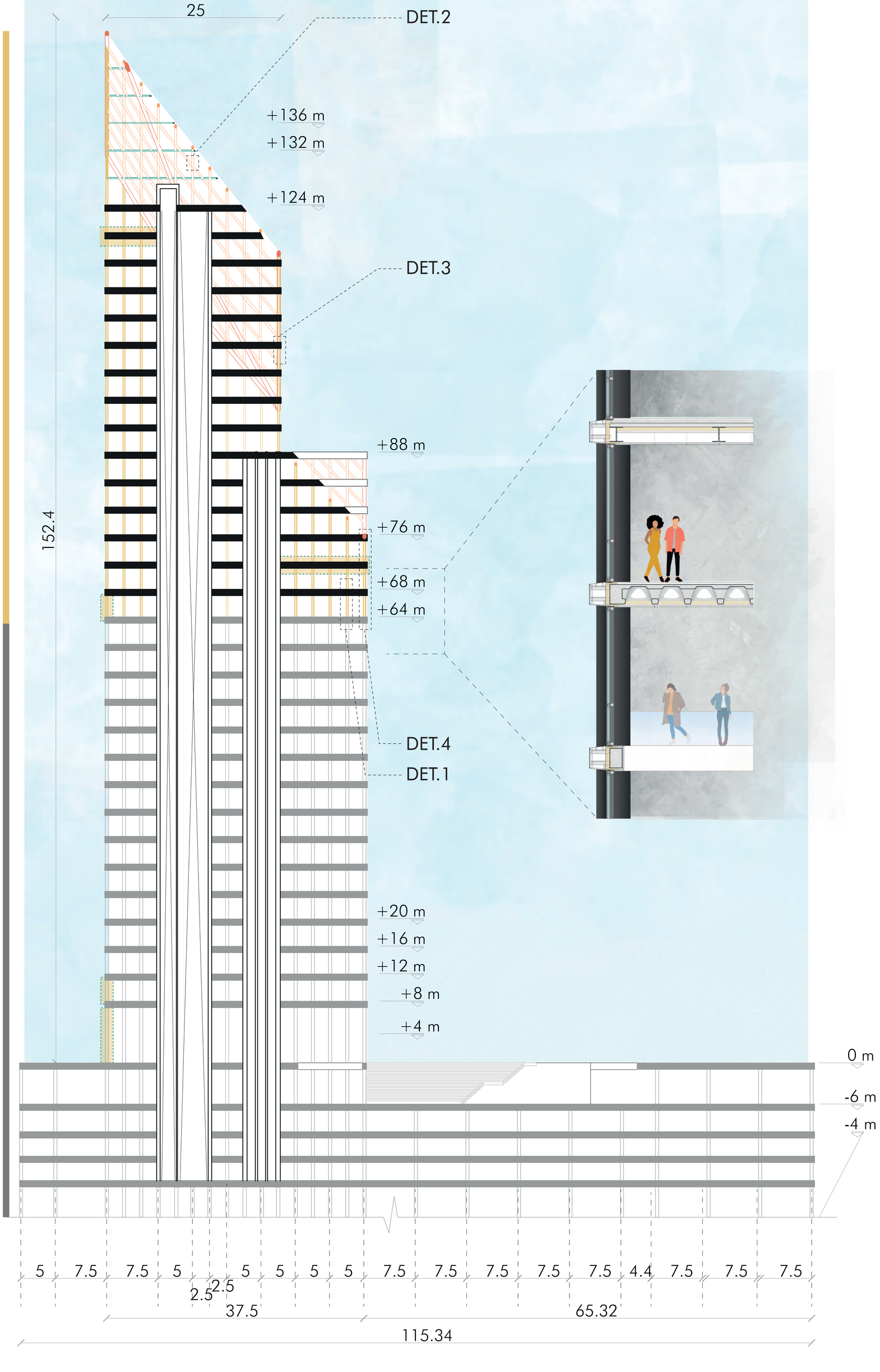


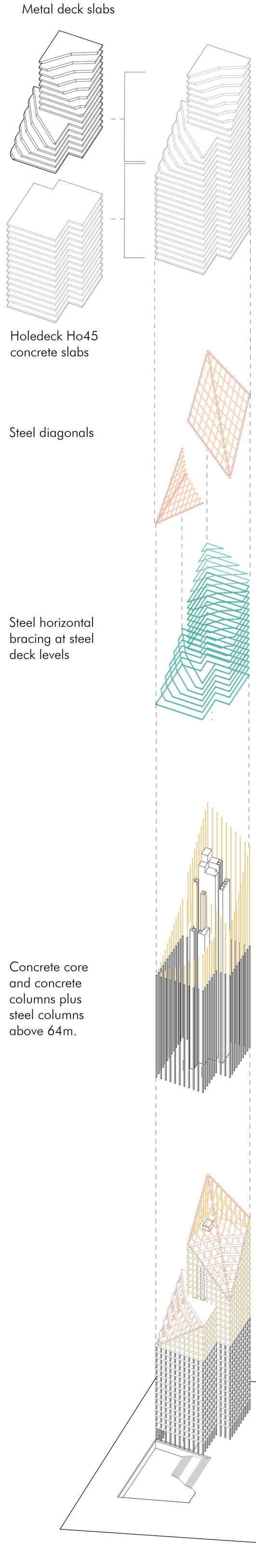
METAL DECK TYP.



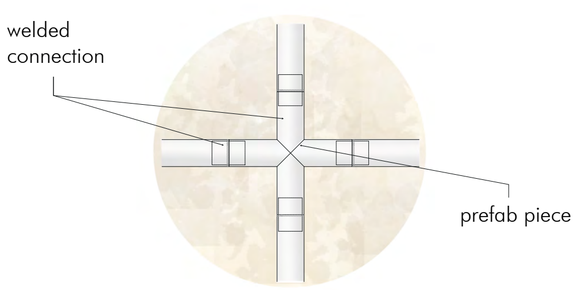
METAL DECK ROOF

STRUCTURAL SECTION



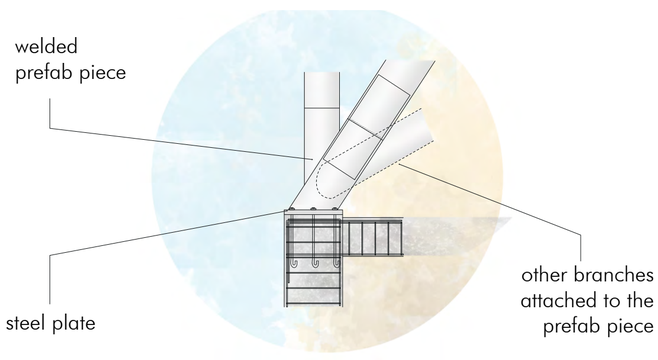


DETAIL 1



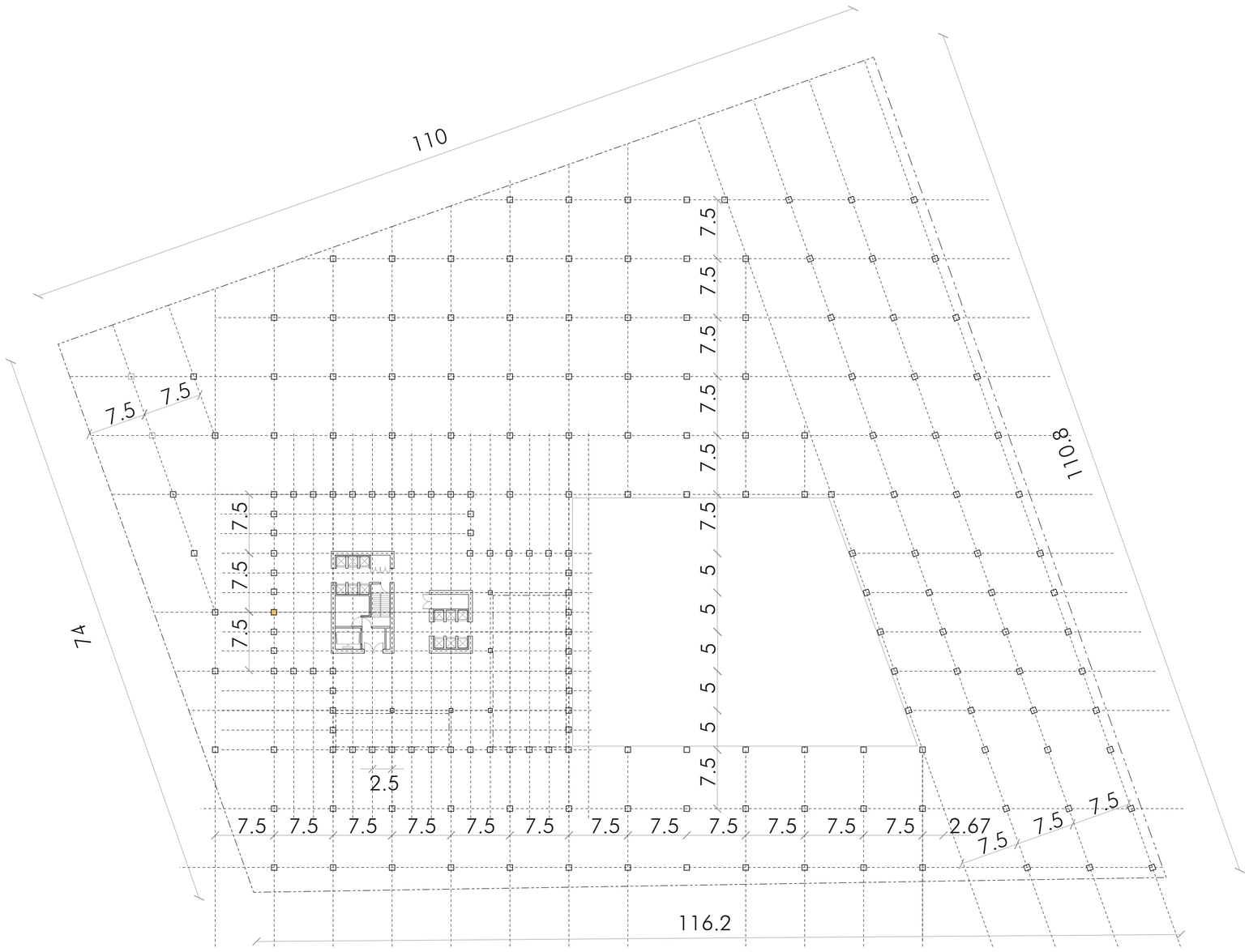
DETAIL 2

DETAIL 3

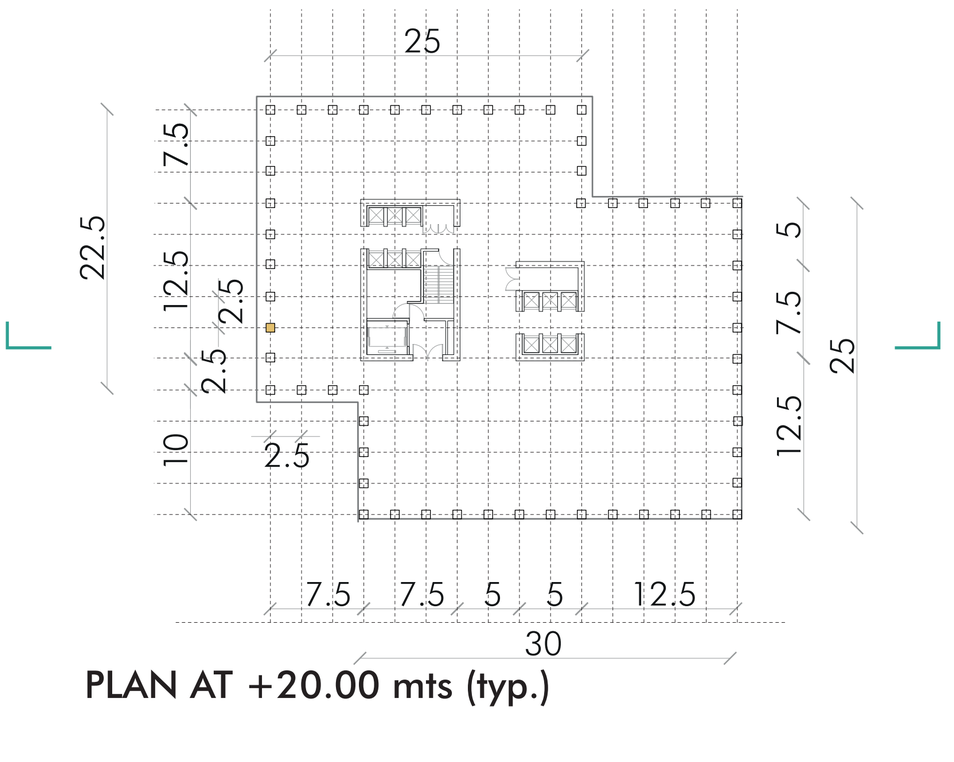


DETAIL 4

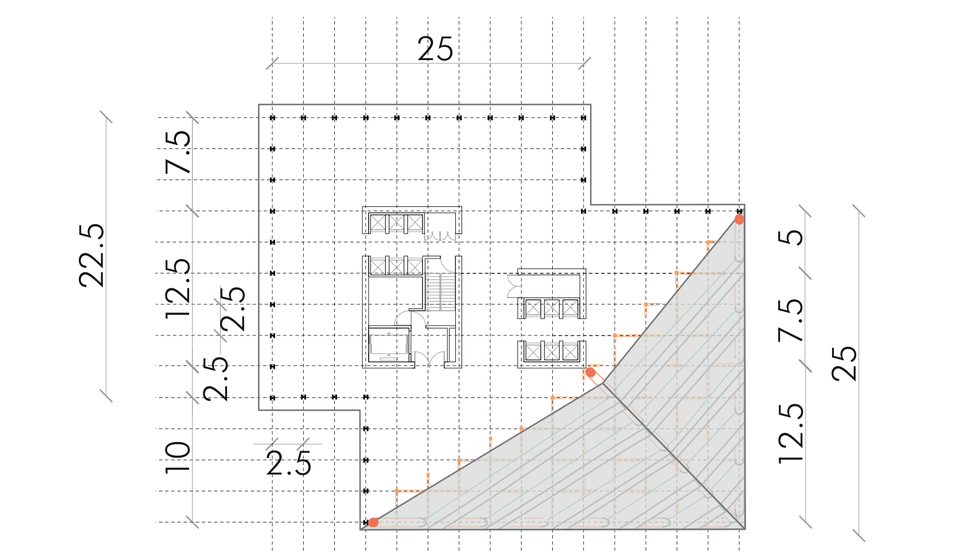
TYPICAL PLANS



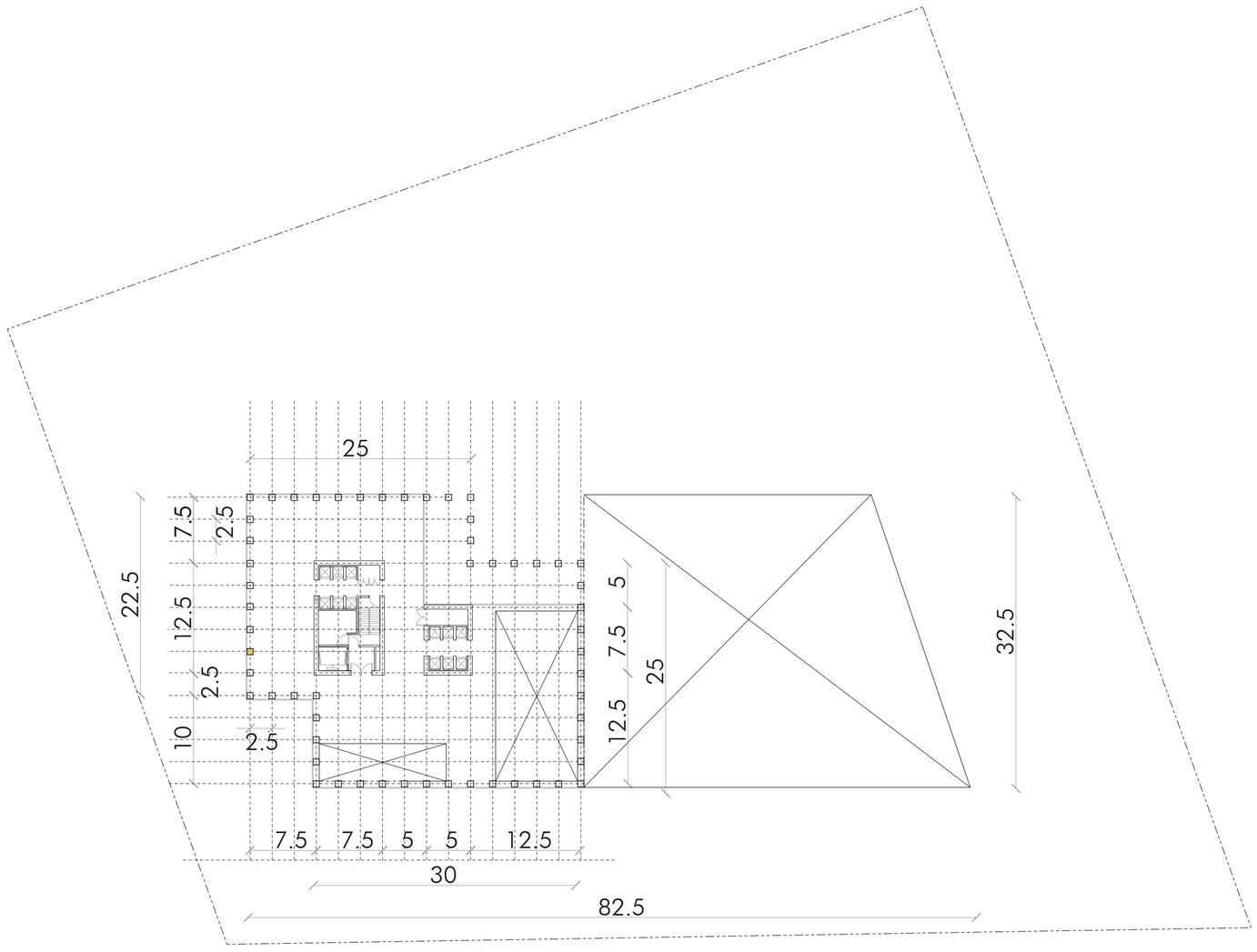
PLAN AT -6.00 mts



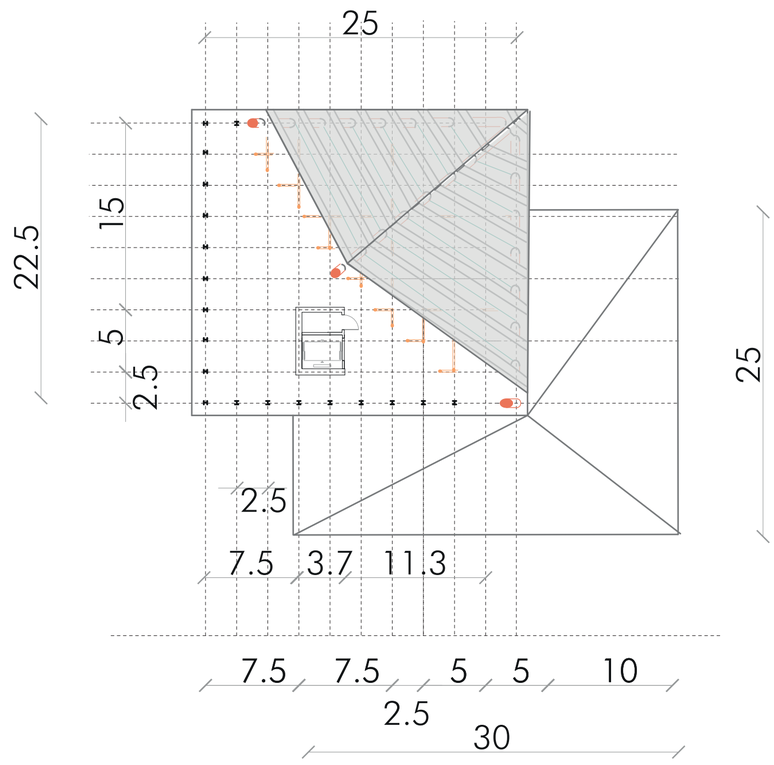
PLAN AT +20.00 mts (typ.)



PLAN AT +88.00 mts



PLAN AT 0.00 mts



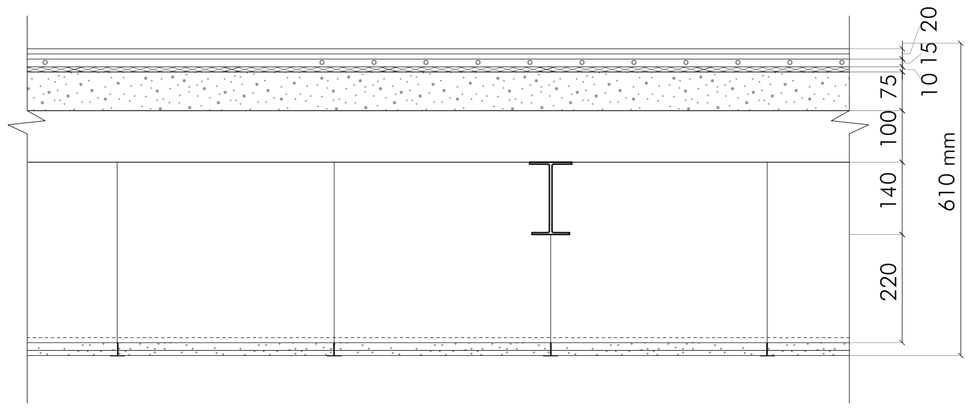
PLAN AT +124.00 mts

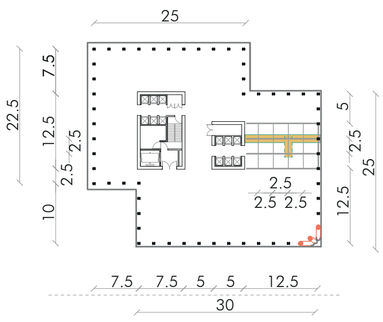
RESULTS

	MATERIAL	DENSITY	THICKNESS	WEIGHT
G				
	floor finishing		10mm	11.24 daN/m2
	thermal floor and gyp. Fibreboard		15mm	40.00 daN/m2
	thermal insulation substrate		5mm	2.00 daN/m2
	concrete (total 150mm deck)	2400 daN/m3	100mm	240.00 daN/m2
	metal deck (ComFlor 100)		100mm	8.16 daN/m2
	insulation		30mm	10.00 daN/m2
	acoustic ceiling		25mm	18.00 daN/m2
	services			50.00 daN/m2
				379.40 daN/m2
				3.72 kN/m2

	ROOF: CATEGORY			WEIGHT
Q	Public Terraces			5.00 kN/m2

	FLOOR: CATEGORY			WEIGHT
Q	Areas with possible physical activities			5.00 kN/m2

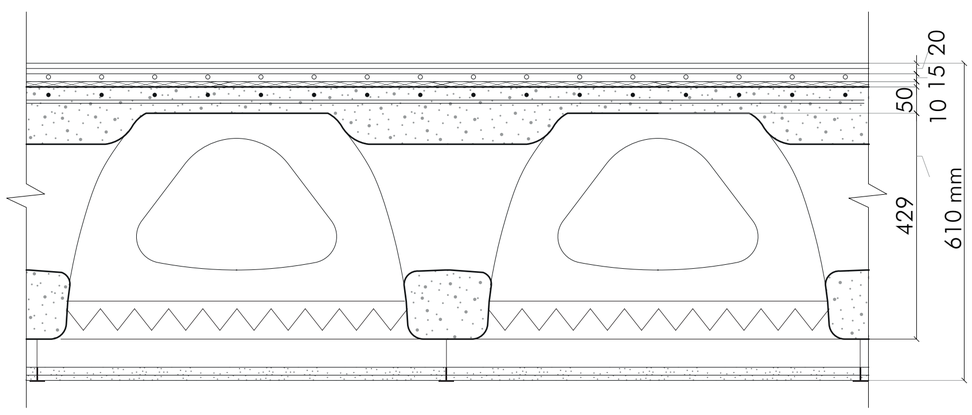


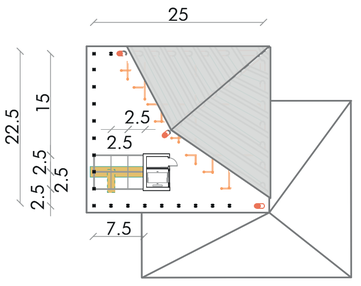


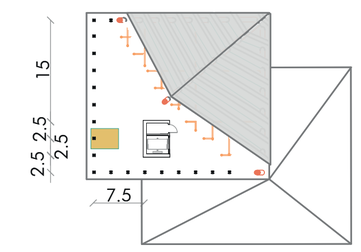
STEEL DECK SLAB SECTION

	MATERIAL	DENSITY	THICKNESS	WEIGHT
G				
	floor finishing and grout		20mm	11.24 daN/m2
	thermal floor and gyp. Fibreboard		15mm	40.00 daN/m2
	thermal insulation substrate		5mm	2.00 daN/m2
	holedeck Ho45 and 50mm topping		500mm	565.00 daN/m2
	sound insulation		30mm	10.00 daN/m2
	acoustic ceiling		25mm	18.00 daN/m2
	services			50.00 daN/m2
				696.24 daN/m2
				6.96 kN/m2

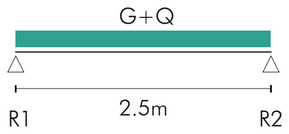
	CATEGORY			WEIGHT
Q	Areas with possible physical activities			5.00 kN/m2







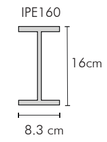
HOLEDECK Ho45 SLAB SECTION

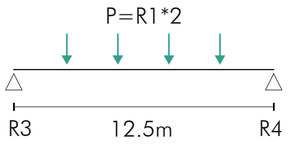


spacing: 2.5m
FLOOR: SECONDARY BEAM

	ULS	SLS
G	4.84 kN/m2	3.72 kN/m2
Q	7.50 kN/m2	5.00 kN/m2
BEAM	0.60 kN/m	0.78 kN/m
LINEAR W.	31.62 kN/m	22.40 kN/m

	MAX/LIM.	REQUIRED	IPE 160	
SHEAR	39.52 kN	1.17 cm2	9.66 cm2	APPROVED
MOMENT	24.70 kN m	73.06 cm3	108.70 cm3	
D. TOTAL	0.0100 m		0.0062 m	
D. Q	0.0083 m		0.0035 m	

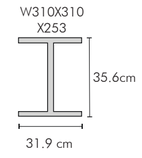


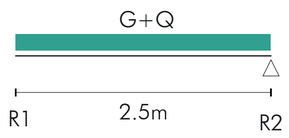


spacing: 2.5m
FLOOR: PRIMARY BEAM

	ULS	SLS
P=R*2	79.05 kN	56.00 kN
Ptot = P*4	316.19 kN	223.99 kN
R3=R4	158.09 kN	112.00 kN

	MAX/LIM.	REQUIRED	W310x310x253	
SHEAR	158.09 kN	4.68 cm2	323 cm2	APPROVED
MOMENT	592.85 kN m	1753.50 cm3	3833 cm3	
D. TOTAL	0.0500 m		0.0481 m	
D. Q	0.0417 m		0.0107 m	

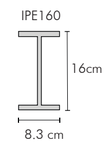


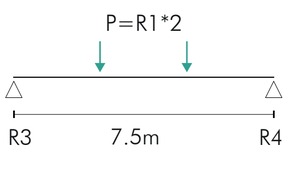


spacing: 2.5m
ROOF: SECONDARY BEAM

	ULS	SLS
G	4.84 kN/m2	3.72 kN/m2
Q	7.50 kN/m2	5.00 kN/m2
BEAM	0.60 kN/m	0.78 kN/m
LINEAR W.	31.62 kN/m	22.40 kN/m

	MAX/LIM.	REQUIRED	IPE 160	
SHEAR	39.52 kN	1.17 cm2	9.66 cm2	APPROVED
MOMENT	24.70 kN m	73.06 cm3	108.70 cm3	
D. TOTAL	0.0100 m		0.0062 m	
D. Q	0.0083 m		0.0035 m	

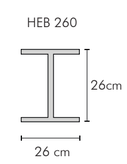


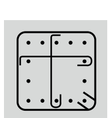


spacing: 2.5m
ROOF: PRIMARY BEAM

	ULS	SLS
P=R*2	79.05 kN	56.00 kN
Ptot = P*2	158.09 kN	112.00 kN
R3=R4	79.05 kN	56.00 kN

	MAX/LIM.	REQUIRED	HEB 260	
SHEAR	79.05 kN	2.34 cm2	37.59 cm2	APPROVED
MOMENT	197.62 kN m	584.50 cm3	1148 cm3	
D. TOTAL	0.0300 m		0.0268 m	
D. Q	0.0250 m		0.0036 m	





700X700

14 rebars D32 and
D12 stirrups

area: 2.5m x 3.75m = 9.4m2
L = 8m
GR. FLOOR COLUMN

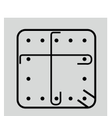
	G	Q AVG
FLOORS (14)	97.47 kN/m2	44.80 kN/m2
FLOORS (16)	59.51 kN/m2	56.50 kN/m2

ULS	356.03 kN/m2
NED	**3504.70 kN**

NED accounts for 5% weight increase for structure

CONCRETE	C80/95
fcd	95000 kN/m2
fyd	500000 kN/m2
E	4224000 kN/m2

	MAX/LIM.	700X700	
COMPRESSION	1	0.1	APPROVED
BUCKLING	3504.7 kN	35856.8 kN	
SLENDERNESS	39.590	39.892	



500X500

14 rebars D32 and
D12 stirrups

area: 2.5m x 3.75m = 9.4m2
L = 4m
1st FLOOR COLUMN

	G	Q AVG.
FLOORS (13)	90.51 kN/m2	39.93 kN/m2
FLOORS (16)	59.51 kN/m2	56.50 kN/m2

ULS	339.68 kN/m2
NED	**3343.68 kN**

NED accounts for 5% weight increase for structure

CONCRETE	C50/60
fcd	60000 kN/m2
fyd	500000 kN/m2
E	37278000 kN/m2

	MAX/LIM.	500X500	
COMPRESSION	1	0.2	APPROVED
BUCKLING	3343.7 kN	12876.0 kN	
SLENDERNESS	27.713	27.74	

W310X310
X253

area: 2.5m x 3.75m = 9.4m2
L = 4m
15th FLOOR COLUMN

	G	Q AVG.
FLOORS (15)	55.79 kN/m2	52.97 kN/m2

ULS	152.55 kN/m2
NED	**1501.67 kN**

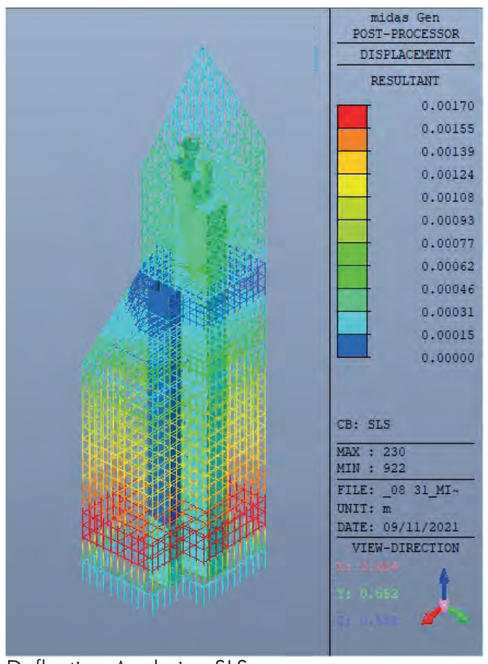
Section chosen for its geometry.
NED accounts for 5% weight increase for structure

STEEL	S355
Fy	355000 kN/m2
Iz	21460 cm4
E	210000000 kN/m2

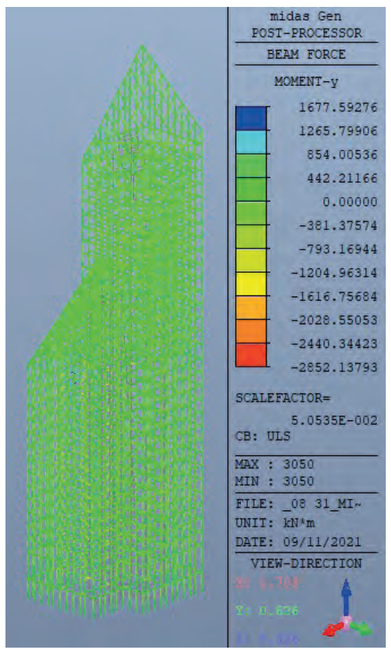
	MAX/LIM.	W310x310x253	
COMPRESSION	1	0.1375	APPROVED
BUCKLING	1501.7 kN	27799.0 kN	
SLENDERNESS	1501.669	11836.418	

MIDAS ANALYSIS

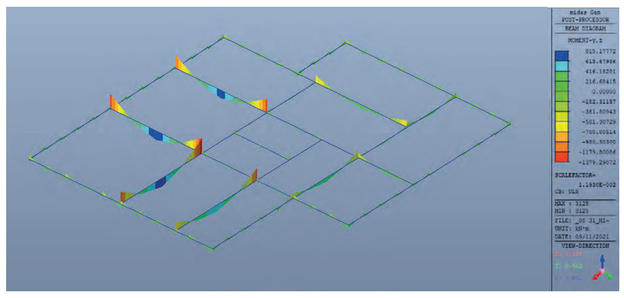
FULL BUILDING ANALYSIS



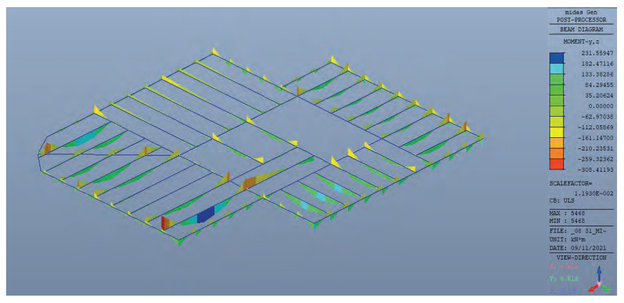
Deflection Analysis - SLS



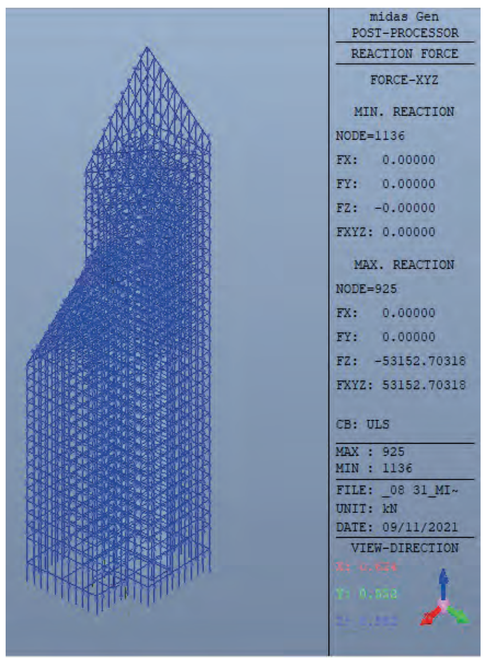
Moment My (highest) - ULS



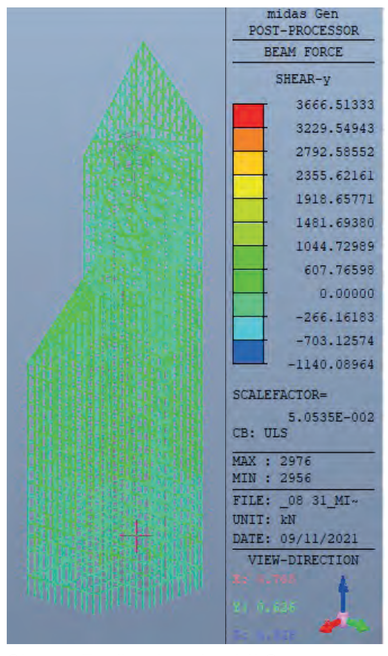
Concrete Floor Moment Mzy - ULS



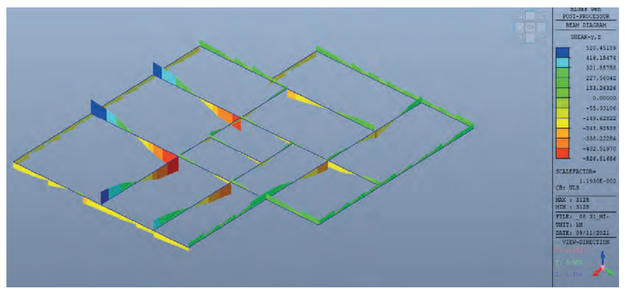
Steel Floor Moment Mzy - ULS



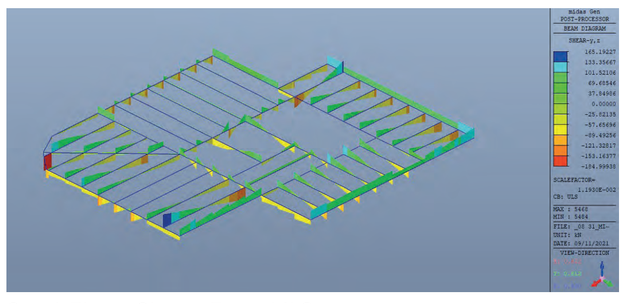
Reactions - ULS



Shear Fy (highest) - ULS

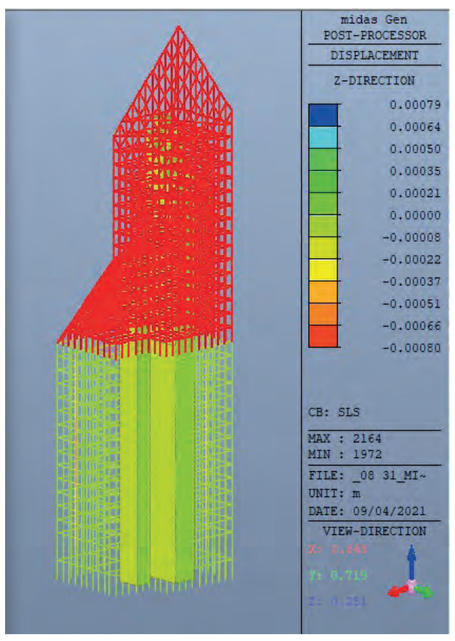


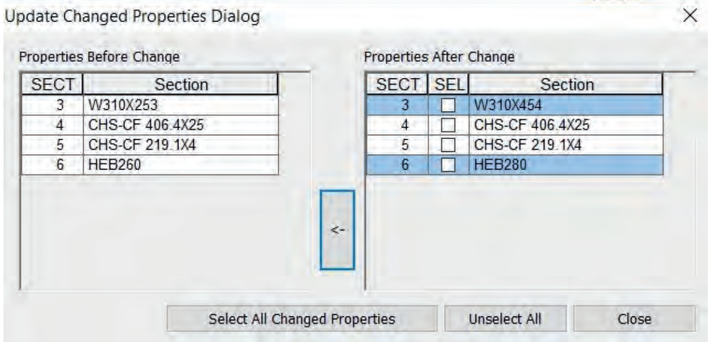
Concrete Floor Shear Fzy - ULS

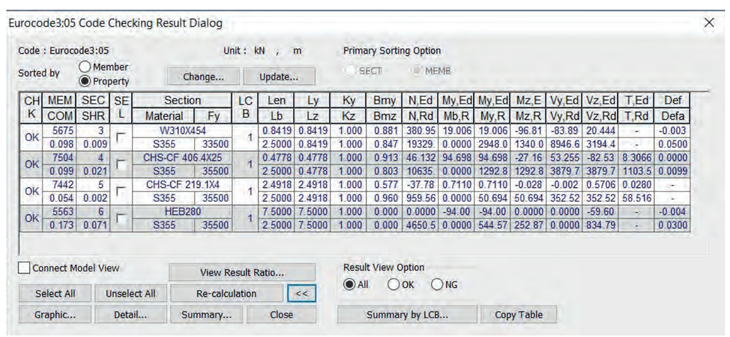


Steel Floor Shear Fzy - ULS

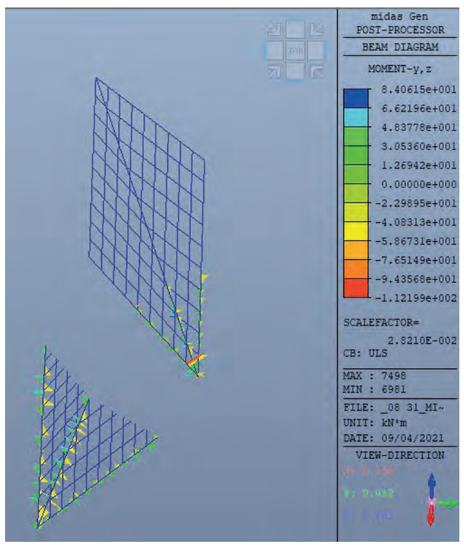
STEEL CODE CHECK



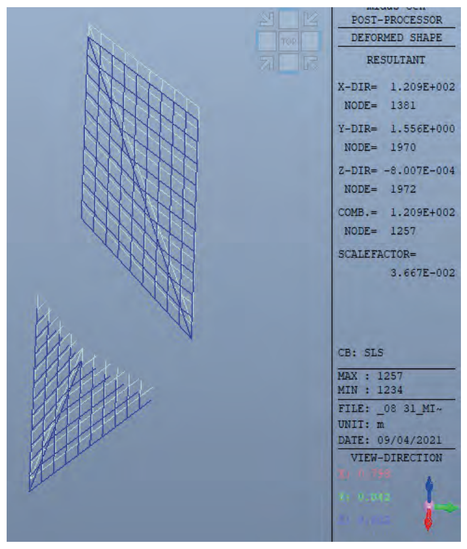




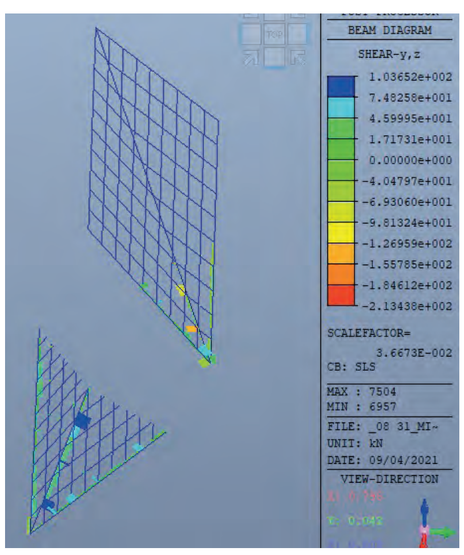
TOP PARTS ANALYSIS



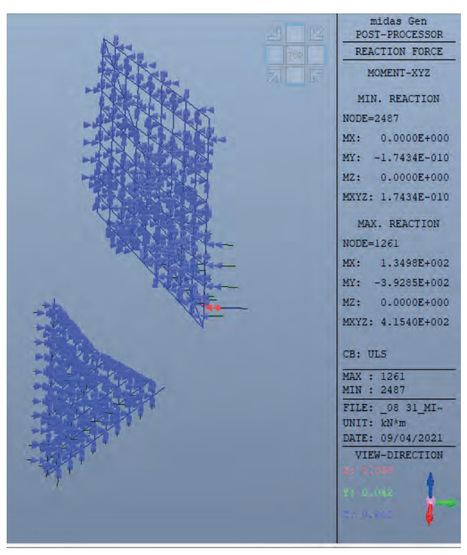
Moment Analysis at diamonds



Deflection Analysis at diamonds

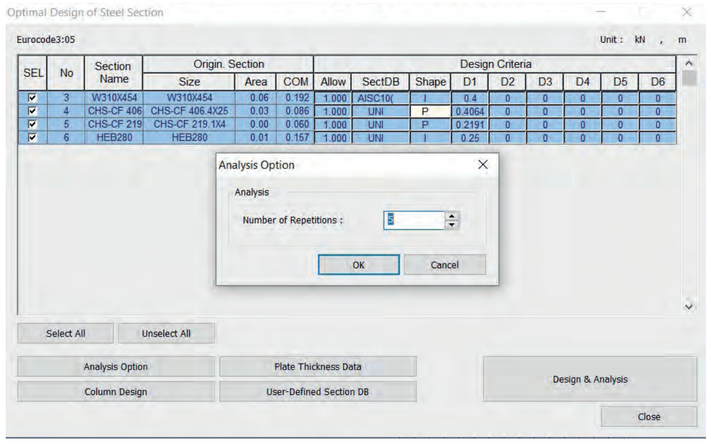


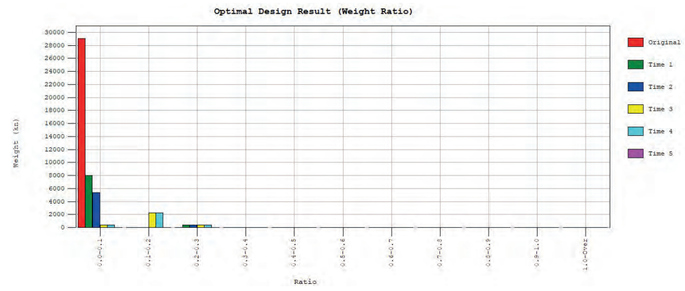
Shear Analysis at diamonds

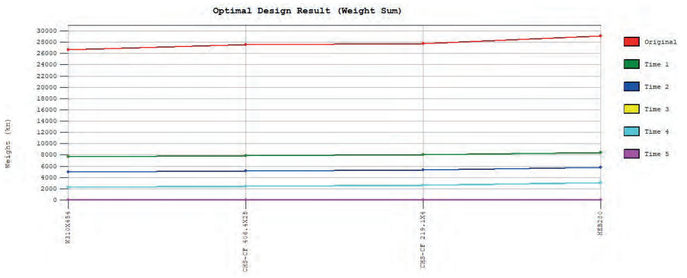


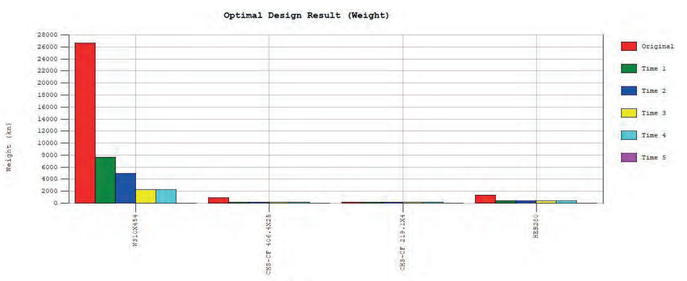
Reaction Analysis at diamonds

MIDAS OPTIMIZATION



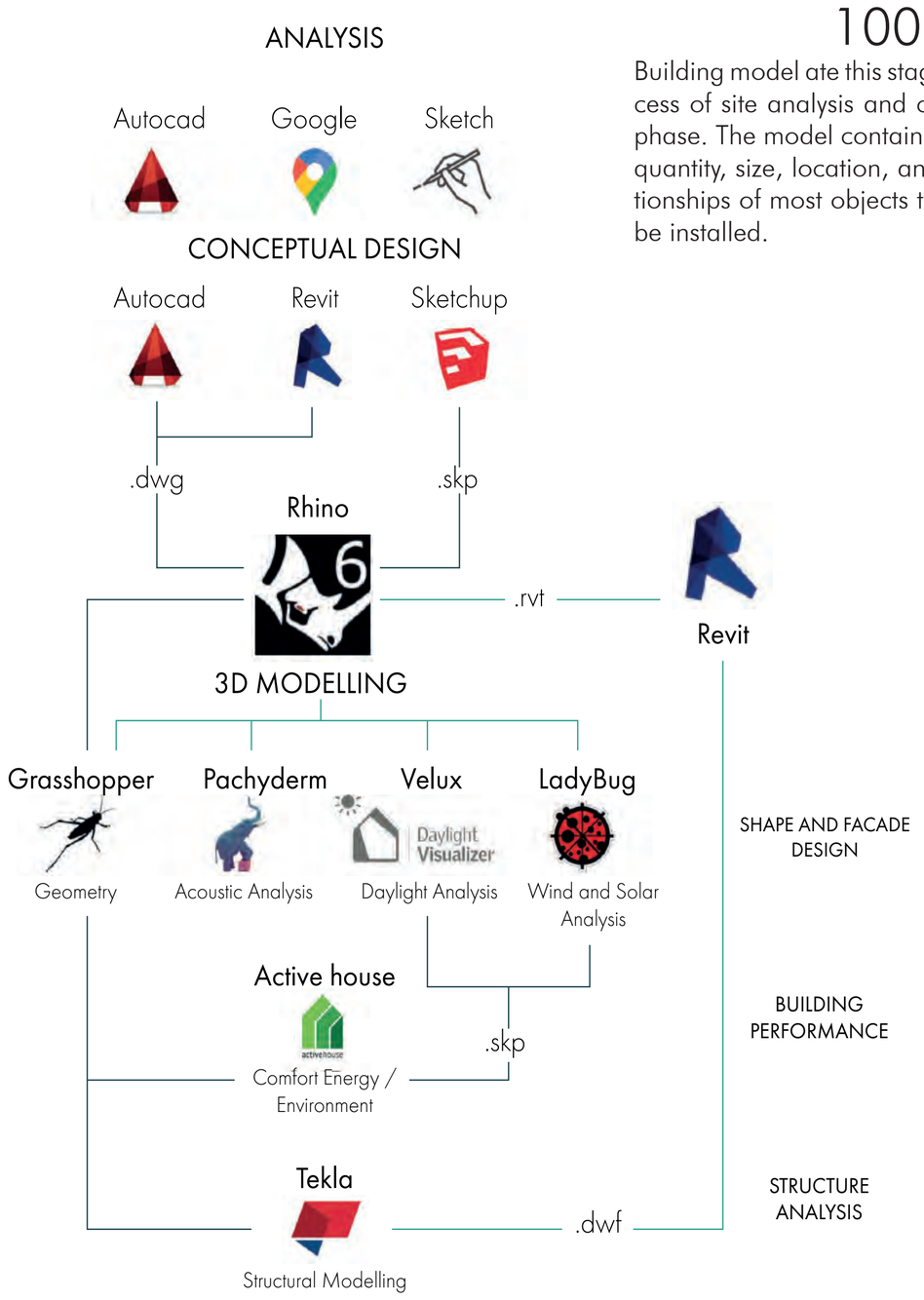






BIM

WORKFLOW



LEVEL OF DESIGN

100

Building model ate this stage reflects the process of site analysis and conceptual design phase. The model contains the approximate quantity, size, location, and systematic relationships of most objects that will eventually be installed.

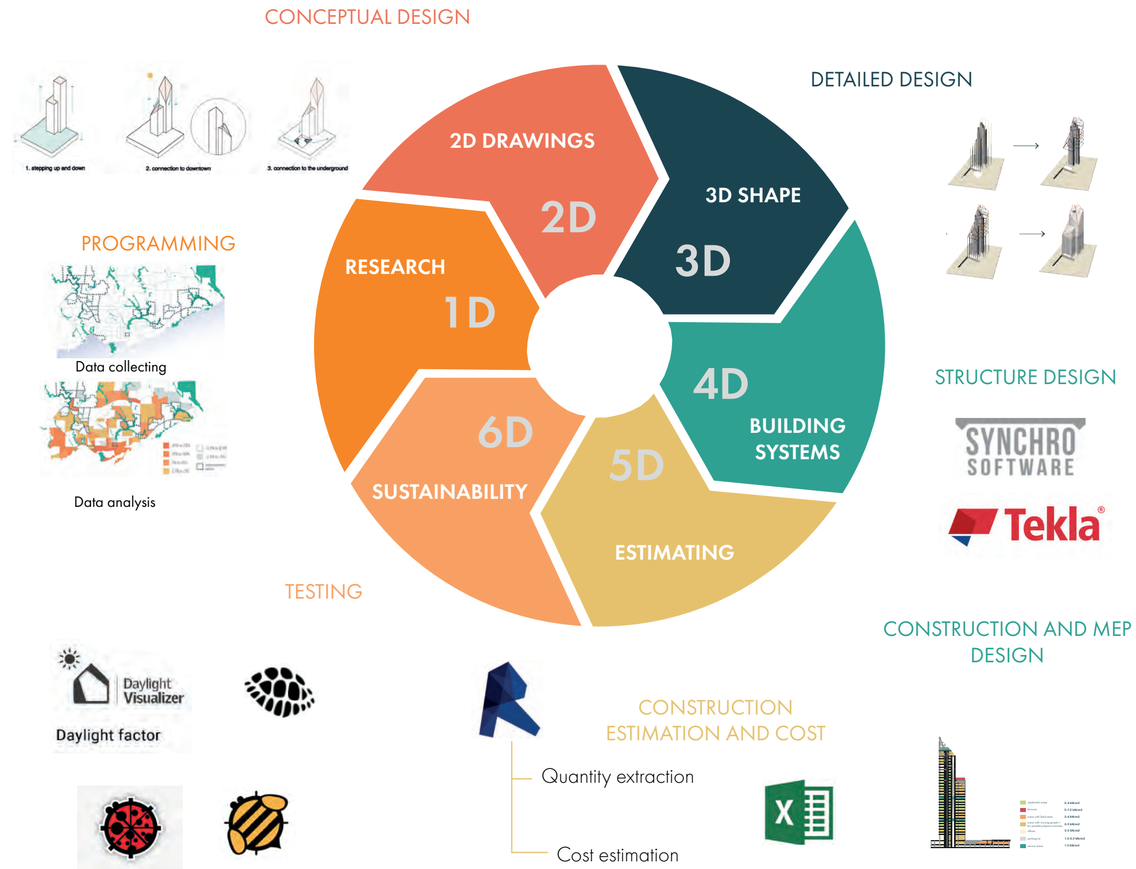
200

Building model contains the accurate quantity, size, location, and systematic relationships of all objects that will eventually be installed. The data about all objects like: typical floor plans, sections, elevations, etc will be clarified in this stage.

300

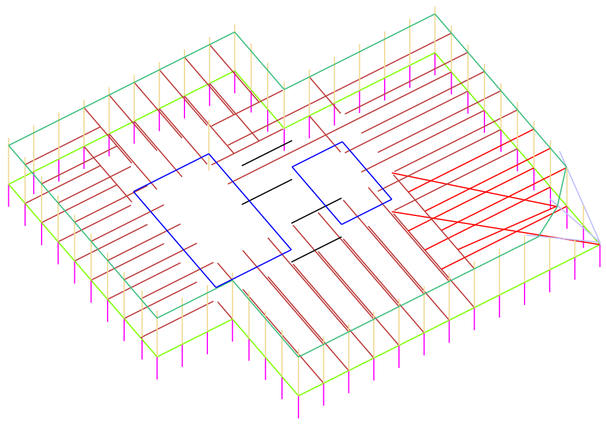
This stage is achieved when fabrication and assembly can be driven directly from the model. Sun radiation, wind analysis, daylight visualizer, energy performance and other necessary studies are applied to analyse in-depth the building effect.

BIM ENVIRONMENT



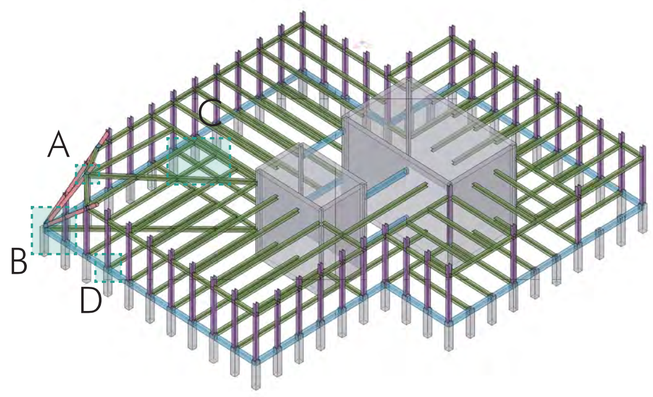
TEKLA 4D

3D MODEL

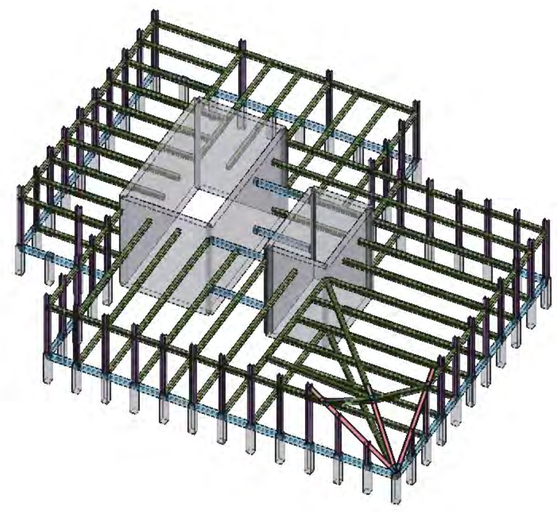


Rhino model to be exported with Tekla Live LInk

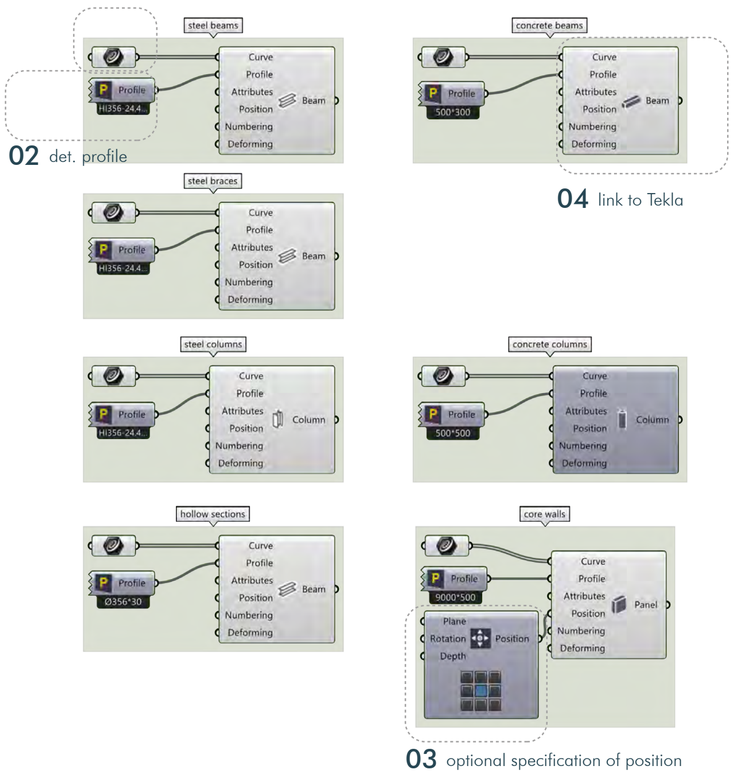
TEKLA VIEWS



Tekla Model views

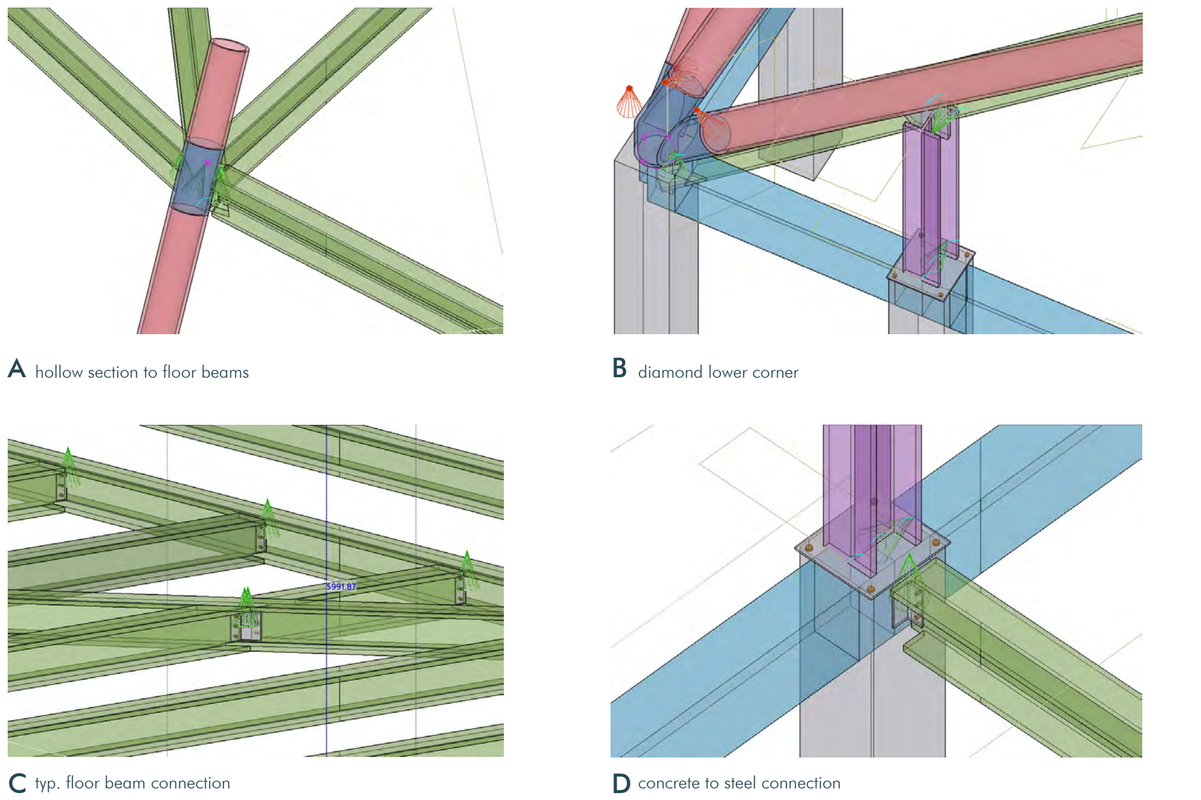


GRASSHOPPER



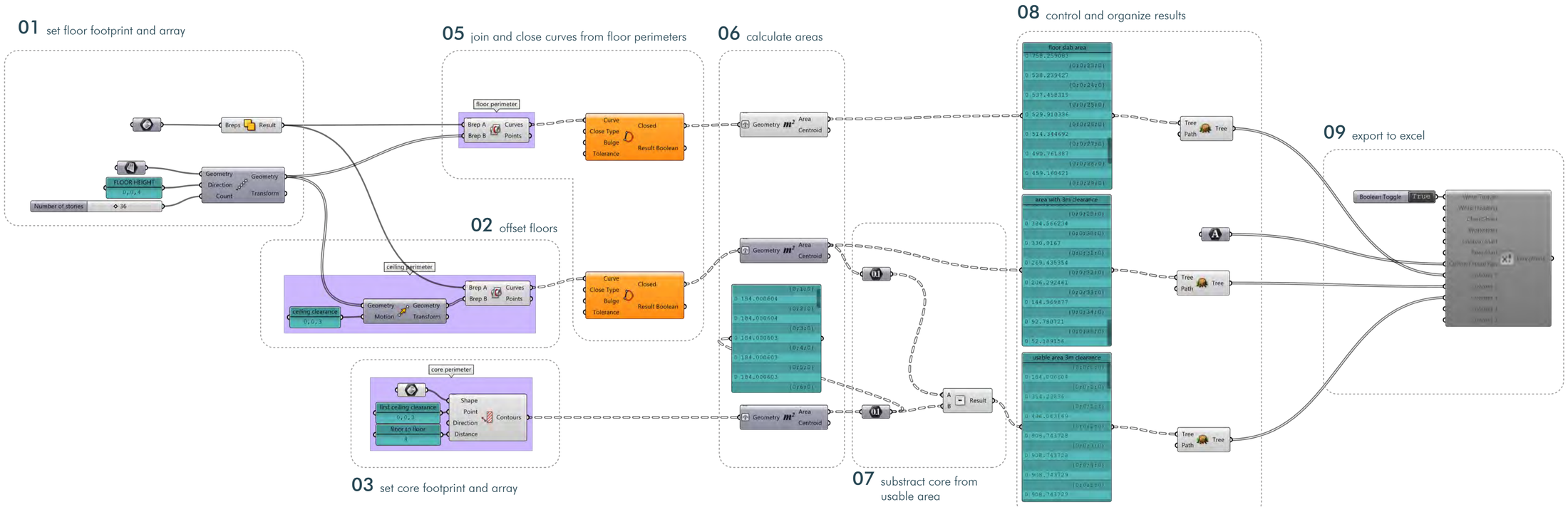
Tekla Live LInk script

DETAILED CONNECTIONS



GROUND FLOOR CONTROL AREA 5D

GRASSHOPPER



Results

FLOOR NO.	SLAB AREA	AREA WITH CLEARANCE 3M	USABLE AREA (NO CORE)
	sqm	sqm	sqm
1	1092.74	1092.74	908.74
2	1092.74	1092.74	908.74
3	1092.74	1092.74	908.74
4	1092.74	1092.74	908.74
5	1092.74	1092.74	908.74
6	1092.74	1092.74	908.74
7	1092.74	1092.74	908.74
8	1092.74	1092.74	908.74
9	1092.74	1092.74	908.74
10	1092.74	1092.74	908.74
11	1092.74	1092.74	908.74
12	1092.74	1092.74	908.74
13	1092.74	1092.74	908.74
14	1092.74	1092.74	908.74
15	1092.74	1087.78	903.78
16	1083.78	1064.78	880.78
17	1056.11	1023.07	839.07

FLOOR NO.	SLAB AREA	AREA WITH CLEARANCE 3M	USABLE AREA (NO CORE)
	sqm	sqm	sqm
18	1009.72	962.65	818.35
19	944.62	883.51	739.21
20	860.80	785.65	641.35
21	758.26	538.24	393.94
22	538.24	538.09	393.79
23	537.46	532.55	388.25
24	529.91	518.99	406.53
25	514.34	497.41	384.95
26	490.76	467.81	428.41
27	459.16	430.20	416.89
28	419.54	384.57	371.26
29	371.91	330.92	317.61
30	316.25	269.44	256.13
31	253.52	206.29	192.98
32	190.72	144.97	131.66
33	130.84	92.78	79.47
34	81.55	52.19	38.88

Results from Excel

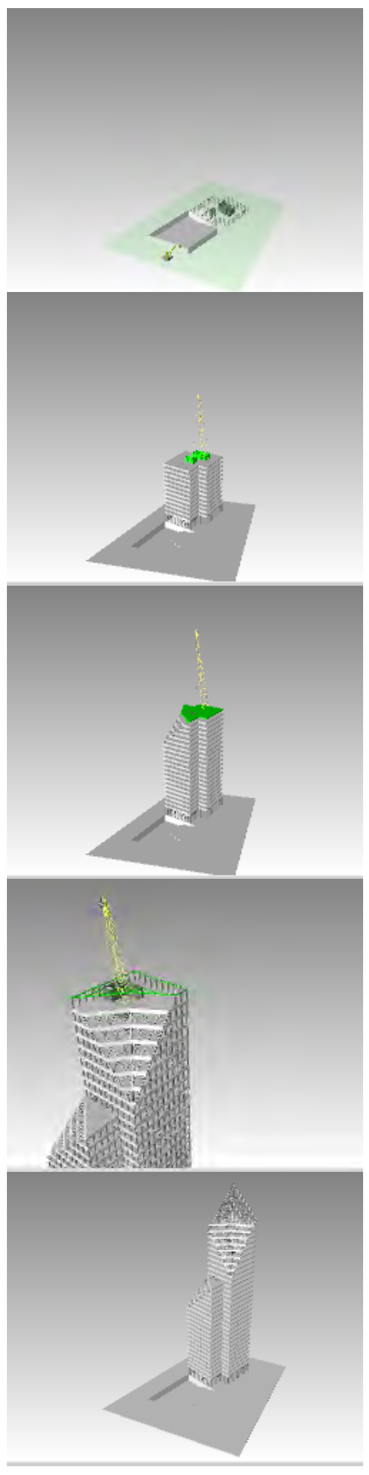
SYNCHRO 6D

BUILDING SIMULATION

Link to video here:

SYNCHRO SOFTWARE

3D Model



Task assignments

ID	Name	Duration	Start	Finish	3D Reso...
ST00...	Foundation	21d	9:00 12/08/2021	17:00 09/09/2021	216
ST00...	Plaza	15d	9:00 10/09/2021 (*)	17:00 30/09/2021 (*)	1
ST00...	Ground Level	9d	14:56 01/10/2021	14:56 14/10/2021	(135)
	1st level	9d	9:00 15/10/2021	17:00 27/10/2021	(142)
ST00...	Core	3d	9:00 15/10/2021	17:00 19/10/2021	11
ST00...	Columns	2d	9:00 20/10/2021 (*)	17:00 21/10/2021 (*)	57
ST00...	Beams	2d	9:00 22/10/2021 (*)	17:00 25/10/2021 (*)	73
ST00...	Slab	2d	9:00 26/10/2021 (*)	17:00 27/10/2021 (*)	1
	2nd level	9d	14:56 28/10/2021	14:56 10/11/2021	(139)
ST00...	Core	3d	14:56 28/10/2021	14:56 02/11/2021	11
ST00...	Columns	2d	14:56 02/11/2021 (*)	14:56 04/11/2021 (*)	57
ST00...	Beams	2d	14:56 04/11/2021 (*)	14:56 08/11/2021 (*)	70

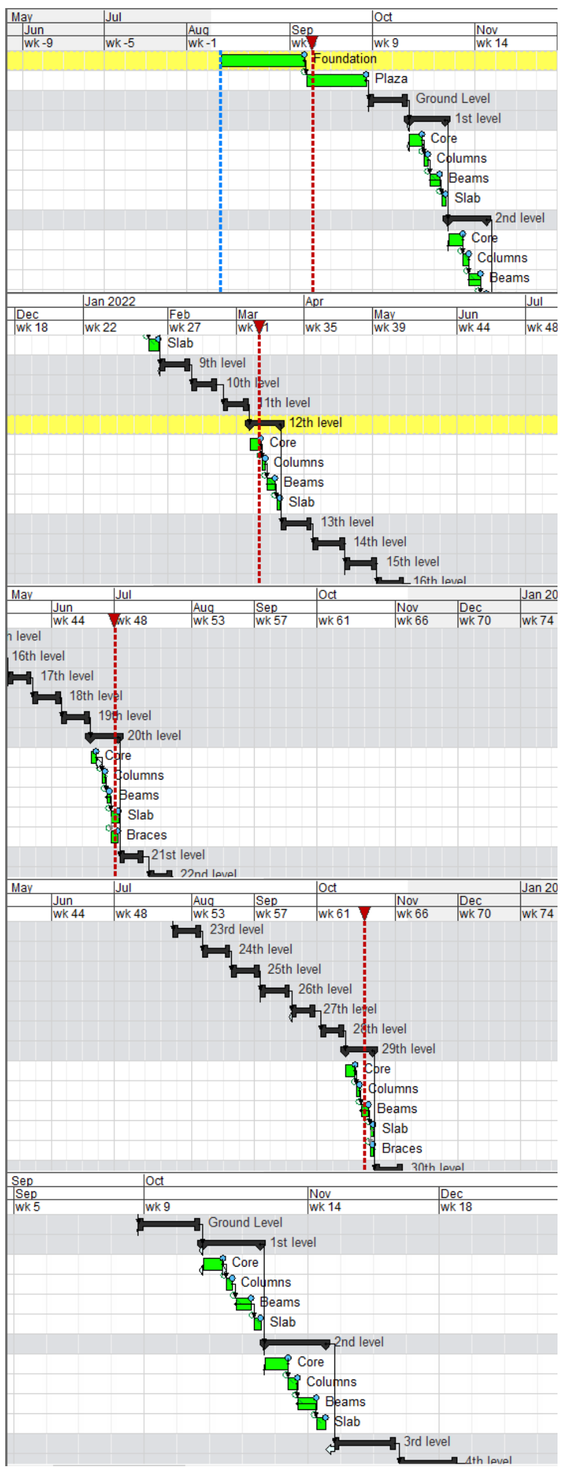
ID	Name	Duration	Start	Finish	3D Reso...
ST00...	Slab	2d	16:41 28/01/2022 (*)	16:41 01/02/2022 (*)	1
	9th level	9d	9:00 02/02/2022	17:00 14/02/2022	(139)
	10th level	9d	9:00 15/02/2022	17:00 25/02/2022	(139)
	11th level	9d	9:00 28/02/2022	17:00 10/03/2022	(139)
	12th level	9d	9:00 11/03/2022	17:00 23/03/2022	(139)
ST00...	Core	3d	9:00 11/03/2022	17:00 15/03/2022	11
ST00...	Columns	2d	9:00 16/03/2022 (*)	17:00 17/03/2022 (*)	57
ST00...	Beams	2d	9:00 18/03/2022 (*)	17:00 21/03/2022 (*)	70
ST00...	Slab	2d	9:00 22/03/2022 (*)	17:00 23/03/2022 (*)	1
	13th level	9d	9:00 24/03/2022	17:00 05/04/2022	(139)
	14th level	9d	9:11 06/04/2022	9:11 19/04/2022	(136)
	15th level	9d	14:47 19/04/2022	14:47 02/05/2022	(194)

ID	Name	Duration	Start	Finish	3D Reso...
	15th level	9d	14:47 19/04/2022	14:47 02/05/2022	(194)
	16th level	9d	16:40 02/05/2022	16:40 13/05/2022	(129)
	17th level	9d	9:00 16/05/2022	17:00 26/05/2022	(129)
	18th level	9d	9:00 27/05/2022	17:00 08/06/2022	(126)
	19th level	9d	9:00 09/06/2022	17:00 21/06/2022	(128)
	20th level	9d	9:00 22/06/2022	17:00 04/07/2022	(118)
ST00...	Core	3d	9:00 22/06/2022	17:00 24/06/2022	11
ST00...	Columns	2d	9:00 27/06/2022 (*)	17:00 28/06/2022 (*)	38
ST00...	Beams	2d	9:00 29/06/2022 (*)	17:00 30/06/2022 (*)	46
ST00...	Slab	2d	9:00 01/07/2022 (*)	17:00 04/07/2022 (*)	1
ST00...	Braces	1d, 2h, 21m	11:13 01/07/2022 (*)	13:34 04/07/2022 (*)	22
	21st level	9d	9:00 05/07/2022	17:00 15/07/2022	(49)

ID	Name	Duration	Start	Finish	3D Reso...
	23rd level	9d	9:00 29/07/2022	17:00 10/08/2022	(82)
	24th level	9d	9:00 11/08/2022	17:00 23/08/2022	(84)
	25th level	9d	9:00 24/08/2022	17:00 05/09/2022	(83)
	26th level	9d	9:21 06/09/2022	9:21 19/09/2022	(79)
	27th level	9d	9:00 20/09/2022	17:00 30/09/2022	(78)
	28th level	9d	9:00 03/10/2022	17:00 13/10/2022	(59)
	29th level	9d	9:00 14/10/2022	17:00 26/10/2022	(70)
ST01...	Core	3d	9:00 14/10/2022	17:00 18/10/2022	10
ST01...	Columns	2d	9:00 19/10/2022 (*)	17:00 20/10/2022 (*)	23
ST01...	Beams	2d	9:00 21/10/2022 (*)	17:00 24/10/2022 (*)	15
ST01...	Slab	2d	9:00 25/10/2022 (*)	17:00 26/10/2022 (*)	1
ST01...	Braces	1d, 2h, 21m	11:13 25/10/2022 (*)	13:34 26/10/2022 (*)	21

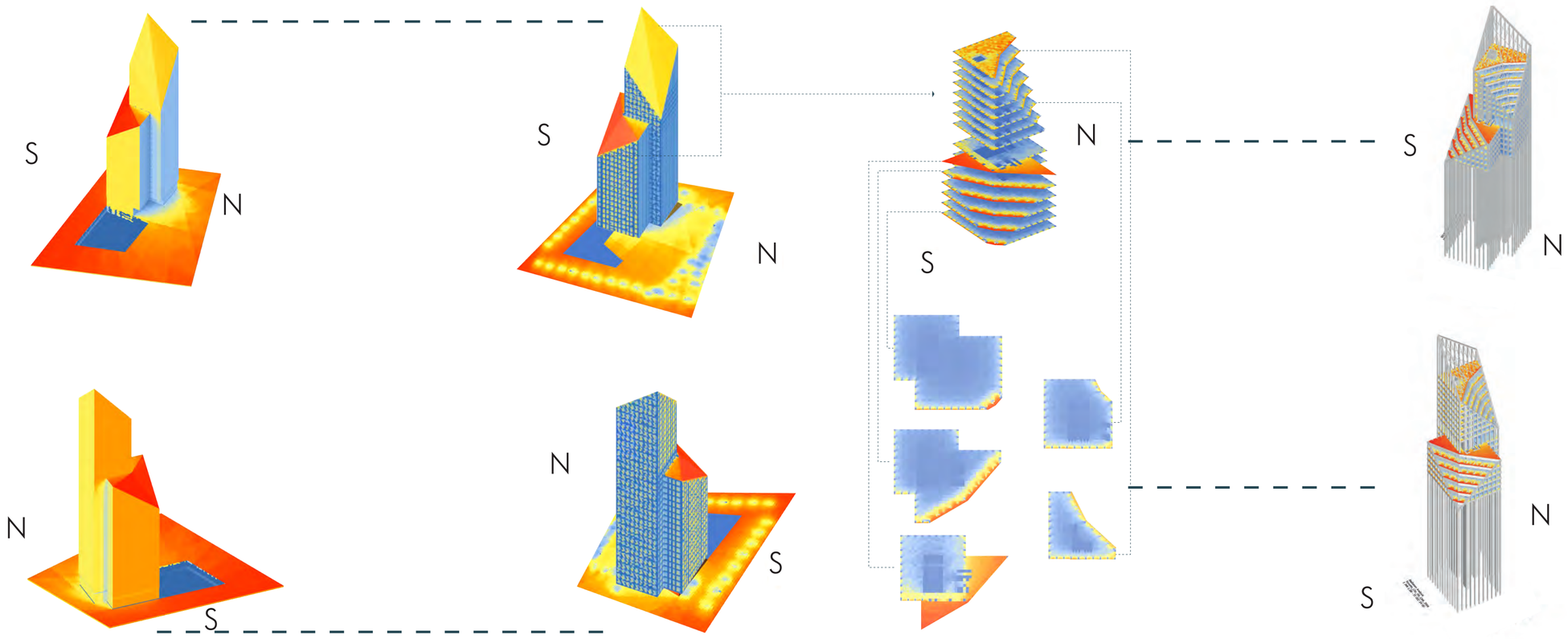
ID	Name	Duration	Start	Finish	3D Reso...
ST00...	Ground Level	9d	14:56 01/10/2021	14:56 14/10/2021	(135)
	1st level	9d	9:00 15/10/2021	17:00 27/10/2021	(142)
ST00...	Core	3d	9:00 15/10/2021	17:00 19/10/2021	11
ST00...	Columns	2d	9:00 20/10/2021 (*)	17:00 21/10/2021 (*)	57
ST00...	Beams	2d	9:00 22/10/2021 (*)	17:00 25/10/2021 (*)	73
ST00...	Slab	2d	9:00 26/10/2021 (*)	17:00 27/10/2021 (*)	1
	2nd level	9d	14:56 28/10/2021	14:56 10/11/2021	(139)
ST00...	Core	3d	14:56 28/10/2021	14:56 02/11/2021	11
ST00...	Columns	2d	14:56 02/11/2021 (*)	14:56 04/11/2021 (*)	57
ST00...	Beams	2d	14:56 04/11/2021 (*)	14:56 08/11/2021 (*)	70
ST00...	Slab	2d	14:56 08/11/2021 (*)	14:56 10/11/2021 (*)	1
	3rd level	9d	13:04 12/11/2021	13:04 25/11/2021	(139)

Schedule



LADYBUG 6D

RADIATION ANALYSIS

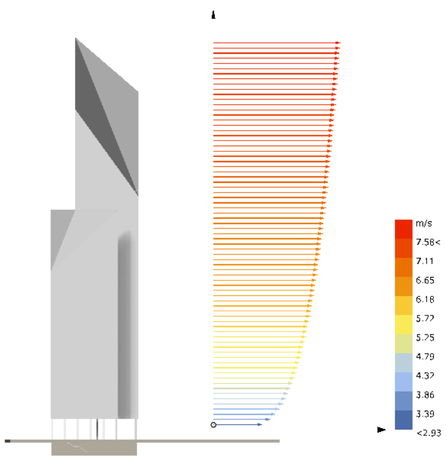


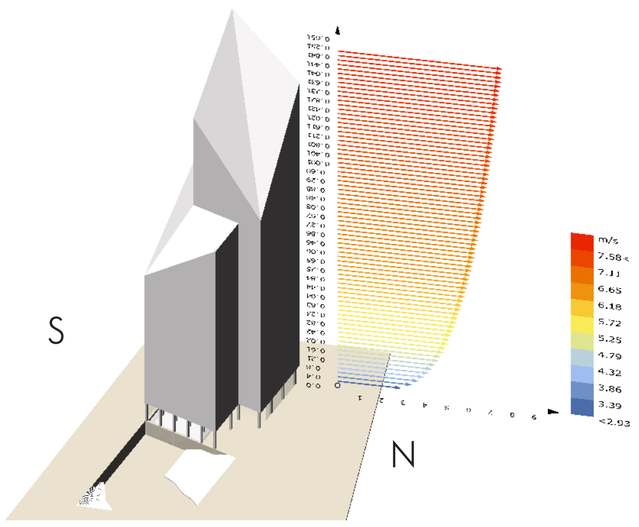
Original Model

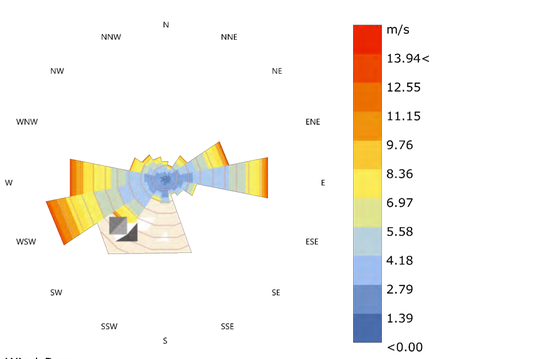
Model with New Facade

WIND ANALYSIS

East facade







Wind-Rose
Toronto-City_ON_CAN
1 JAN 1:00 - 31 DEC 24:00
Hourly Data: Wind Speed (m/s)
Calm for 0.05% of the time = 4 hours.
Each closed polyline shows frequency of 1.7%. = 148 hours.

VELUX DAYLIGHT VISUALIZER 6D

Daylight Visualizer

Daylight factor

VIZ

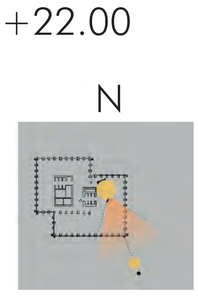
ILLUMINANCE ANALYSIS

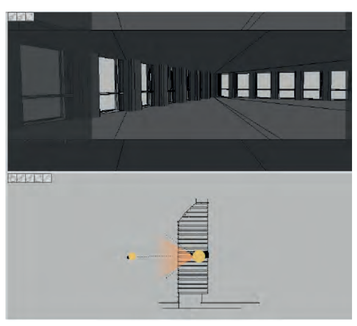
January at 12.00

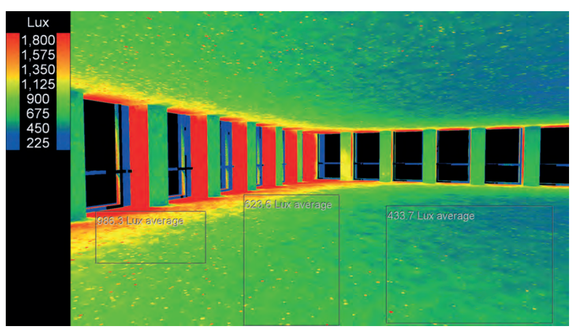
Julyl at 12.00

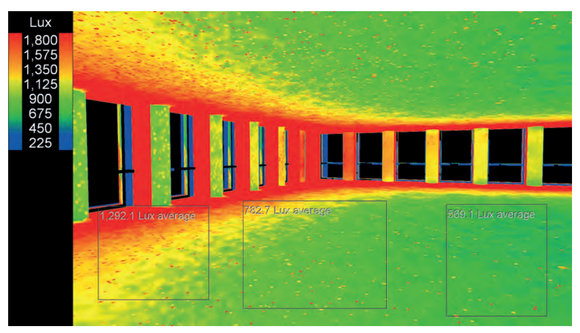
Level +22.00

N



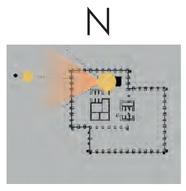


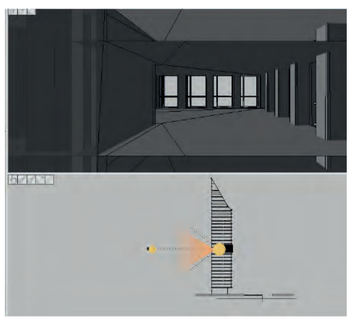


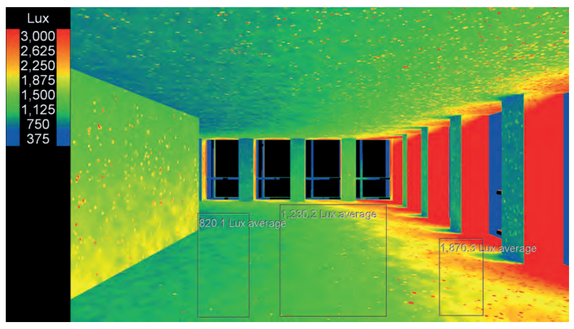


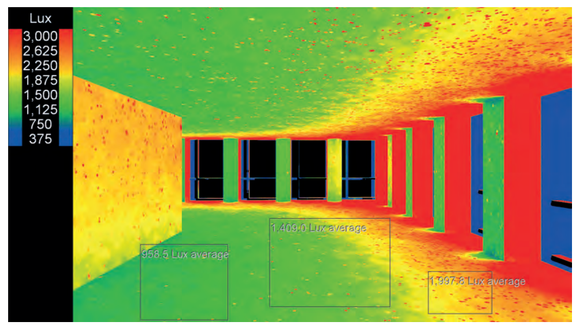
Level +54.00

N



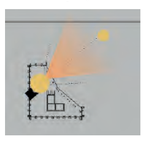


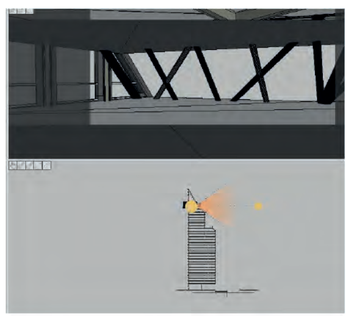


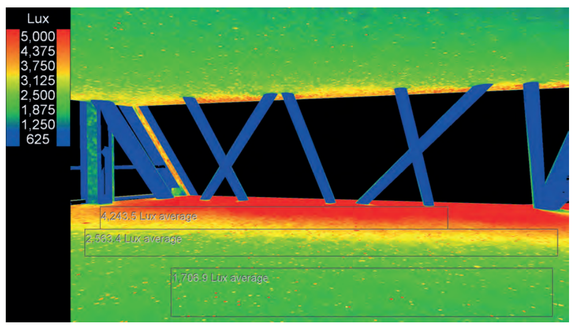


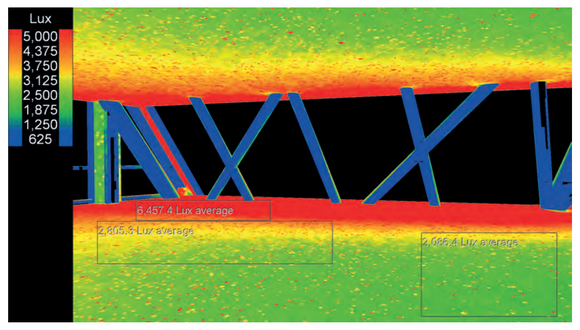
Level +122.00

N





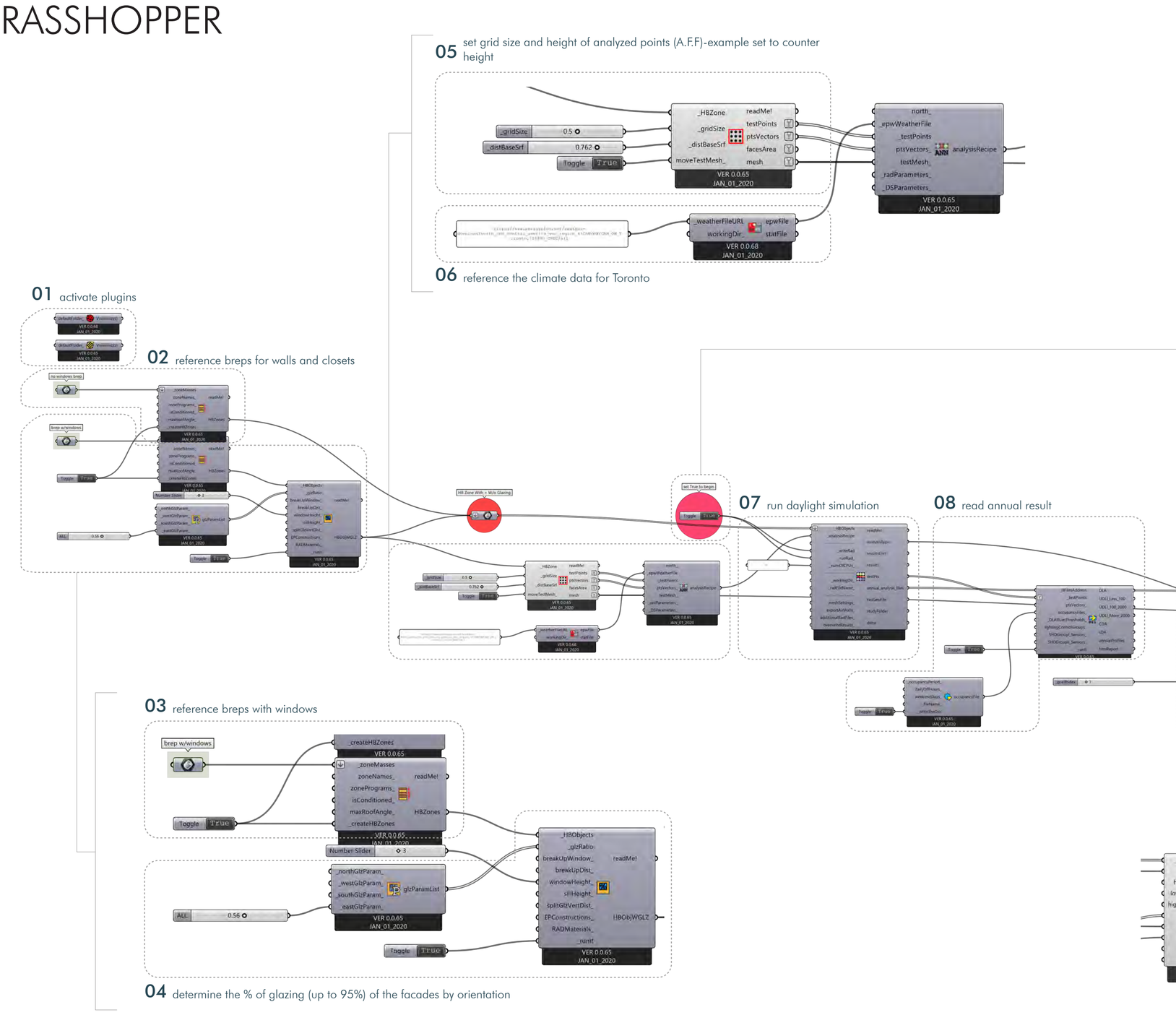




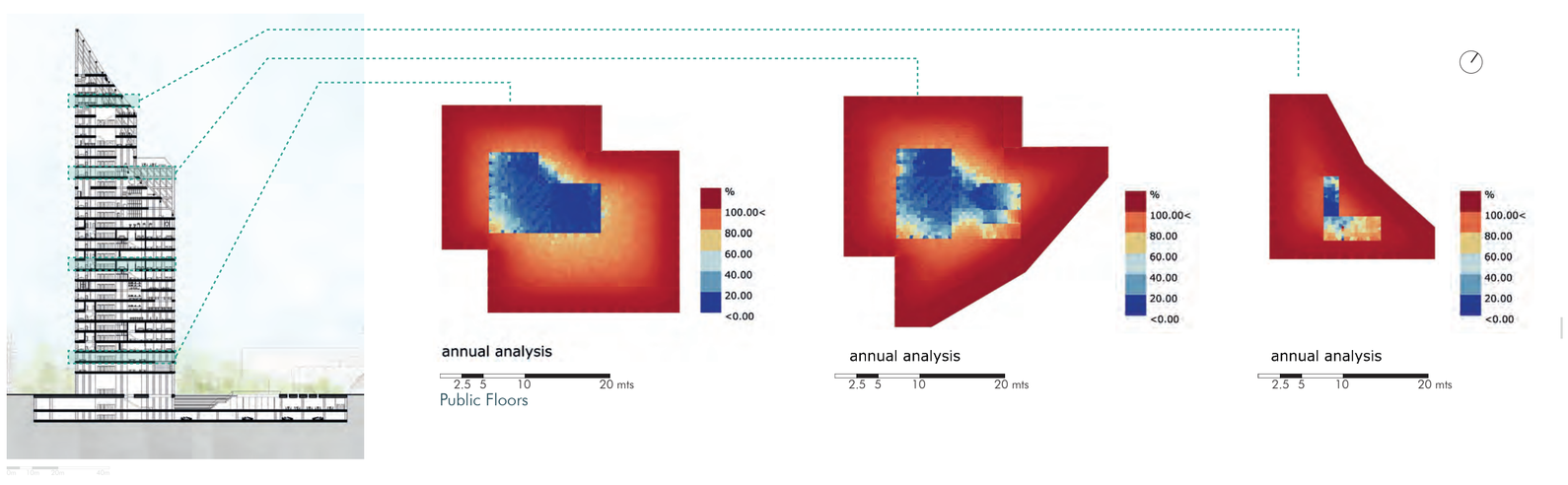
HONEYBEE 6D

ANNUAL DAYLIGHT EXPOSURE

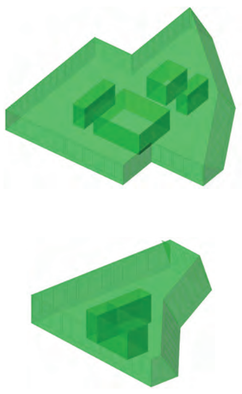
GRASSHOPPER



ANNUAL ANALYSIS BY FLOOR



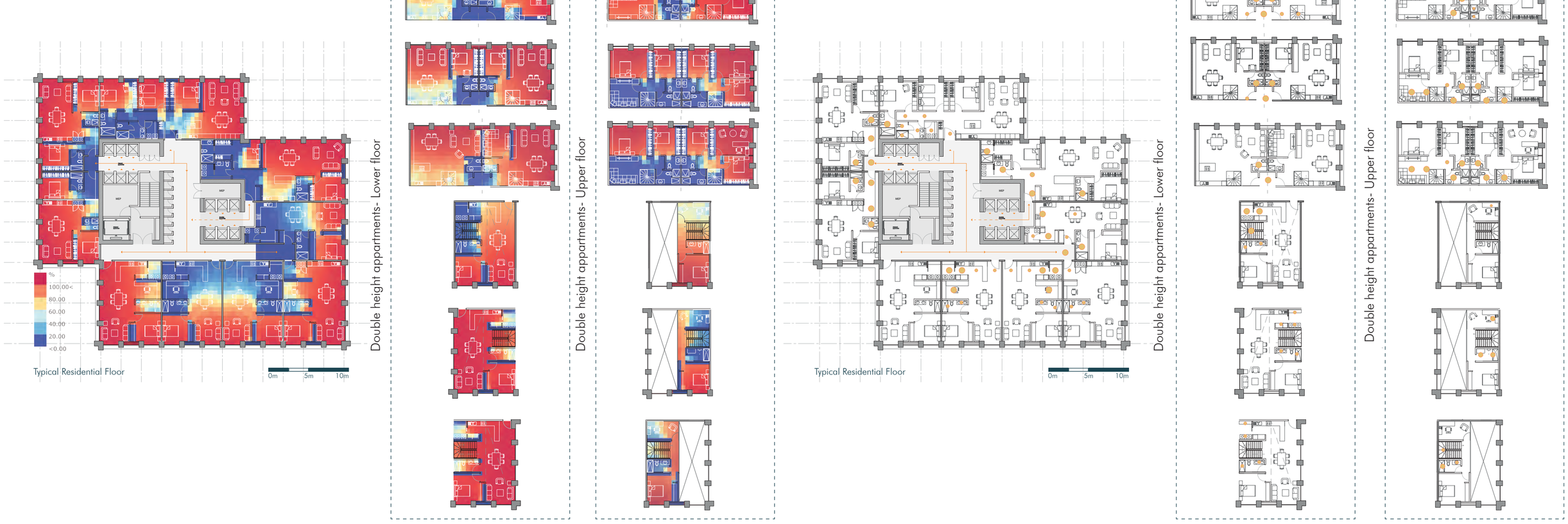
Note: most non-illuminated areas are bathrooms, laundry closets and the movie room.



Grashopper models

TYPICAL FLOOR PLAN RESULTS

OPPORTUNITY AREAS



POLITECNICO MILANO 1863

MSC BUILDING ARCHITECTURE THESIS

PROFESSORS:
MARIA GRAZIA FOLLI
CORRADO PECORA
GIOVANNI DOTELLI
FRANCESCO ROMANO
MARCO IMPERADORI

STUDENTS:
JUAN CARLOS MEDINA 10702592
MARIA JOSE MONTERO 10712731
DIANA MARISOL NARVAEZ 10704376

OUR BEACON: TORONTO AFFORDABLE HOUSING

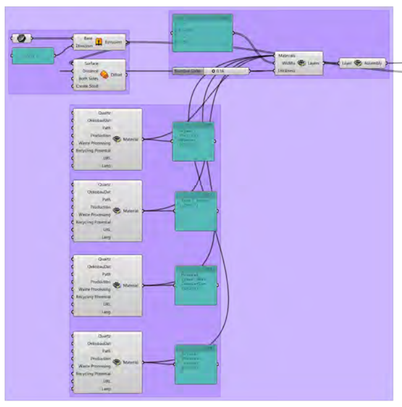
1m 5m 10m

TORTUGA 6D

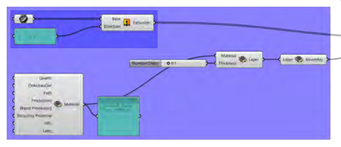
LCA (LIFE CYCLE ASSESMENT)

GRASSHOPPER

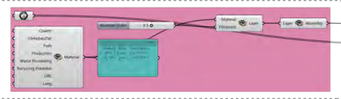
01 set interior wall materials and thicknesses



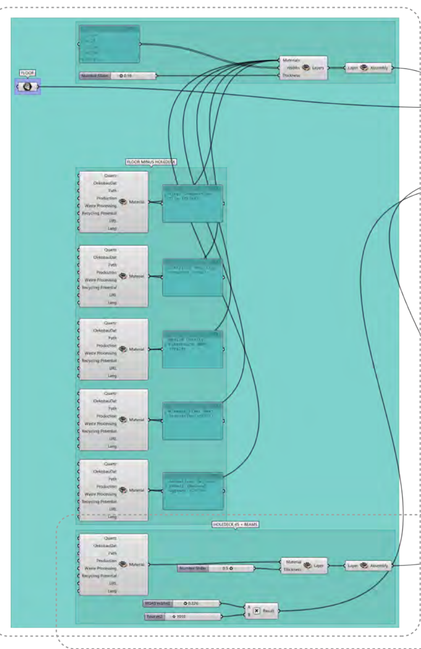
02 set glass facade profile and material



03 set concrete geometry and material

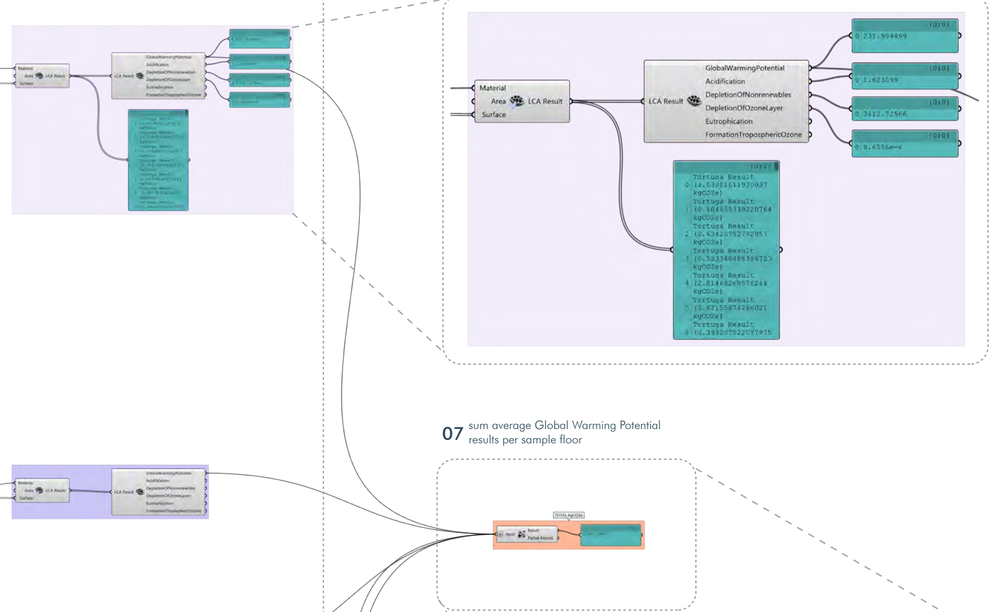


04 set floor area and materials

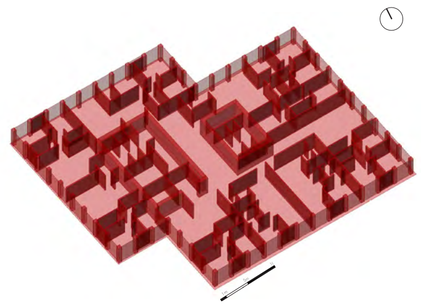


05 calculate HoleDeck volume from manufacturer's data

06 compute individual LCA results by area/volume

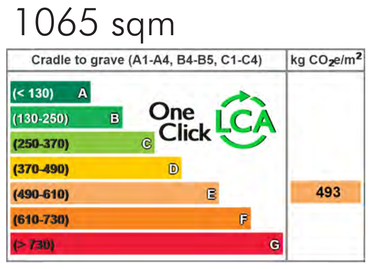


07 sum average Global Warming Potential results per sample floor

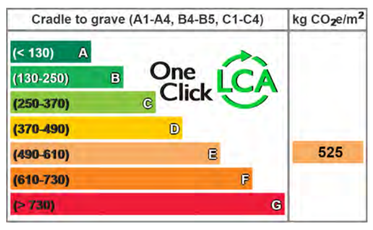


Grashopper model - sample floor

Result by sqm
1065 sqm



Canada LEED Standard example to achieve- Qualifying



Canada LEED Standard example - Baseline

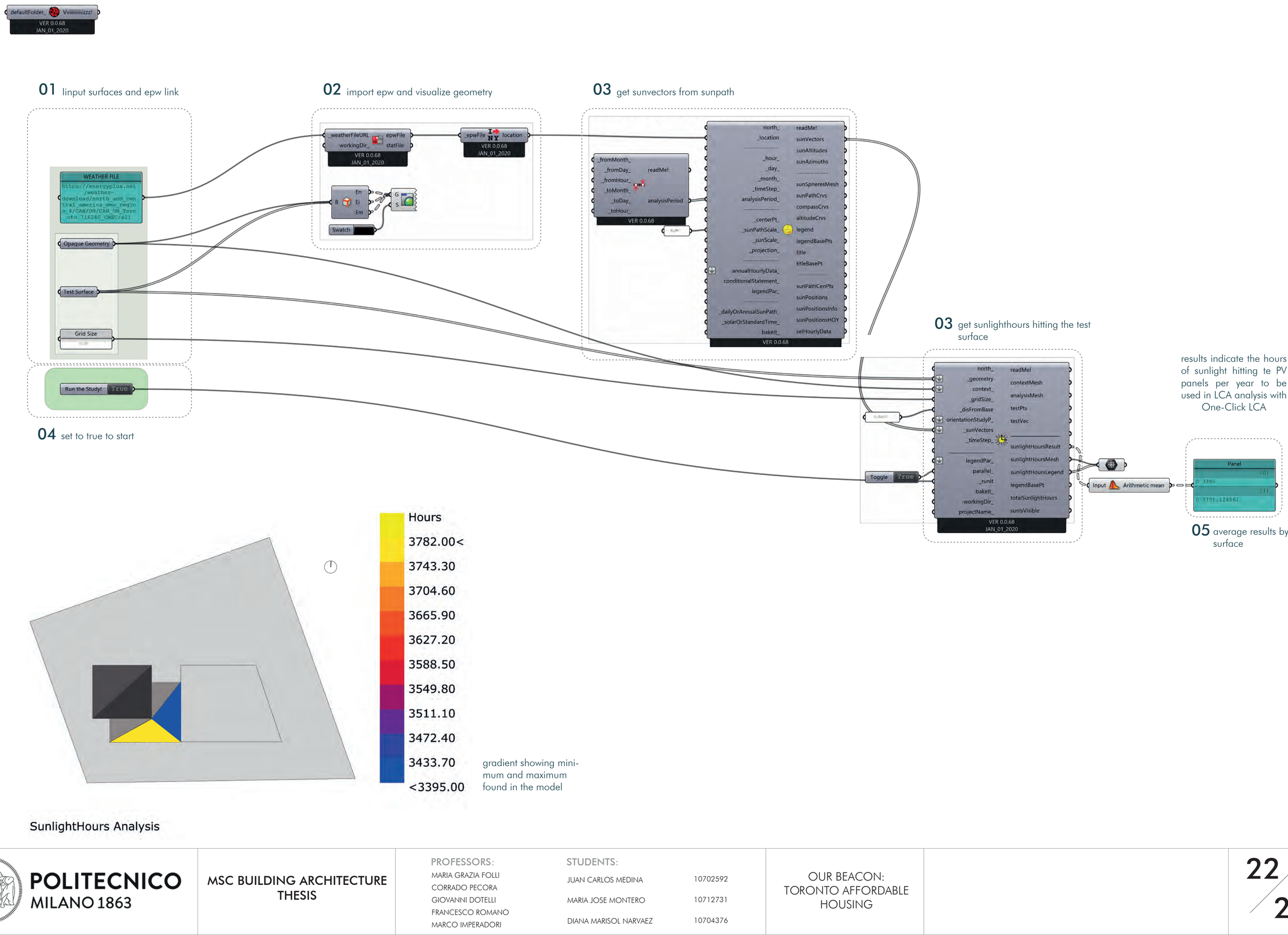
Option 1

BETTER OPTION	Global Warming Potential kgCO2	Acidification kgSO2	Depletion of Non-renewables MJ	Depletion of Ozone Layer kgFCF11
INTERIOR WALLS Drywall / Natural Gypsum Steel Studs Mineral Fiber Batt Insulation Drywall / Natural Gypsum	231.99	1.62	3412.7	8.60E-06
FAÇADE Triple pane IGU	89.51	0.4	1254	9.37E-07
COLUMNS AND CORE Ready Mix Concrete (BF Slag)	10.99	0.046	11.33	1.54E-08
FLOOR/CEILING Vinyl Composition Tile Sub-Floor Smoothing Compound Fiber Glass Board Insulation Mineral Fiber Batt Insulation Acoustical Ceiling Panels (Natural Gypsum)	284.33	2.05	4483.74	9.86E-06
Holedeck 45 with Beams: Ready Mix Concrete (BF Slag)	20.81	0.088	210.7	2.92E-08
TOTAL	637.63	4.204	9372.47	1.944E-05

Option 2 (best result)

BEST OPTION	Global Warming Potential kgCO2	Acidification kgSO2	Depletion of Non-renewables MJ	Depletion of Ozone Layer kgFCF11
INTERIOR WALLS Drywall / Natural Gypsum Steel Studs Mineral Fiber Batt Insulation Drywall / Natural Gypsum	231.99	1.62	3412.7	8.60E-06
FAÇADE Triple pane IGU	89.51	0.4	1254	9.37E-07
COLUMNS AND CORE Ready Mix Concrete (BF Slag)	10.99	0.046	11.33	1.54E-08
FLOOR/CEILING Vinyl Composition Tile Sub-Floor Smoothing Compound Medium Density Fiberboard (MDF) Mineral Fiber Batt Insulation Acoustical Ceiling Panels (Natural Gypsum)	204.98	1.77	4118.78	4.48E-06
Holedeck 45 with Beams: Ready Mix Concrete (BF Slag)	20.81	0.088	210.7	2.92E-08
TOTAL	558.28	3.924	9007.51	1.406E-05

PV PANELS POTENTIAL ANALYSIS 6D



gradient showing minimum and maximum found in the model

SunlightHours Analysis

MEP
PLUMBING

PUMP ROOM

FRESH WATER TANK

TREATED WATER TANK

FRESH WATER PUMPS
LOW - MID - HIGH PRESSURE

GREY WATER PUMPS
HIGH PRESSURE

HIGH RISE PUMP ROOM 2
LOW - MID PRESSURE

MID RISE PUMP ROOM
LOW - MID PRESSURE

ROOF WATER TANKS

by gravity

APARTMENTS

PUBLIC SPACES

BOILER

SERVICES

HYDRONEUMATIC EQUIPMENT

CONTACT WATER

WC

AHU (HVAC)

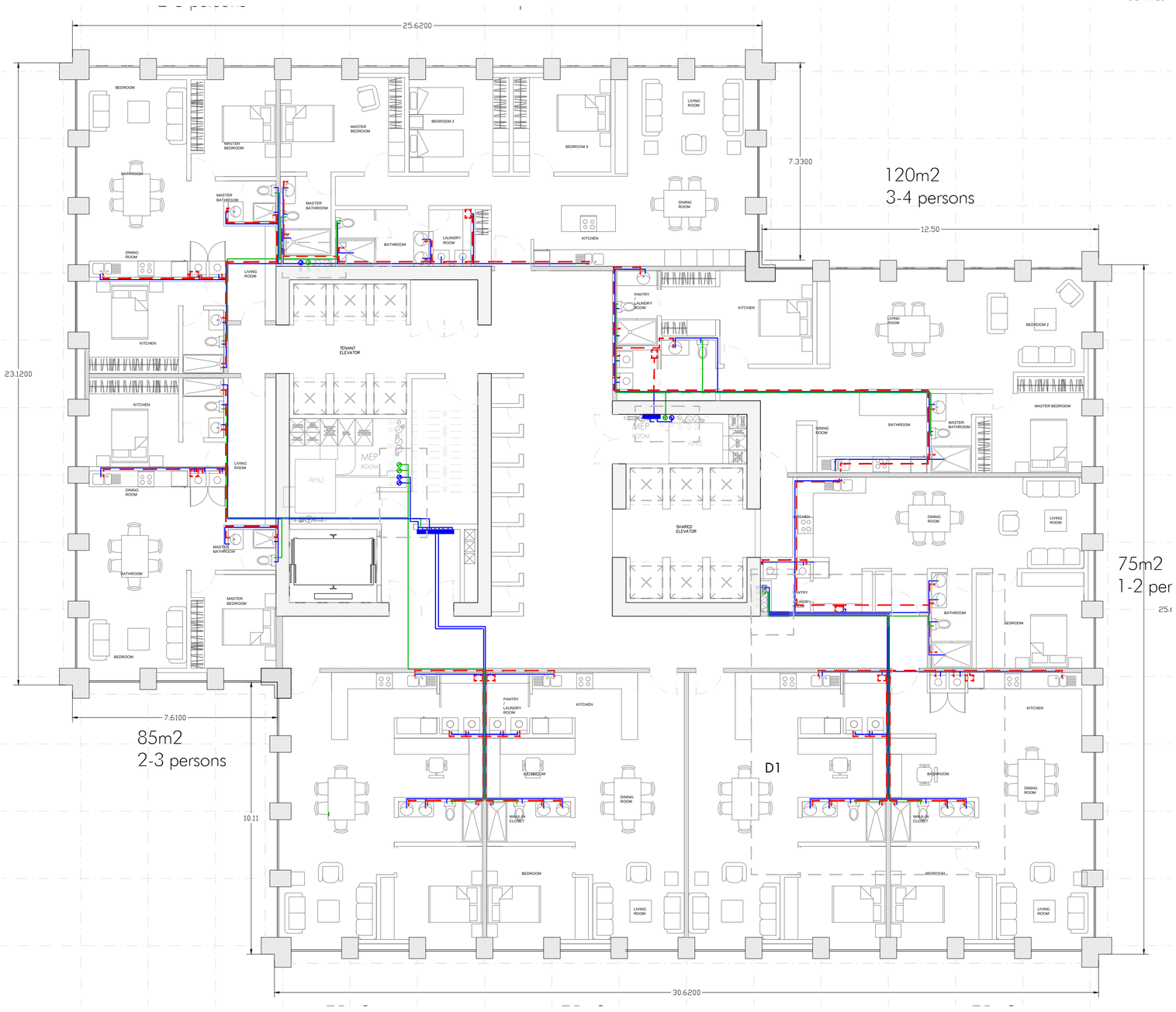
IRRIGATION

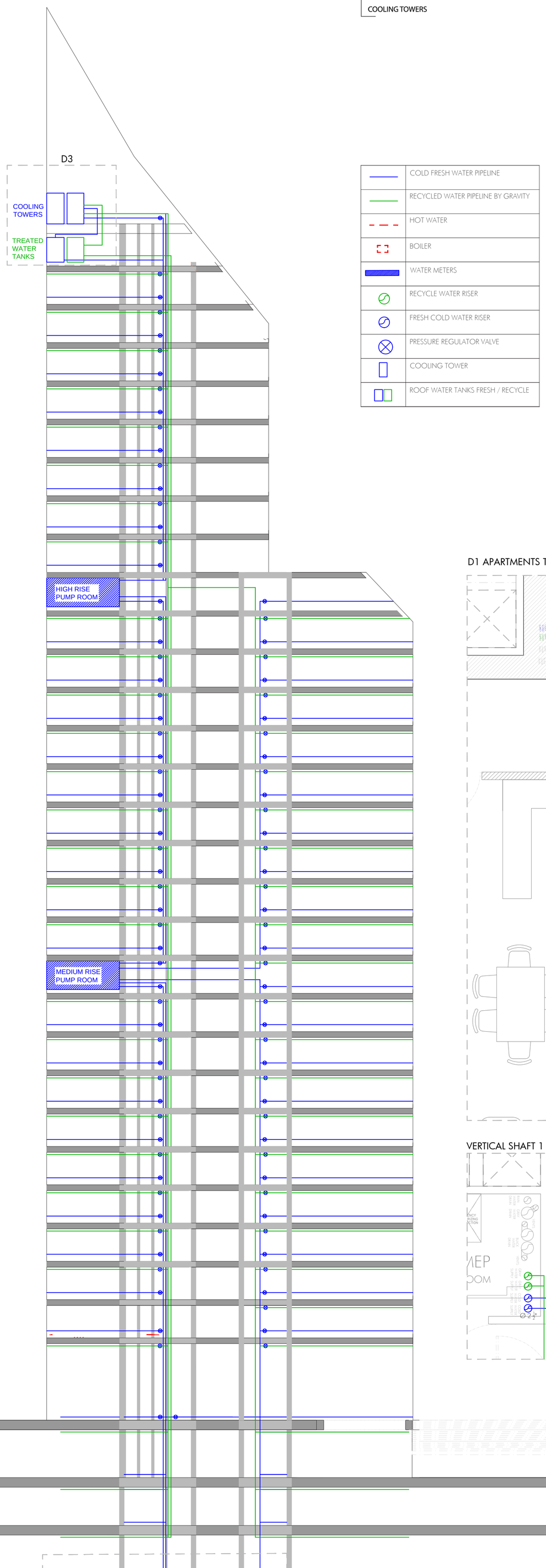
COOLING TOWERS

	COLD FRESH WATER PIPELINE
	RECYCLED WATER PIPELINE BY GRAVITY
	HOT WATER
	BOILER
	WATER METERS
	RECYCLE WATER RISER
	FRESH COLD WATER RISER
	PRESSURE REGULATOR VALVE
	COOLING TOWER
	ROOF WATER TANKS FRESH / RECYCLE

RESIDENTIAL FLOOR TYPICAL PLAN

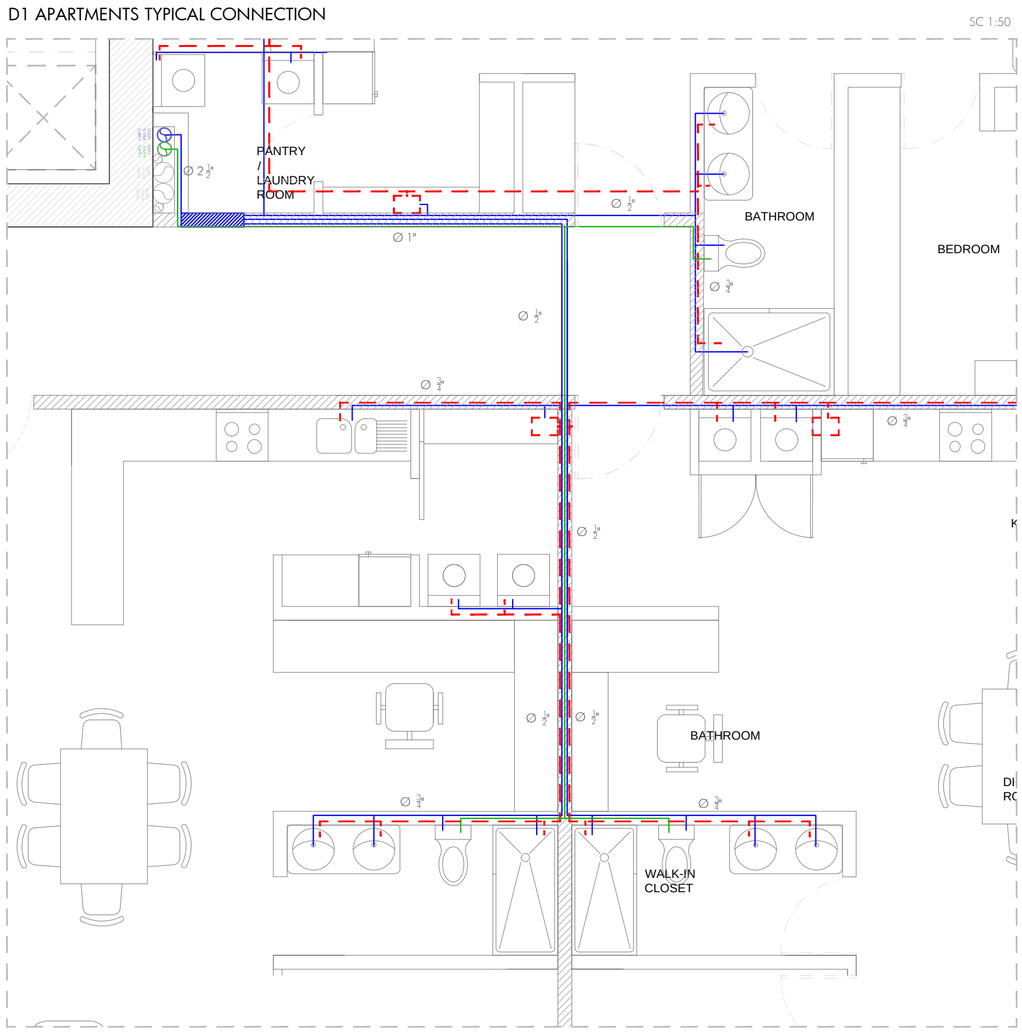
SC 1:125





D1 APARTMENTS TYPICAL CONNECTION

SC 1:50

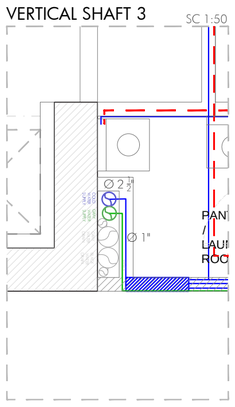


VERTICAL SHAFT 1

SC 1:50

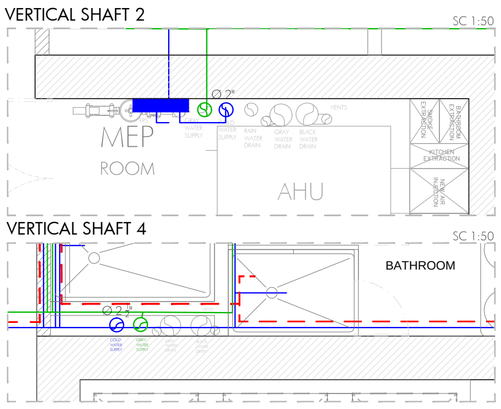
VERTICAL SHAFT 3

SC 1:50



VERTICAL SHAFT 2

SC 1:50

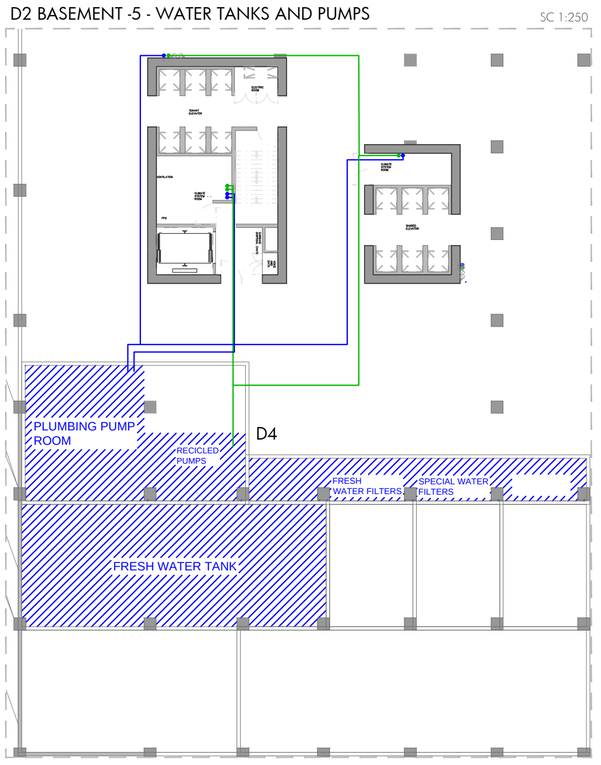


VERTICAL SHAFT 4

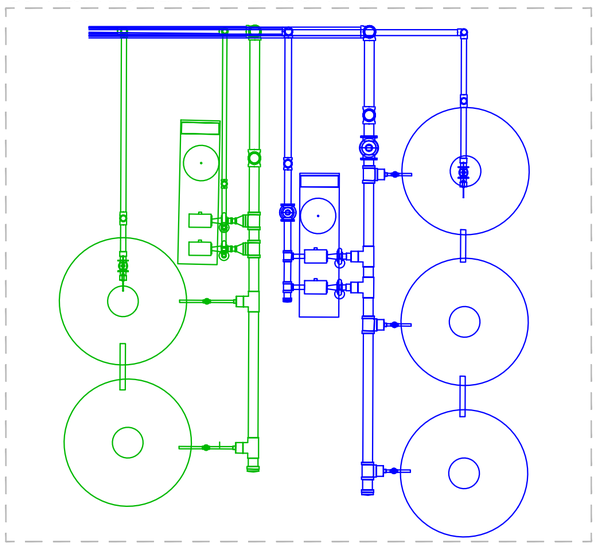
SC 1:50

D2 BASEMENT -5 - WATER TANKS AND PUMPS

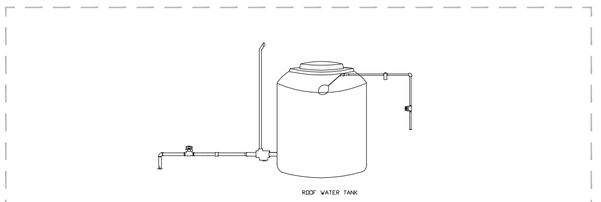
SC 1:250



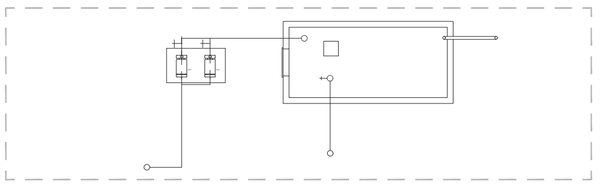
D3 - FRESH AND TREATED WATER ROOF TANKS



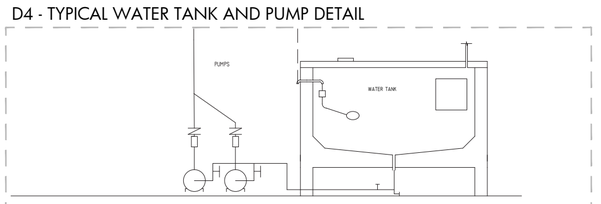
D3 - TYPICAL ROOF WATER TANK



D4 - TYPICAL WATER TANK AND PUMP DETAIL



D4 - TYPICAL WATER TANK AND PUMP DETAIL



POLITECNICO MILANO 1863

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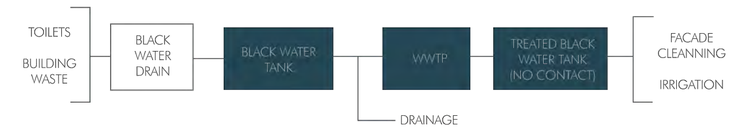
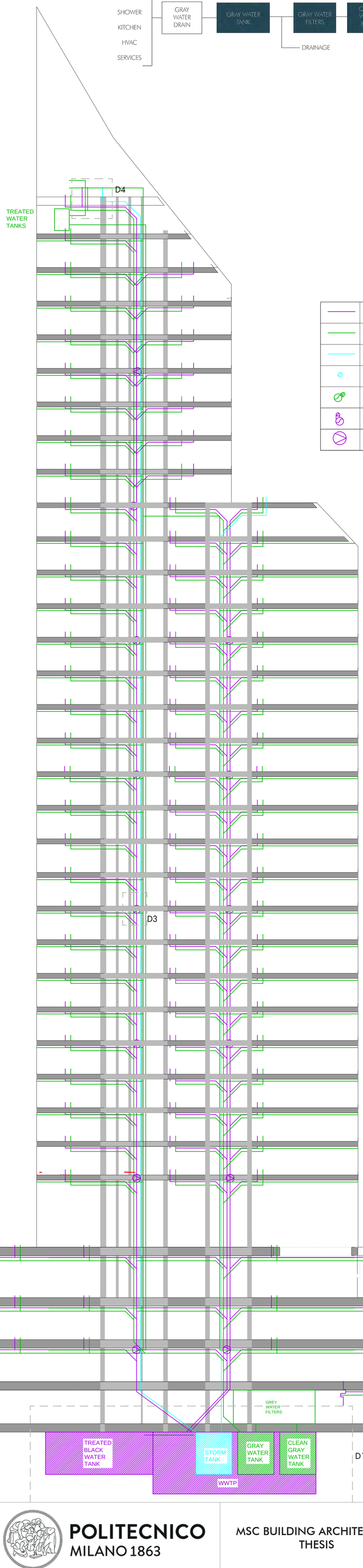
OUR BEACON:
TORONTO AFFORDABLE HOUSING

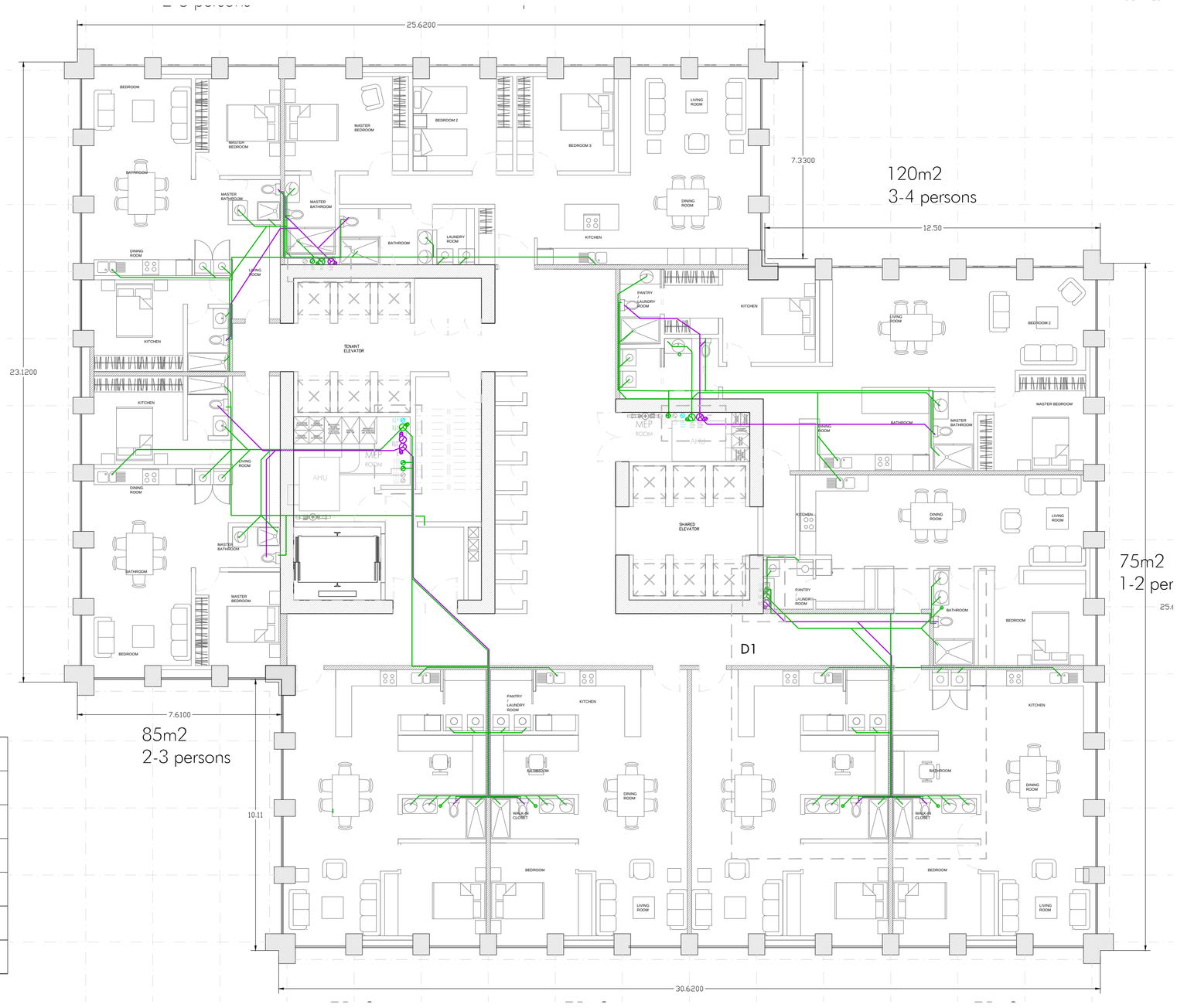
DRAINAGE SYSTEM





RESIDENTIAL FLOOR TYPICAL PLAN

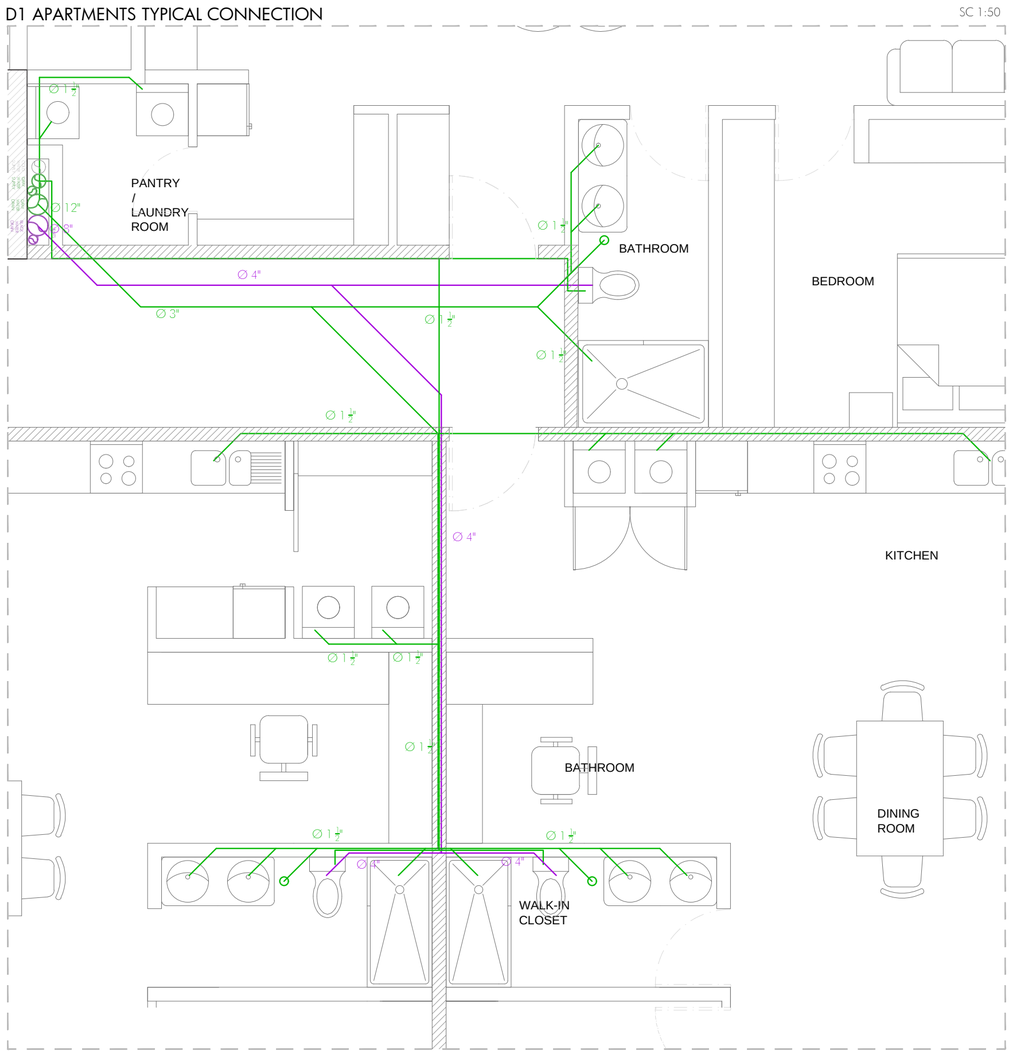
SC 1:125



	BLACK WATER DRAINAGE PIPELINE
	GRAY WATER DRAINAGE PIPELINE
	RAIN WATER DRAINAGE PIPELINE
	RAIN WATER VERTICAL PIPELINE
	GRAY WATER VERTICAL PIPELINE WITH VENT
	BLACK WATER VERTICAL PIPELINE WITH VENT
	SPEED REDUCER

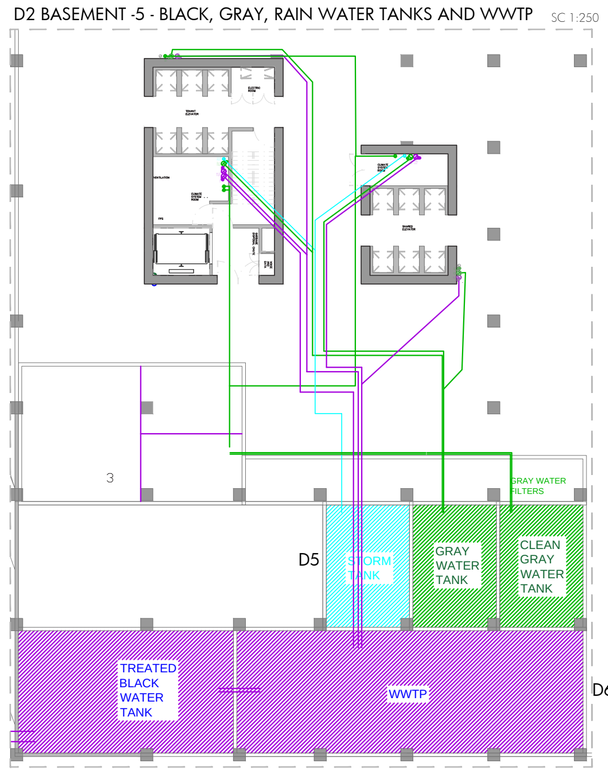
D1 APARTMENTS TYPICAL CONNECTION

SC 1:50



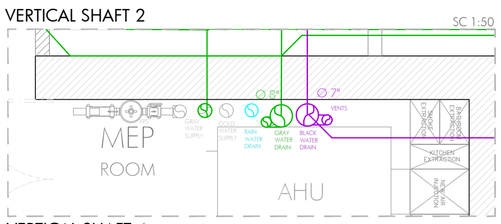
D2 BASEMENT -5 - BLACK, GRAY, RAIN WATER TANKS AND WWTP

SC 1:250



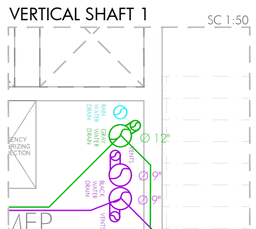
VERTICAL SHAFT 2

SC 1:50



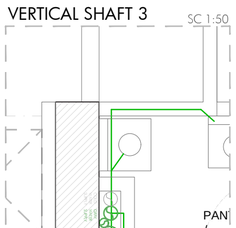
VERTICAL SHAFT 1

SC 1:50



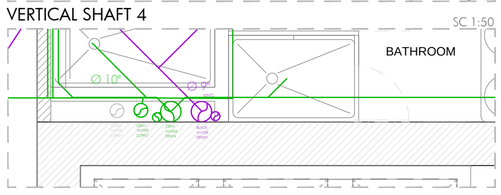
VERTICAL SHAFT 3

SC 1:50

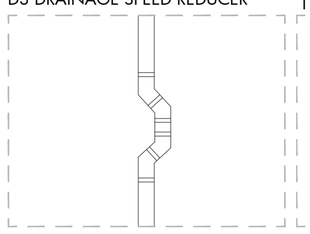


VERTICAL SHAFT 4

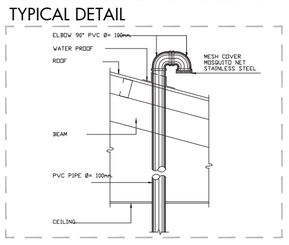
SC 1:50



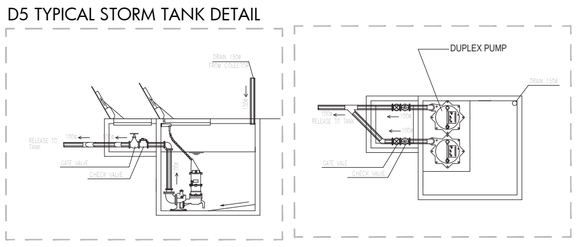
D3 DRAINAGE SPEED REDUCER



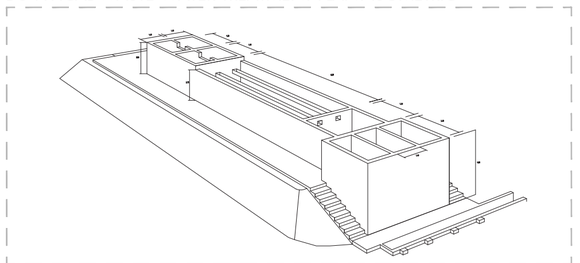
D4- ROOF VENTILATION COLUMN TYPICAL DETAIL



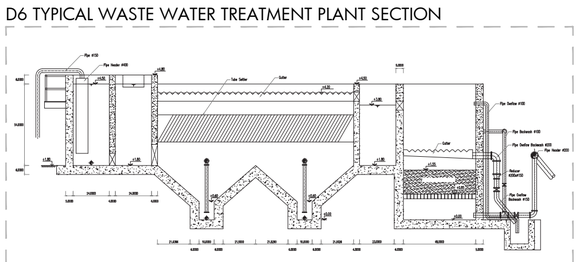
D5 TYPICAL STORM TANK DETAIL



D6 TYPICAL WASTE WATER TREATMENT PLANT ISOMETRIC



D6 TYPICAL WASTE WATER TREATMENT PLANT SECTION



POLITECNICO MILANO 1863

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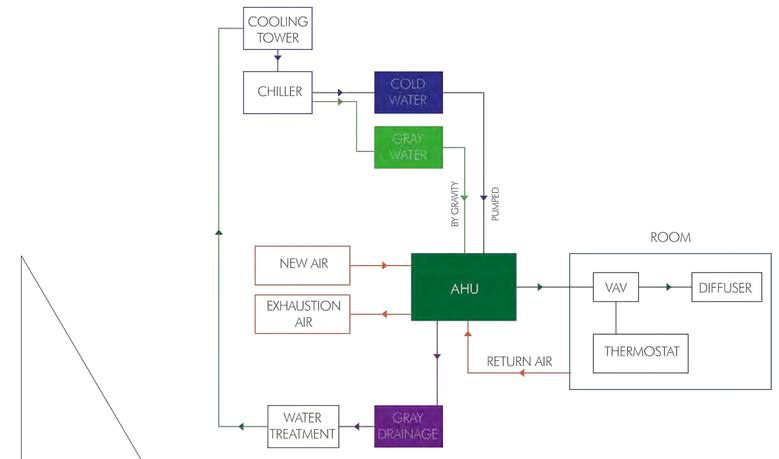
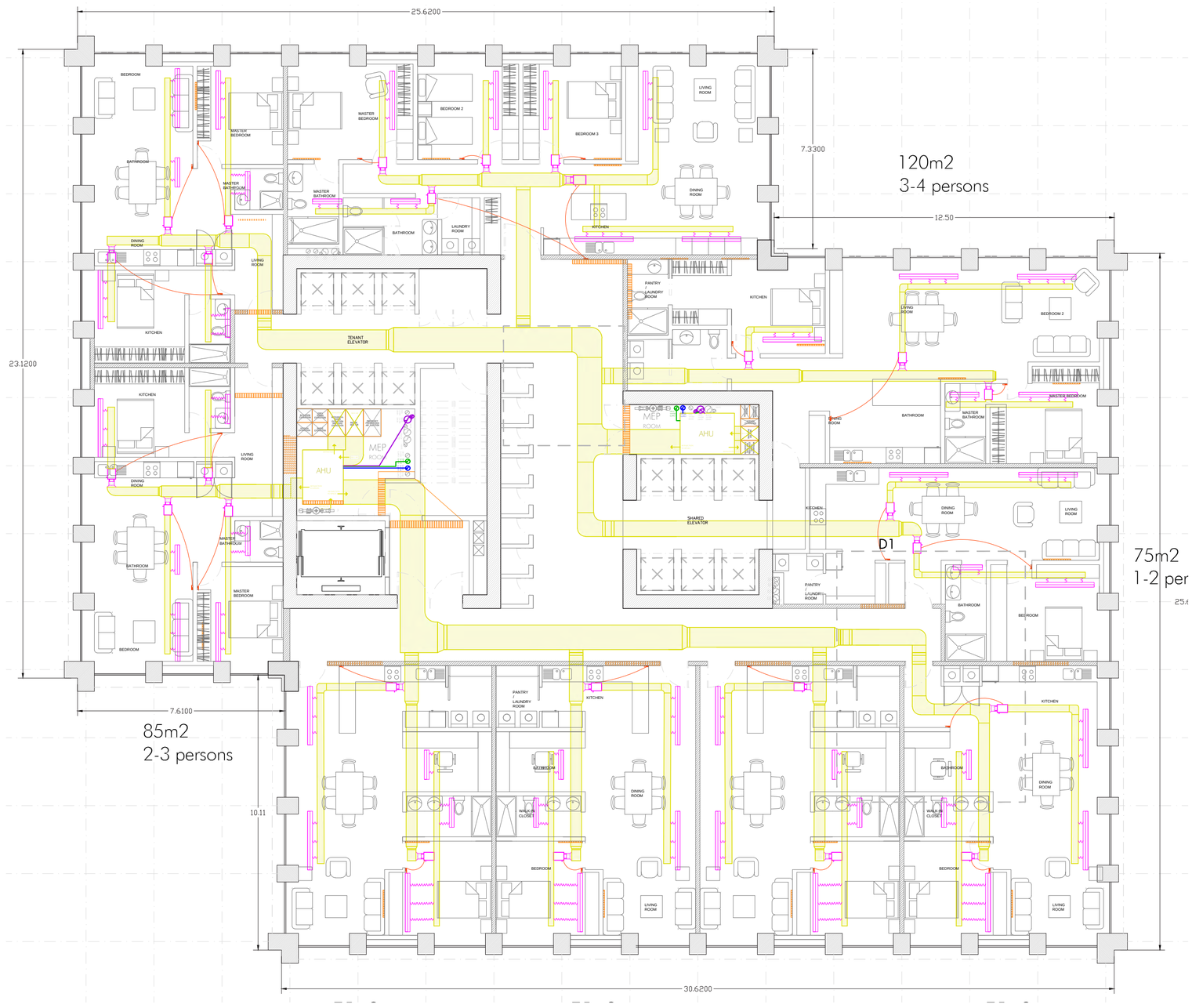
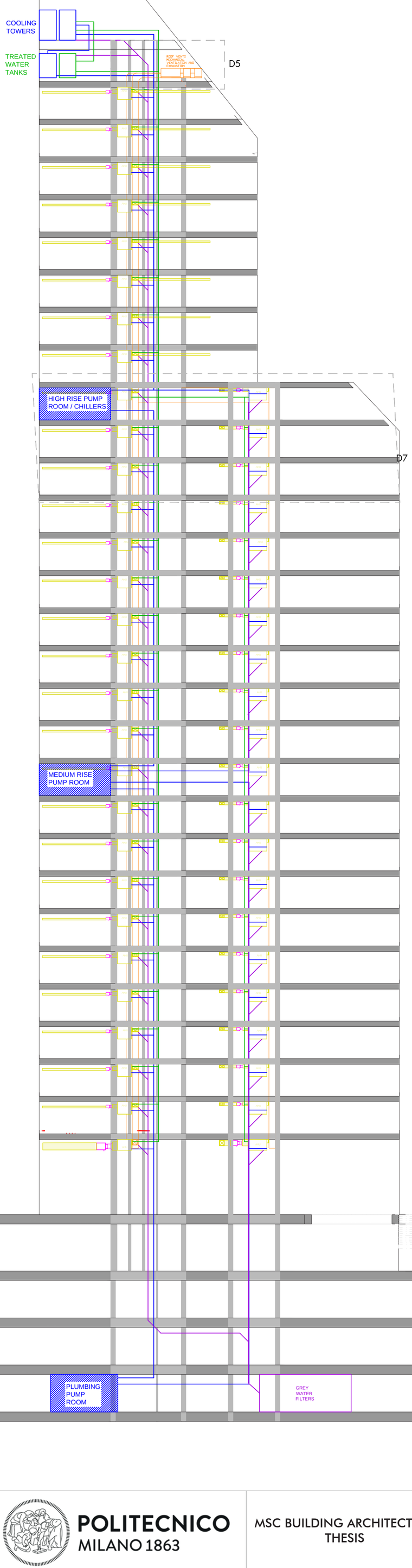
TORONTO AFFORDABLE HOUSING

HVAC SYSTEM



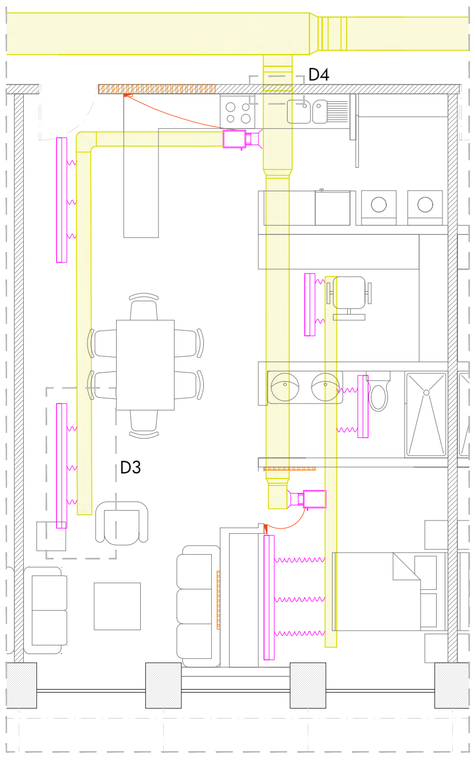
RESIDENTIAL TYPICAL FLOOR PLAN





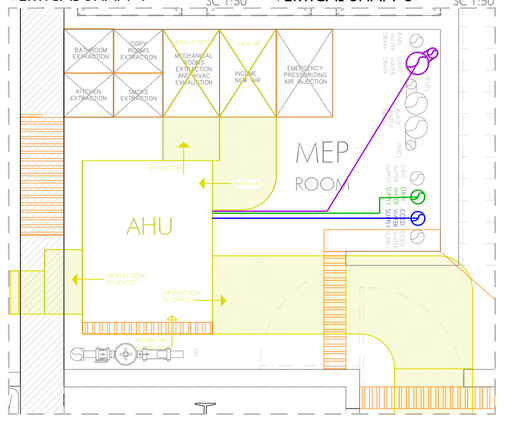
D1 APARTMENTS TYPICAL CONNECTION

SC 1:100



VERTICAL SHAFT 1

SC 1:50

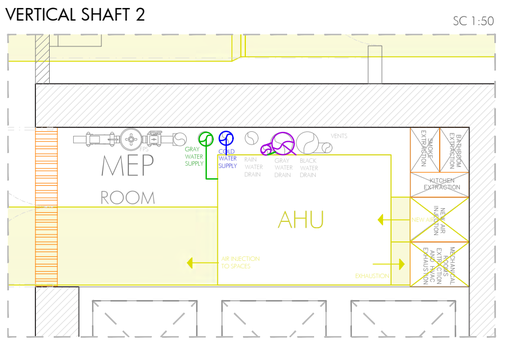


VERTICAL SHAFT 3

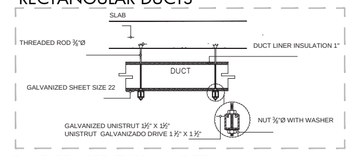
SC 1:50

VERTICAL SHAFT 2

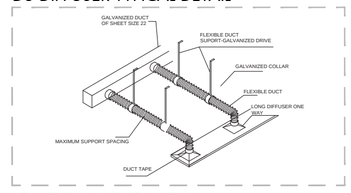
SC 1:50



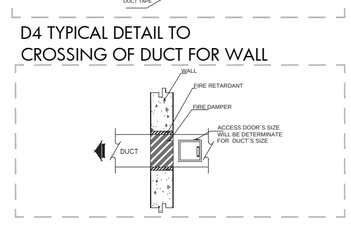
D2 TYPICAL SUPPORT DETAIL FOR RECTANGULAR DUCTS



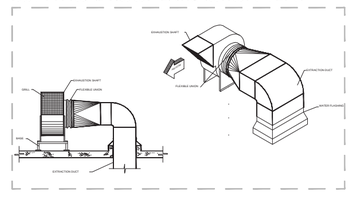
D3 DIFFUSER TYPICAL DETAIL



D4 TYPICAL DETAIL TO CROSSING OF DUCT FOR WALL



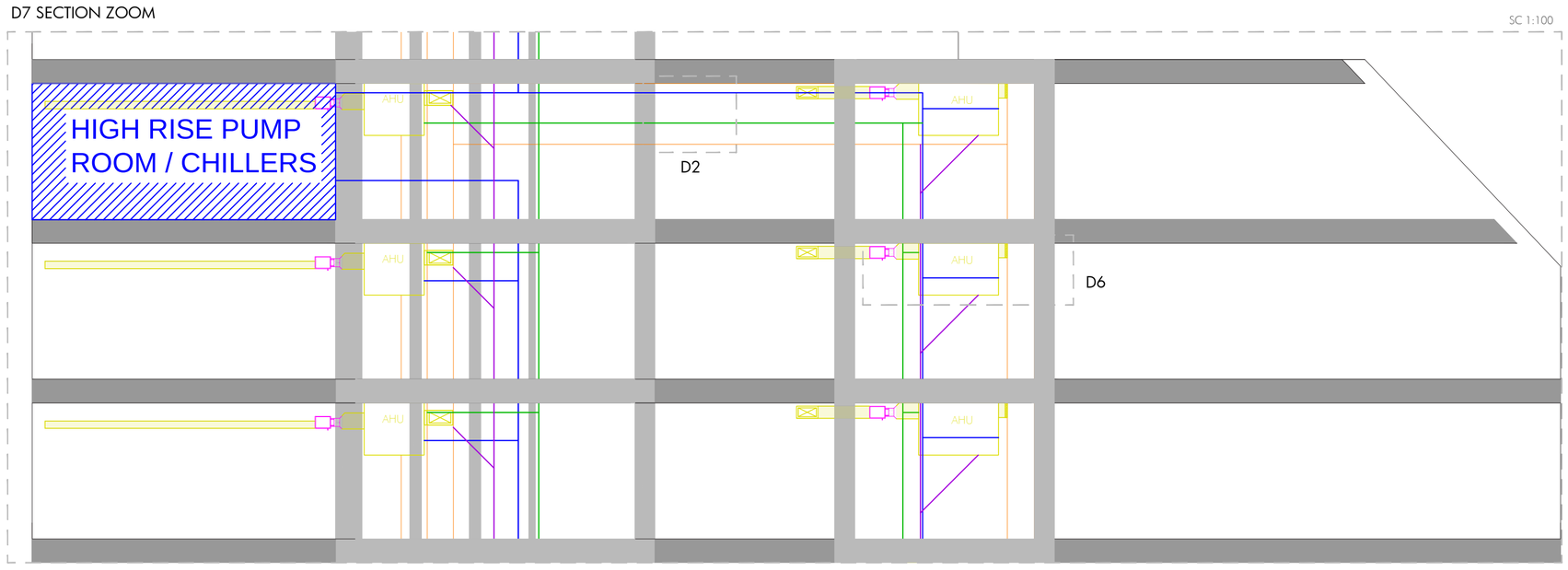
D5. TYPICAL ROOF EXTRACTION VENT



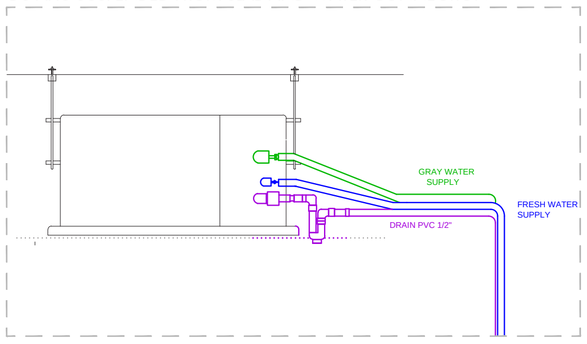
	ALUMINUM DUCT HVAC SUPPLIER
	AIR DUCT SHAFT VERTICAL
	AIR HANDLING UNIT
	RETURN GRID VENT TO FULL CHAMBER / CEILING/ PLENUM
	VARIABLE AIR VOLUME (VAV)
	FLEXIBLE DUCT CONNECTION
	AIR DIFFUSER
	INDIVIDUAL THERMOSTAT PANEL
	CABLE CONNECTION FROM THERMOSTAT TO VAV
	COLD/FRESH WATER SUPPLY
	COLD/FRESH WATER SUPPLY PIPELINE
	RECYCLE (GRAY) WATER SUPPLY
	RECYCLE (GRAY) WATER SUPPLY PIPELINE
	GRAY WATER DRAINAGE
	GRAY WATER DRAINAGE PIPELINE
	VENTILATION SYSTEM ALUMINUM DUCT
	COOLING TOWERS
	ROOF WATER TANKS

D7 SECTION ZOOM

SC 1:100



D6 AHU SUSPENDED FROM SLAB AND WATER CONNECTION



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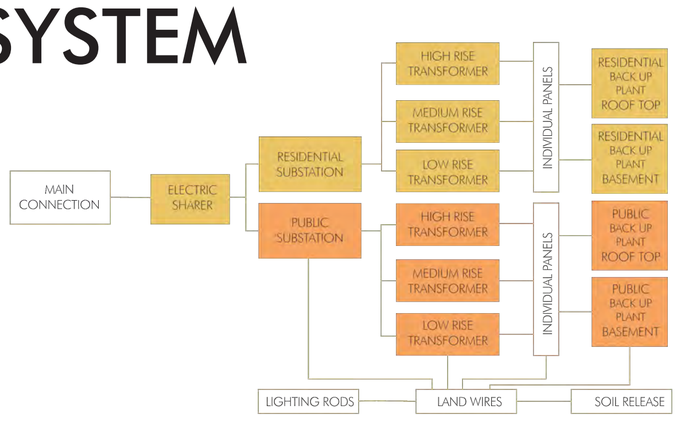
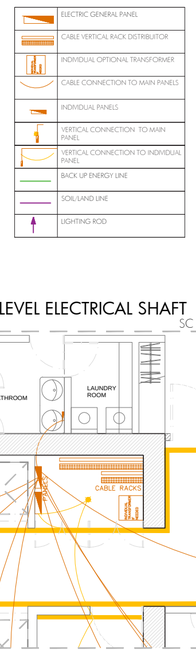
OUR BEACON: TORONTO AFFORDABLE HOUSING

ELECTRICAL SYSTEM



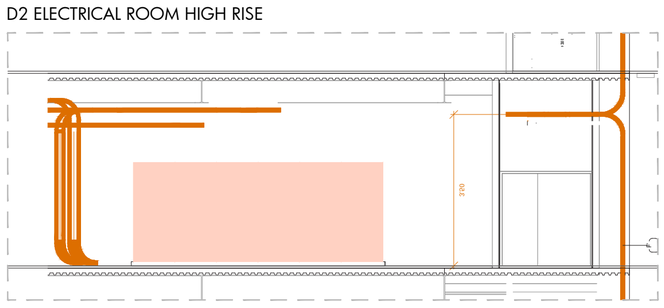


D1 ELECTRIC ROOM GROUND FLOOR SC 1:500

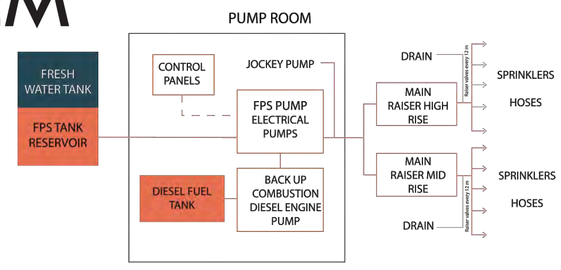
EVERY LEVEL ELECTRICAL SHAFT SC 1:100

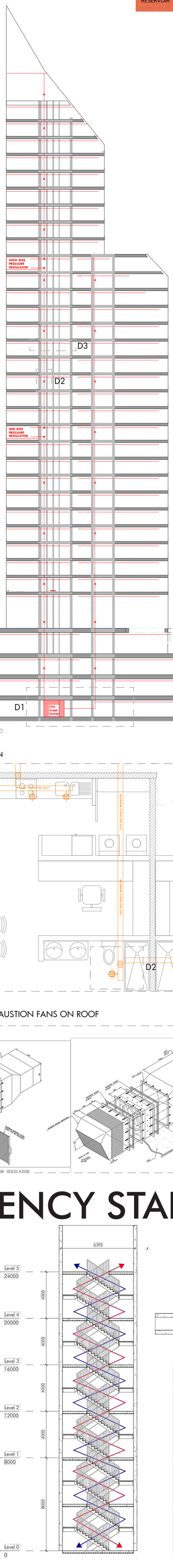
	ELECTRIC GENERAL PANEL
	CABLE VERTICAL RACK DISTRIBUTOR
	INDIVIDUAL OPTIONAL TRANSFORMER
	CABLE CONNECTION TO MAIN PANELS
	INDIVIDUAL PANELS
	VERTICAL CONNECTION TO MAIN PANEL
	VERTICAL CONNECTION TO INDIVIDUAL PANEL
	BACK UP ENERGY LINE
	SOIL/LAND LINE
	LIGHTING ROD

D2 ELECTRICAL ROOM HIGH RISE



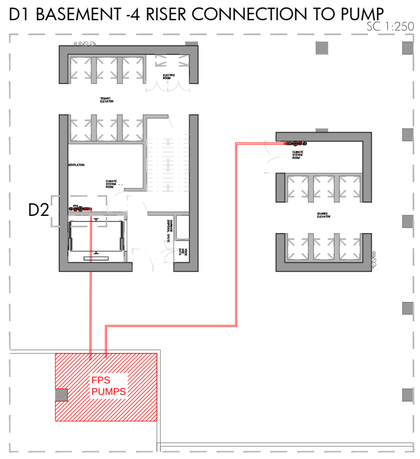
FPS SYSTEM





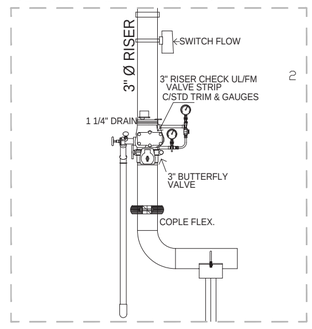
SC 1:500

D1 BASEMENT -4 RISER CONNECTION TO PUMP SC 1:250

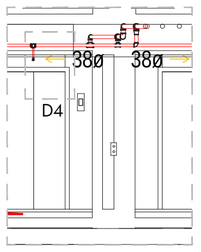


	DOUBLE SPRINKLER ON SUSPENDED CEILING
	HOSE AND EXTINGUISHER CABINET
	RISER MANIFORLD VALVE AND PRESSURE GAUGE
	SPRINKLER WATER DEFLECTOR RADIO 4M Ø
	TEMPERATURE / SMOKE DETECTOR RADIO 14M Ø
	TEMPERATURE / SMOKE RADIO DETECTION 4M Ø
	FPS PRESSURIZE WATER LINE 3"Ø
	SENSOR / ALARM CABLE CONNECTION
	PANEL ALARM SYSTEM
	RISER VALVE EVERY 12 M.

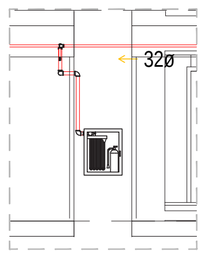
D2 RISER VALVE TYPICAL DETAIL



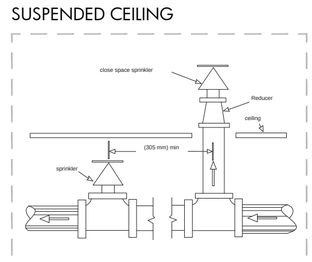
D3 SPRINKLER COMMON AREAS



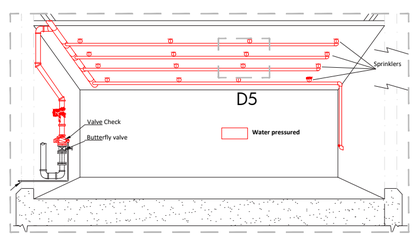
HOSE CABINET



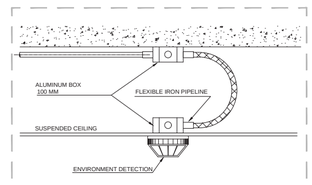
D4 DOUBLE SPRINKLER ON SUSPENDED CEILING



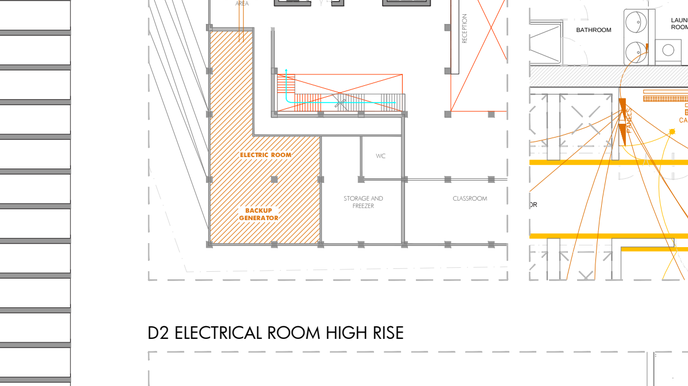
TYPICAL SPRINKLER DETAIL



D5 SMOKE / TEMPERATURE DETECTOR ON SUSPENDED CEILING

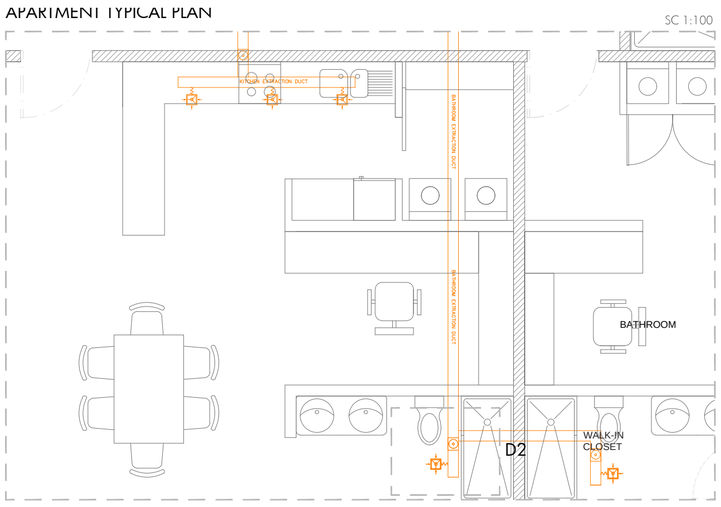


VENTILATION SYSTEM

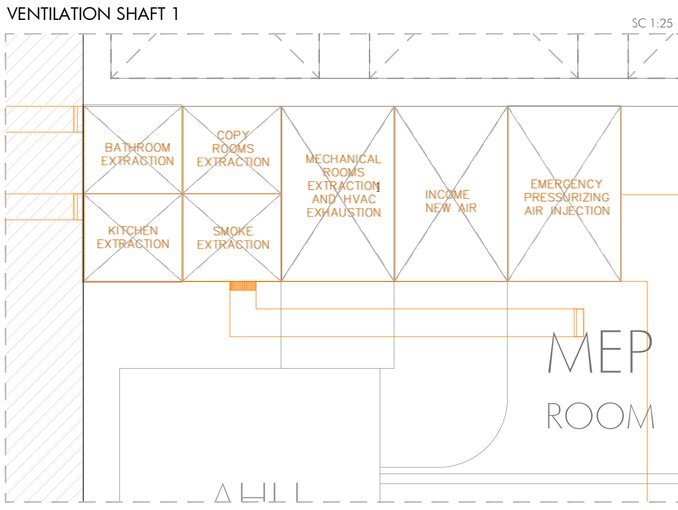


	GALVANIZED DUCT
	AIR DUCT SHAFT VERTICAL
	VENT
	EXTRACTION DIFUSER ON CEILING
	MECHANICAL FAN FOR EXTRACTION
	FLEXIBLE DUCT CONNECTION
	VENT SIDE VIEW

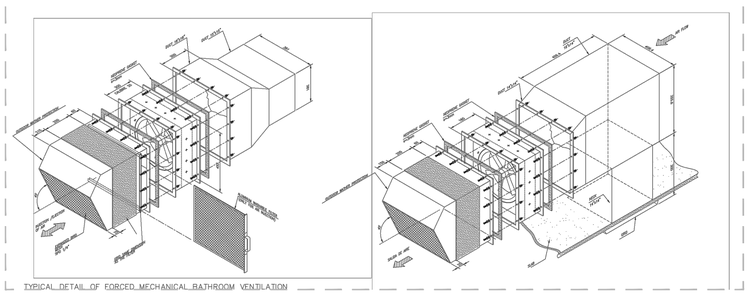
APARTMENT TYPICAL PLAN SC 1:100



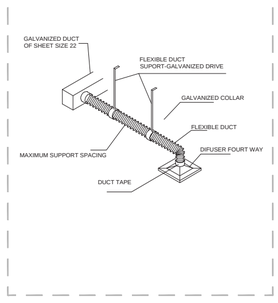
VENTILATION SHAFT 1 SC 1:25



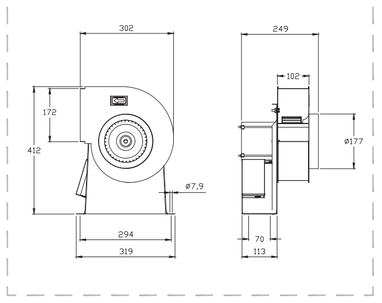
D1 TYPICAL DETAL OF EXHAUSTION FANS ON ROOF



D2 DETAIL INSTALATION FLEXIBLE DUCT TO DIFUSER



D1 EXHAUSTION MOTOR



EMERGENCY STAIRCASE

SC 1:500

POLITECNICO MILANO 1863

MSC BUILDING ARCHITECTURE THESIS

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OUR BEACON: TORONTO AFFORDABLE HOUSING