

STEEL BUTTERFLIES

a climate driven approach to sustainable housing in Astana, Kazakhstan

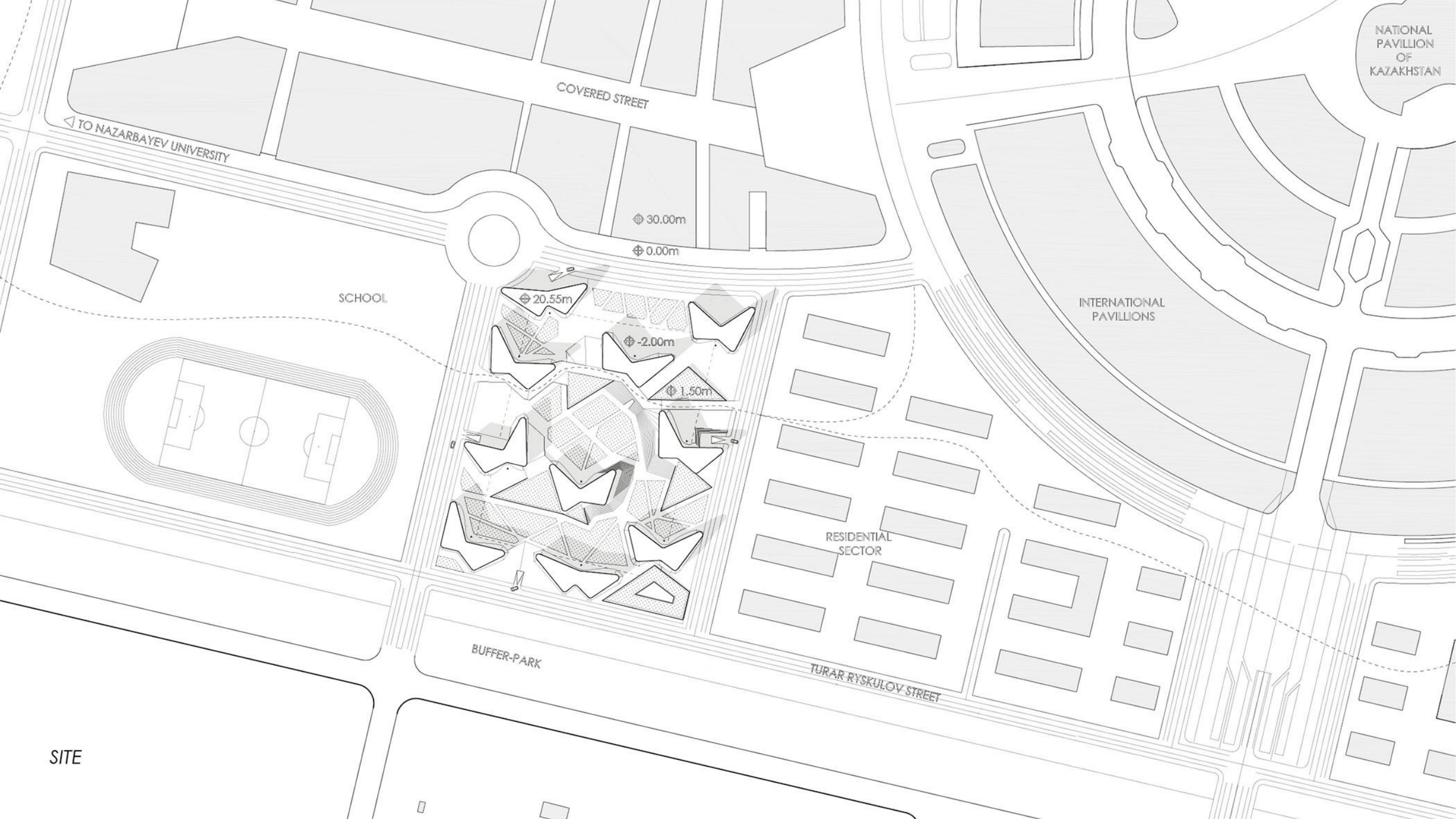


Team :
John EDOM | H       LACOMBE

FRANCE
ENSA Paris-Malaquais

Under the direction of :
Sandra PLANCHEZ | Pascal GONTIER

ISOVER



NATIONAL
PAVILLION
OF
KAZAKHSTAN

COVERED STREET

TO NAZARBAYEV UNIVERSITY

SCHOOL

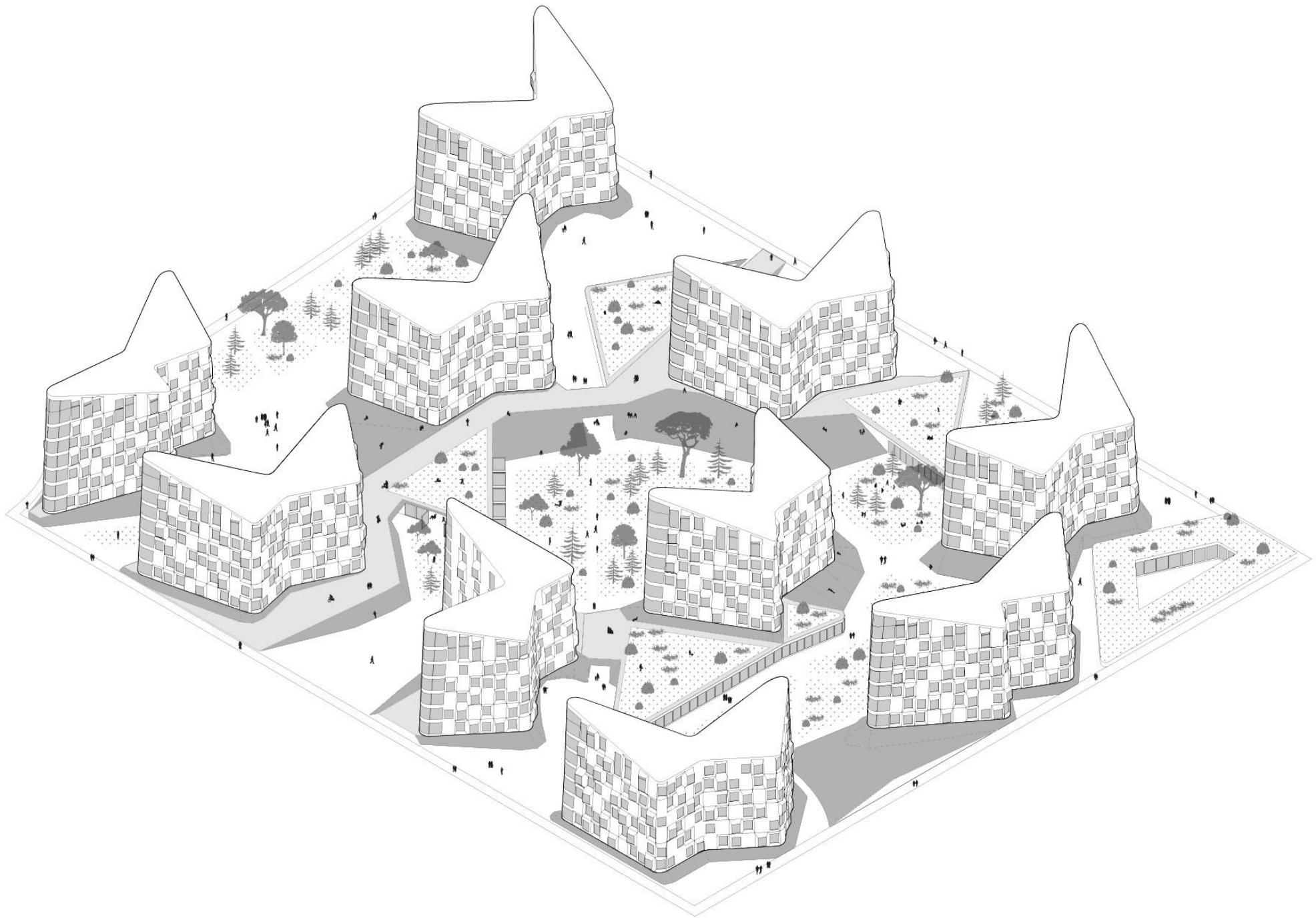
INTERNATIONAL
PAVILLIONS

RESIDENTIAL
SECTOR

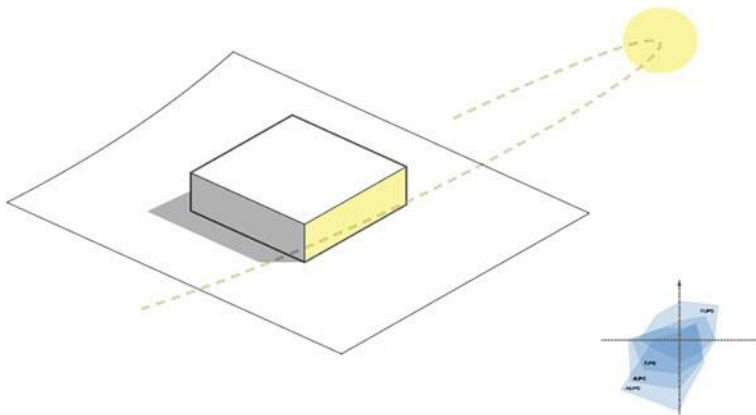
BUFFER-PARK

TURAR RYSKULOV STREET

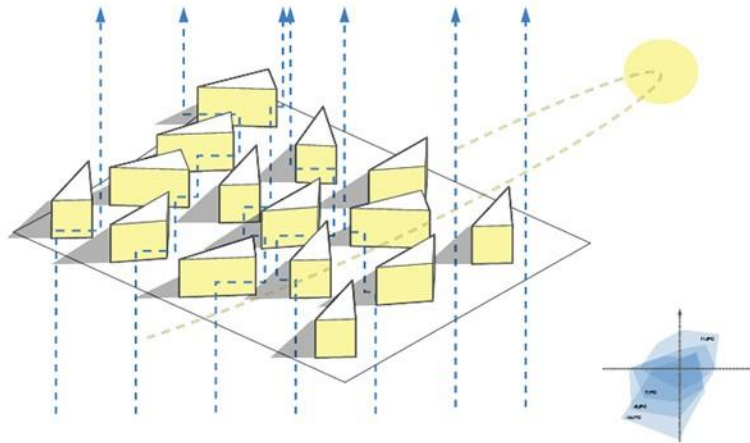
SITE



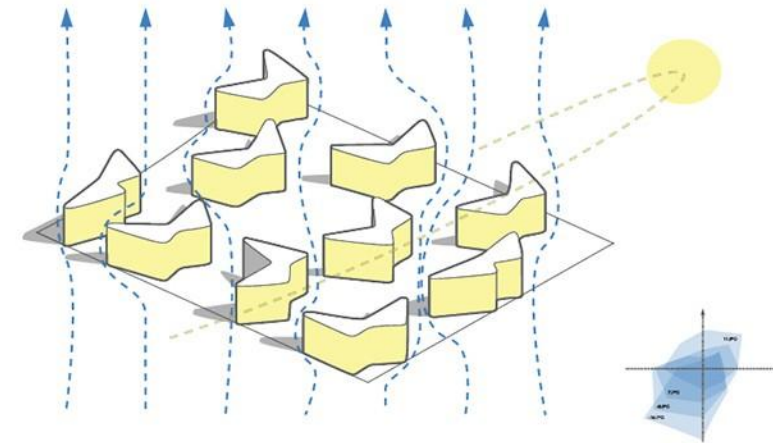
*BUILDING TYPOLOGY AND
SITE CONCEPT*



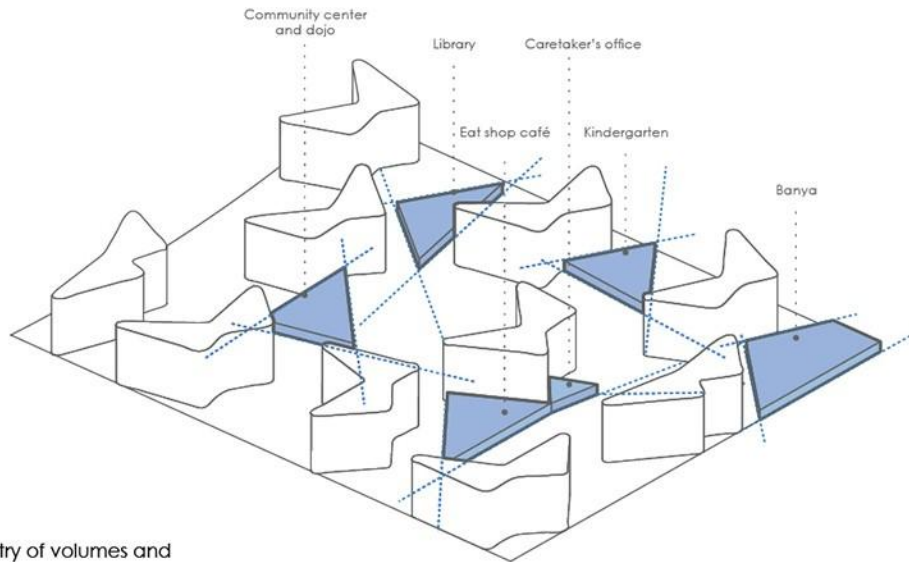
- Single volume representing required floor area.
- Low ratio of facade facing south.
- No wind protection.



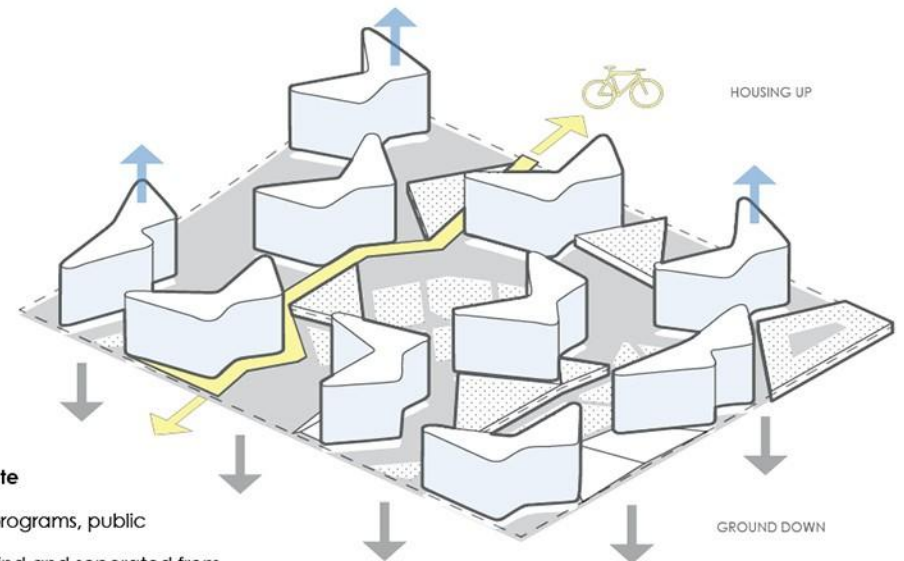
- Triangular volumes combined and angles smoothed to **reduce wind turbulence and thermal bridges**.
- **Orientations optimised** for solar gains, to reduce visual intrusion and to shelter and define public spaces.



- Triangular volumes **increase facade** oriented south - east / south - west.
- Separation of volumes **create intermediate public spaces**, but unprotected from wind.



Geometry of volumes and circulation in the site define the **placement of program elements**.



Introduction of **vertical separation between private (+2m) and public (-2 m) programs**, public spaces protected from wind and separated from bicycle path that crosses the site on the roofs of the program.

PROGRAM

HOUSING

9 RESIDENTIAL BUILDINGS	27 300 m²
320 DWELLINGS Studio → 60	23 m ²
1 Bed → 80	54 m ²
2 Bed → 90	>77 m ²
3 Bed → 90	>93 m ²
Vertical circulation <i>per building</i>	266 m ²
Dustbin location <i>per building</i>	18 m ²
Bicycle storage <i>per building</i>	15 m ²
1 STUDENT RESIDENCE	2 730 m²
TOTAL	30 030 m²

PUBLIC - LEVEL RESIDENTIAL AMENITIES

COMMUNITY CENTRE	573 m ²
BANYA	820 m ²
LIBRARY	536 m ²
EAT SHOP CAFÉ	632 m ²
KINDERGARTEN	465 m ²
CARETAKER	103 m ²
PARKING	22 000 m ²
TOTAL	25 109 m²

EXTERIOR AMENITIES

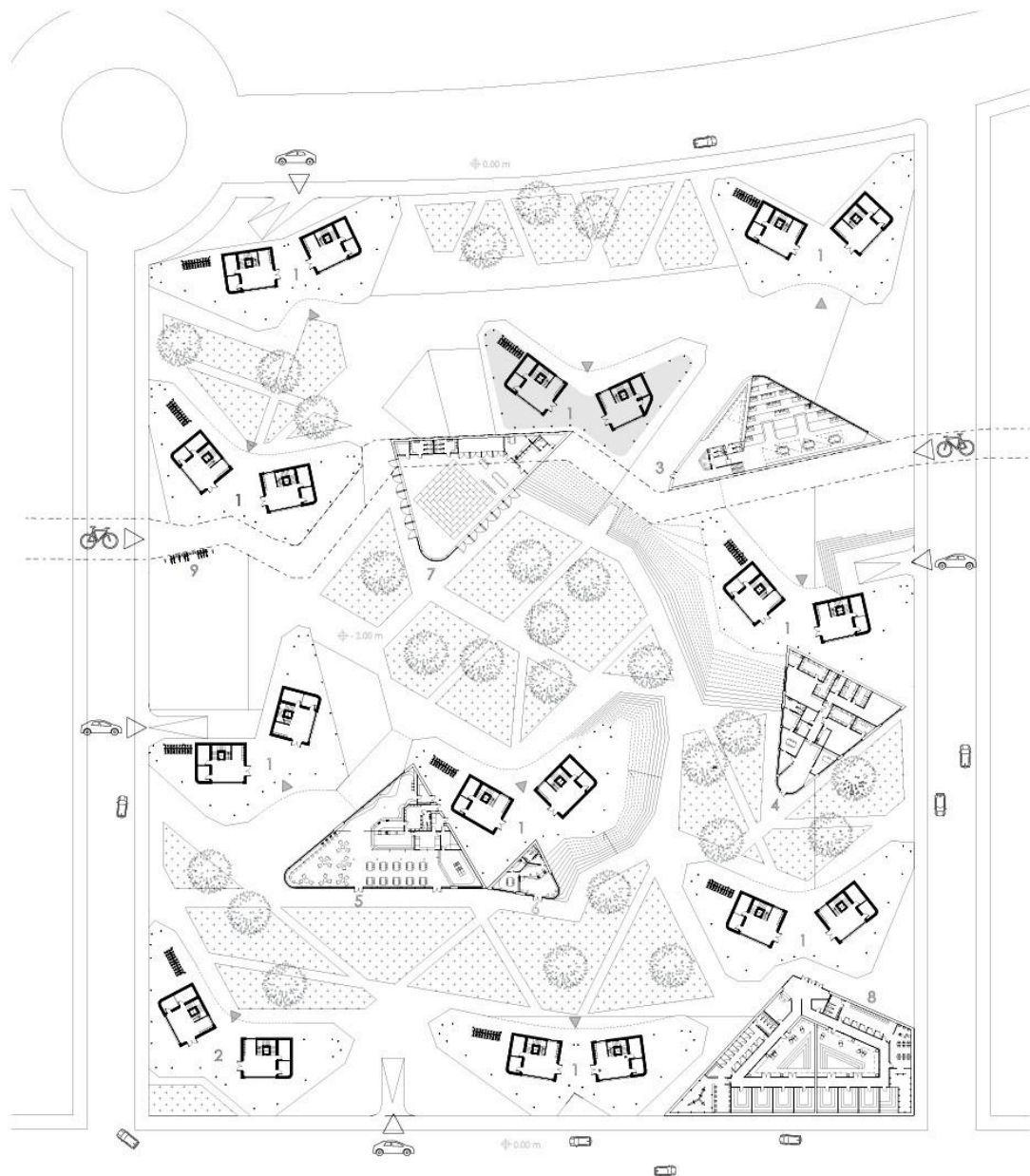
BICYCLE PATH	1095 m ²
ASTANA BIKE STATION	29 m ²
VEGETATION	5053 m ²
TOTAL	6 177 m²

AREA OVERVIEW

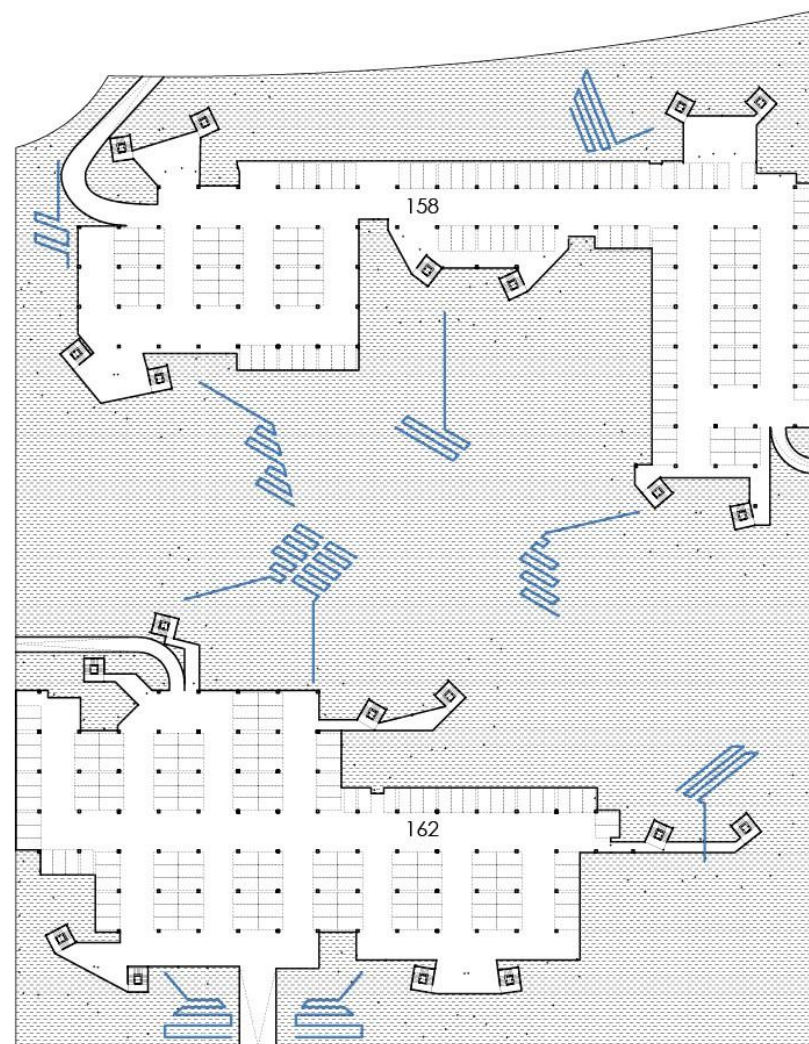
TOTAL SITE	31 000 m ²
BUILT AREA (28.1%)	8 715 m ²
GROSS FLOOR AREA	30 030 m ²
EXTERIOR PROGRAMMED AREA	6 177 m ²

OPEN GROUND COEFFICIENT (28.6%)	0.286
BUILT AREA COEFFICIENT (28.1%)	0.281

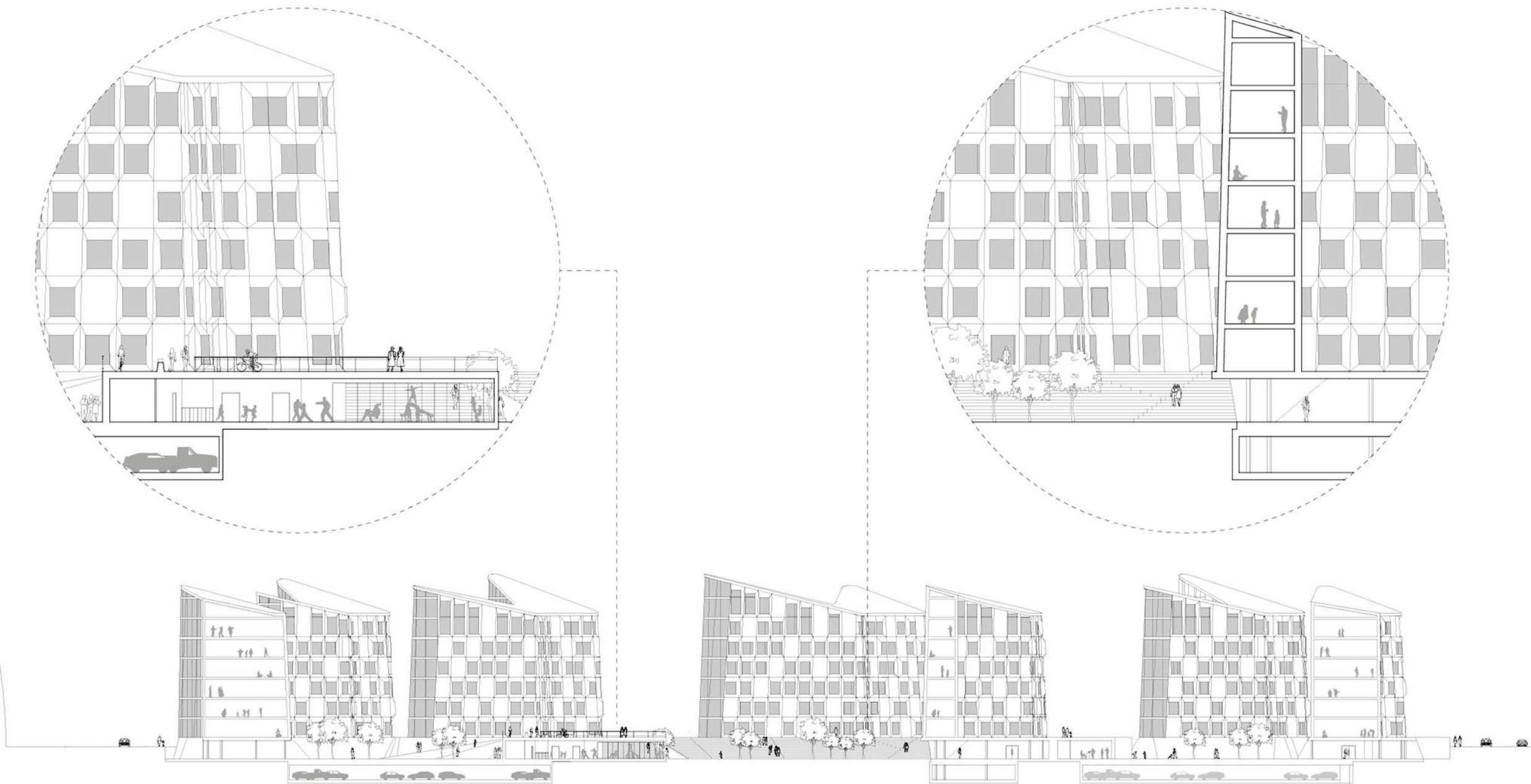
- | | |
|--------------------|-----------------------|
| 1 Housing building | 6 Caretaker |
| 2 Student Home | 7 Community Centre |
| 3 Library | 8 Banya |
| 4 Kindergarten | 9 Astana Bike Station |
| 5 Eat Shop Café | |



GROUND FLOOR PLAN / ACCESS TO SITE



BASEMENT PARKING PLAN



LONGITUDINAL SECTION / SITE



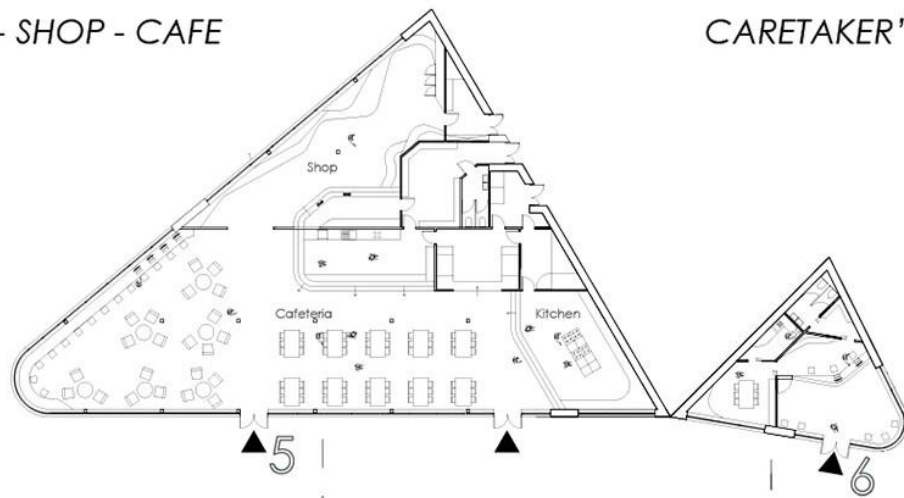
ZOOM IN

the programs

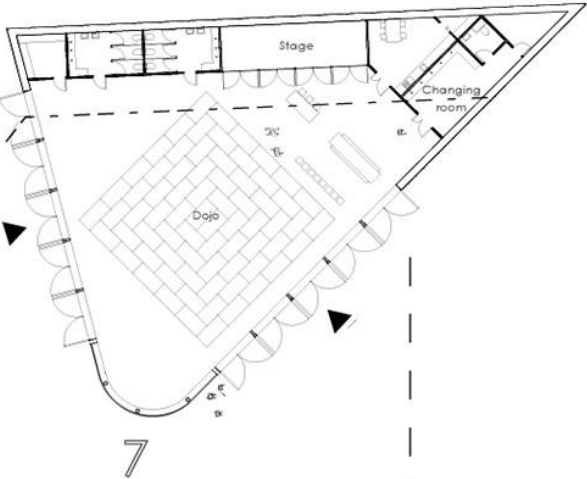
EAT - SHOP - CAFE

CARETAKER'S OFFICE

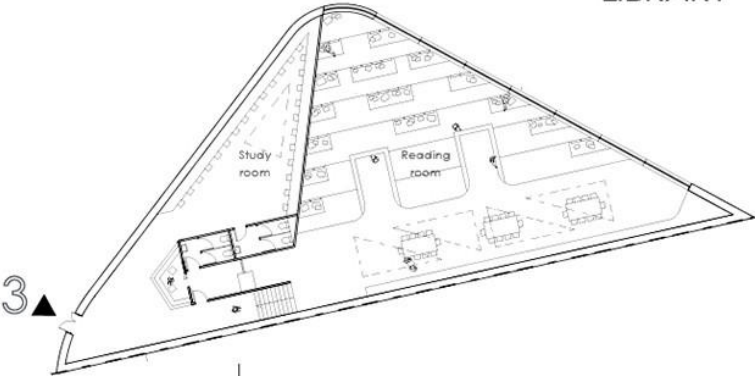
BANYA



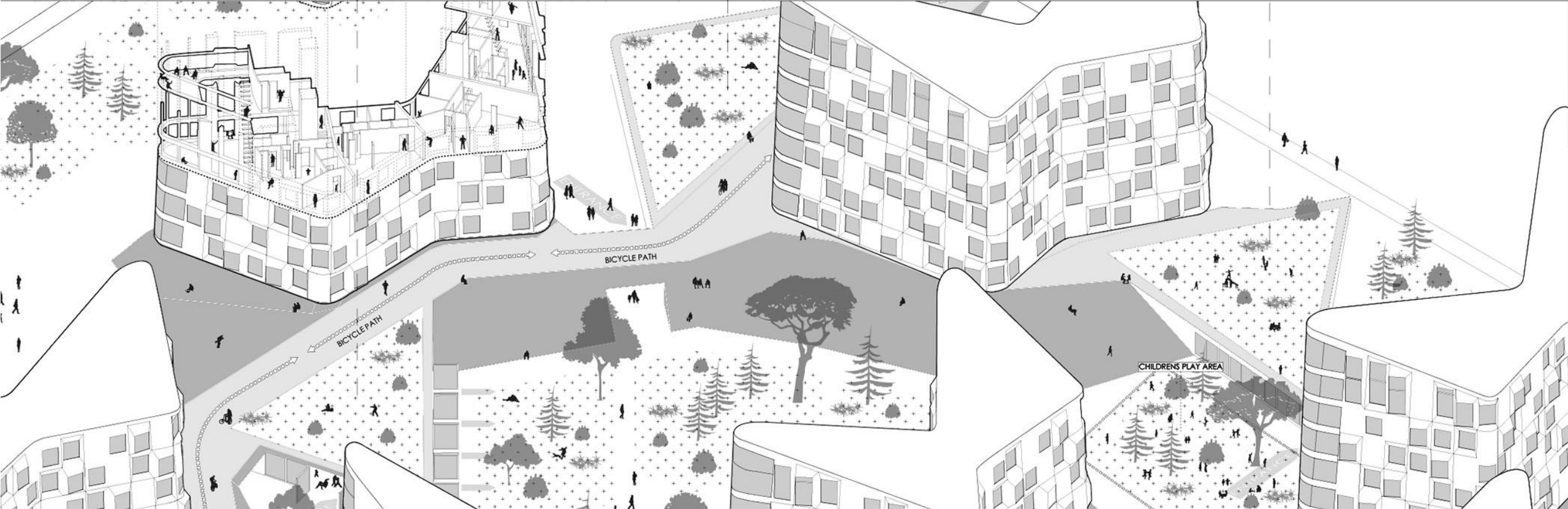
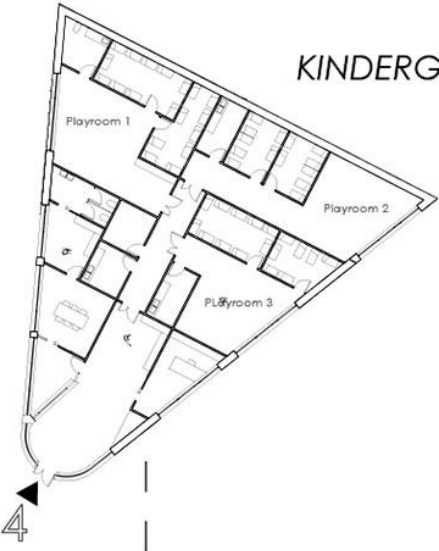
COMMUNITY CENTRE/DOJO



LIBRARY



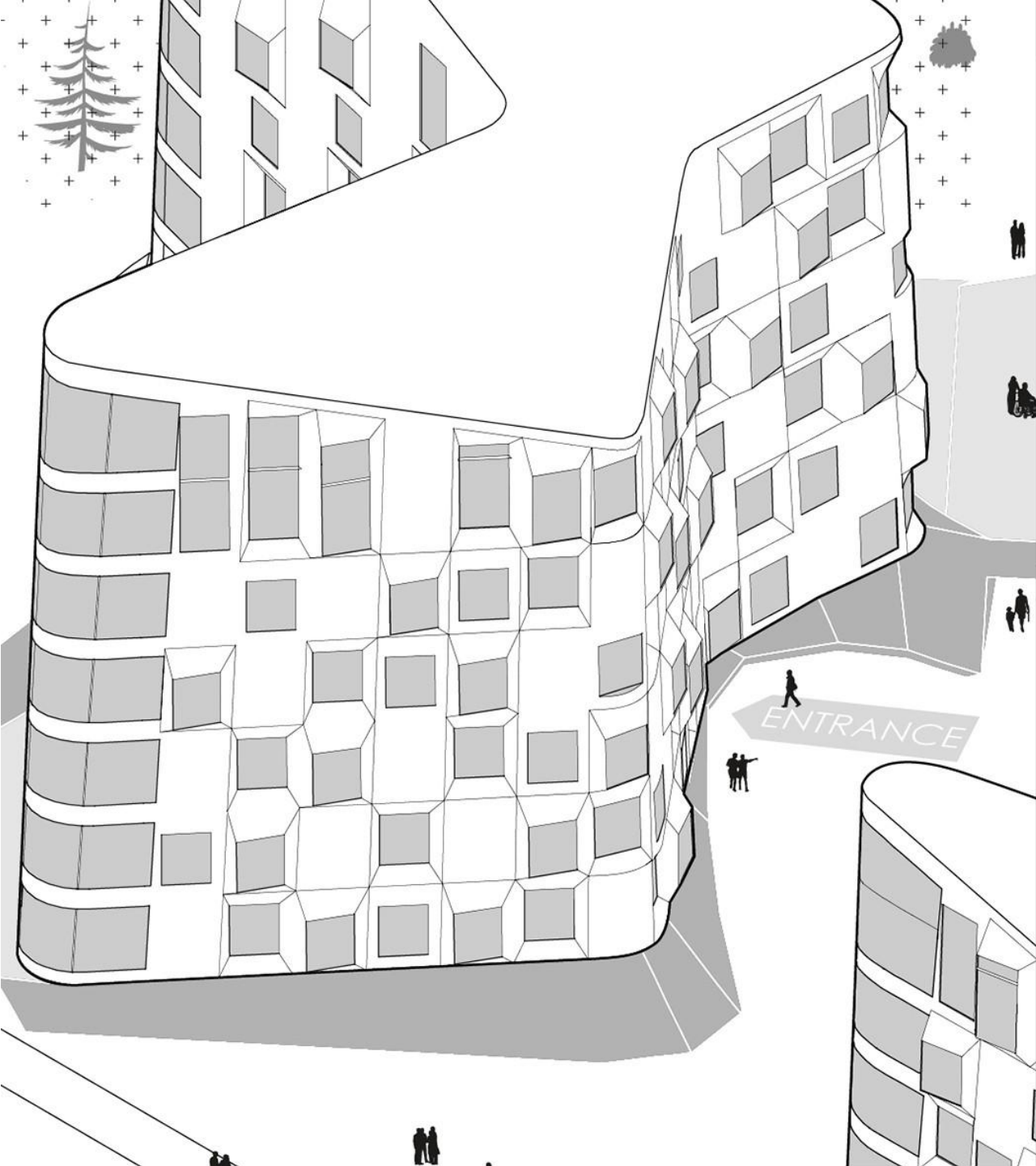
KINDERGARTEN



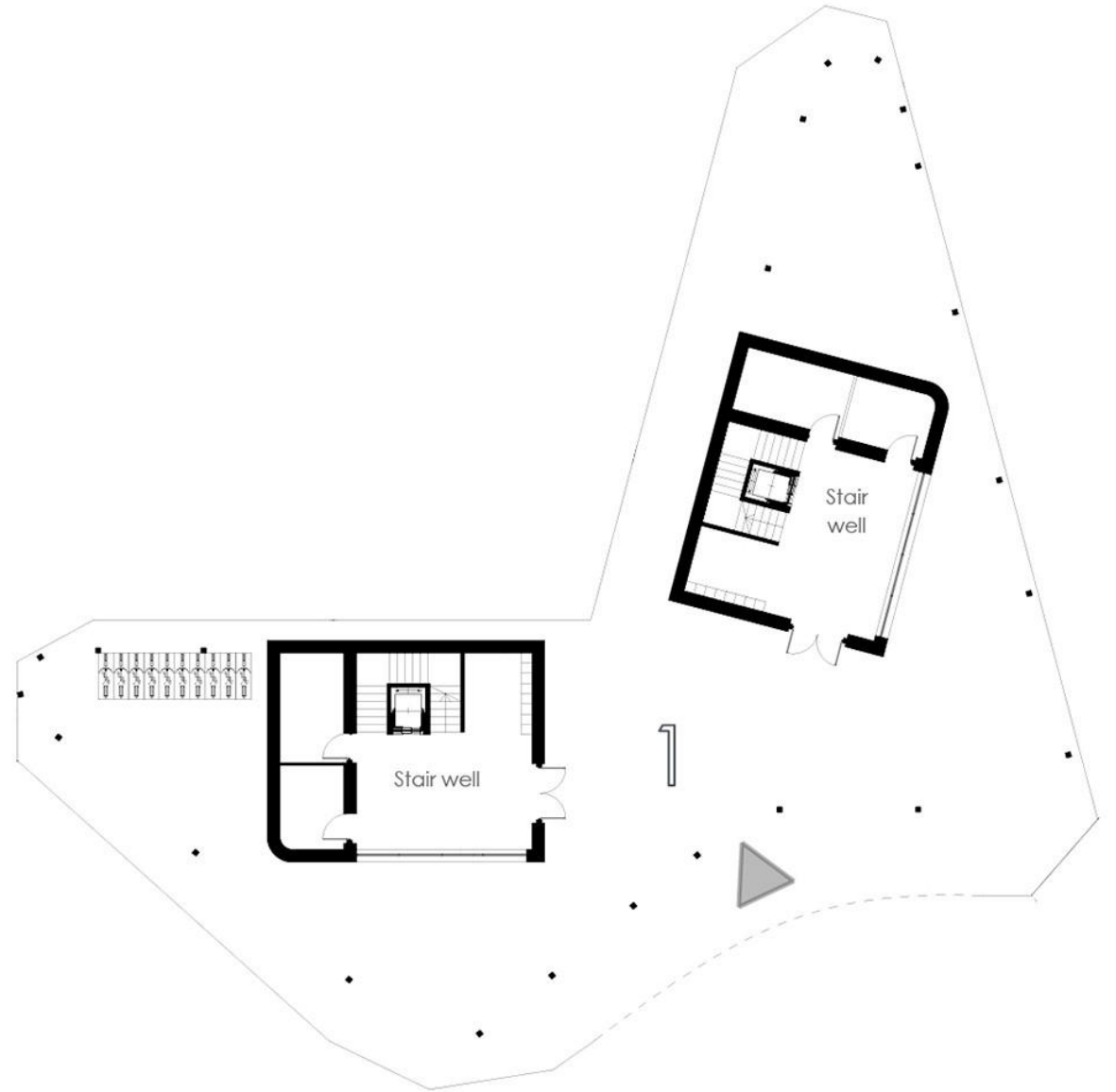


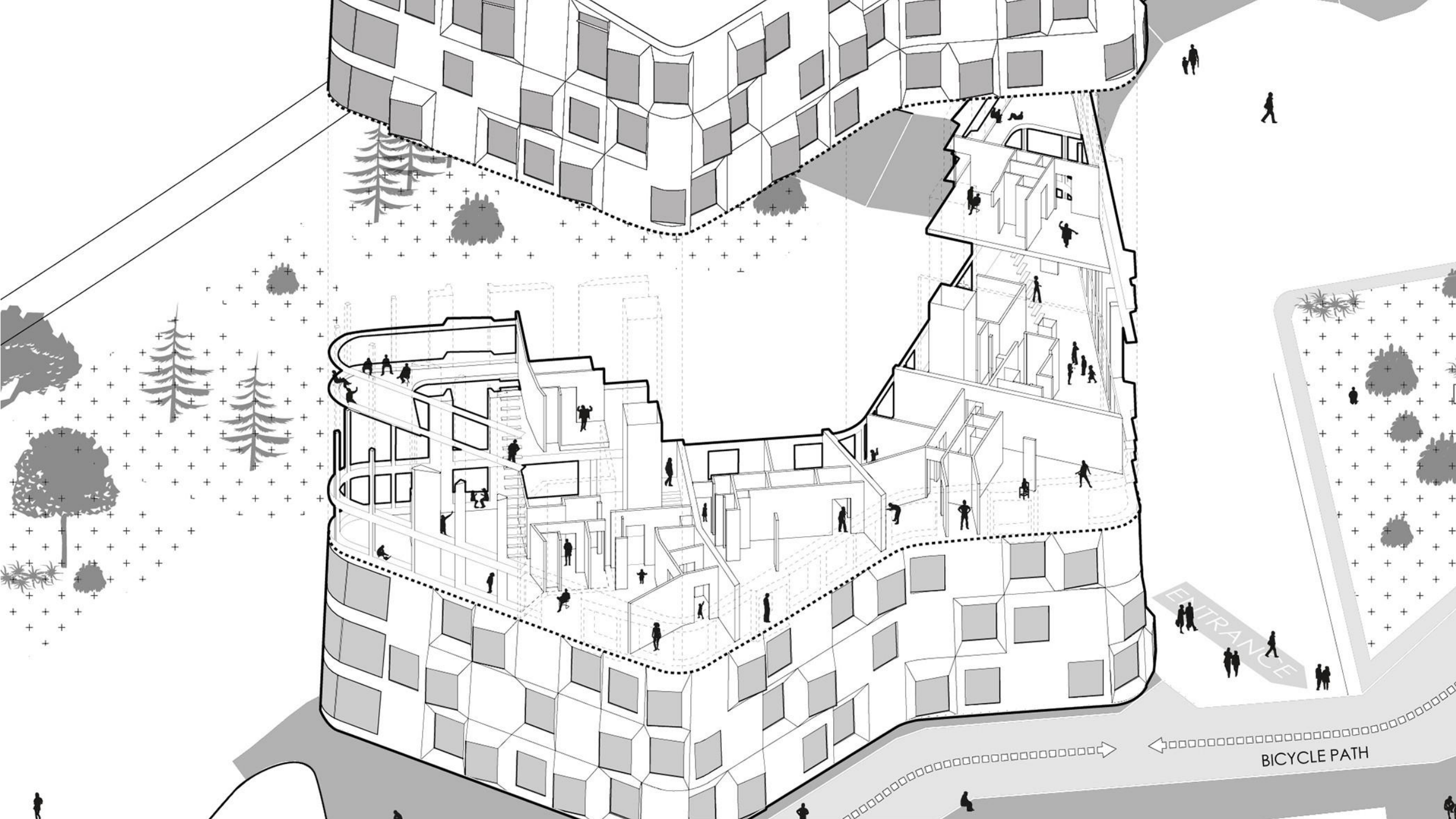
ZOOM IN

the housing



ENTRANCE HALL





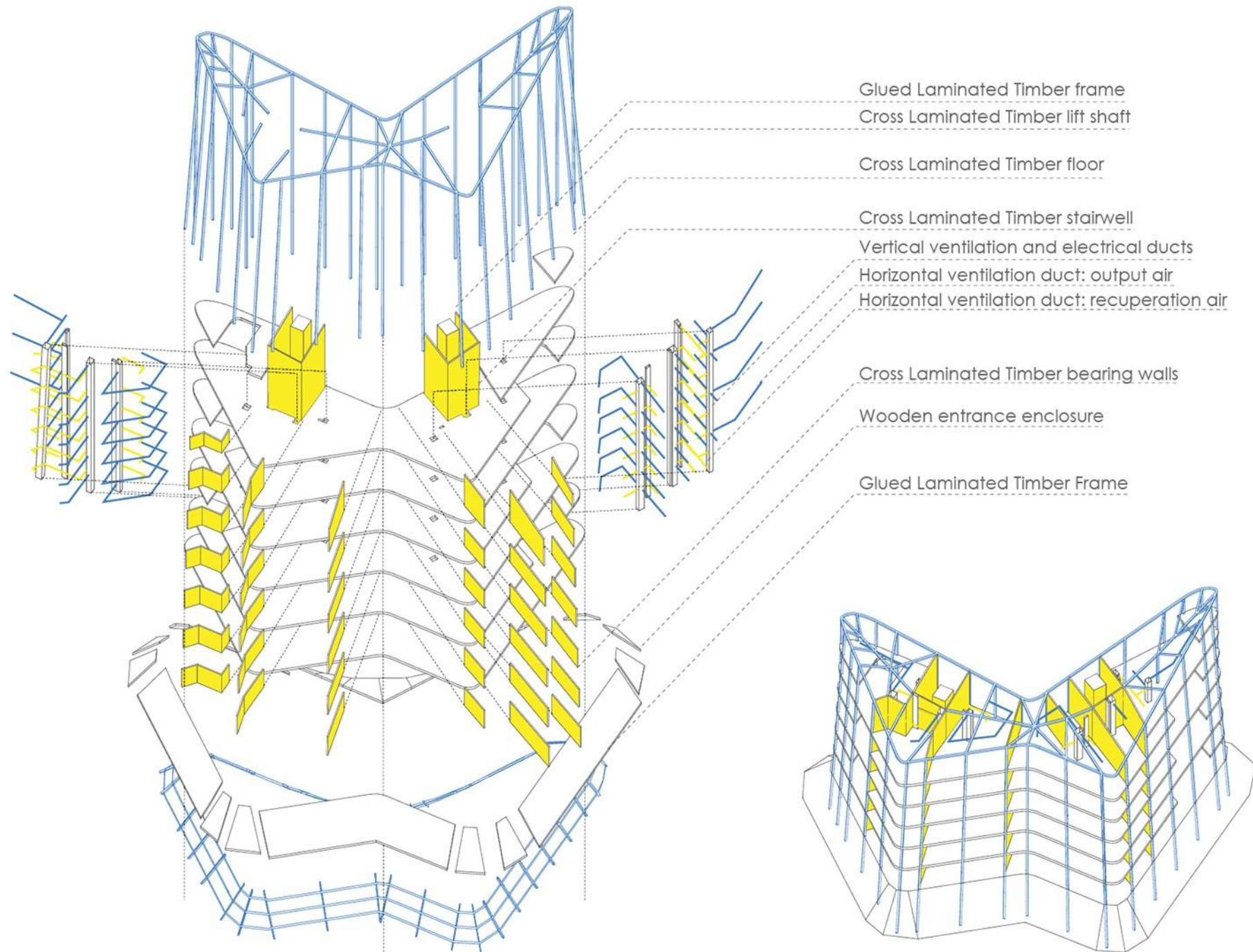


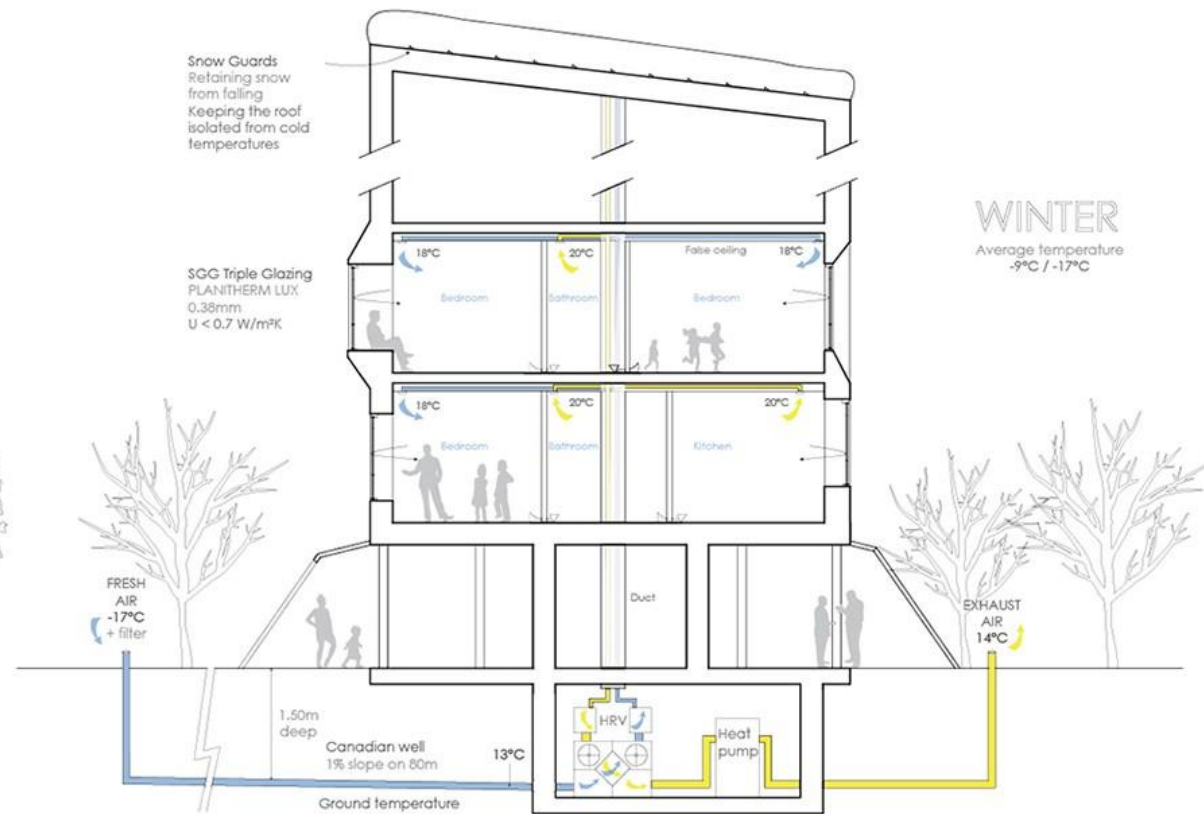
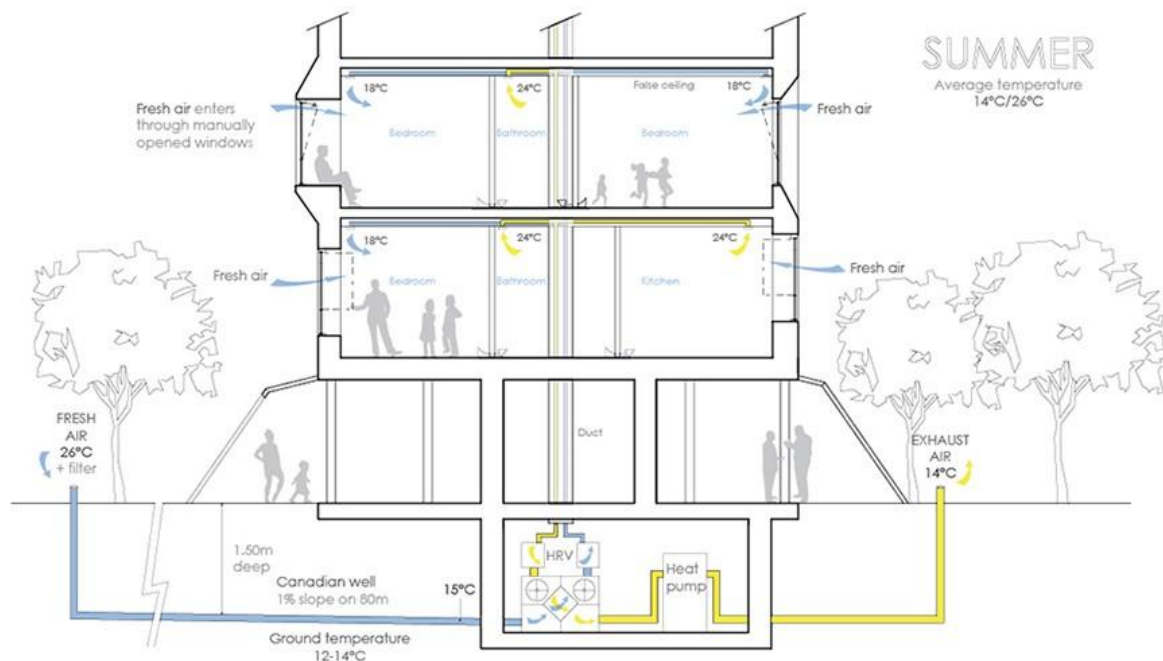
4TH FLOOR PLAN /
MEZZANINE LEVEL



APARTMENT /
PERSPECTIVE SECTION

TECHNICAL CRITERIA





Heating / Cooling

Air quality

Level of indoor CO2

Airflow

Airtightness

Thermal insulation

Hourly ventilation rate

Air change rate

Day time ventilation

Night time ventilation

Canadian well + HRV

Natural ventilation with HRV

< 1000 ppm

30 cm/h/p

0,6 V/h

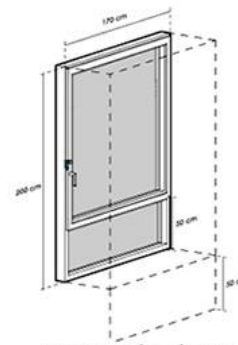
U < 0.10 kWh/am² - Thermal Bridge Free

3780 m³/h

0.58

Tilted windows - 25% - 1h

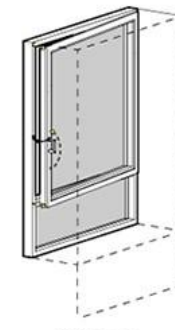
Opened windows - 25% - 1h



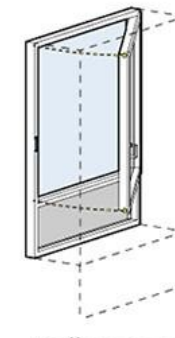
Bay window



Tilted
- safety lock

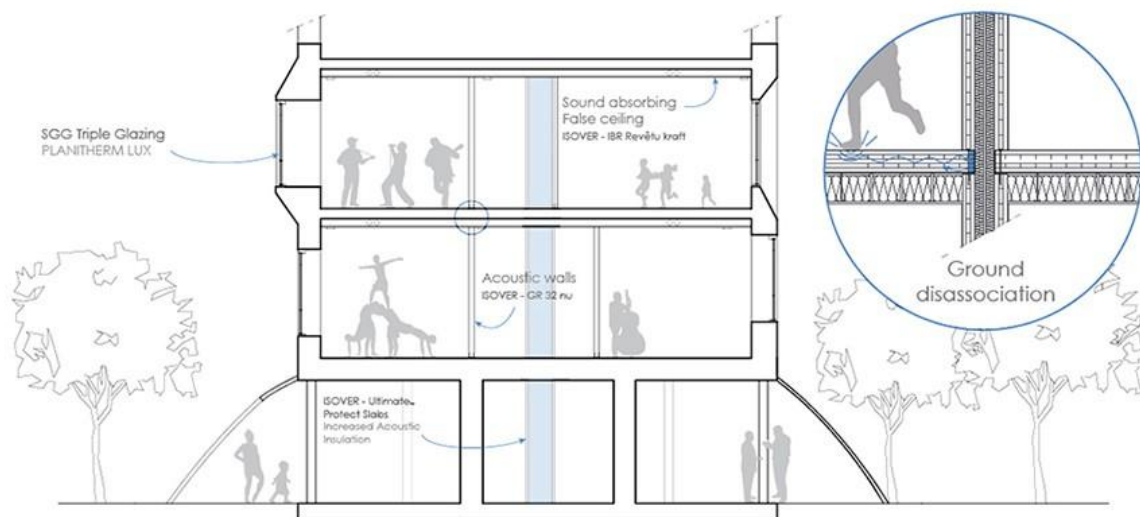


Open
- safety lock



Fully open
- guard rail

THERMAL COMFORT / VENTILATION STRATEGY



Impact

Sound absorbing suspended ceiling

Airborne

Insulation between dwellings 70.5 dB (33.5 + 37)

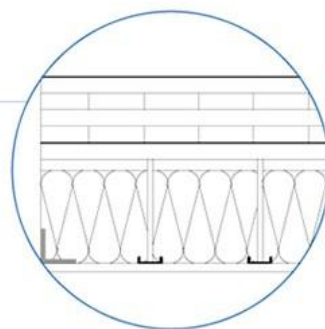
Insulation between rooms 57.5 dB (24.5 + 33)

Exterior $25 < L < 20$ dB

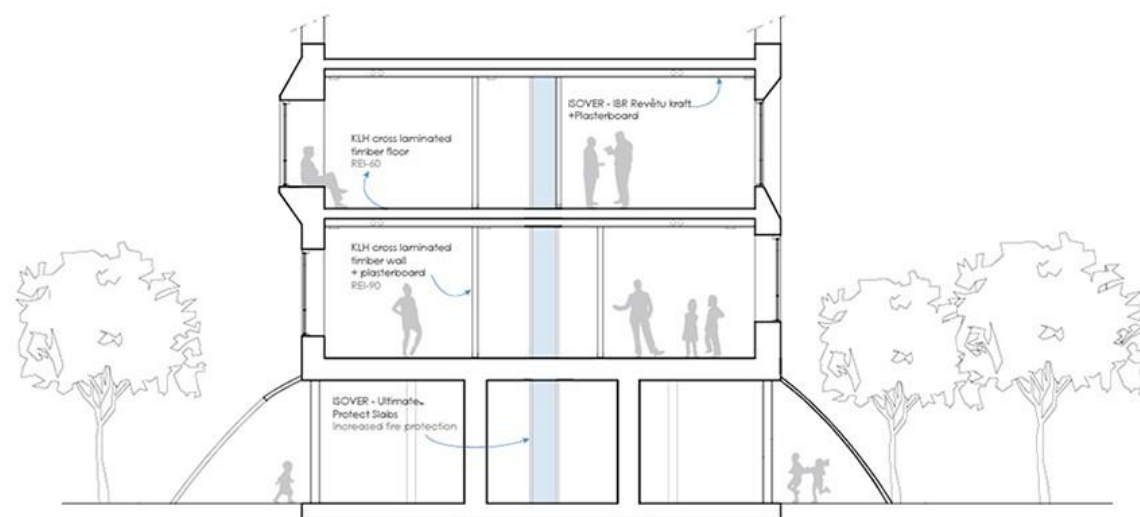
Noise from technical equipment

Ducts + Elevators are insulated with mineral wool

ISOVER - Ultimate Protect Slabs



- 150 Cross laminated timber floor KLH
- ISOVER - Suspente integra
- 120 ISOVER - IBR Revêtu kraft (Mineral wool)
- ISOVER - Fourrure Optima 240
- L ISOVER - Lisse clip Optima
- 15 Plasterboard



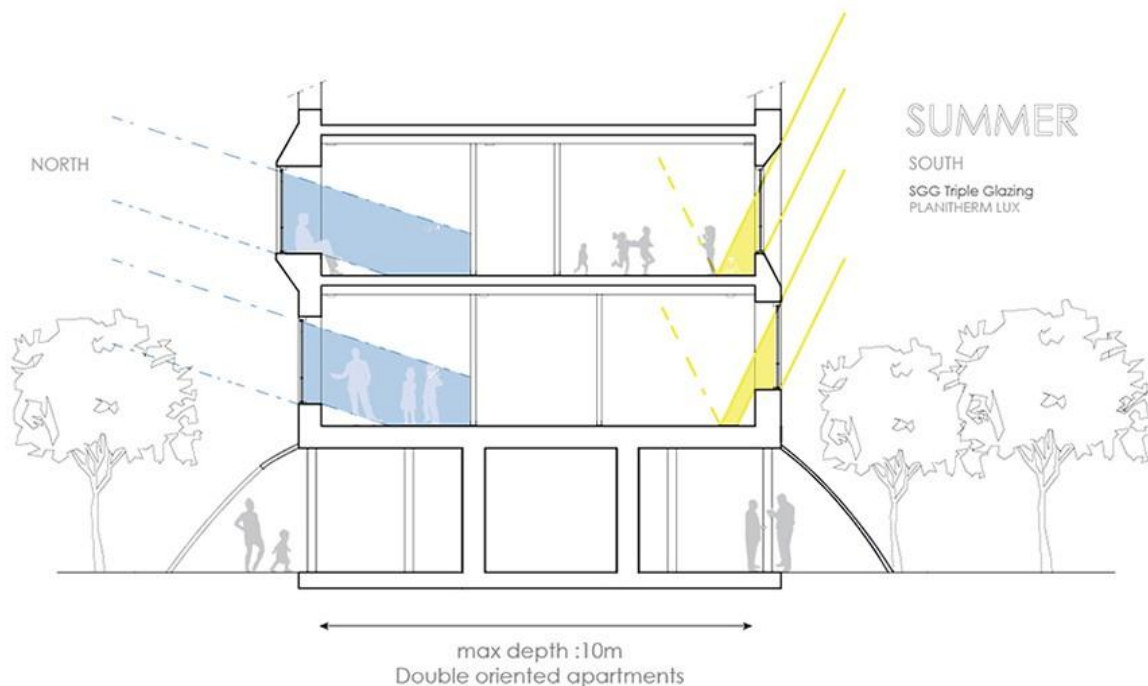
Fire resistance

KLH cross laminated timber wall : REI-90

+ Plasterboard fire protection of 15mm

KLH cross laminated timber floor : REI-60

Wood burns in a predictable way : once a layer of char has formed, the wood beneath is protected from the heat and the section remains structurally sound. The layer of char can be factored into the structural calculation in order to achieve the desired fire rating.



SGG Triple Glazing
PLANITHERM LUX 0.38mm

$U < 0.7 \text{ W/m}^2\text{K}$

Saint-Gobain Glazing
Visible Transmittance

73%

Daylight Autonomy

> 60%

Average Daylight Factor

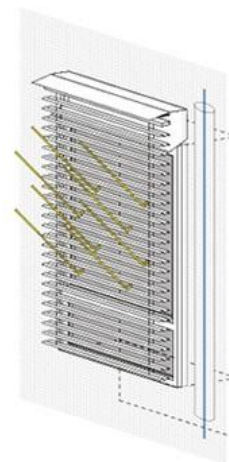
6,2

Southern Solar Shading device

6,5



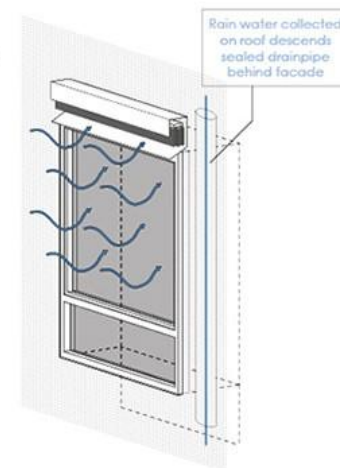
Woven stainless steel façade reflects diffuse light into north oriented buildings and public spaces.



Soliso orientable external horizontal blinds on south facing windows.

Angled slats reduce over-heating whilst directing diffuse light towards the ceiling.

Blind retracts automatically when sensor detects increased wind that might lead to damage to blind or window.



DAYLIGHTING

A. PROJECT DATA

Object : Housing
Climate Zone : Astana
Construction : New Building
Building Type : Residential
Usage : For Living
Interior Temperature : 20°C

B. AREA INPUT

Sum of Living Area : 2202 m²
Sum of Heated Space Volume : 6495.90 m³
V/A Ratio : 2.95
Sum of Thermal Envelope : 4147.09 m²

C. OPAQUE ELEMENTS (MEAN U-VALUES)

Mono-pitched roof : 0.12
Wall against air : 0.09
Slab against unheated cellar : 0.16

D. WINDOWS / DOORS (MEAN U-VALUES)

Windows : 0.70
Doors : 0.70

E. QUALITY

Airtightness Rate : 0.60
Thermal Bridge Free : Yes

F. SHADING

South-East : 0.07
- Jalousie Slats - mounted outside window : 0.1
South-West : 0.70
South : 0.53
North-West : 0.70

G. HVAC

η Heat Recovery System : 95.00
η Subsoil Heat Exchanger : 33.00 (80m)

H. CALCULATIONS

Transmission Heat Losses : 117 027.62 kWh/a
Ventilation Heat Losses : 16 744.88 kWh/a
Total Heat Losses : 133 772.51 kWh/a
Internal Heat Gains : 24 748.72 kWh/a
Available Solar Heat Gains : 93 853 kWh/a
Total Heat Gains : 104 276.11 kWh/a
Annual Heat Demand : - 29 496.39 kWh/a

Specific Annual Heat Demand : 13.40 kWh/a per m²

I. OVERHEATING CALCULATIONS

Exterior Thermal Transmittance : 801.38 W/K
Ground Thermal Transmittance : 43.04 W/K
Exterior Ventilation Transmittance : 1003.23 W/K
Ground Ventilation Transmittance : 282.96 W/K
Solar Aperture : 193.26 m²

Frequency of Overheating : 0.00%
Overheating limit = 24°C (25°C required)

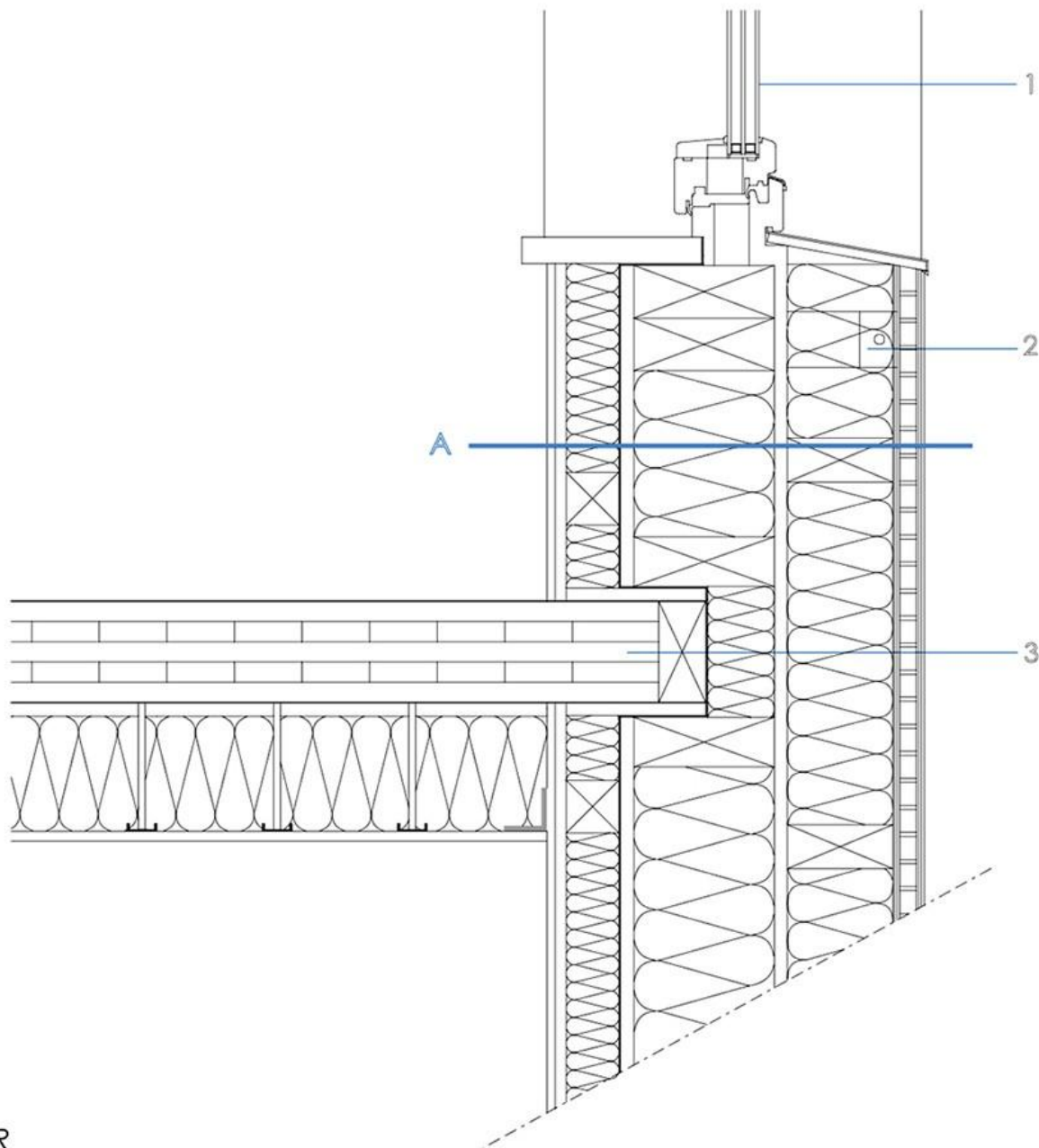


ENERGY EFFICIENCY CLASSES

MULTI-COMFORT DESIGNER:

STEEL BUTTERFLIES PERFORMANCE SIMULATION - OVERVIEW PALETTE

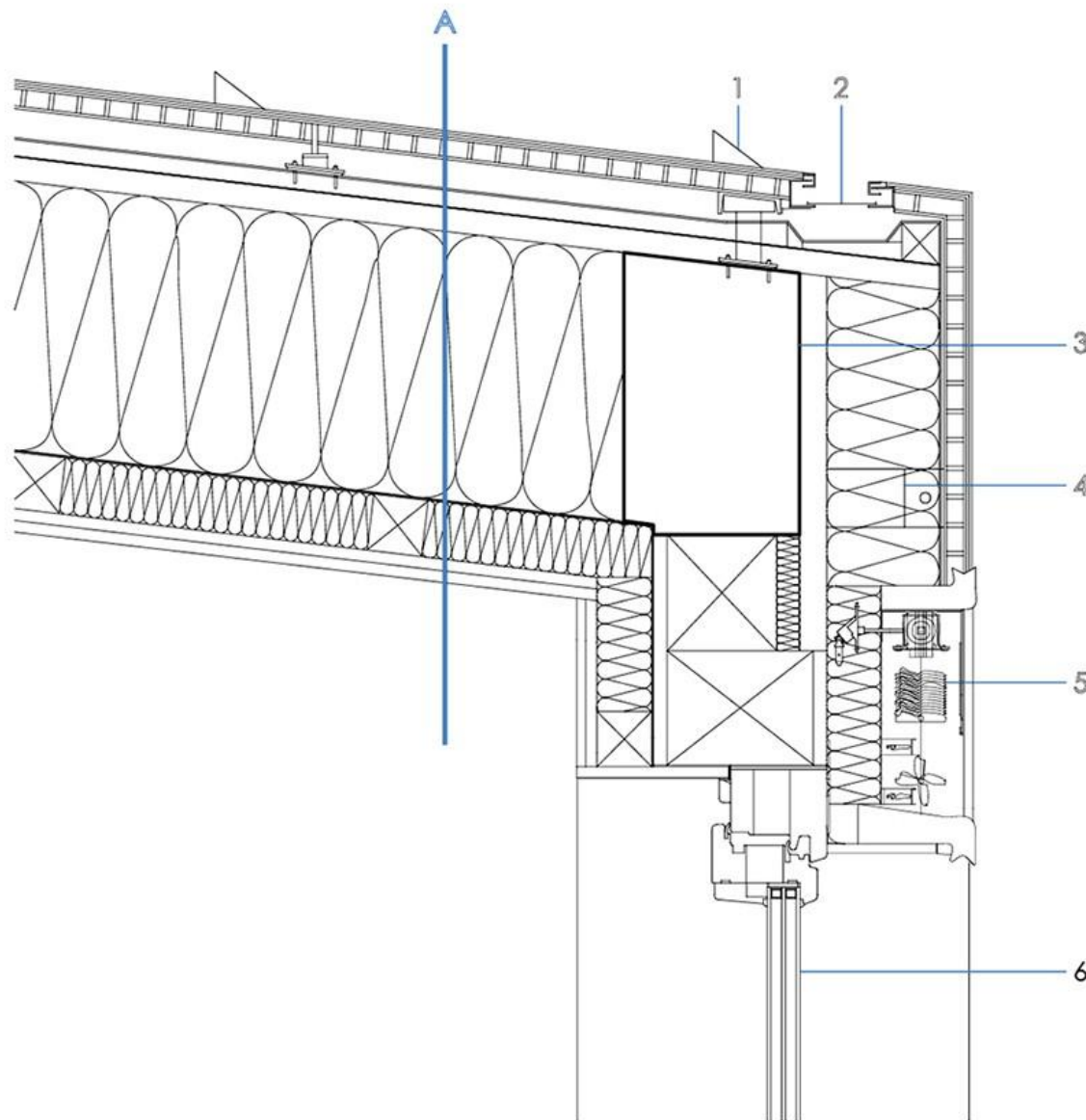
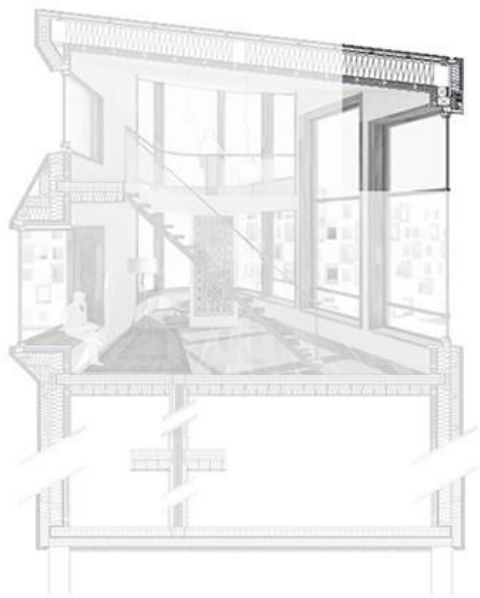
DETAILS



Section A (mm)

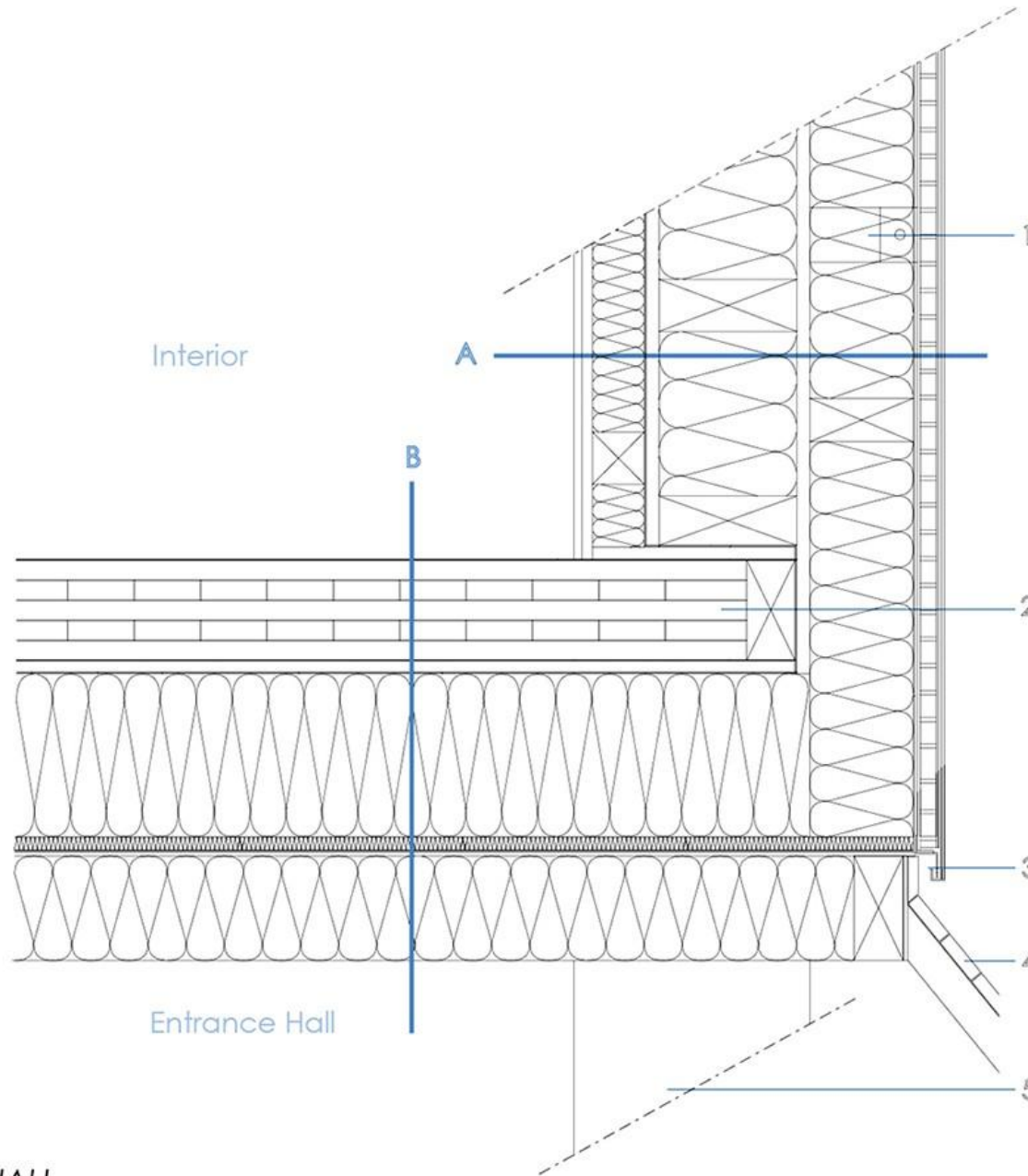
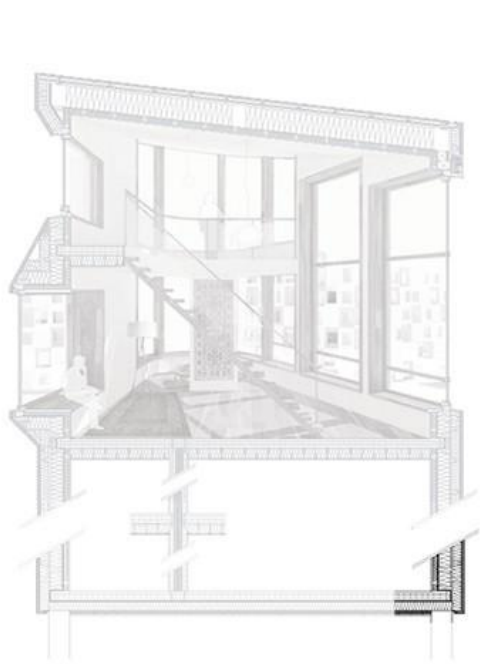
- | | |
|-----|---|
| 25 | Rigips Rigidur H double layer |
| 60 | ISOVER - Integra UKF 1-032 |
| | ISOVER - Sealer Vario KM |
| | Duplex UV |
| 15 | OSB board |
| 160 | ISOVER - Isofaçade Noir 35R |
| 15 | OSB board |
| 120 | Kontur FSP 1-032 Easy Fix 120 |
| 28 | GRP grating (40/40mm mesh)
+ Supporting structure for GPR
grating (steel T-sections, steel
angles) |
| 08 | Stainless-steel mesh
(50/0.4mm flat strips) |
| 1. | 38 mm - Triple glazing
SGG PLANITHERM LUX |
| 2. | Galvanized steel fixing lugs
50/6 mm and 110/6mm |
| 3. | Cross laminated timber floor |

WINDOW / EXTERIOR WALL / FLOOR



Section A (mm)

- | | |
|-----|---|
| 08 | Stainless-steel mesh
(50/0.4mm flat strips) |
| 28 | GRP grating (40/40mm mesh)
+ Supporting structure for GPR
grating (steel T-sections, steel
angles) |
| 50 | Counter battens 5/8
+ ISOVER - Integra ZUB under-
lay sheeting |
| 48 | Solid timber panelling |
| 260 | ISOVER - Integra ZKF 1-032
+ ISOVER - VARIO KM Duplex
UV |
| 60 | ISOVER - Integra UKF 1-032 |
| 05 | Rigips Rigidur H double layer |
| 1. | Snow guard |
| 2. | Stainless-steel perforated
sheeting |
| 3. | Glued laminated timber
beam |
| 4. | Galvanized steel fixing lugs |
| 5. | 50/6 mm and 110/6mm
External Orientable Blinds |
| 6. | 38 mm - Triple glazing -
SGG PLANITHERM LUX |



Section A (mm)

- 25 Rigips Rigidur H double layer
- 60 ISOVER - Integra UKF 1-032
+ ISOVER - Sealer Vario KM
Duplex UV
- 15 OSB board
- 160 ISOVER - Isofaçade Noir 35R
- 15 OSB board
- 120 Kontur FSP 1-032 Easy Fix 120
- 28 GRP grating (40/40mm mesh)
+ Supporting structure for GPR
grating (steel T-sections, steel
angles)
- 08 Stainless-steel mesh
(50/0.4mm flat strips)

Section B (mm)

- 150 Cross laminated timber
floor KLH
 - 30 ISOVER - Akustic EP 1
ISOVER - Sealer Vario KM
Duplex UV
 - 200 ISOVER - Exporit EPS 100/035
Wood battens
 - 15 OSB board
 - 120 ISOVER - Topdec DP1 032
ULTIMATE
1. Galvanized steel fixing lugs
50/6 mm and 110/6mm
 2. Cross laminated timber floor
 3. Rear ventilation opening
 4. Entrance hall shelter
 5. Glued laminated timber
beam

WALL / FLOOR ABOVE ENTRANCE HALL

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- thank you -

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