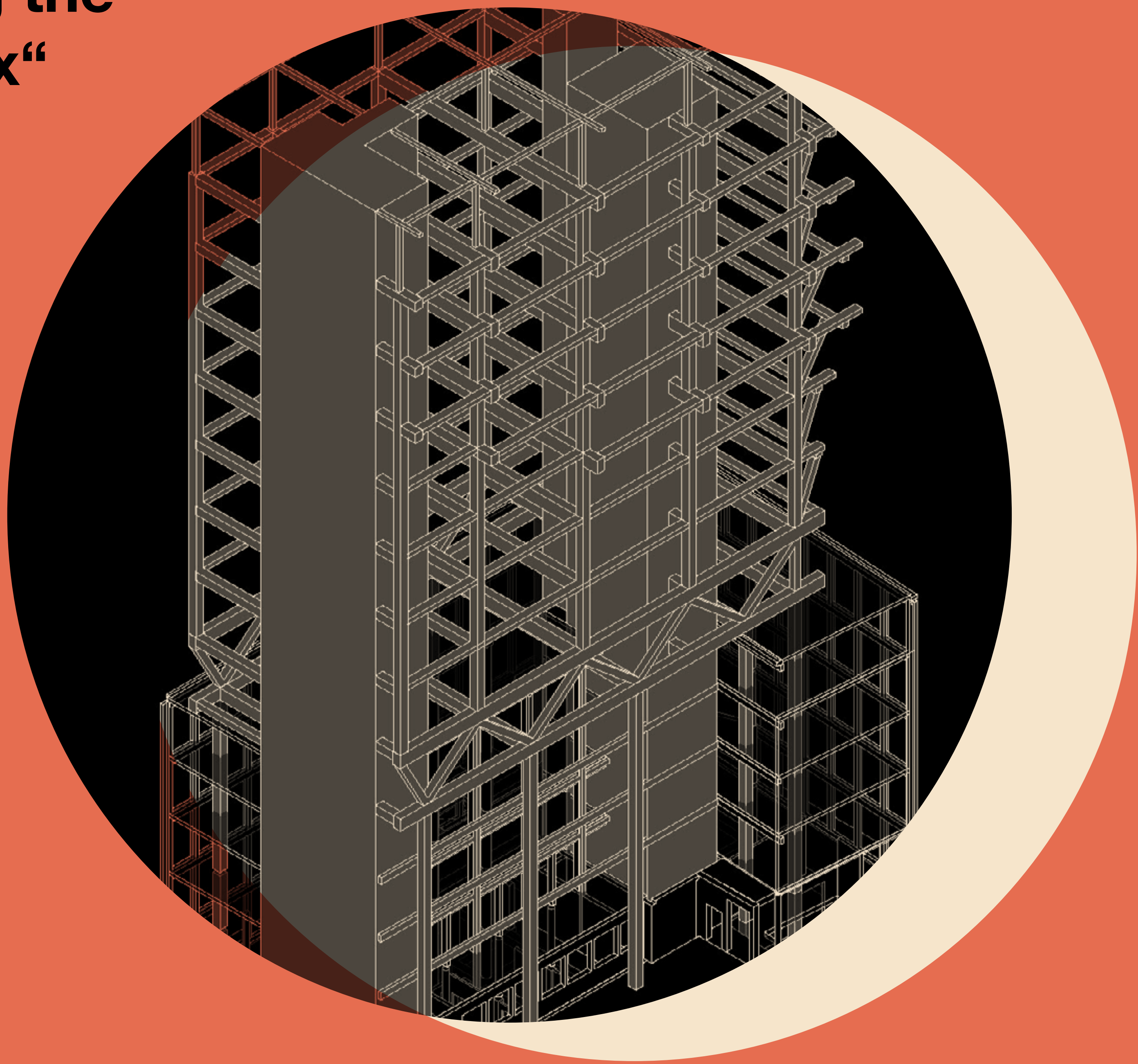
Activating the "glass box"



BUILDING TECHNOLOGY

2021-2022

Aistė Mankutė
4918851

Adapting 20th Century Heritage
Heritage & Architecture | TU Delft

Project:

Activating the “glass box“

The post-war International style office building’s contribution to the future densification challenges of the city centre of Rotterdam

Keywords: post-war reconstruction, authenticity, open plan, densification, adaptability for future uses, active plinth, urban agriculture, Open Building.

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2021 - 2022

Delft | The Netherlands | 2022

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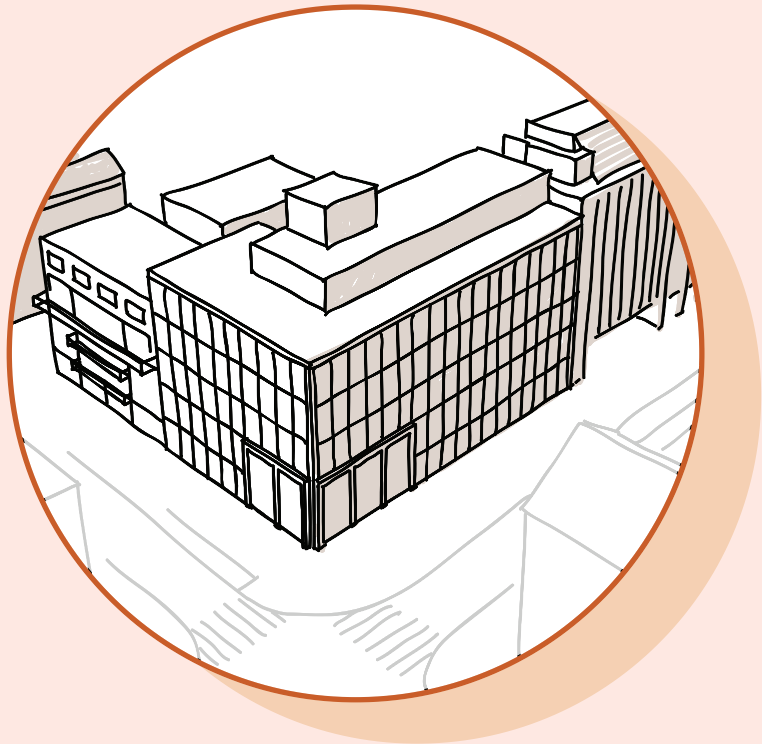
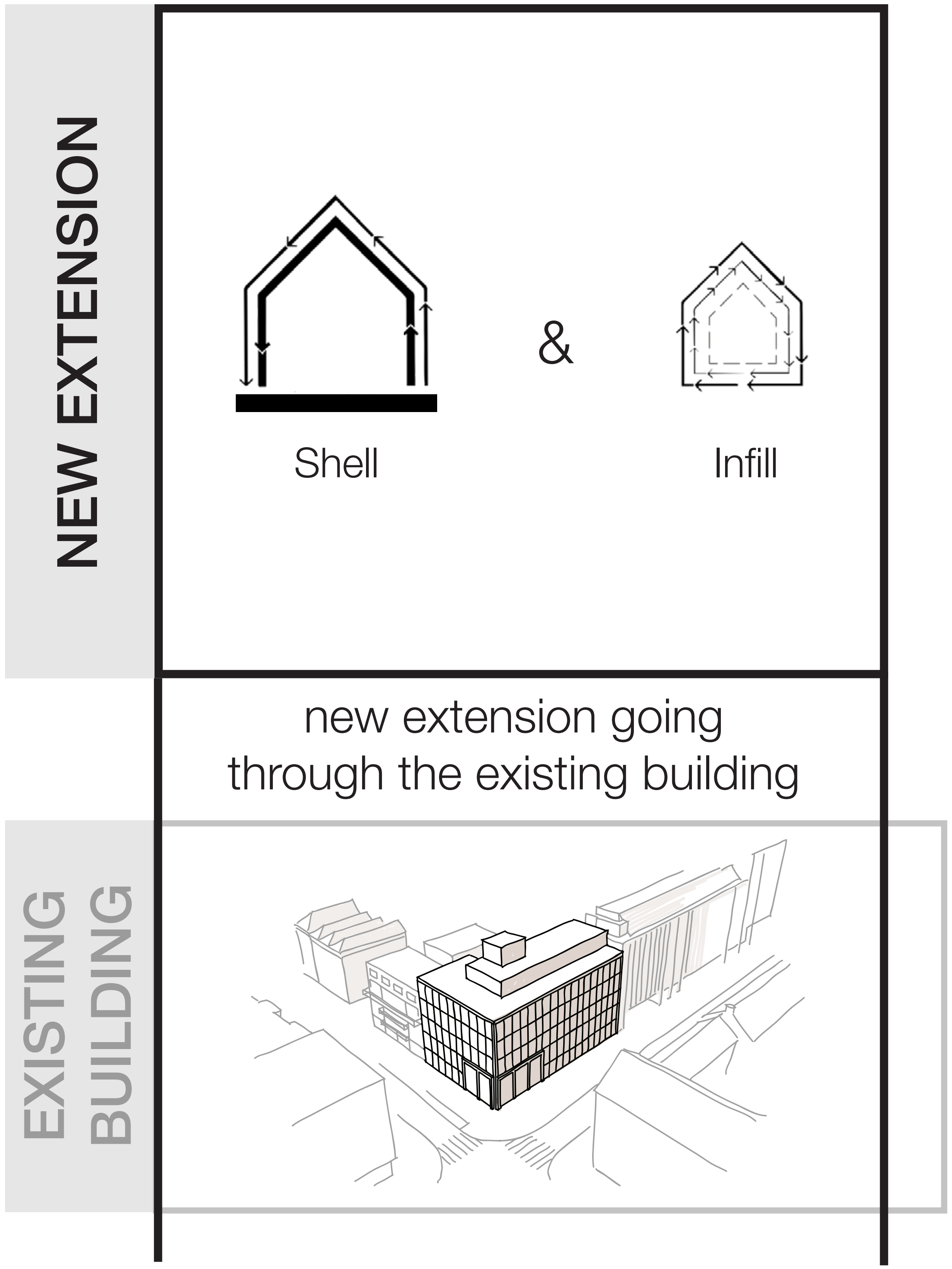


Figure: Sketch of the existing building from the bird's eye view
Source: Own work

1. Design Strategy

Starting points:
technical scale



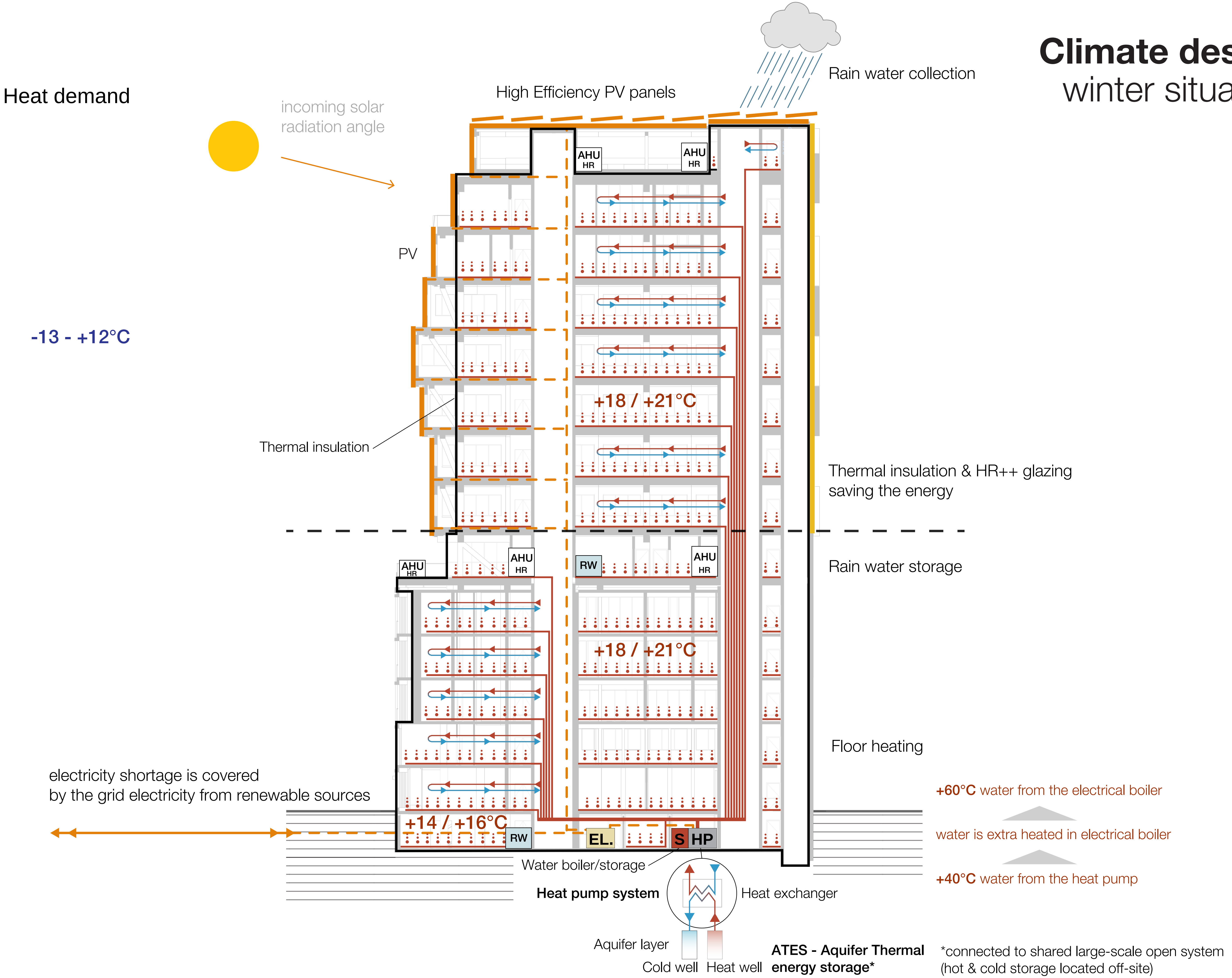
Energy producing building
(generating solar energy, water collection, sustainable materials)

Open Building principles
(access floors, high storey height, adaptability)

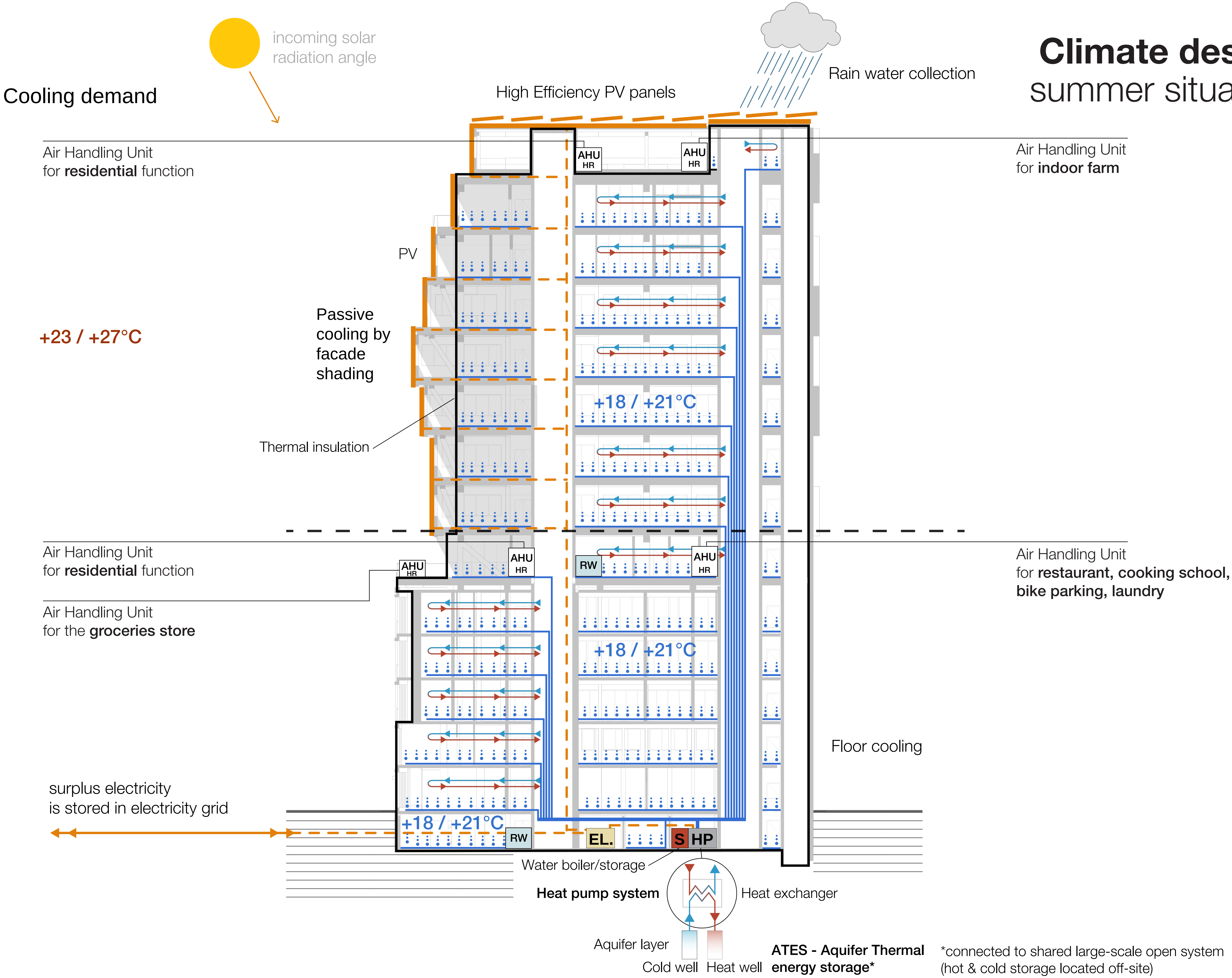
Insulating & Improving
(more efficient heating and ventilation system, strenghtening the existing elements where needed)

2. Climate design

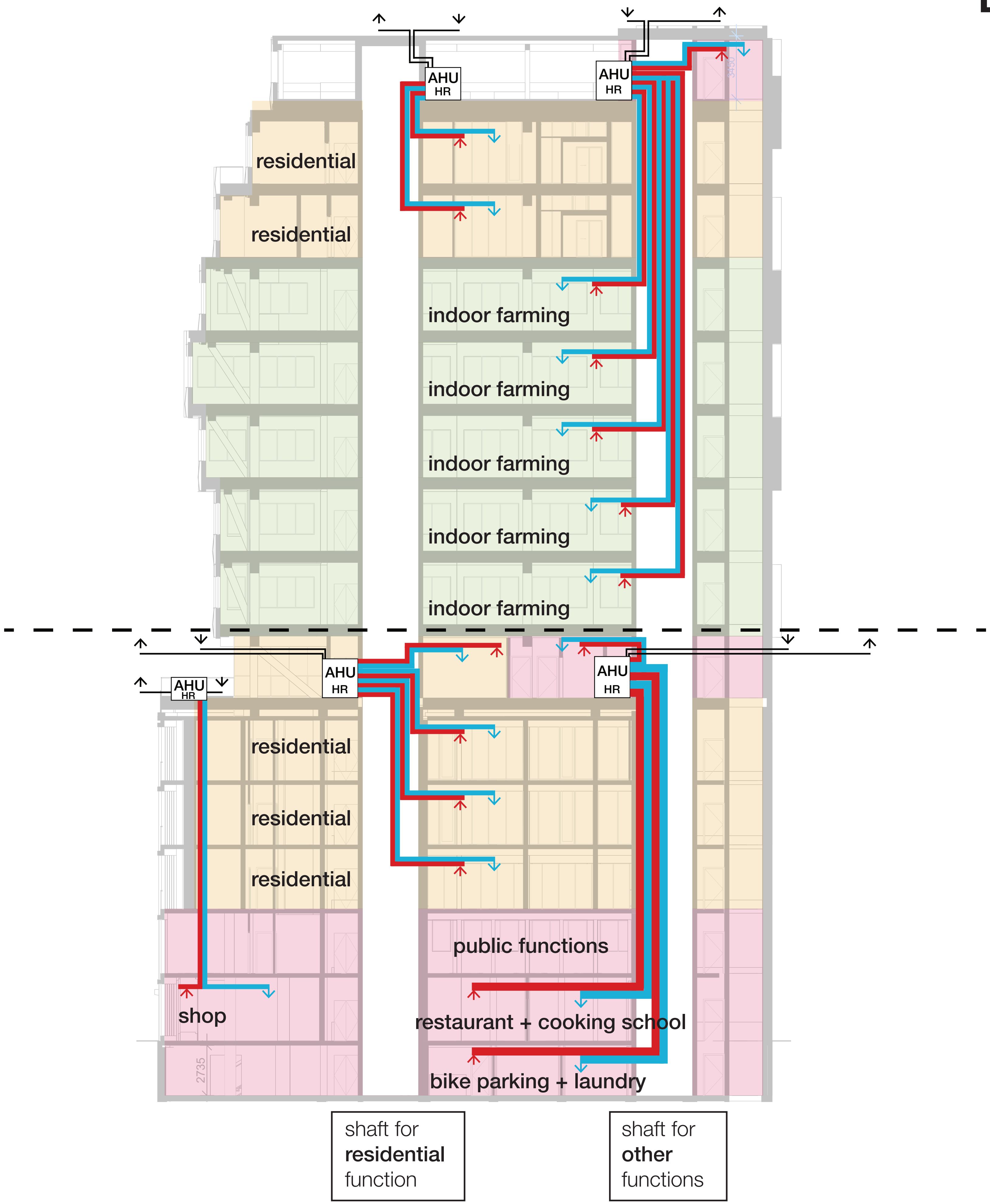
Climate design
winter situation



Climate design
summer situation



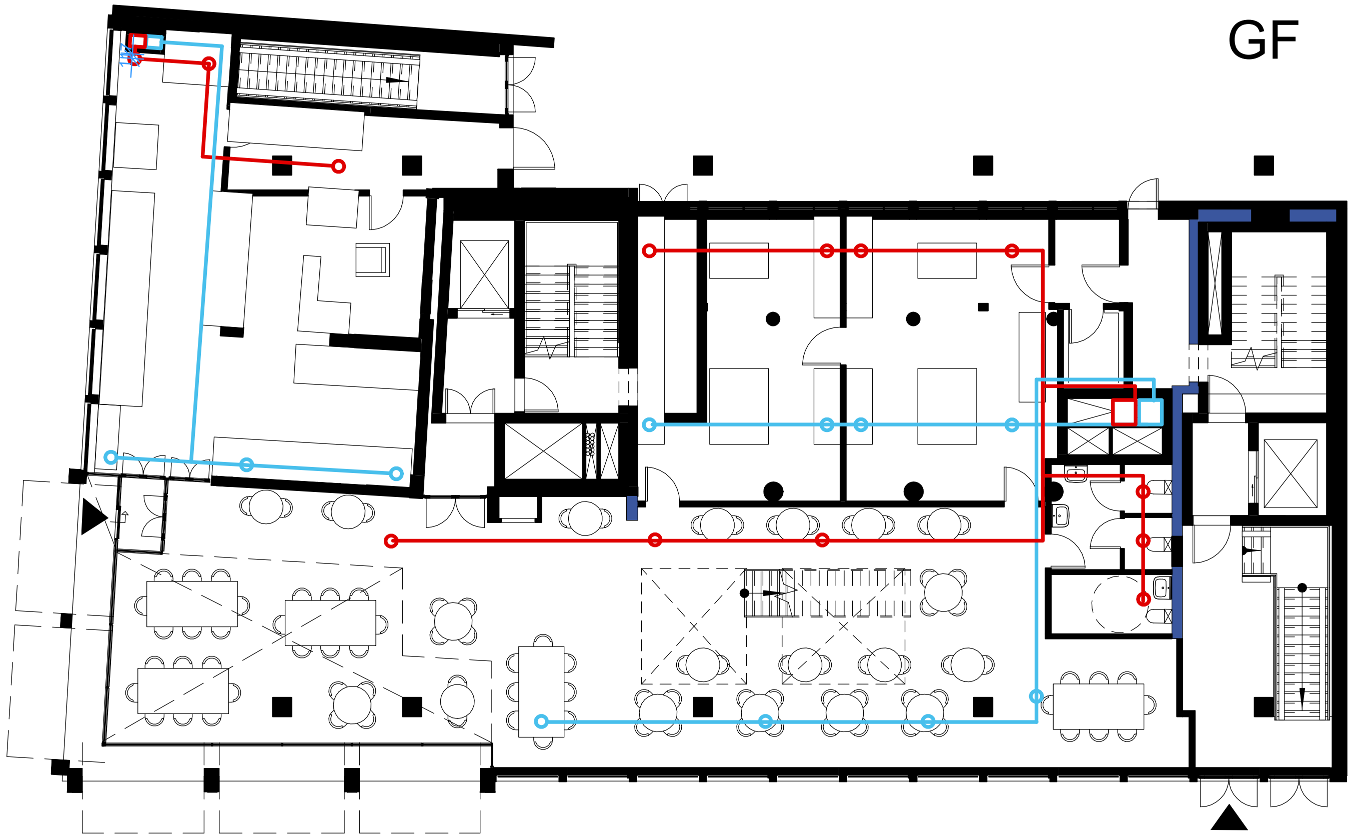
Building technology
Ventilation strategy
longitudinal section



SC 1:250

Building technology
Ventilation strategy
plans

GF



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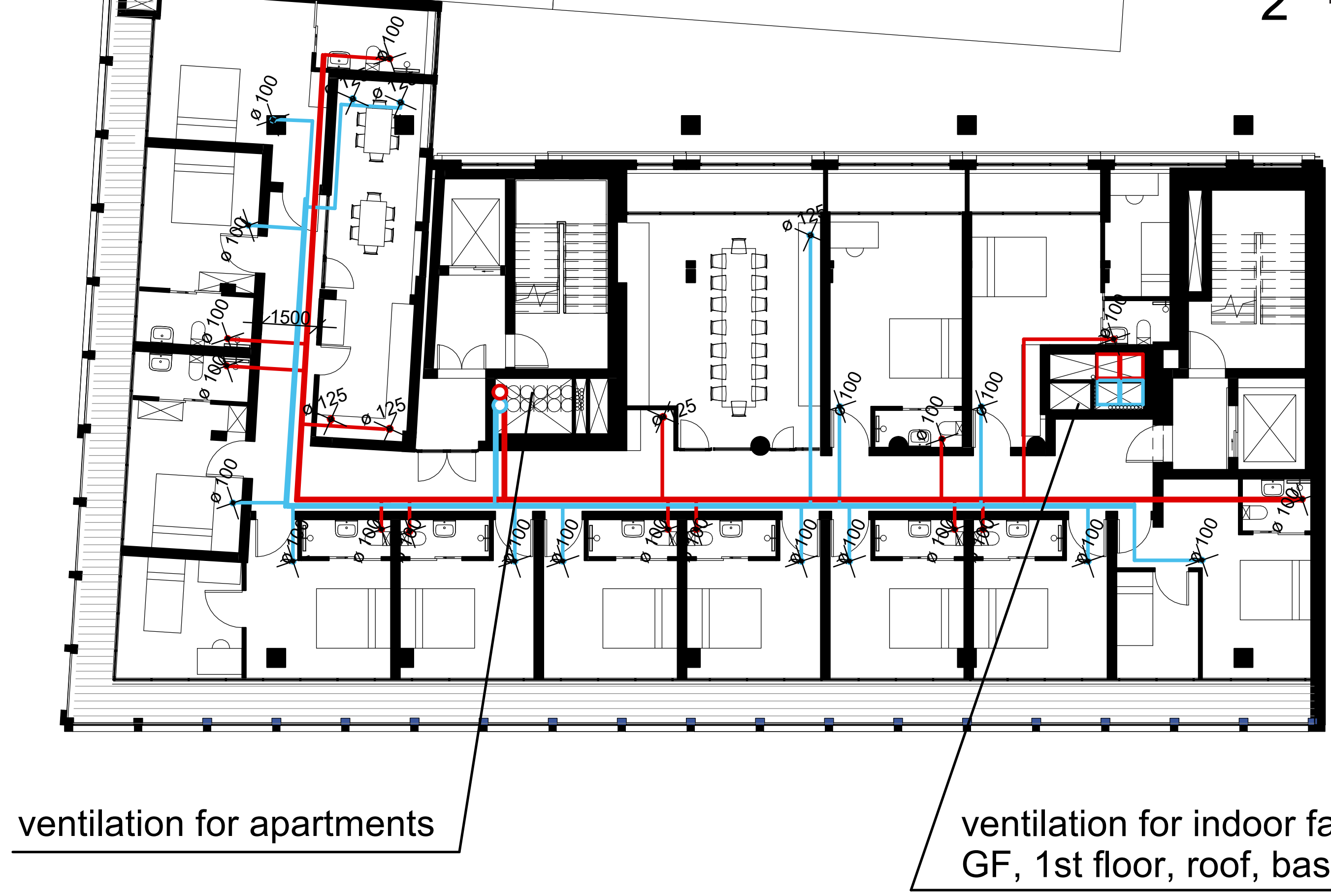

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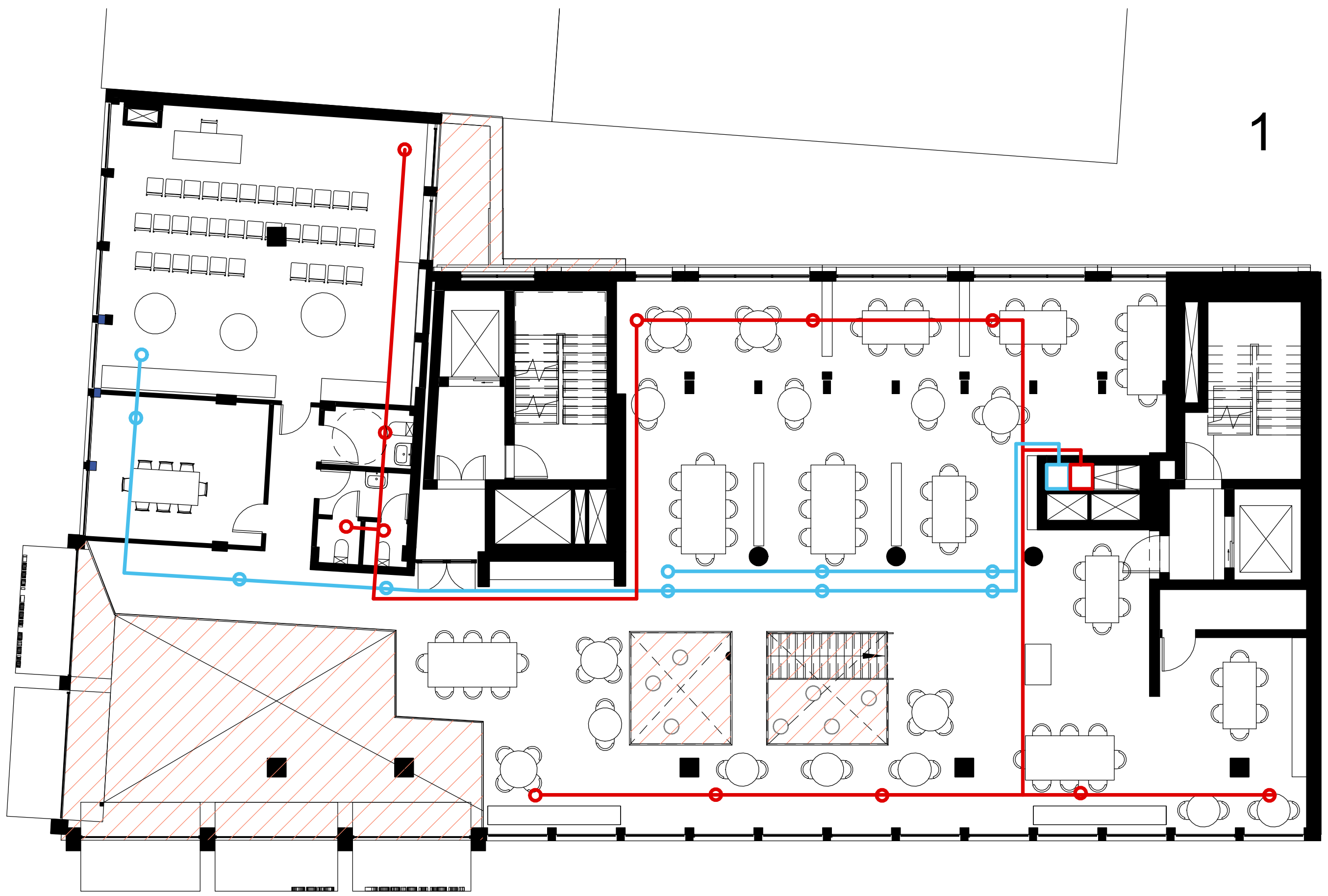

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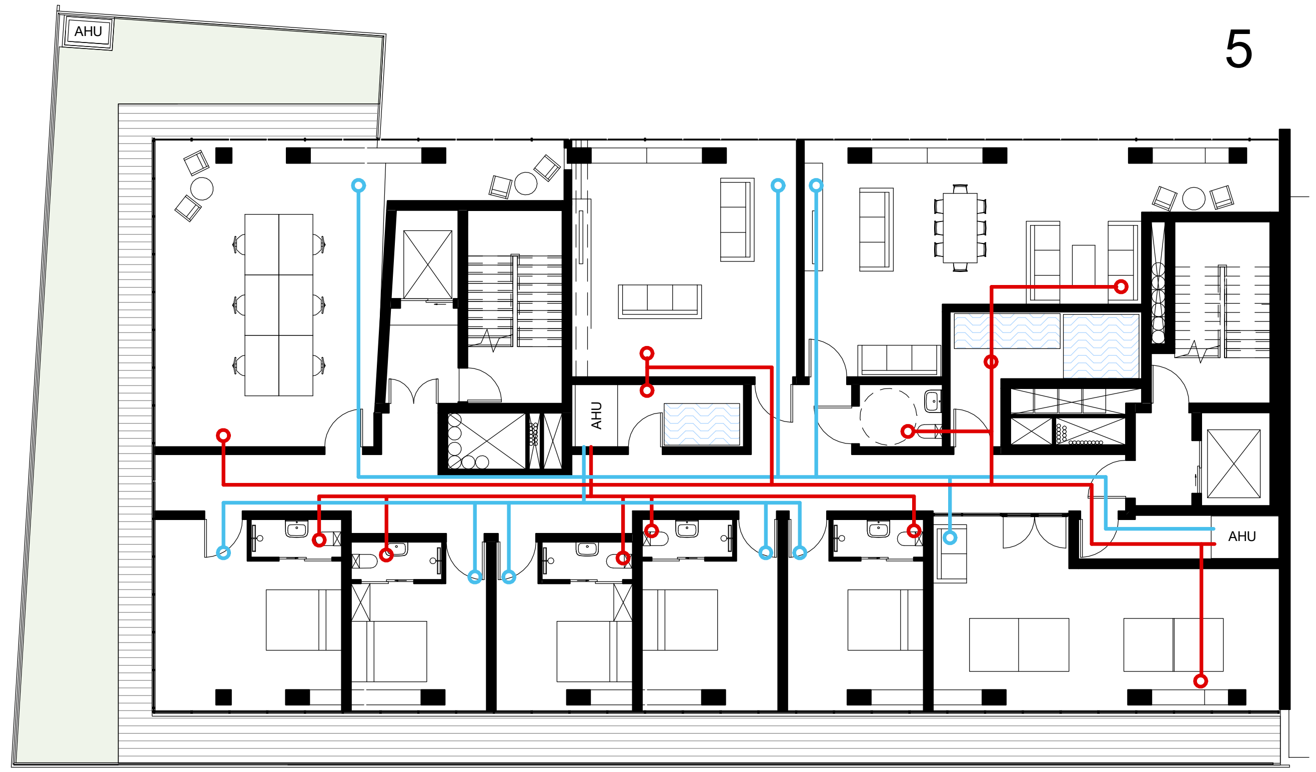

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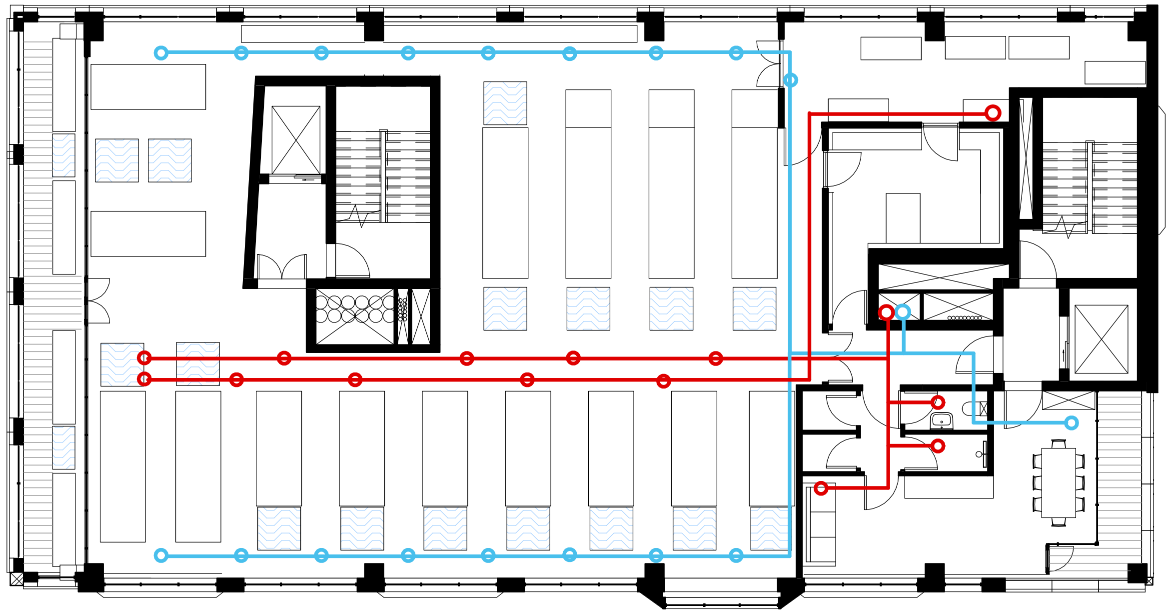

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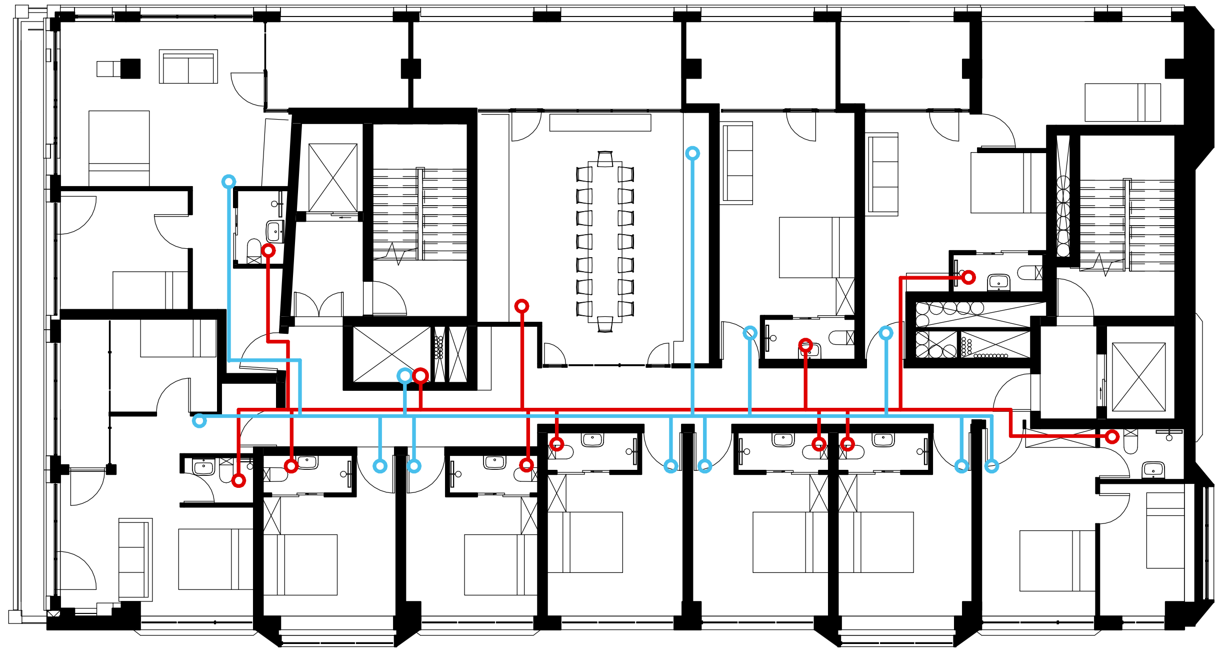


Building technology

Ventilation strategy

plan of the 2nd floor

apartments: —

air quality regulations - IDA2 400<x<600 ppm, 45 m3/u.pers.
2 x 45 = 90 m3/h - amount of air
speed - 2,5 m/s
duct size - 100 mm

kitchen: —

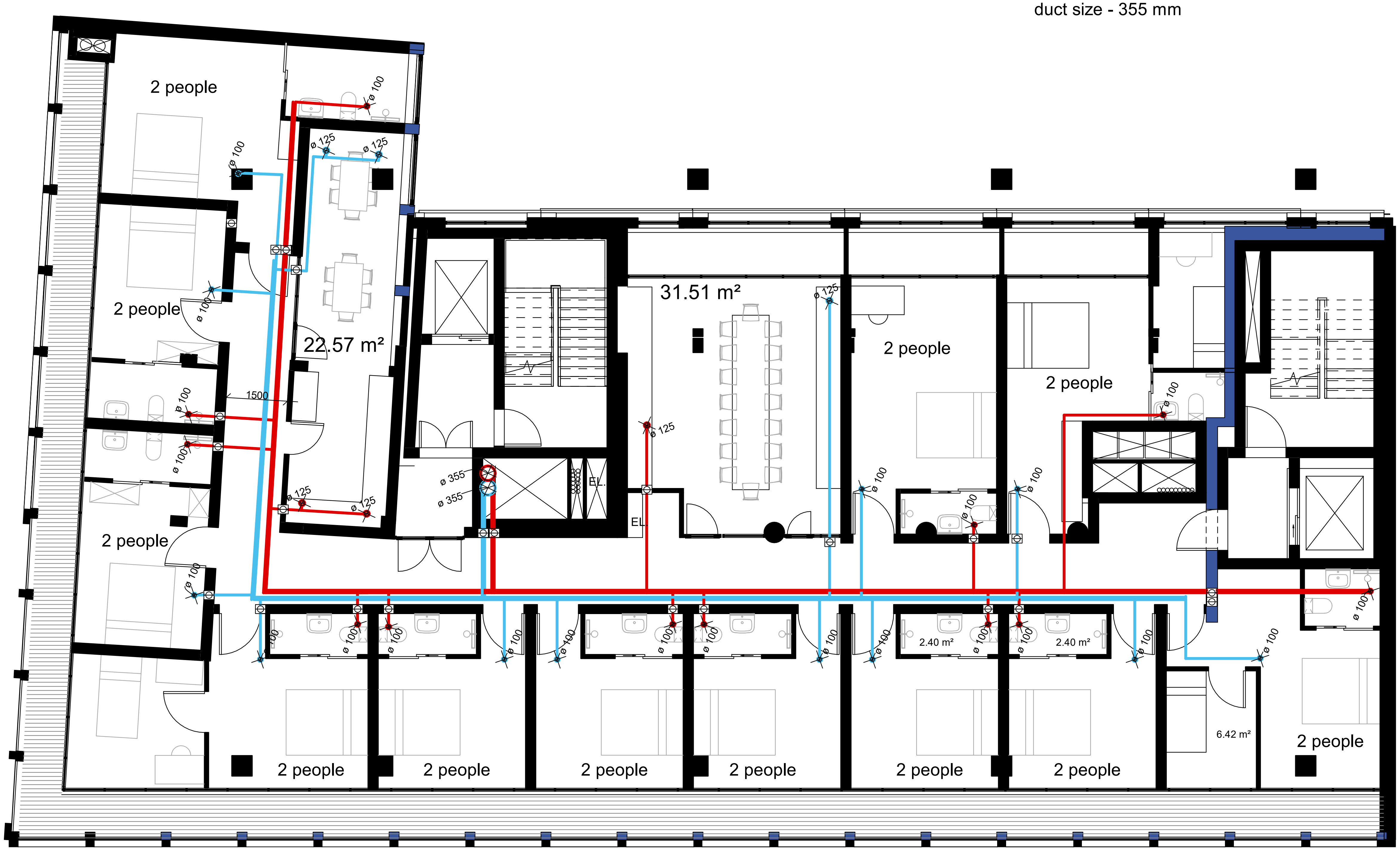
air quality regulations - IDA2 400<x<600 ppm, 45 m3/u.pers.
34 m2 kitchen
3,4 x 45 = 153 m3/h - amount of air
speed - 3-4 m/s
duct size - 125 mm

per floor: —

2x kitchens:
2 x 153 = 306 m3/h - amount of air
12 x apartments:
12 x 90= 1080 m3/h - amount of air

Total: 1386 m3/h - amount of air

duct size - 355 mm

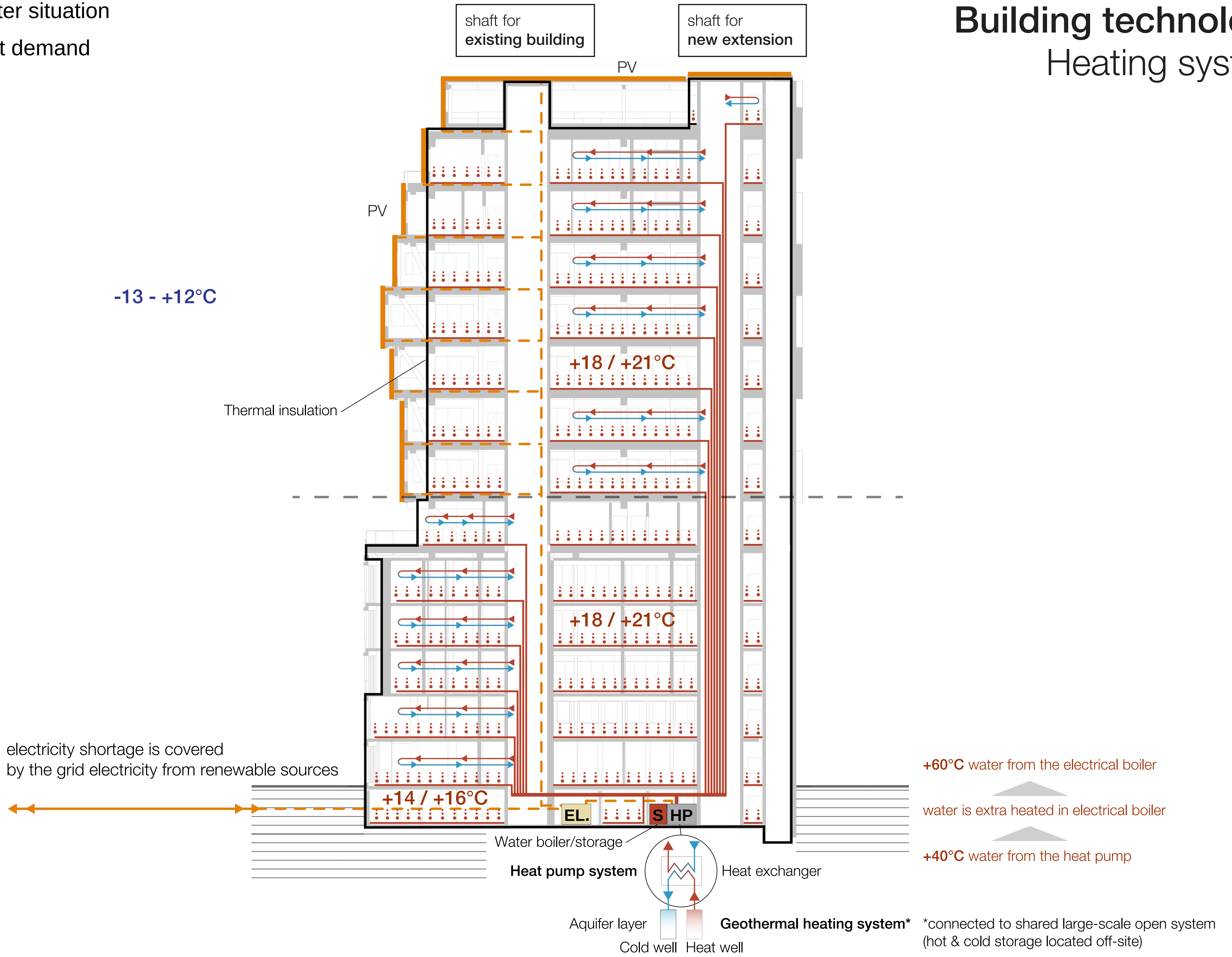


Fire dampers are placed when the duct is crossing fire compartment wall

Winter situation

Heat demand

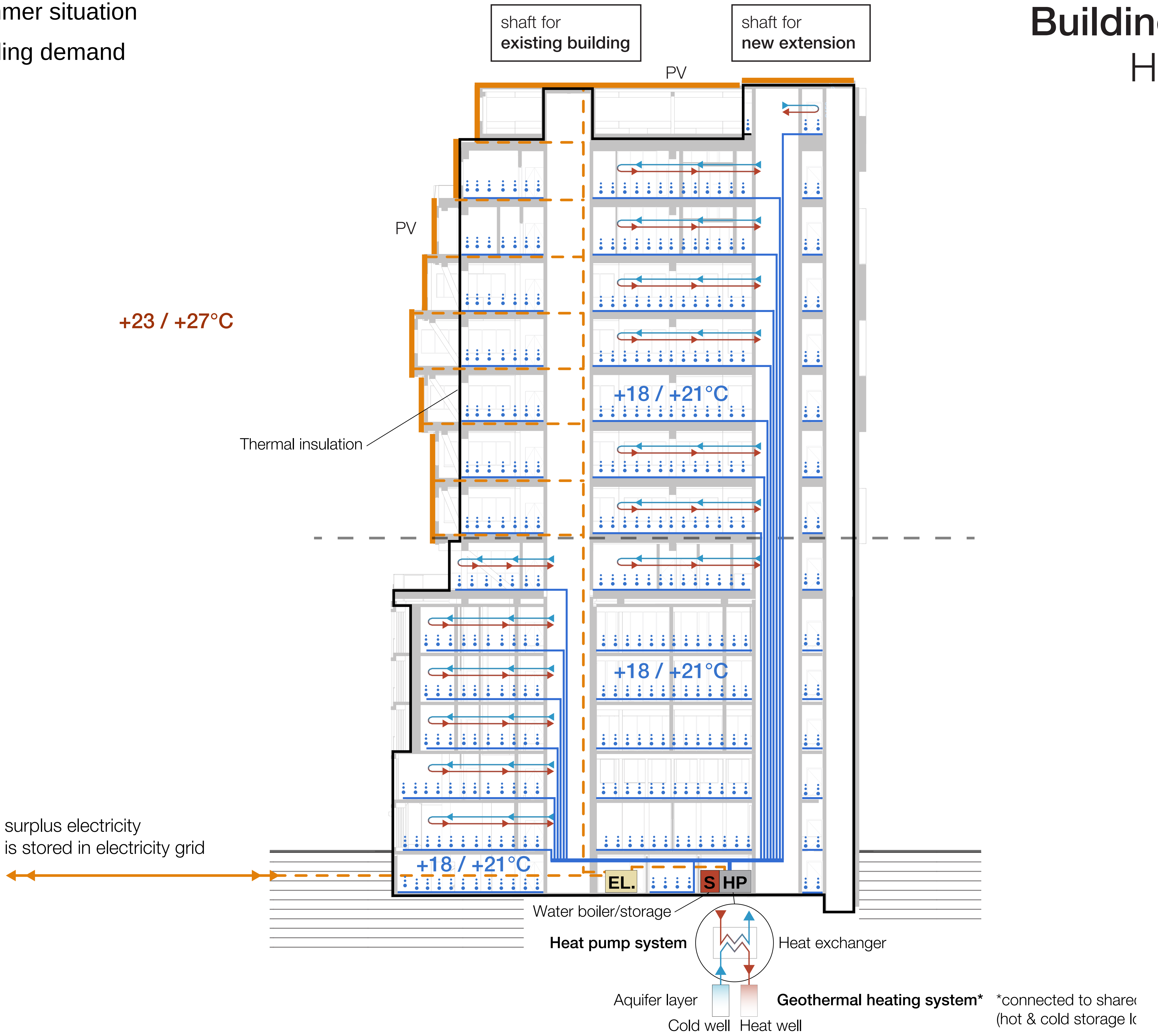
Building technology
Heating system



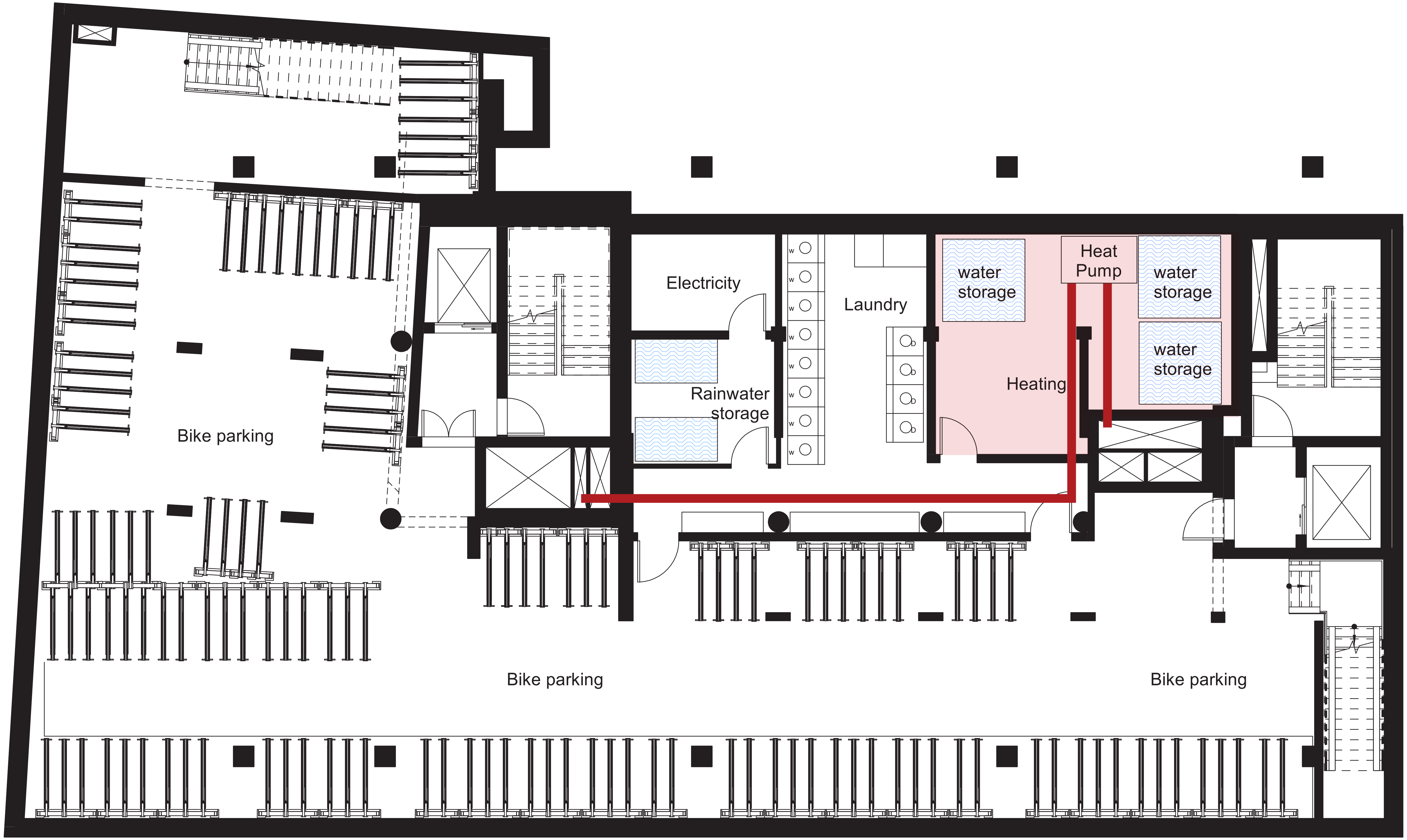
Building technology
Heating system

Summer situation

Cooling demand

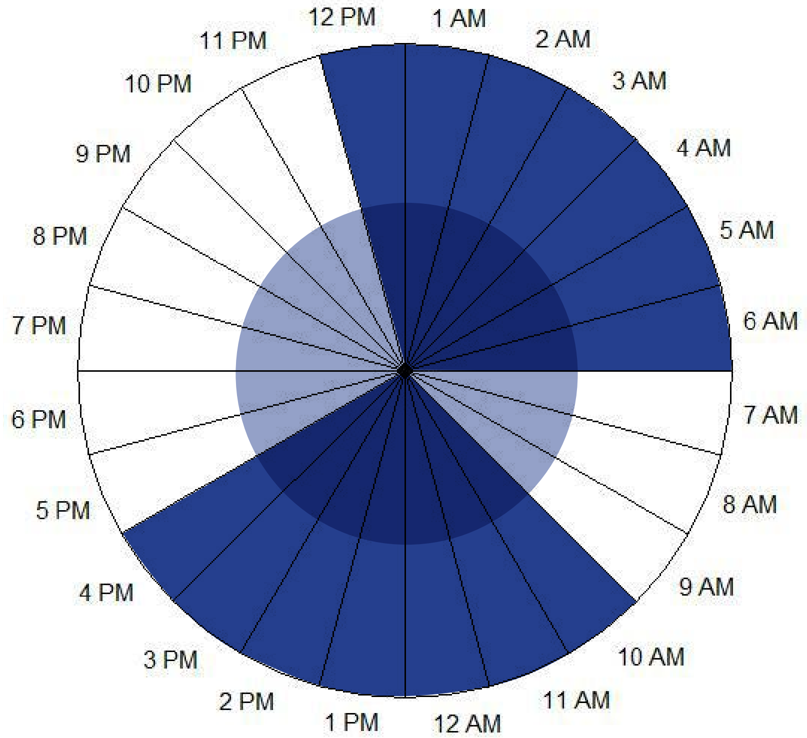


Building technology
Heating system
basement plan_1:100



Climate design
electricity use during daytime

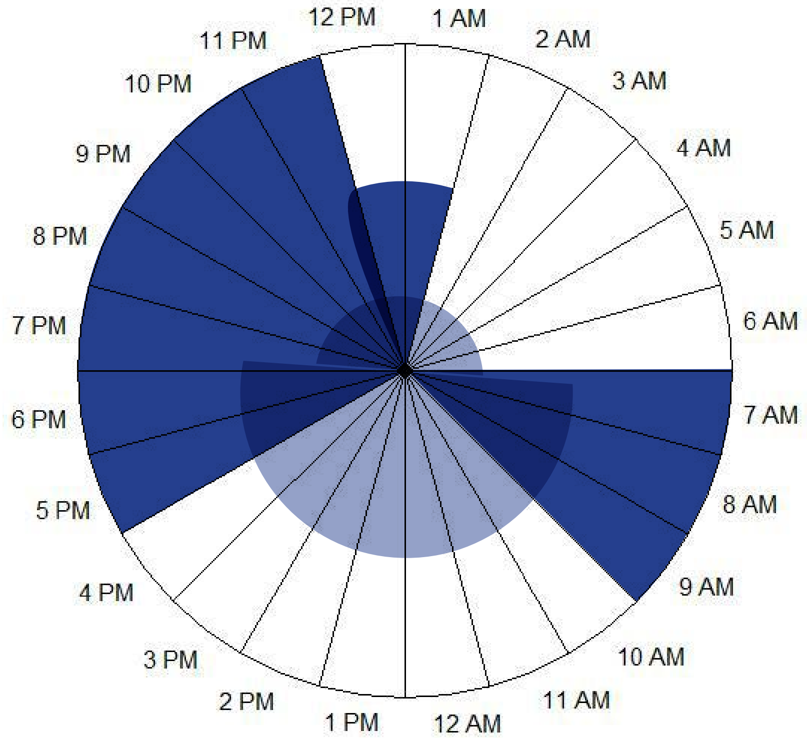
43,5 % in total usable area



urban farm

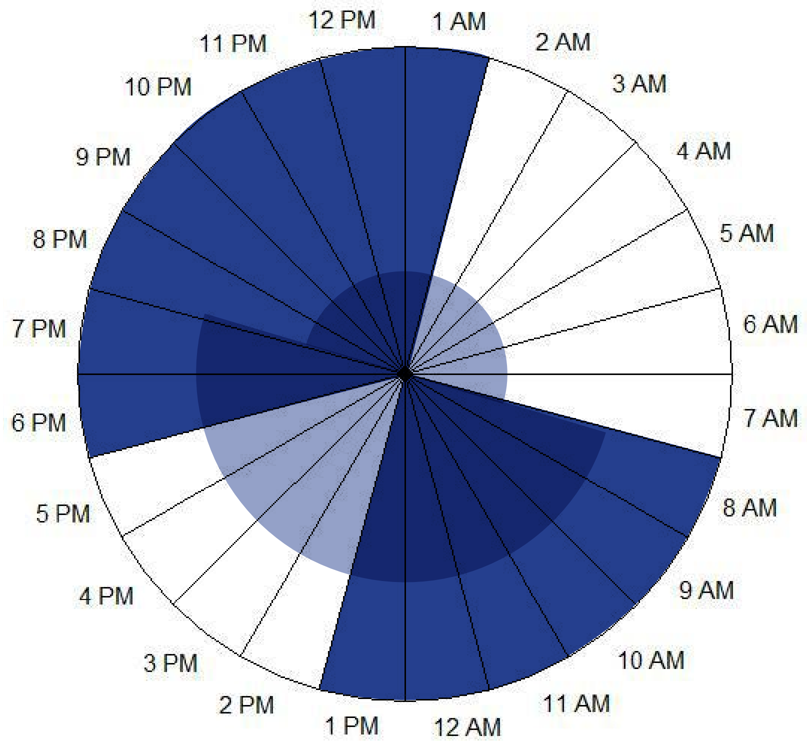
LED lamps (65%), air conditioners (20%)
mostly in use during nightime and working hours

39,2 % in total usable area



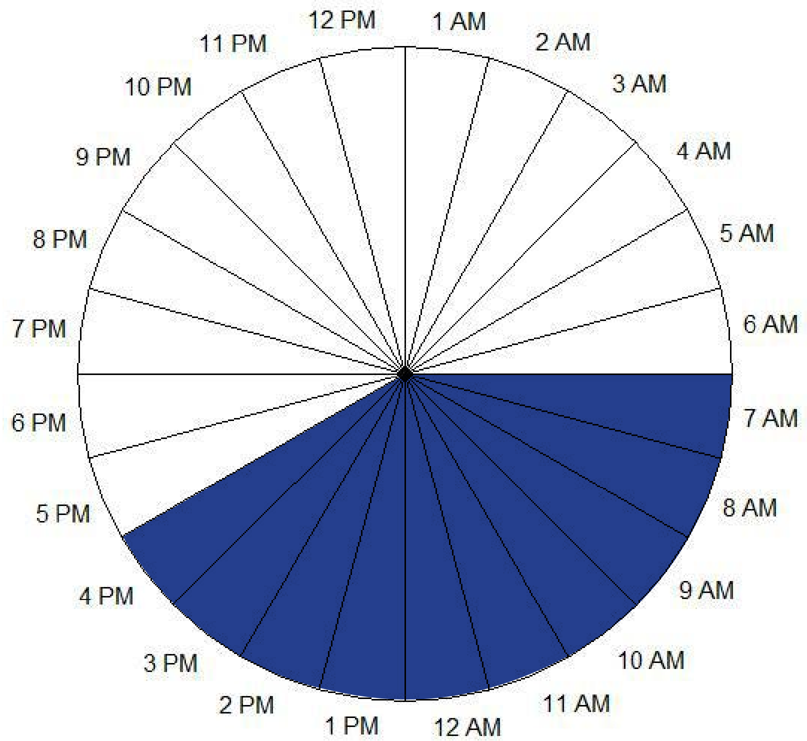
residential

10,6 % in total usable area



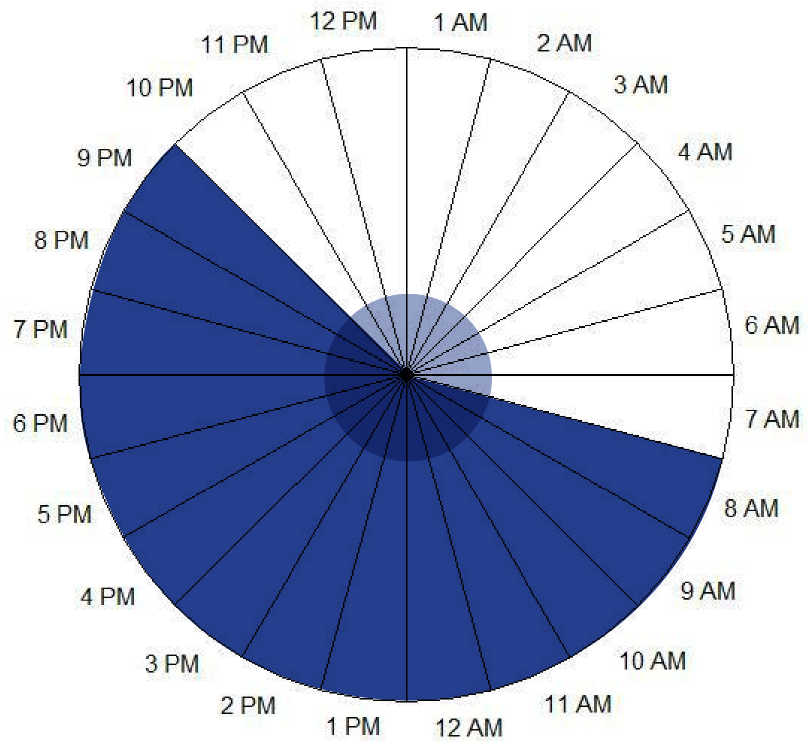
restaurant

4,2 % in total usable area



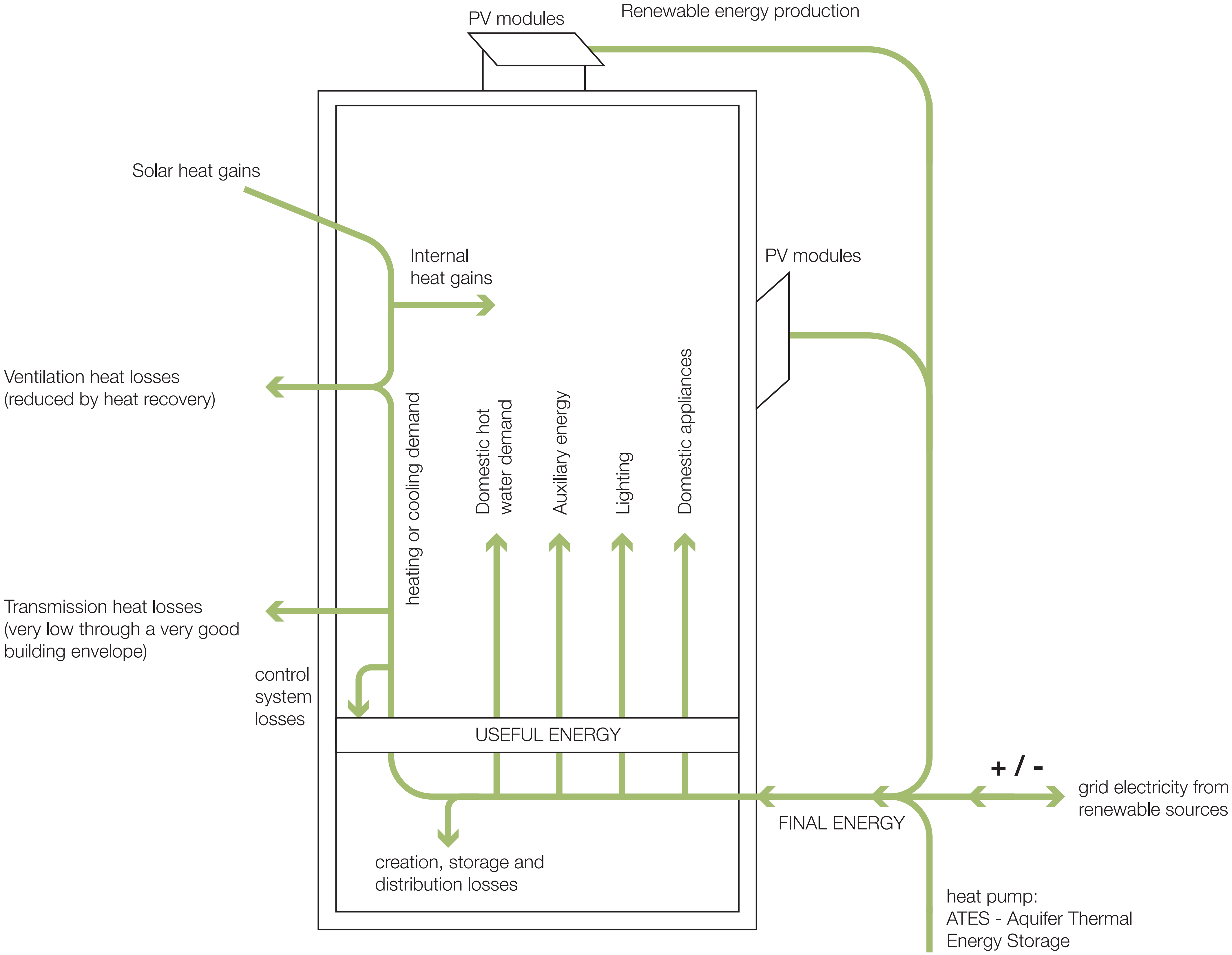
cooking school

2,5 % in total usable area



food shop

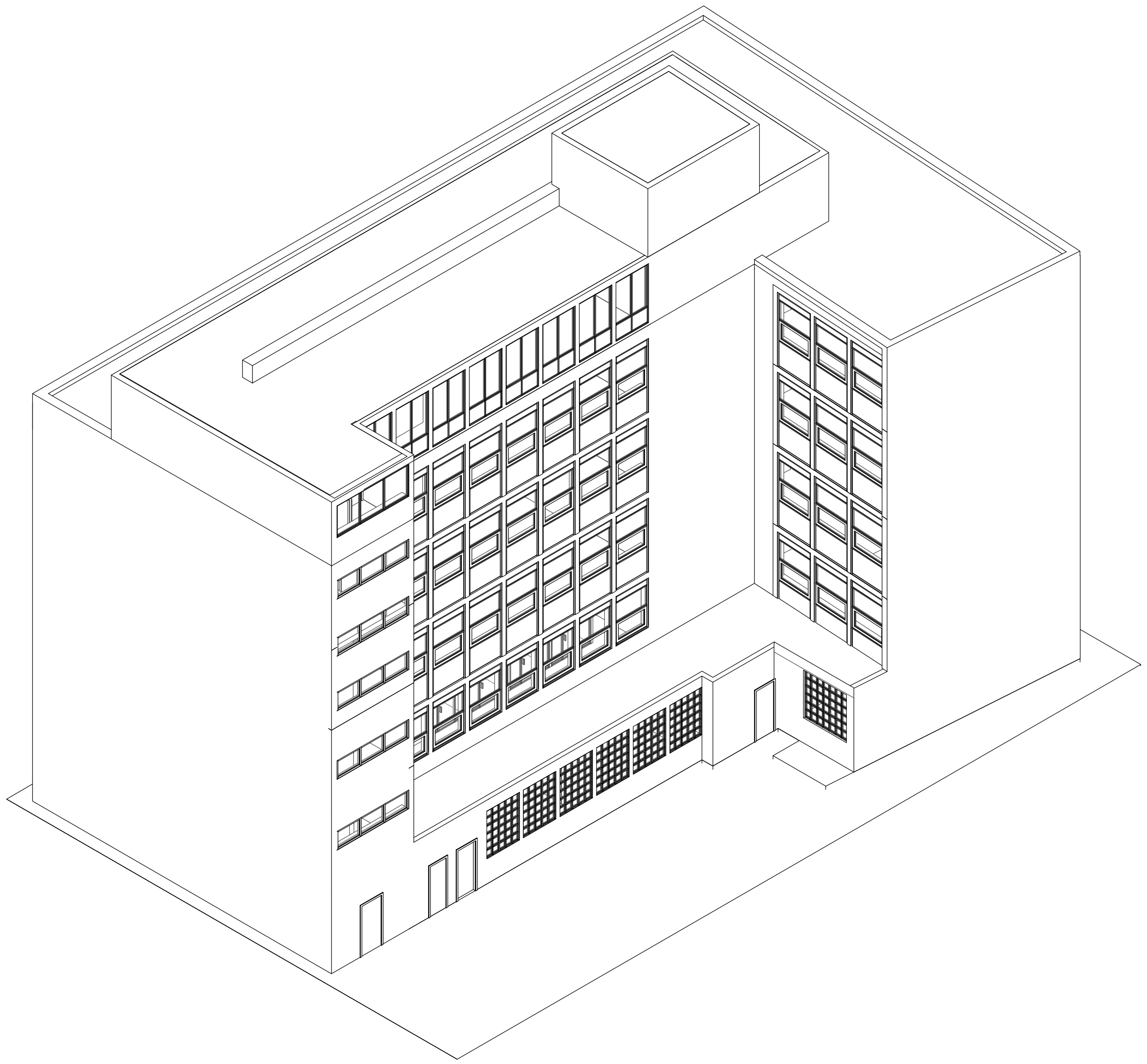
Climate design
energy balance in the building

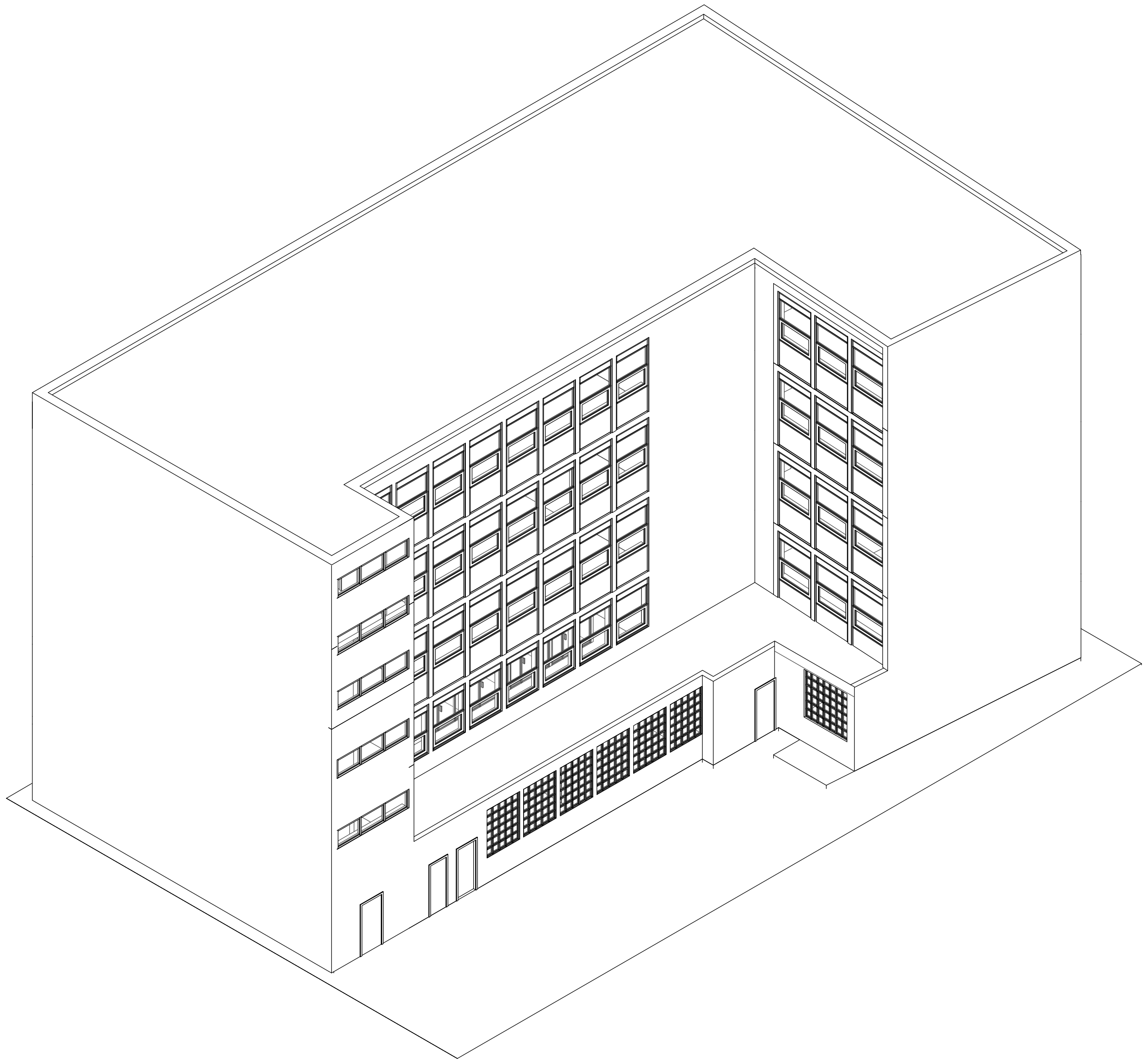


3. Interventions & Structure

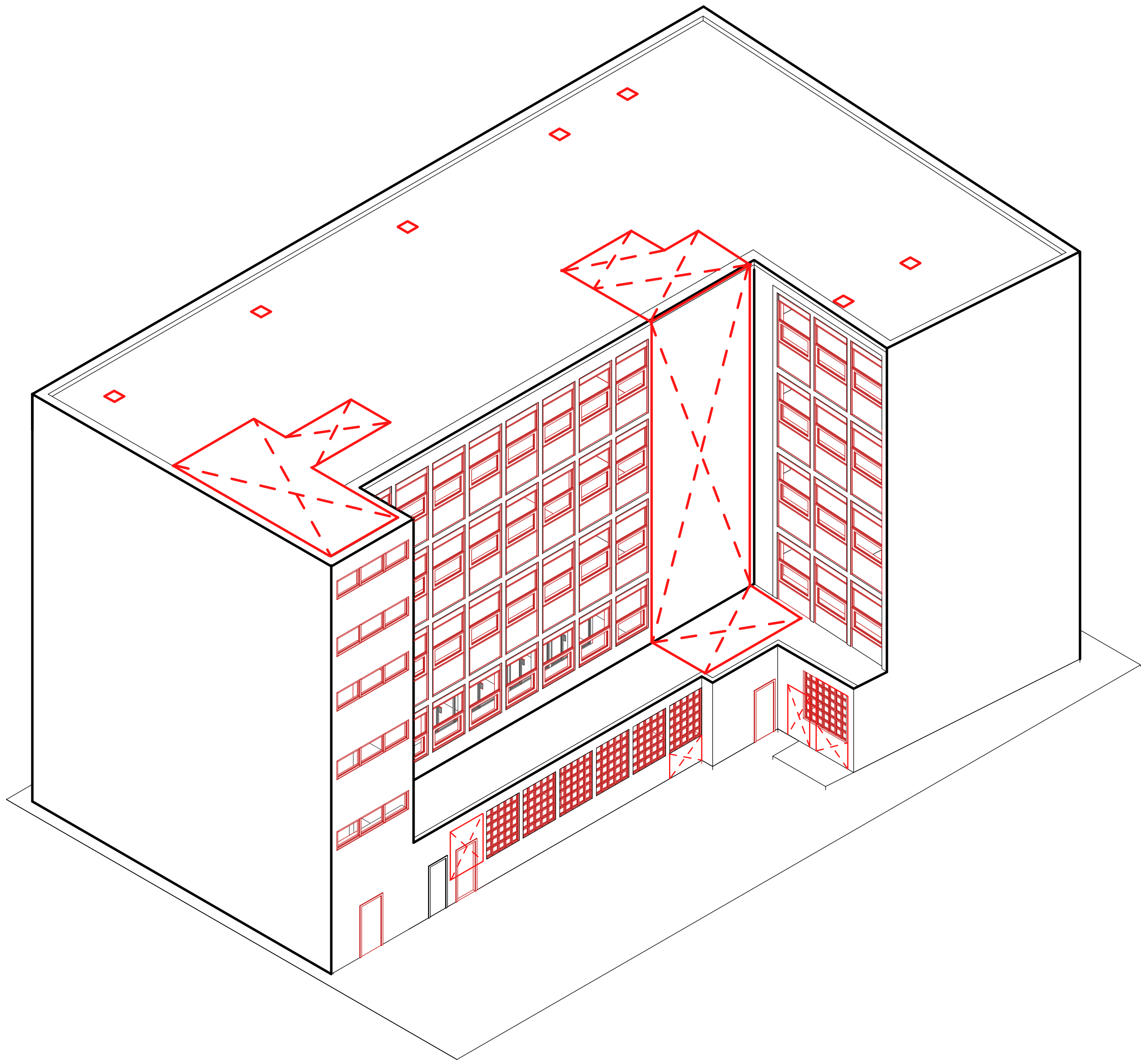
Interventions diagrams

existing building

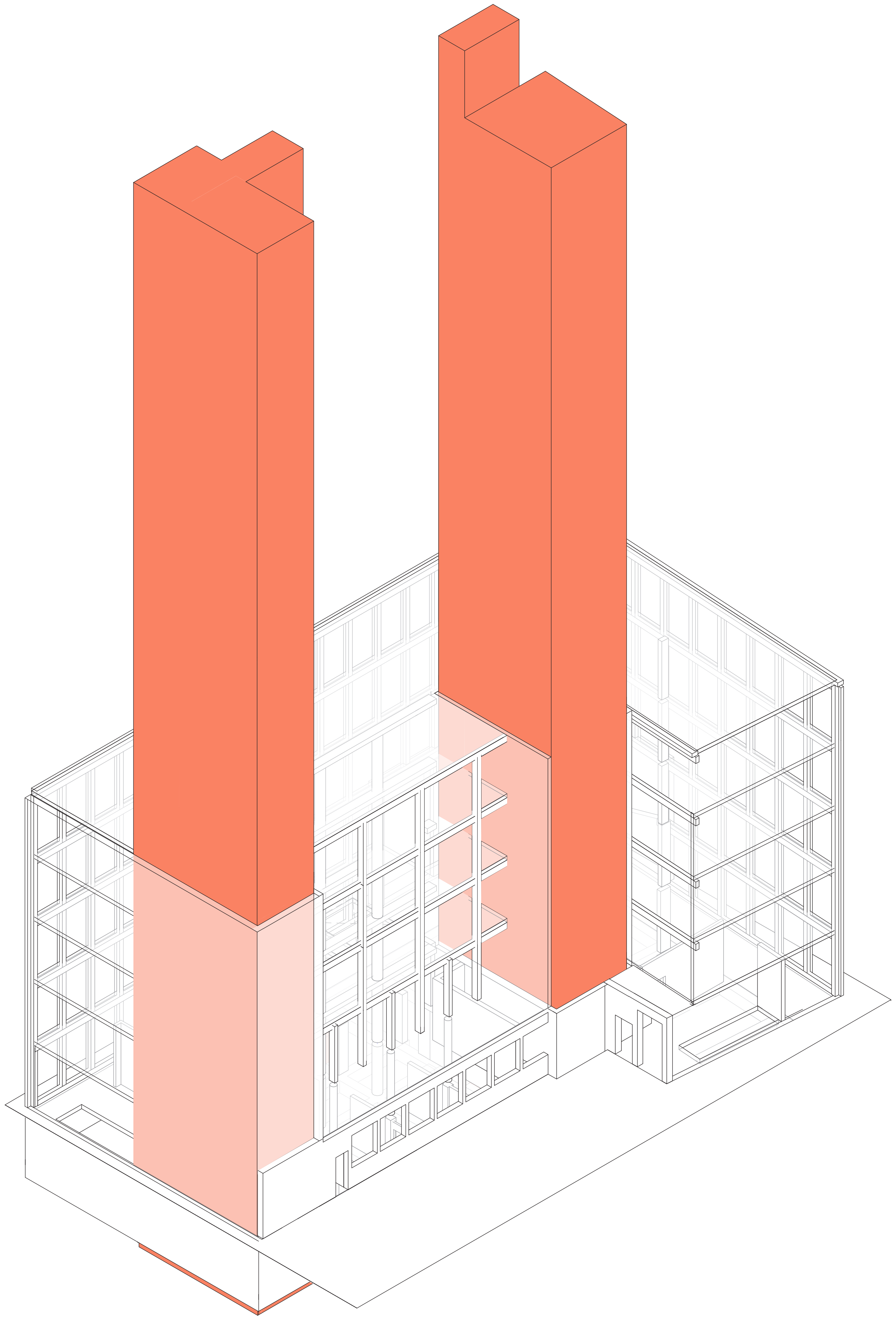


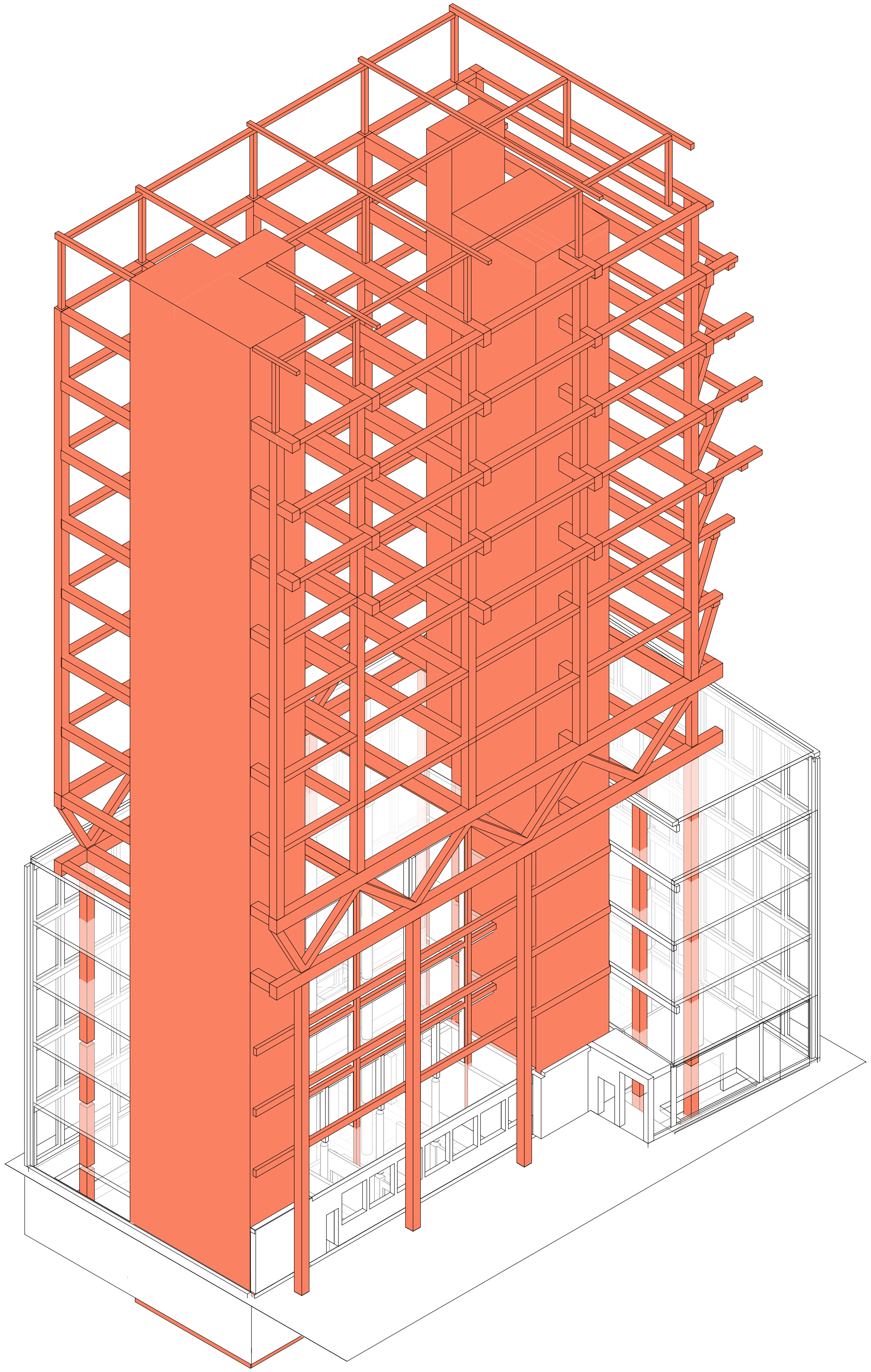


- windows
holes are made in existing floors

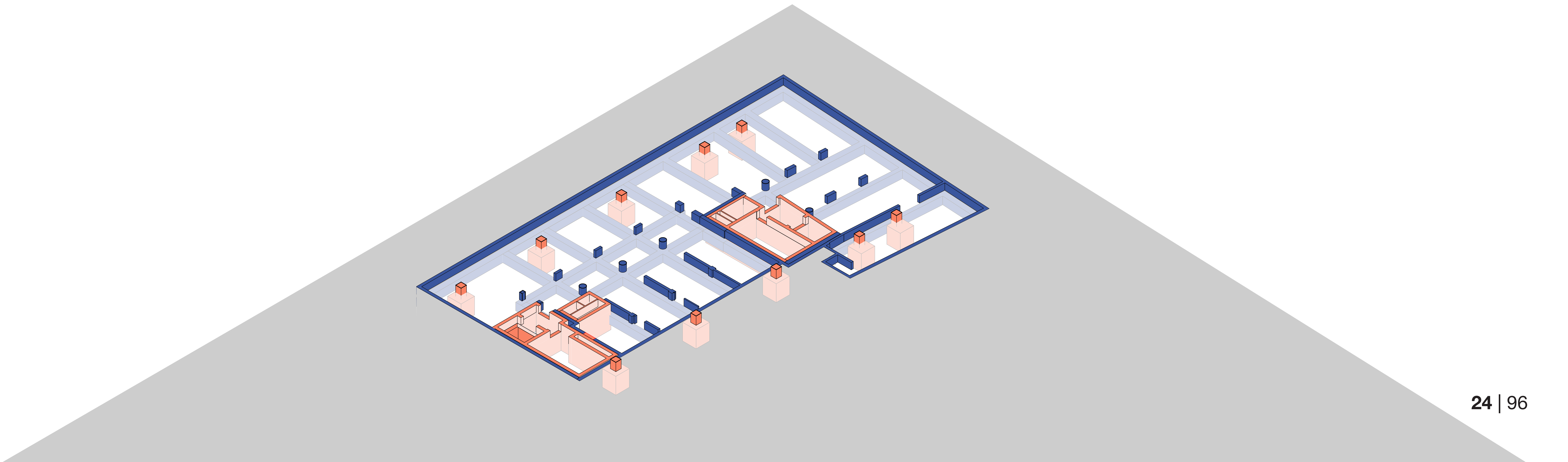


new cores introduced inside the existing ones

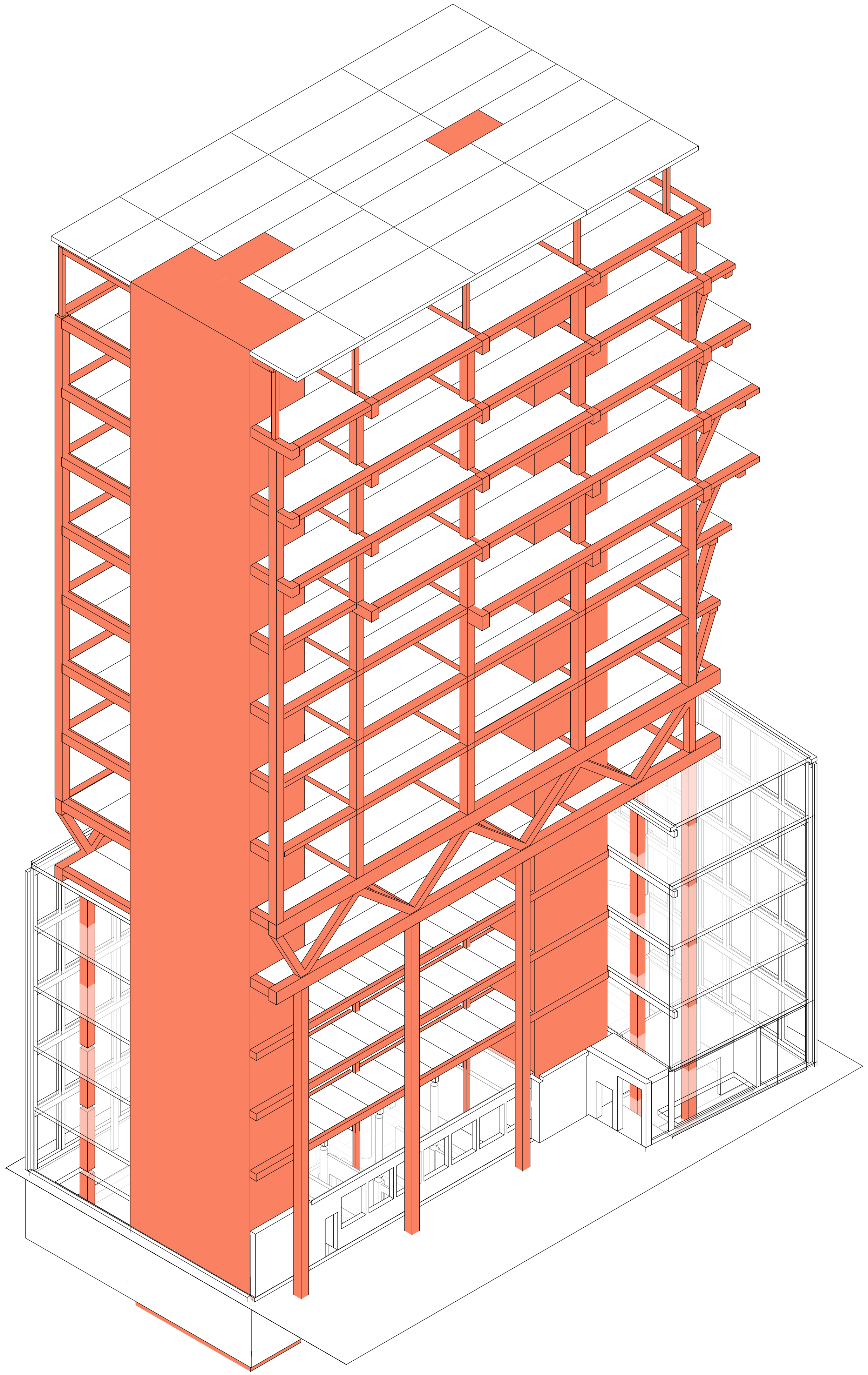


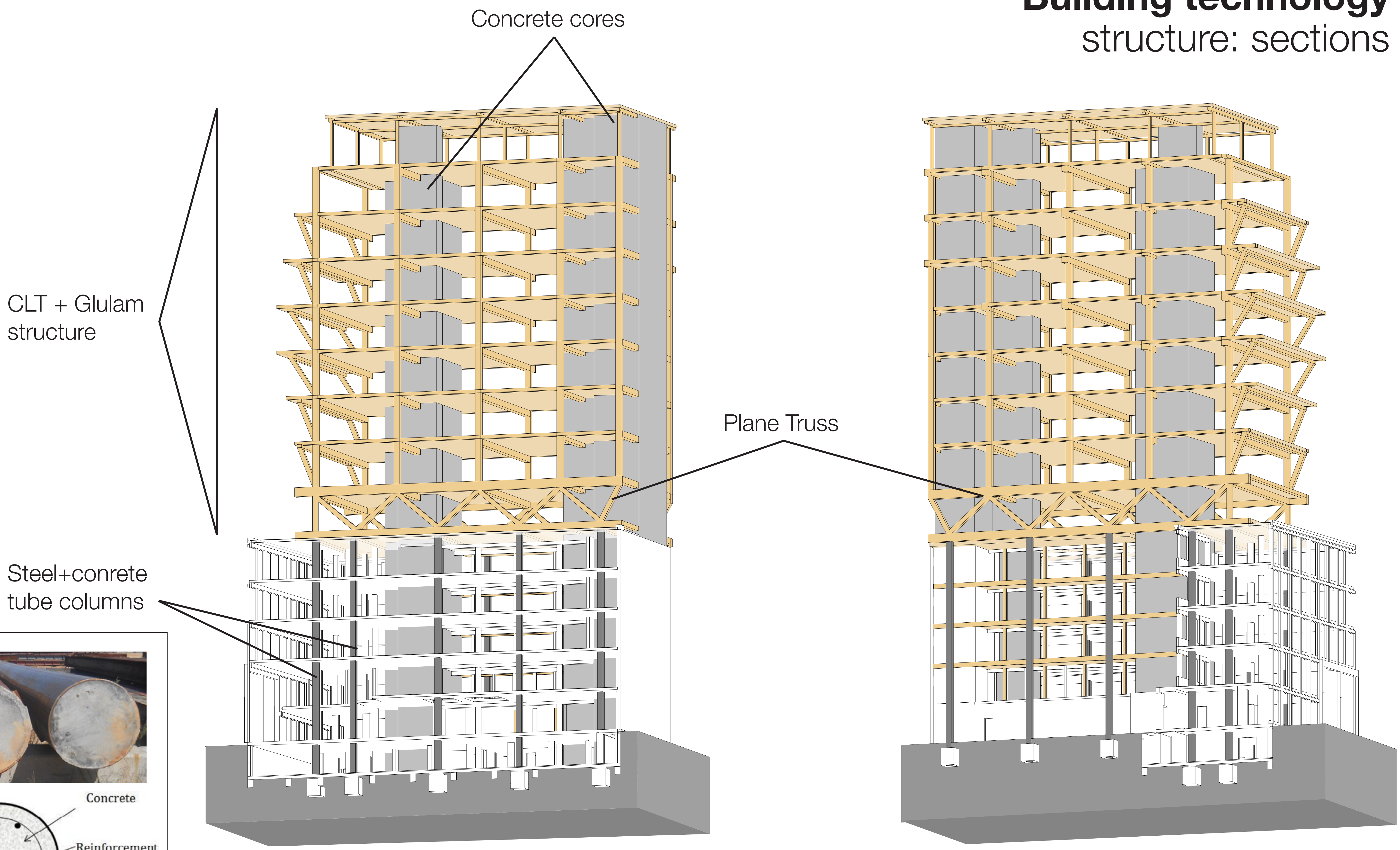


new foundation going in between the old foundation

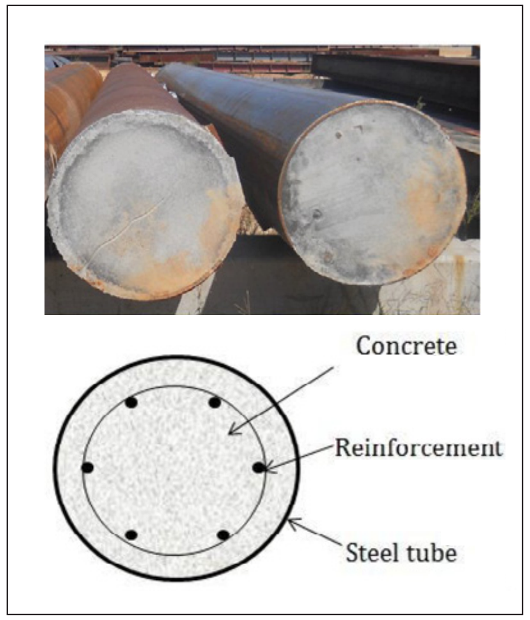


CLT floor slabs laid on the beams

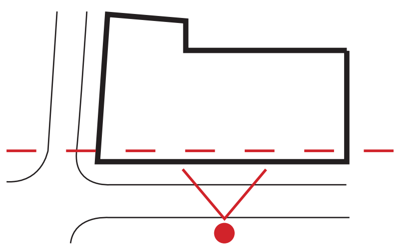


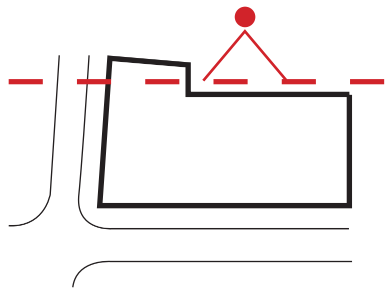


Concrete cores
CLT + Glulam structure
Plane Truss
Steel+conrete tube columns



Concrete
Reinforcement
Steel tube





*plans show the floor slabs below the section

Building technology

slabs & span directions in plans

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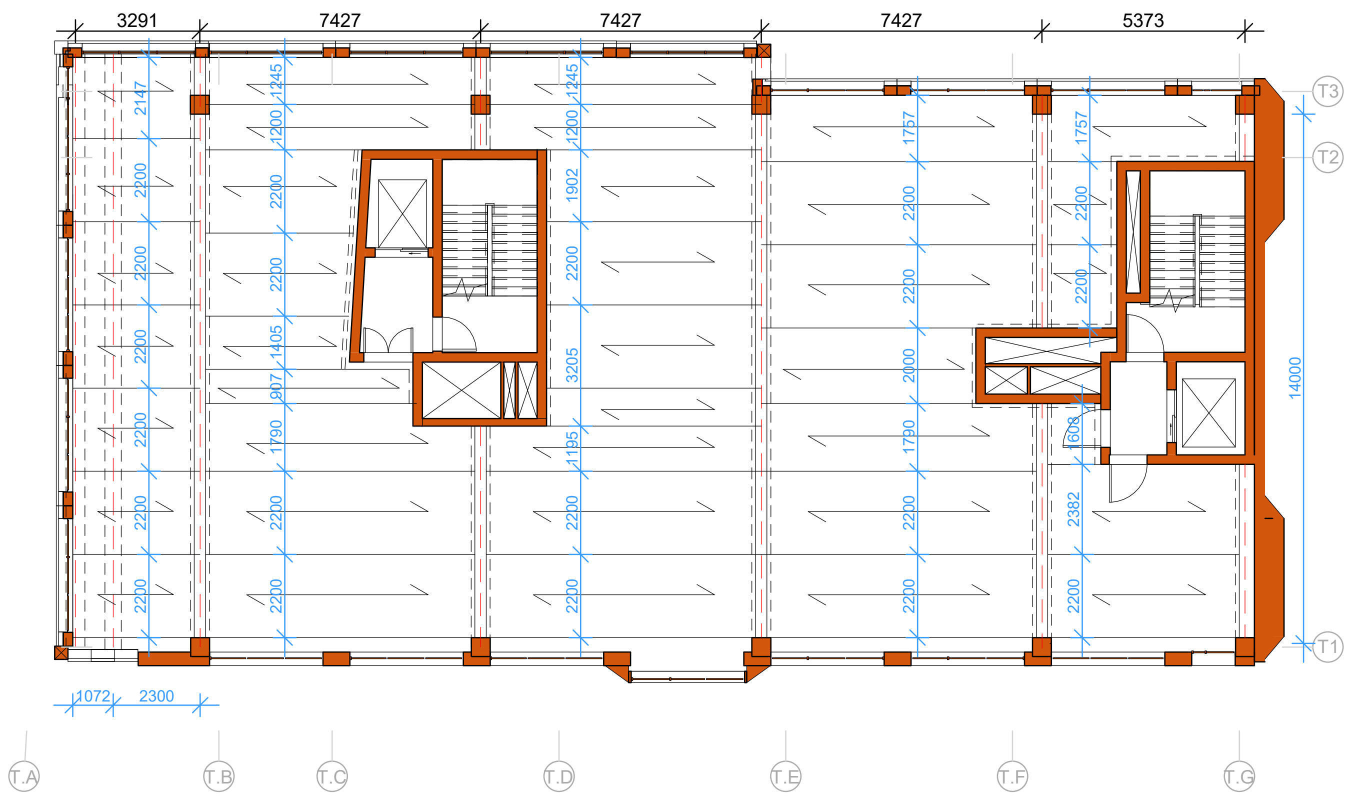

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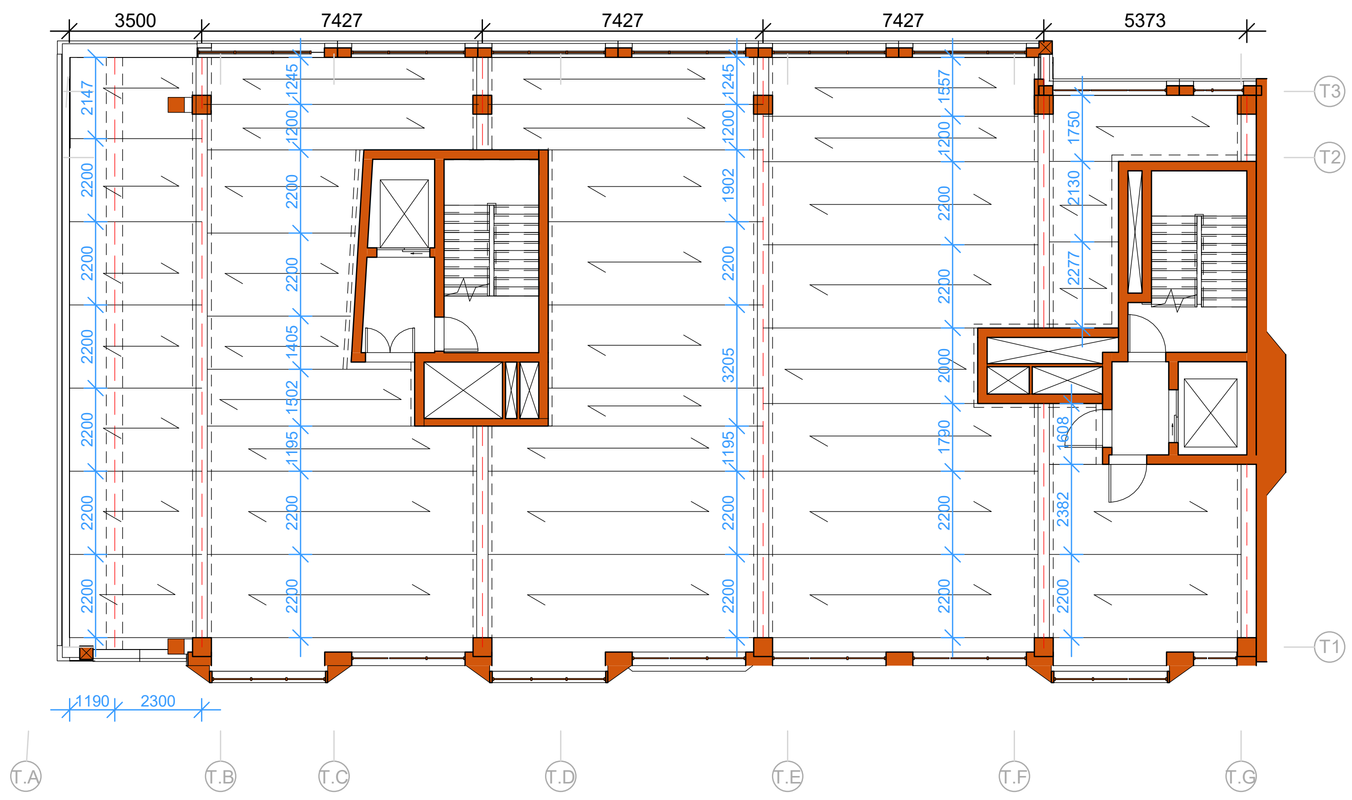

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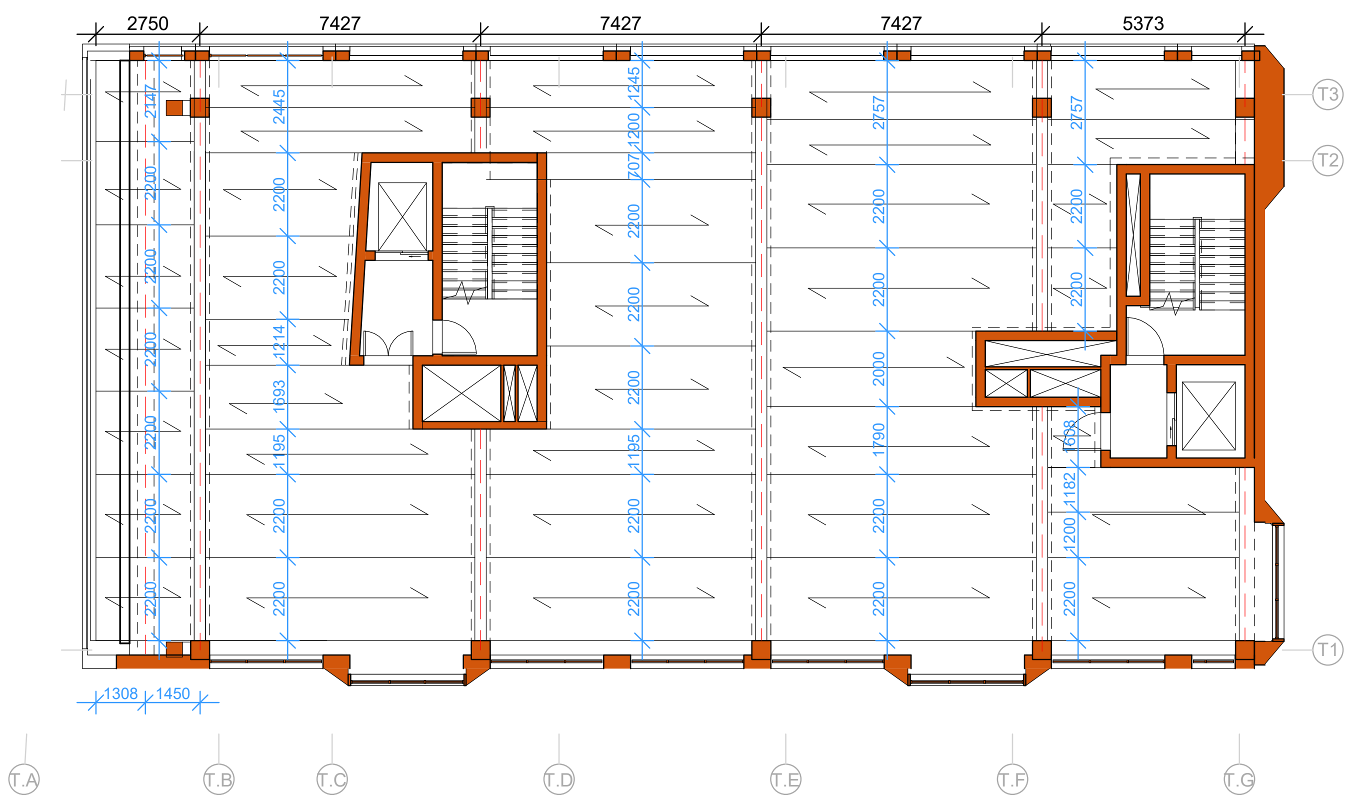

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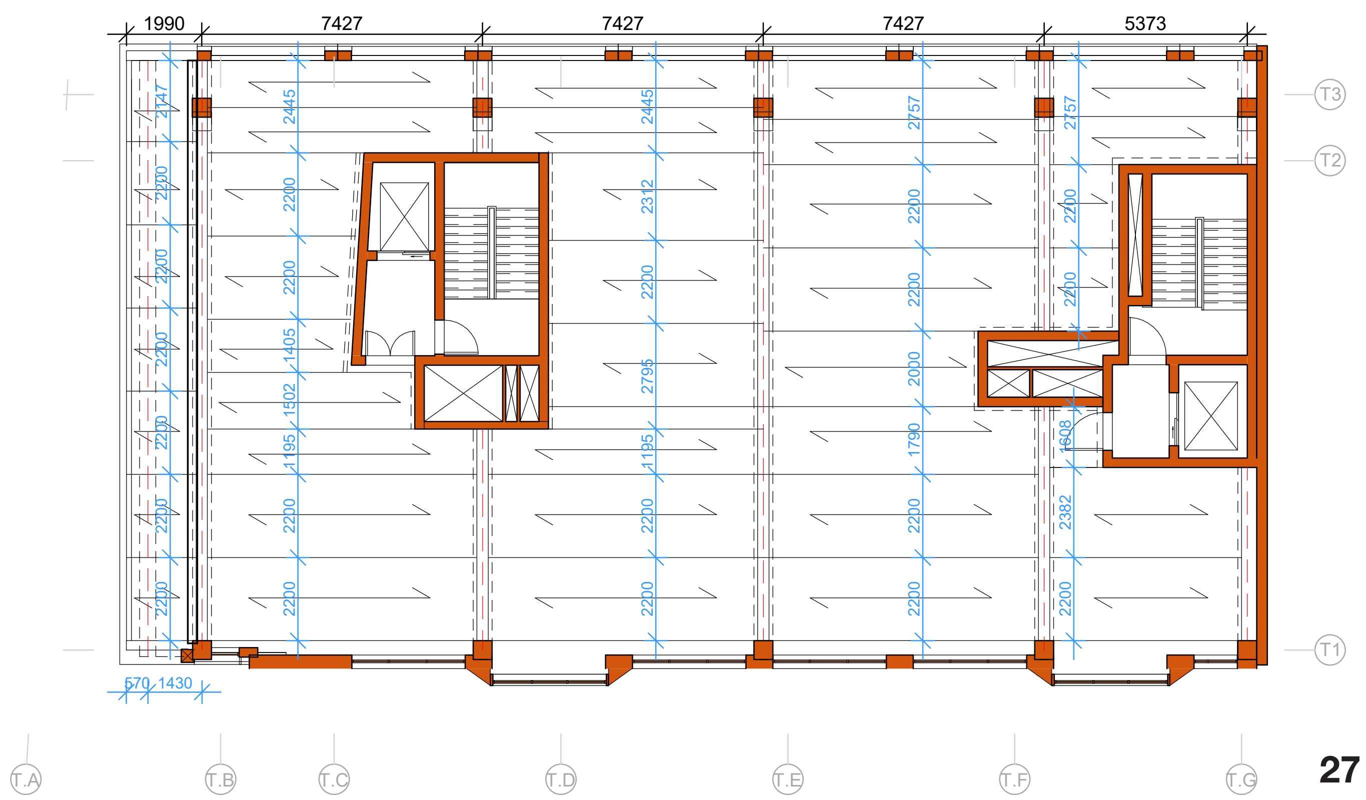


4. Facades

Facade
existing building

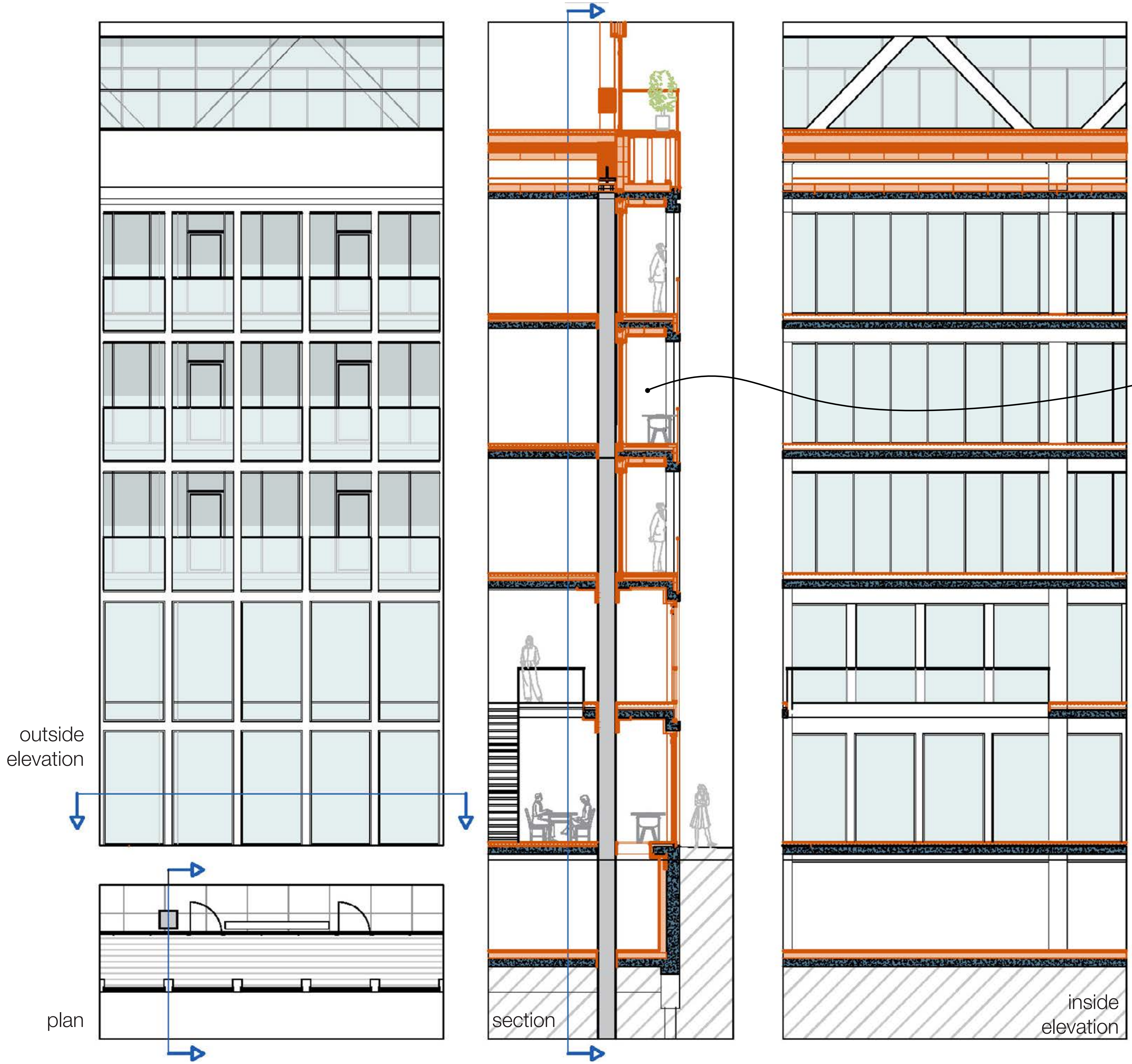
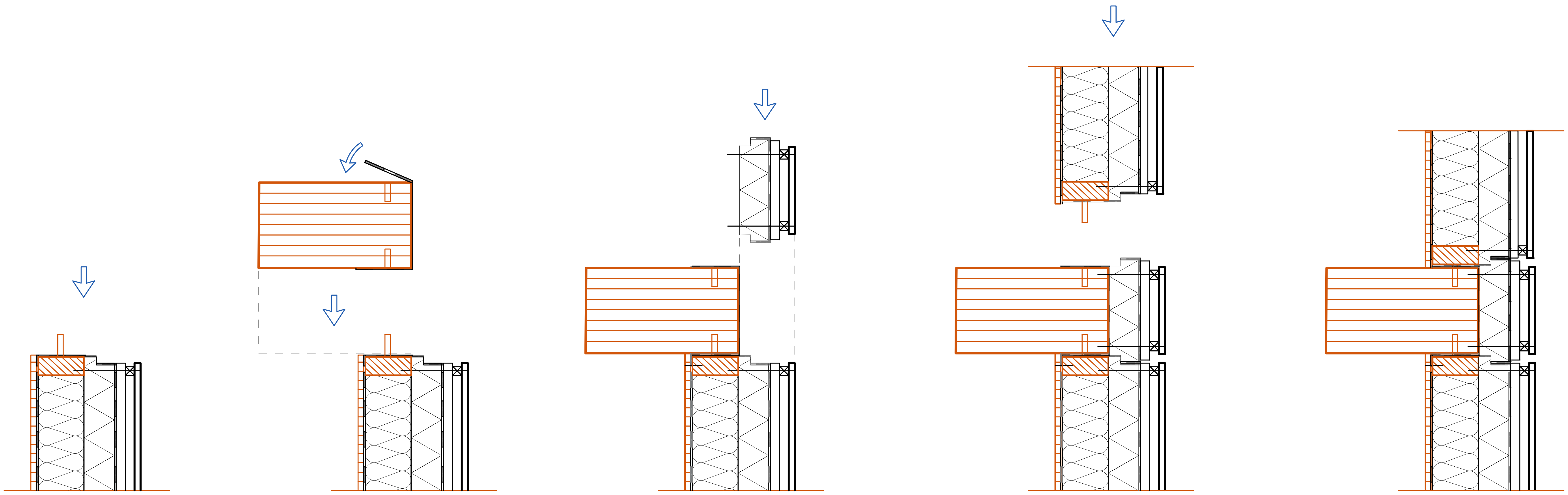


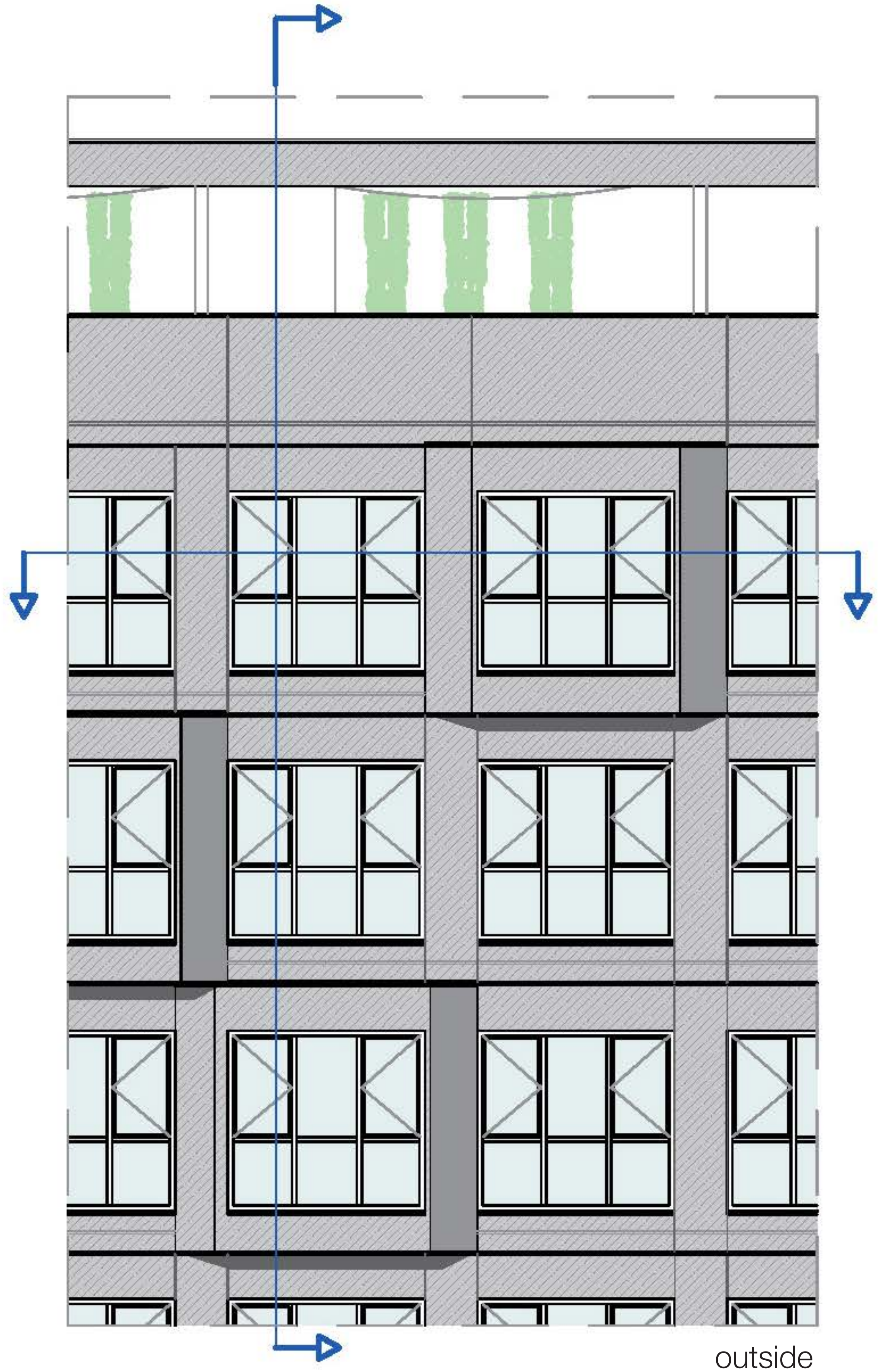
Figure: new outdoor space created by recessed curtain wall

Building technology
assembling of the modules in section

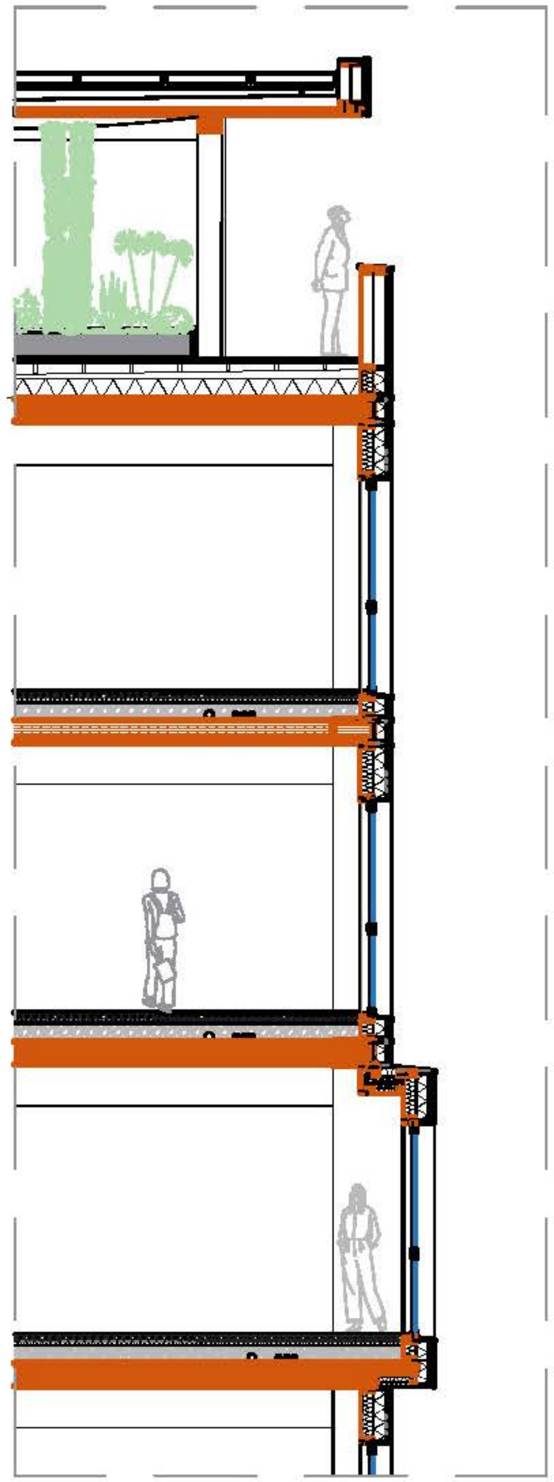


1 2 3 4 5

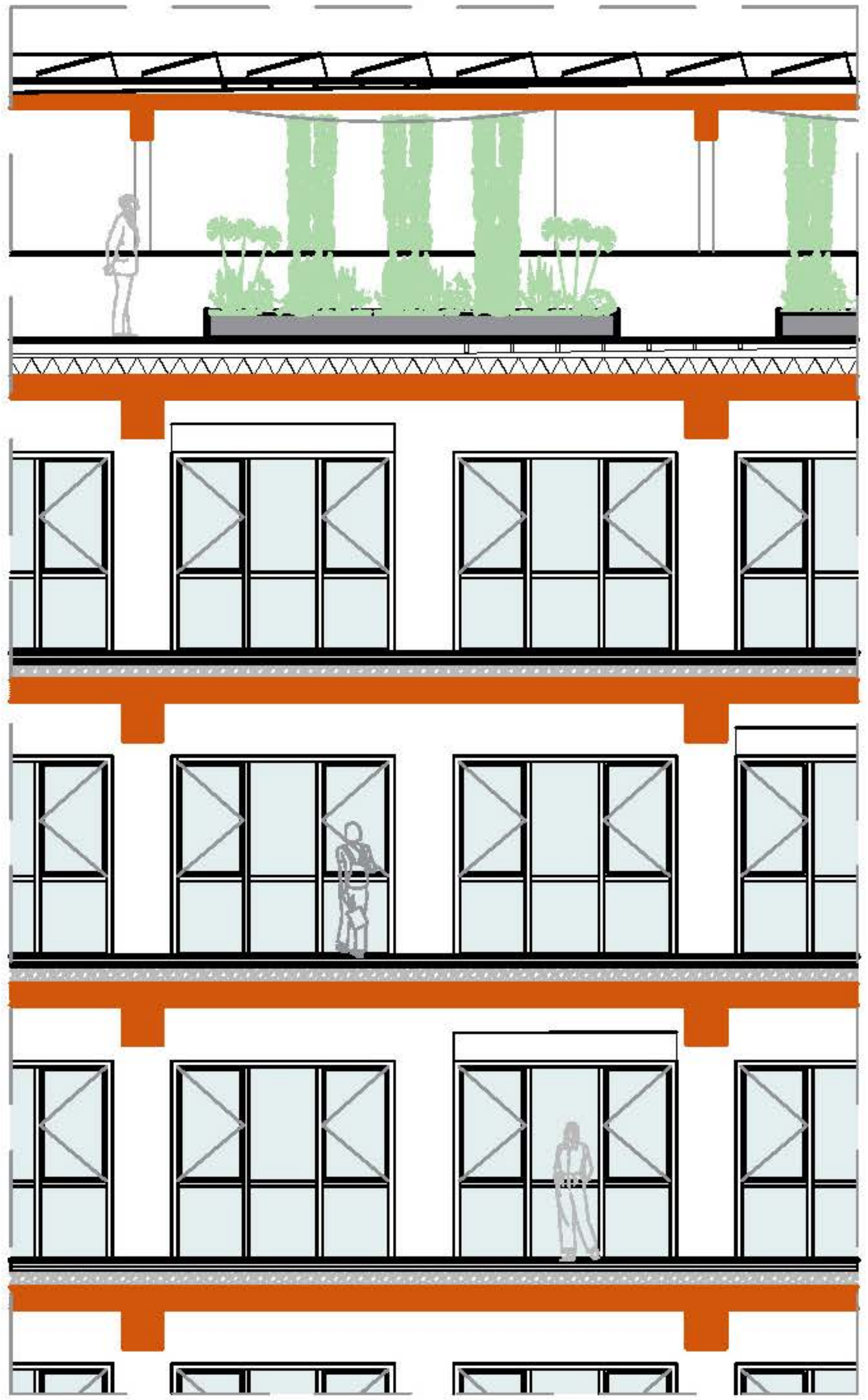
“rock” facade



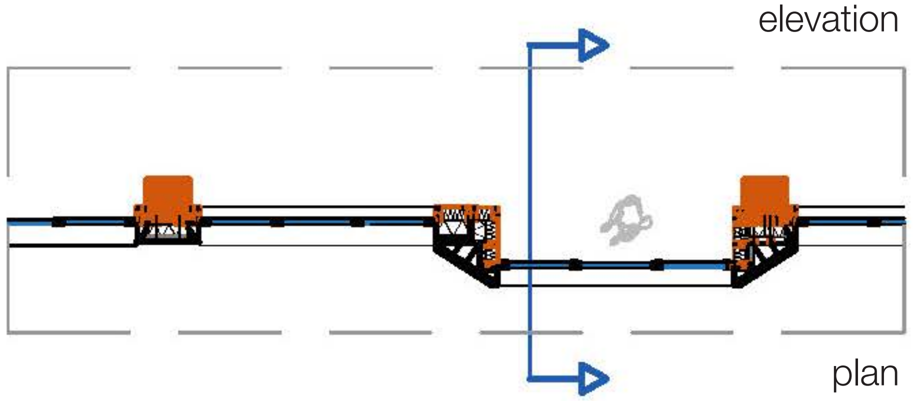
outside
elevation



section

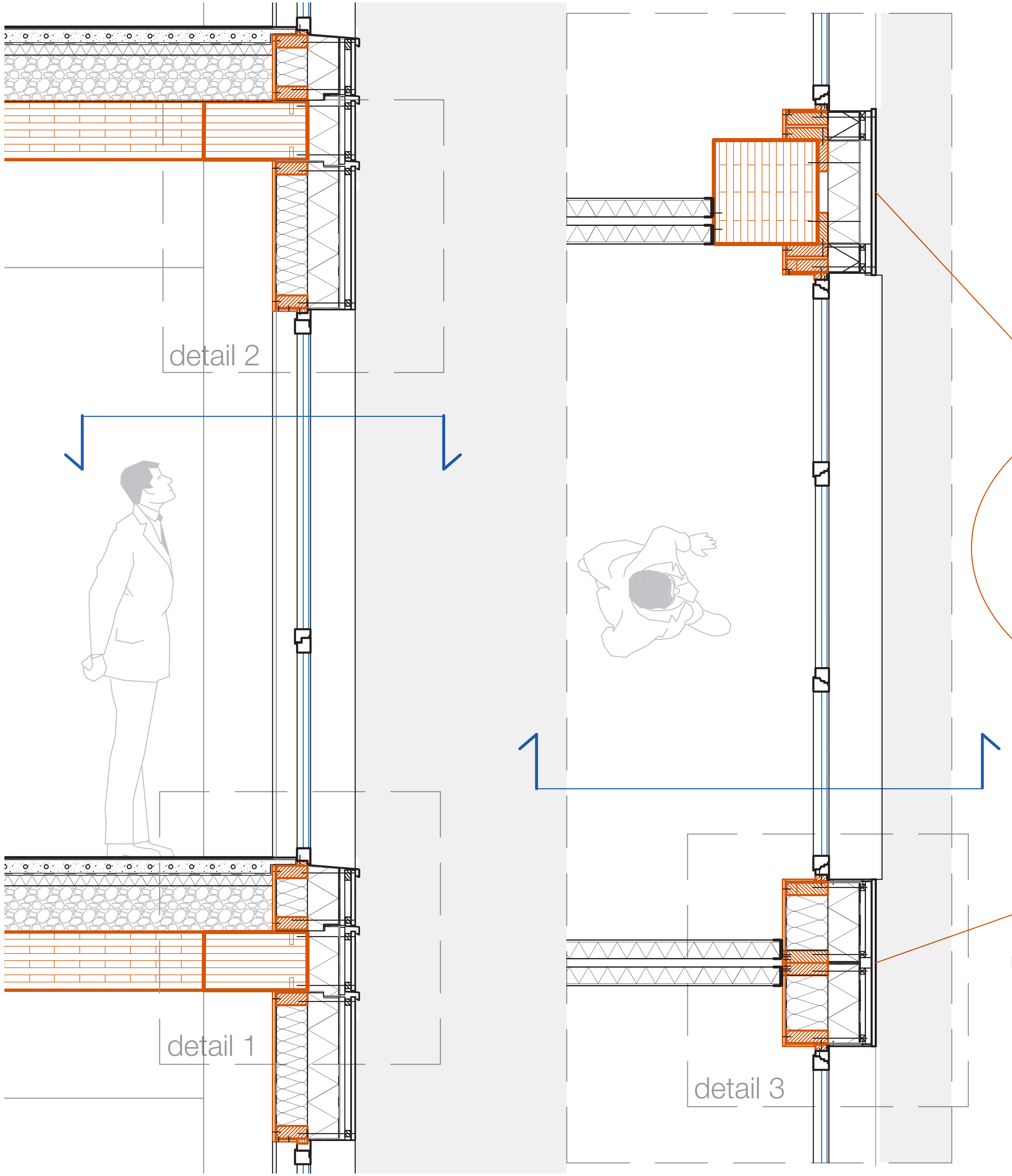


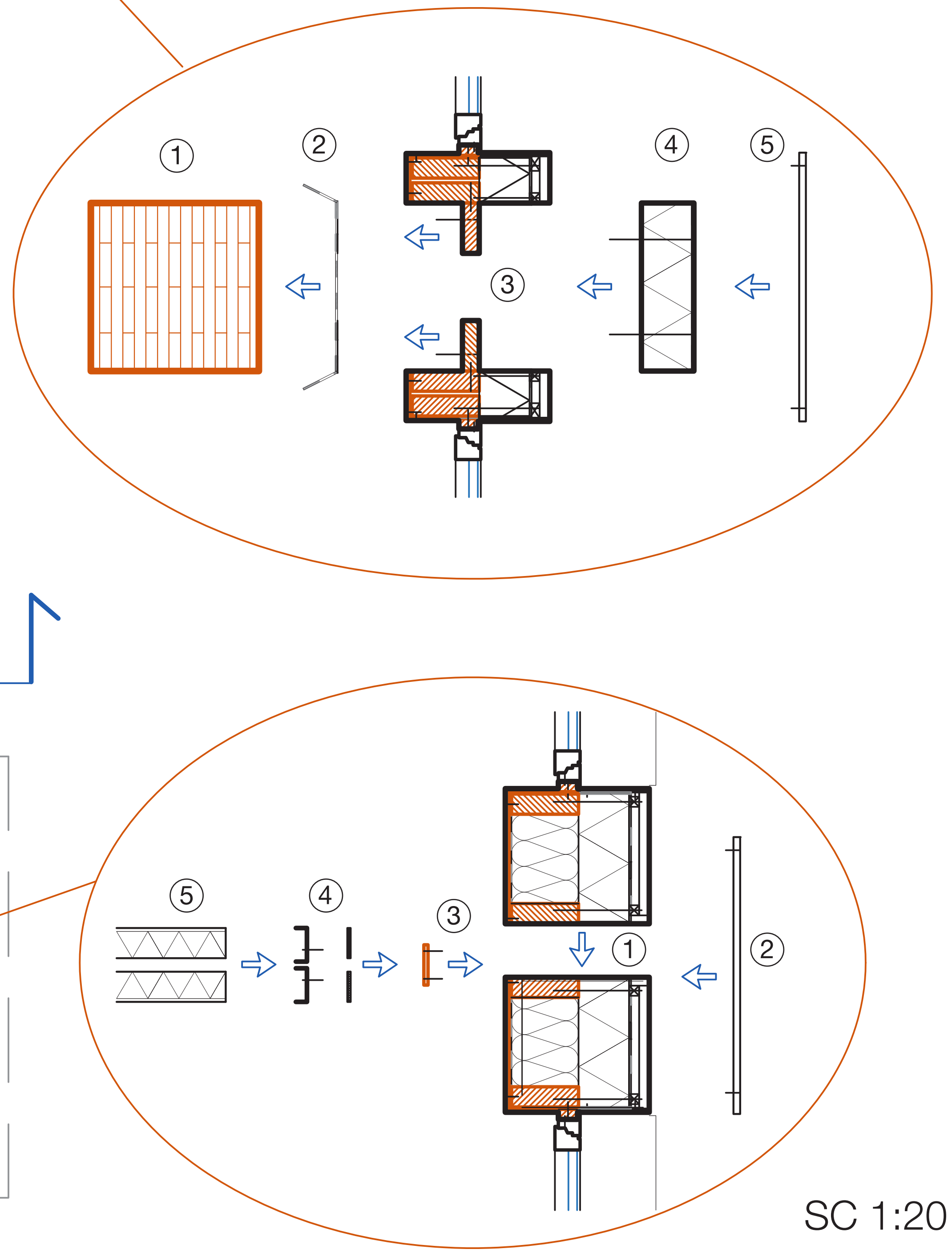
inside
elevation



plan

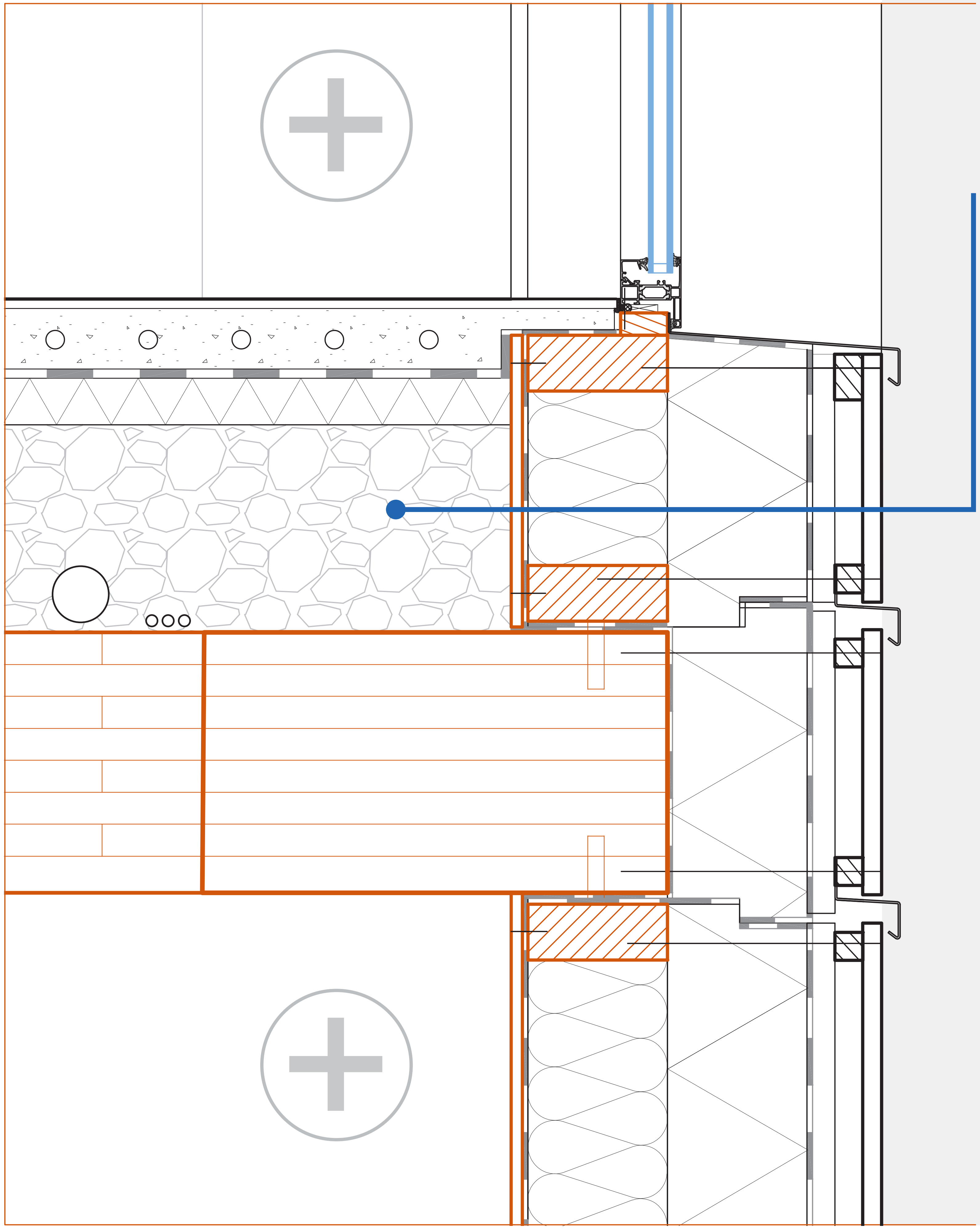
“rock” facade
fragment 1





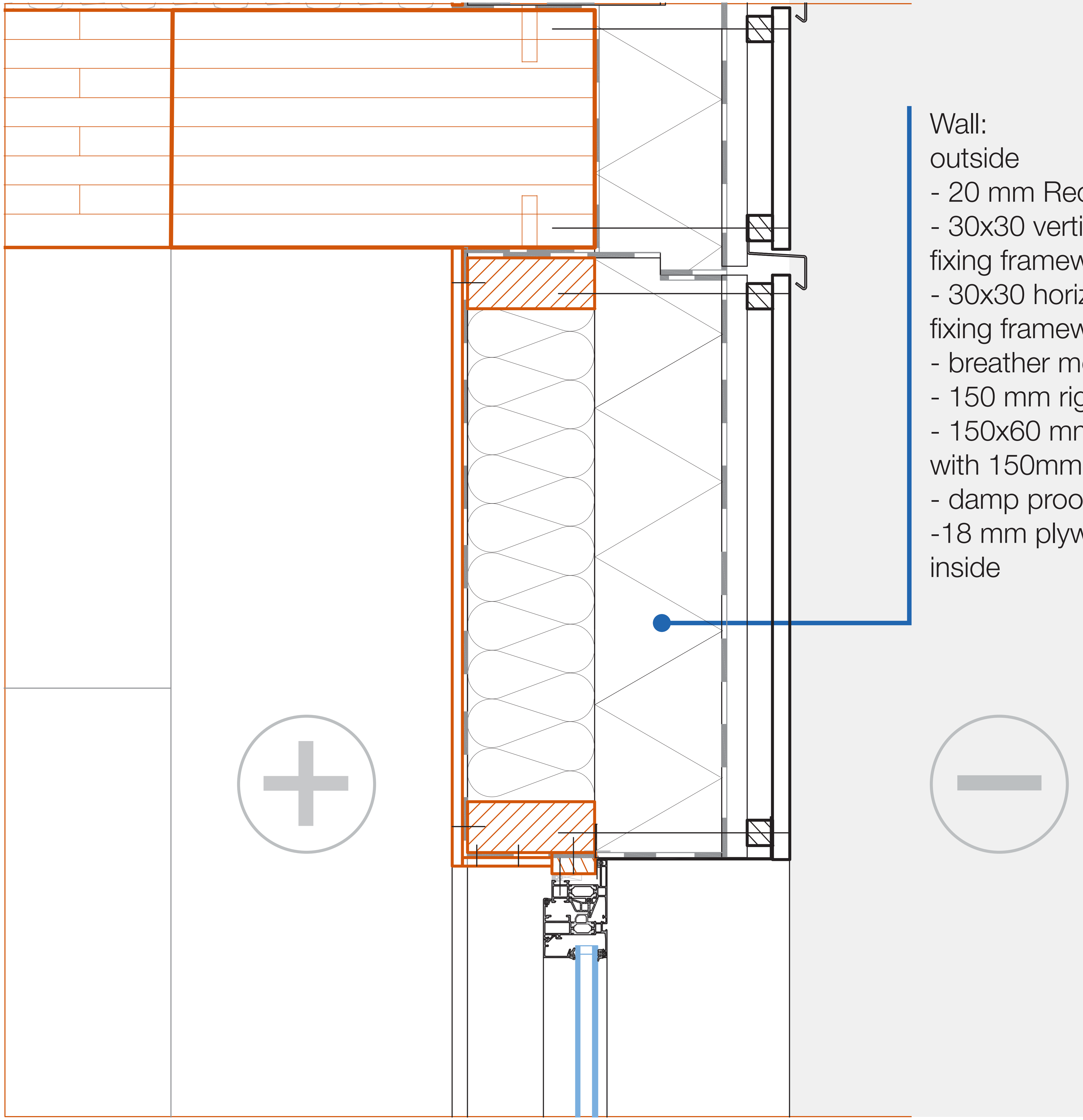
SC 1:20

“rock” facade
detail 1



Floor (360 mm):
- 10 mm linoleum flooring from recycled waste materials
- 65 mm screed with underfloor heating
- 1 mm separating layer (plastic sheet)
- 50 mm rigid wood fibre impact sound insulation
- 220 mm dry crushed stone ballast/ infill
- 280 mm cross-laminated timber floor (spaning 7,4 m between 800 mm deep glue-laminated beams)

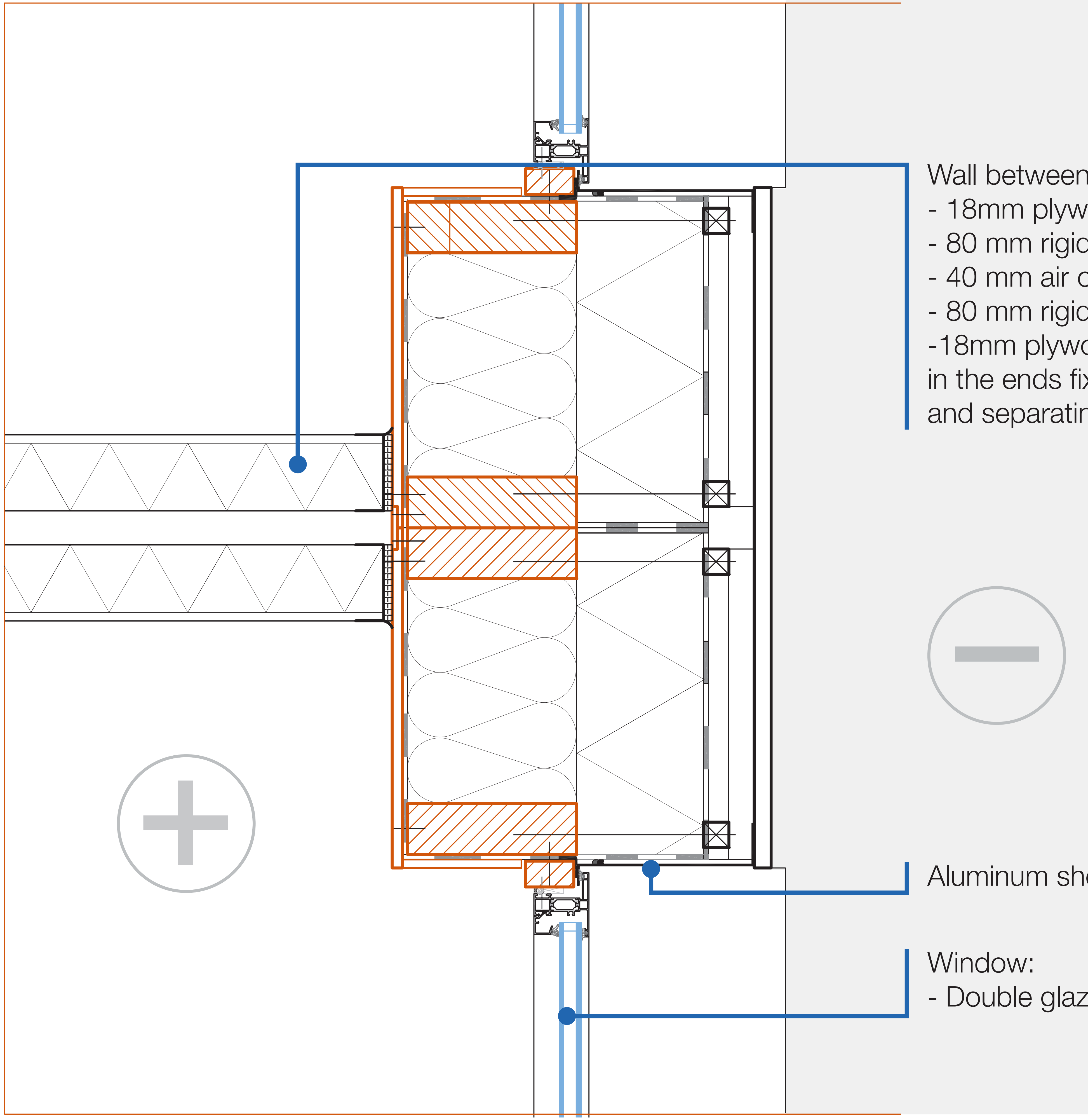
SC 1:5



“rock” facade
detail 2

Wall:
outside
- 20 mm Recycled plastic board cladding
- 30x30 vertical timber batten facade cladding fixing framework
- 30x30 horizontal timber batten facade cladding fixing framework
- breather membrane
- 150 mm rigid wood fiber thermal insulation
- 150x60 mm timber batten facade structure filled with 150mm soft wood fibre thermal insulation
- damp proof/ vapour membrane
-18 mm plywood
inside

“rock” facade
detail 3

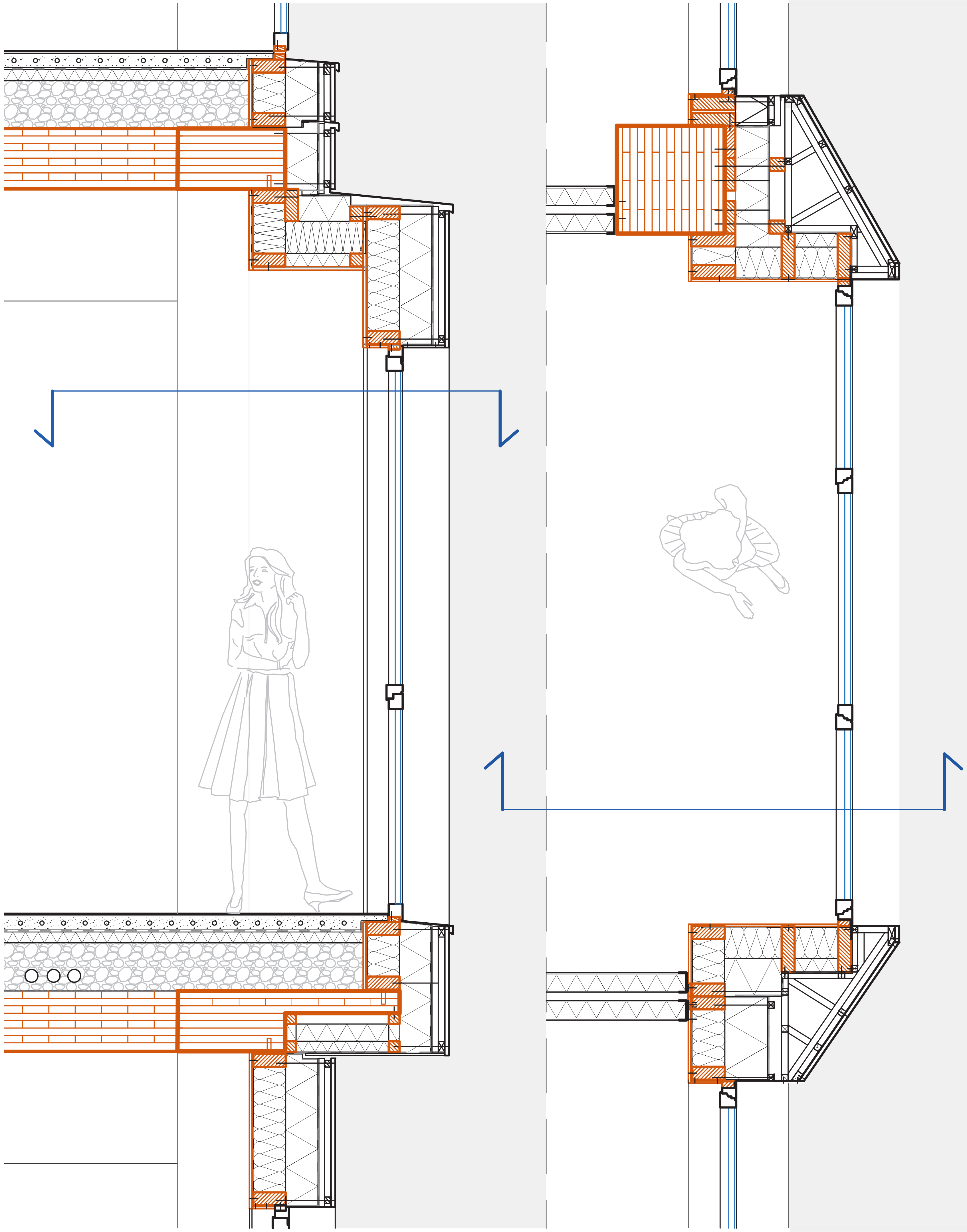


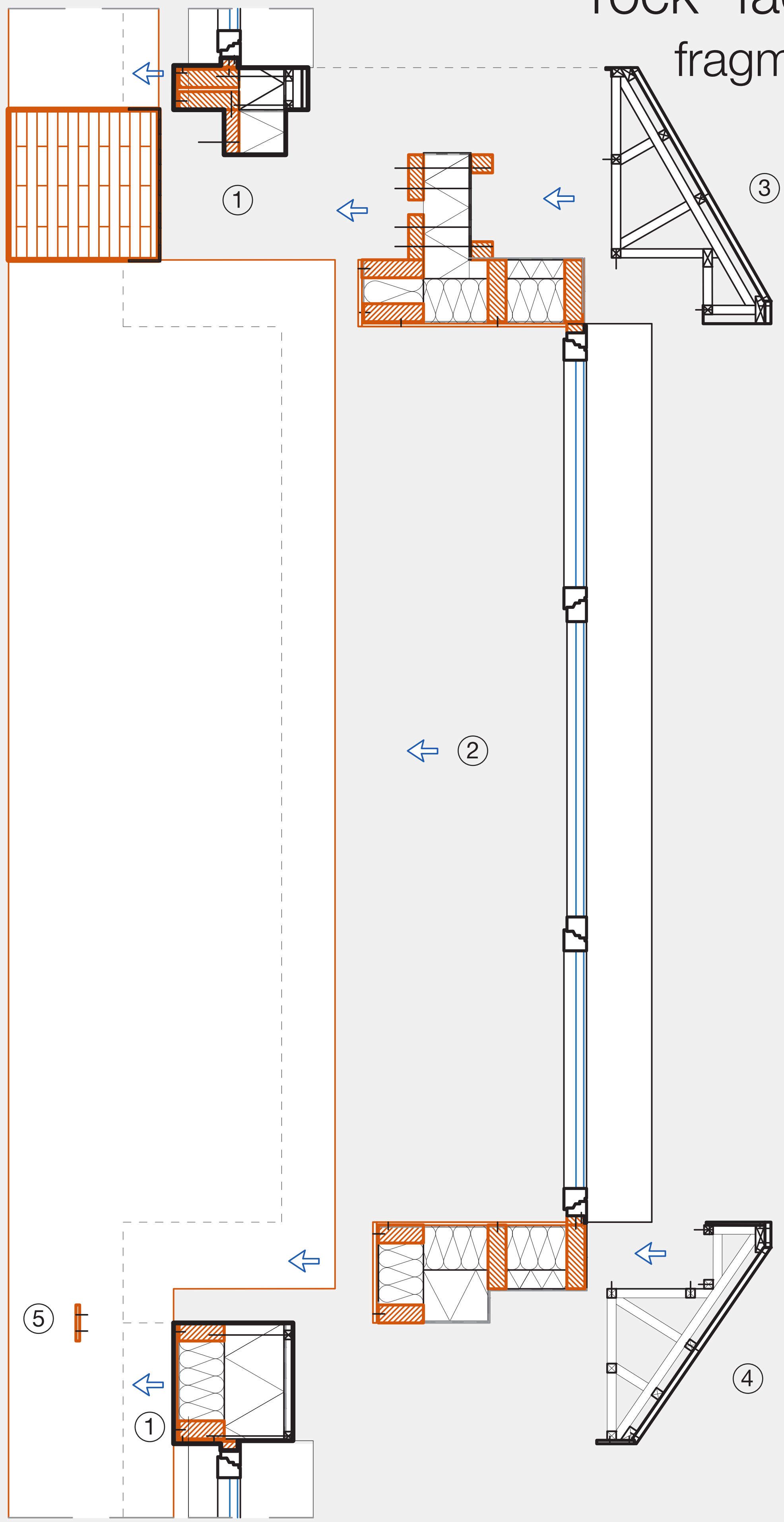
Wall between apartments:
- 18mm plywood
- 80 mm rigid wood fiber thermal insulation
- 40 mm air cavity
- 80 mm rigid wood fiber thermal insulation
-18mm plywood
in the ends fixed through the aluminum framing and separating acoustic strip + silicon seal

Aluminum sheet wrapping around

Window:
- Double glazing in aluminum frame

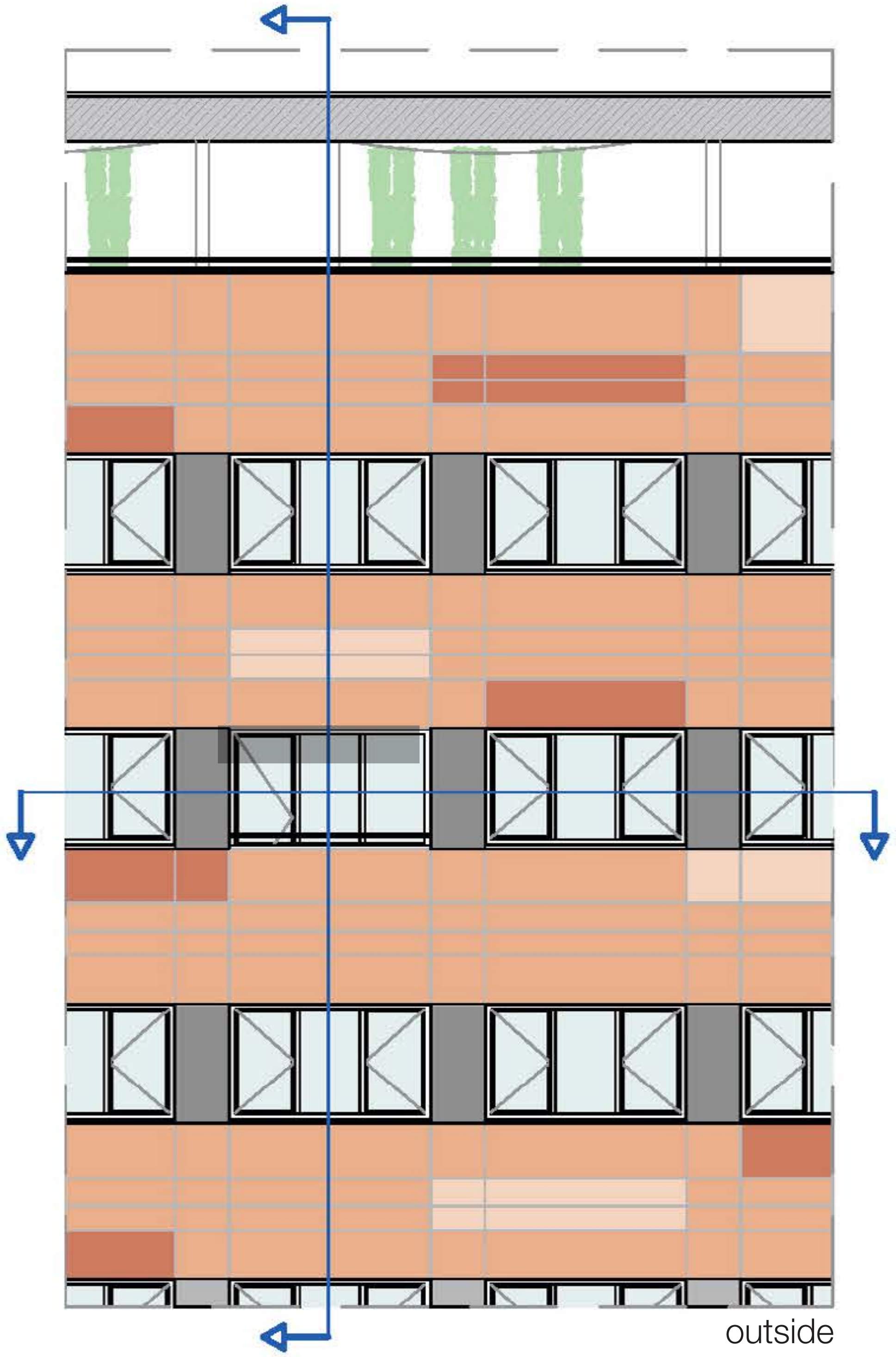
“rock” facade
fragment 2



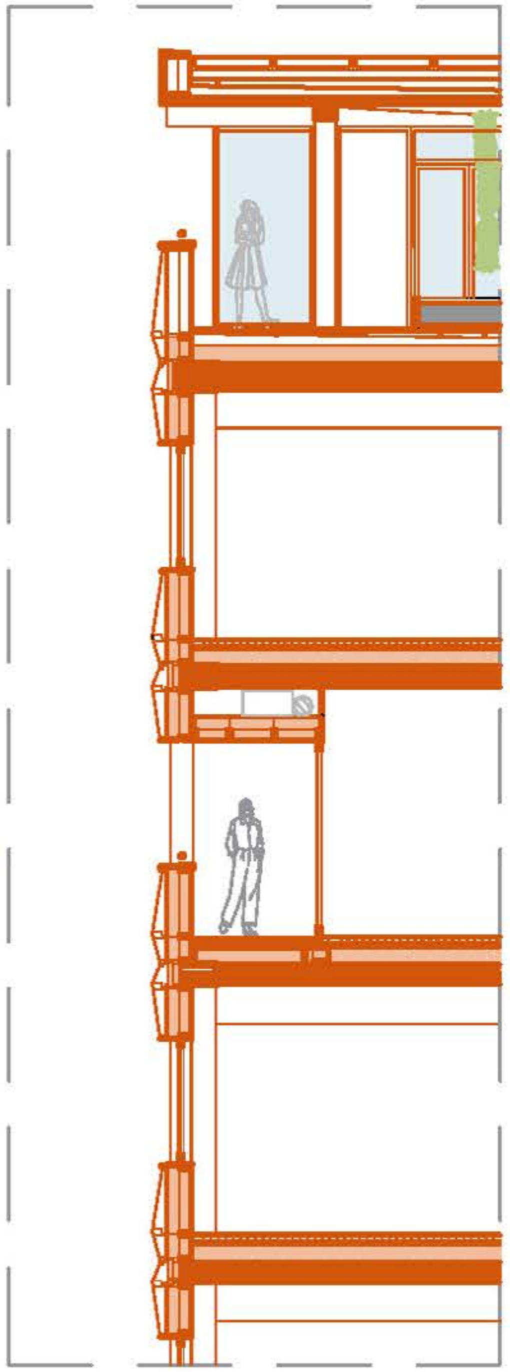


Fragment

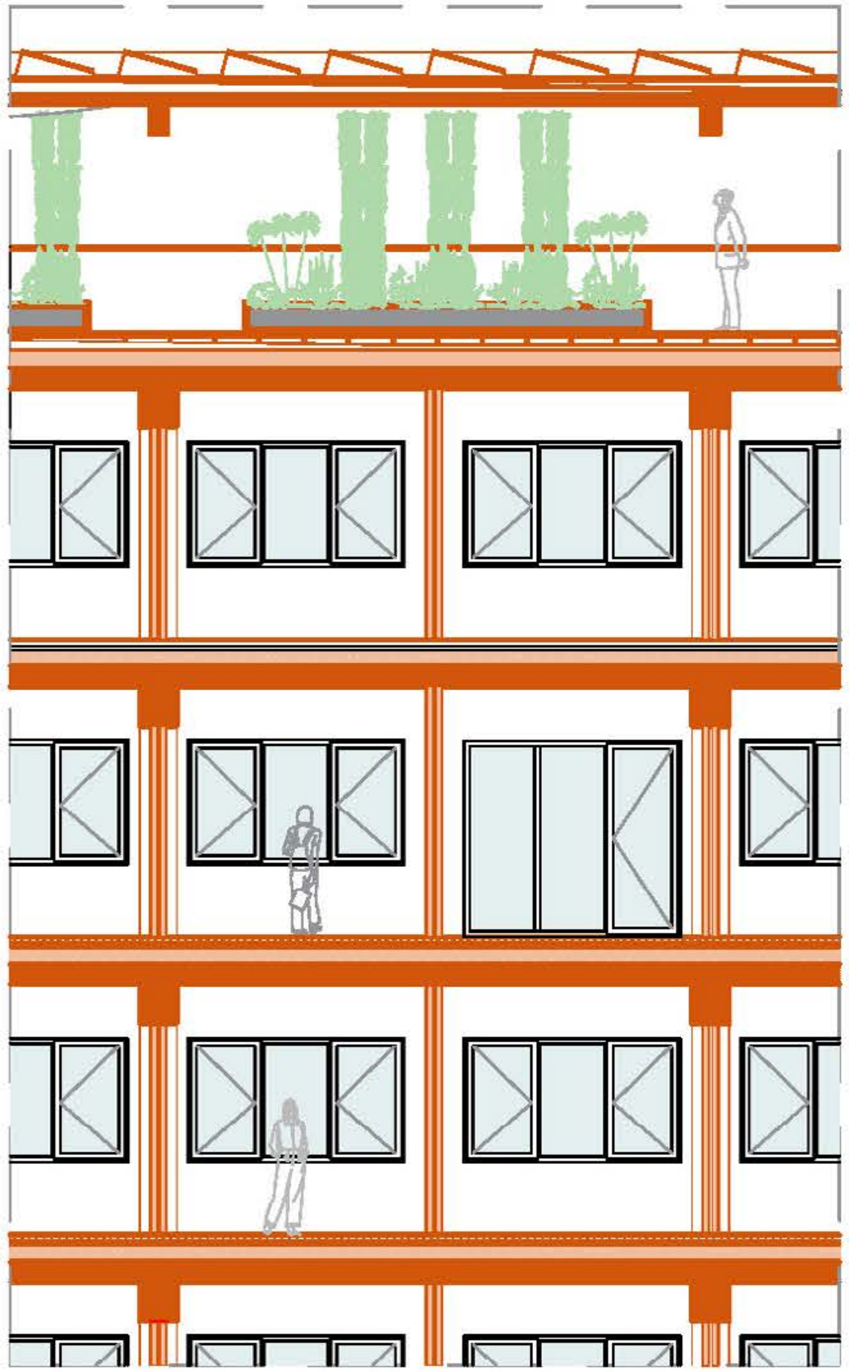
“extrovert” facade



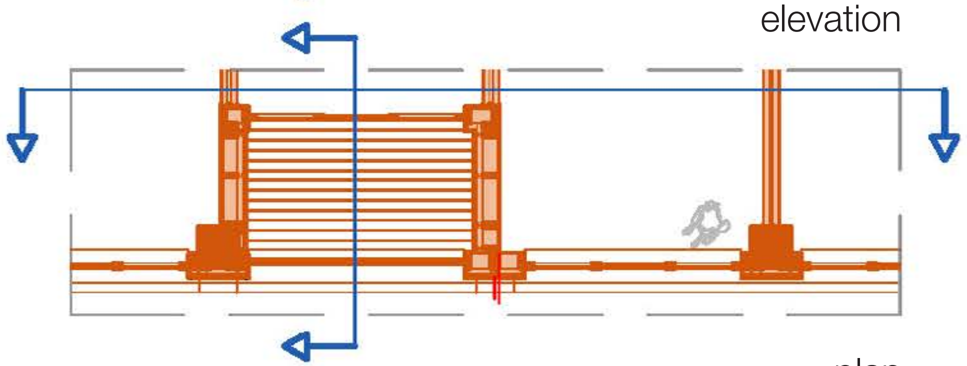
outside
elevation



section

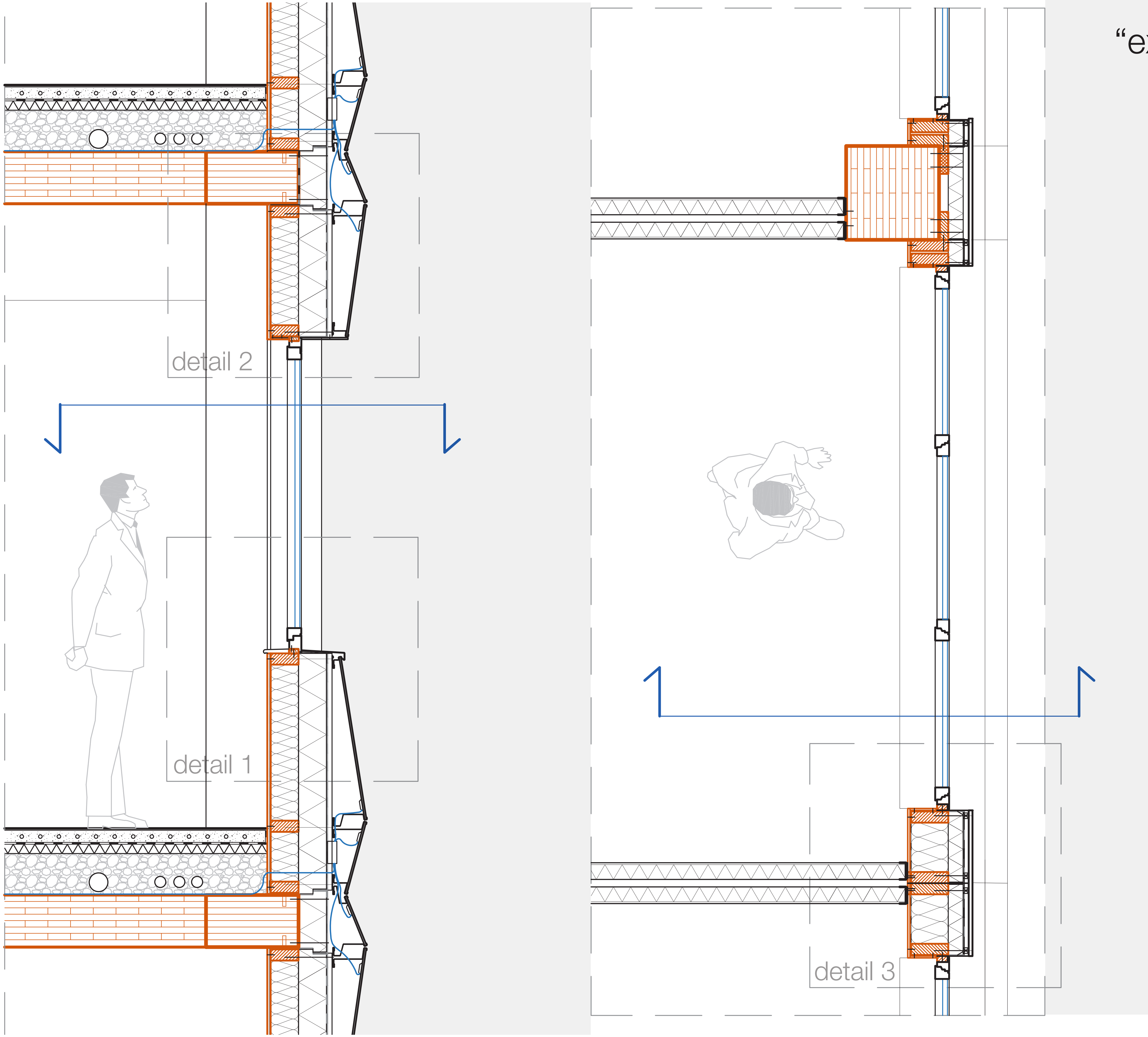


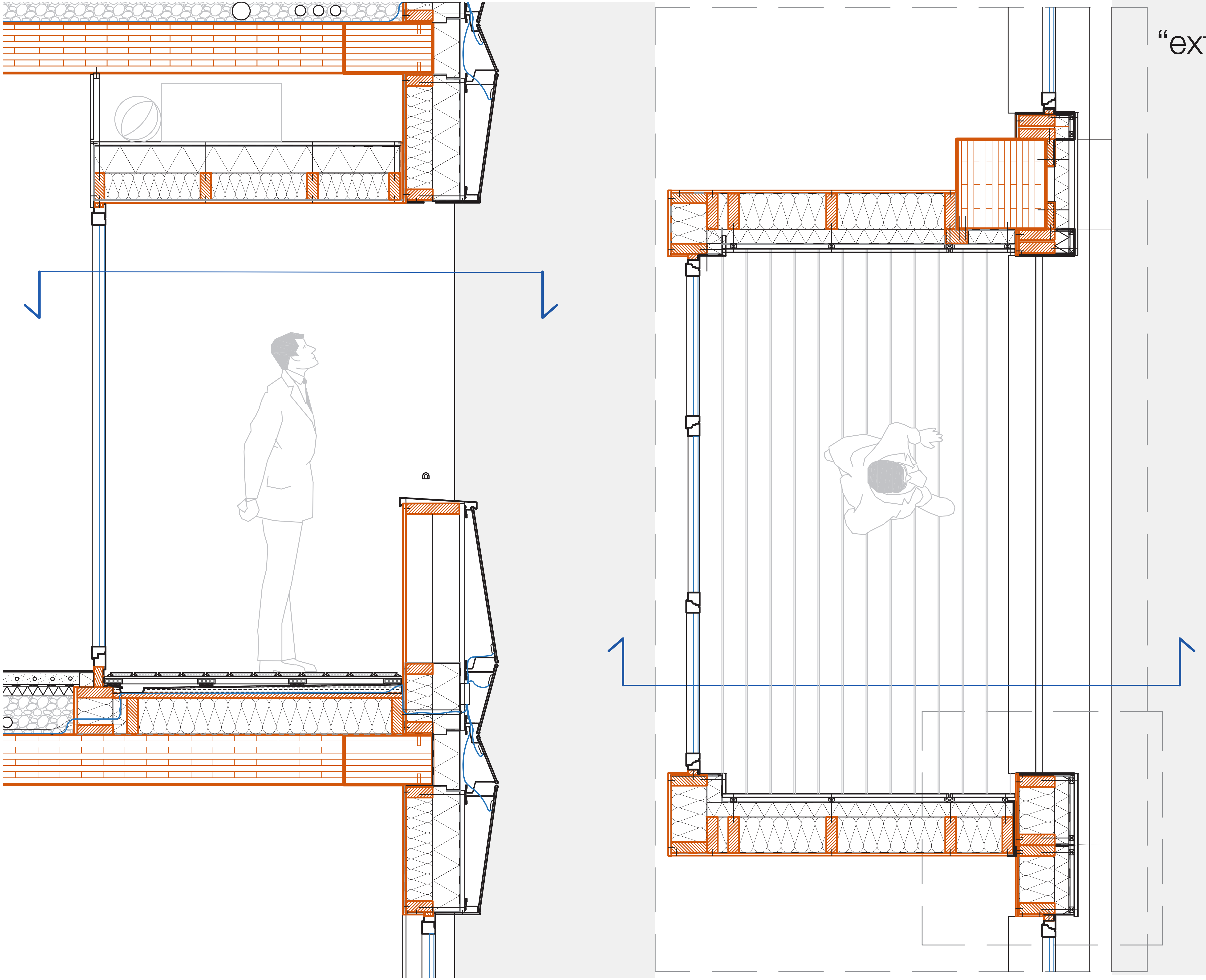
inside
elevation



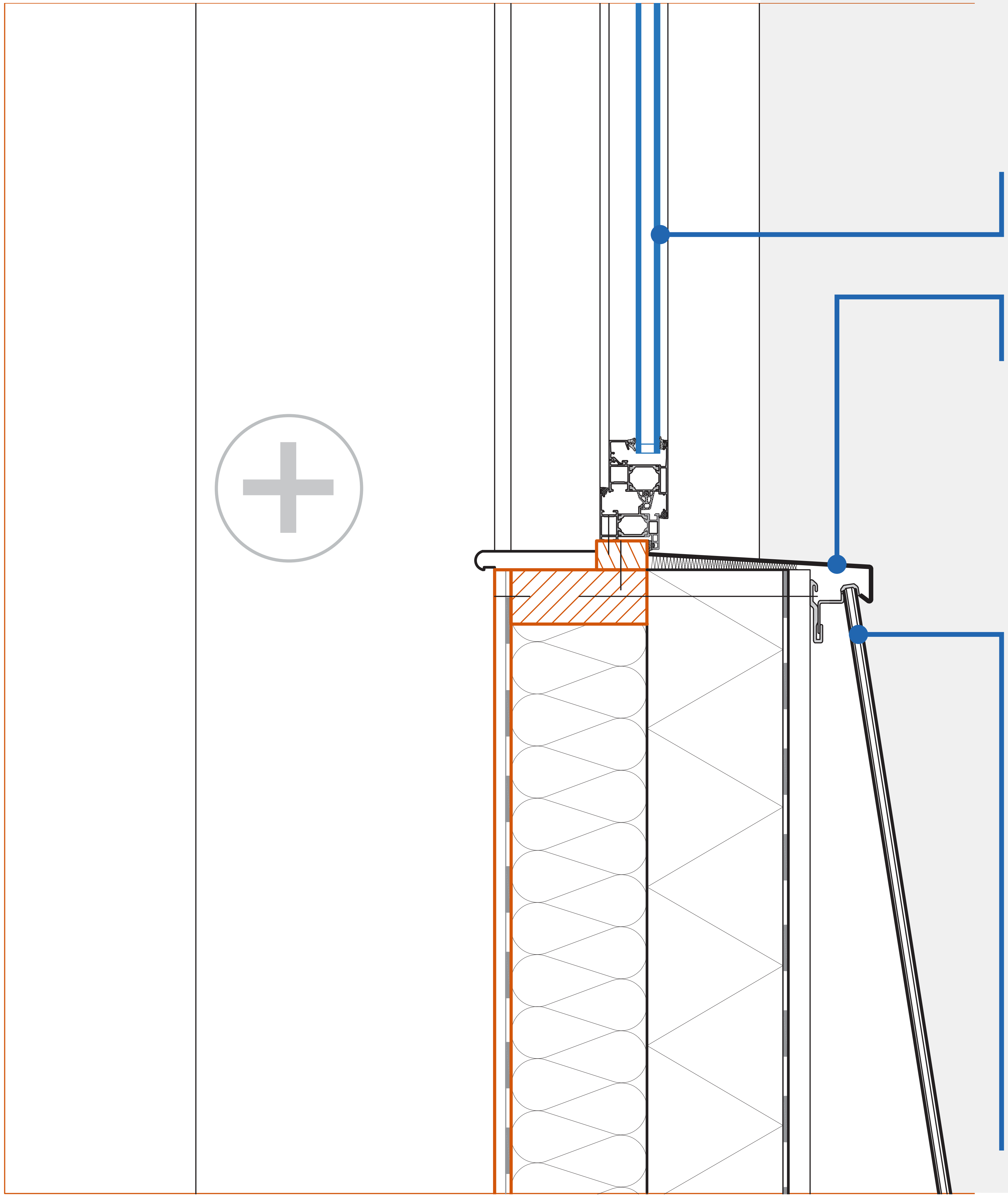
plan

“extrovert” facade
fragment 1





“extrovert” facade
fragment 2



“extrovert” facade detail 1

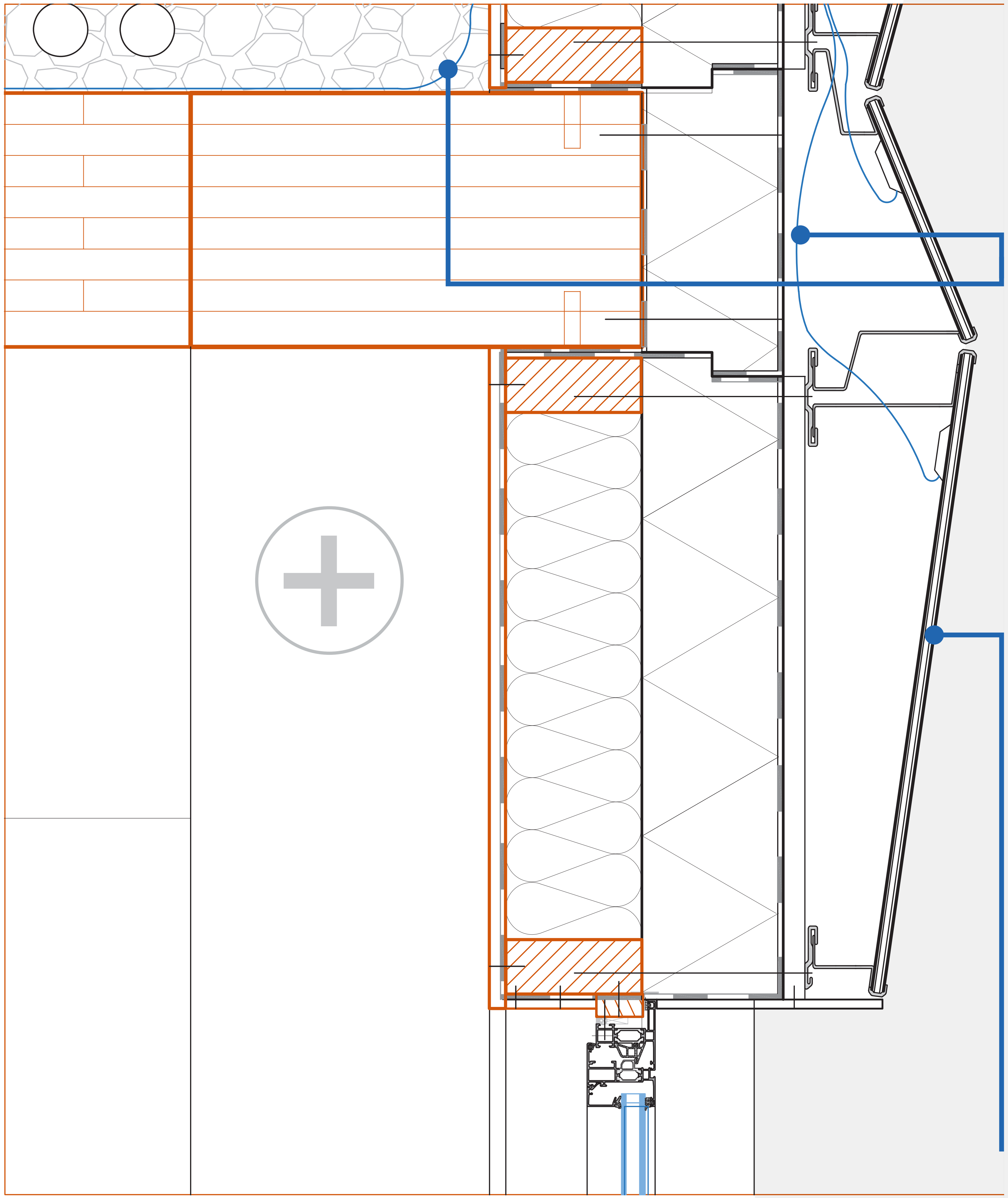
Openable window:
- Double glazing in aluminum frame

Window sill:
- Aluminum sheet profile

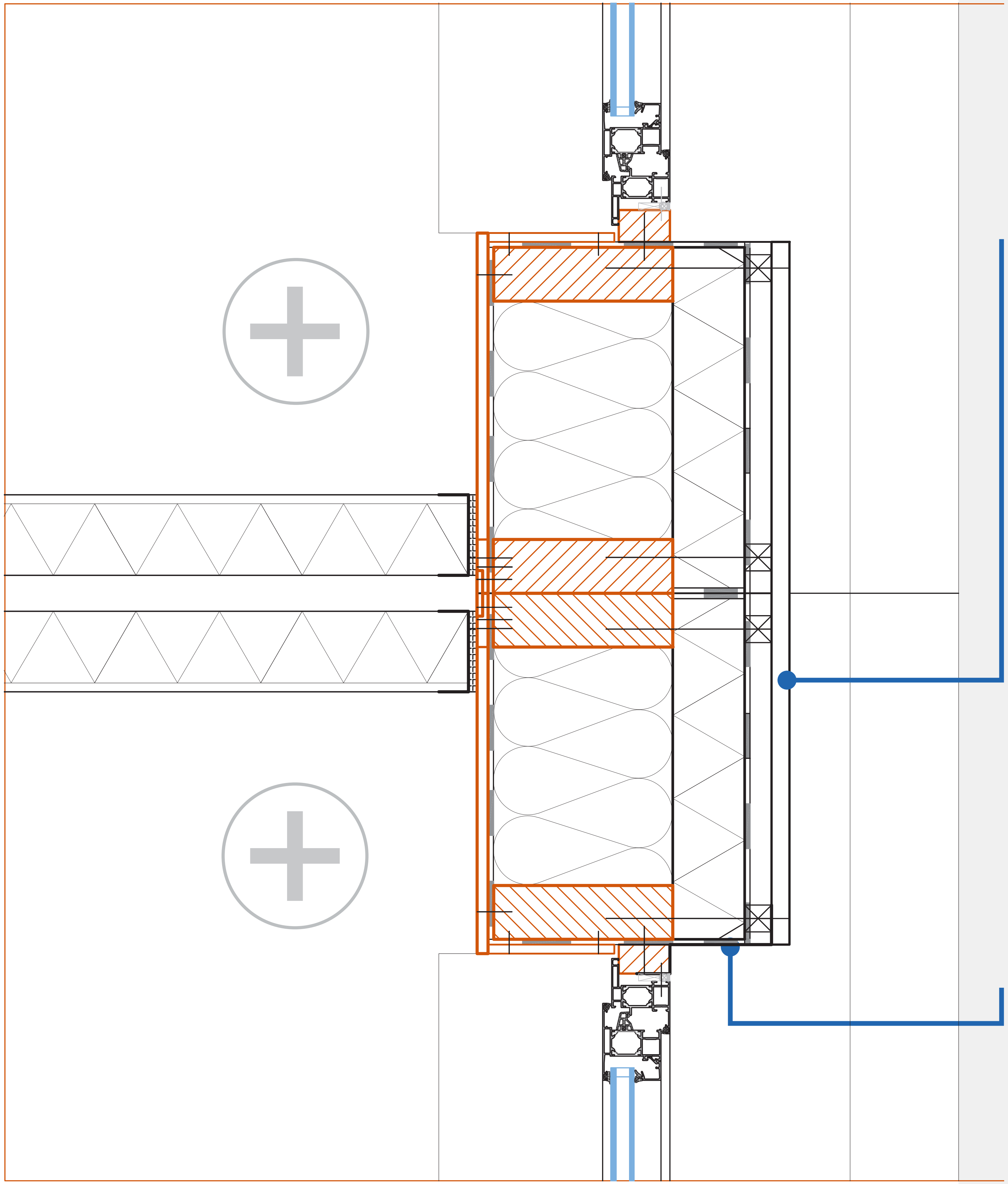
Wall:
outside
- PV panel with coloured glass
- < 60 mm air cavity for better PV panel performance
- Horizontal aluminium rainscreen cladding fixing system, screwed to vertical timber battens
- 30x30 mm vertical timber batten framework
- breather membrane
- 150 mm rigid wood fiber thermal insulation
- 150x60 mm timber batten facade structure filled with 150 mm soft wood fibre thermal insulation
- damp proof/ vapour membrane
-18mm plywood
inside

SC 1:5

“extrovert” facade
detail 2



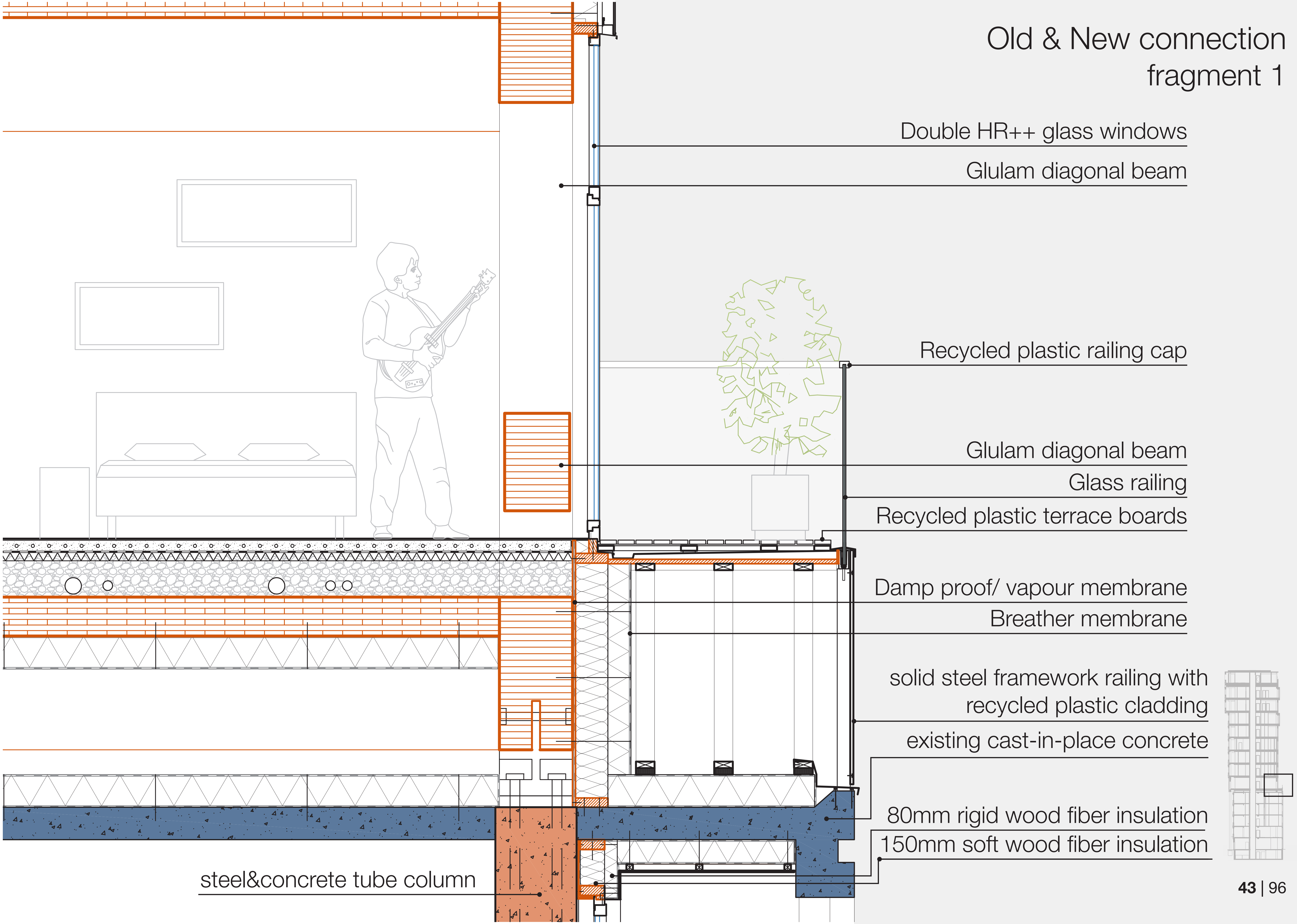
"extrovert" facade
detail 3



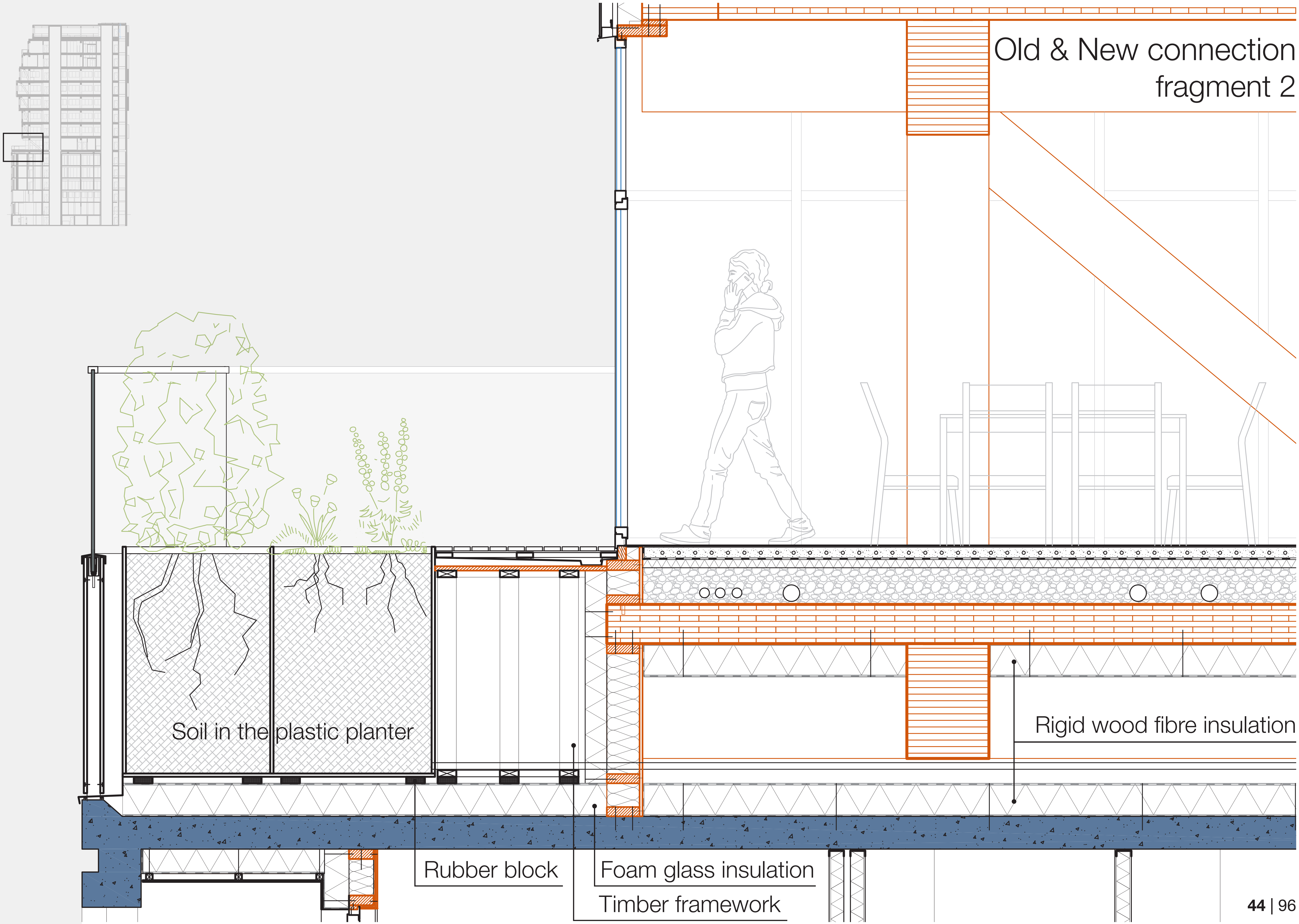
Wall section between windows:
outside
- 20 mm Recycled plastic board cladding
- 30x30 mm Vertical timber batten facade cladding fixing framework
- breather membrane
- 80 mm rigid wood fiber thermal insulation
- 200x60 timber batten facade structure filled with 200 mm soft wood fibre thermal insulation
- damp proof/ vapour membrane
-18 mm plywood
inside

Aluminum sheet wrapping around

Old & New connection fragment 1



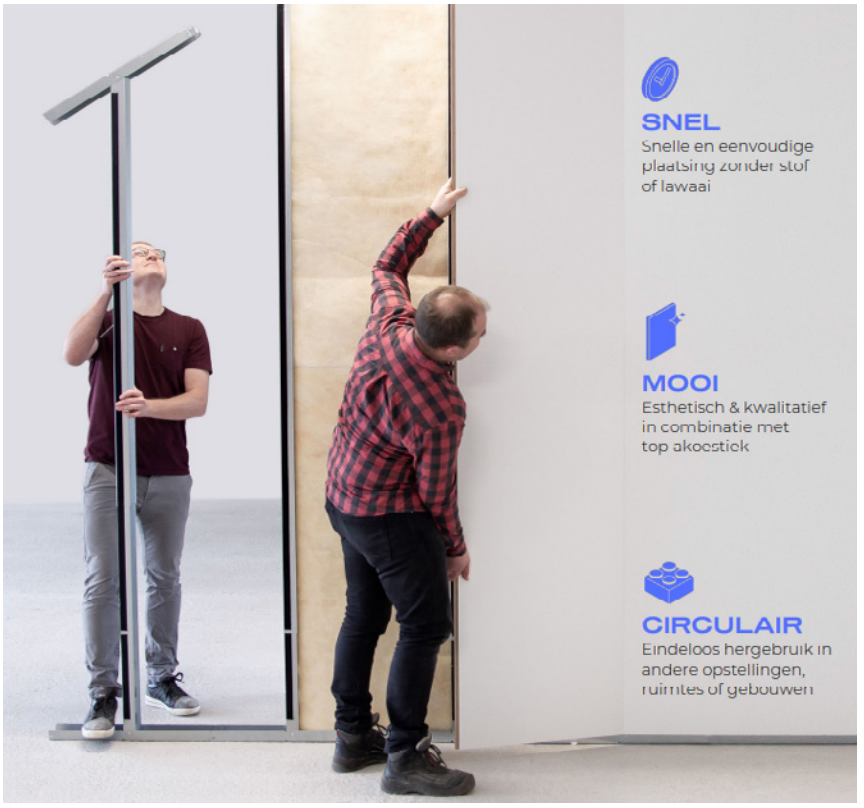
Old & New connection fragment 2



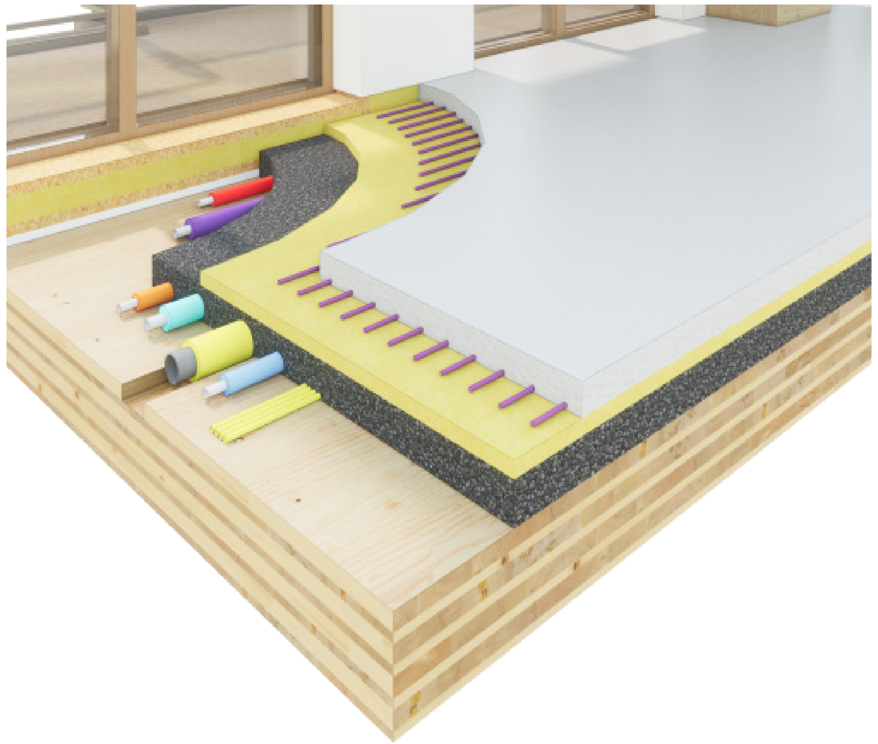
4.4 Materials

Designing for material recovery

demountable prefab concrete elements for cores



adaptable and reusible partitioning systems



raised floor for dry disassembly of installations

demountable prefab CLT elements

Recycled plastic boards can be recycled again

modular facade elements
(as it was in the existing building)

https://www.concrete-international.nl/wp-content/uploads/2016/03/BETONELEMENTEN.jpg
https://www.juunoo.com/waarom-juunoo/, https://mei-arch.eu/wp-content/uploads/2021/11/19010_SAWA_openbouwen_open-trans-vk-Large.png?image-crop-positioner-ts=1642759479,
https://www.hess-timber.com/fileadmin/_processed_/csm_20160612_00054_HessSydney__c_RenstephThompson_6609760a2c.jpg, https://www.s-polytec.com/plastic-sheets/abs-sheets.html

“extrovert” facade

Satin finish PV

Building Integrated PhotoVoltaics (BIPV)

https://neufert-cdn.archdaily.net/uploads/photo/image/281030/full_Solarlab.dk-SolarFacade-7.jpg?v=1634589376
https://neufert-cdn.archdaily.net/uploads/photo/image/281054/full_Solarlab.dk-Sequins-2.jpeg?v=1634589717

“rock” facade

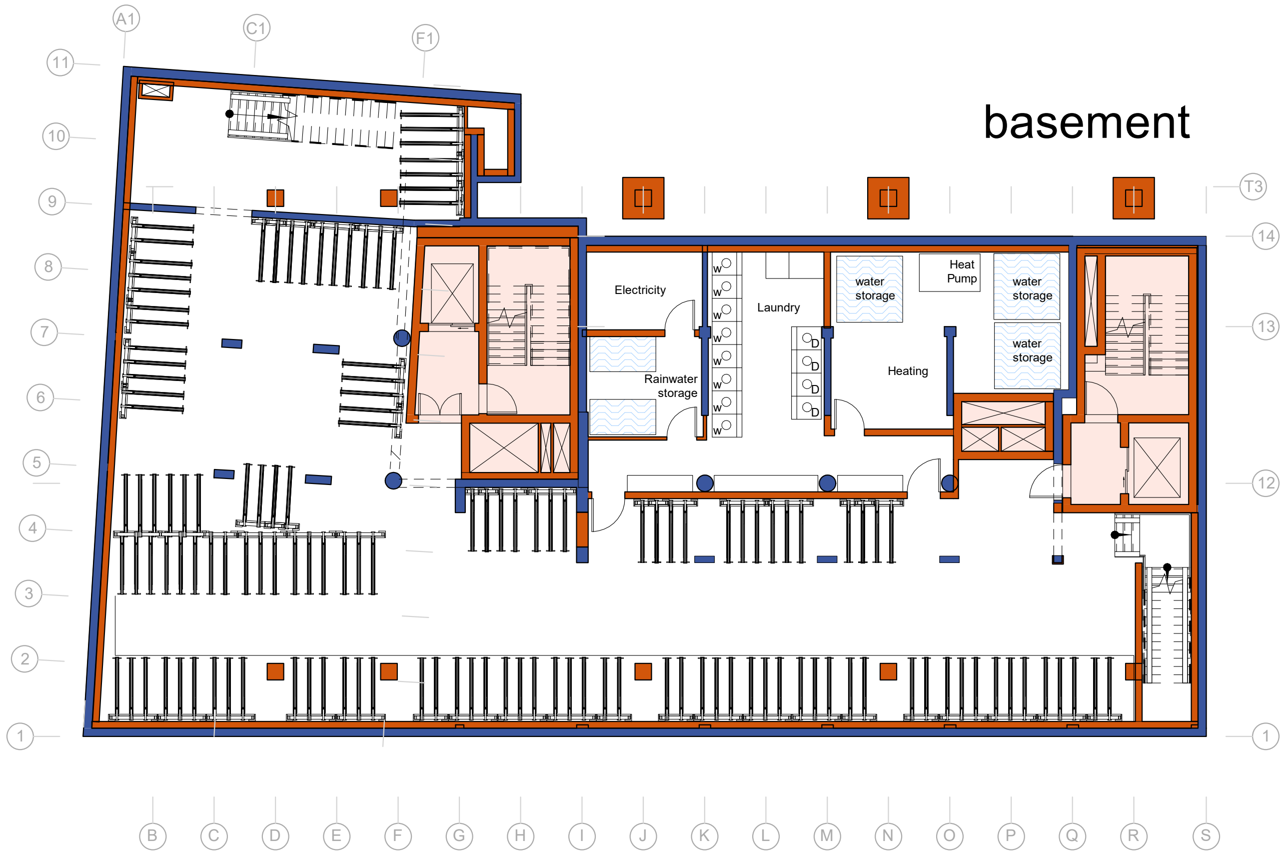
dark brown recycled plastic panels

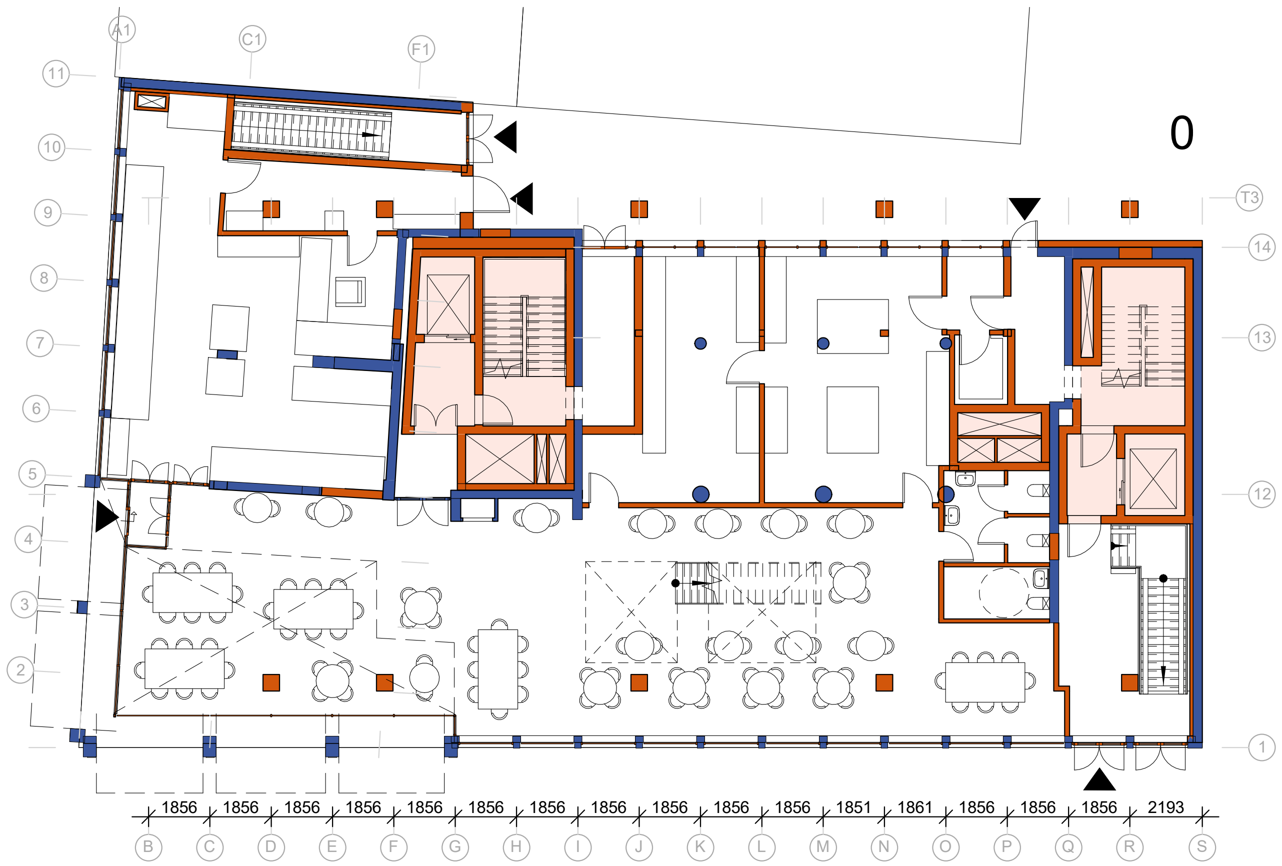
- Made from reclaimed plastic
- UV & weather resistant
- do not rot
- do not require maintenance
- can be recycled again

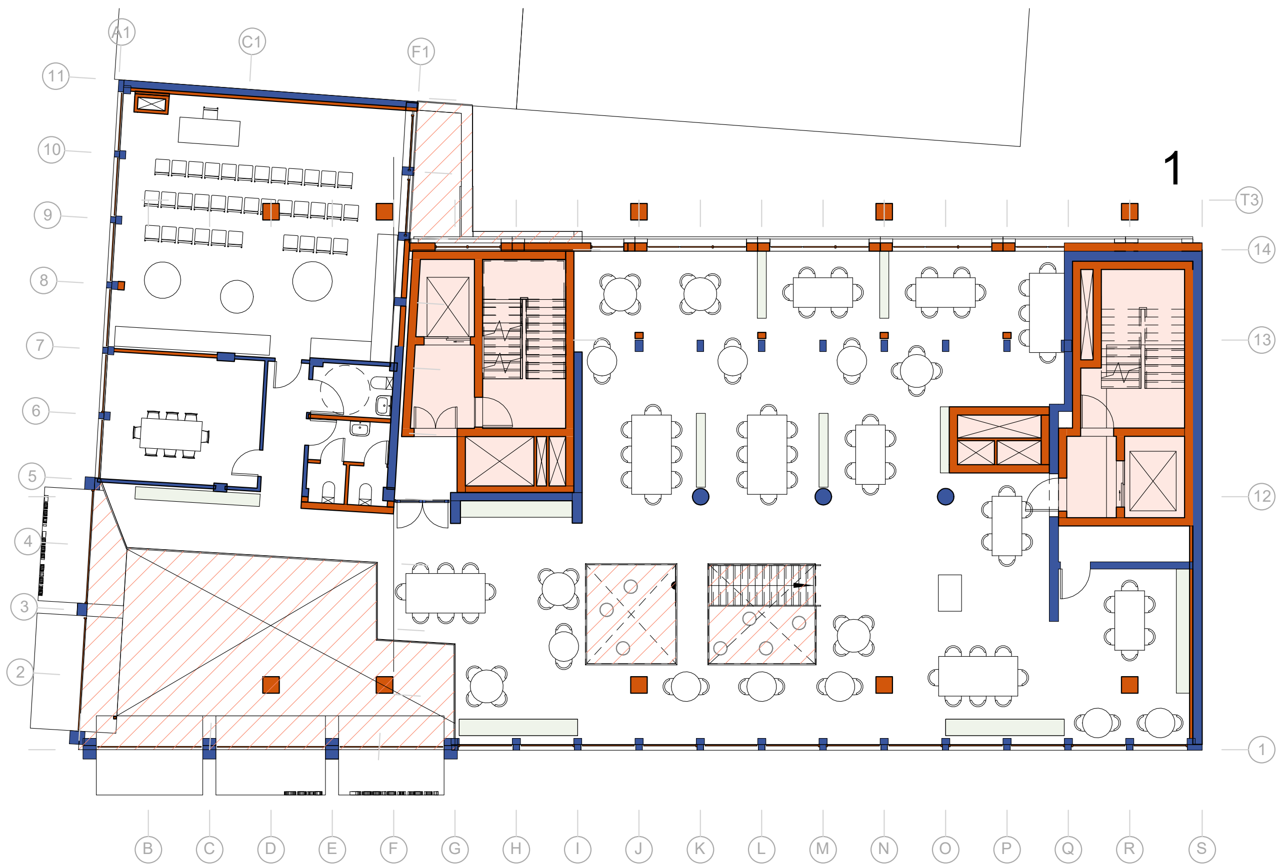
https://www.filcris.co.uk/cms-files/5715/5715db2e6b825_large.jpghttps://neufert-cdn.archdaily.net/uploads/photo/image/281054/full_Solarlab.dk-Sequins-2.jpeg?v=1634589717

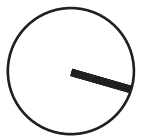
5. Floor plans

Existing building
plans_old & new





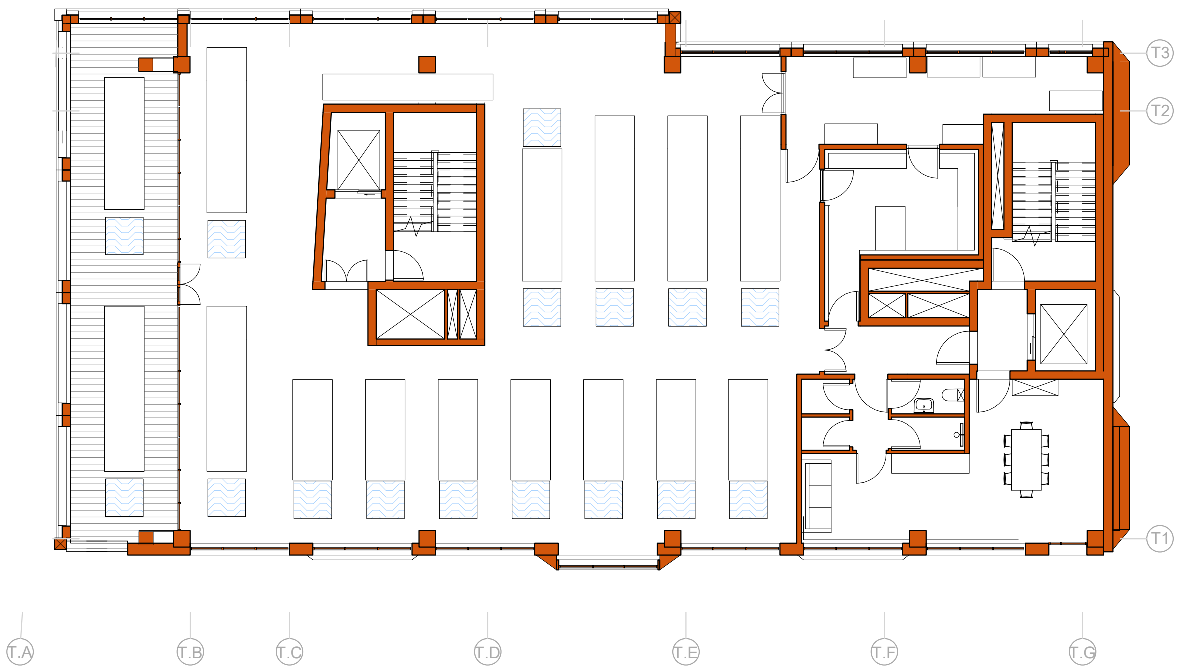




New tower
plans

New tower
plans

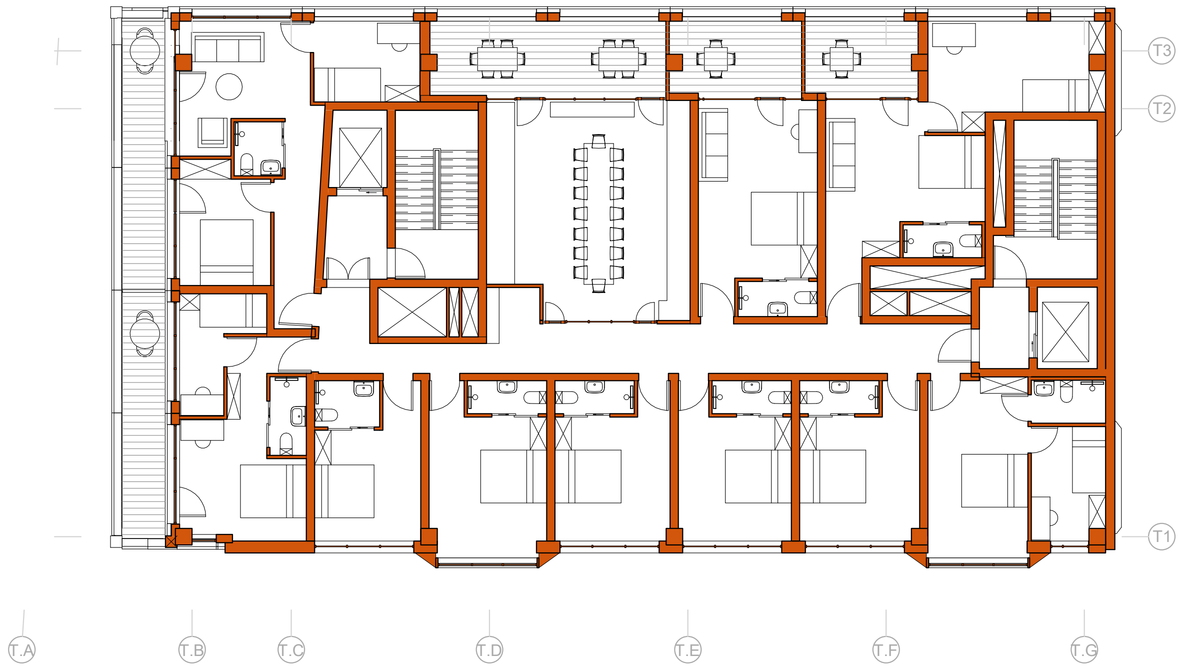
9

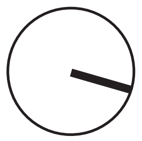


10

11

12



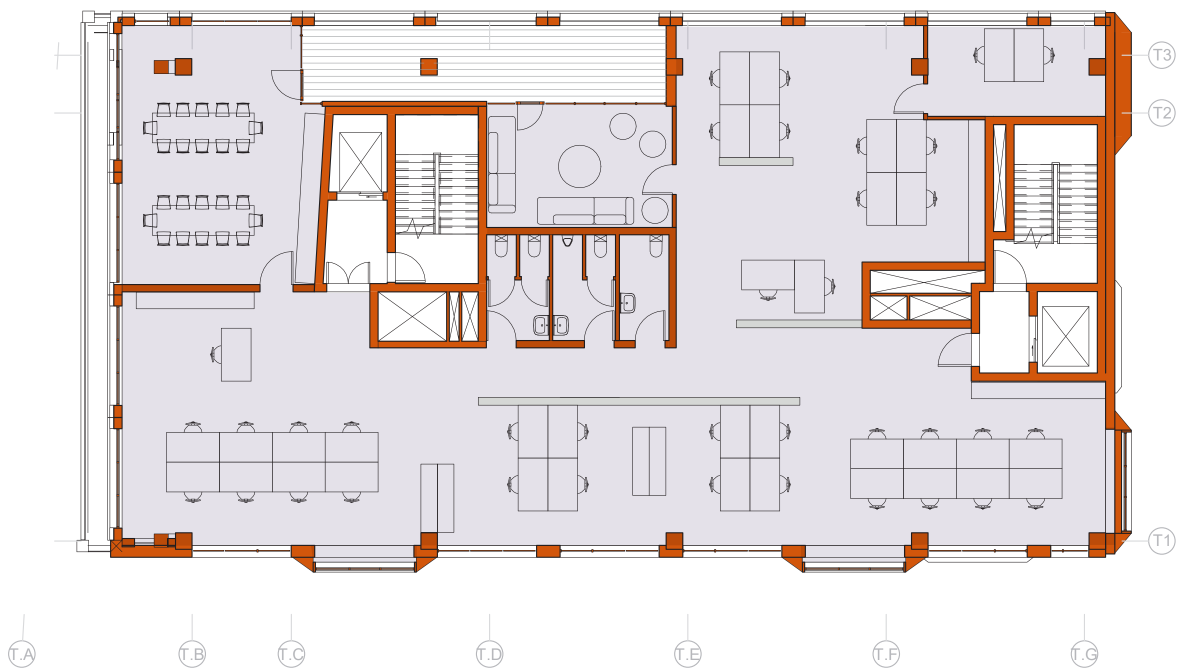


Adaptability for different functions

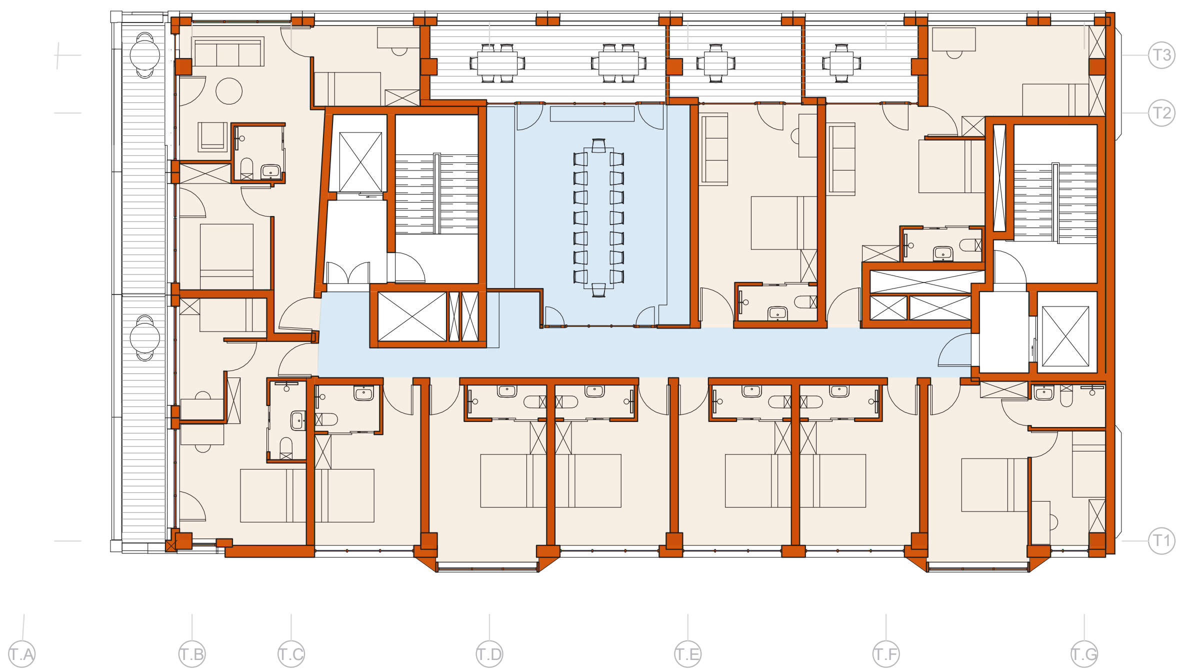
2 luxurious apartments (aprox.170 m²) 9

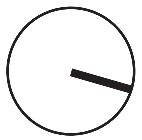
Indoor farm 10

Office space 11

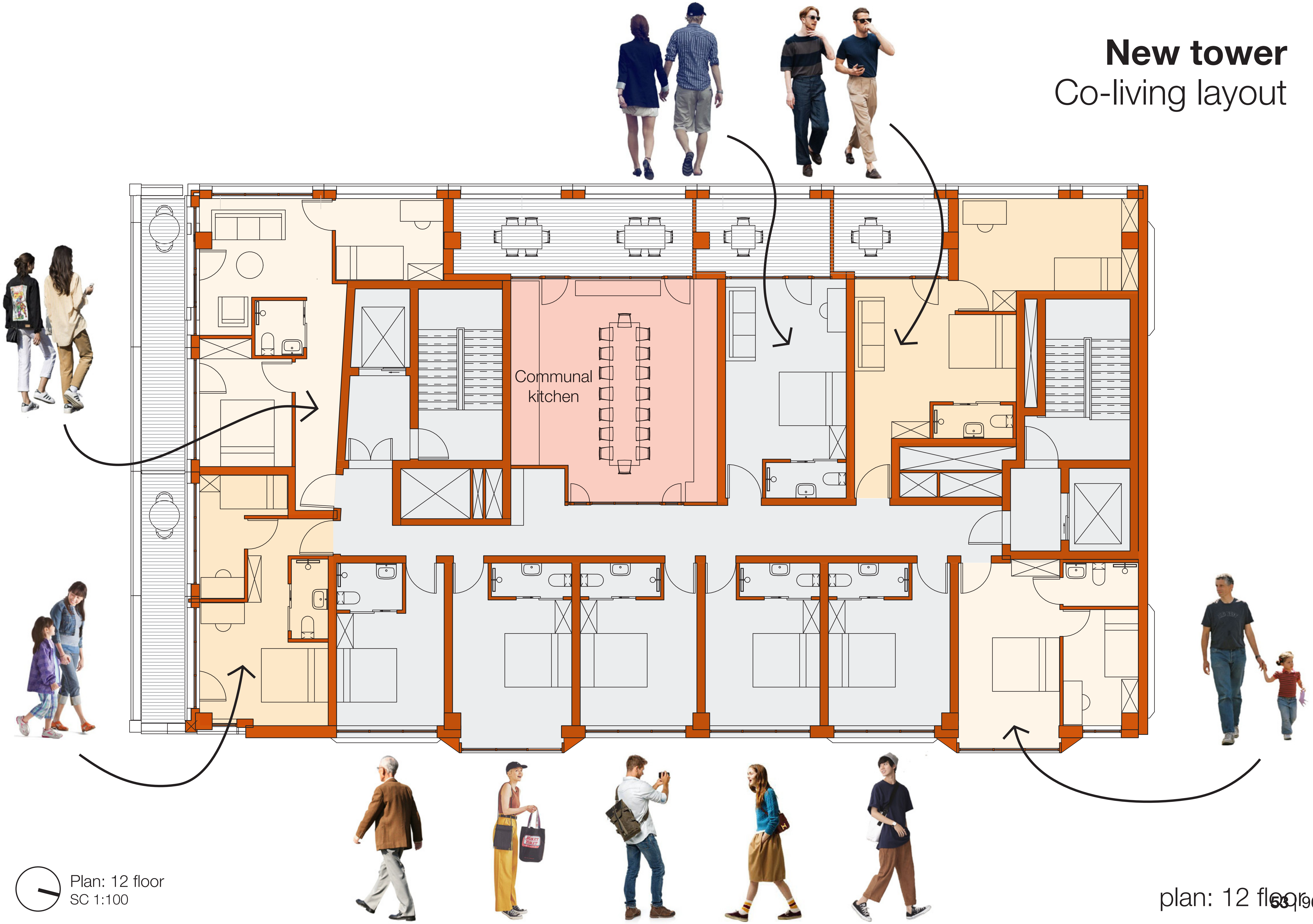


Co-living apartments 12

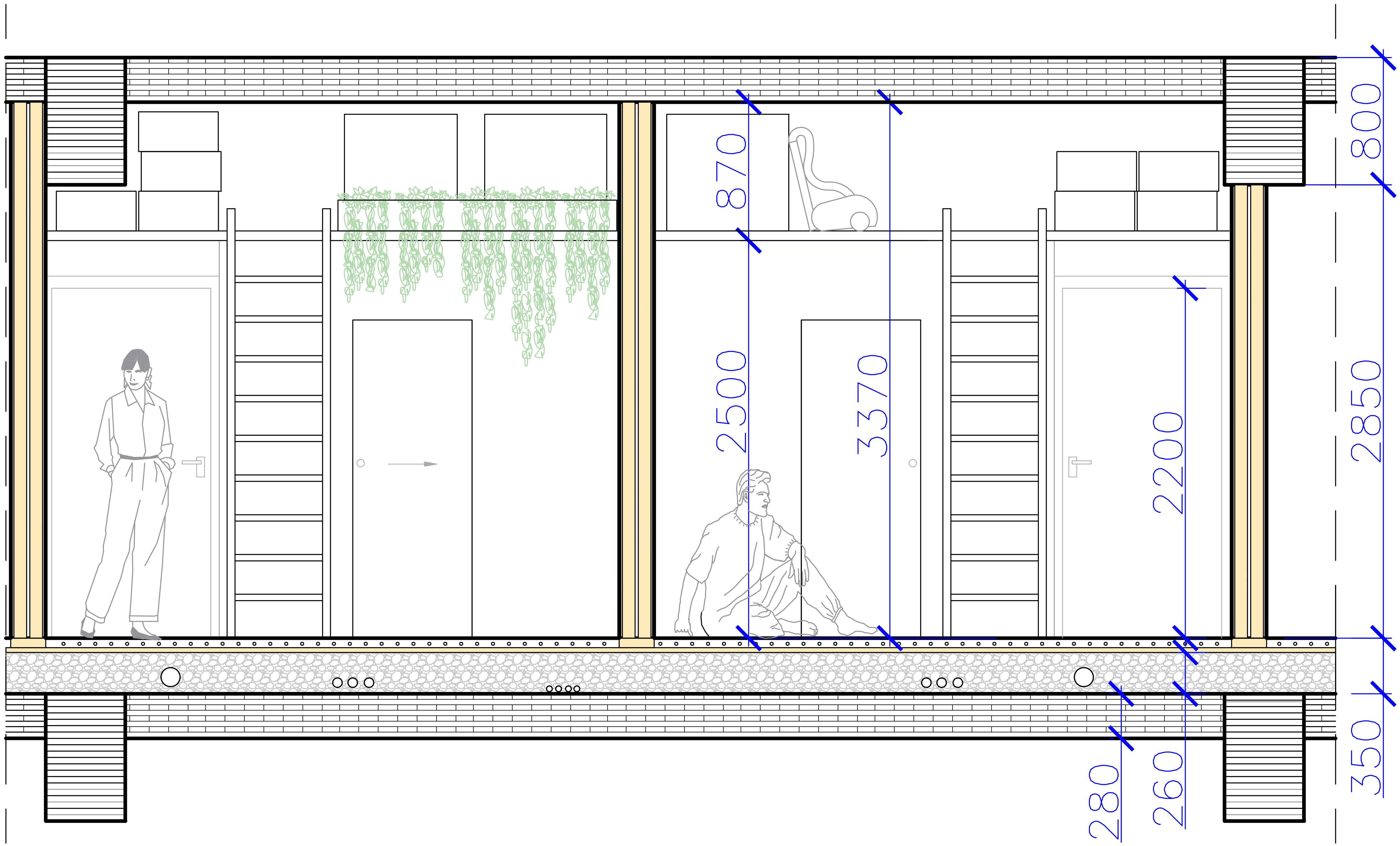


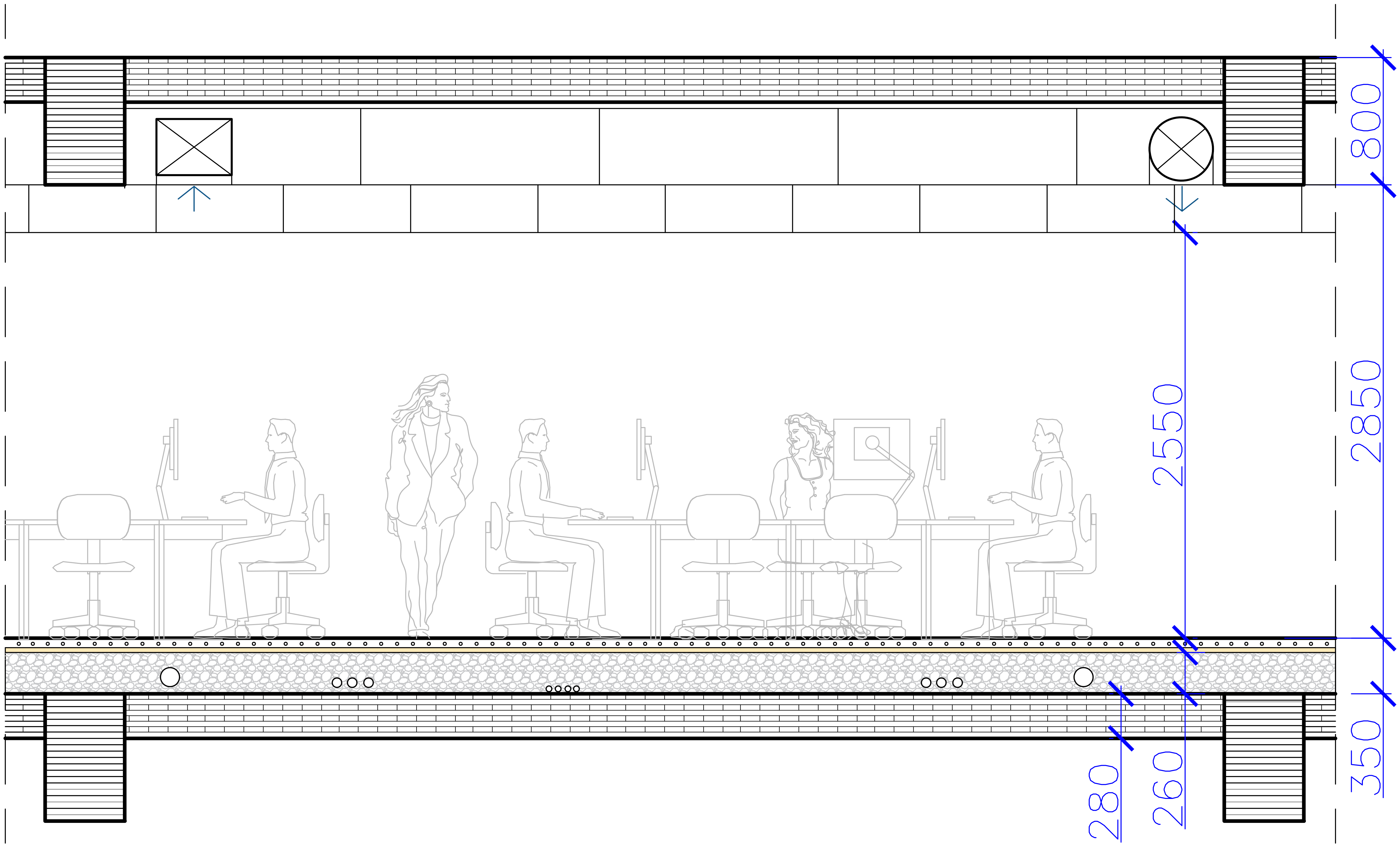


New tower
Co-living layout



Plan: 12 floor
SC 1:100


870
2500
3370
2200
800
2850
350
280
260


800
2850
2550
280
260
350

Access to the building

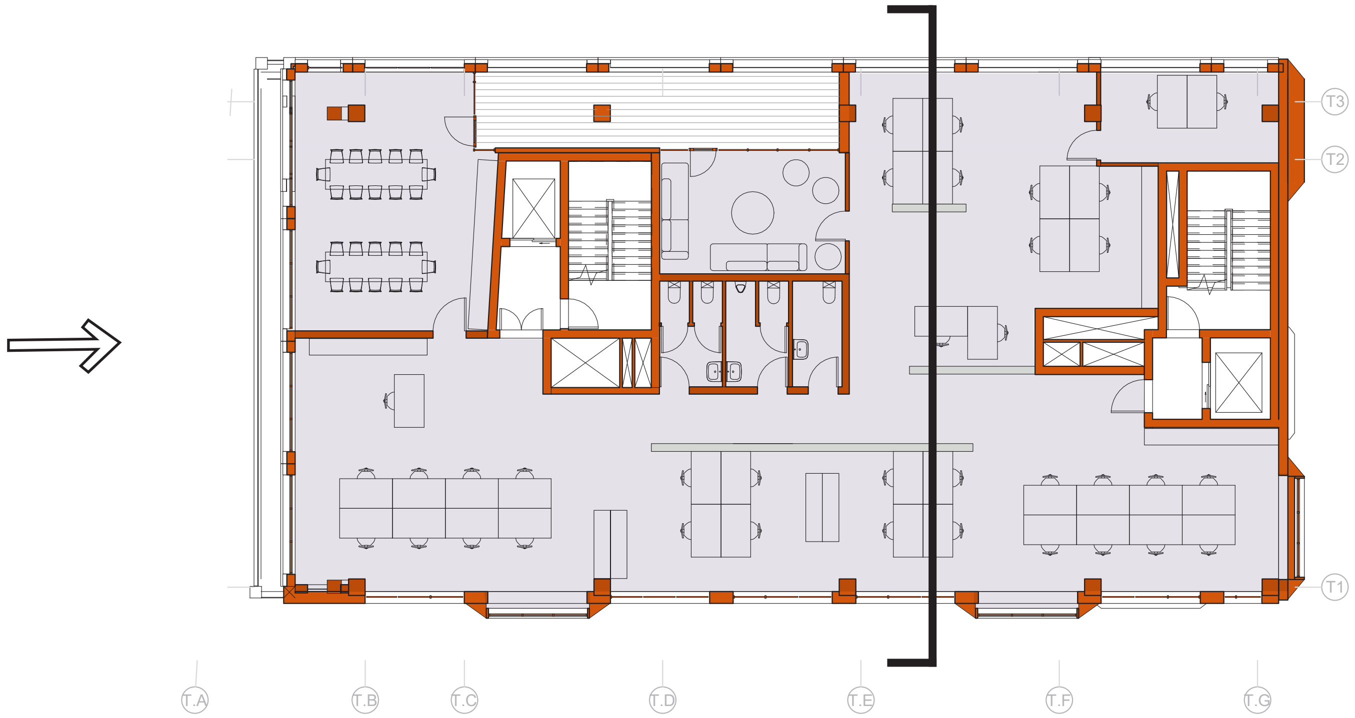
6. How to change the function?

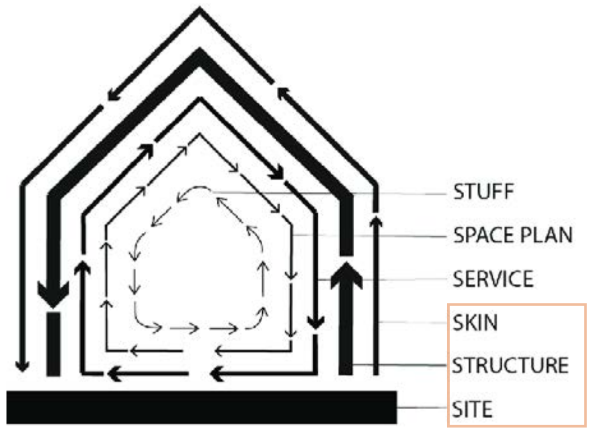
Changing the function of a storey

residential to office

Co-living apartments

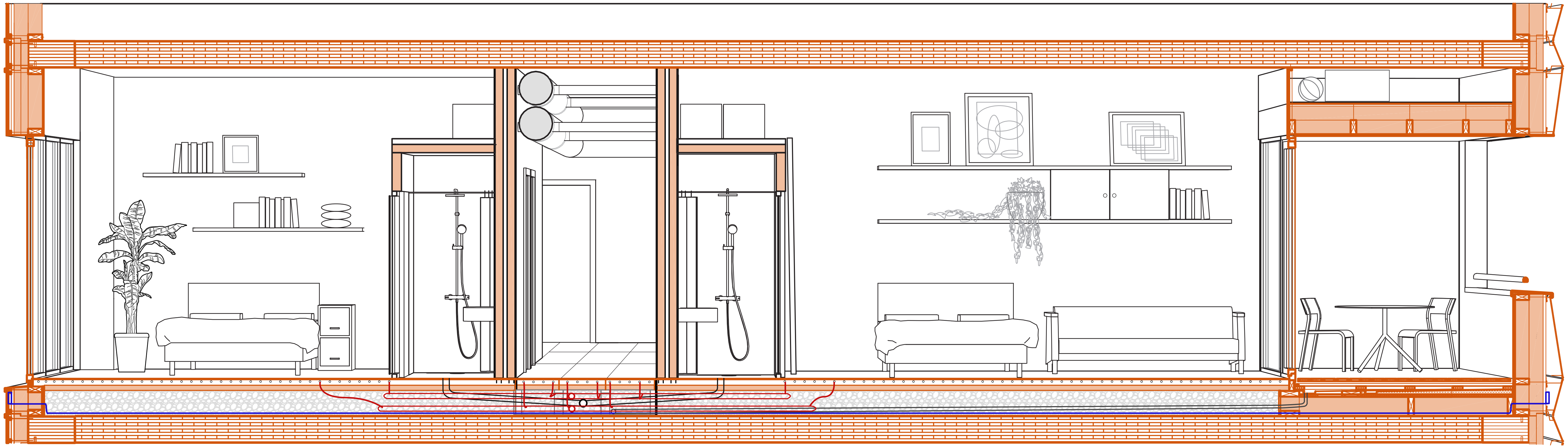
Office space

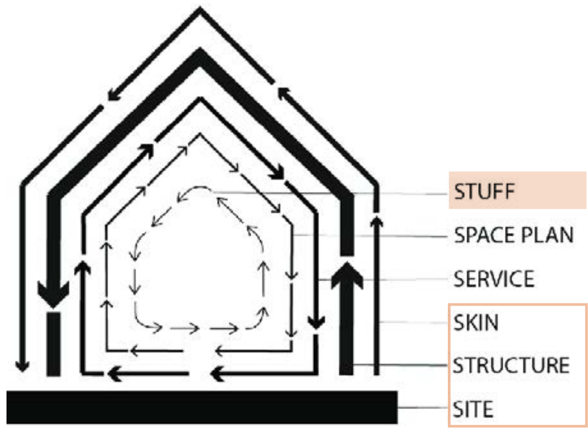




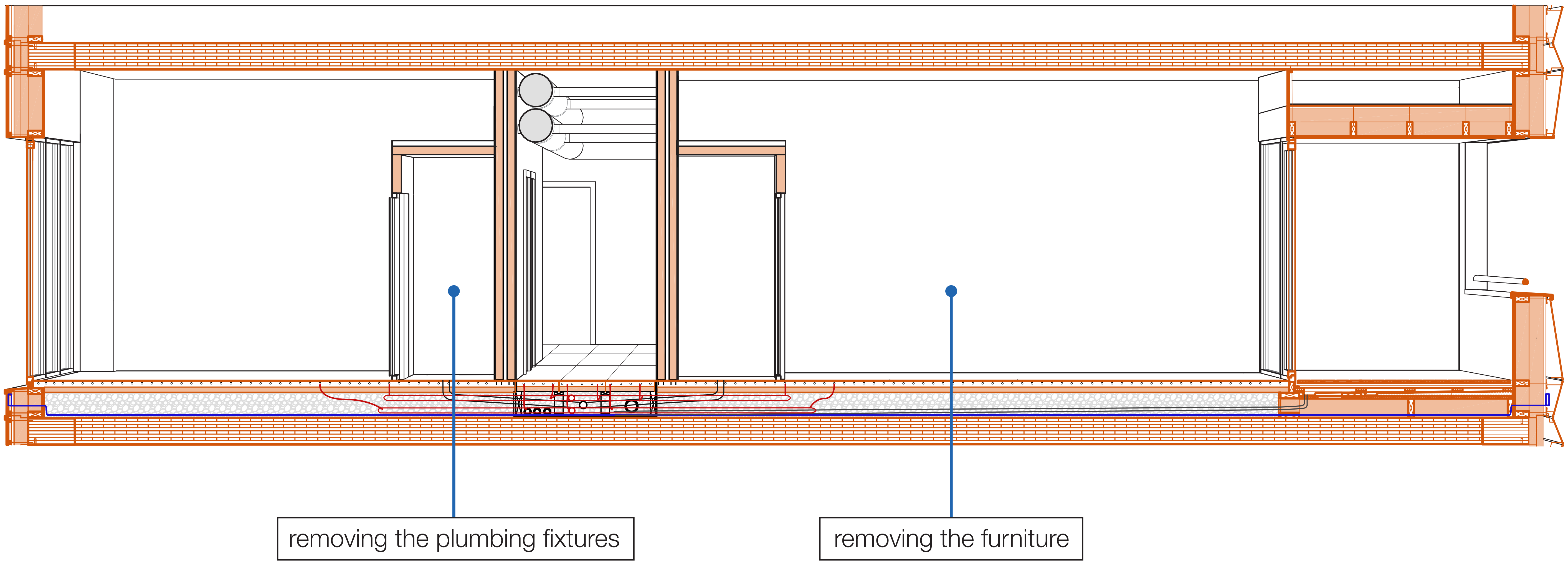
Changing the function of a storey

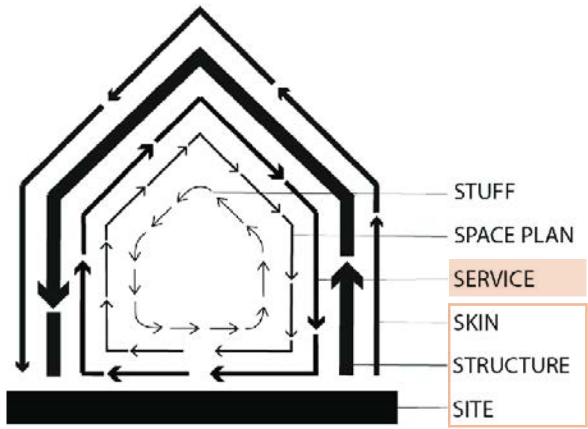
Co-living apartments



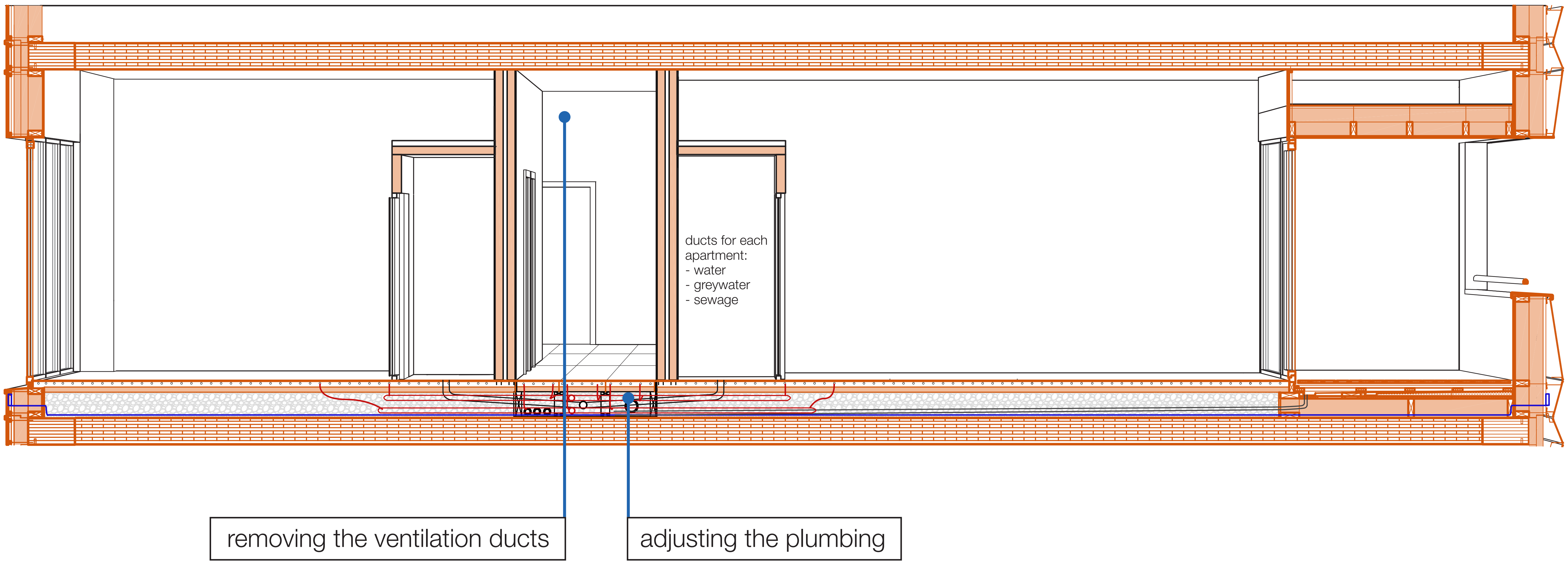


Step 1: removing the STUFF layer



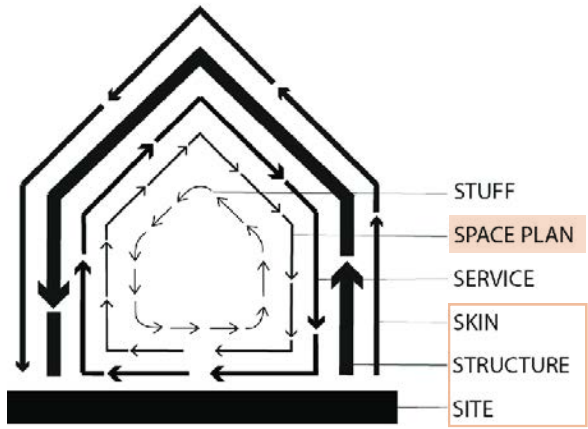


Step 2: removing the SERVICES layer

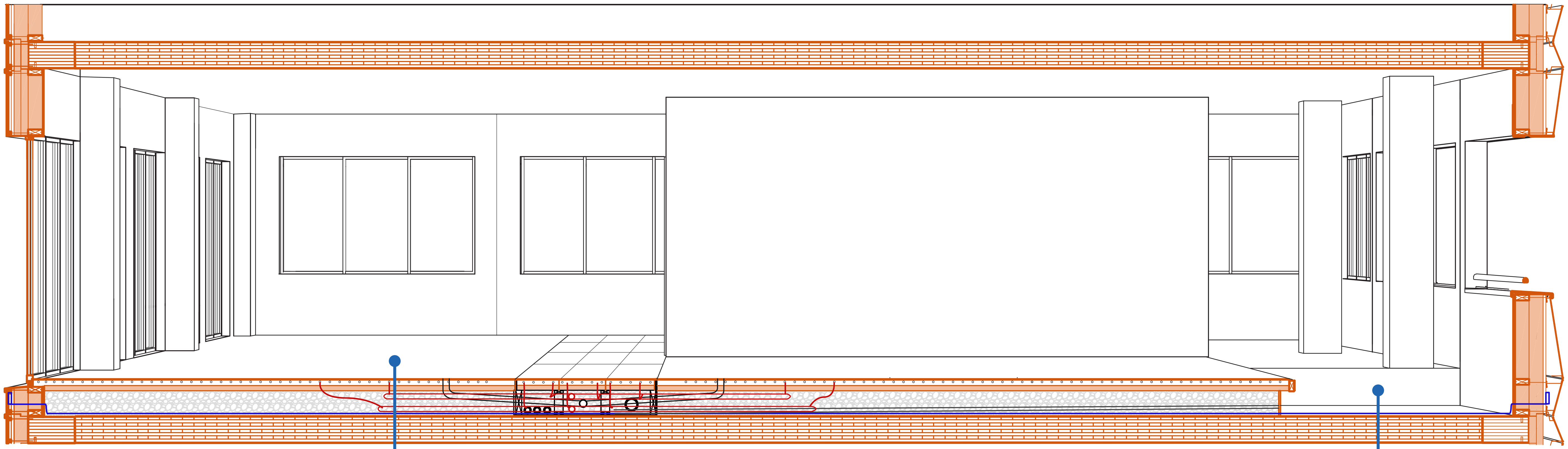


! **the limit :** the installations in the raised floor are difficult to dismantle, for drastic change of function can require partial re-flooring

allowance for change: the floor under the top layer is made for dry disassembly, ceiling installation are quite easily dismantled



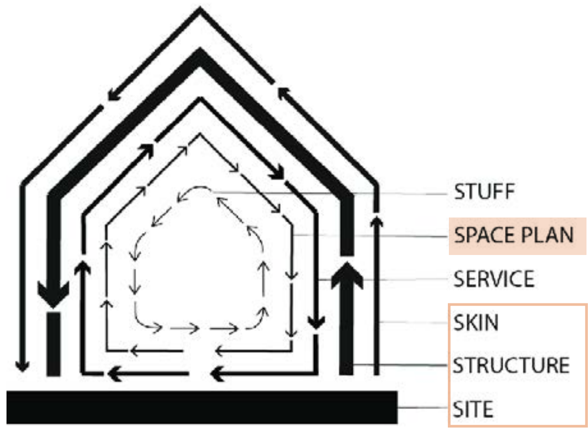
Step 3: removing the SPACE PLAN layer



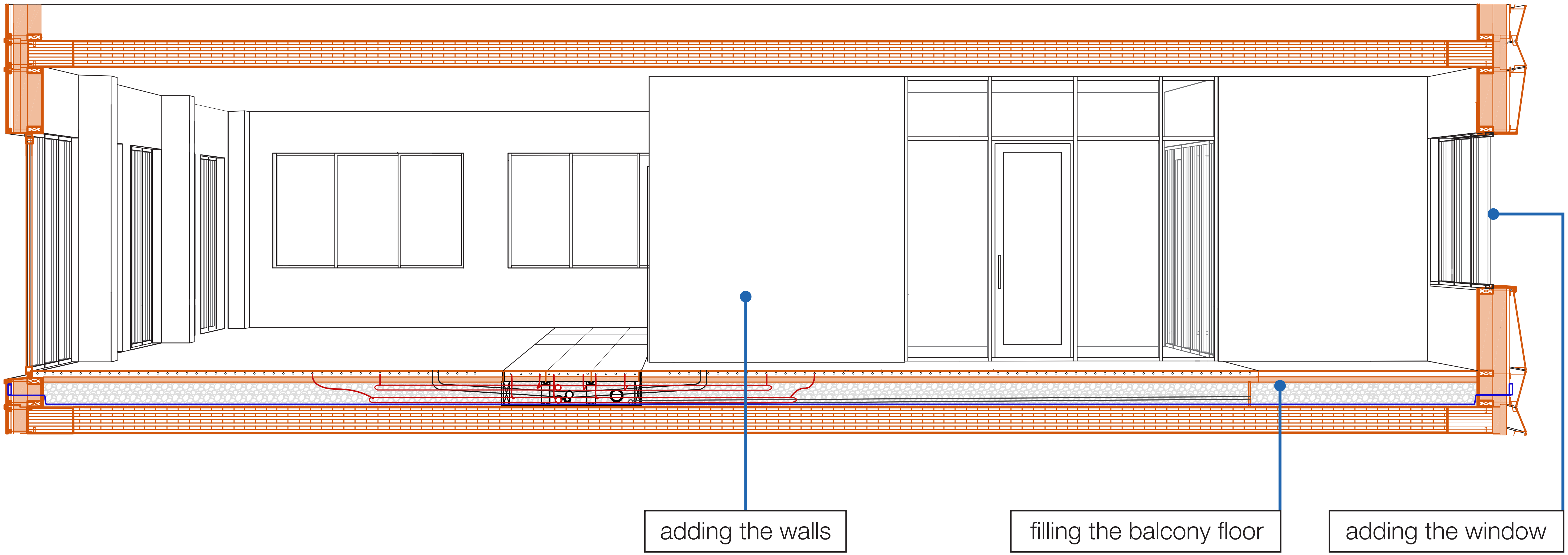
removing the walls

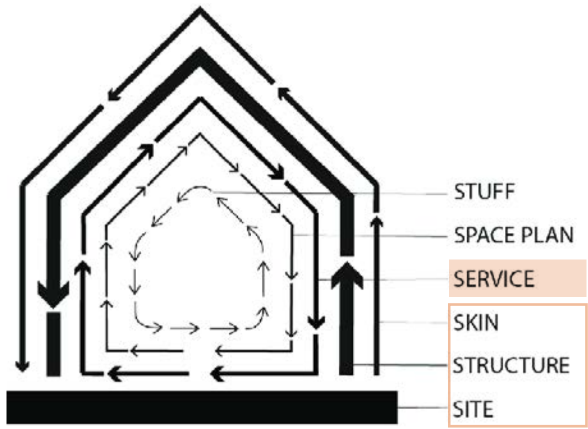
removing the balcony floor

unnecessary walls & other materials can be reused in other part of the building or in other project

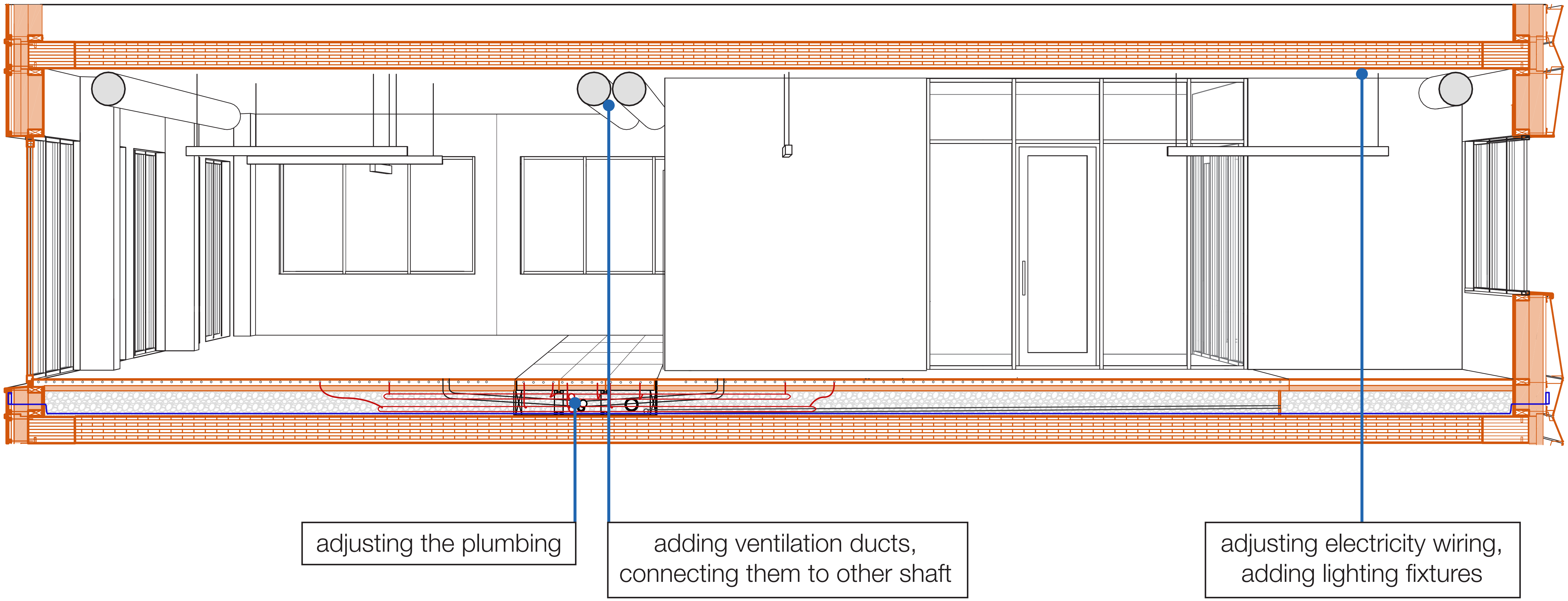


Step 4: adding the SPACE PLAN layer





Step 5: adding the SERVICE layer

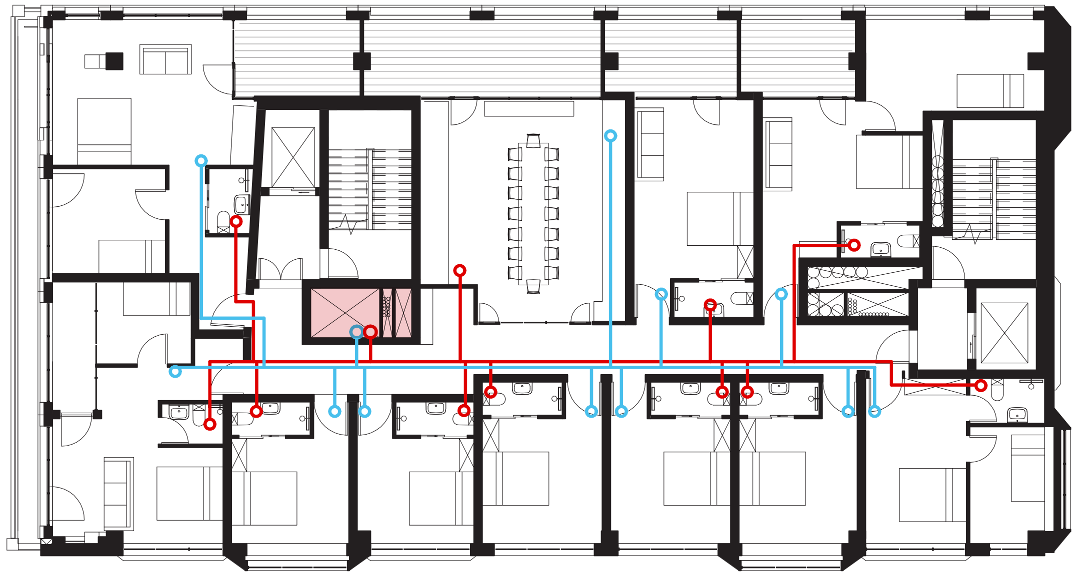


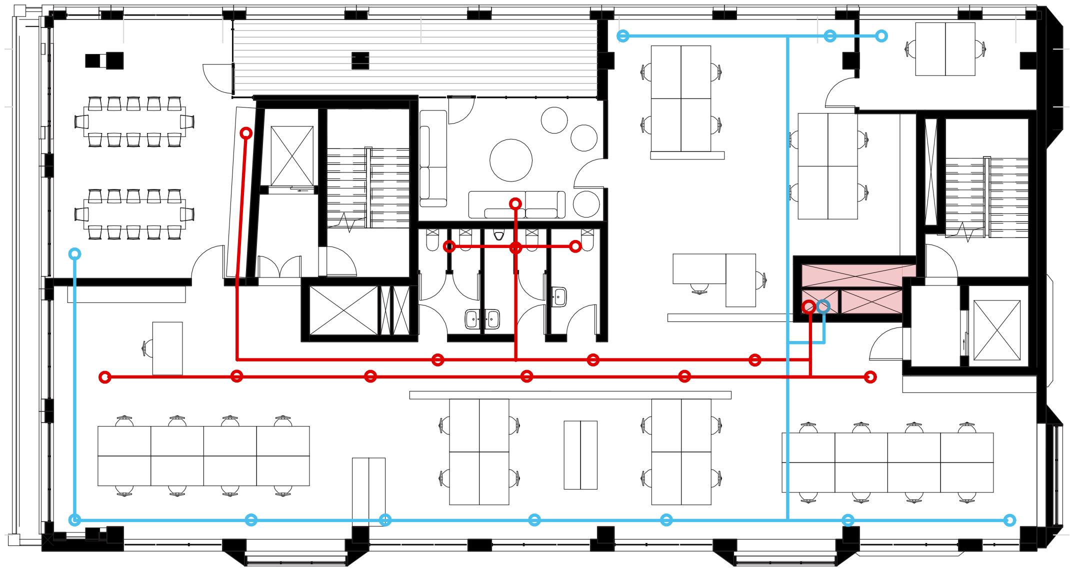
SERVICE layer

Co-living apartments

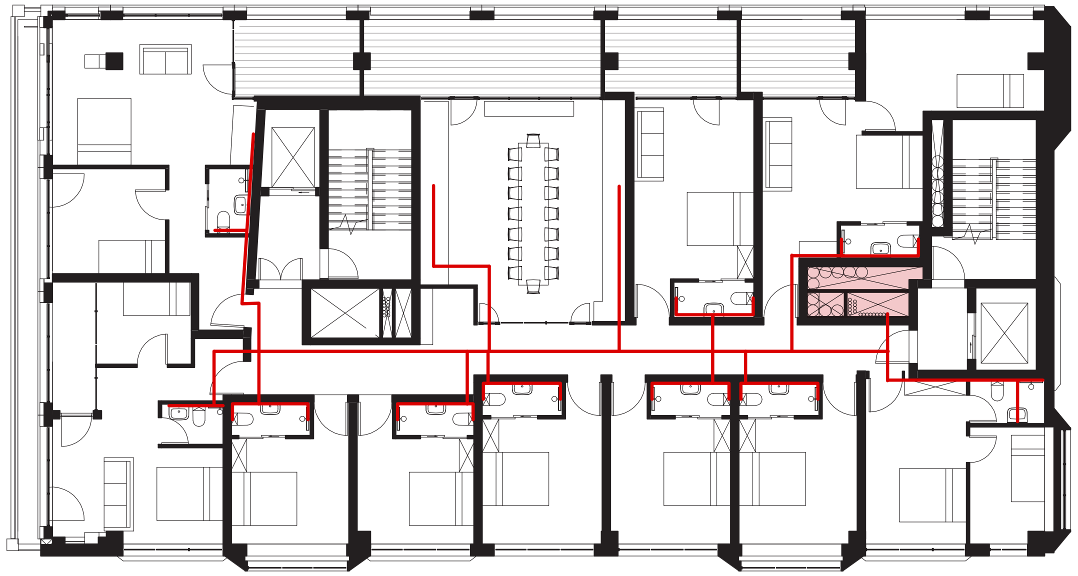
Office space

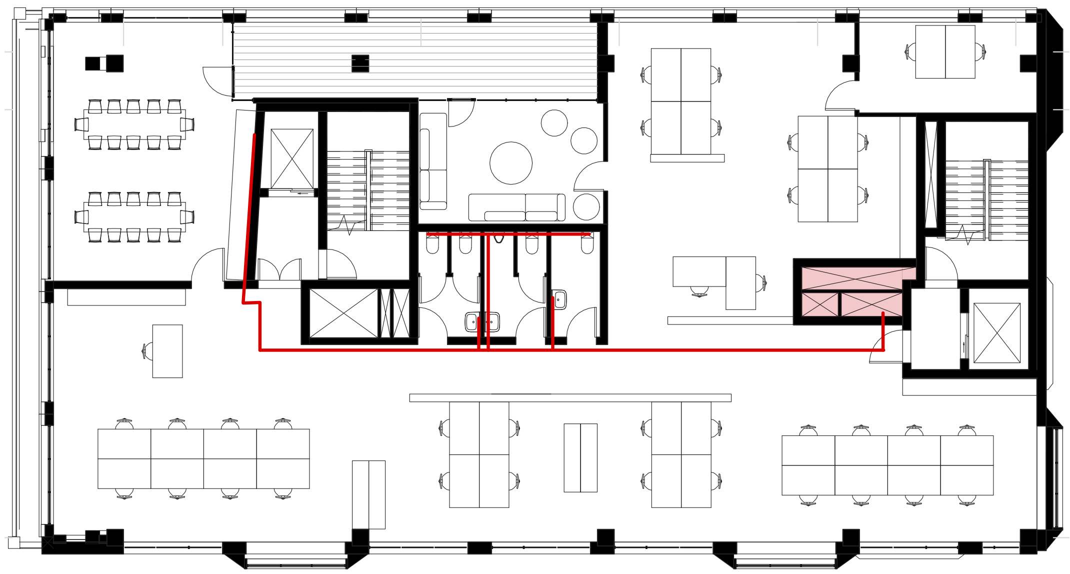
Ventilation

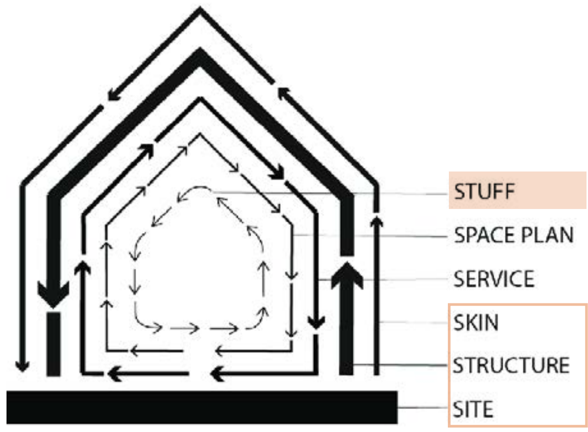




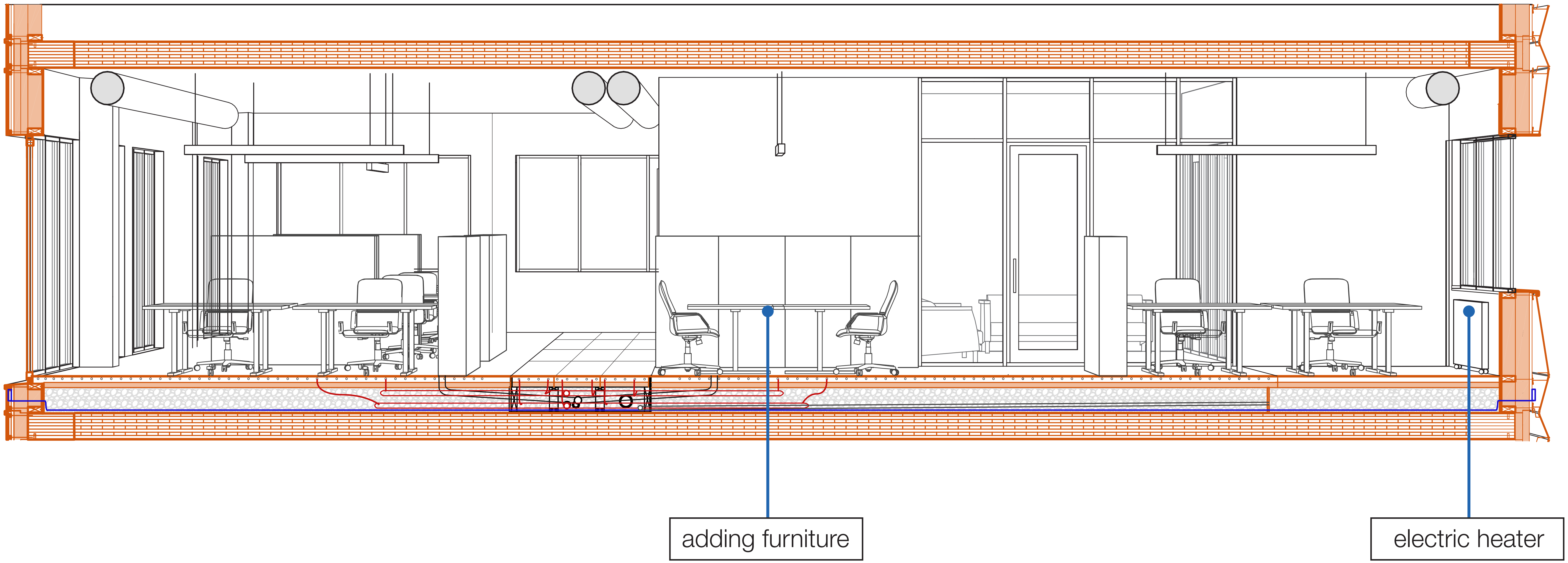
Plumbing ducts







Step 6: adding the STUFF layer



! **the limit :** electric heater might be needed in the former balcony place to avoid condensation on the windows

allowance for change: the floor can be re-done in that area to implement the floor heating

7. Is it feasible?

Building is located in the Horeca cluster

\+ **indoor urban farm** reduces food miles and food supply chain for the restaurants,
job opportunities

\+
\- **shop** locally grown food for citizens, profit, job opportunities

\+ **cooking school** cooks are always needed in this sector--> social mobility (gaining profession),
profit, job opportunities

\+ **restaurant** high quality nutricious meal service, supports street's identity - attractive for visitors,
profit, job opportunities

co-living apartments
\+ social mobility (networking & support, central location in city),
\- economically & socially efficient accommodation -> co-living (saves space, energy, improves well-being),
apartments with less than 43 m2 in area do not need parking - saves space & money - profit

Is it feasible?

Financial feasibility

Sale	housing in old building	in Witte de Withstraat 5,8 K €/m² 4,7 K €/m² 6,2 K €/m² approx 5 K €/m² in Blaak street 3,9 K €/m²	approx 29 000 000 €
	housing in newly-built tower nearby	6,5 K €/m² 6,9 K €/m² approx 6,7 K €/m²	approx 38 860 000 €
	office space	in 1877 building 5,07 K €/m²	approx 29 000 000 €
Rental	housing in centre	approx. 50 €/m²/month	approx. 290 000 €/m²/month
	office space, centre	approx. 150 €/m²/year	approx. 870 000 €/m²/year
	retail with showroom	approx. 300 €/m²/year	approx. 1 740 000 €/m²/year

existing building - 3.357 m2
Typical building floor approx. 565 m2
plot - 568 m2

Estimation of new project: approx. 5800 m2

source for estimations: https://www.funda.nl/

Construction costs:

Generally, **1200 €/m² for renovation can be considered as a good average**, excluding the architect's fee. (2021)

New construction: 2500 €/m² at a minimum - no marble floors or automated windows.

https://www.iamexpat.nl/housing/real-estate-news/estimating-costs-renovating-your-home
https://www.quora.com/How-do-I-estimate-the-construction-cost-in-the-Netherlands-I-am-looking-at-a-high-level-estimate-The-land-area-is-180-m2-and-the-construction-area-is-300-m2#:~:text=It%20will%20be%20about%202500e,marble%20floors%20or%20automated%20windows.

Preliminary estimation:

Construction costs approx. 2000 €/m2

existing building part - 6 (floors) x 565 m2 (typical floor) = 3 390 m2
new tower building part - 8 (floors) x 300 m2 (typical floor) = 2 400 m2
= approx. 5800 m2

Total: 2000 € x 5800 = approx. 11 600 000 €

Is it feasible?

Overall planning

Developer/ investor

feasibility phase ↔ government/municipal support for social programs

preliminary design phase ↔ construction costs

final design phase

permit procedure

realization phase

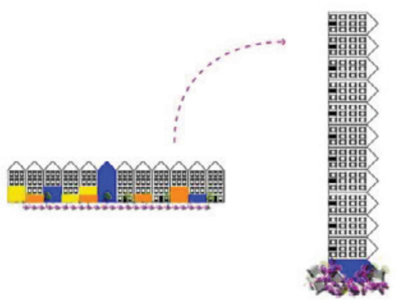
1) prefab construction elements are being made
2) demolishing 5th floor
3) taking off the facade in parts to store somewhere
4) new foundation, supports
5) putting back the facade

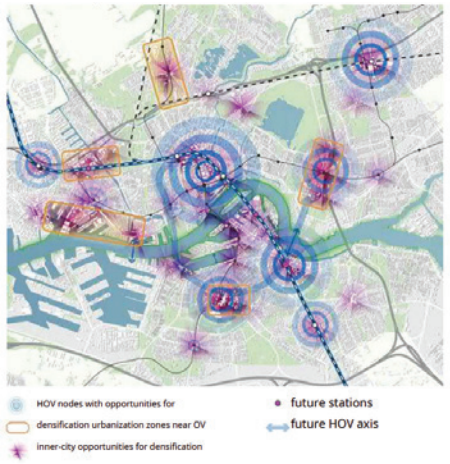
6) demolishing parts for new cores
7) adding new foundation
8) adding new cores, floors, roofing
9) adding facade glazing and prefab elements, doors
10) installing services/installations
11) interior works

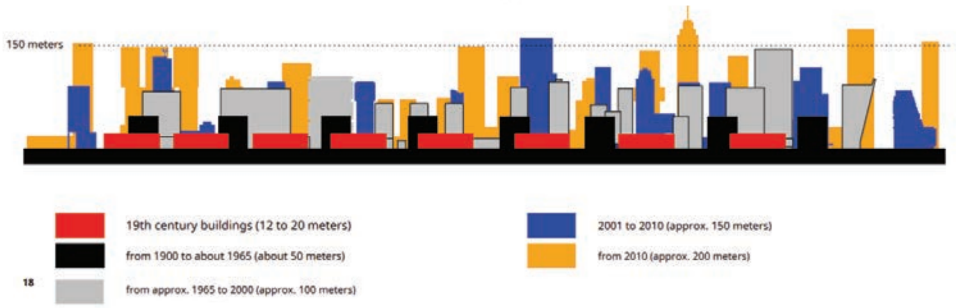
realization phase ↔ labor costs, material costs, Building warranty period

labor costs
material costs
Building warranty period

What are the risks?

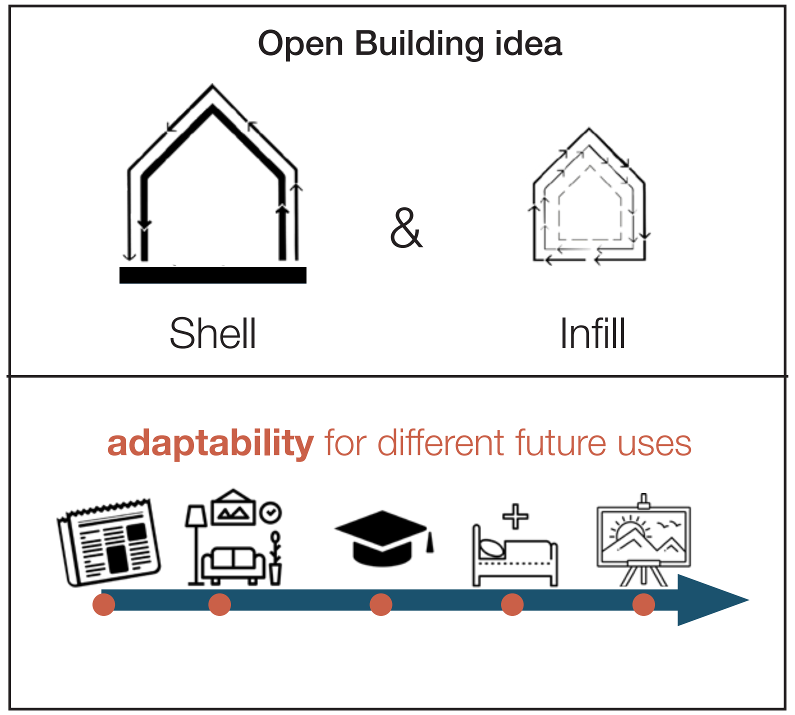






1.Requires changing maximum building height in the zoning

hight-rise Rotterdam centre is allready being developed close to the site



2.Functions proposed will not be profitable enough

Building will be easily adaptible for new functions

3.The site can be challenging for construction works - closely surrounded by neighbouring buildings

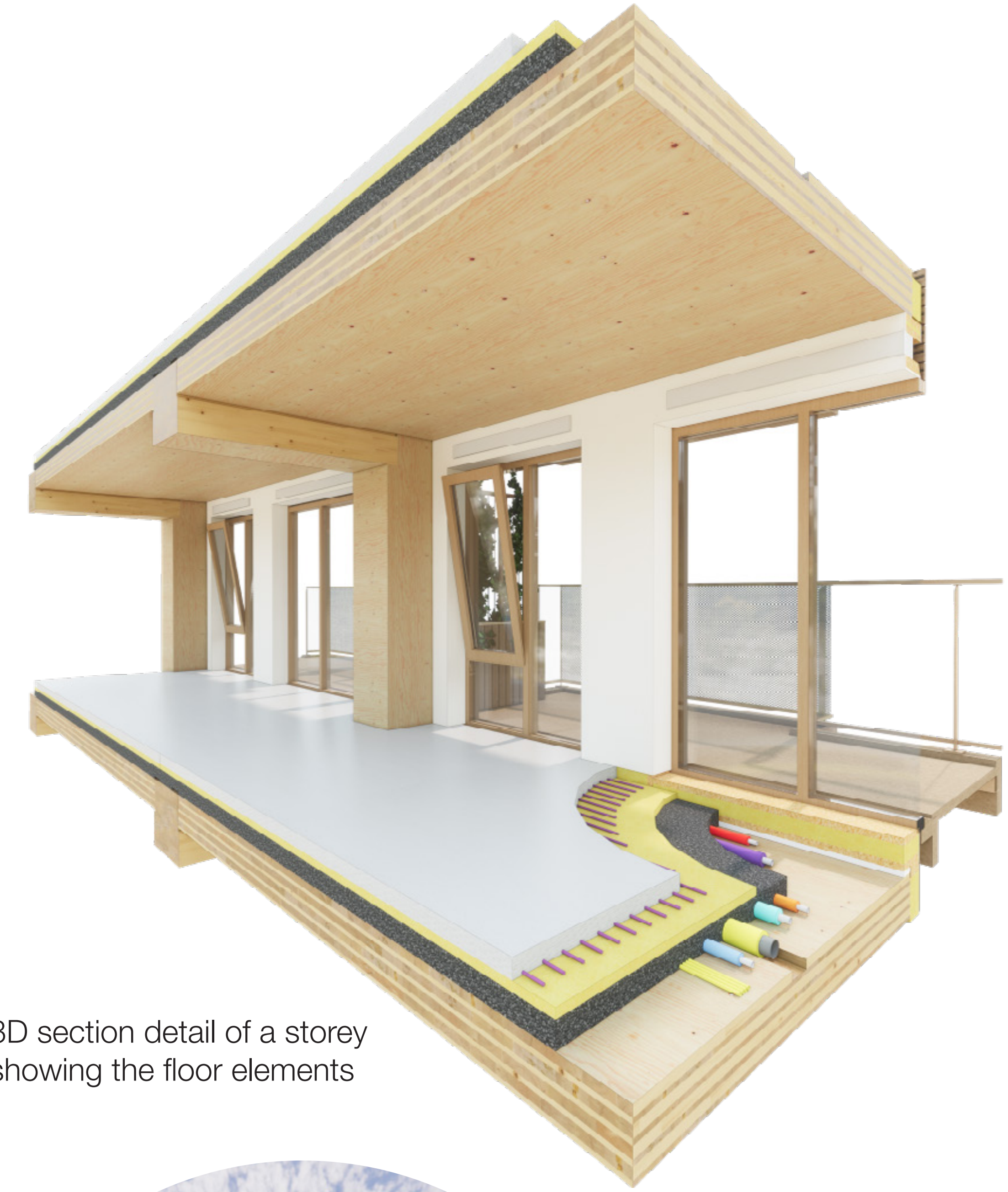
the construction site will have to be carefully planned, neighbours informed

8. The most impactful reference projects

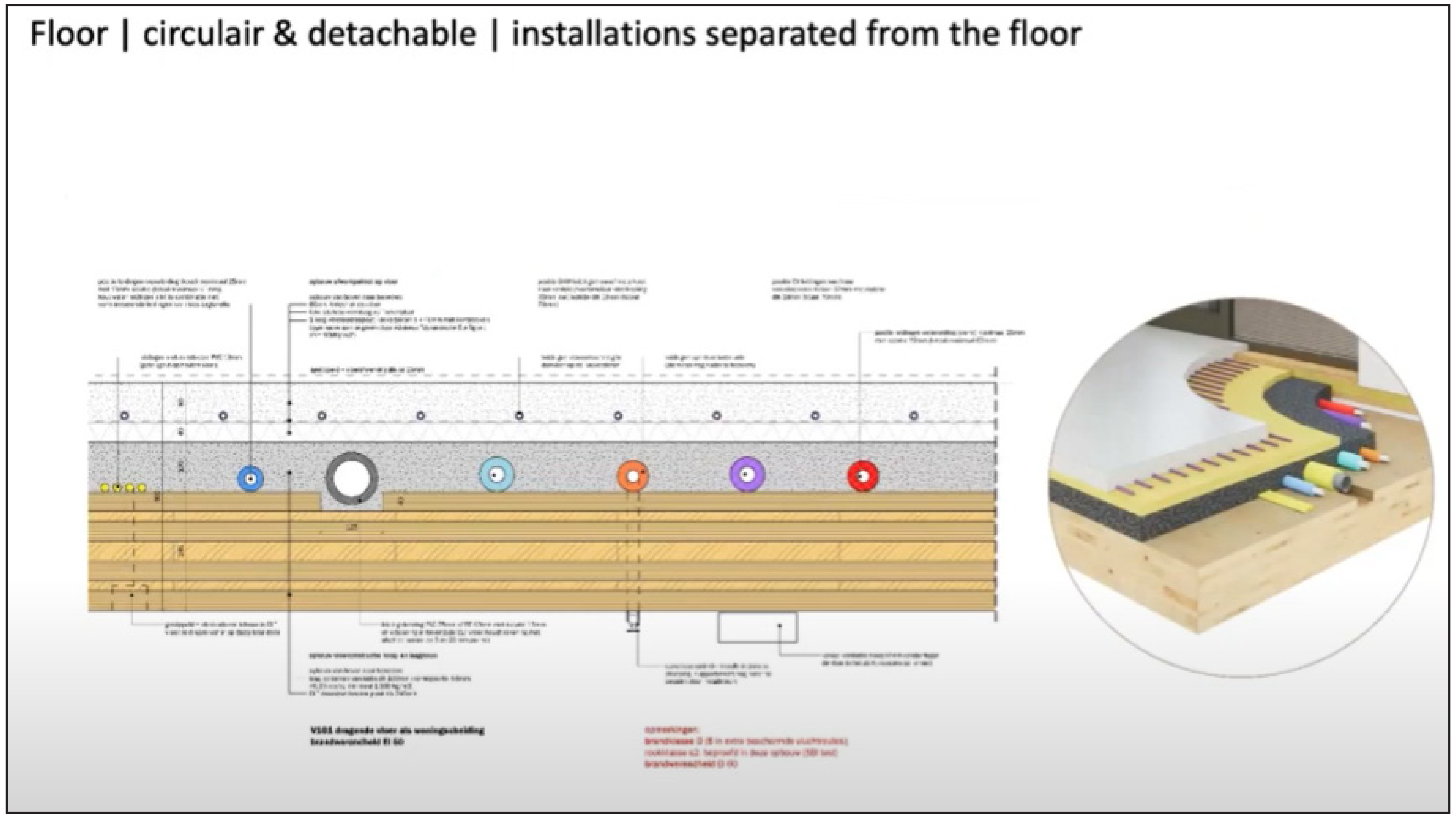
Raised floor

SAWA building

by Mei architects and planners,
2022 (start of construction)



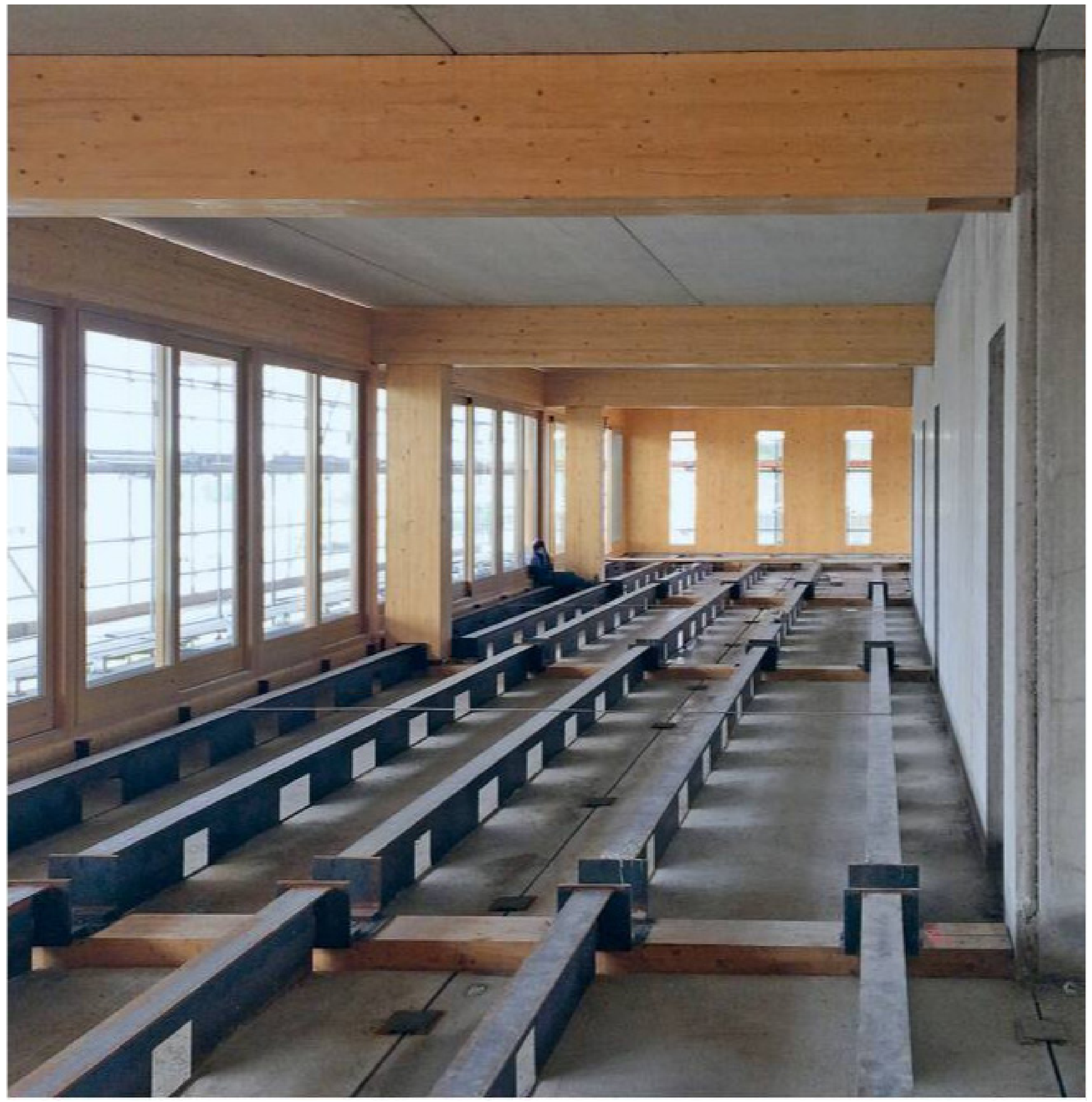
3D section detail of a storey
showing the floor elements

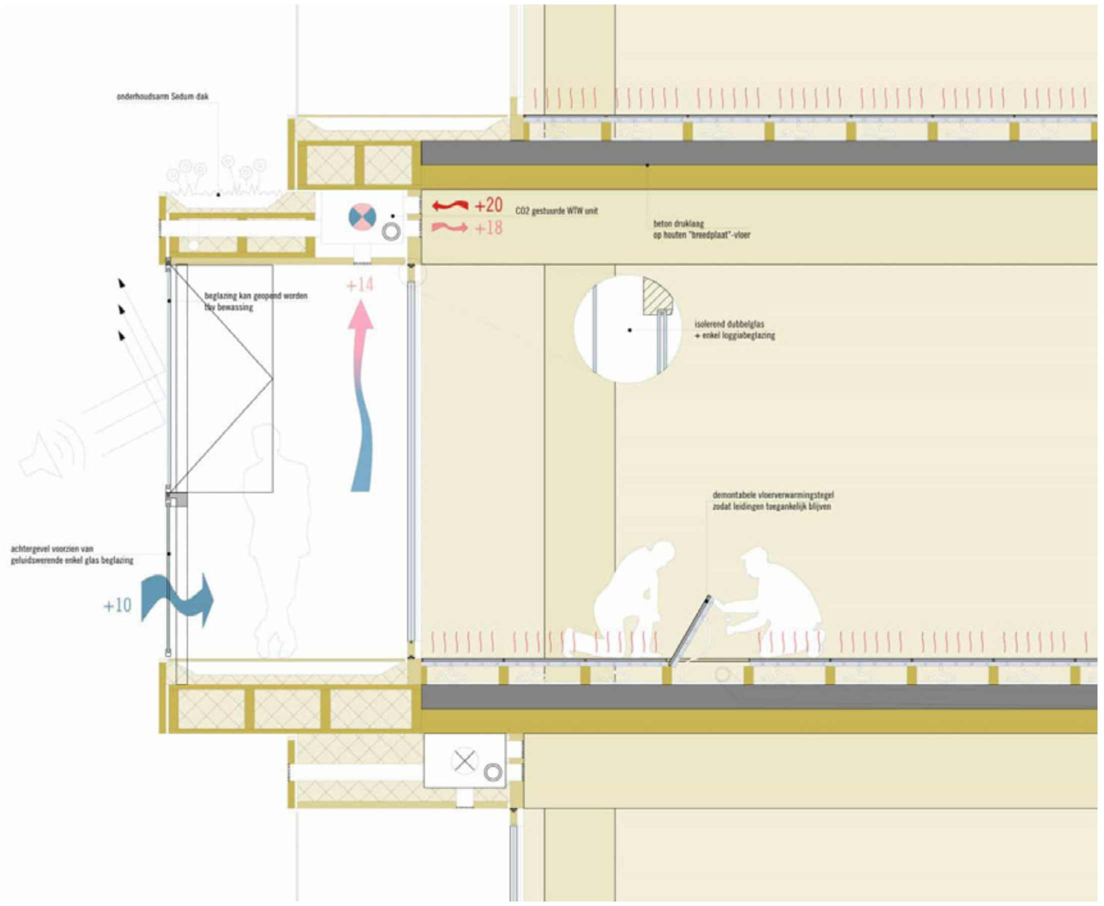


https://www.youtube.com/watch?v=-mvMIS44Vwc&t=1560s

Raised floor

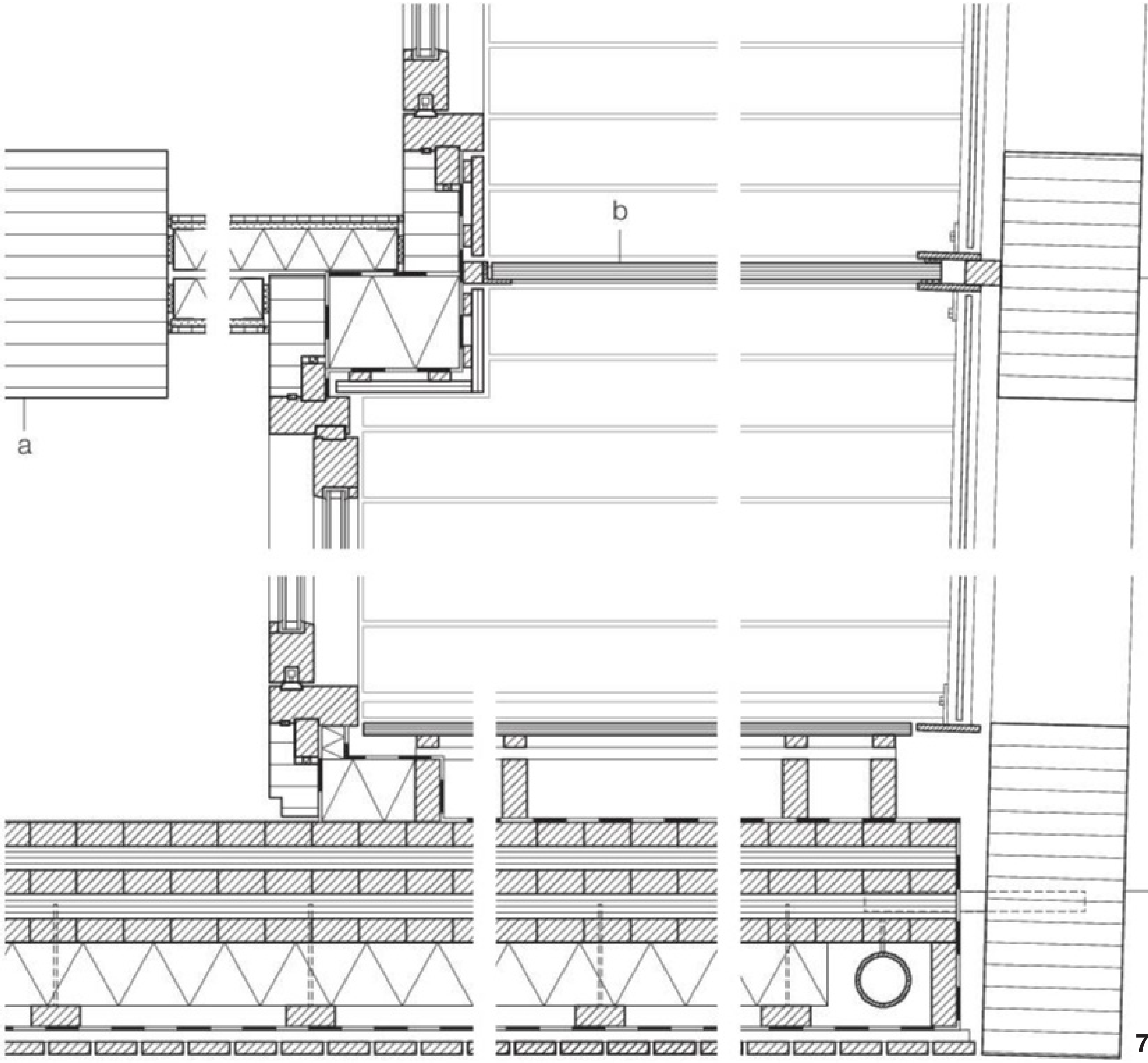
Patch22 building
by Lemniskade Projects,
2016





Horizontal section,
west/south facade
Scale 1:20

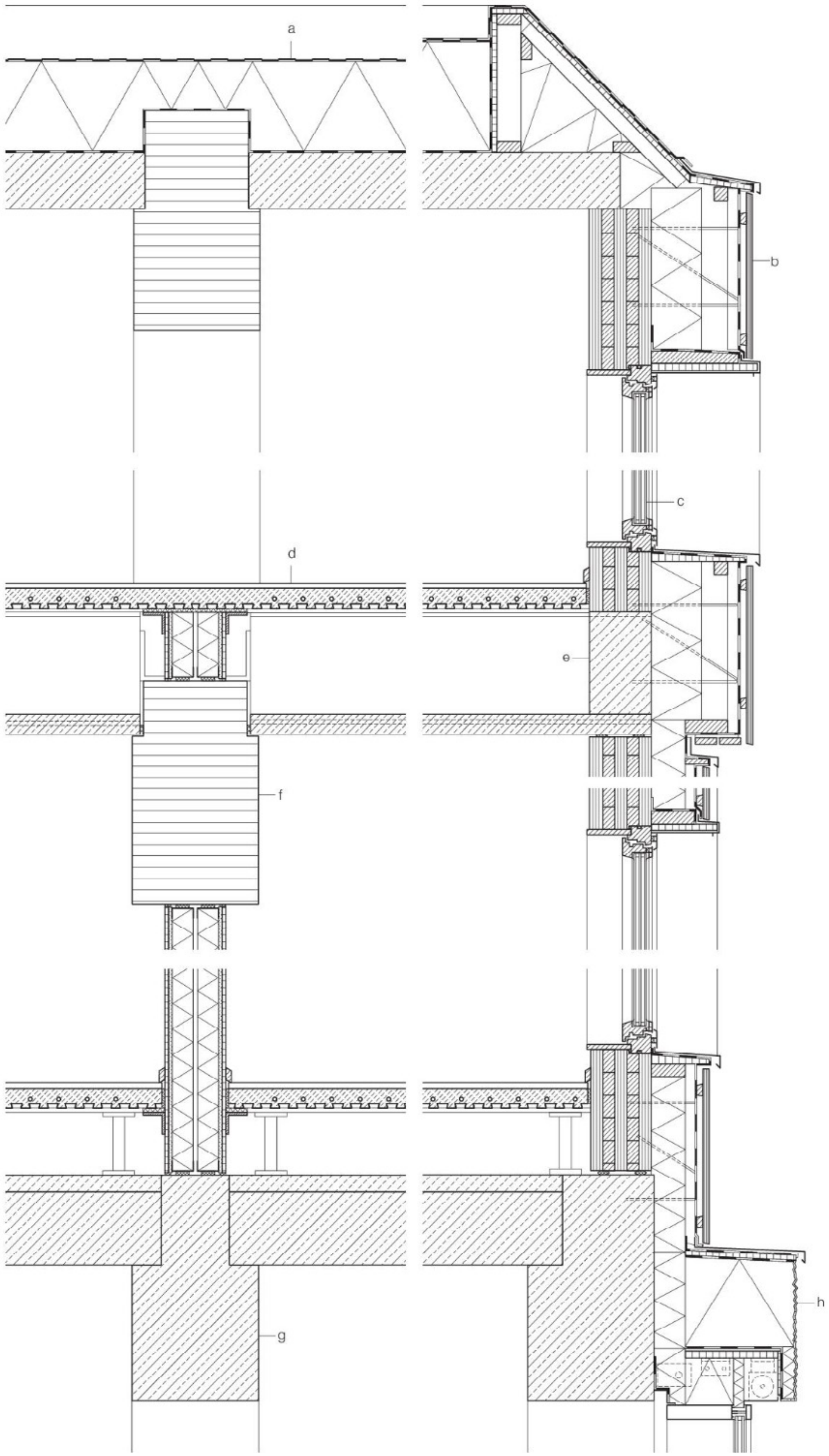
- a 450/600 mm glulam post
- b 30mm Douglas fir partition wall, fire-retardant impregnation
- c 450/250 mm glulam post
- d 600/250 mm glulam post



Raised floor

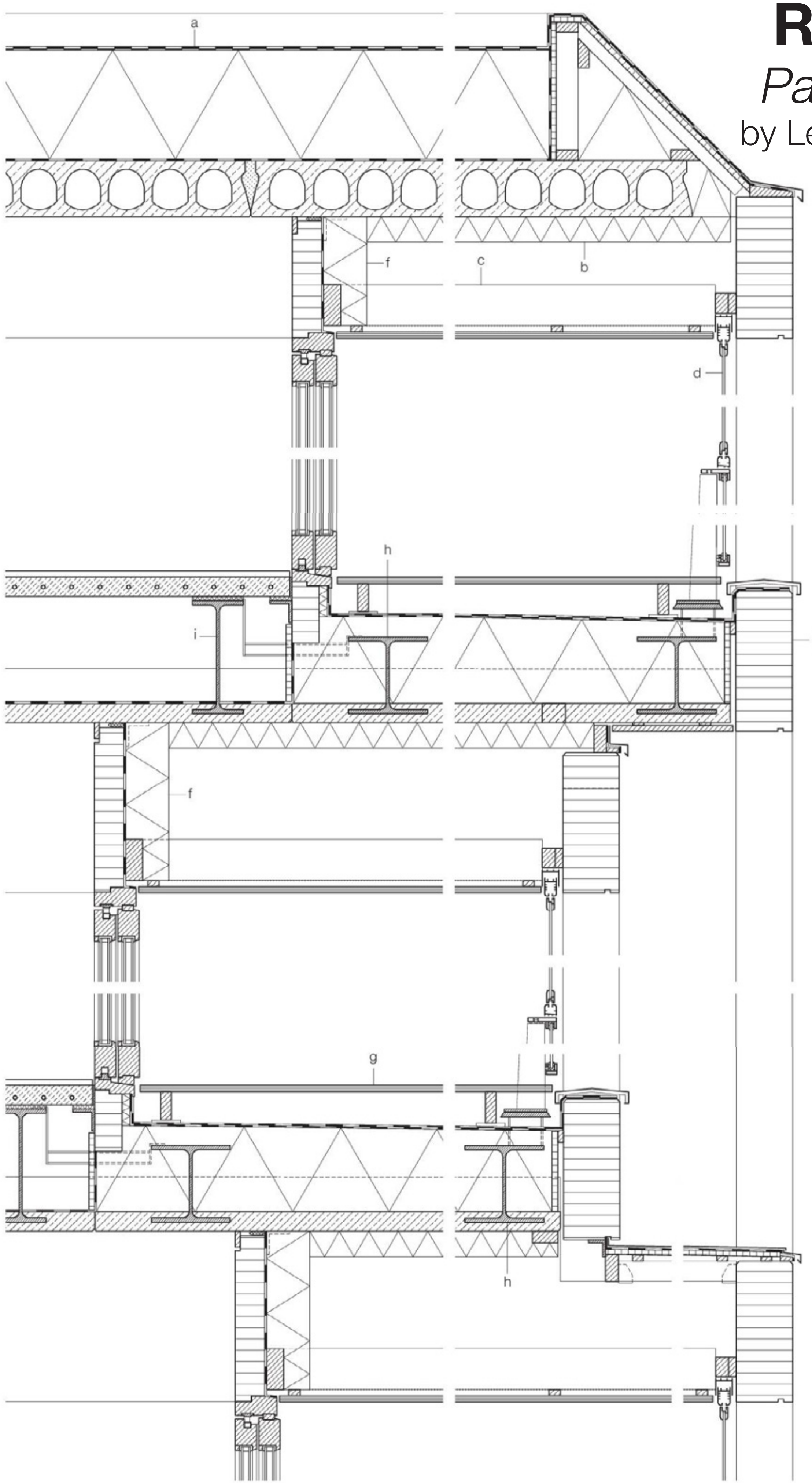
Patch22 building

by Lemniskade Projects, 2016



Section, roof/west facade
Scale 1:20

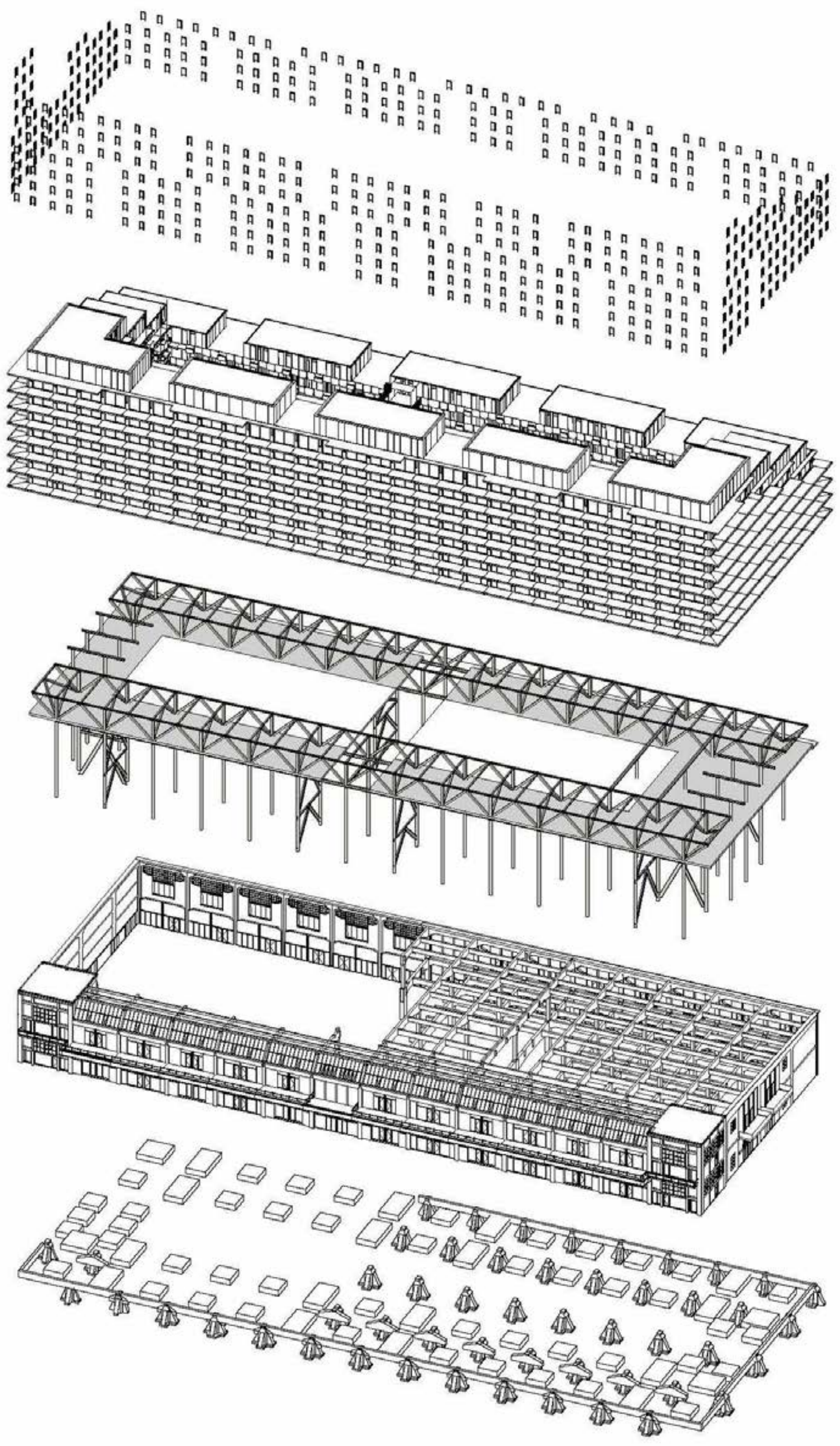
- a 2-ply sealing sheet
  380 mm insulation, aerated concrete with EPS beads, to falls
  vapour barrier
  200 mm prestressed hollow concrete floor slabs
- b 22/75 mm Douglas fir cladding
  22/45 mm horizontal battens
  breather membrane
  38/89 mm vertical battens
  92 mm ventilation cavity
  180 mm glass wool insulation
  216 mm exterior wall, CLT panel
- c Window:
  triple glazing in wood/aluminium frame
- d 20 mm floor covering (owner's choice)
  70 mm anhydrite screed with underfloor heating
  trapezoidal sheet metal
  IPE 400 steel beam/
  330 mm installation cavity
  70 mm prefabricated reinforced concrete floor slab
- e 220/363 mm perimeter reinforced concrete beam
- f 450/800 mm downstand glulam beam
- g 450/800 mm downstand reinforced concrete beam
- h 385 mm EPS insulation, rendered



Section roof/south facade
Scale 1:20

- a 2-ply waterproofing membrane
  380 mm insulation, aerated concrete with EPS beads, to falls
  vapour barrier
  200 mm pre-stressed hollow concrete floor slab
- b 90 mm mineral wool insulation
- c 120 mm timber substructure
  insect wire mesh
  22 mm battens
  22/75 mm Douglas fir cladding
- d Balcony glazing, toughened safety glass
- e 200/500 mm glulam perimeter beam
- f 160 mm glass wool insulation
  vapour barrier
  96 mm exterior wall, CLT panel
- g 125/25 mm Douglas fir decking
  pedestal feet
  2-ply EPDM waterproofing membrane
  295 mm insulation, aerated concrete with EPS beads, to falls
  vapour barrier
  70 mm prefabricated reinforced concrete floor elements
  100 mm glass wool insulation
- h 280 mm HEA steel beam
- i 400 mm IPE steel beam

Tower on top
Fenix I, Rotterdam



Tower on top
De Karel Doorman, Rotterdam

De Karel Doorman was constructed on top of the Ter Meulen store, originally built in 1948. To construct the additional floors, a lightweight alternative to traditional multistory framing was approached. The building utilizes two reinforced concrete cores inserted into the existing structure, a framework of steel columns and beams, a wooden floor system topped with 55mm of concrete and a wooden exterior wall clad with a glass facade. The resulting structure's floors weigh 250 kilograms per square meter, one fifth of the weight of a standard high-rise apartment building constructed entirely of reinforced concrete.

Recessed tower

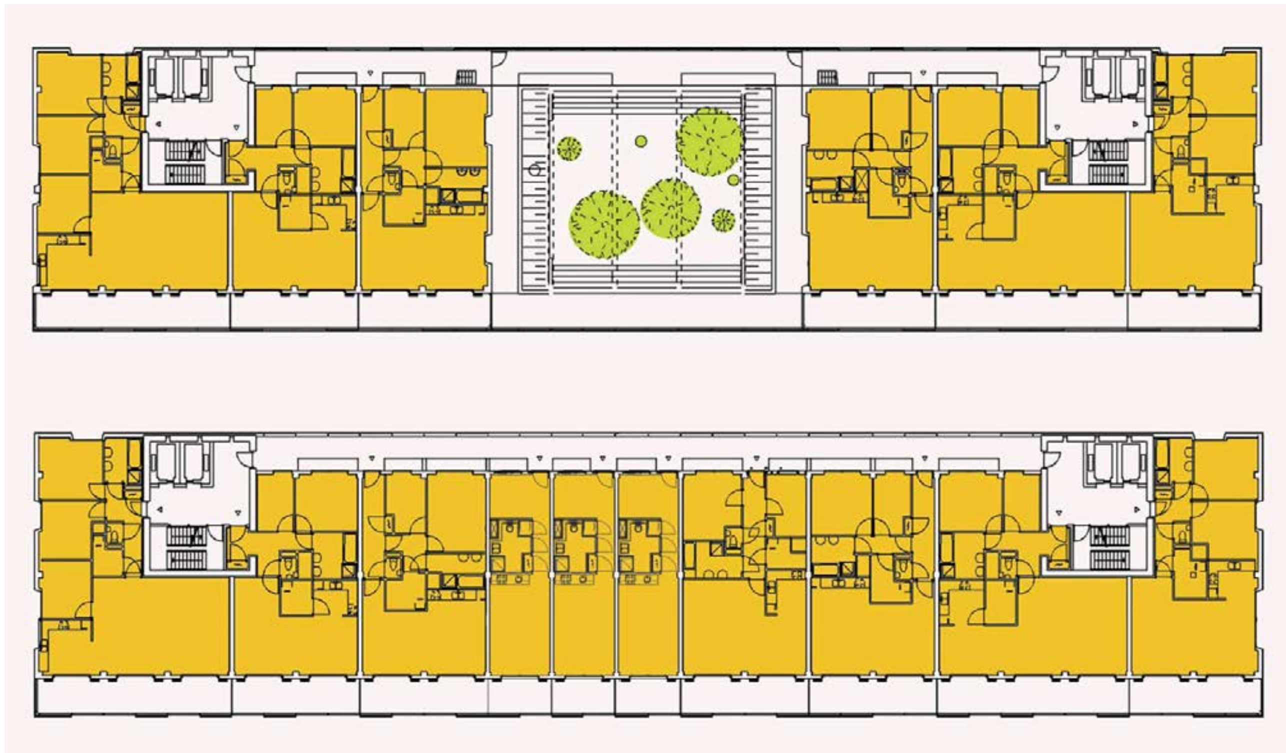
The new residential building is recessed in relation to the shopping centre's building line, which ensures that **seen from the street the Ter Meulen building** - which is home to fashion shops onc more - has **retained much of its former character**.

Light-weight construction

The new construction has been **placed on the pillars and foundations of the existing building**. This was made possible by releasing extra load capacity in the existing building in combination with an extremely light-weight new construction of steel and wood that is **five times lighter than traditional construction methods for apartment buildings**. This had the additional advantage that the building could be manufactured in **large prefabricated elements**, which could be lifted and fitted straight from the truck. This eliminated the need for a large building site which is a considerable advantage in the city centre.

The apartments have a wooden facade with galleries on the outsides and a second skin of tempered glass. The glass is covered with a screen print consisting of small dots that hide the loggias and galleries from view.

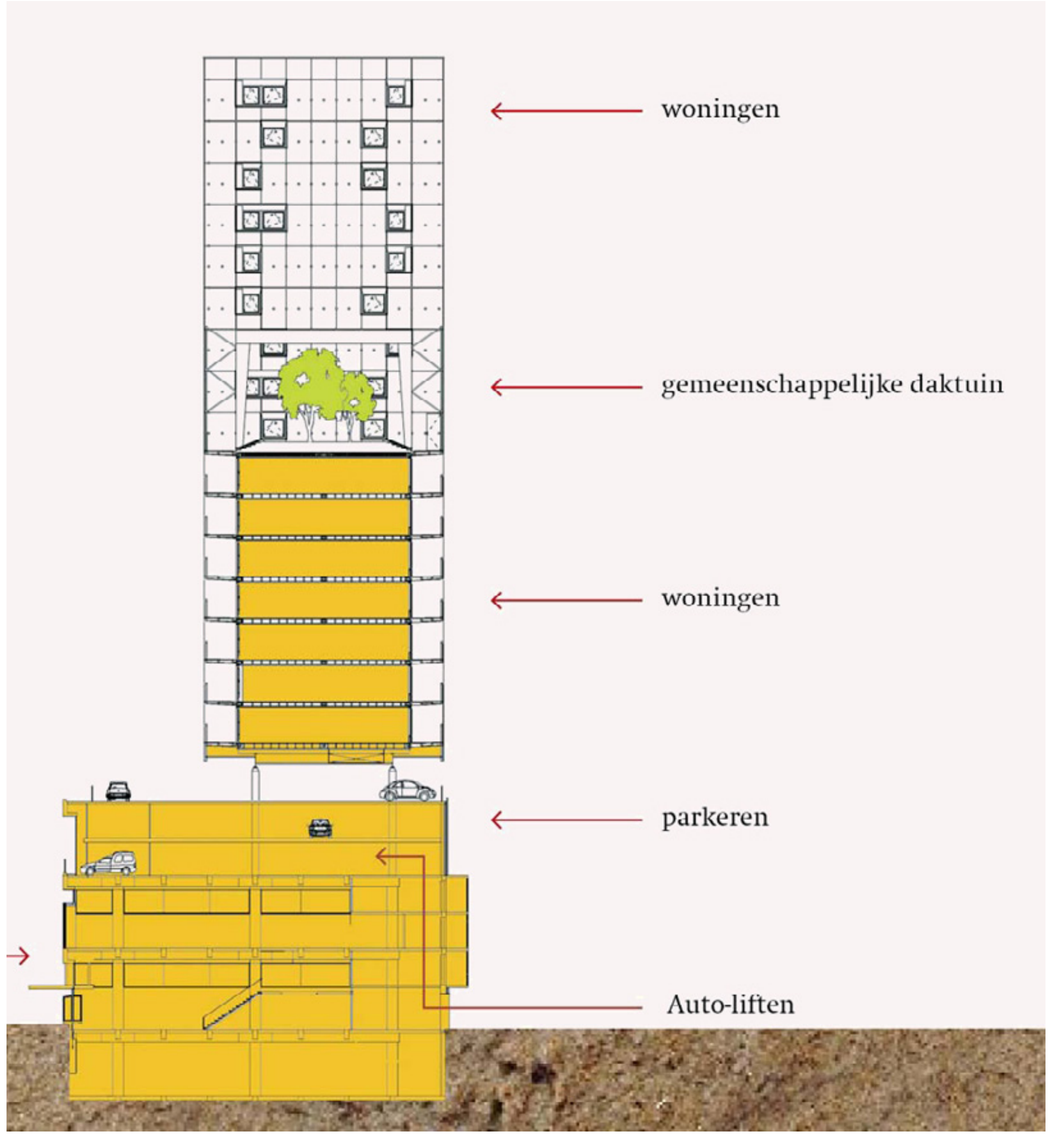
Architect: Royal Haskoning DHV
Height: 70.5 m
Floors: 22 --> 16 added
Source: https://www.skyscrapercenter.com/building/de-karel-doorman/5562
https://www.metsawood.com/global/news-media/references/Pages/16-floors-extension-with-Kerto.aspx

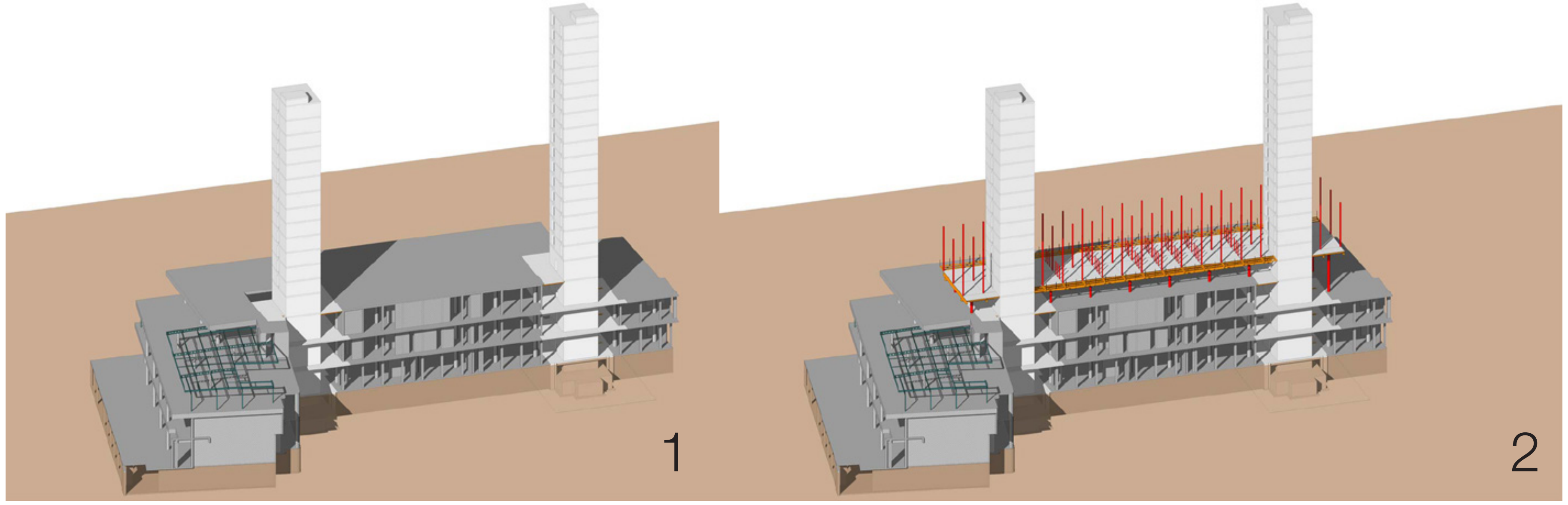


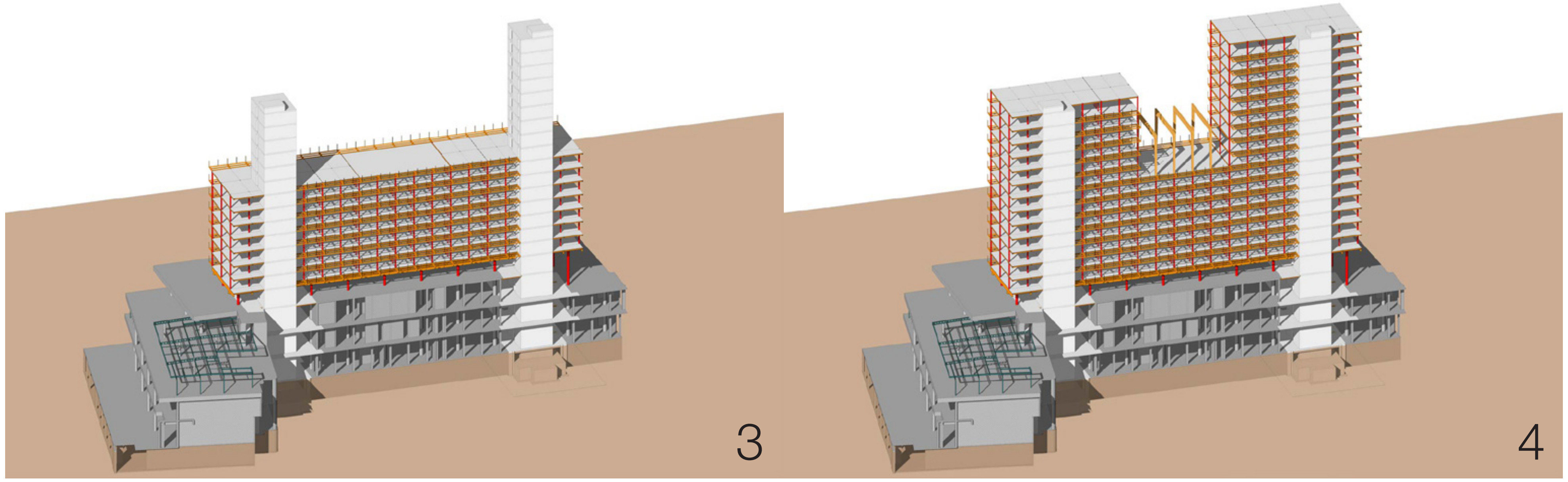
Tower on top
De Karel Doorman, Rotterdam

Flexibility
The apartment building has sixteen floors and 114 apartments. The apartments are distributed over seven adjoining floors, topped by two towers with nine and six floors. Between these towers, at a height of 40 metres, there is a sheltered rooftop garden. The size of the apartments varies from 45 to 124 square metres. The selected building method based on steel columns, gypsum partition walls and wooden floors is not only light, but also very flexible. Even during construction some of the apartments were split in separate units while others were combined.

Sustainability
By choosing to 'top up' the building we prevented demolition and the need to remove 15,000 tonnes of concrete from the city centre. In addition, the available space is used intensively which contributes to sustainable urban development. The flexibility to split up or join apartments also makes the building more future-proof. The light-weight construction materials can be recycled and have a low impact on the environment, for example during transportation. Galleries and loggias with a width of 2.4 metres prevent the apartments from heating up too much as a result of direct sunlight. The apartments are also connected to the district heating network.







Tower on top
De Karel Doorman, Rotterdam

The analyses of the load bearing system of the existing building

Available data. The **existing building was well documented**: gravity load calculations and stability calculations, concrete dimension and reinforcement calculations and drawings of reinforcement were available. Also the pile plan, **the geotechnical survey and advice and a report on the installation and testing of a test pile were available, together with a calendering drawing of the installation of the piles**.

Existing load bearing system. The load bearing system was completely cast-in-situ concrete. The columns and beams did provide the lateral stability of the building through rigid frame action. The column grid was 8 x 10 meters. Because of the rigid frame action the columns are almost similar in dimension on all floors: round 850 mm in the basement to round 800 in the 2nd floor. The intended compression strength of the columns was 250 kgf/cm2 , which can be compared to a C14/17 strength according to Eurocode. The main beams are 600 x 850 mm with an intended compression strength of 200 kg/cm2.

Existing Foundation.
The foundation was designed with reinforced prefabricated concrete piles, with a shaft dimension of **square 380 mm and a + shaped pile tip of 760 mm**. The calendering showed that there had been a great amount of **soil densification** due to the installation of the piles: in a group of 8 piles the last 25 blows on the pile caused a settlement of 200 mm in the first, down to only 40 mm in the last pile of the group. This was **a strong indication that the bearing capacity of the piles was much larger than the originally intended** 70 tons (or 900 kN according to present codes).

Tests. First inspections (visual and with a Schmidt Hammer) indicated that the quality of the construction and thus the concrete strength was very good. In combination with experience and literature the first starting point was a present concrete strength of C28/35 for the columns. In a later stage cylinders were drilled and tested from 18 different columns, giving a real concrete strength of even 40,9 N/mm2.
To be able to **recalculate the capacity of the existing piles as accurate as possible new cone penetration tests (CPT's) were made**, inside the building right next to the pile groups, thus measuring the soil densification: the load bearing capacity according to present codes was 1.600 up to 2.00
0 kN.
Structural design of the new apartment block
Load bearing capacity of the existing building. The solution for the challenge to place the 16 stories truly on top of the existing building was found by separating the horizontal loads from the vertical, for the new expansion as well as for the existing building: 2 concrete stability cores were added (for staircases, elevators and ducts) with a section of 7 by 9 meters and wall thickness of 0,4 meters. These were not only used for the new building, but also the floors of the existing building were rigidly connected to the new stability cores.
In the existing building the structural load bearing system thus changed from a system with rigid frame action, with bending moments in the beams and columns caused by horizontal loads, to a system with supported columns, only having to carry vertical loads (see Figure 5).

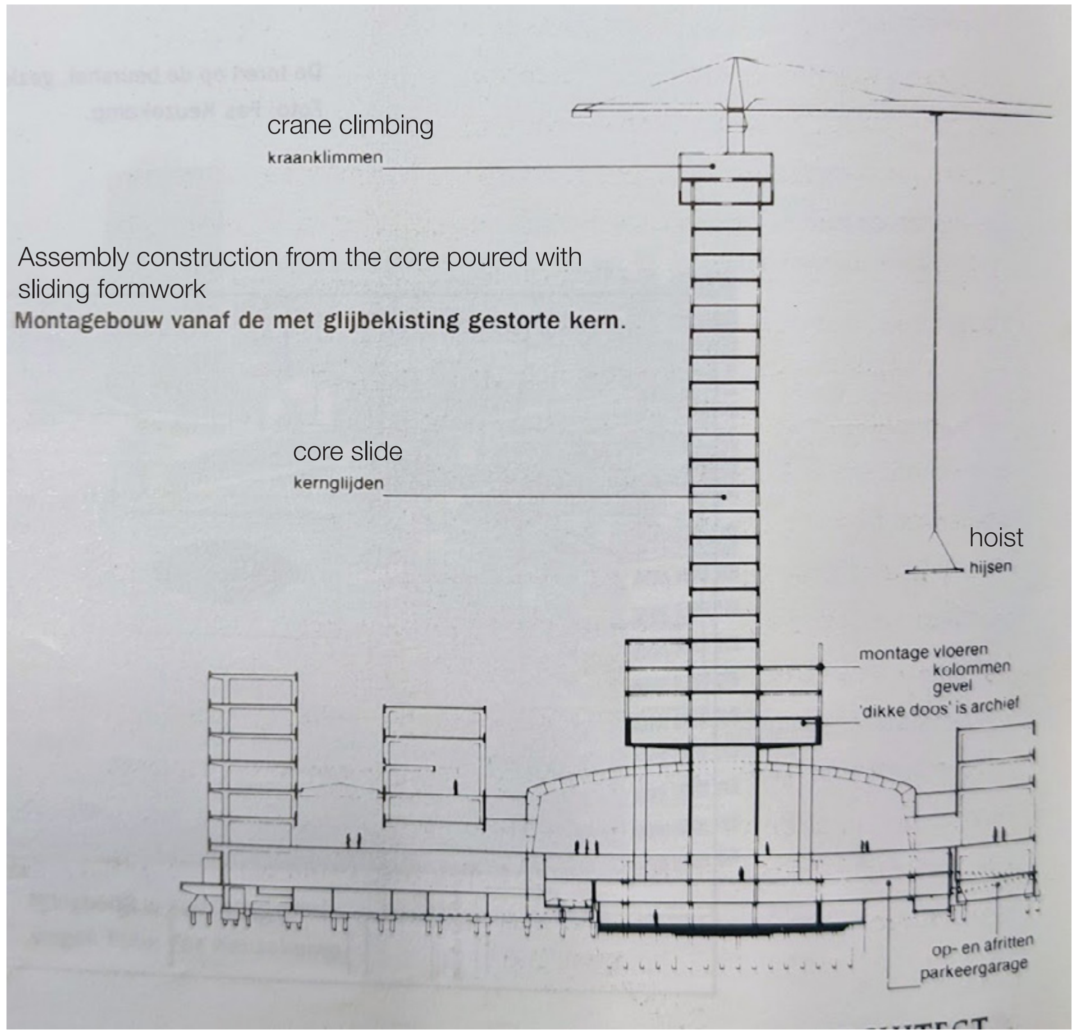
Tower on top
WTC office tower, Rotterdam

Hybrid construction
Concrete and steel facade.

The tower protrudes through the hall and is set on its own foundations.
At the bottom the columns go through the hall floor and rest on the large concrete slab (which also serves as a top parking floor). The carrying construction under the hall floor had to be reorganized.
The columns end just above the roof of the hall. The “thick box” acts like a table for the rest of the tower.

The tower itself was developed as a building box principle around the solid core. This core was made on site with the sliding formwork. Prefab TT plates protrude from the core to the facade as floor panels for the office floors.There are T-shaped fork beams installed for laying the floor beams. In the facade the steel floors are accomodated in steel box profiles.

Architect: Rob van Erk.
Height: 93 m
Floors: 25 --> 20 added



Prefab TT plates

floor, columns,
facade mounting

“thick box” is archive

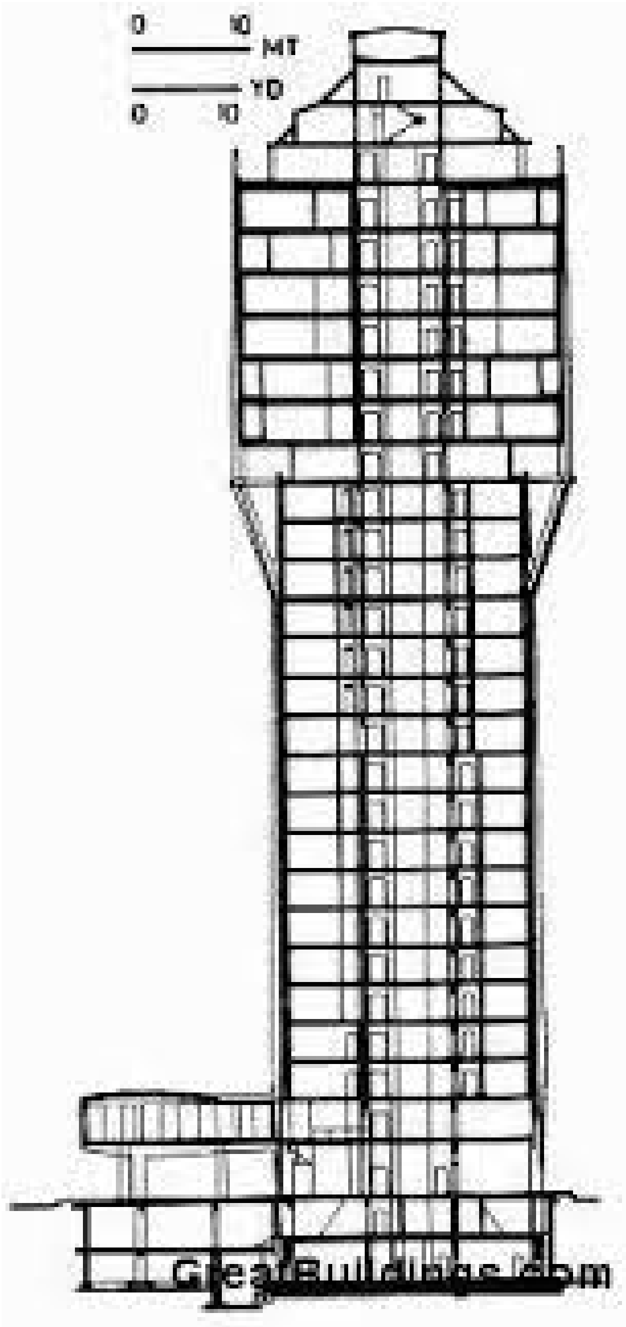
parking garage
entrances and exits

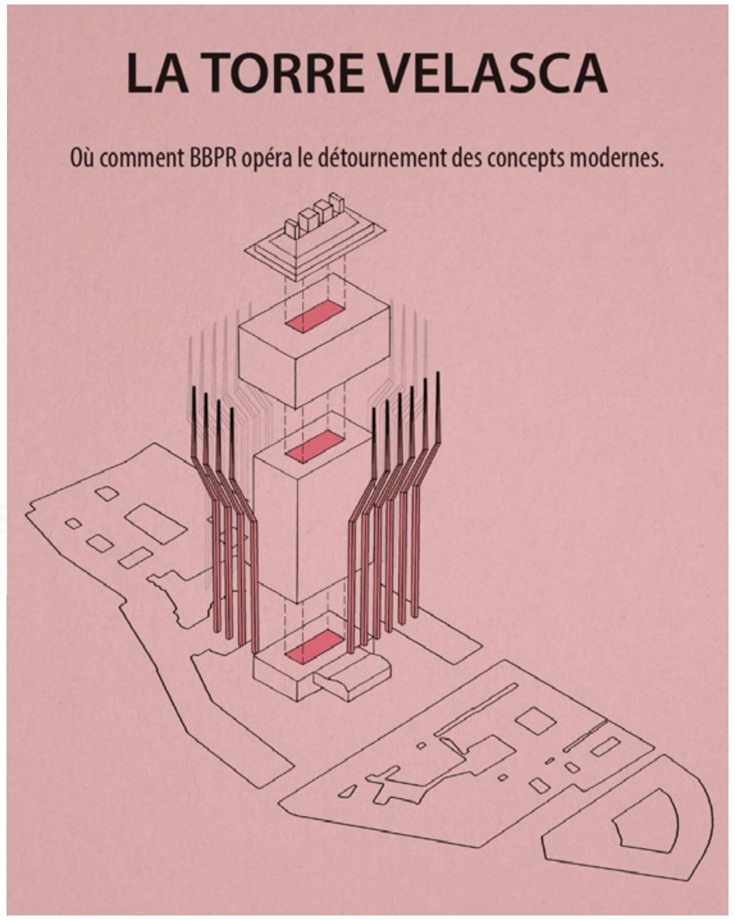
Source: Journal “De Architect”, 1987 june issue, 70-79 p.

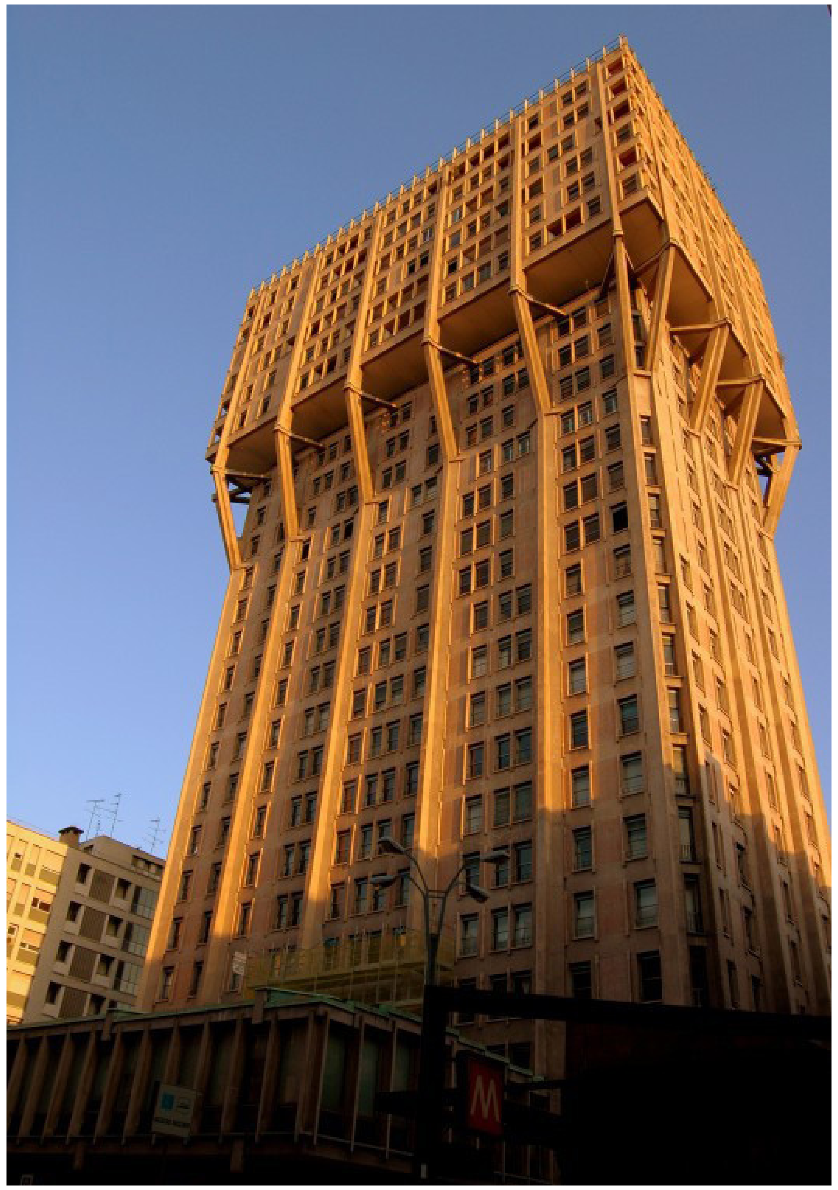
Tower on top
Torre Velasca, Milan, Italy

1958
Architects : BBPR

The tower's stone material and supporting struts that add stability to the projecting section not only further its resemblance to Italy's medieval defense towers, but also mimic some of the Gothic features of its surrounding structures.







Timber construction
HAUT in Amterdam

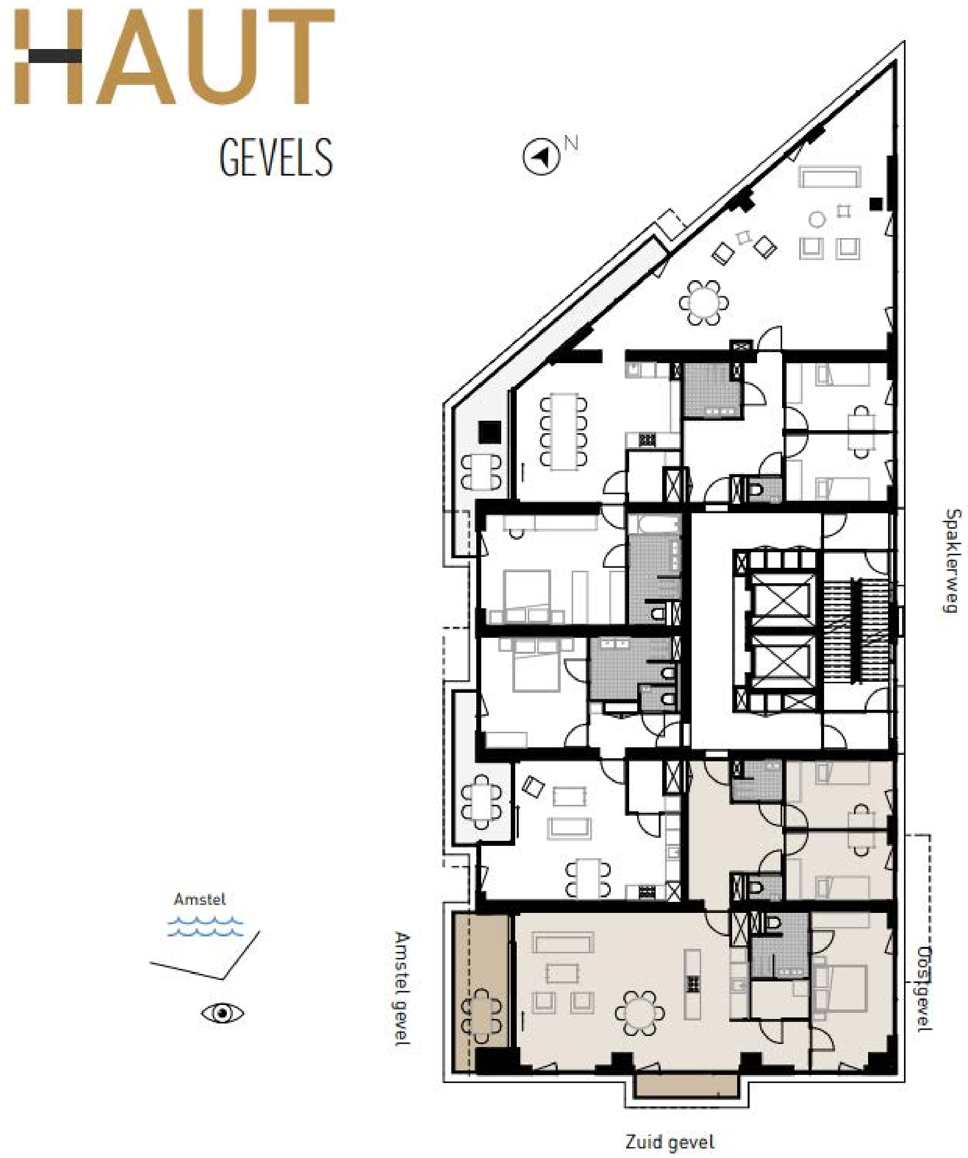
The development site of HAUT beside the River Amstel did not simply go to the highest bidder. In assessing offers, the municipality of Amsterdam also weighed both architectural quality and sustainability. The selected proposal is for a twenty-one-floor residential tower in timber, one of the tallest such structures in the world. The innovative project will help to put timber back on the world map as a structural building material.

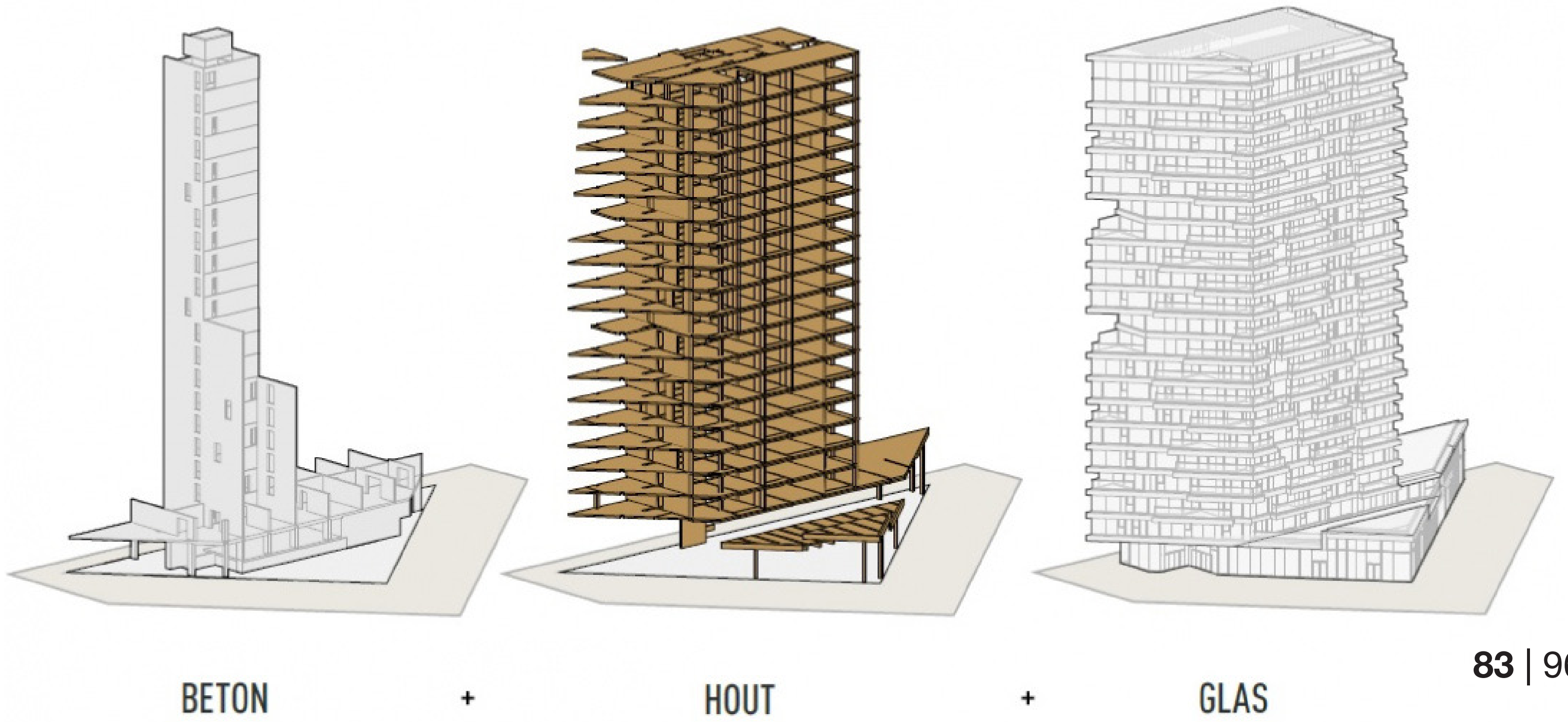
SUSTAINABILITY – In contrast to concrete and steel, the production of timber causes no carbon emissions. Timber actually stores carbon. Moreover, timber is renewable if harvested from sustainable production forestry. HAUT is an example of innovative sustainability in other ways, too. The building is fitted with solar panels on the roof and façade, a cold source in the ground, sensor-controlled installations with low-temperature floor heating and cooling, nesting boxes for birds and bats, charging points for shared electric cars, and a rooftop garden with rainwater storage.

HYBRID TIMBER – The load-bearing structure of HAUT is made of cross-laminated timber (CLT) panels, which are manufactured off-site, ensuring low waste production and fast and clean on-site assemblage. There are no standard building regulations for high-rise timber construction. The design team therefore invested considerable time and energy in technical innovation and safety. The floors and walls are constructed in timber, but a structure made completely of timber in wet and windy Amsterdam would have been impossible. Consequently, the foundations, basement, and core are made of concrete.

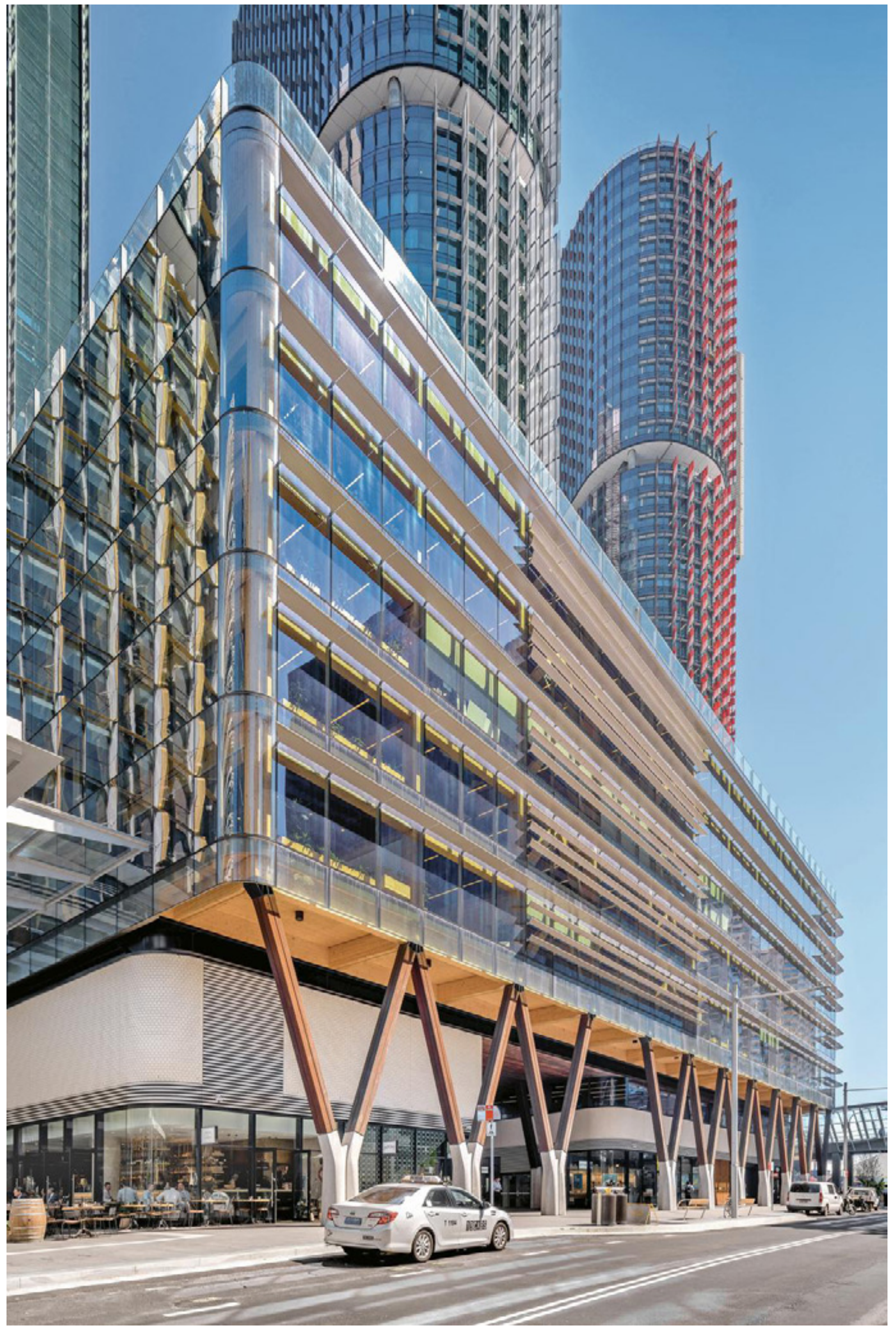
HAUTE ARCHITECTURE – A benefit of timber construction is that it offers a warm feel and allows for a high level of customization, or bespoke “haute architecture.” CLT panels are easily adaptable, offering first buyers a choice in the size of their apartment, the number of floors, the layout, and the positioning of double-height spaces, loggias, and balconies. Unlike most timber buildings, only the inner walls of HAUT are load-bearing, which allows for large floor-to-ceiling windows in the façade. The irregular pattern of balconies and the pronounced, double-height spaces facing the River Amstel make HAUT’s architecture distinctive.

by: Team V Architecture with Lingotto, Nicole Maarsen, ARUP and brand partner NLE
2016-2022
https://teamv.nl/en/projects/haut/



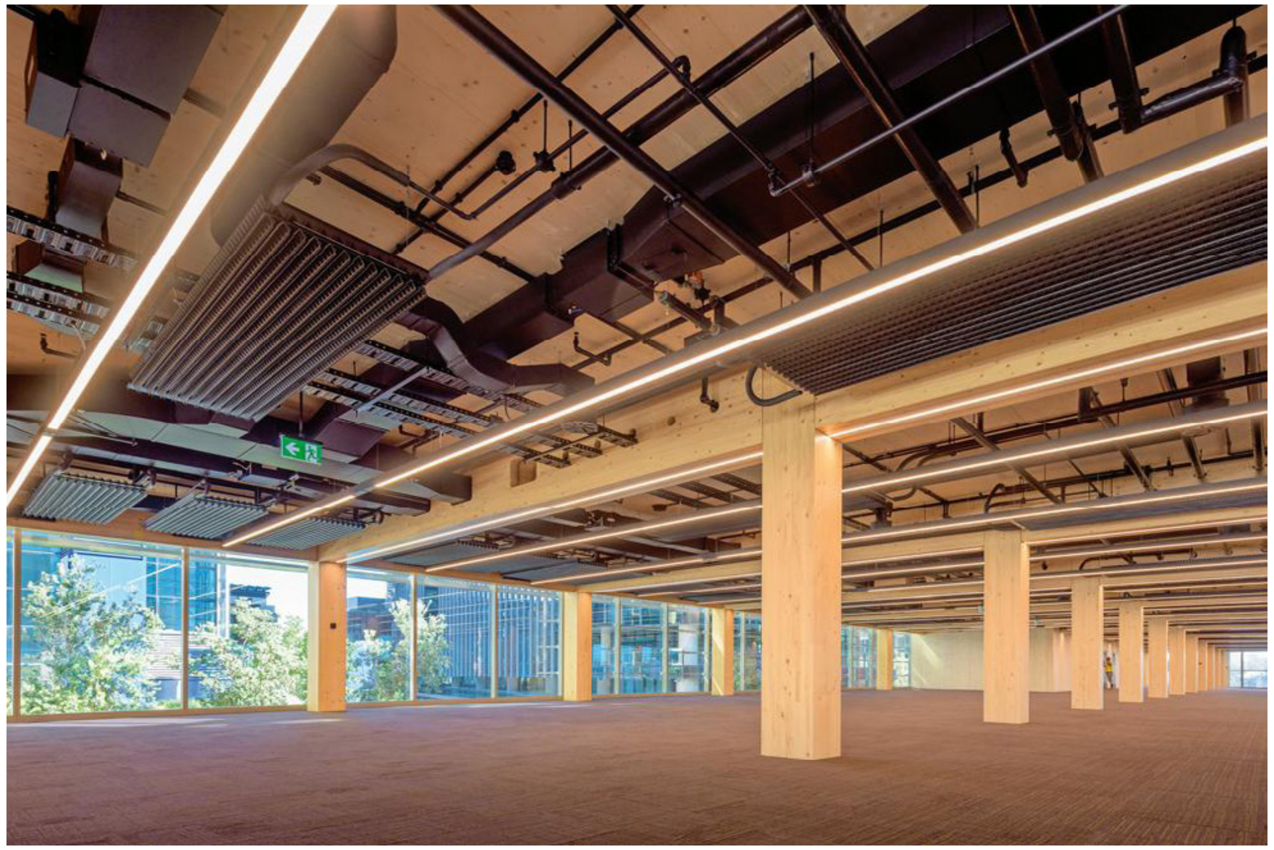


Timber construction
International House in Sydney



Architect: Tzannes Architects
Structural Engineer: Lendlease DesignMake
Source: DETAIL structure 4/2018

https://inspiration.detail.de/international-house-in-sydney-114722.html



open plan office with unclad glued laminated timber (GLT) beams and columns and cross laminated timber (CLT) walls and ceilings

hybrid beam manufactured from spruce glued laminated timber (GLT) with internal laminations of beech laminated veneer lumber (LVL).

FACADE
shading + adaptability

GSW Headquarters, Berlin by sauerbruch hutton
Realization: 1999

A low-energy building emerged, which not only offers an exemplary working environment in its passive control of energy consumption, but also aims to improve the immediate well-being of its inhabitants through an architecture in which the value of sensuous space is rediscovered.

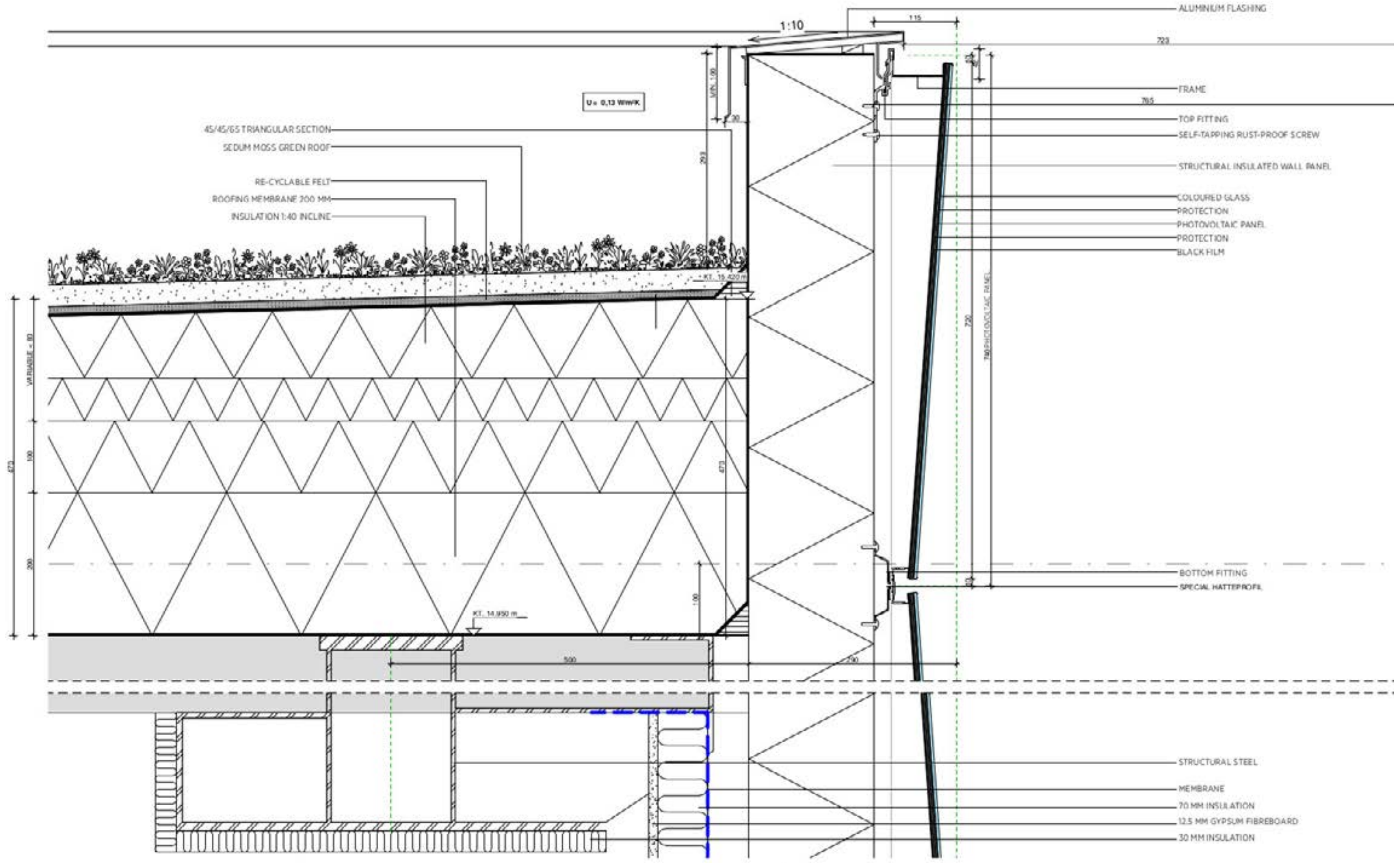
https://www.sauerbruchhutton.de/en/project/gsw

FACADE
PV facade

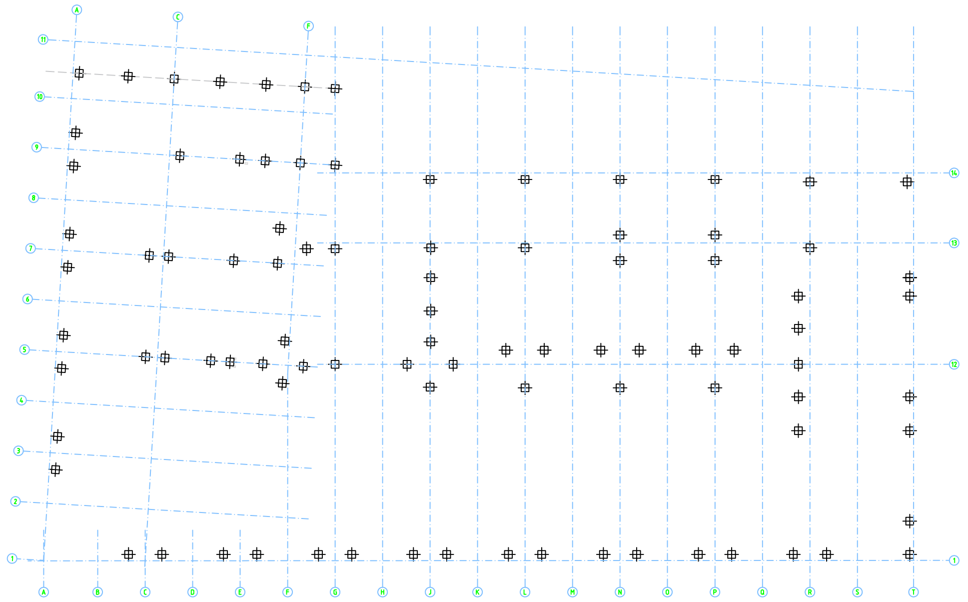
The Copenhagen International School by C.F. Møller Architects
Realization: 2017

The distinctive exterior of the school building is covered in 12,000 solar panels, each individually oriented to create a sequin-like effect, and provides more than half of the school's yearly electricity use. The solar cells covers a total surface of 6,048 square meters, making it one of Denmark's largest building-integrated solar power plants, capable of producing more than 200 MWh per year.

https://www.archdaily.com/879152/copenhagen-international-school-nordhavn-cf-moller



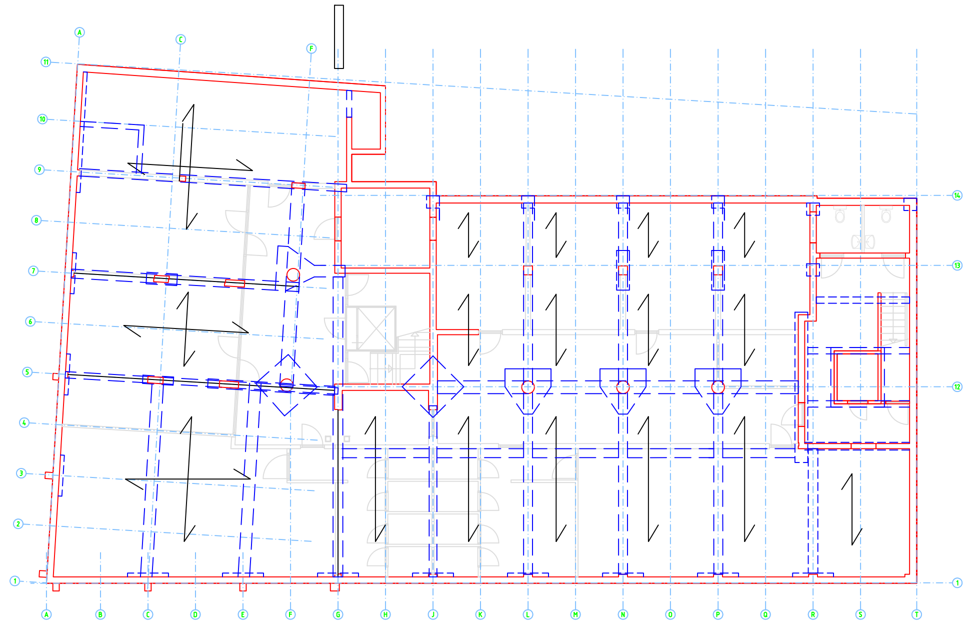
9. Existing building



LEGEND:
- structural grid
- pole foundation

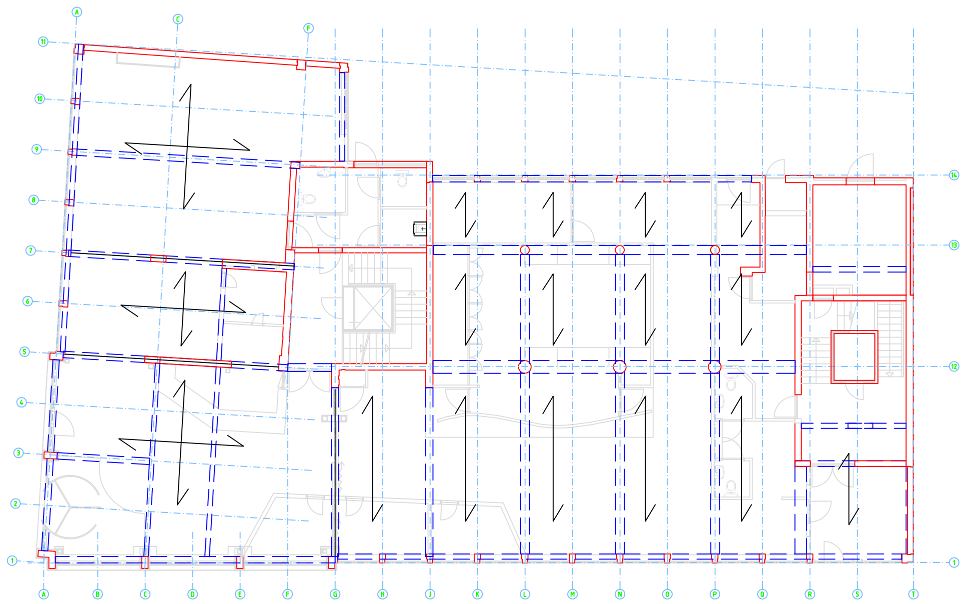
0 5 10

Note: plan showing the beams and directions below the floor
pole plan



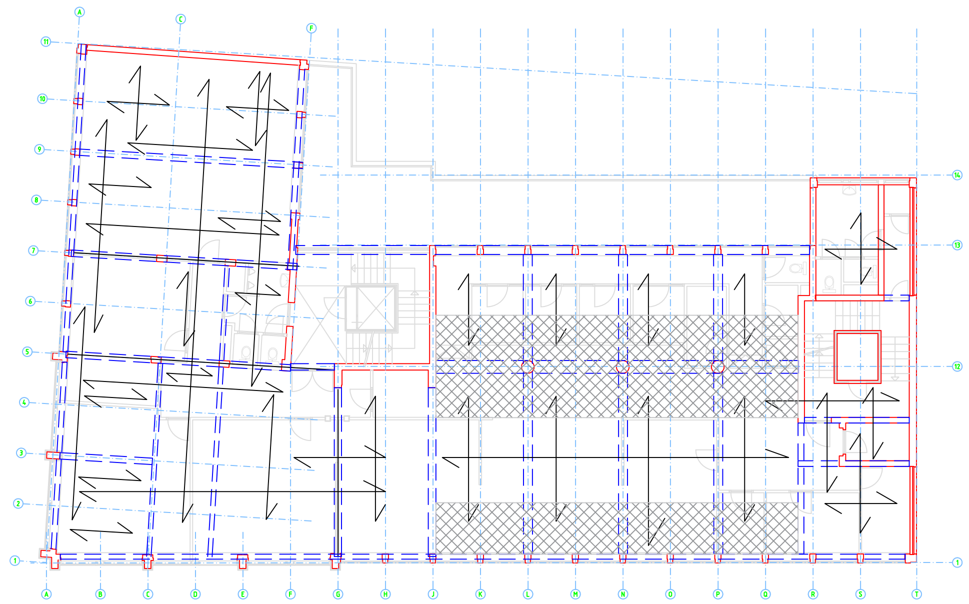
0 5 10

Note: plan showing the beams and directions below the floor
Basement



0 5 10

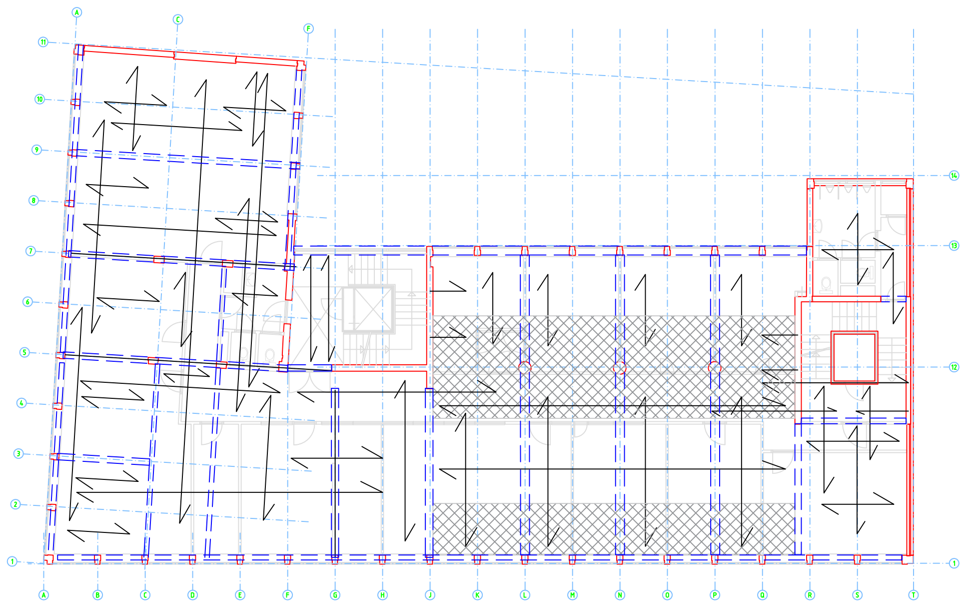
Note: plan showing the beams and directions below the floor
Ground floor



LEGEND:
- load-bearing wall
- reinforced concrete beam
- extra reinforced concrete
- span direction /reinforcement

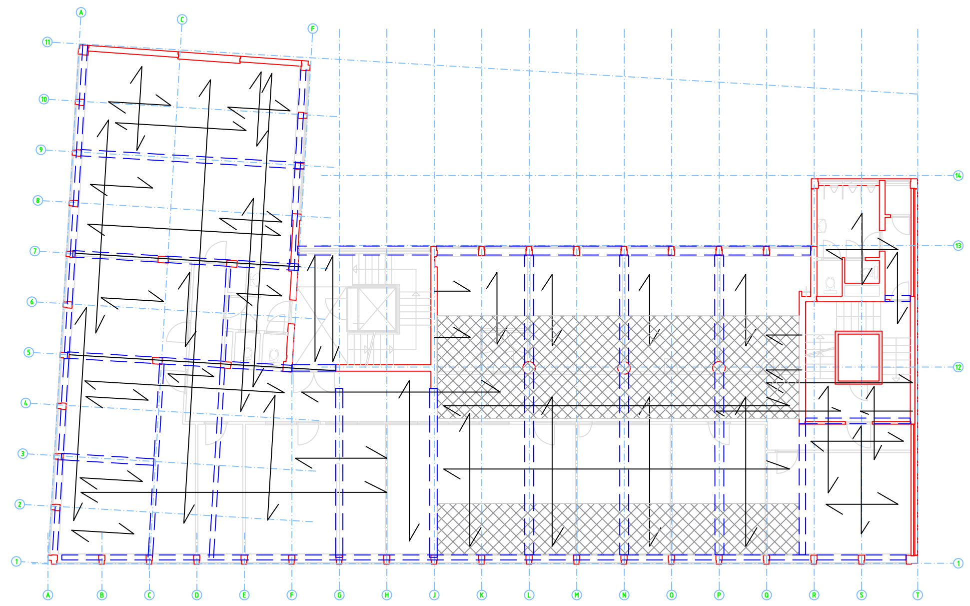
0 5 10

Note: plan showing the beams and directions below the floor
1st floor



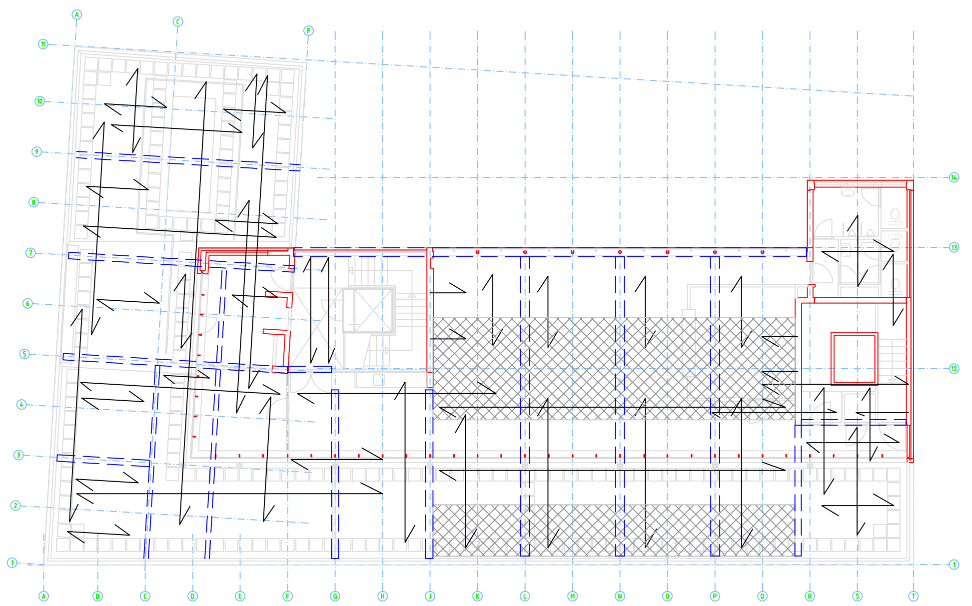
Note: plan showing the beams and directions below the floor

2nd floor



Note: plan showing the beams and directions below the floor

3rd floor

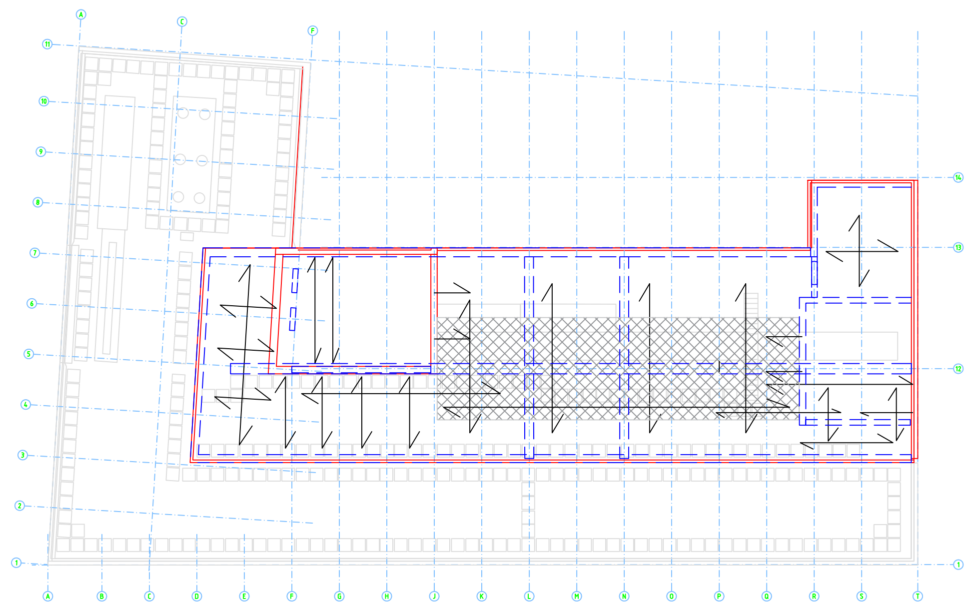


Note: plan showing the beams and directions below the floor

4th floor

LEGEND:

- load-bearing wall
- reinforced concrete beam
- extra reinforced concrete
- span direction /reinforcement

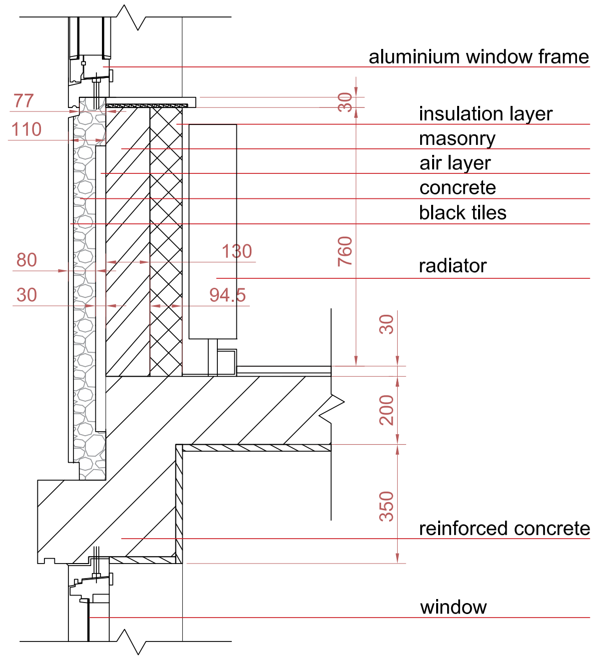


Note: plan showing the beams and directions below the floor

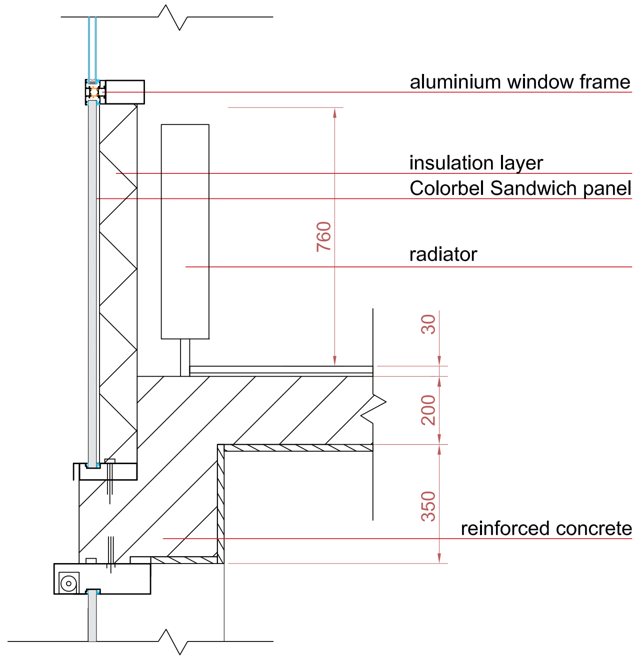
5th floor

Physical conditions of the WdW25:

- facade system has been changed from the original one

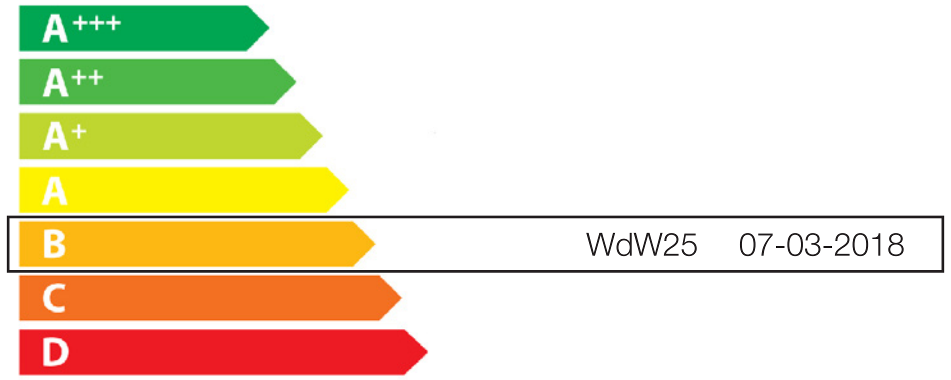


original facade detail



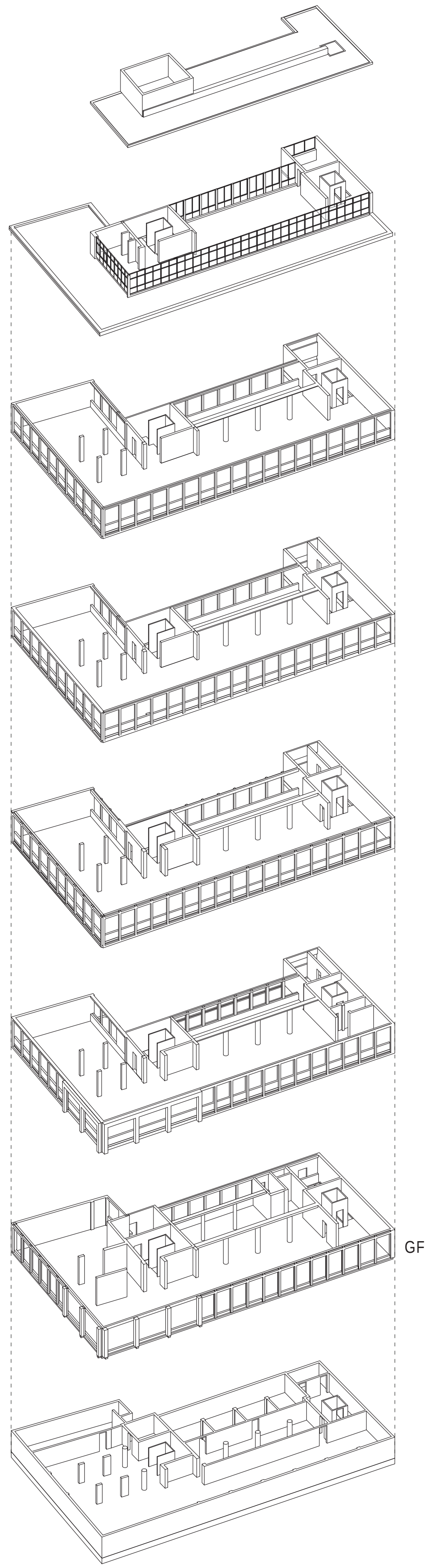
existing facade detail

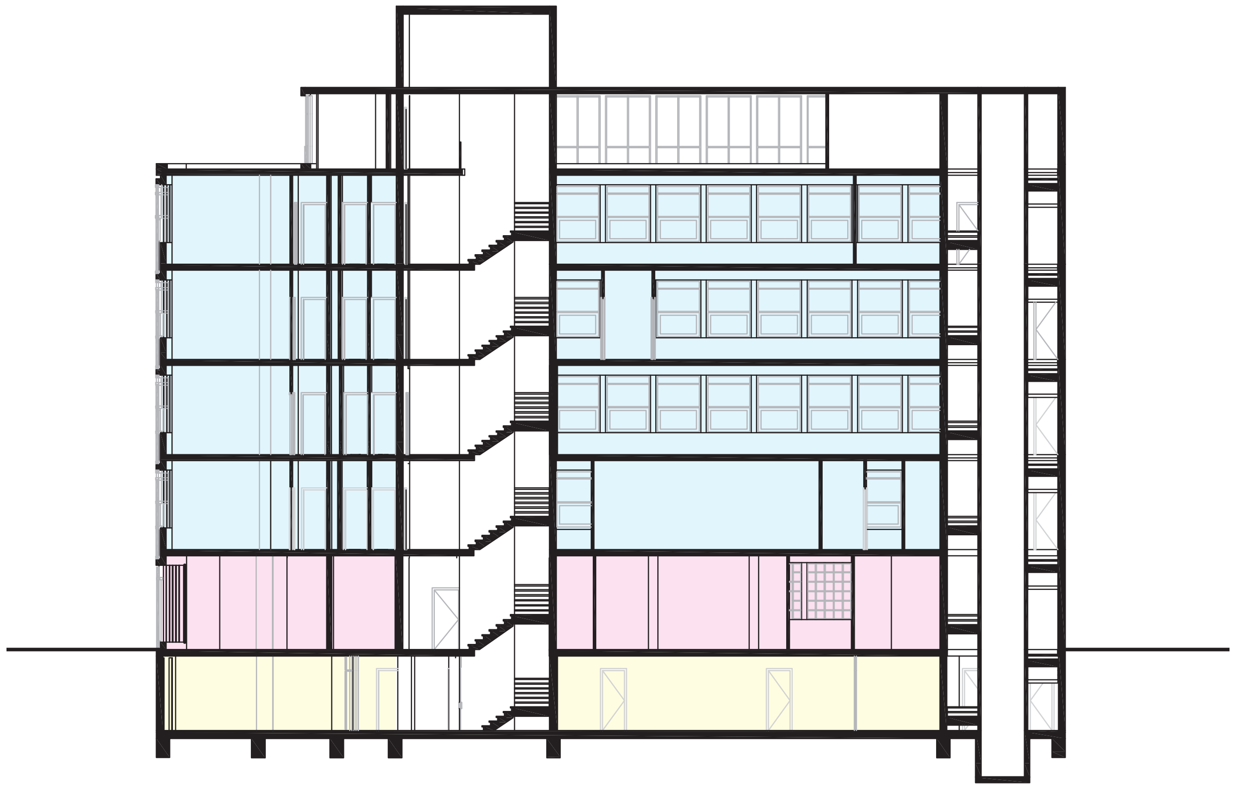
- has energy label B



- facades are in good/usable shape
- insufficiently insulated (cold bridges)

Physical conditions of the WdW25:



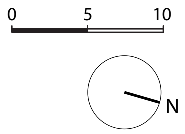


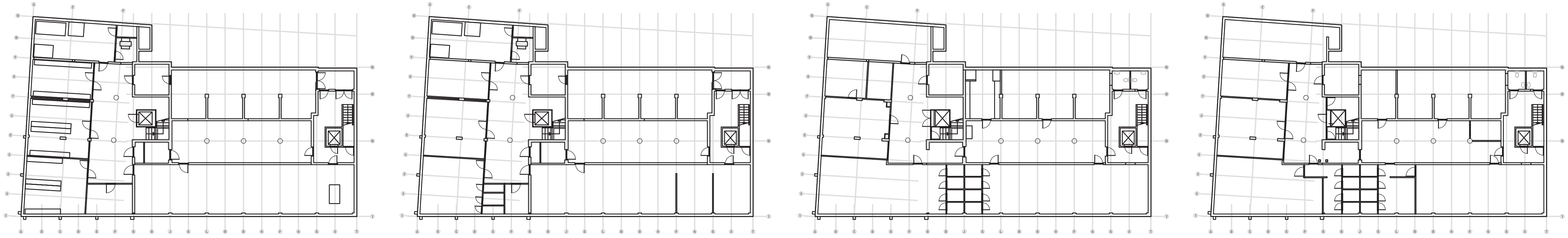
- typical floor height (1st-4th floors, floor to floor) - 3,5 m
- higher ground floor (floor to floor)- 3,675 m
- basement height (floor to GF floor) - 2,975 m

- the load-bearing column stucture allows open plan flexibility

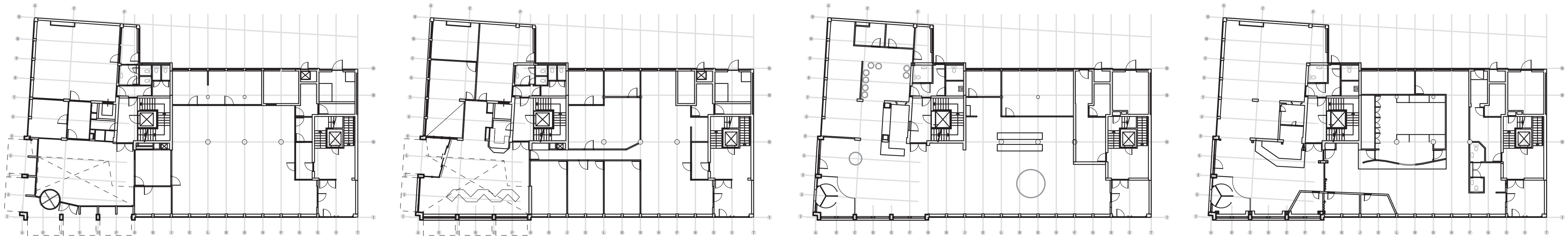
plan changes over time

1956-58 – The original design for “De Rotterdammer” & “Trouw” → 1979 – Renovation for “Het Vrije Volk” → 1993 – Renovation for the Police → 2005 – Refurbishment for the Police

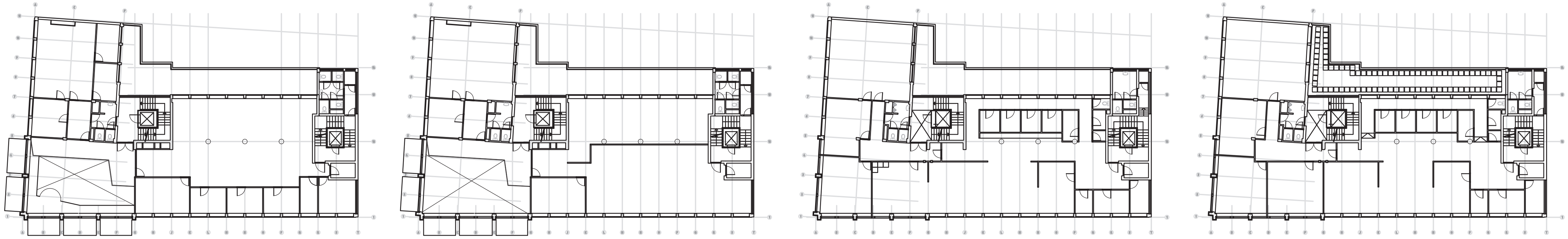




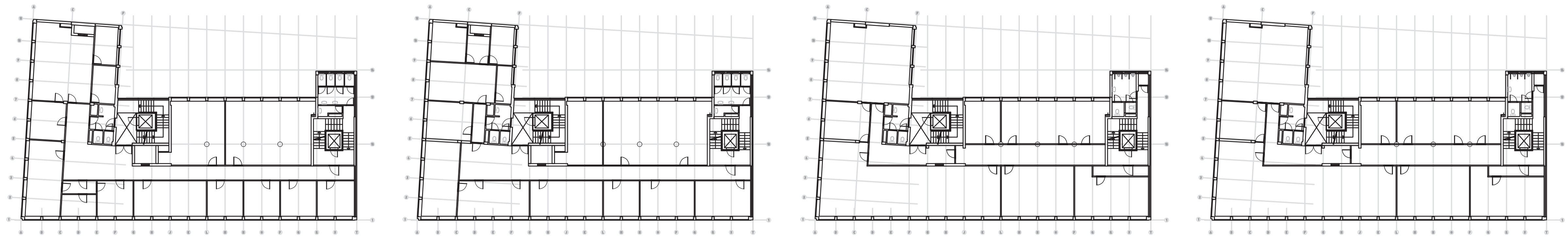
-1_basement



0_ground floor



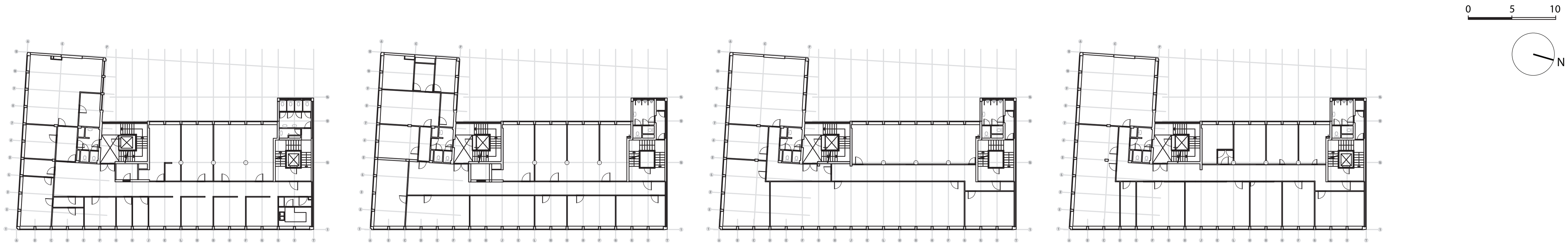
1 floor



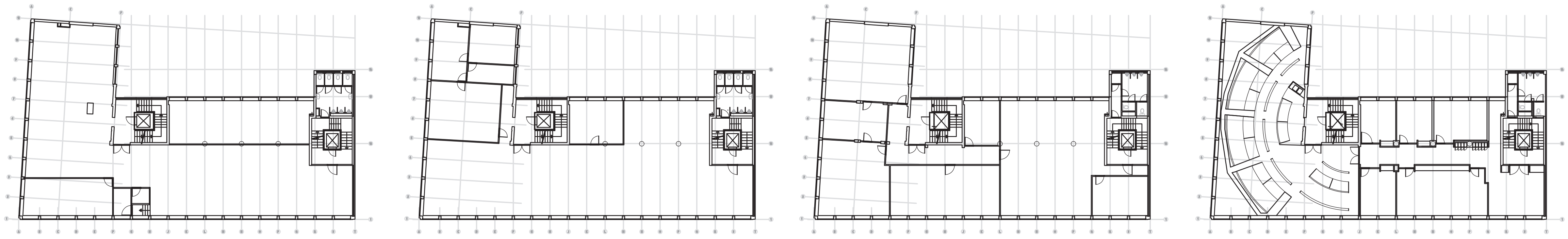
2 floor

plan changes over time

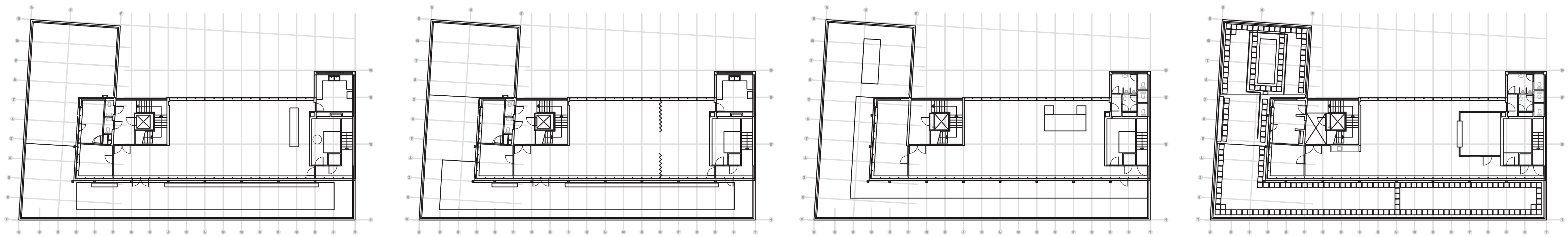
1956-58 – The original design for “De Rotterdammer” & “Trouw”	1979 – Renovation for “Het Vrije Volk”	1993 – Renovation for the Police	2005 – Refurbishment for the Police



3 floor



4 floor



5 floor

10. Guideleines for the tower extension

Different options of possible structure

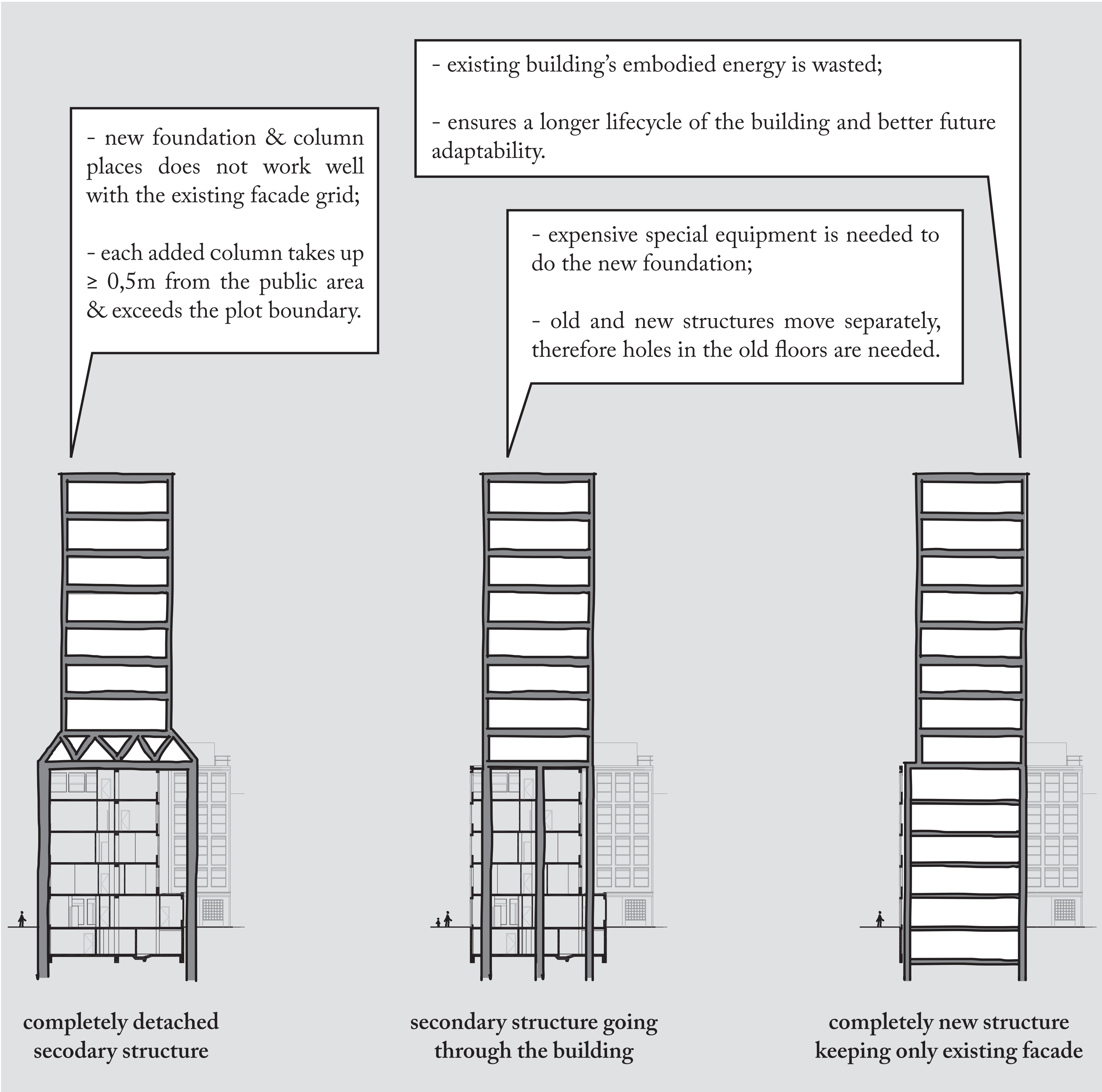
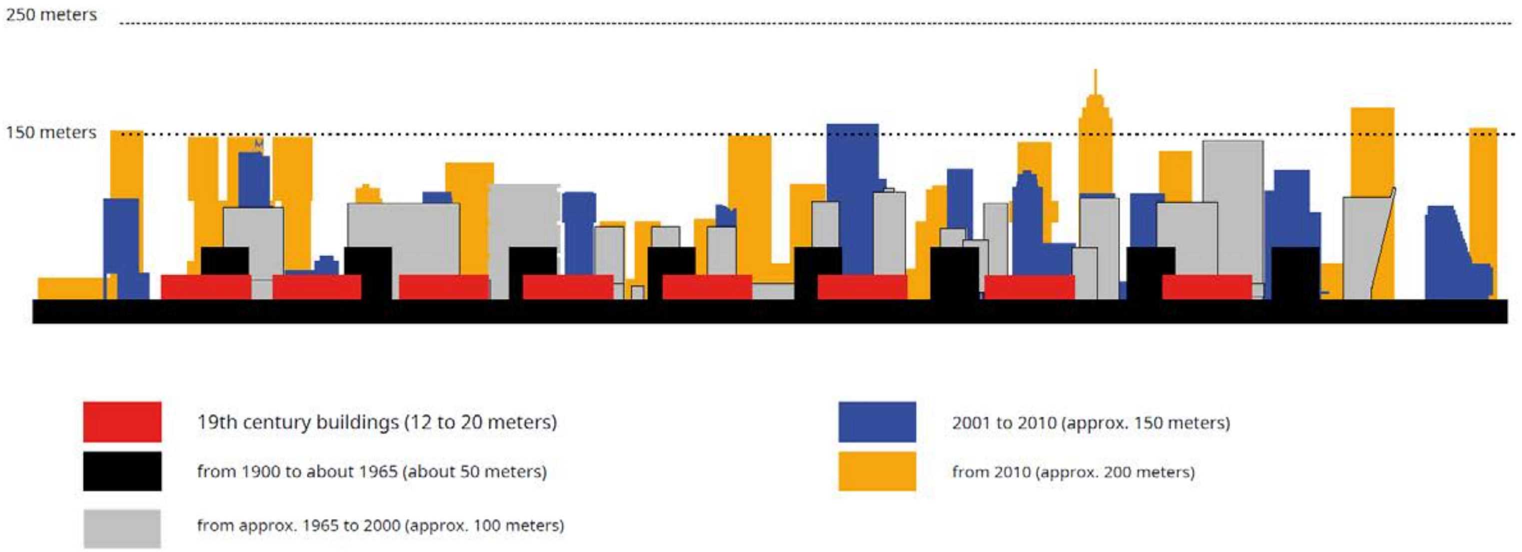


Figure: Different possible methods of how the tower can be built on top of the existing structure shown in section + arguments about each of the method.

Rules for the high-rise in Rotterdam

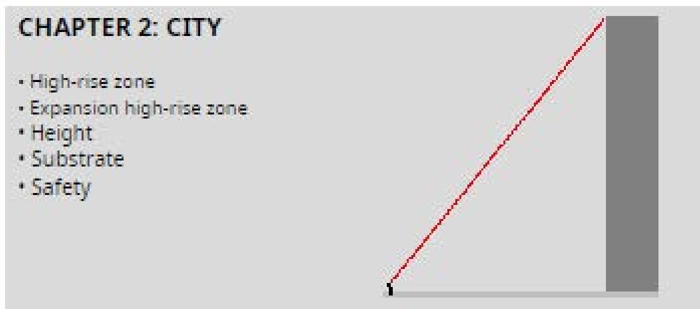
HIGH BUILD VISION 2019.

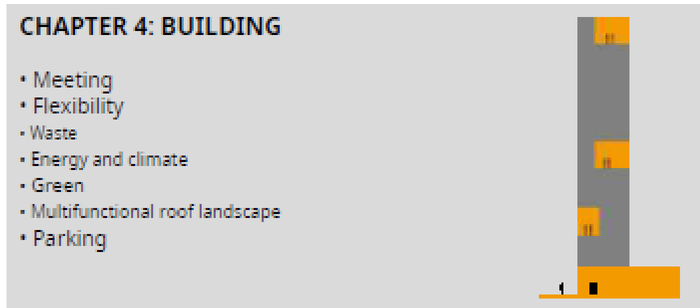
The former Police station building now reaches **20,7m** height (or **23,7m** including the installation room on top of the 5th floor) and to reach **50m (the second level in the city centre)** 7 additional floors could be added.



High-rise buildings are considered to be higher than 70 metres. In this high-rise vision, a maximum height of approximately 250 meters is set for the city center along the city axis. For the other areas where highrise buildings are made possible, the maximum height is 150 meters.

The plinth must be transparent and vertically articulated and have multiple spaces (with doors) to do justice to the city at eye level. In addition, the height of the substructure depends on the so-called Rotterdam layer. This Rotterdam layer can differ per area and is the average building height in an area, usually between 15 and 25 metres.





https://www.stichtinghoogbouw.nl/wp-content/uploads/2019/10/Hoogbouwvisie-2019.pdf

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