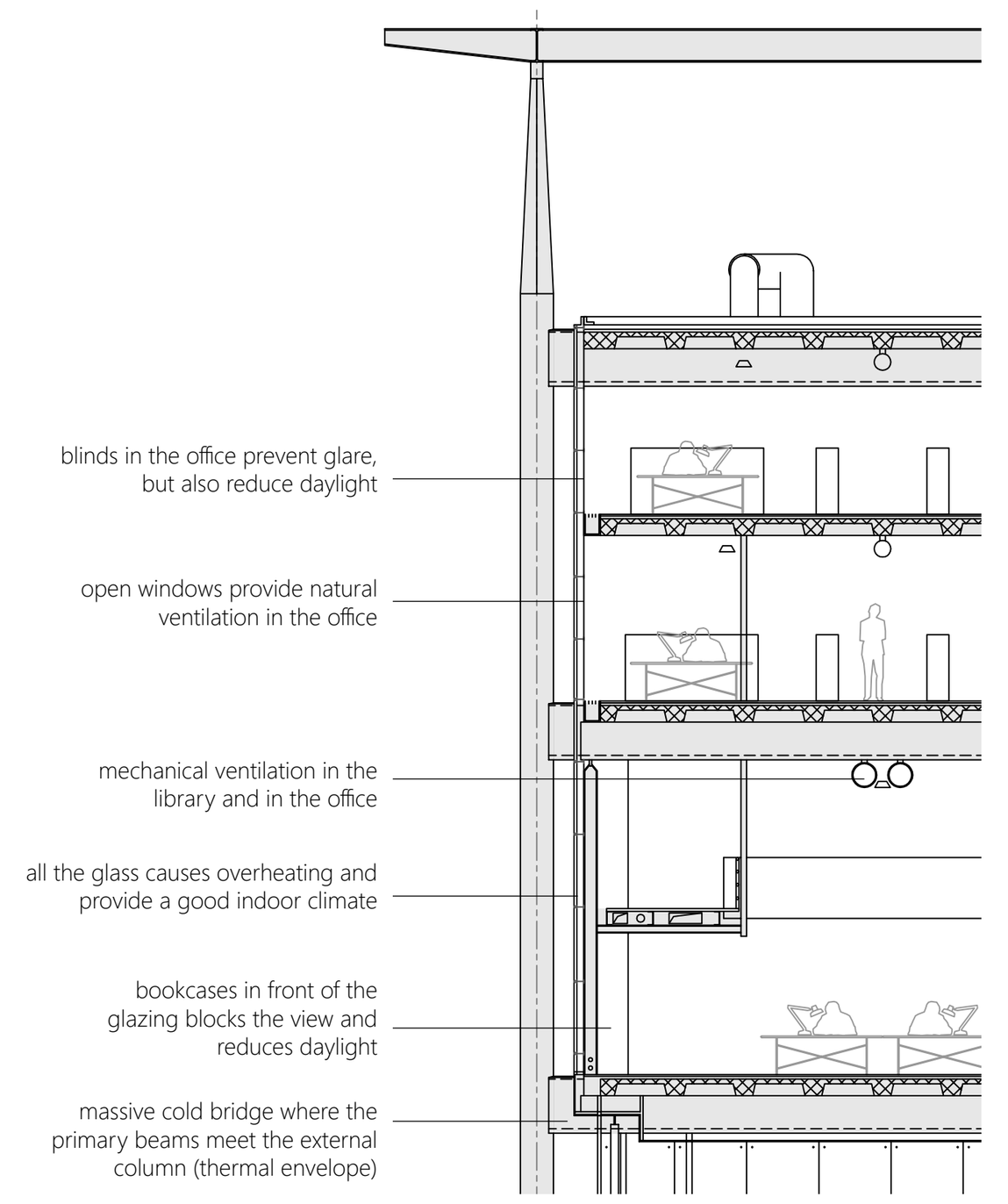
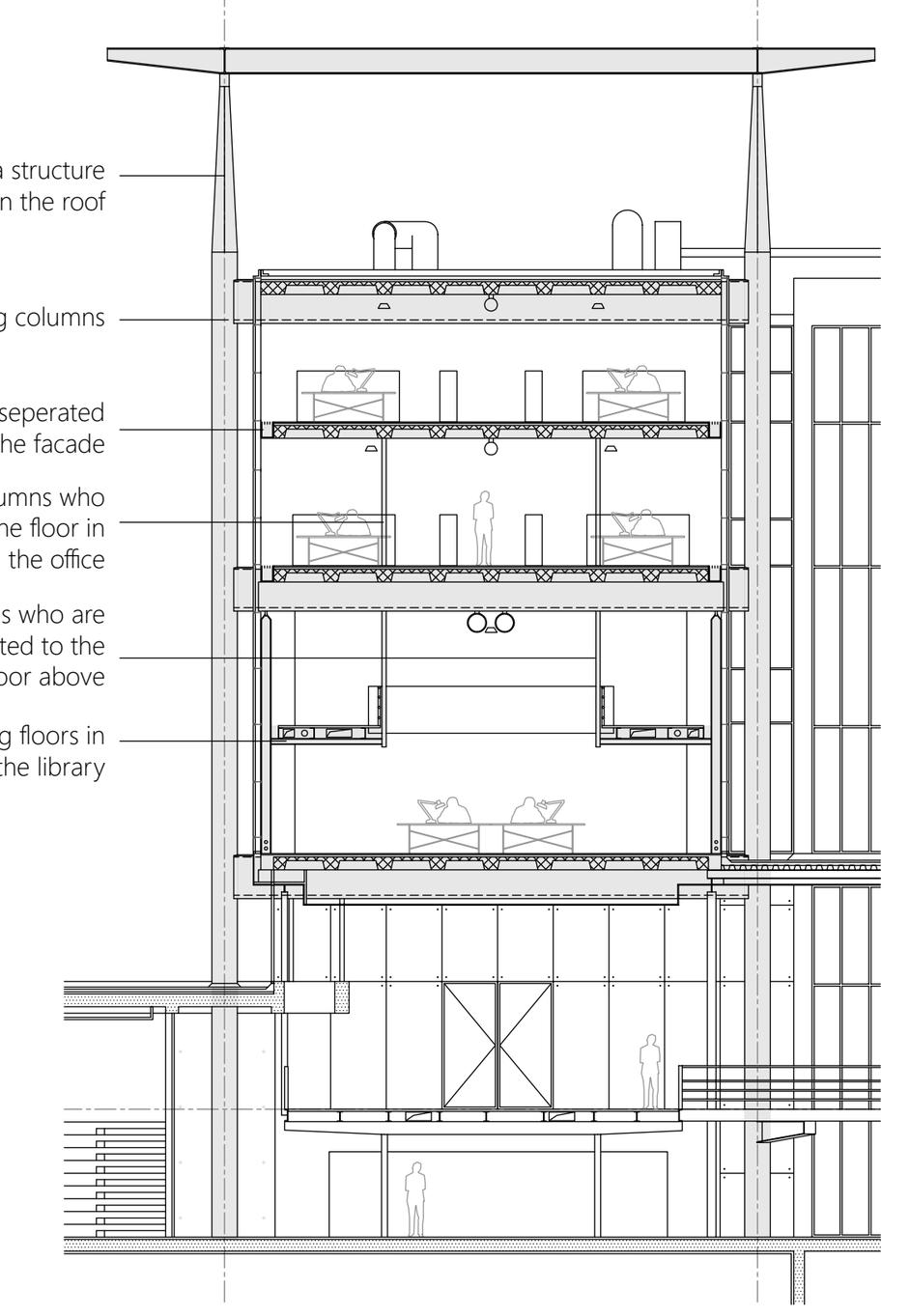
Analysis

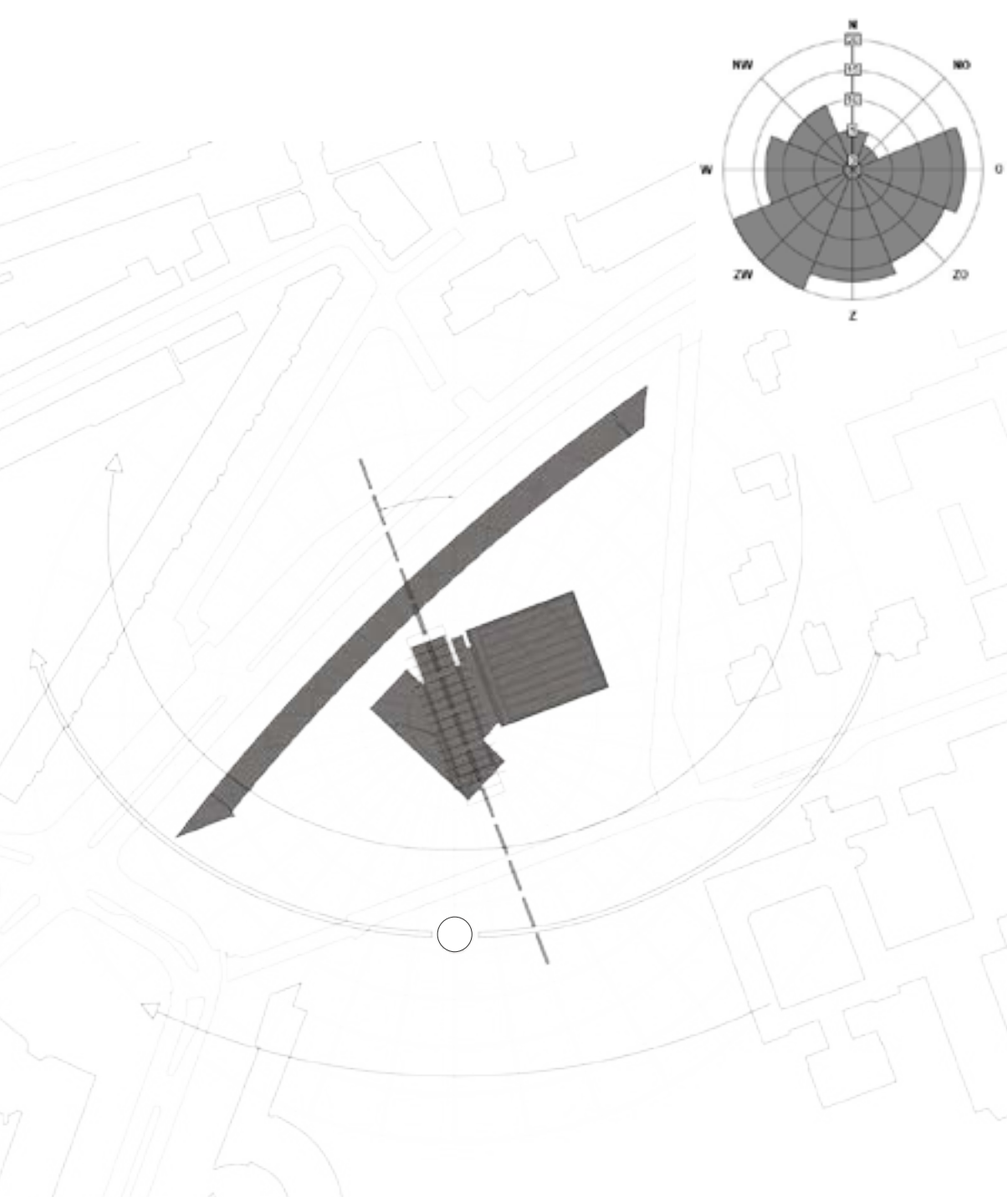


blinds in the office prevent glare, but also reduce daylight
open windows provide natural ventilation in the office
mechanical ventilation in the library and in the office
all the glass causes overheating and provide a good indoor climate
bookcases in front of the glazing blocks the view and reduces daylight
massive cold bridge where the primary beams meet the external column (thermal envelope)

Climate

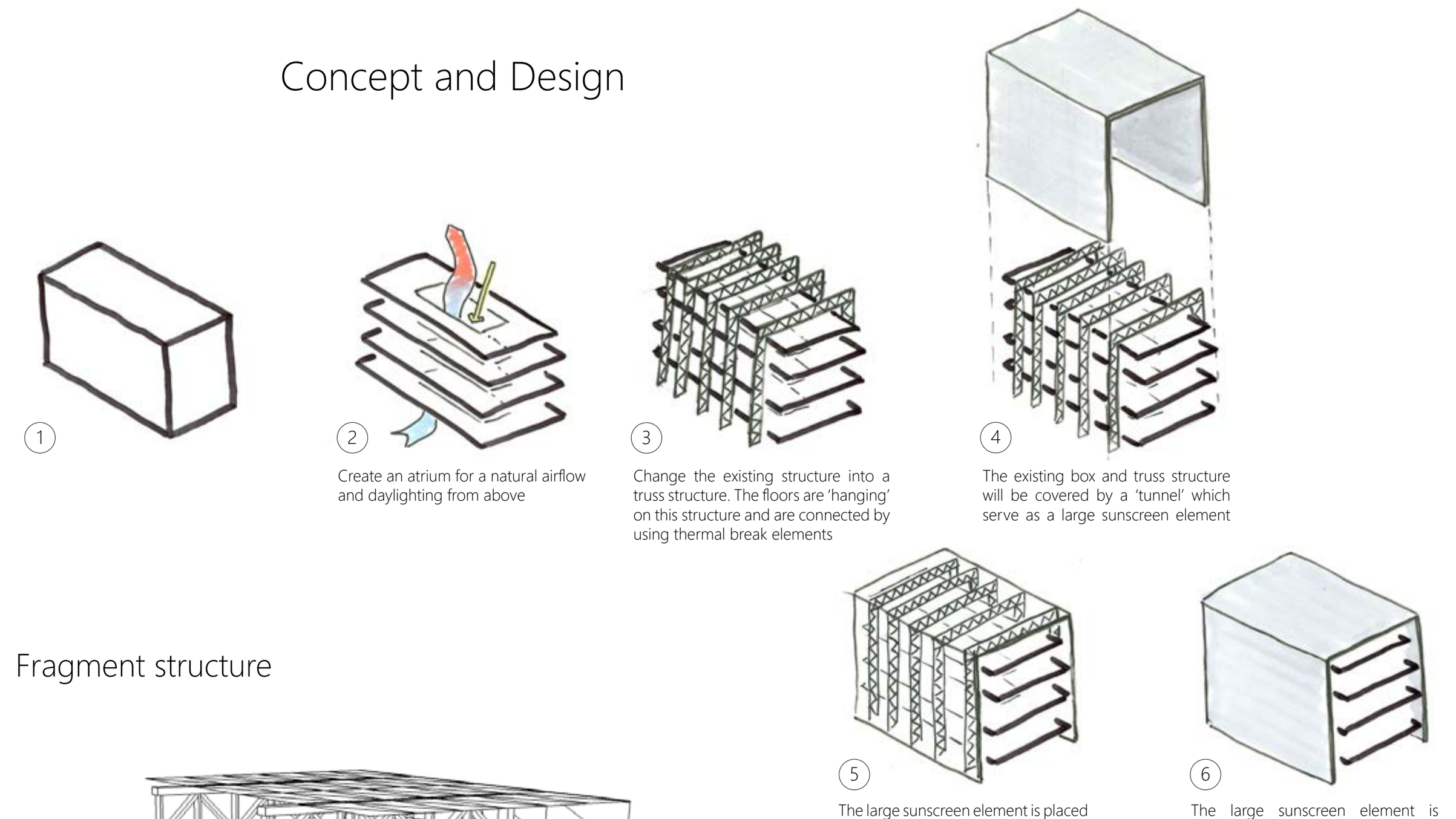


Structure



Solar path and average wind direction

Concept and Design



2 Create an atrium for a natural airflow and daylighting from above

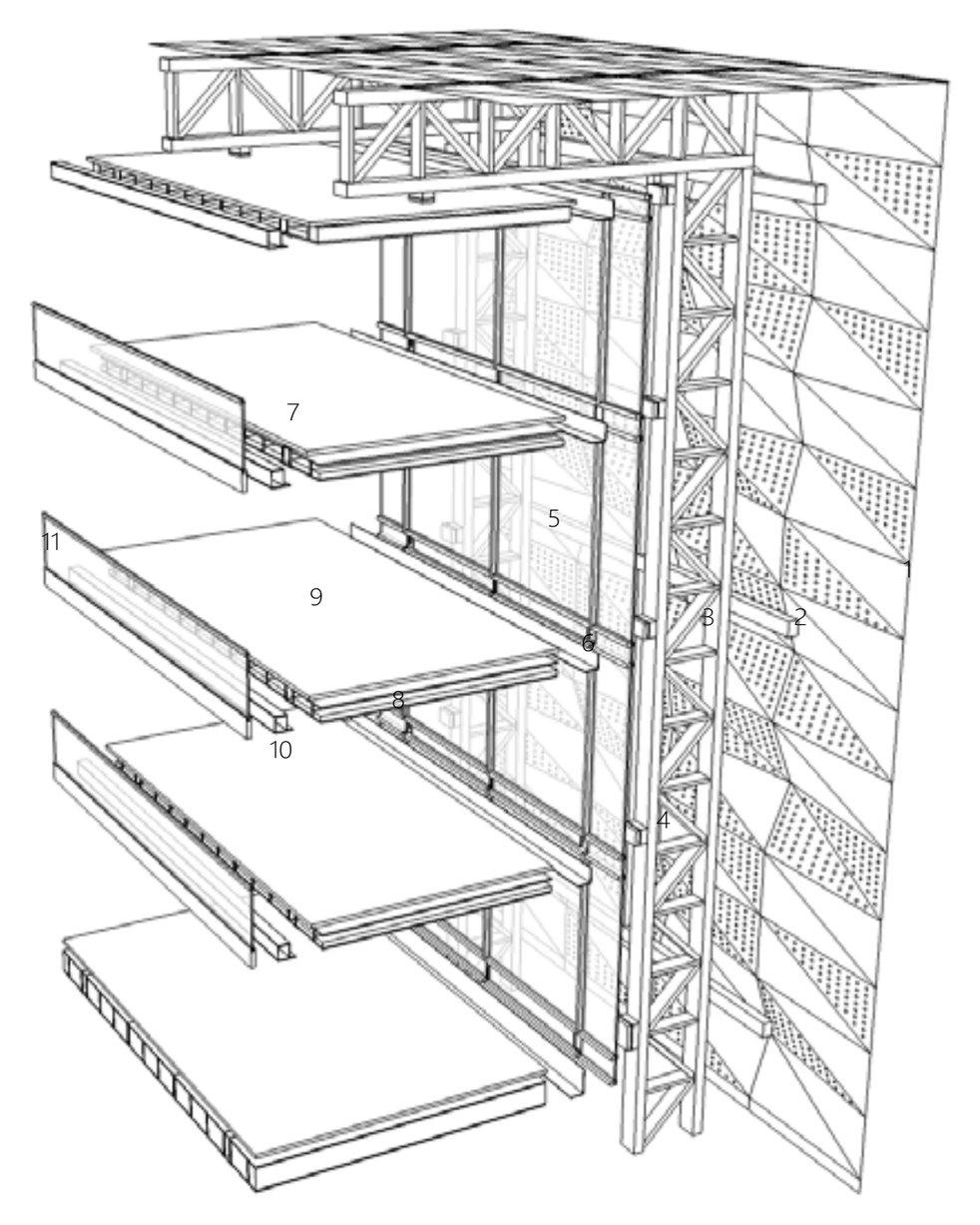
3 Change the existing structure into a truss structure. The floors are 'hanging' on this structure and are connected by using thermal break elements

4 The existing box and truss structure will be covered by a 'tunnel' which serve as a large sunscreen element

5 The large sunscreen element is placed on the East and West side of the building to block direct sunlight and prevent overheating of the glass-box

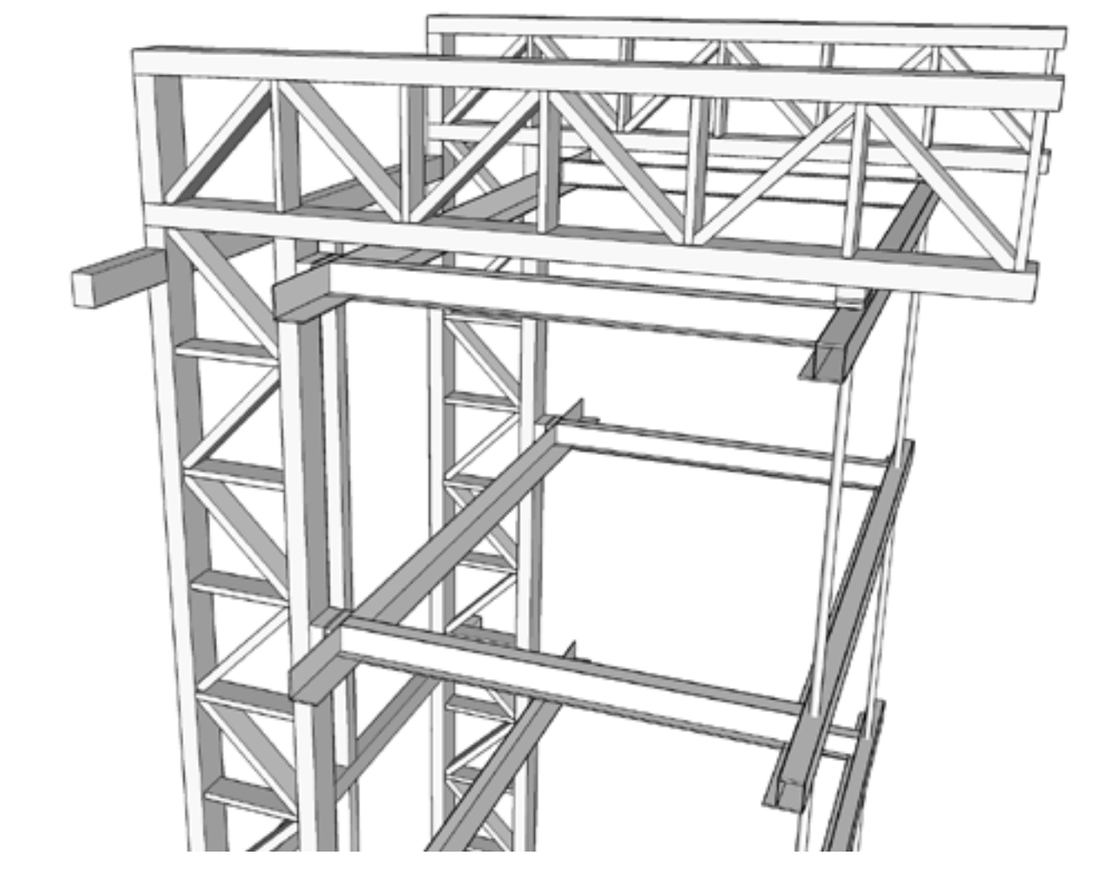
6 The large sunscreen element is made out of perforated metal panels and cover the entire building. All structural elements will disappear

Fragment structure



Exploded view

1 8mm perforated and non-perforated metal panels
2 Supporting structure to connect the metal panels to the truss structure
3 1500mm truss structure made out of steel (load bearing structure)
4 Thermal break element to prevent cold bridges (thermal envelope)
5 Curtain wall system
6 Steel L-shaped beam connected to the thermal break element
7 Steel THQ-beam (top-head-Q-beam)
8 245mm Kerto Ripa wooden floor element
9 65mm floor finishing: 45mm of floating screed and 20mm of top flood screed
10 Steel cap-shaped beam
11 Glass balustrade with integrated connecting to the cap-shaped beam

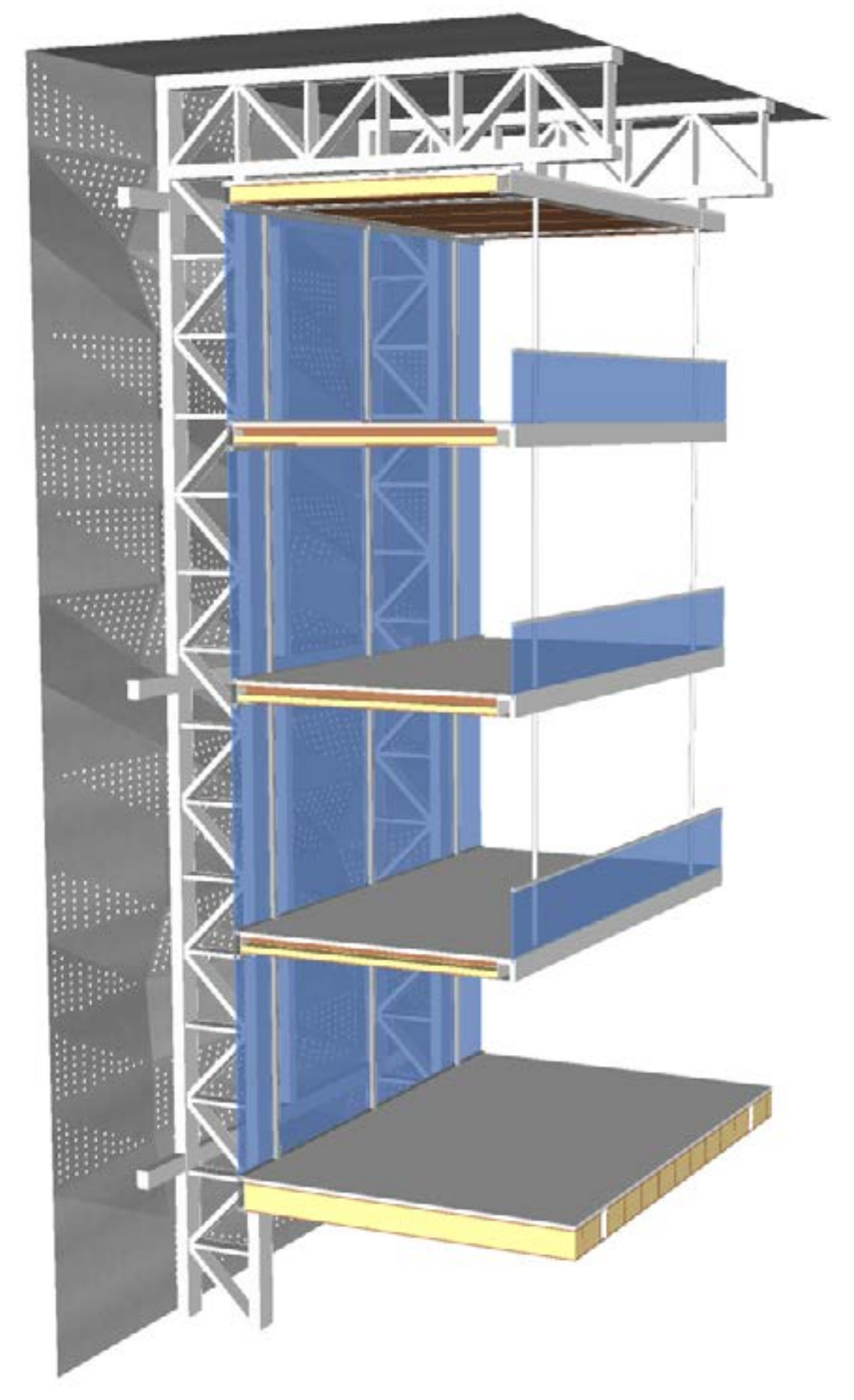


Structural 3D view

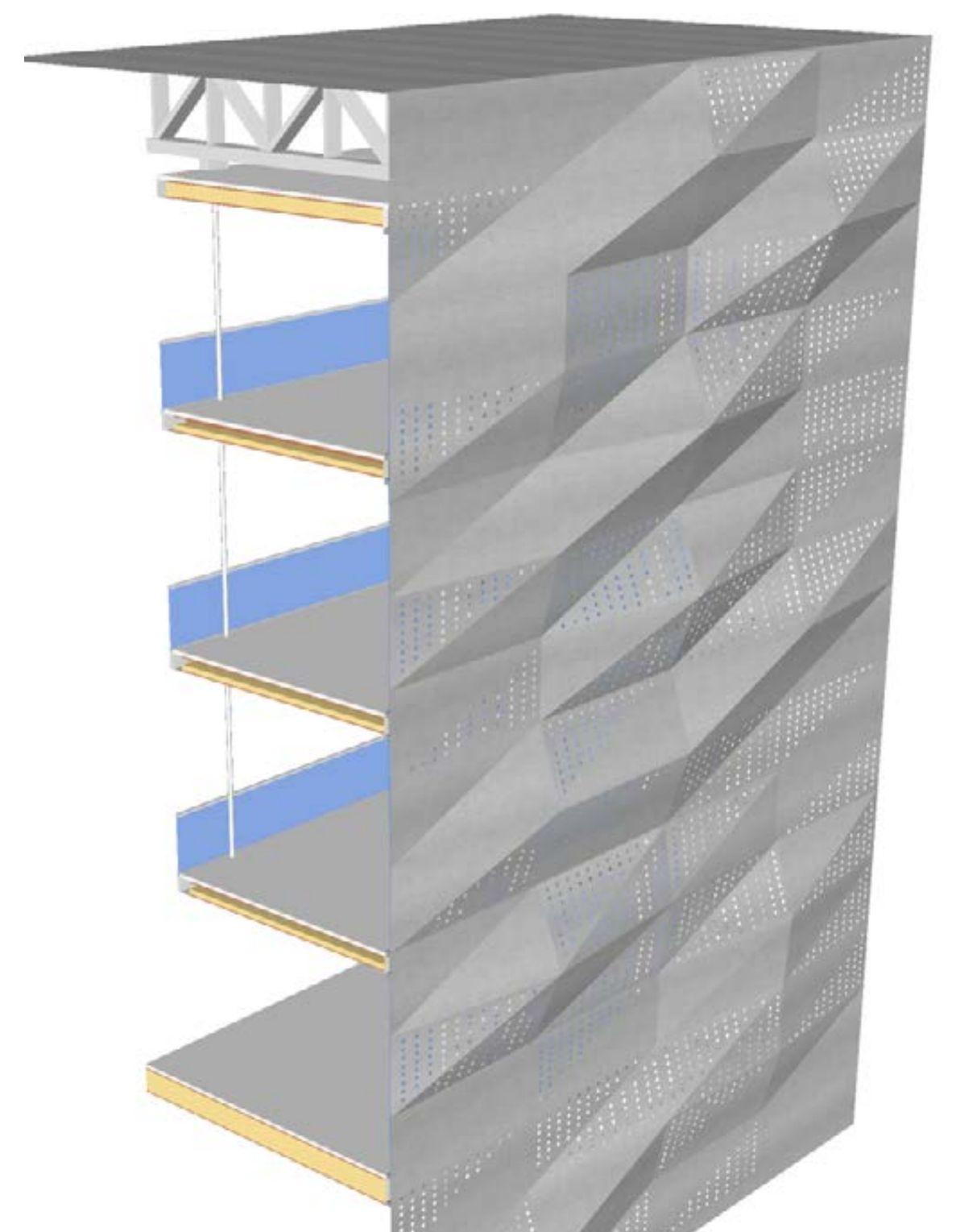
The existing column structure is replaced by a steel truss structure. The span of the trusses is 15 metres, what means that the high of the truss is about 1,5 metres (one tenth of the span). The floors hang on this truss structure. By using an atrium the span of the floors is only 4,5 metres. The floors will be carried by different kind of steel beams. A L-shaped beam is connected to the truss structure on the side. On the other side there is a cap-shaped beam. Right-angled on these beams there are two THQ-beams which ensure the stability of the structure. The steel support rod is connected to the cap-shaped beam and to the truss structure. By using an thermal break element the thermal envelope will not be interrupted.

On the outside of the truss structure the supporting elements for the metal panels are connected to the load bearing trusses as well. This also applies for the roof-structure.

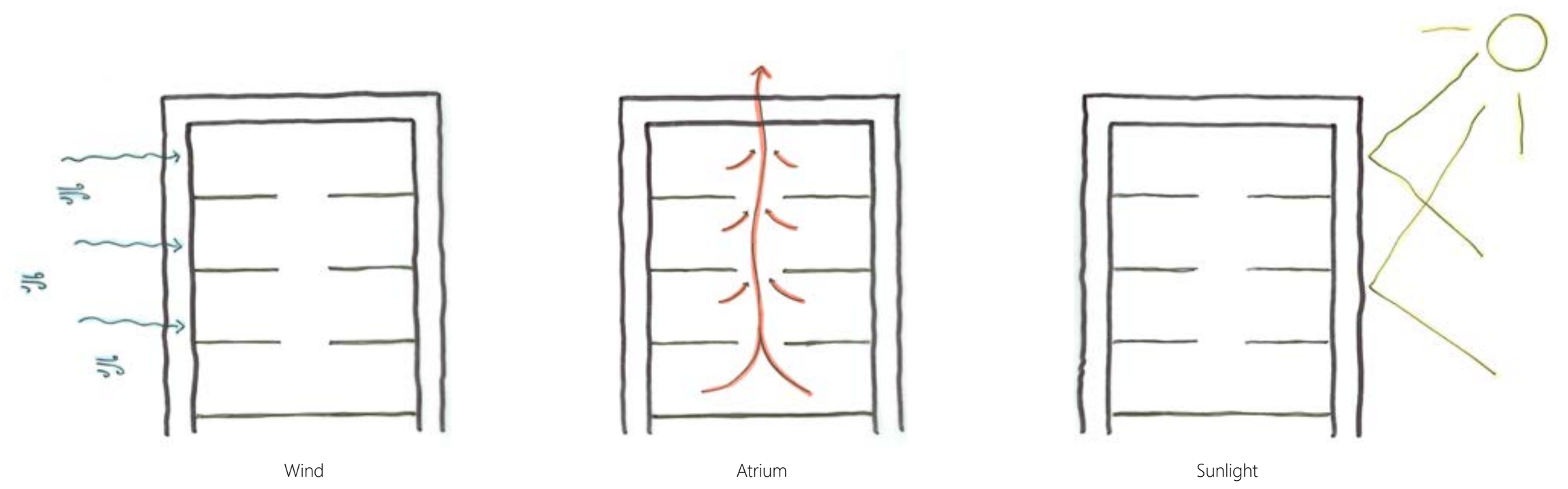
Interior 3D view



Exterior 3D view



Climate Strategy



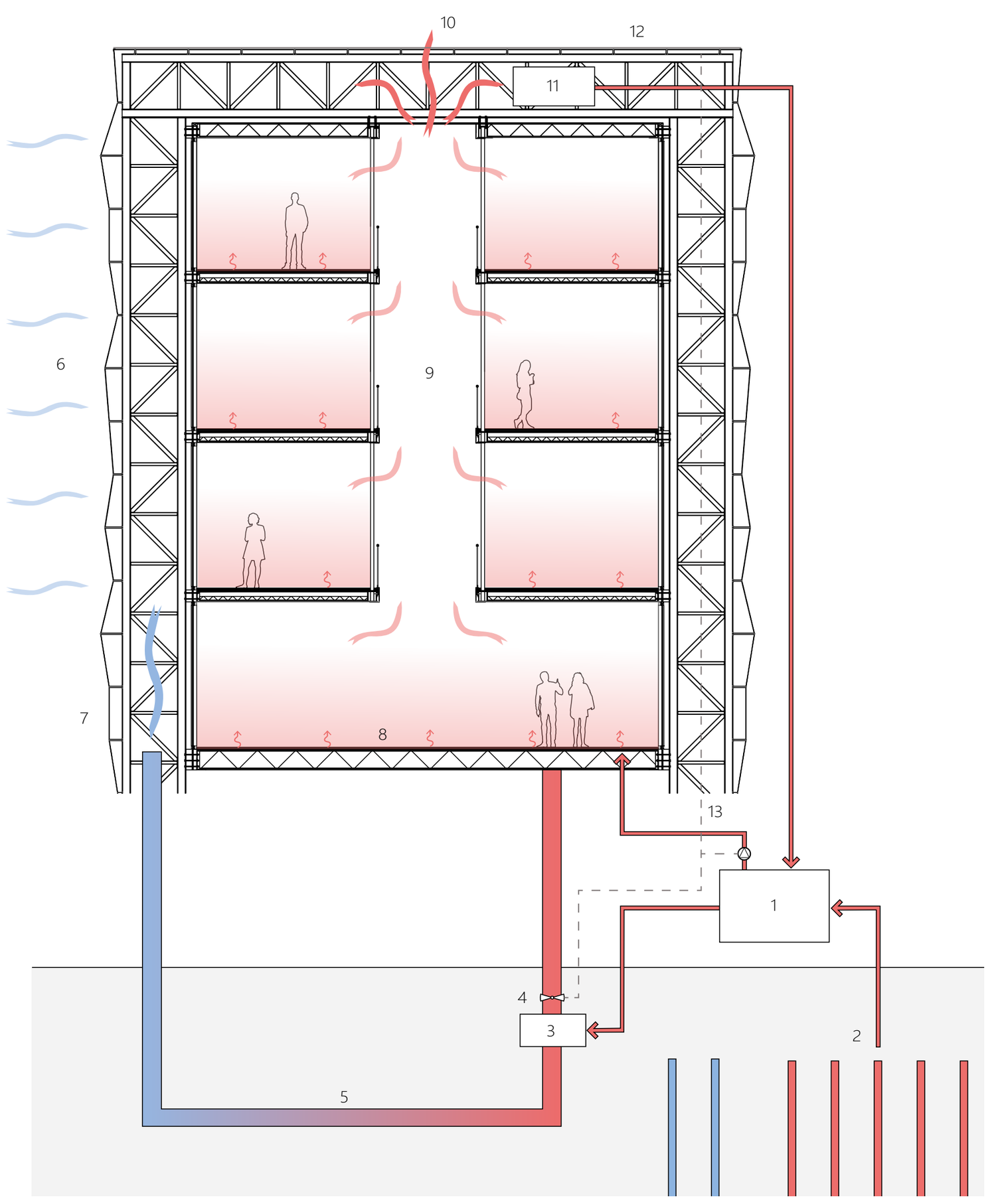
Winter

In the winter cold air passes through the perforated metal panels. The space between the metal panels and the curtain wall functions as a dubble skin facade. The air will go into the earth tube, where it is pre-heated by the ground and through an heat exhanger. The air will be blown into the building. Pressure sensors on the boost fan limit mechanical supply to run only when natural ventilation is not producing enough air flow. The heat store in deep boreholes feeds the underfloor heating.

By using an atrium warm air will rise to the top where it can leave the building. The heat of the exhausted air will flow into a heat recovery element which is connected to the thermal buffer tank.

Electrical energy is generated by photovoltaic cells integrated into the roof structure. This electicity will be used to support the mechnical part of the ventilation system.

1 Thermal buffer tank
2 Deep boreholes to store heat
3 Heat exchange element
4 Boost fan
5 Earth tube
6 Cold air passing through the facade
7 Earth tube inlet
8 Underfloor heating
9 Rising warm air
10 Warm air leaving the building
11 Heat recovery element
12 Photovoltaic cells integretad in roof panels
13 Electric supply



Winter

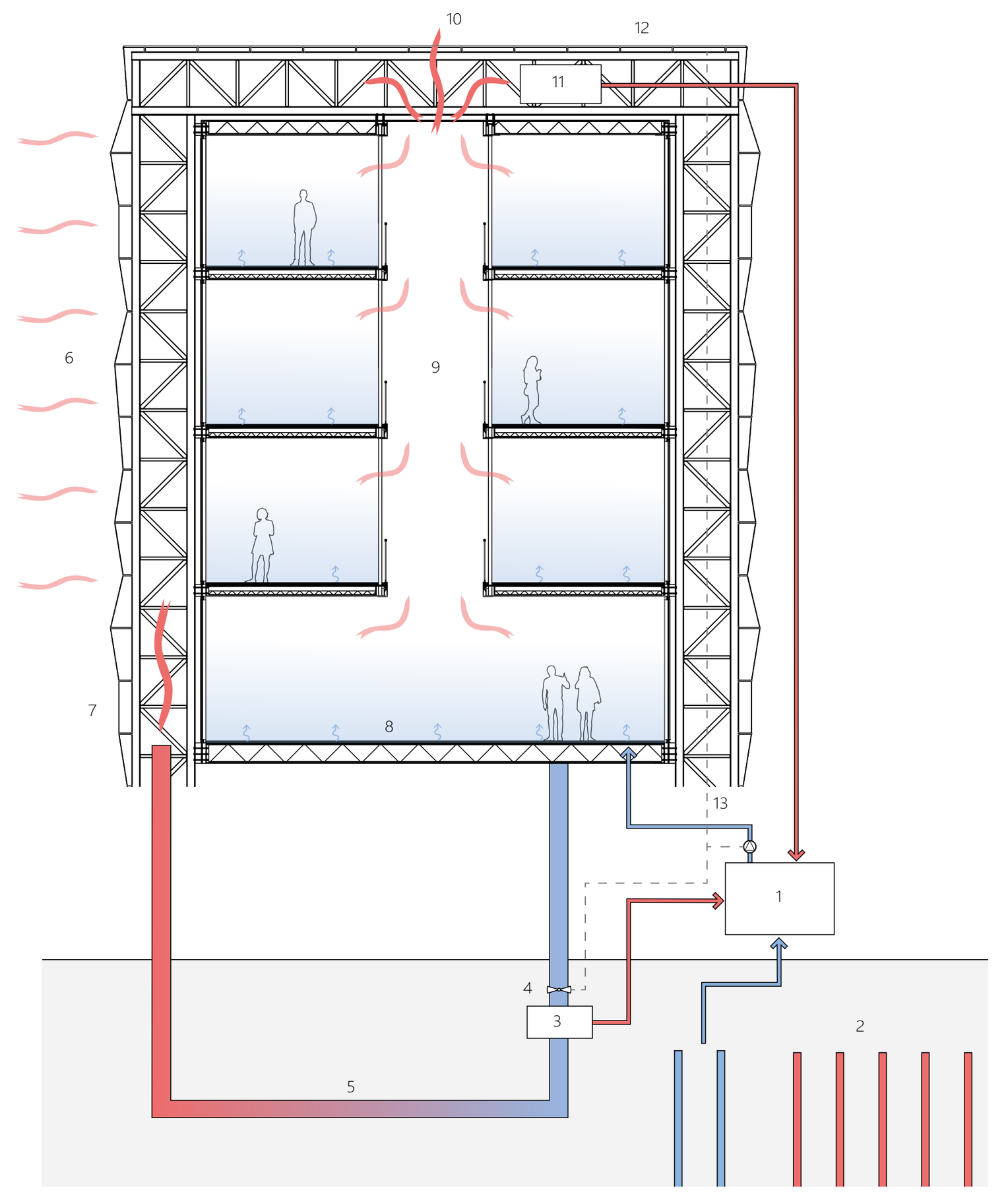
Summer

When the weather is hot, warm air passes through the perforated metal panels. The air will go into the earth tube, where it is cooled by the ground which has a constant temperature of 10 to 12 degrees. The warmth of the air that is released will be stored into the thermal buffer tank. The cold air will cool the building. Using underfloor cooling on every level ensures a pleasant working environment. This cooling is feeded by a cold store in deep boreholes.

Also in summer warm air will rise to the top of the building. To open the skylight warm air will leave the building. The heat of the exhausted air will flow into a heat recovery element which is connected to the thermal buffer tank.

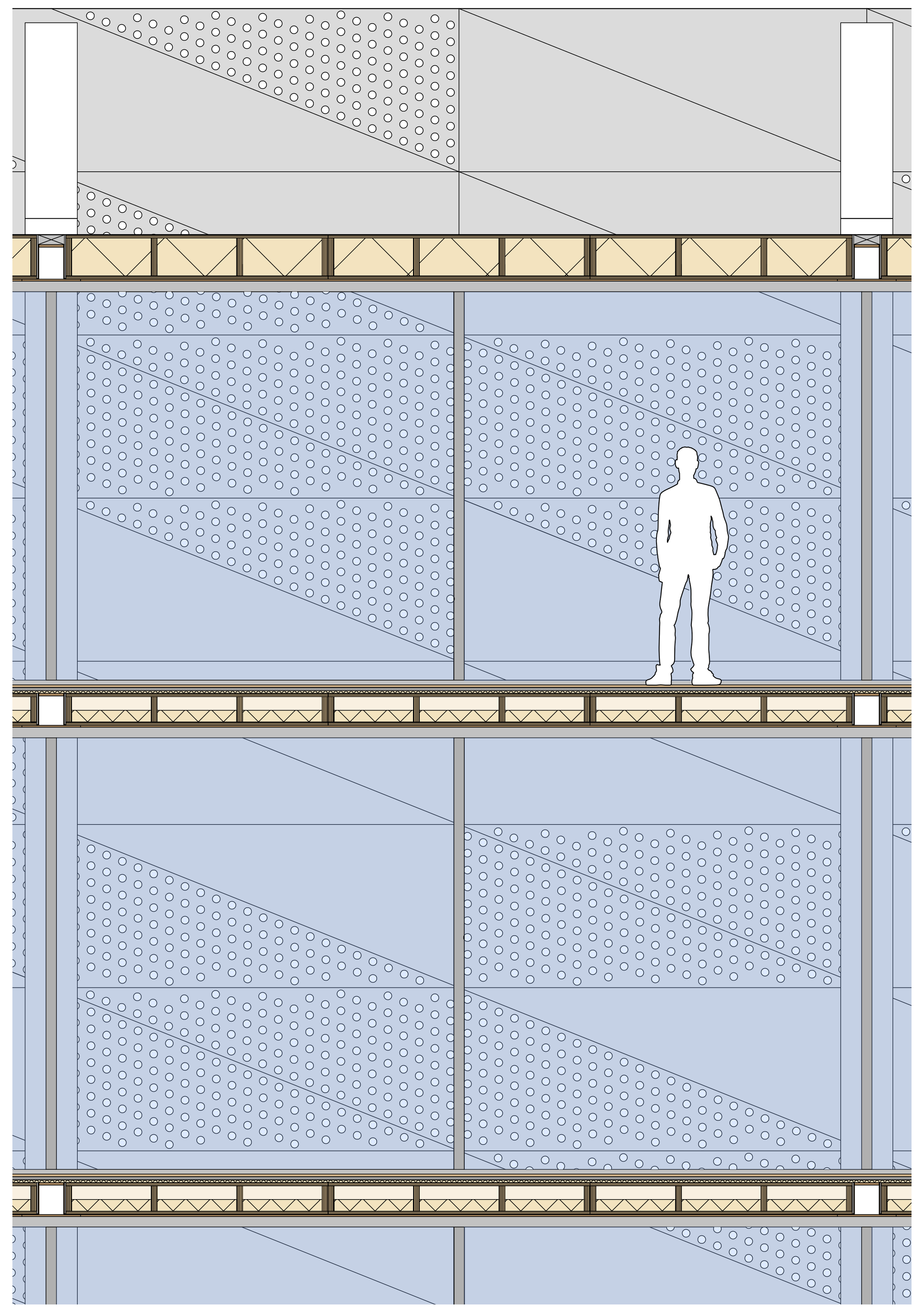
Photovoltaic cells integrated into the roof panels can generate electricity to be used within the building.

1 Thermal buffer tank
2 Deep boreholes to store cold
3 Heat exchange element
4 Boost fan
5 Earth tube
6 Warm air passing through the facade
7 Earth tube inlet
8 Underfloor cooling
9 Rising warm air
10 Warm air leaving the building
11 Heat recovery element
12 Photovoltaic cells integretad in roof panels
13 Electric supply

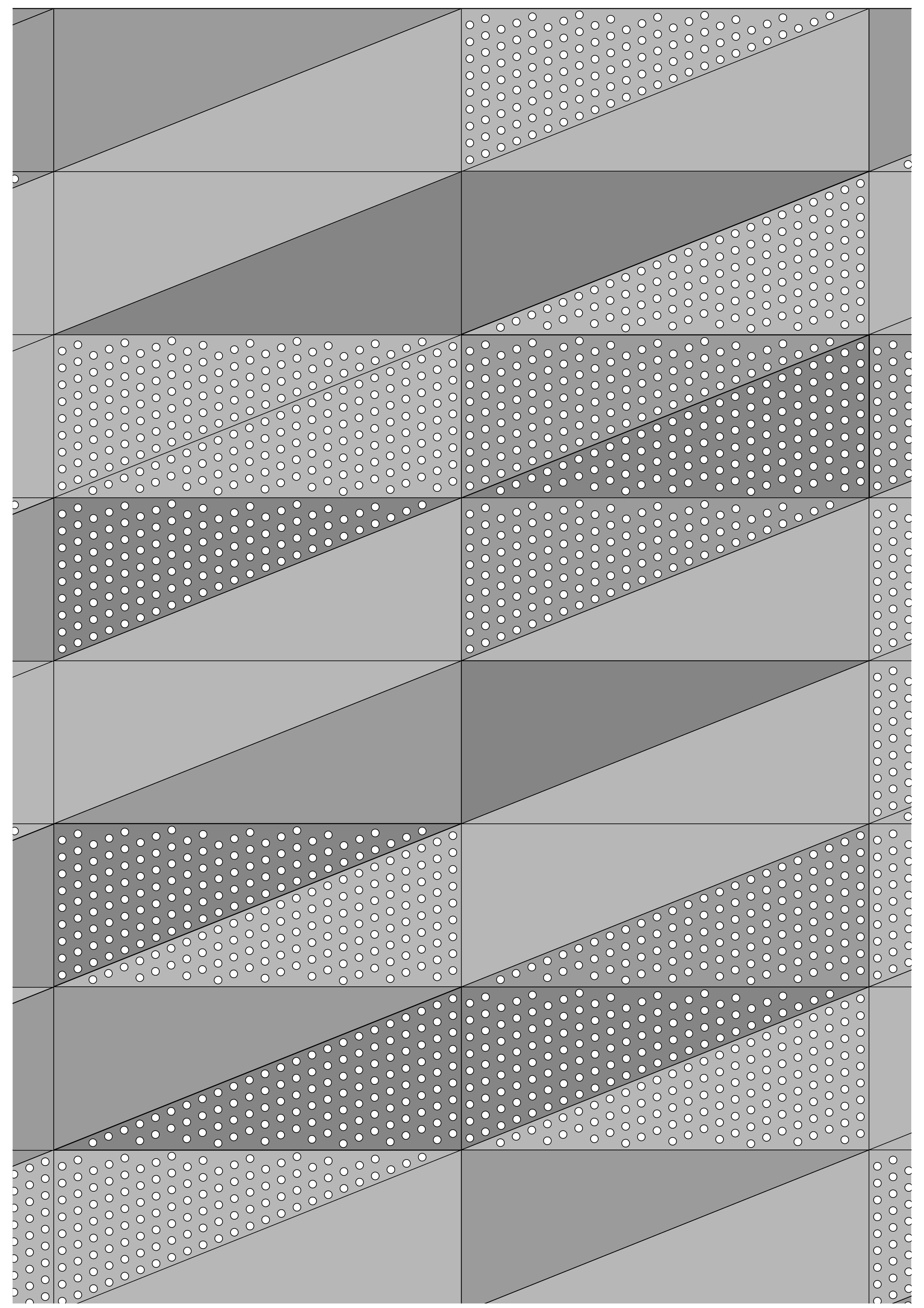


Summer

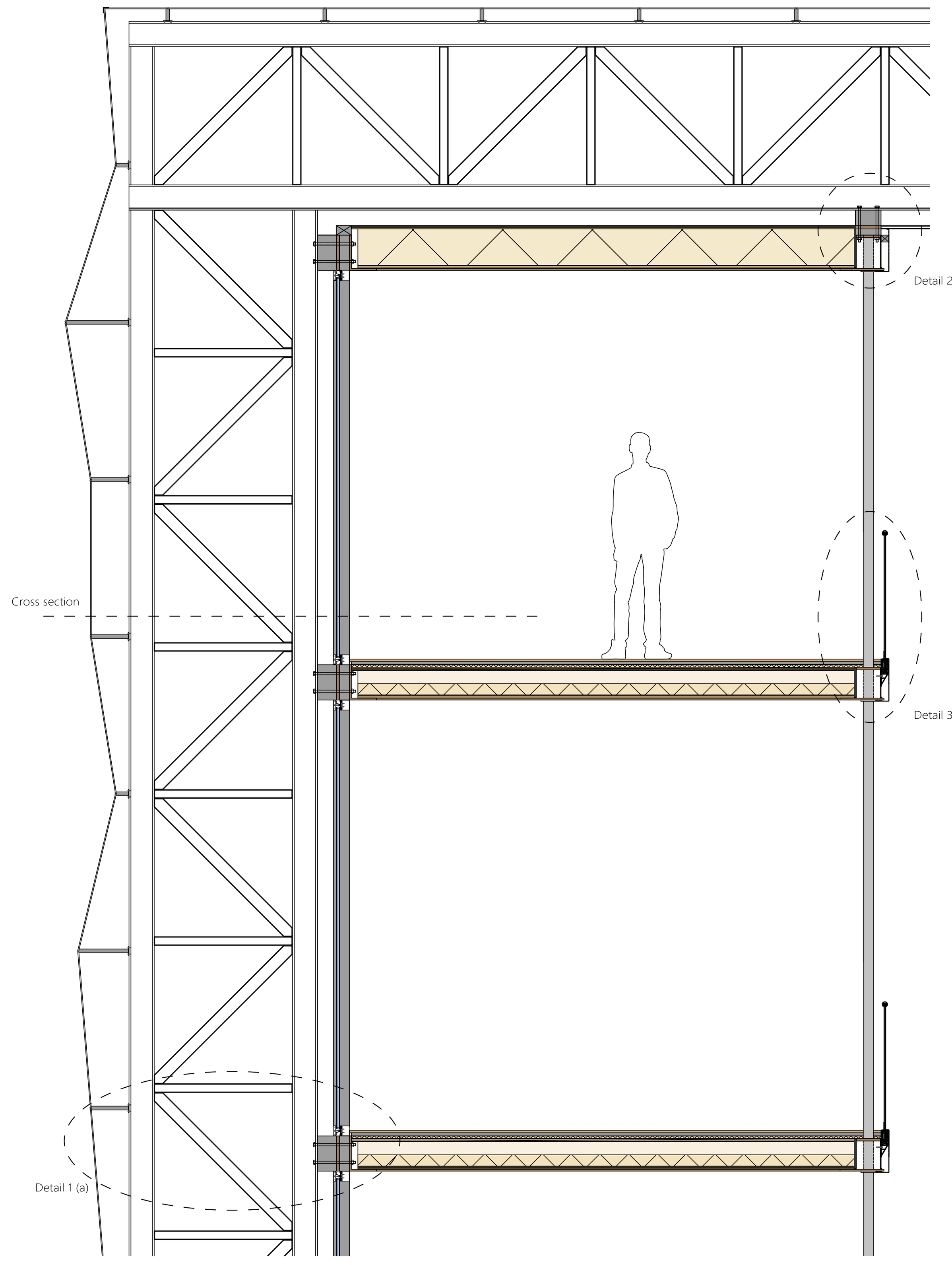
Internal facade — scale 1 : 20



External facade — scale 1 : 20

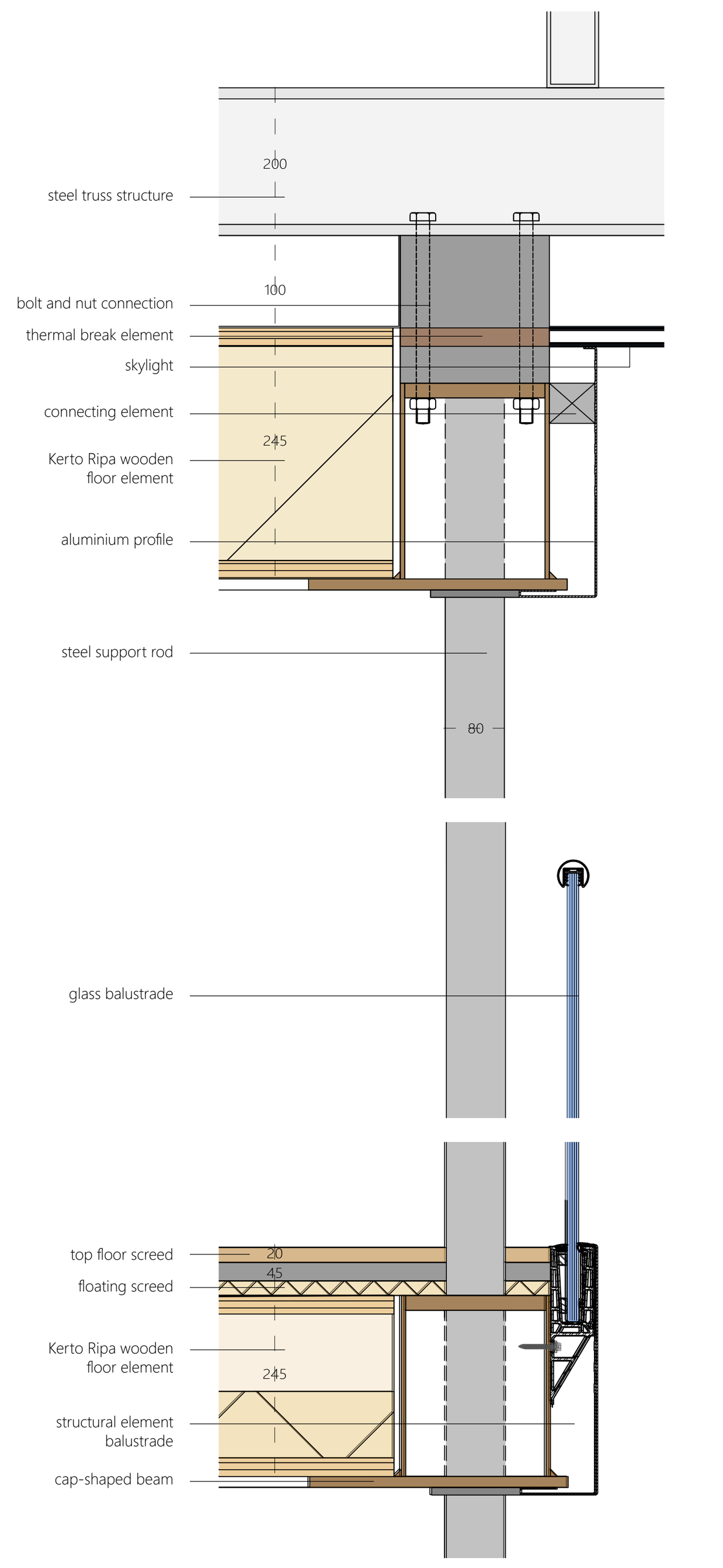


Longitudinal section — scale 1 : 20



Building Fragment

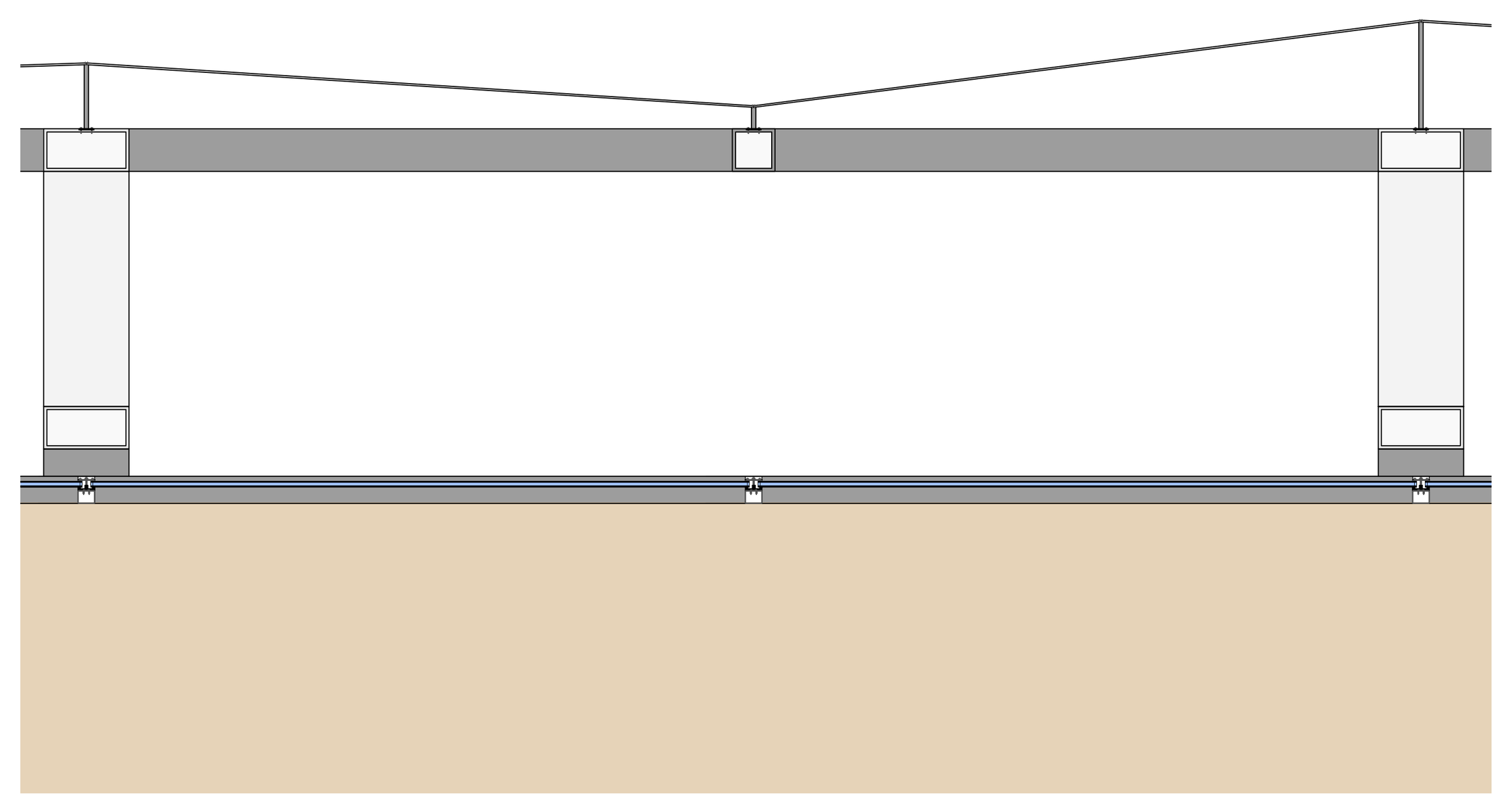
Detail 2 — scale 1 : 5



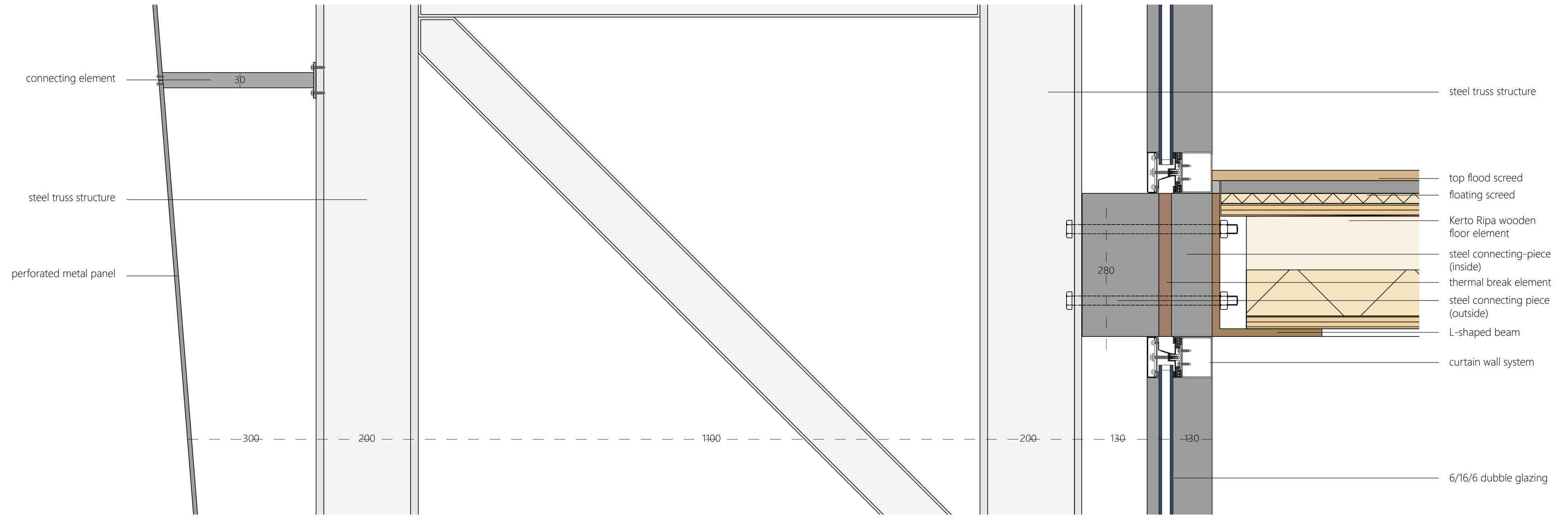
steel truss structure
bolt and nut connection
thermal break element
skylight
connecting element
Kerto Ripa wooden floor element
aluminium profile
steel support rod
glass balustrade
top floor screed
floating screed
Kerto Ripa wooden floor element
structural element balustrade
cap-shaped beam
200
100
245
80
20
45

Detail 3 — scale 1 : 5

Cross section and floorplan — scale 1 : 20

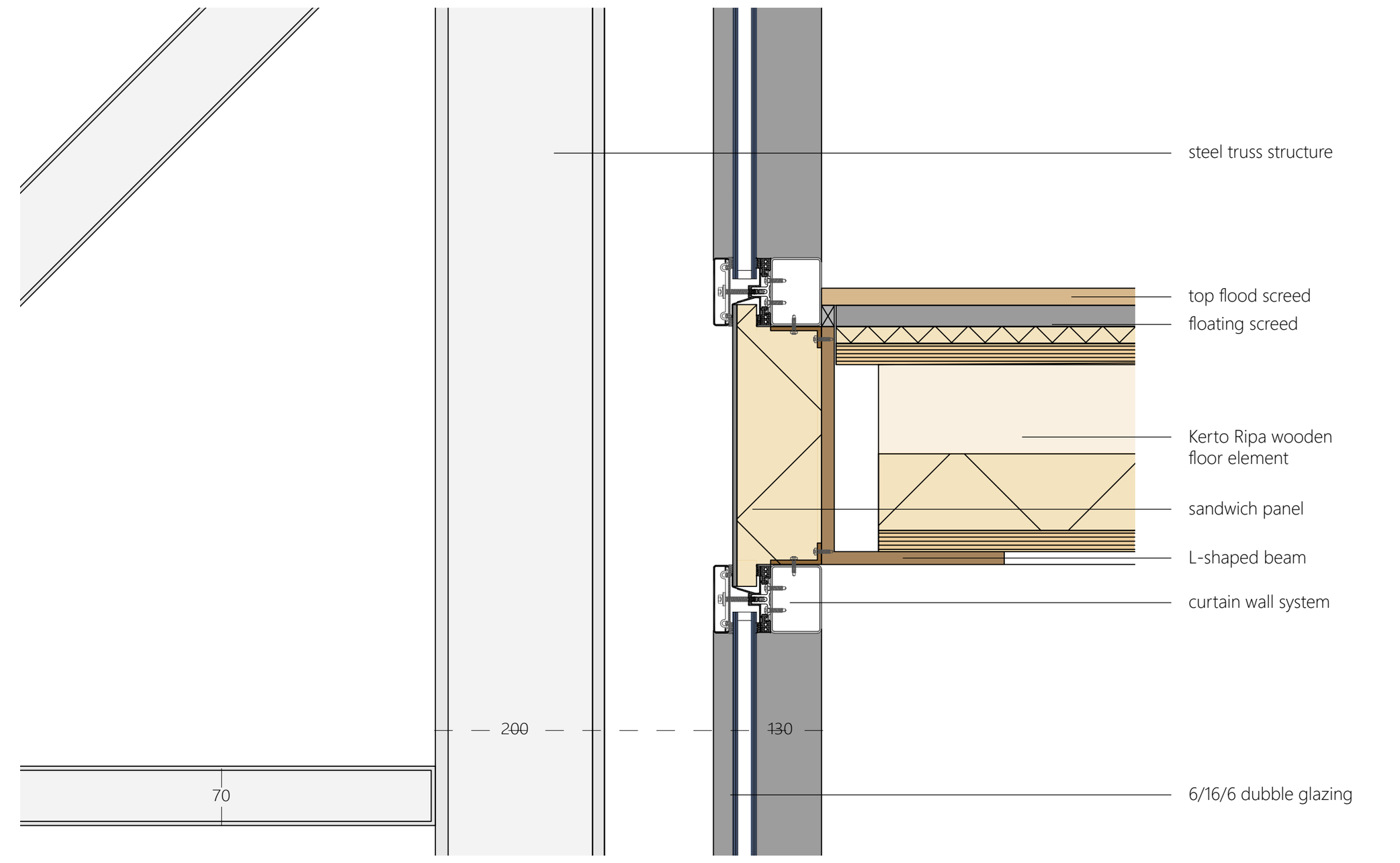


Detail 1 — scale 1 : 5



connecting element
steel truss structure
perforated metal panel
steel truss structure
top flood screed
floating screed
Kerto Ripa wooden floor element
steel connecting-piece (inside)
thermal break element
steel connecting piece (outside)
L-shaped beam
curtain wall system
6/16/6 dubble glazing
280
200
130

Detail 1a — scale 1 : 5



DELFT SEMINARS ON BUILDING TECHNOLOGY - LIGHTNESS

(AR1A075) 2017/18-Q1 | FINAL PRESENTATION | NAi ROTTERDAM | DAPHNE HOMAN | 4369637 | GROUP 20 | HERMEN SMELT