

Manual

MSc4 Building Technology Report

Gizmo

The Theatre of Automation in the
post-labour society of Hammerfest,
Norway.

MSc4 Building Technology Report

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Transitional Territories Studio 2019-2020

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Abstract

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Abstract

The following booklet is part of a series of three volumes that collects and presents the story of the project 'Gizmo. The Theatre of Automation', developed within the framework of the Transitional Territories Studio 2019-20 and flourished under the particular conditions of the pandemic.

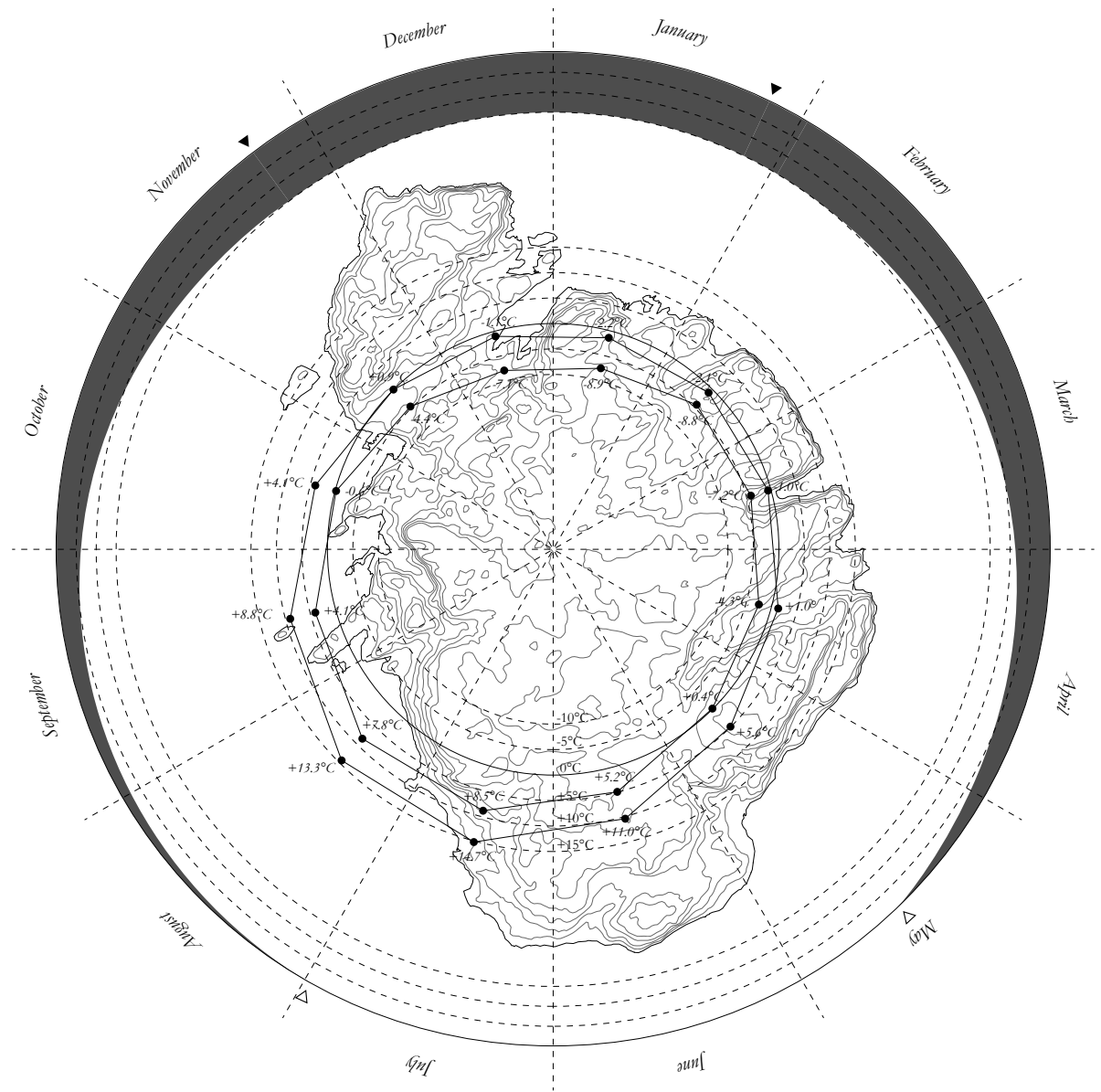
The Manual attempts to clarify the 'backstage' of the project, as the fundamental spine that allows the performance to emotionally move the audience. As essential component of the design process, the Machinery of the Theatre is hereby divided and analysed according to four technological aspects, from structural and climate solutions, to façades and technical details.

Only through the accordance of these four components can the social and cultural aspect of the project evolve into the physical transformation of the site. Similar to an old medieval water clock, the 'gizmos' of the Theatre measures the pace of changes, interpolating the urgency of human *artifex* with the rhythm of natural systems.

Key words: theatre, automation, machine, collective memory, new society

Hammerfest 70° 41' N 23° 44' E

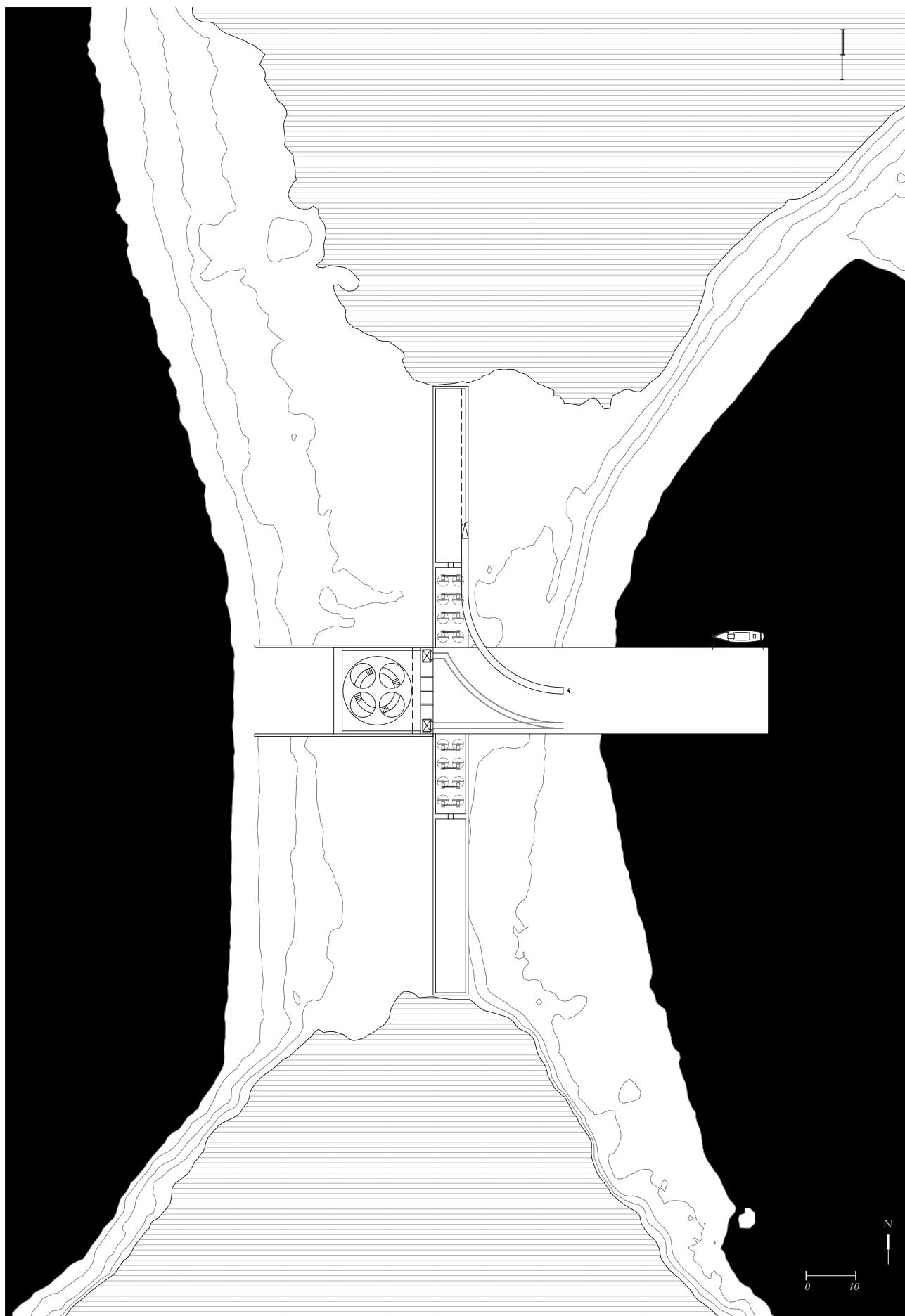
Sunlight and mean temperatures in Hammerfest over the year. The polar night is from 20th of November to 22nd of January, while from the 16th of May to the 29th of July the sun never sets.

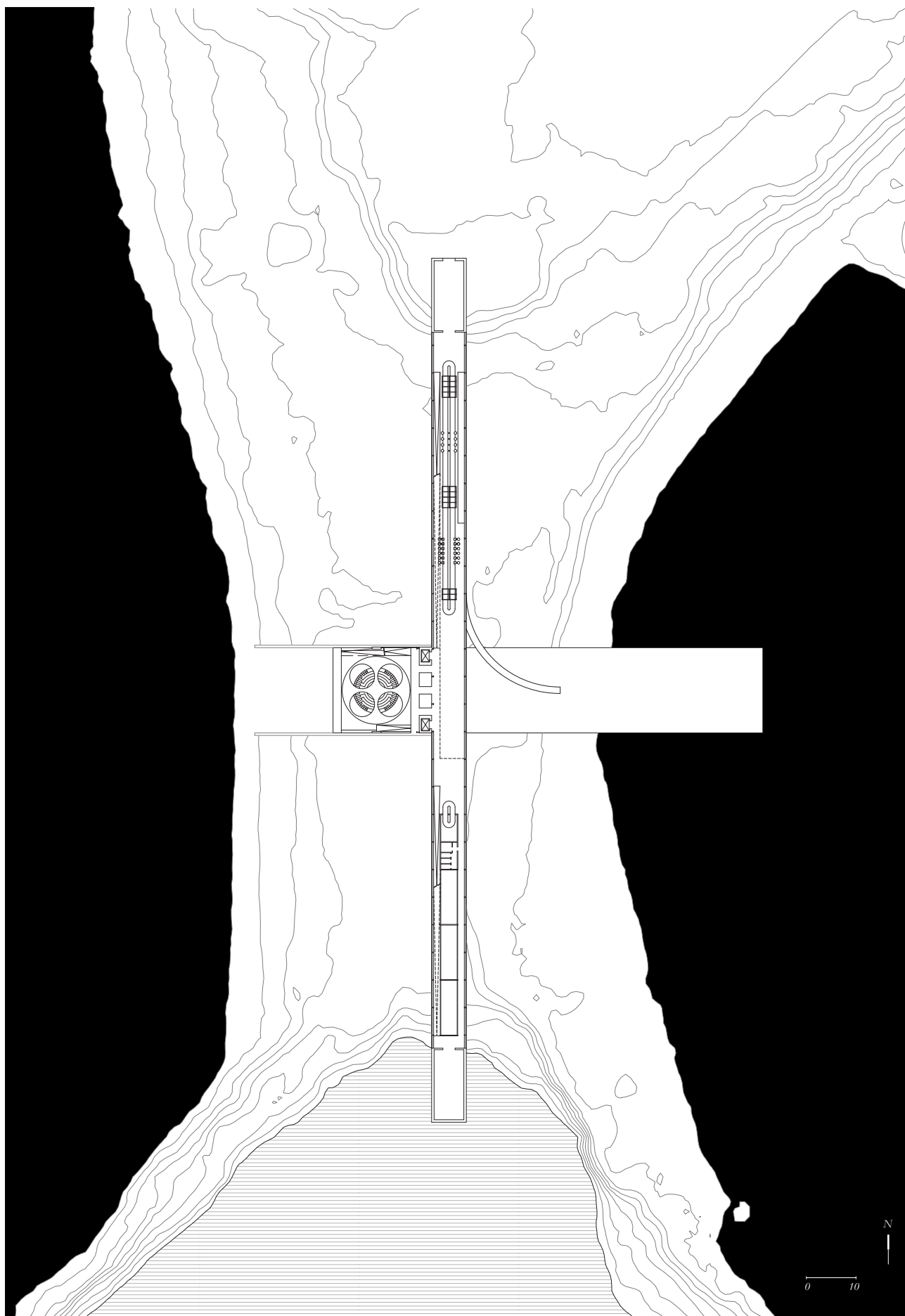


Caption or title of the image

Scale
Source

- 01 Legend
- 02 Legend
- 03 Legend
- 04 Legend
- 05 Legend etc.





I.

Structure

Structural Scheme

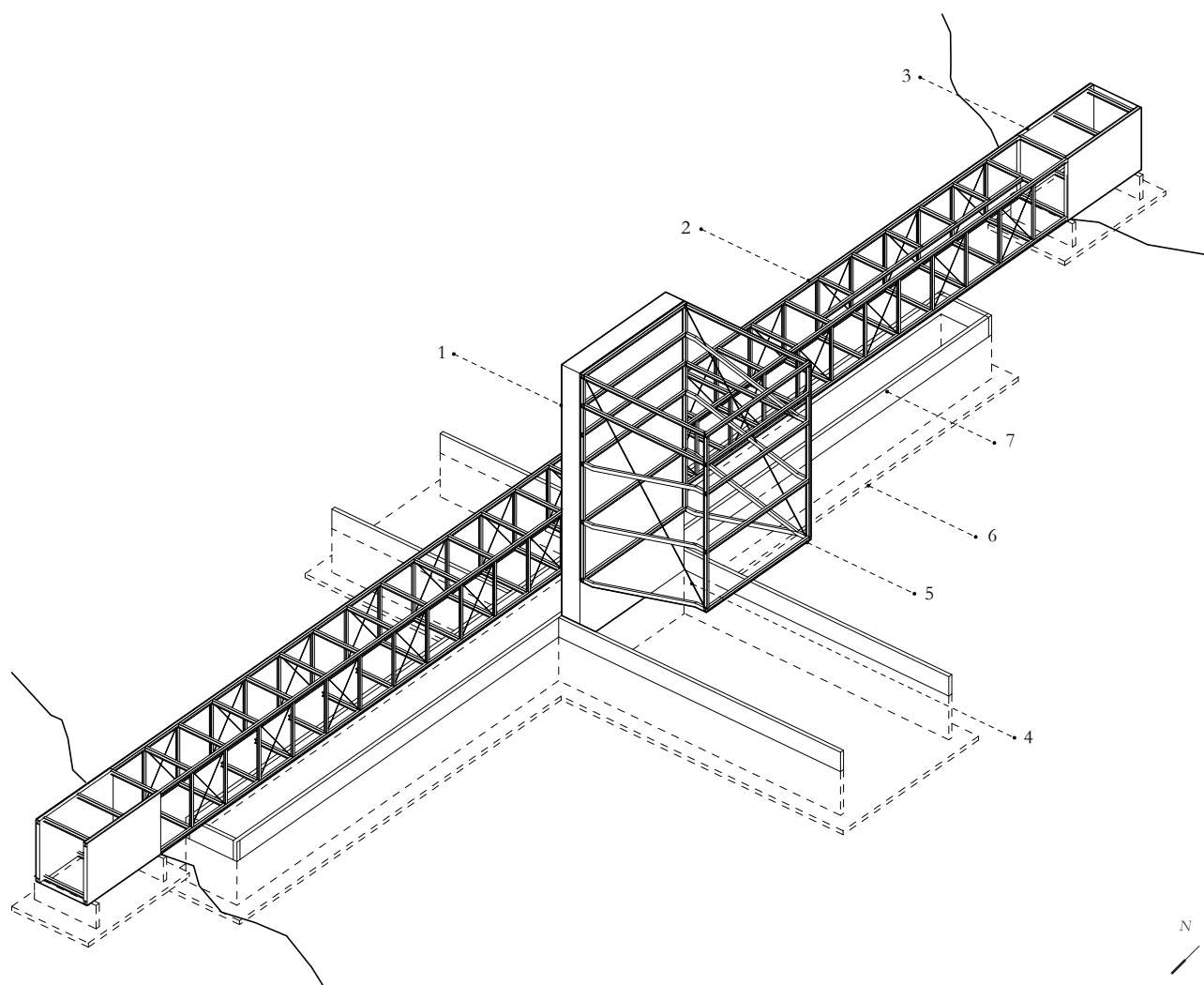
The structure of the project can be divided into three components.

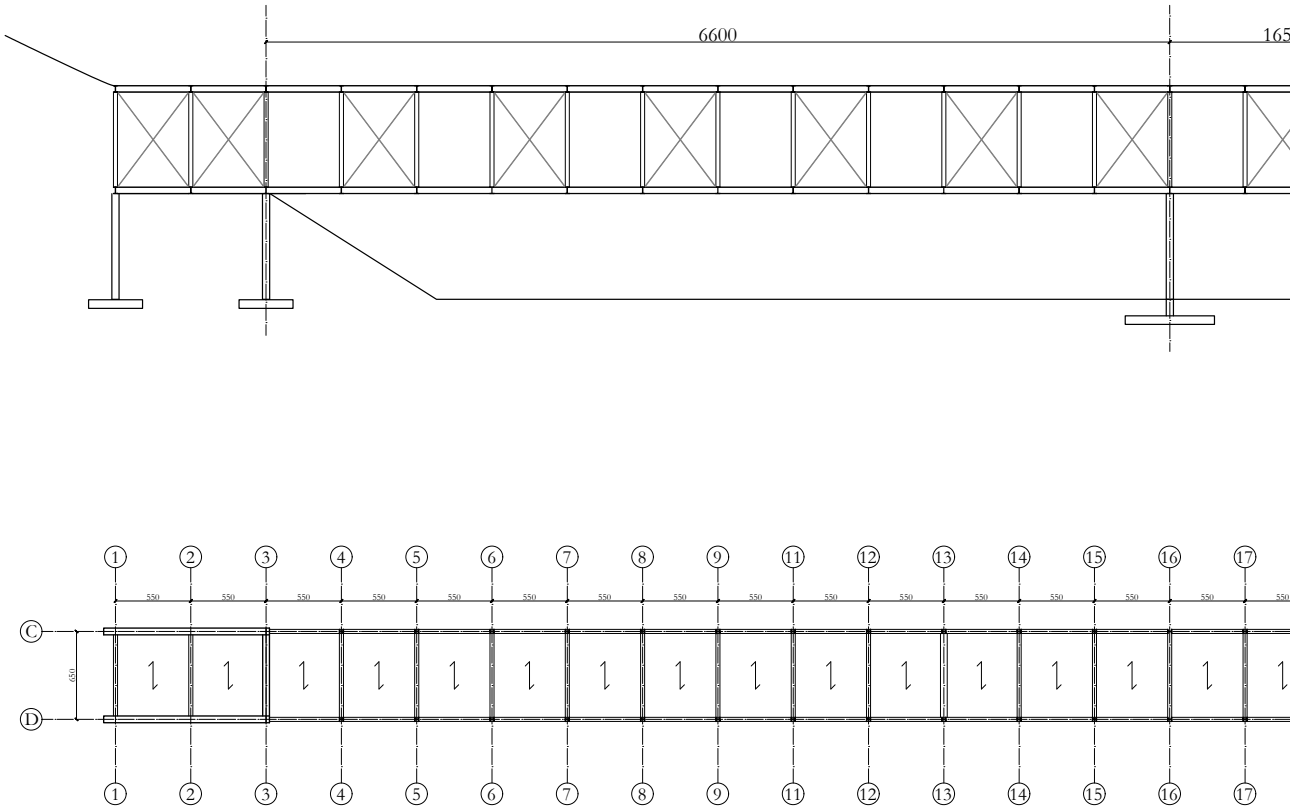
The slender element of the bar stretches across the landscape formation, hold by the steel truss-structure. As a bridge, the structure is anchored at the edges with concrete walls and supported in the middle by two concrete elements, attached to the shear wall. Braces guarantee the stability of the structure.

The shear wall indeed represents the second structural component, that accommodates the vertical distribution of props inside the theatre.

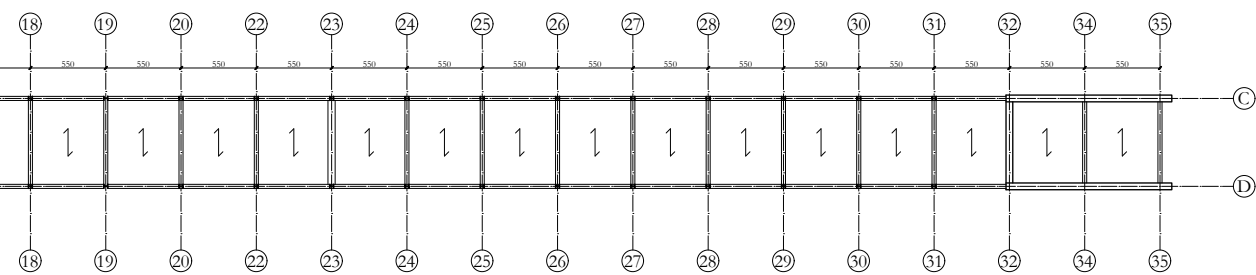
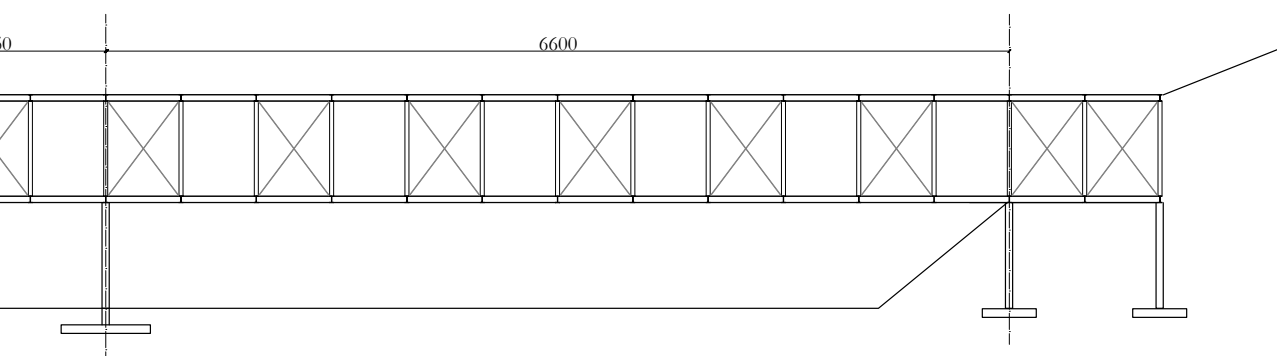
The cantilevered fly tower is the third main structural object and it is supported by the shear wall, that, for this reason, has to dig down in the ground and to be provided with a counterbalanced platform foundation. The stability of the tower is enhanced by two bracing cables.

- 01 shear wall
- 02 bar/truss
- 03 concrete wall / bar foundation
- 04 bracing
- 05 tower
- 06 foundations
- 07 retaining walls for water storage





Structure: Bar
Scale 1:500

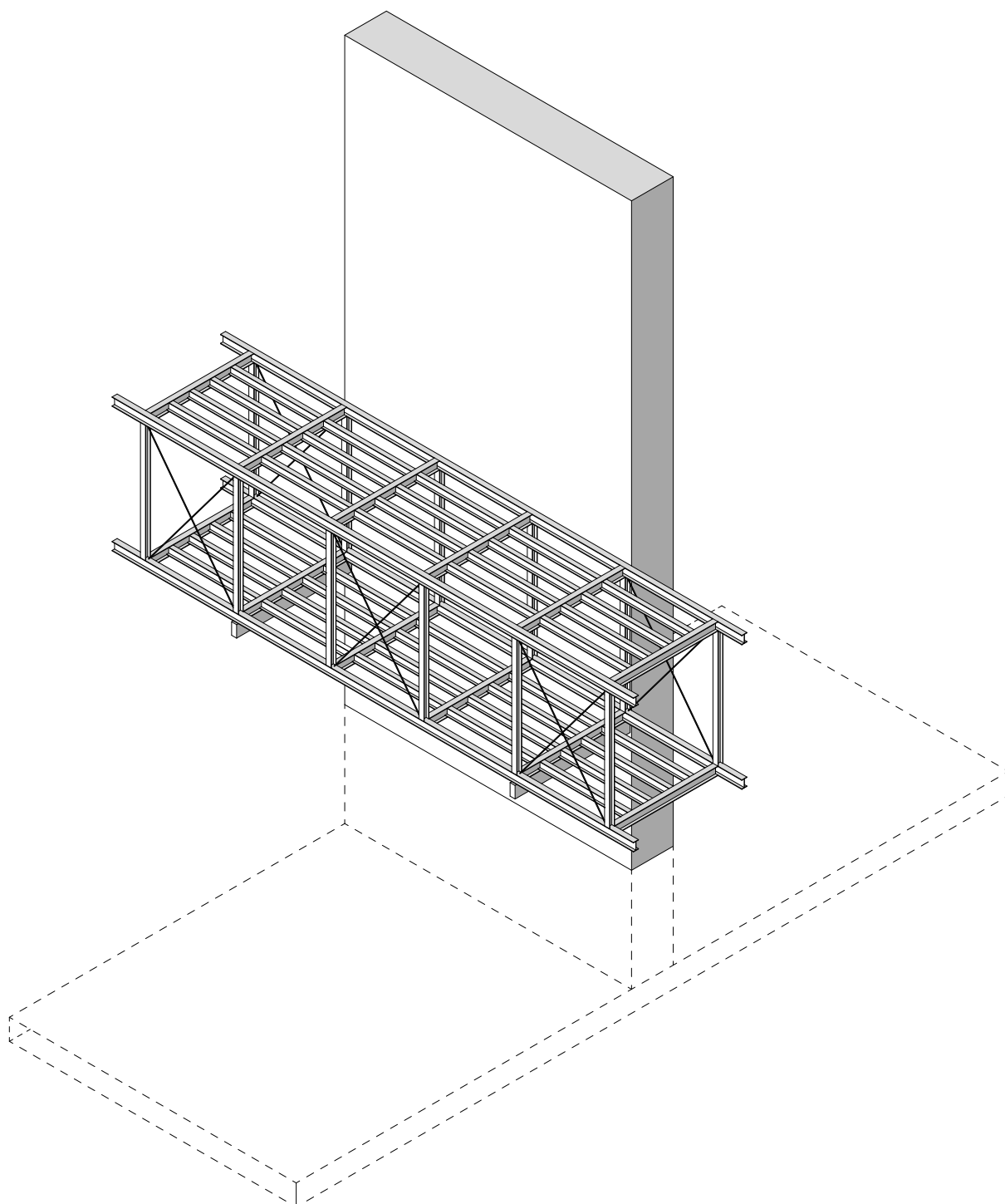


Structure: Bar

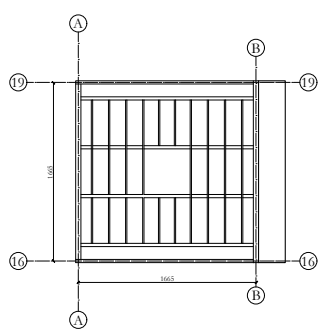
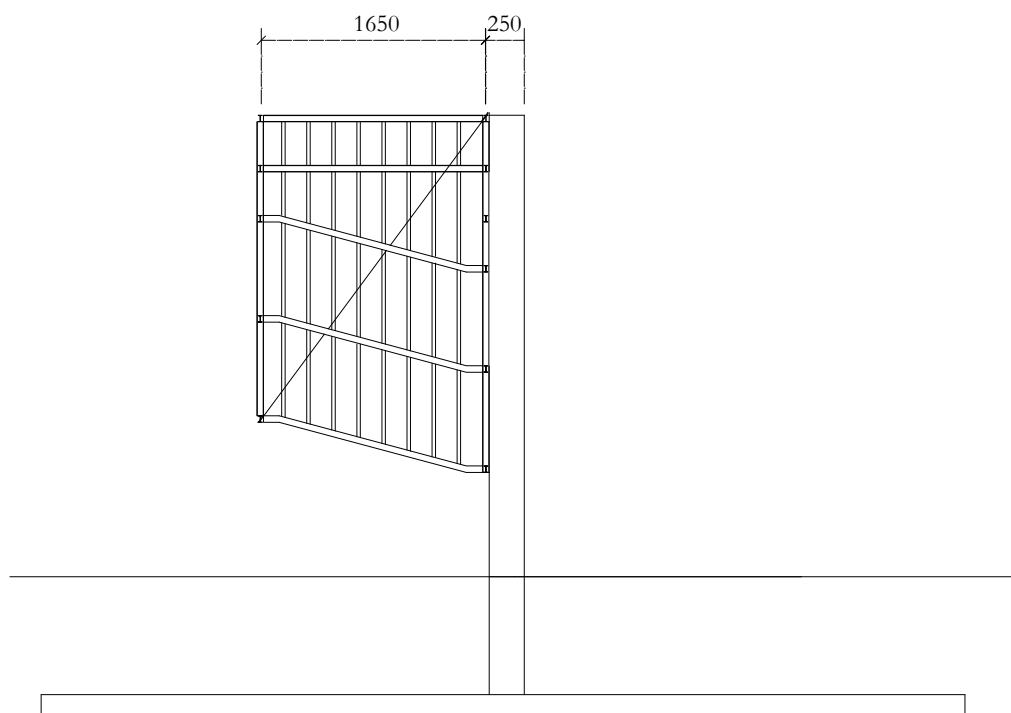
The diagram shows a portion of the steel truss at its connection with the shear wall. Two concrete beams hold the bar in the middle of its length, adding support besides the anchoring at the edges.

The truss is constituted by HEA 500 elements for the main beams, HEA 300 for the secondary ones and for the columns and HEB 200 for the third order of beams. Braces enhance the stability of the structure against horizontal forces.

The simple, repetitive structure frames the landscape and provide a unitary, uninterrupted interior space, where activities related to the preparation to the performance and to the accommodation of the actors can take place.



N



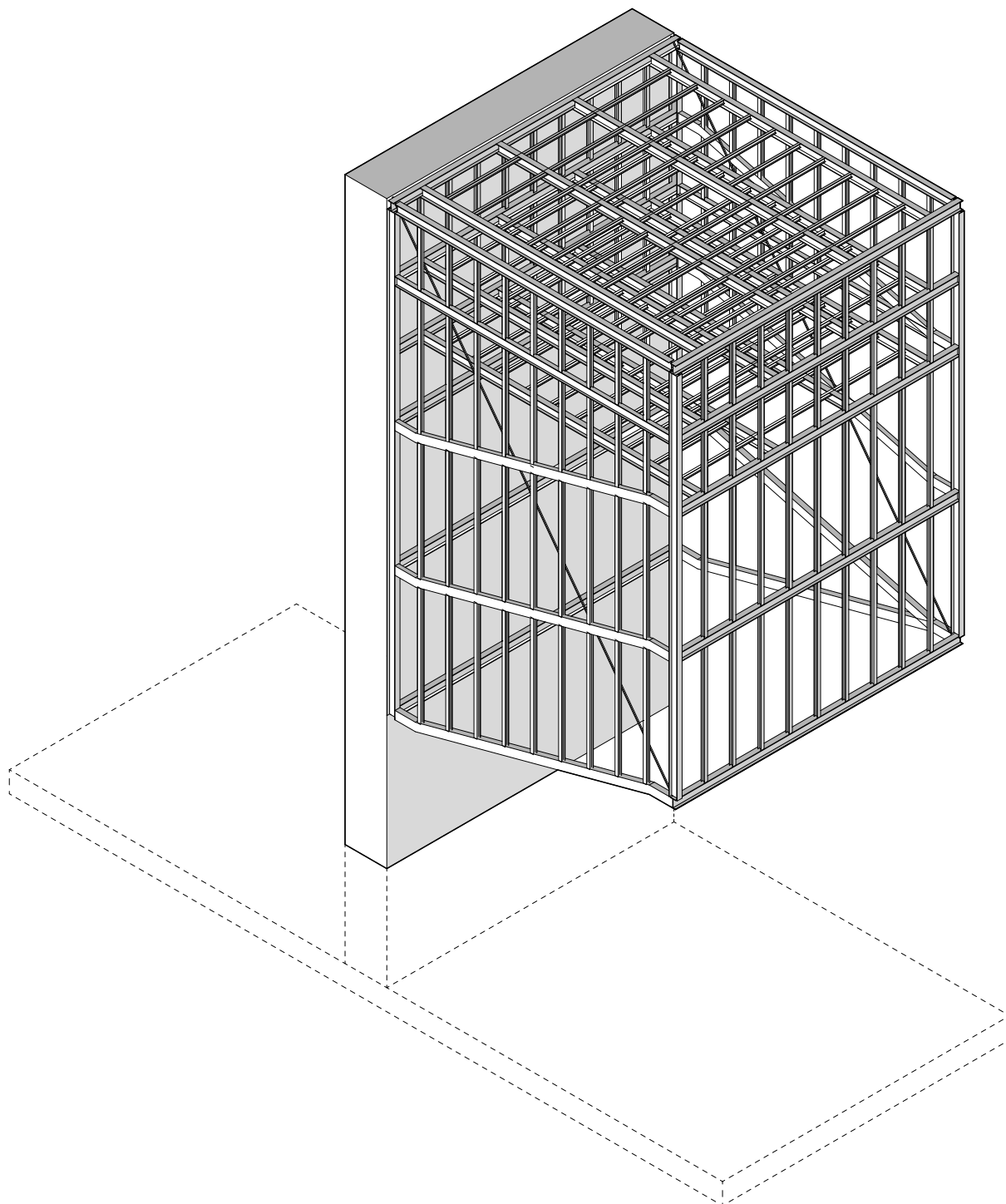
Structure: Tower

The diagram shows the steel structure of the tower at its connection with the shear wall.

The cantilevered structure of the fly tower is composed by diagonal steel profiles, that bring the loads to the shear wall, and vertical columns that connect the different levels.

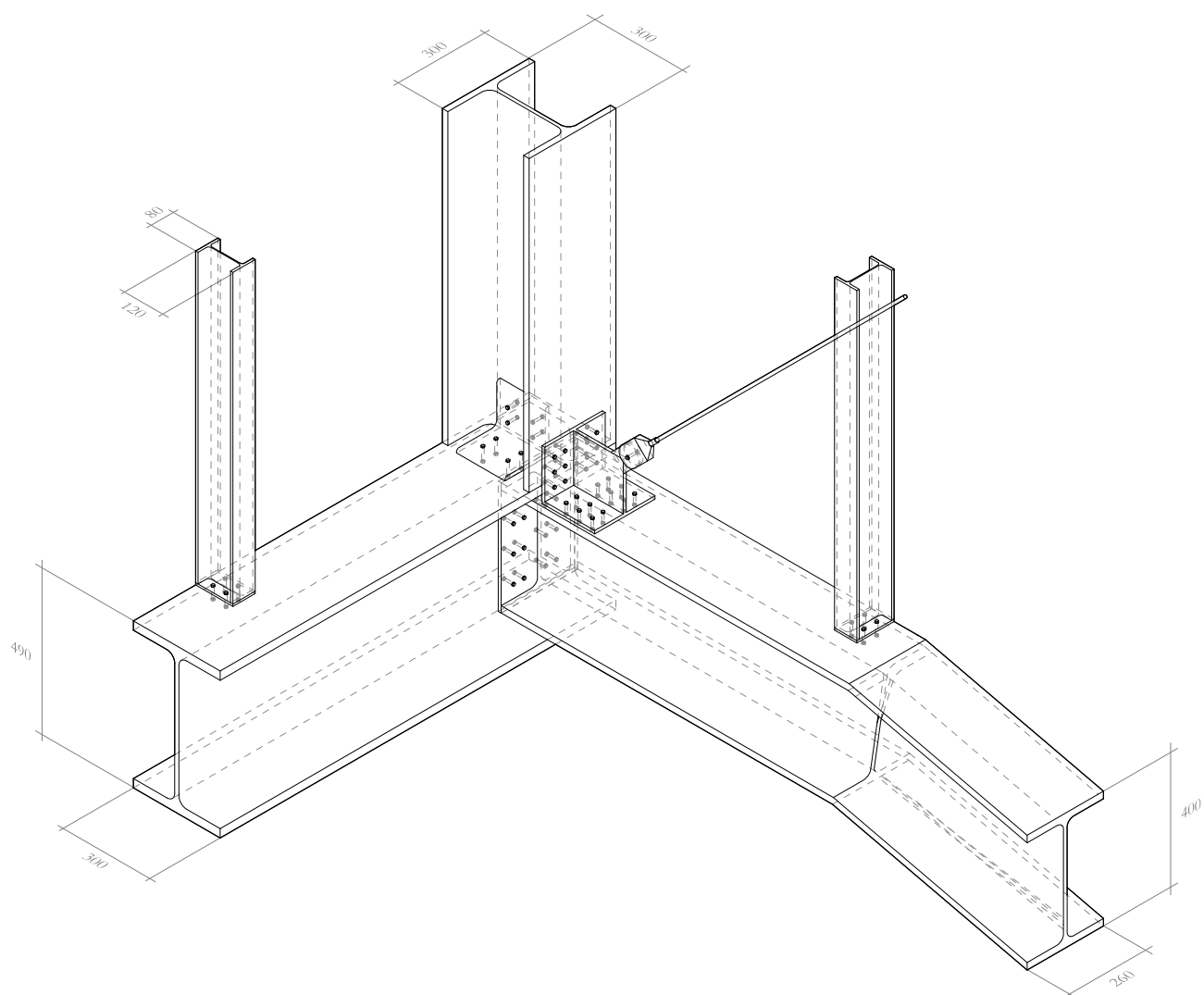
The belt truss is constituted by HEA 500 elements for the main beams and HEA 300 for the columns. HEB 120 are used as secondary order of columns. Two braces allow the resistance of the structure against gravitational forces, while the frame of the slabs enhances its stability against horizontal forces.

The particular structure provides a unitary, uninterrupted enclosed space, where the stage tower and the performance-related activities can be accommodated. Moreover, open on the exterior, it allows the free movement of the floating stage underneath.



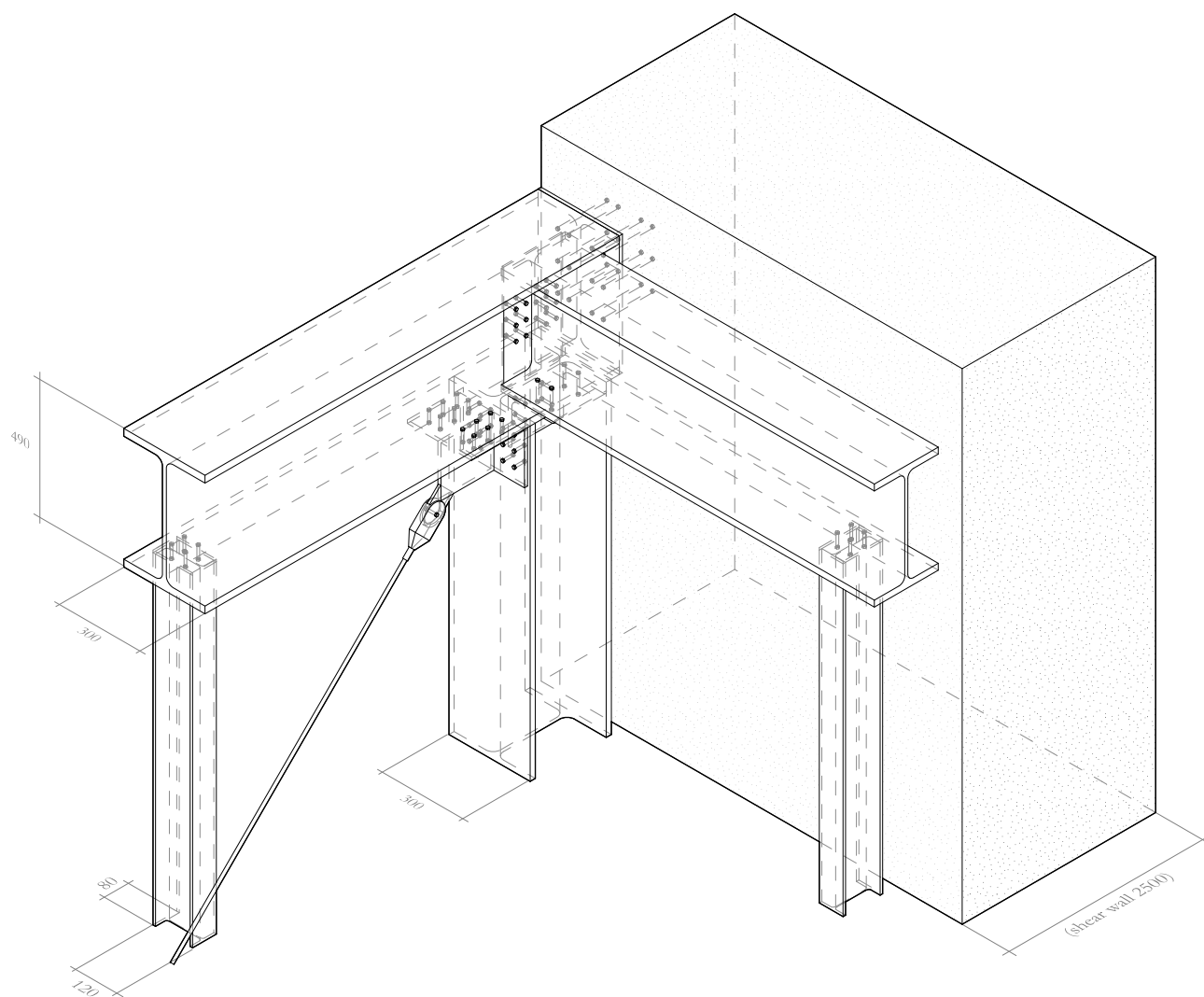
Structural joint 1

Scale 1:20



Structural joint 2

Scale 1:20



II.

Climate

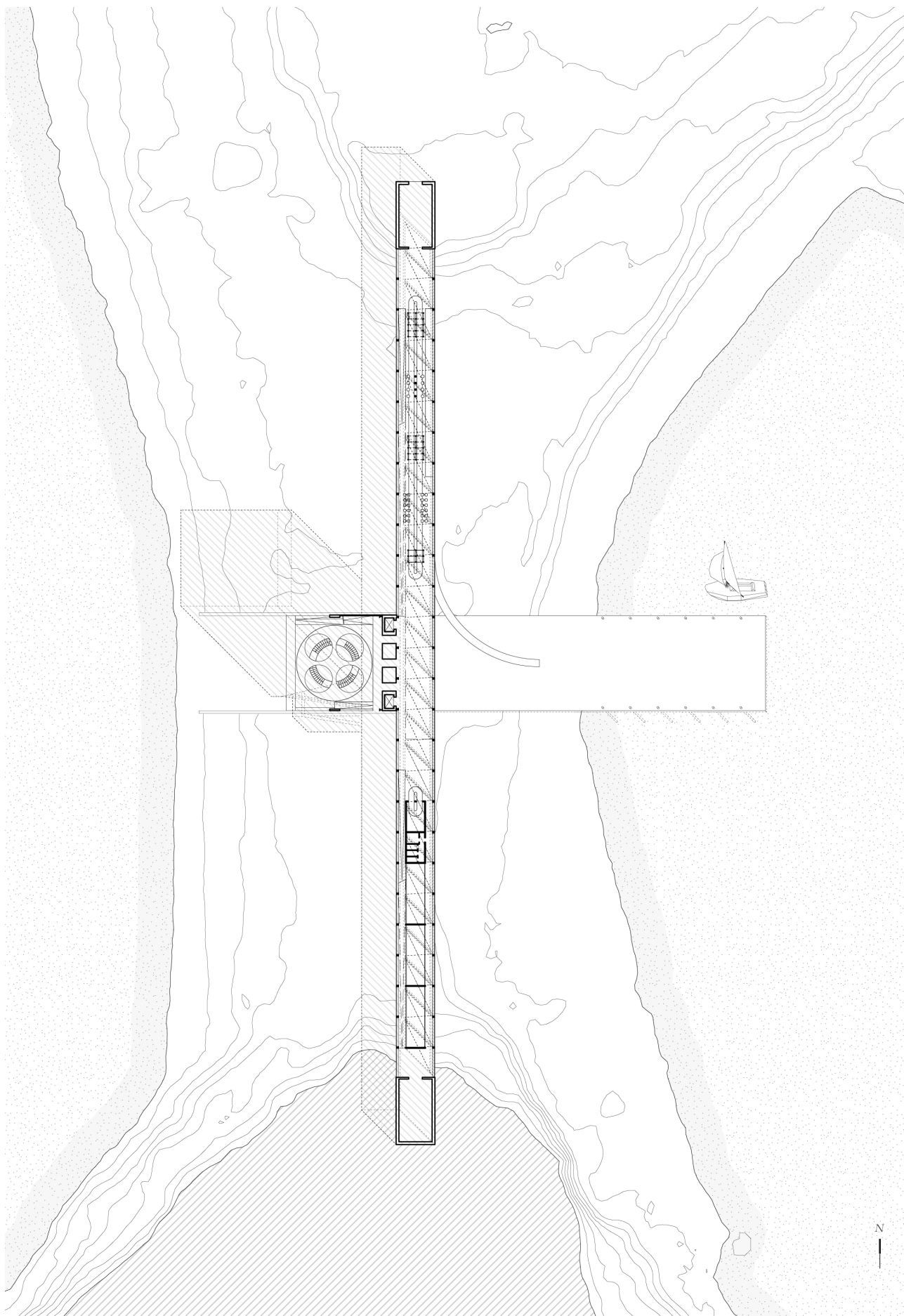
2.1. Climate Scheme

The island of Hammerfest, at 70° N, has a subarctic climate, characterised by long cold winters and cool to mild summers. Due to the latitude, the natural light conditions are peculiar. From the 20th of November to the 22nd of January, in the long polar night, the sun never rises, while it barely touches the horizon from the 16th of May to the 29th of July.

Nonetheless, in spite of the harsh conditions, public life still takes place in the outside space, and the connection with the exterior is an essential element for the community. The difficult beauty of snow and the ever-changing nature of the landscape strengthen the human relations, that have to cooperate.

The greatest challenge of the project is therefore to create the conditions for the spectacle of the landscape, in its undergoing processes of automation, providing a comfortable indoor climate while allowing the performance to happen in the outside space. The bare human body of the actors are put in dialogue with the movement of the tides, under the cold unfavourable climate of the Arctic.

For this reason, the climate strategy of the project develops along two main lines. Two schemes are adopted, in response to the different particular uses and experiences in the intervention. The bar and the tower, as for the structural scheme, while part of the same theatrical machine, have two different characters.



Indoor Climate

Despite the difference in latitude, the city of Kiruna, in Sweden, can be taken as reference location for climatic investigation on the software Climate Consultant.

Source: <https://energyplus.net>

LOCATION: KIRUNA, -, SWE

Latitude/Longitude: 67.82° North, 20.33° East, **Time Zone from Greenwich** 1

Data Source: IWE C Data 020440 WMO Station Number, **Elevation** 452 m

RELATIVE HUMIDITY

DESIGN STRATEGIES: JANUARY through DECEMBER

0.4% 1 Comfort(37 hrs)

2 Sun Shading of Windows(0 hrs)

3 High Thermal Mass(0 hrs)

4 High Thermal Mass Night Flushed(0 hrs)

5 Direct Evaporative Cooling(0 hrs)

6 Two-Stage Evaporative Cooling(0 hrs)

7 Natural Ventilation Cooling(0 hrs)

8 Fan-Forced Ventilation Cooling(0 hrs)

7.5% 9 Internal Heat Gain(659 hrs)

10 Passive Solar Direct Gain Low Mass(0 hrs)

3.5% 11 Passive Solar Direct Gain High Mass(310 hrs)

4.6% 12 Wind Protection of Outdoor Spaces(405 hrs)

13 Humidification Only(0 hrs)

14 Dehumidification Only(0 hrs)

15 Cooling, add Dehumidification if needed(0 hrs)

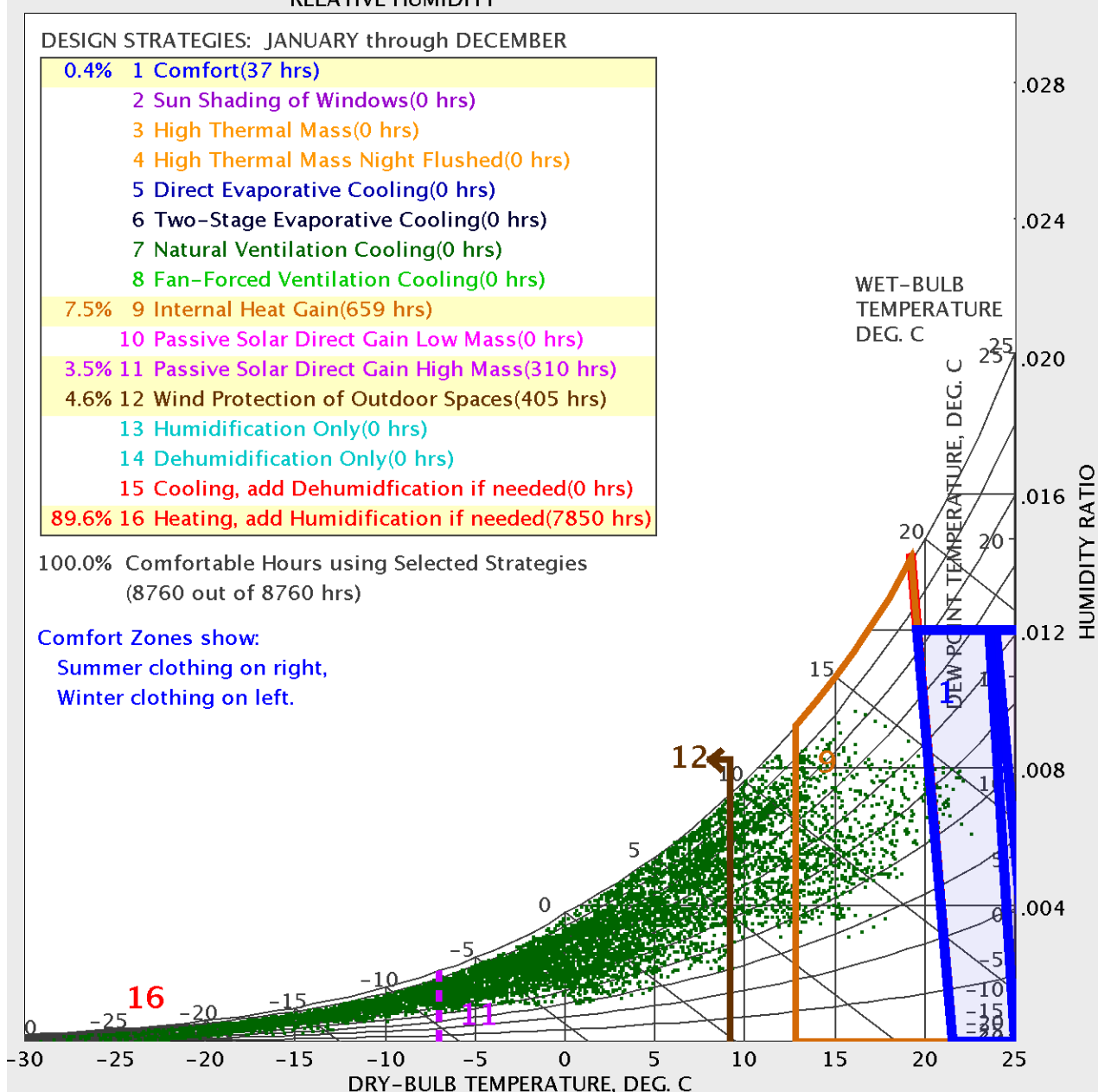
89.6% 16 Heating, add Humidification if needed(7850 hrs)

100.0% Comfortable Hours using Selected Strategies
(8760 out of 8760 hrs)

Comfort Zones show:

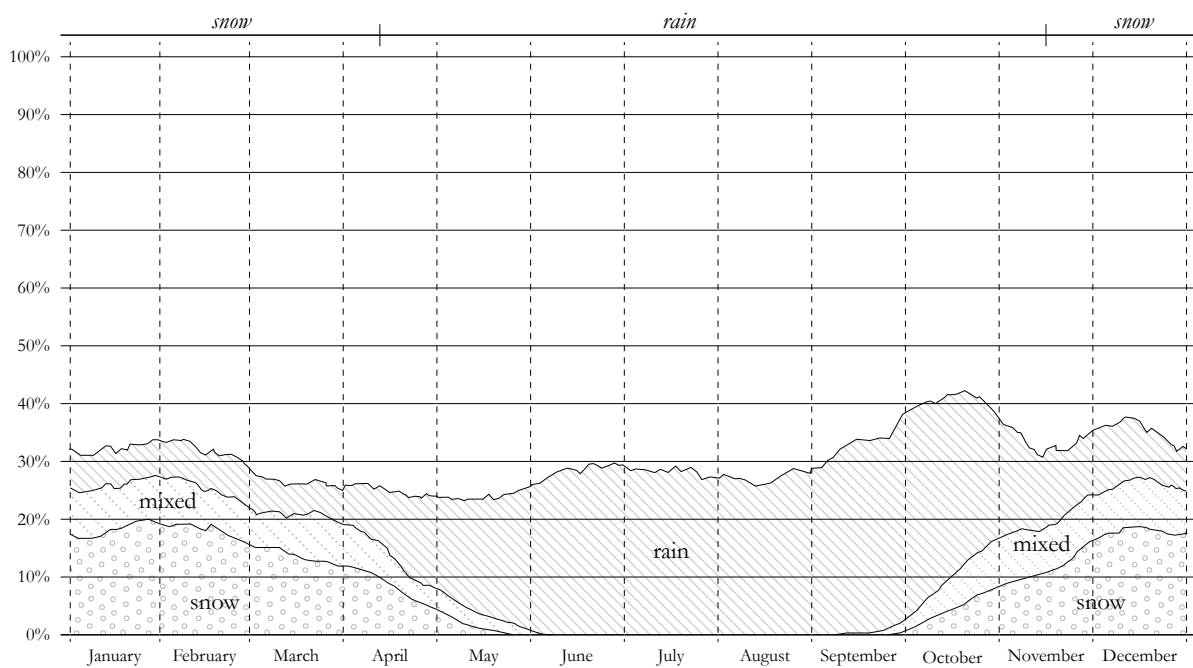
Summer clothing on right,

Winter clothing on left.



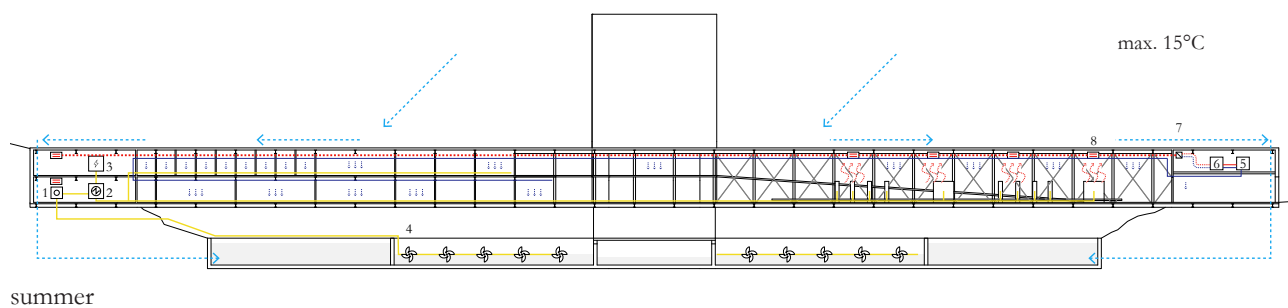
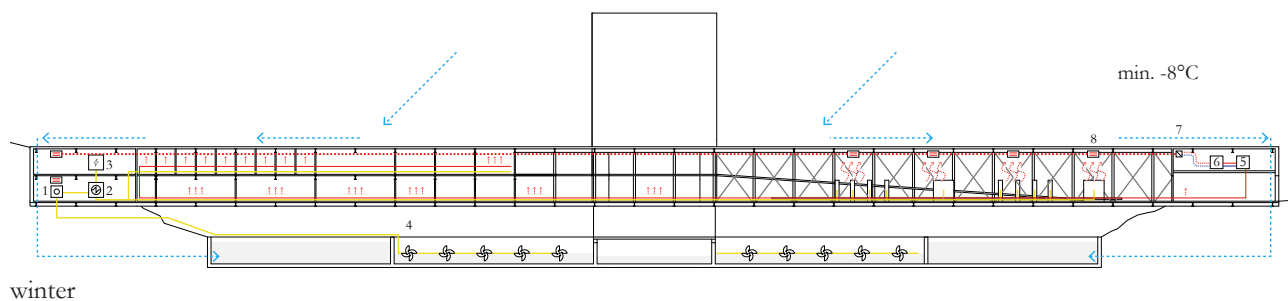
Daily Chance of Precipitation

Source: <https://it.climate-data.org>



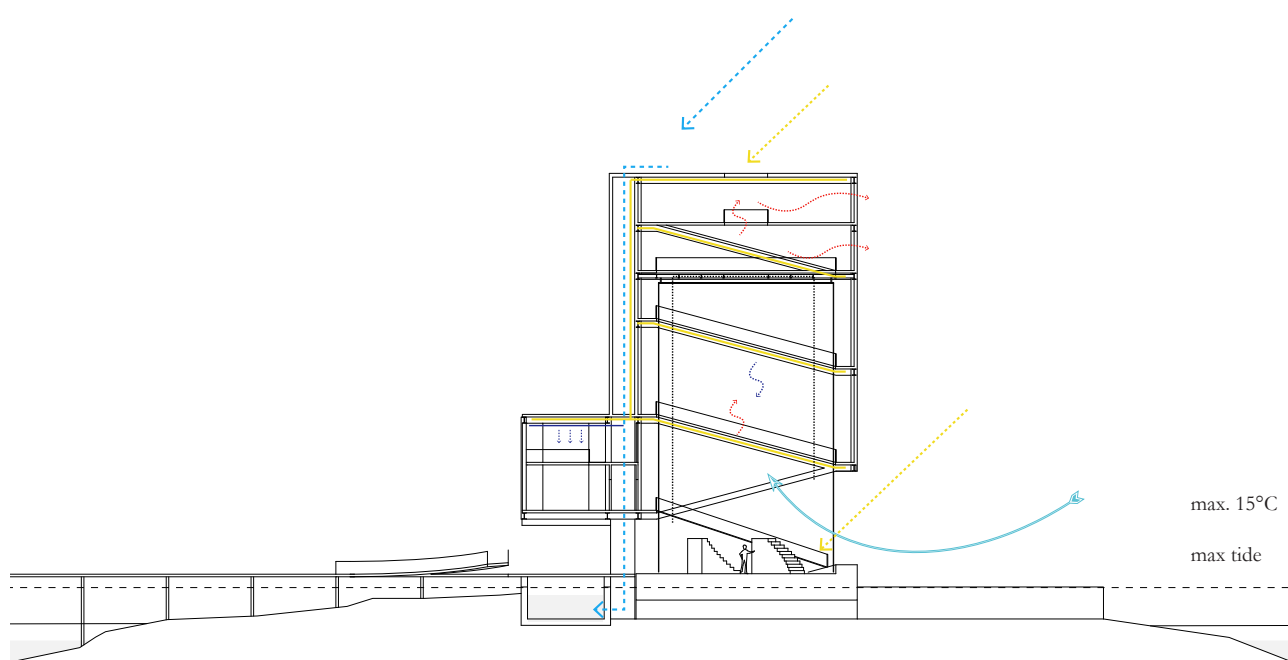
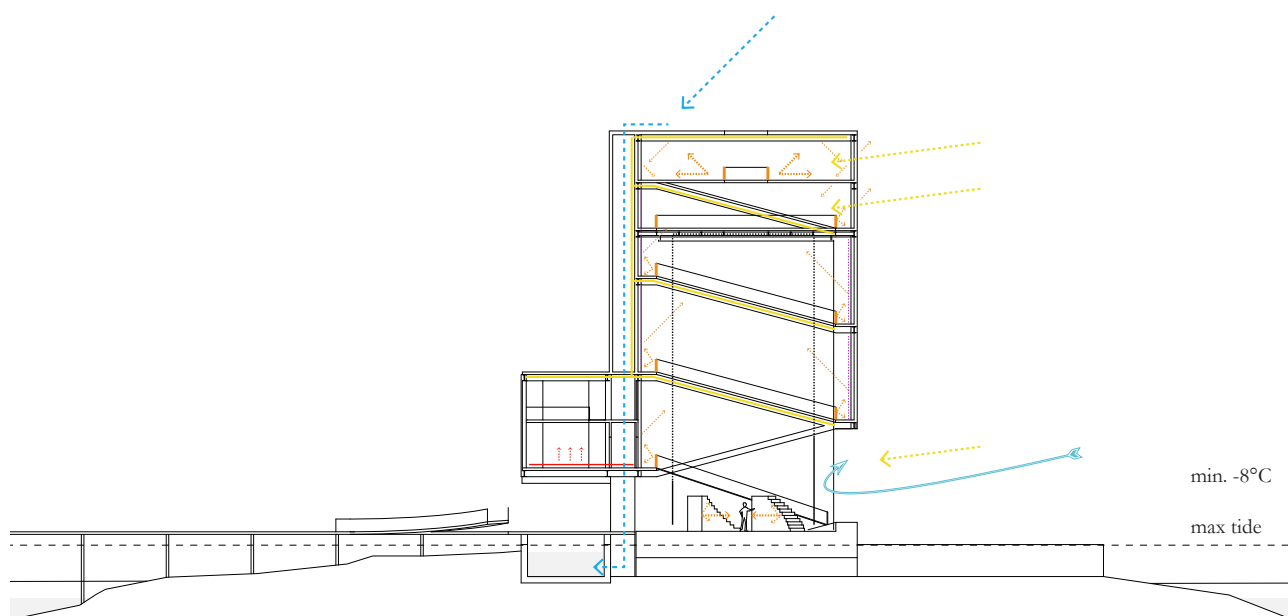
Climate Scheme: Bar

- 01 transformer
 - 02 converter
 - 03 batteries
 - 04 turbines
 - 05 waterpump
 - 06 water-source heat pump
 - 07 pre-heating unit
 - 08 heat exchanger for ventilation
-
- sunlight
 - electricity
 - rainwater
 - warm air
 - cold air
 - liquid heating system
 - liquid cooling system
 - radiator
 - infrated radiation



Climate Scheme: Tower

- 01 transformer
 - 02 converter
 - 03 batteries
 - 04 turbines
 - 05 waterpump
 - 06 water-source heat pump
 - 07 pre-heating unit
 - 08 heat exchanger for ventilation
-
- sunlight
 - electricity
 - rainwater
 - warm air
 - cold air
 - liquid heating system
 - liquid cooling system
 - radiator
 - infrated radiation

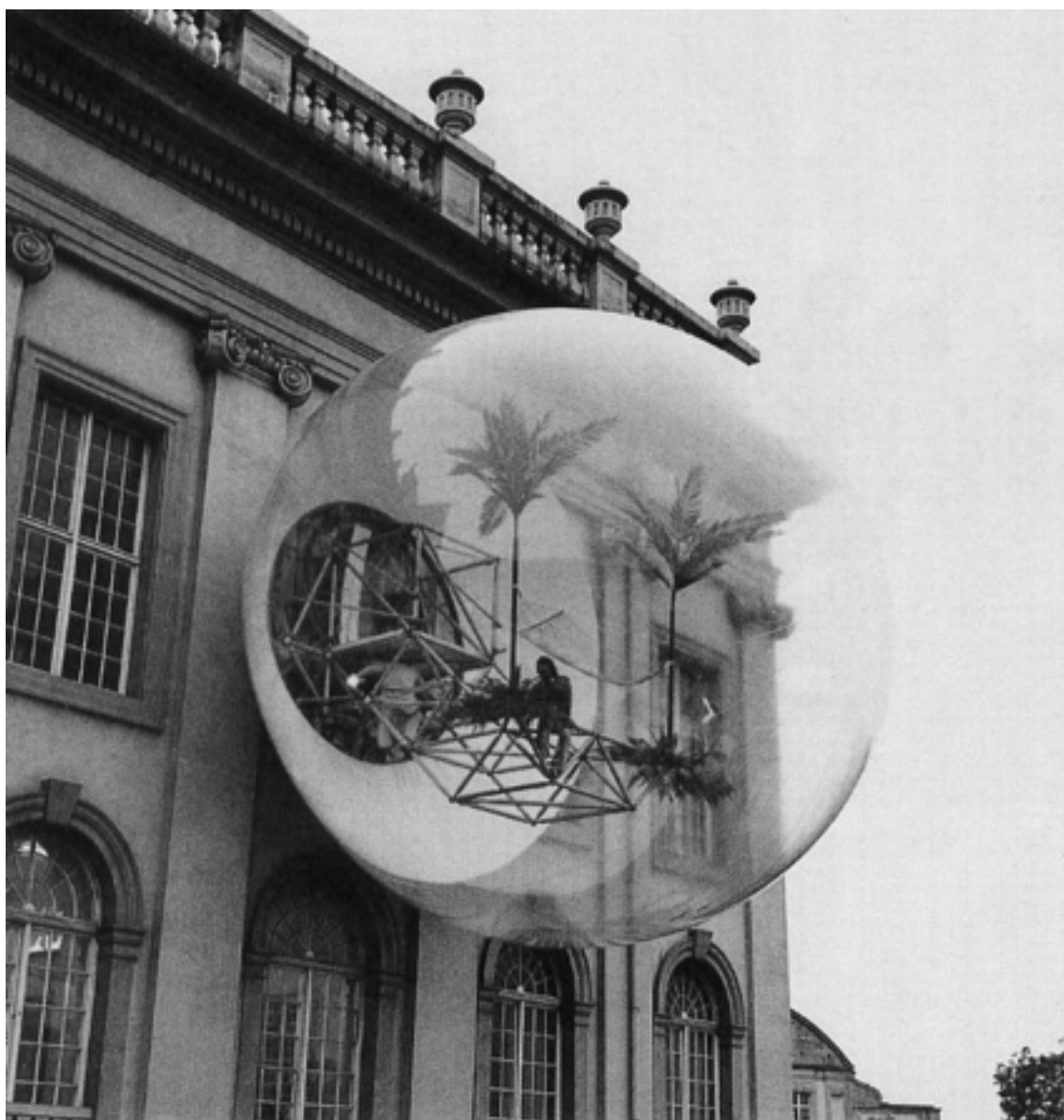


Balconies

The diagram illustrates the composition of the balconies. The parapet is thus composed: on one side, infrared panels provide a diffuse feeling of warmth to the spectators on the balcony; on the other, acoustic panels are embedded in the structure, to absorb the noise reflection towards the stage.

The internal metal cladding keeps the infrared radiation inside the building by reflecting it. In such a way, the dispersion is contained and the consumes strongly reduced.

1. metal interior cladding, reflecting radiation
2. infrared panel
3. white acoustic panel



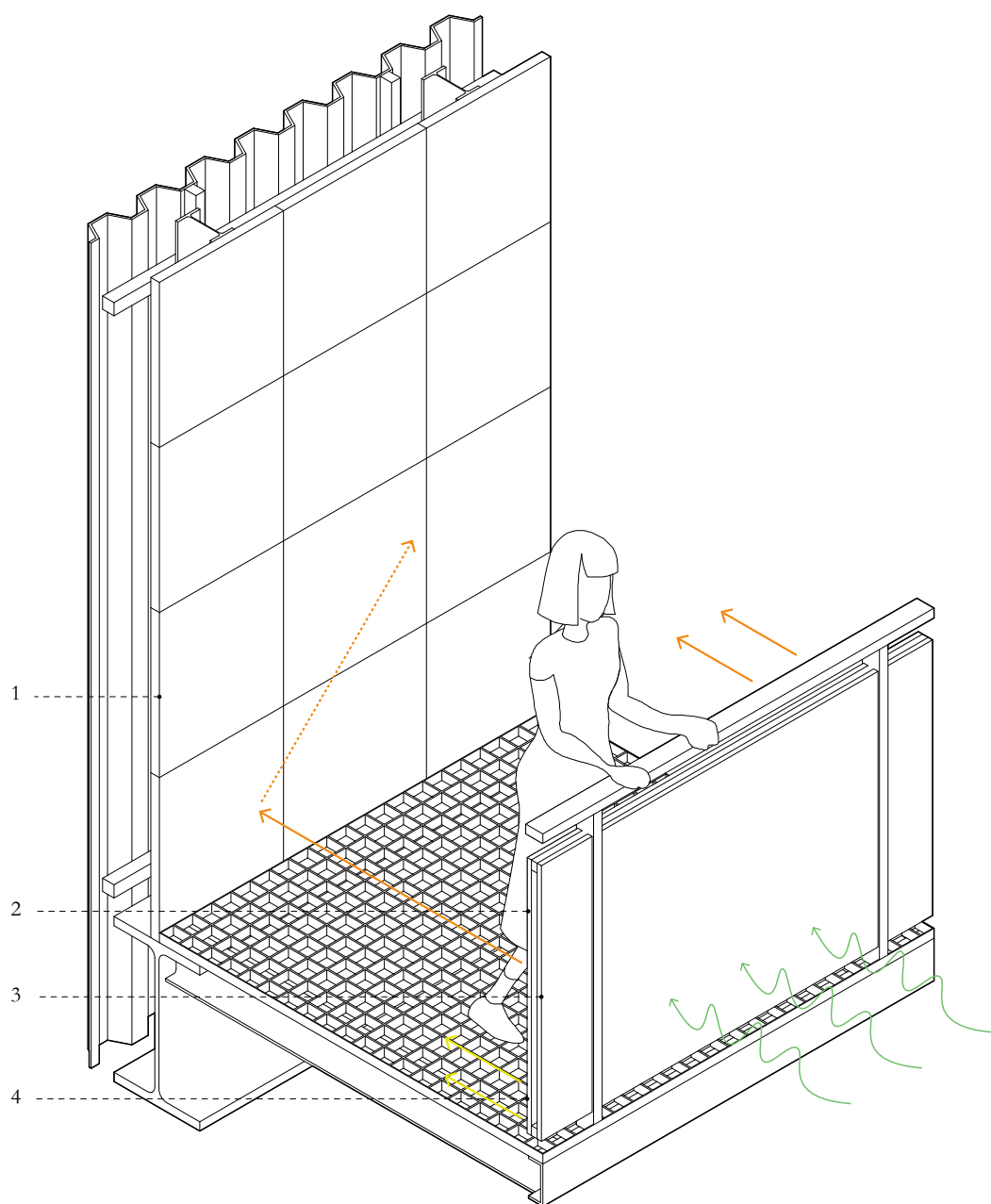
Balconies

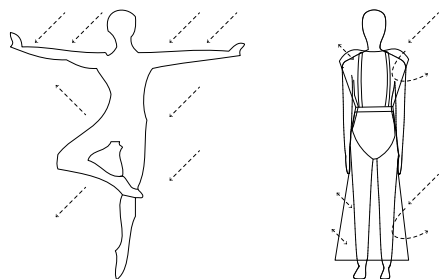
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The internal metal cladding keeps the infrared radiation inside the building by reflecting it. In such a way, the dispersion is contained and the consumes strongly reduced.

1. metal interior cladding, reflecting radiation
2. infrared panel
3. white acoustic panel
4. service lights for balconies

— noise
— infrared emission
- - - infrared reflection
— light

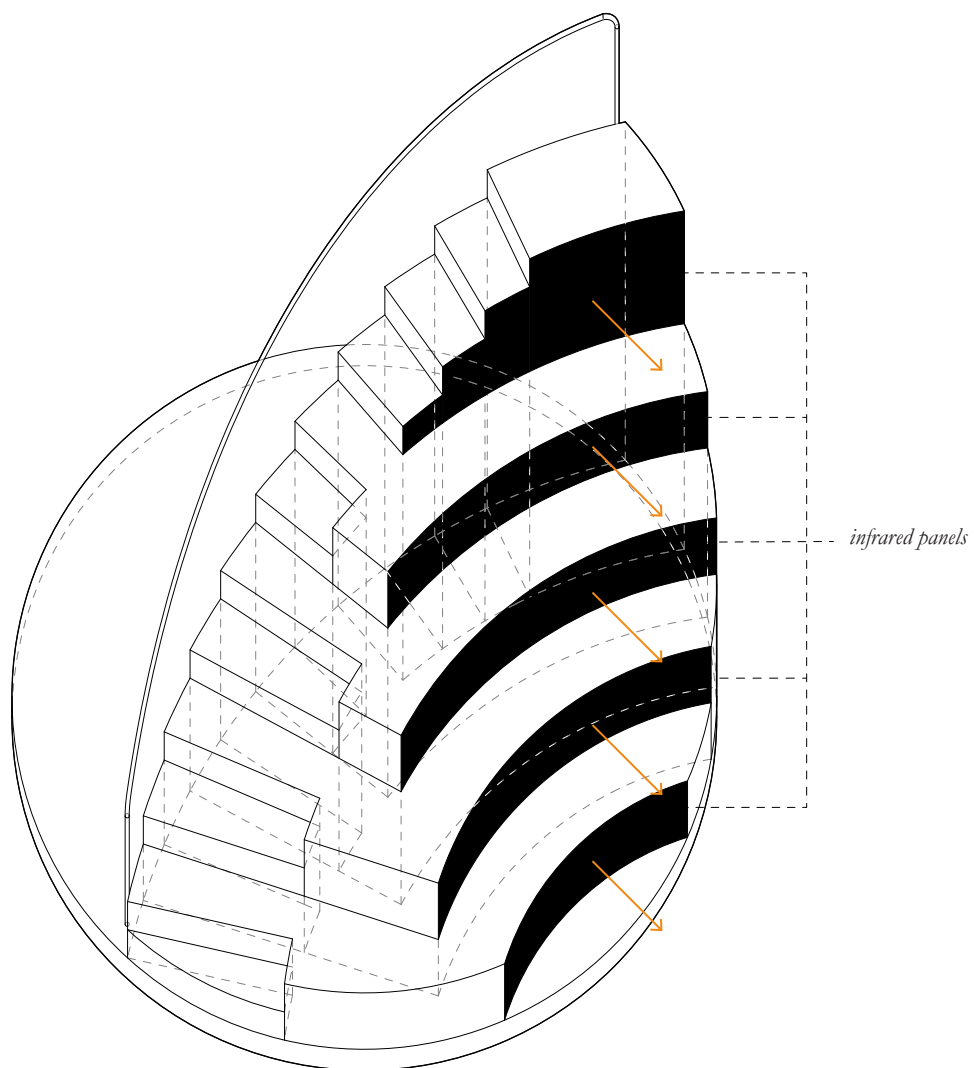




maximum exposure to radiation
of the naked body of the actors;
radiation control for the spectators on the balconies.

Stage platforms

The four rotating elements of the stage-audience are composed by metal panels and infrared radiating panels in order to guarantee the comfort for the performance in the outside. Thanks to this, the naked human body of dancer and actors freely moves in the cold landscape of the Arctic.



III.

Façade

Case studies

F1. Bar's façade 1:20

A1. Vertical detail 1:10 roof connection

A2. Vertical detail 1:10 slab connection

A3. Horizontal detail 1:10 façade

F2. 'Tower' façade 1:20

B1. Vertical detail 1:10 roof connection

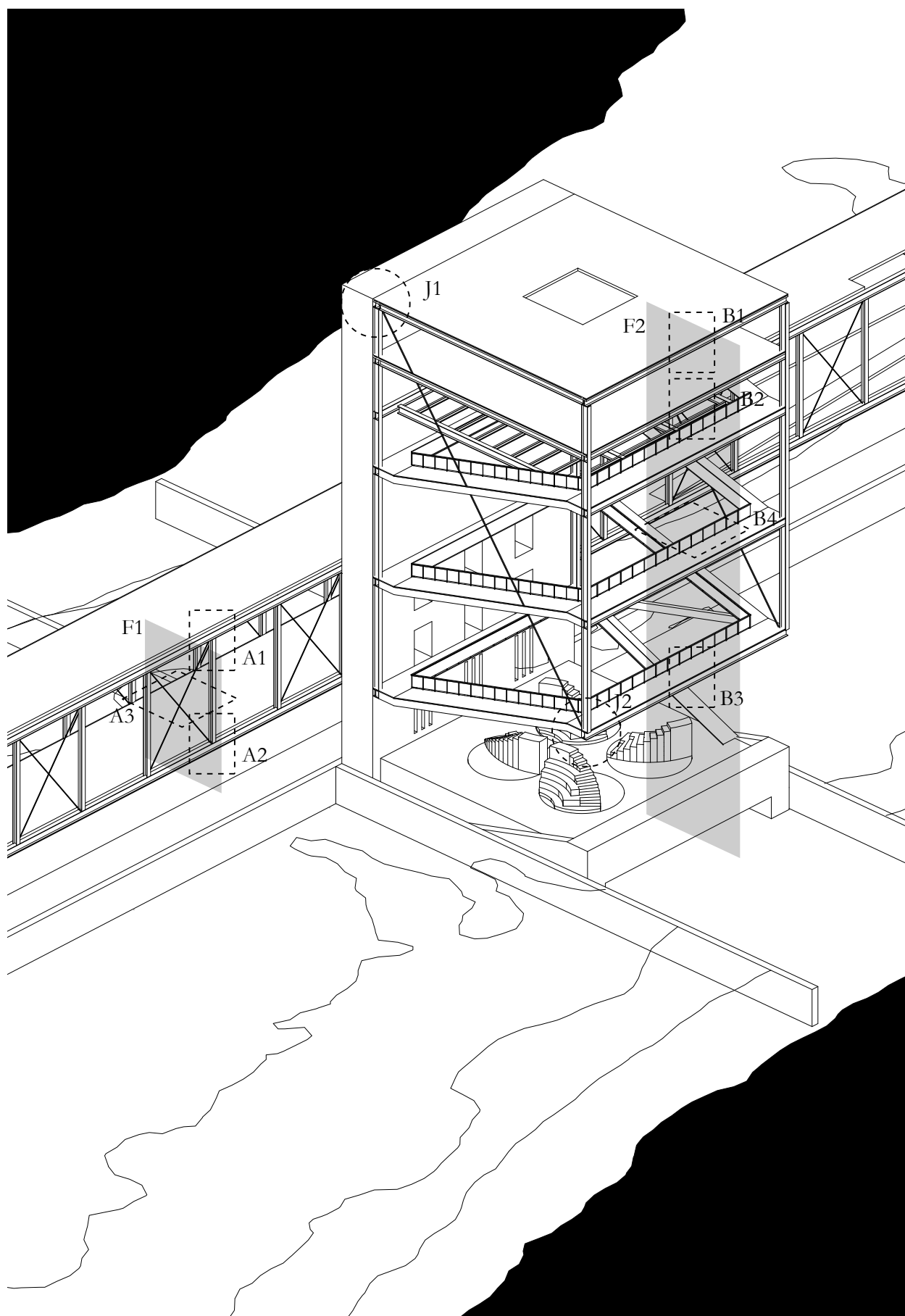
B2. Vertical detail 1:10 slab connection

B3. Vertical detail 1:10 balcony

B4. Horizontal detail 1:10 façade

J1. Structural joint 1 (see *Structure* chapter)

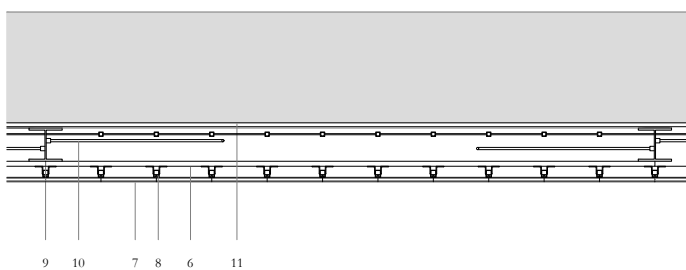
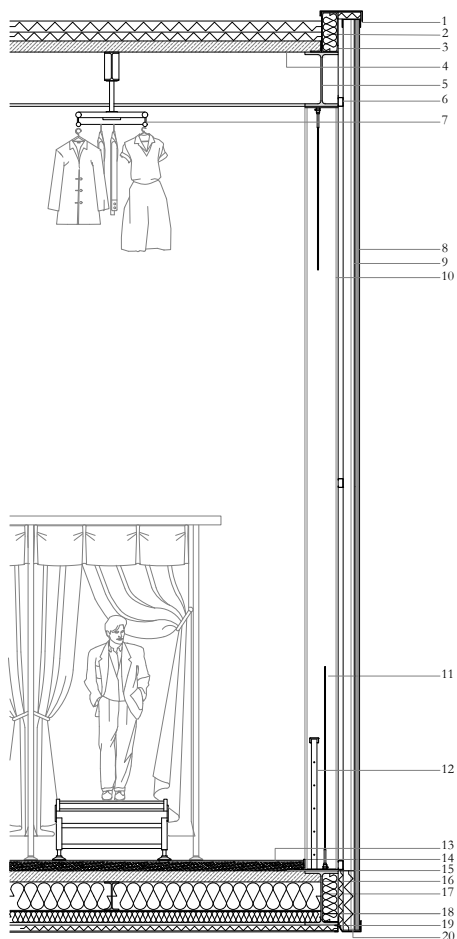
J2. Structural joint 2 (see *Structure* chapter)



Façade: Bar

Scale 1:20 (out of scale)

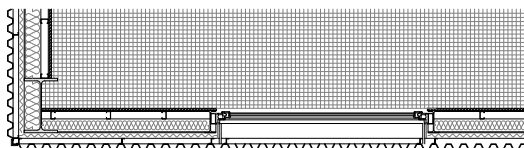
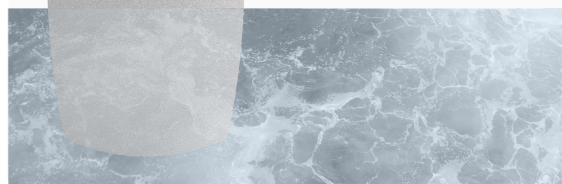
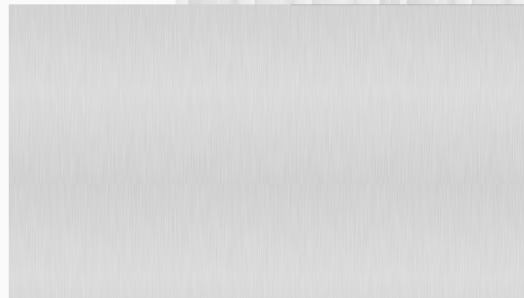
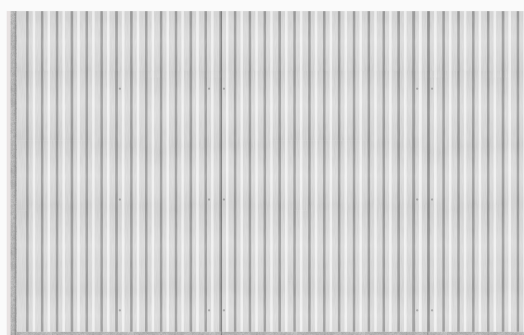
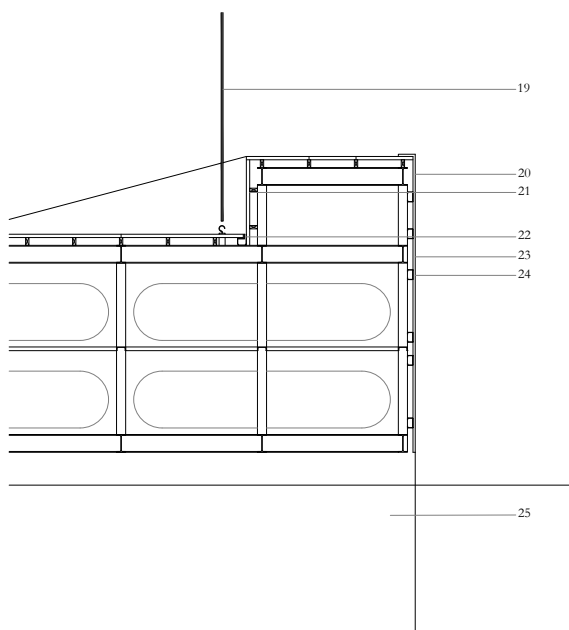
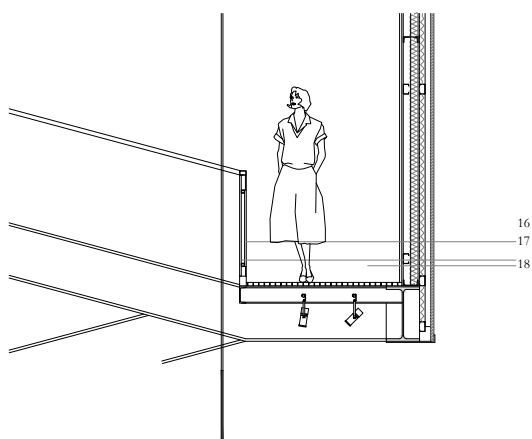
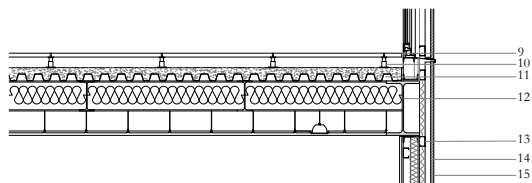
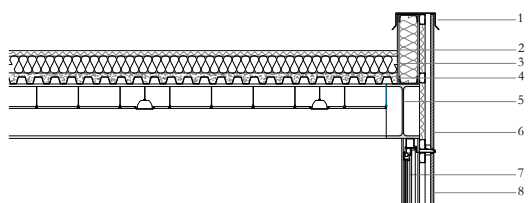
1. sheet aluminium capping, 2 mm
2. 180 mm thermal insulation
3. U-shaped steel profiles and insulation
4. corrugated metal sheet and reinforced concrete
5. steel frame, main beam, HEA 500
6. steel C-section support for façade, screwed to bearing structure, 5 mm
7. Automatic garment conveyor system
8. polycarbonate multi-web sheet, 40x550 mm U-value= 1.65 W/m²K
9. vertical battens
10. steel frame, load bearing structure, HEA 300
11. bracing
12. balustrade for safety and façade protection
13. light gray polished concrete floor
14. L-shaped aluminium profile
15. screed
16. reinforced concrete
17. 300 mm thermal insulation
18. 100 mm thermal insulation
19. 70 mm thermal insulation panel
20. flashing



Façade: Tower

Scale 1:20 (out of scale)

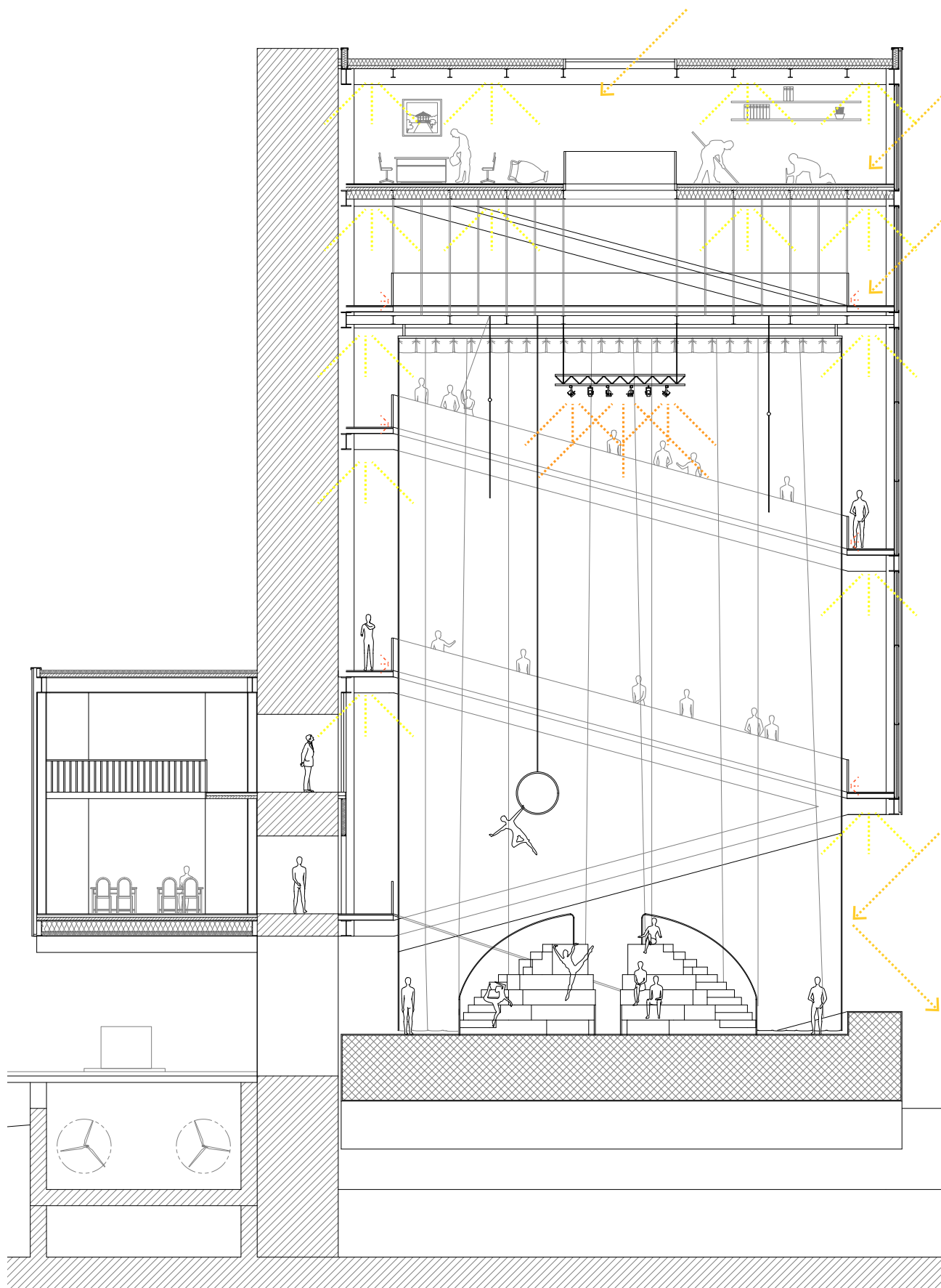
1. sheet aluminium capping, 2 mm
2. 50 mm rigid thermal insulating panels
3. 150 mm thermal insulation
4. reinforced concrete
5. steel frame, main beam, HEA 500
6. corrugated metal cladding, 2.8 mm
7. double glazed glass window
8. perforated metal panel, 2.8 mm
9. wooden flooring
10. adjustable pad
11. reinforced concrete
12. 250 mm acoustic insulation
13. steel C-section support for façade,
screwed to bearing structure, 5 mm
14. steel Z-section, vertical battens
15. corrugated metal cladding, 2.8 mm
16. balustrade
17. infrared panel
18. perforated steel deck
19. stage curtain
20. metal cladding
21. wooden board
22. gutter
23. floating structure of the stage
24. steel C-section support for external
cladding, screwed to steel structure, 5 mm
25. inflatable air cushion



Lighting scheme

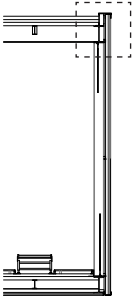
Scale 1:50

- service light
- stage light
- balconies illumination
- sunlight



IV.

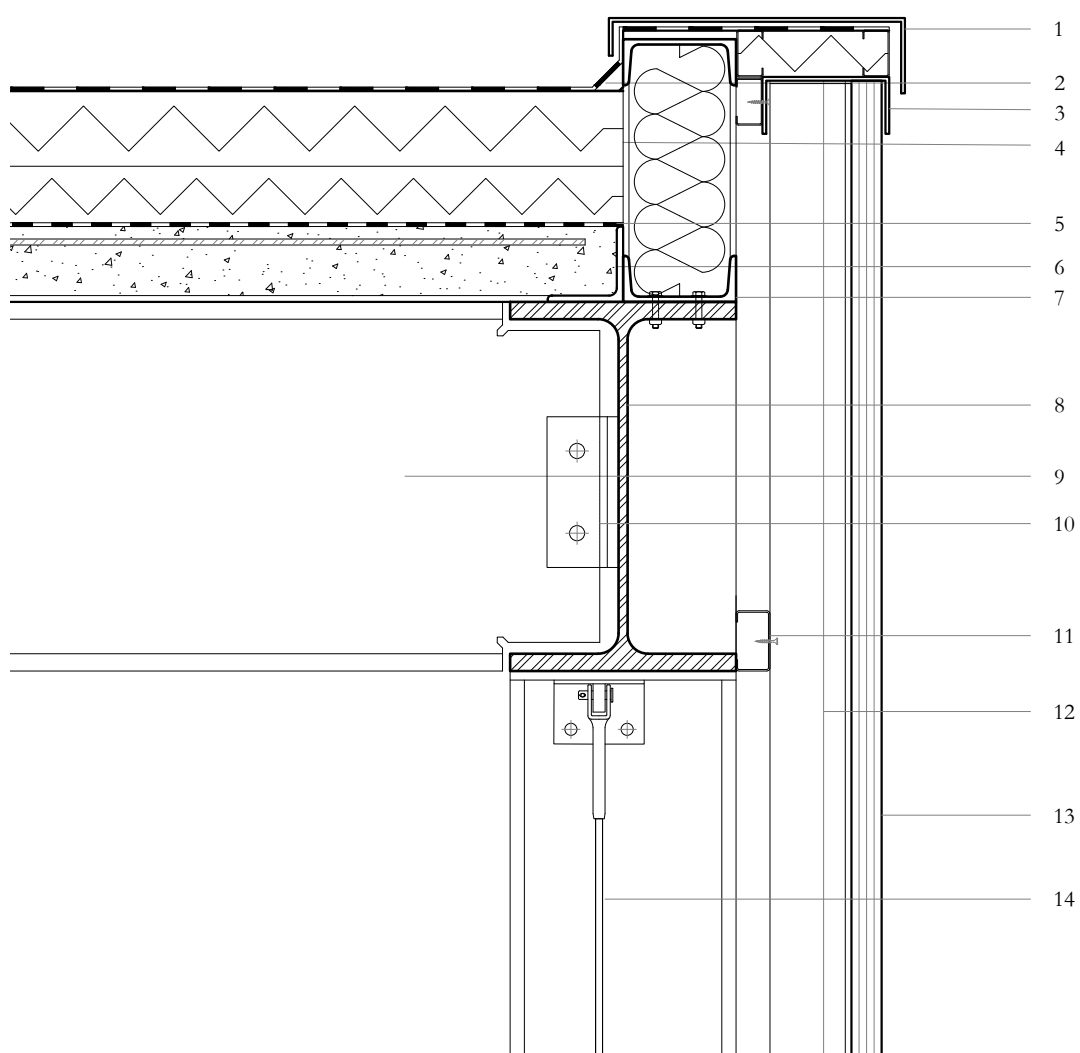
Details



Detail A1: roof connection

Scale 1:10

1. sheet aluminium capping, 2 mm
2. waterproof membrane
3. metal frame for polycarbonate panels
4. 180 mm thermal insulation
5. vapour barrier
6. corrugated metal sheet and reinforced concrete
7. U-shaped steel profiles and insulation
8. steel frame, main beam, HEA 500
9. steel frame, secondary beam, HEA 500
10. metal plate
11. steel C-section support for façade, screwed to bearing structure, 5 mm
12. vertical batten
13. polycarbonate multi-web sheet, 40x550 mm U-value= 1.65 W/m²K
14. bracing

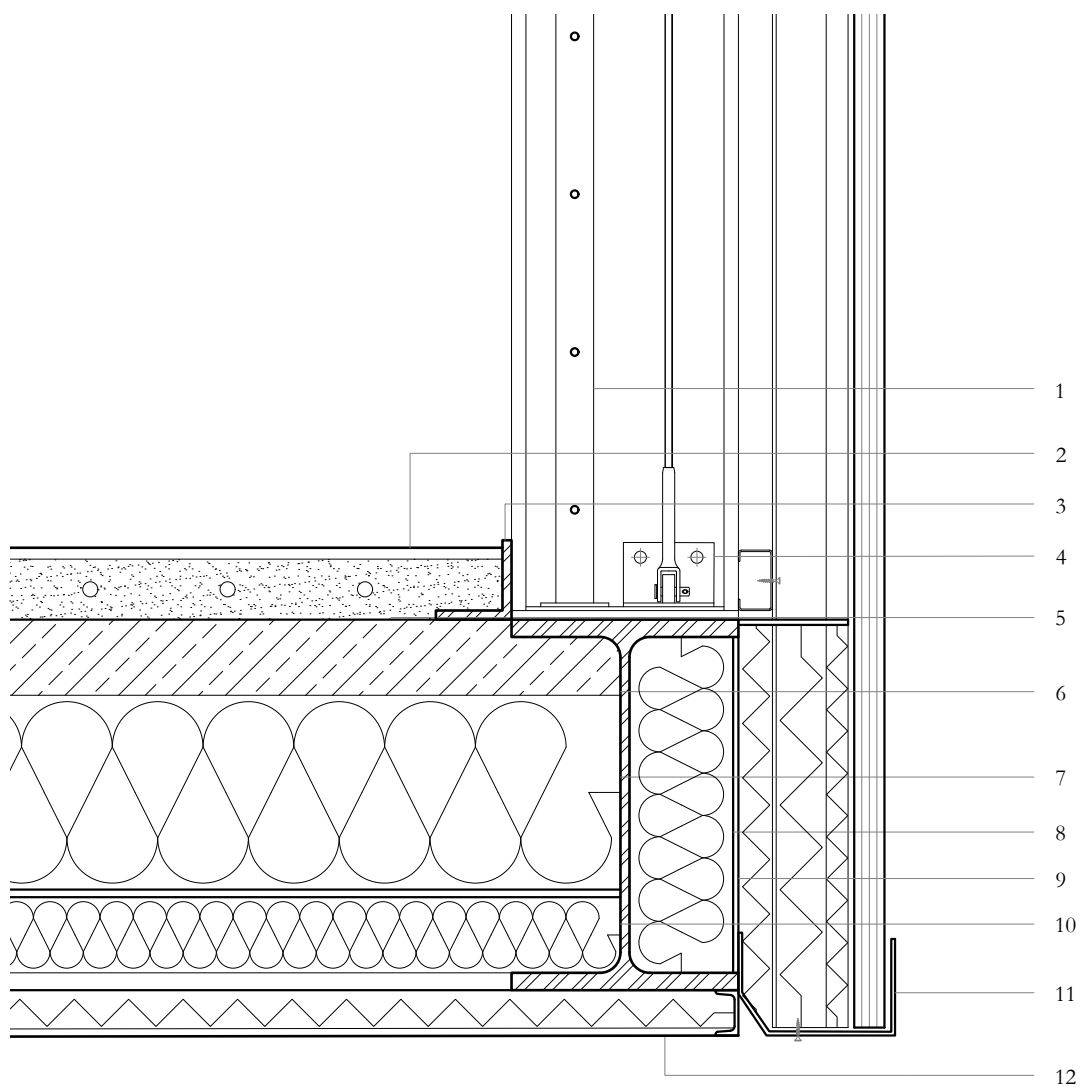


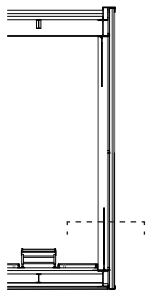


Detail A2: slab connection

Scale 1:10

1. balustrade for safety and façade protection
2. perforated steel deck
3. adjustable pad
4. metal plate
5. screed
6. reinforced concrete
7. 300 mm thermal insulation
8. 130 mm thermal insulation
9. metal sheet
10. 100 mm thermal insulation
11. flashing
12. 700 mm rigid thermal insulating panel with metal cladding

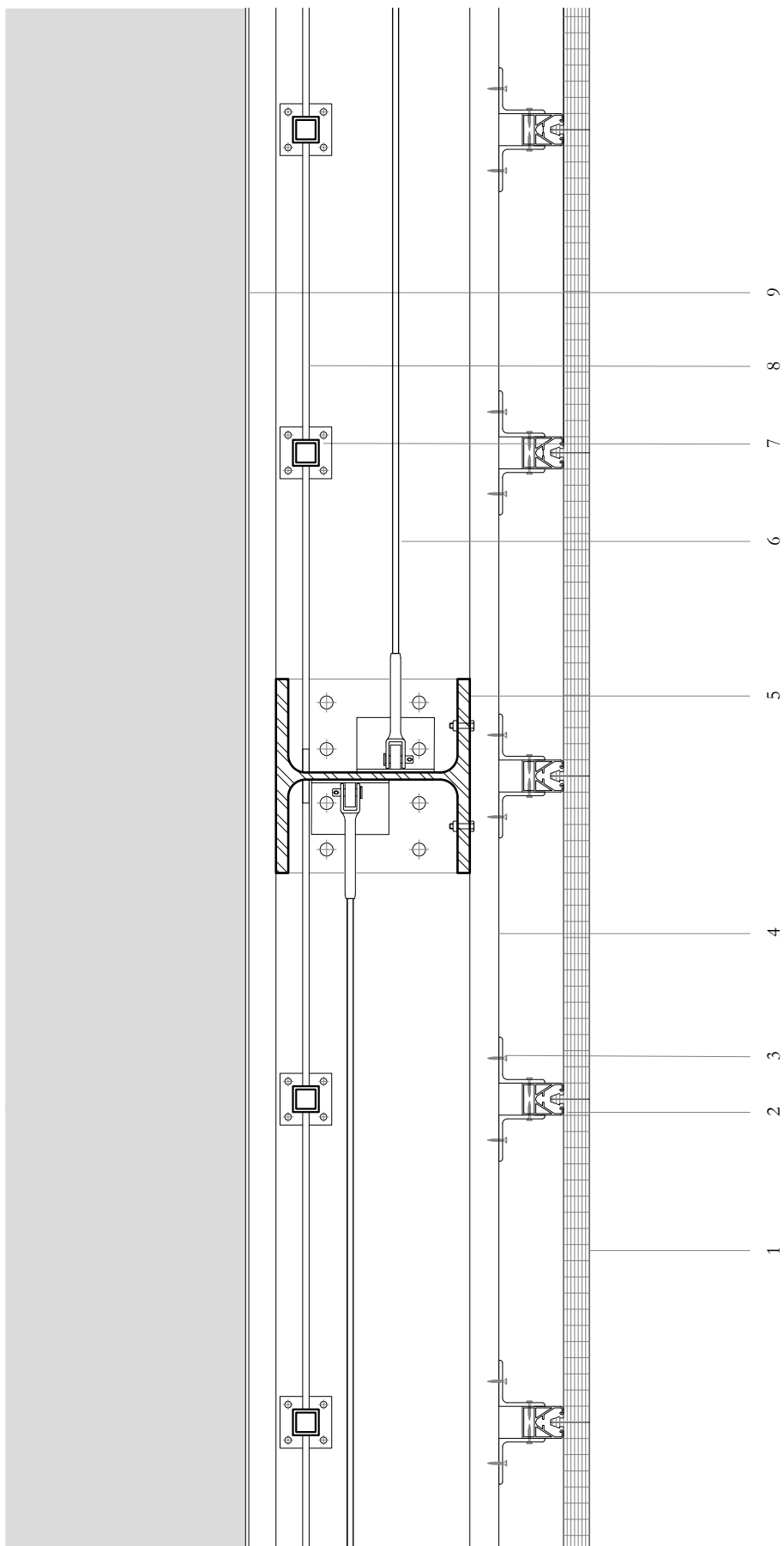


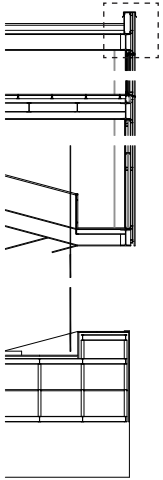


Detail A3: horizontal section façade

Scale 1:10

1. polycarbonate multi-web sheet, 40x550 mm U-value= 1.65 W/m²K
2. vertical battens
3. L-connector
4. steel C-section support for façade, screwed to bearing structure, 5 mm
5. steel frame, main column, HEA 300
6. bracing
7. balustrade, vertical support
8. balustrade, metal cables
9. perforated metal decking

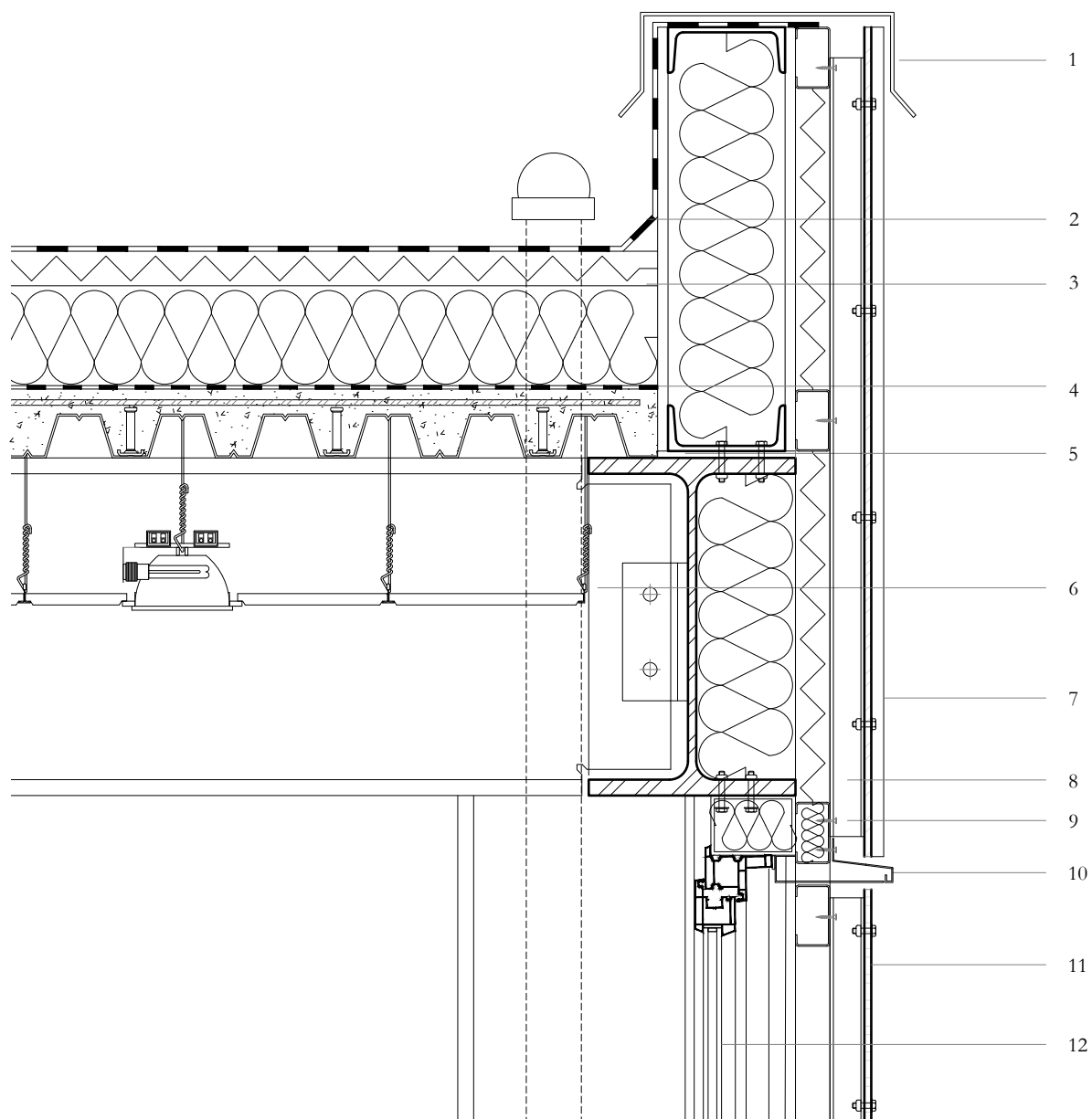


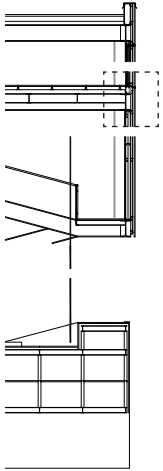


Detail B1: roof connection

Scale 1:10

1. sheet aluminium capping, 2 mm
2. waterproof membrane
3. 50 mm rigid thermal insulating panels
4. vapour barrier
5. reinforced concrete
6. steel frame, main beam, HEA 500
7. corrugated metal cladding, 2.8 mm
8. steel S-section, vertical battens
9. steel C-section support for façade, screwed to bearing structure, 5 mm
10. flashing
11. perforated metal sheet
12. double-glazed glass window

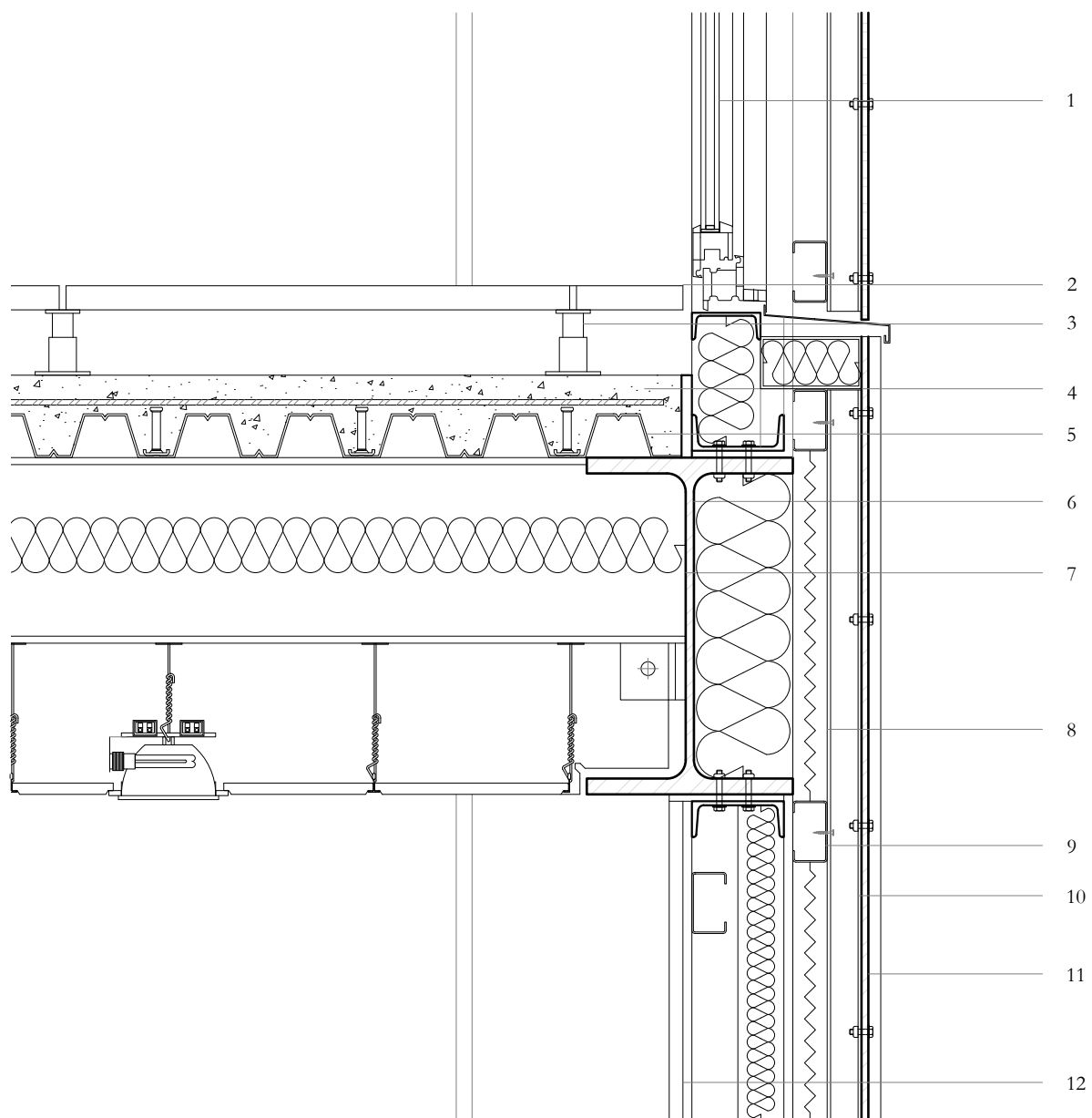


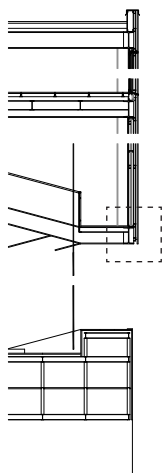


Detail B2: slab connection

Scale 1:10

1. double-glazed glass window
2. perforated steel deck
3. adjustable pad
4. reinforced concrete
5. corrugated metal sheet
6. steel frame, main beam, HEA 500
7. 250 mm thermal insulation
8. 50 mm rigid thermal insulating panels
9. steel C-section support for façade,
screwed to bearing structure, 5 mm
10. steel S-section, vertical battens
11. corrugated metal cladding, 2.8 mm
12. internal metal cladding

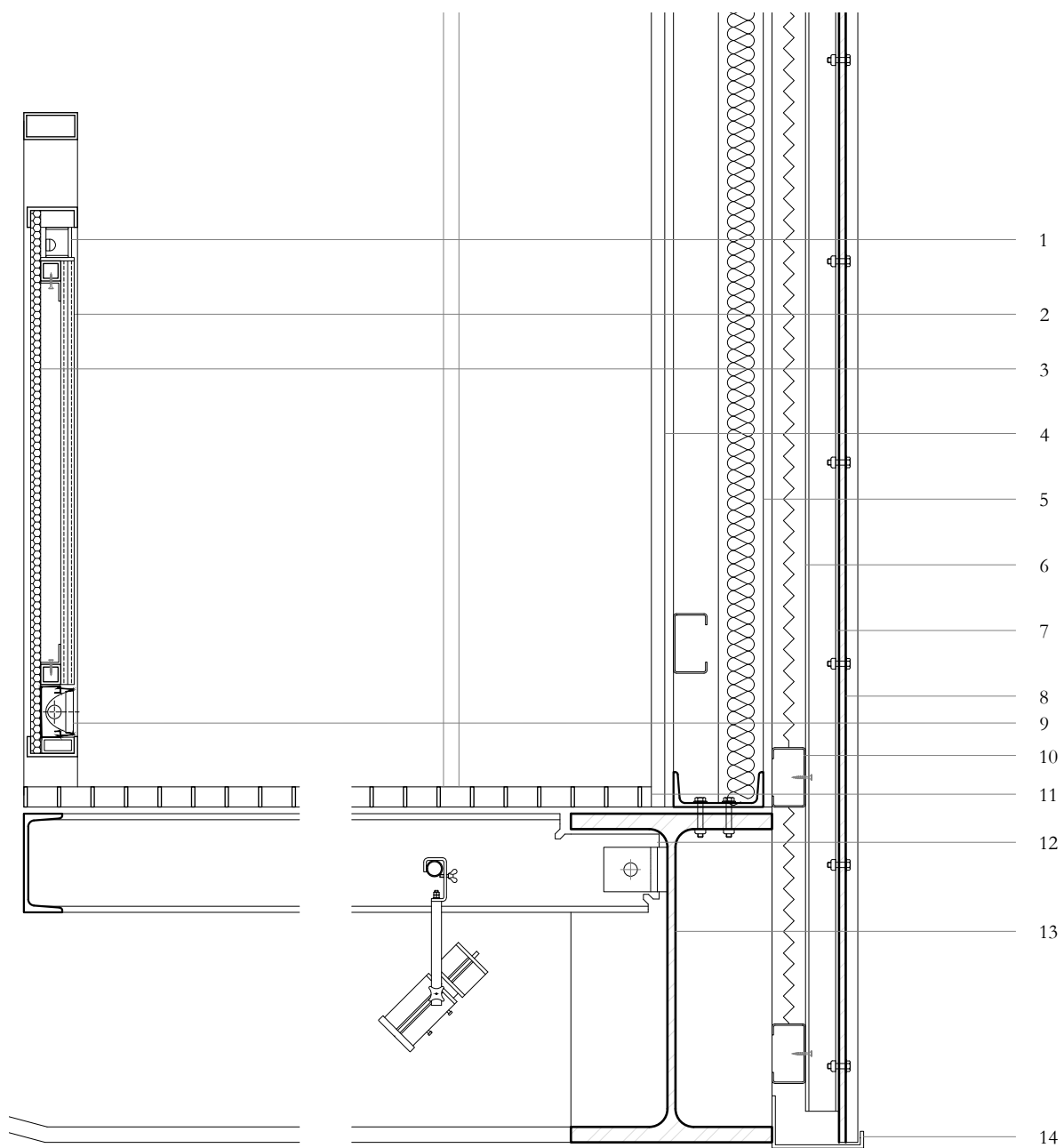


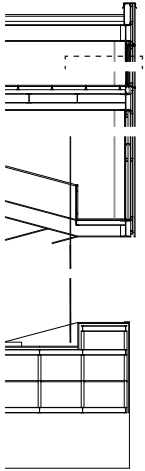


Detail B3: balcony connection

Scale 1:10

1. hue motion sensor for infrared panel
2. infrared radiating panel 20 mm
3. acoustic panel for sound absorption, metal frame,
4. internal metal cladding
5. 70 mm thermal insulation
6. 50 mm rigid thermal insulating panels
7. steel S-section, vertical battens
8. corrugated metal cladding, 2.8 mm
9. service light
10. steel C-section support for façade, screwed to bearing structure, 5 mm
11. perforated steel deck
12. secondary beam, IPE 14, supporting balconies
13. steel frame, main beam, HEA 500
14. flashing

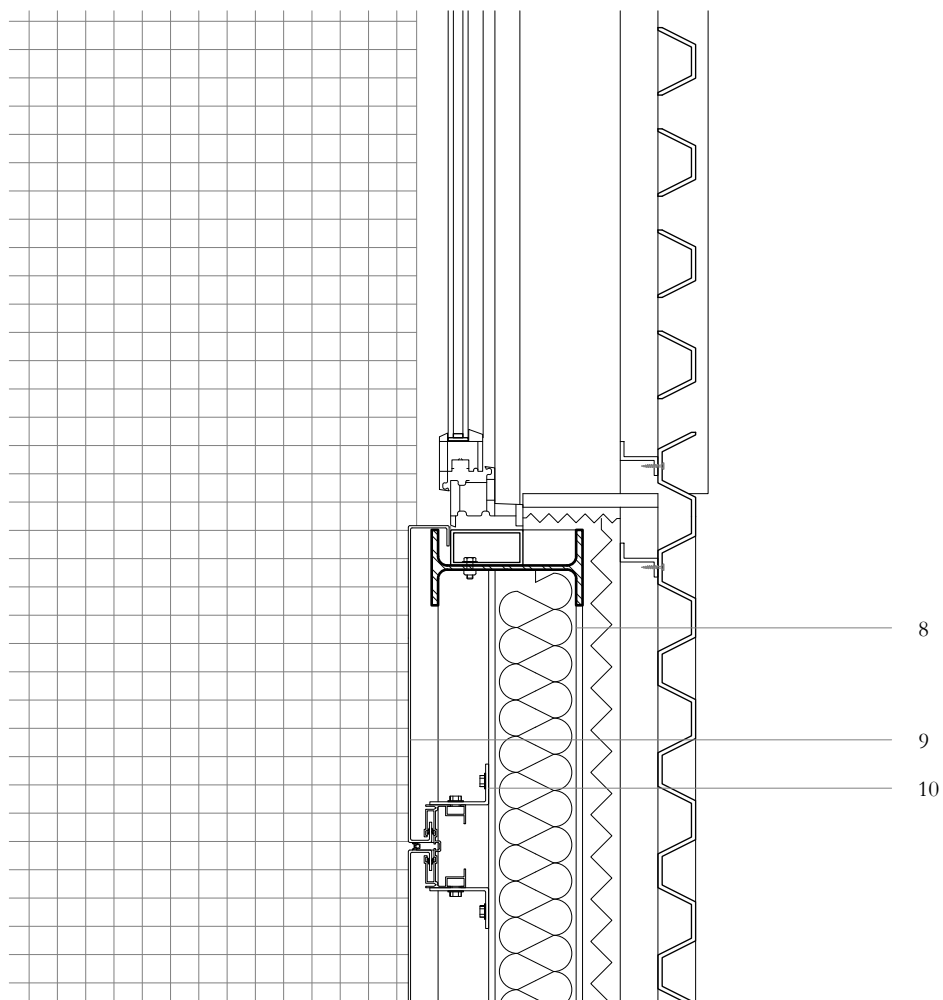
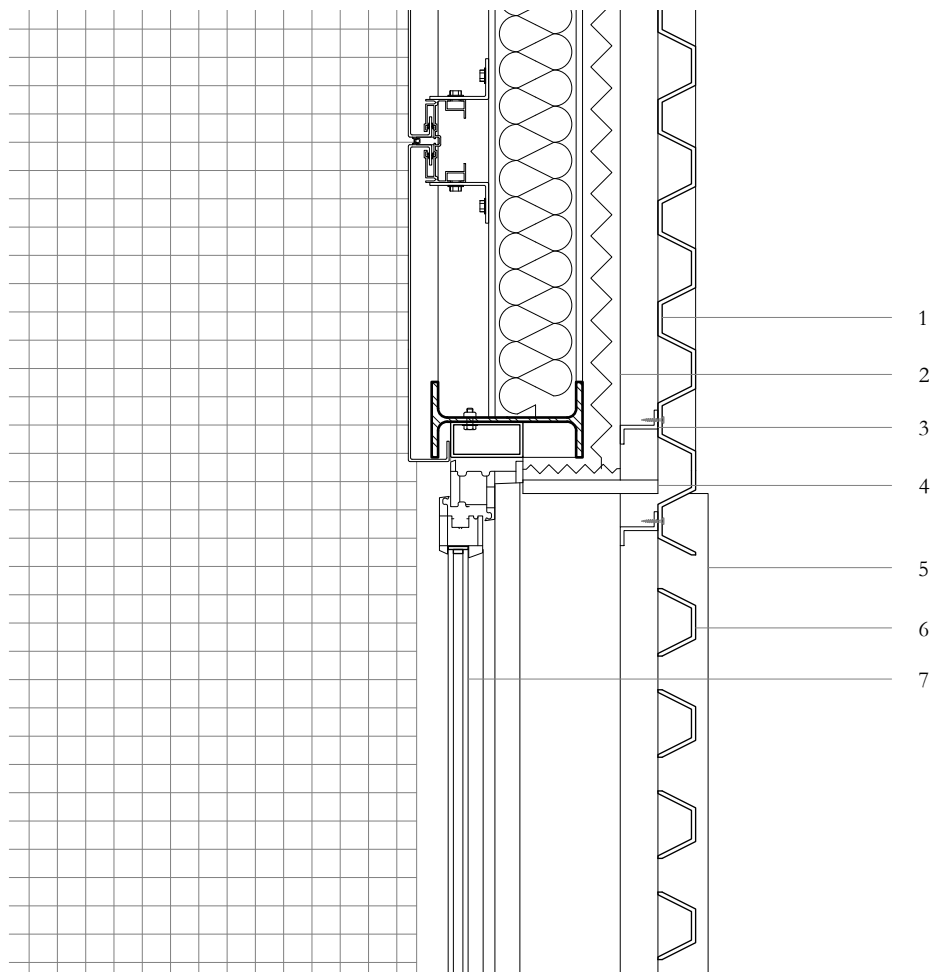




Detail B4: horizontal section opening

Scale 1:10

1. corrugated metal cladding, 2.8 mm
2. steel C-section support for façade, screwed to bearing structure, 5 mm / Rigid insulating panel.
3. steel S-section, vertical battens
4. metal plate
5. flashing
6. fixed metal sunscreen
7. double glazed glass window
8. 100 mm thermal insulation
9. interior metal cladding
10. aluminium profile support of metal cladding



V.

Conclusions

5. Results

The technological analysis and development of the project allows to detect the social and cultural relevance of our research, highlighting its tangible results and possible applications. In terms of outputs, it is possible to identify three main technological aspects the project entailed.

First, the project resonates on the possibility of an autonomous architecture, thanks to the reliable source of energy represented by the tides. The dialectic relation between building and tides highlights the importance of the sea as fundamental resource, both of spiritual and technological nature. While producing energy by means of turbines and water collectors, the tidal forces mechanically move the platforms of the stage, every time determining the specific conditions in which the performance is set.

The archetypal character of the building - an ultimate denotation of its theatricality - stands both in its typological research for a different theatre and in its distinctive connection with the production of energy.

In line with this, the second 'result' of the project is concerning the relation between building and surroundings; between interior and exterior. The particular climatic conditions of the Arctic lean towards an almost absolute closure from the outside. However, the spectacle of the landscape, as well as the conviction that public life happens in the open space, call for a stronger connection between envelope and exterior.

For this reason, the development of a diverse climate scheme brings together sealed, fully controlled spaces with a reflection on the manner in which the exterior can still be experienced regardless of the harsh condition - making it part of the playful participation. On the one hand, the choice of a polycarbonate façade define an atmosphere of blurred visual relations between inside and outside, at the same time showing and hiding; building becomes a theatrical act in itself. On the other hand, the recurrent element of the curtain attempts to create an interior space in an exterior condition, challenging the conventional use of space. Instead of hiding the scene from the audience, as in a traditional theatre, the curtain is here describing the intimate space of action, in its ephemeral dimension.

Finally, the attention towards stage design and costumes of the play highlights the importance of the human dimension, especially in times - like the ones we are living - where its standards are constantly asking for a revision. The architecture of the body emerges as fundamental request to be taken care of by the machinic, in the perspective of an inevitable collision between human and machine.

