

DWELLING IN LIGHT - 70° N

Arctic light as generator for new architectural typologies



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Unless stated in the binder, all
illustrations are by the author

For expanded version of the project see Binder 2

ABSTRACT

Norway, due to its specific location on Earth, experiences various climatic as well as topographic challenges that architecture has had to face over time in order to cope with its harsh surroundings. In addition, the Arctic region of Norway has to face irregularities in daylight distribution throughout the year, phenomena called polar days and polar nights. As I have been traveling to Northern-Norway, exploring cities such as Tromsø, Bodø, Vardø, and other smaller villages in the county of Troms & Finnmark, I have experienced architecture that is oddly similar to the one we find in Southern-Norway. The shape of a single-family house, its materials, the quantity of windows and its size speak more or less the same language.

Tromsø, located at approximately 70° North, has more sunhours (around 4541 hours) above the horizon during a year comparing to Oslo (around 4441 hours) at 50° North. Despite that being a fact, it is strictly related to a mathematical calculation. It is, rather, the distribution of these hours and the light conditions they create that should be of interest. Light phenomena that occur in Northern-Norway play an important role in everyday life for the inhabitants that live there, which happens to be one of the biggest accumulations of people living above the Arctic Circle on Earth. In the summer, you can experience the midnightsun while, on the contrary, in winter, the sun never rises above the horizon for some weeks, creating extended sunrise and sunset colors in the sky as it approaches from the south for a few hours of the day. Dwelling in Light - 70° N aims to address thematic irregularities in daylight distribution in single-family house typologies in Arctic Norway, with Tromsø as a reference point. Through my investigation, I wish to learn from the locals, professionals, case studies, history, and a more analog approach to light using a method developed during my pre-diploma semester.

That will hopefully raise new questions and contribute to a better understanding and exploration of the light conditions this region offers on a daily basis, creating an architecture generated by this region by implementing the surroundings in the shell we call our home.

BACKGROUND



SINGLE-FAMILY HOUSE
SOUTHERN NORWAY



SINGLE-FAMILY HOUSE
NORTHERN NORWAY

1. FINAL PROJECT

- 1.1 - Project description & Program
- 1.2 - Diagrams
- 1.3 - Construction
- 1.4 - Section - Imaginary life
- 1.5 - Plans
- 1.6 - Specific site
- 1.7 - Interior photos of 1:20 model
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- 1.10 - Dedication
- 1.11 - Sources



1.1 - Project description & Program

Dwelling in Light - 70° N takes a new approach to single-family house typology within Arctic Norway. Based on a fundamental component of our daily life routine, daylight, it has guided the very characteristic of this specific outcome. The leveled floor plan is harmonic, mediating with daylight through four equal in length and height perpendicular facade walls. One glazed wall is completely exposed to its circumstances; the other three facades filter the strong horizontal light through an arrangement of diagonal walls within a grid of 3x1.5m. Niches, being in between spaces, reflect the light rays, filtering the cold outdoor light into a warm, honey-like glow. The light experience given by the niches is both a shared occasion and a more intimate moment. Within the main 3x3m grid, a timber-framed structure covered with epoxy-treated plywood plates rises above the flat roof structure. It appears as a transparent crystal to the public due to its glazed octagonal base shape. The outer layer of the funnel-shaped shower within the bathroom captures light from a 360° angle, bending the light down to floor level, while the inner part gives a vertical view of changing skylight, as well as an observation point for light phenomena that occur in the arctic. The concrete pillar foundation allows for smaller excavations in the ground, along with adaptability to irregular terrain conditions. A glulam structure is placed along the axes of the pillar foundations, which are covered with CLT slabs. The roof's glulam beams span across the whole building on mirrored load-bearing glulam pillars. Due to the stair-like shape of the beams, they diversify the height within the inner core and the filter wall areas. The core is 2.4m from floor to ceiling, while the niches are 3 m high. The use of timber in the exterior and interior parts of the house emphasizes the material connection with its context, as well as the fact that the wood transmits warmer light from its reflections in an otherwise harsh and cold environment.




1.1 - Project description & Program

- Single family-house
- Around 200 sqm
- Access to daylight in every space
- Max 2/2,5 floors
- Max height 9m-regulations (can be lower depending on context)
- No basement in the ground/ no large excavations on the plot.
- Kitchen
- Living room
- Bedrooms
- Bathroom




*In addition to the base of the program I am including findings from the research that guided development of the project: BLUE colored words are included

SURVEY:

Most favorite rooms + <<Daylight is an important factor in why this is my favorite room>>

- LIVING ROOM  LARGE WINDOWS
LIGHT CONDITIONS
VIEW
SPACIOUS
- KITCHEN  BRIGHT
SOCIAL ROOM
LIGHT CONDITIONS
- BEDROOM  DARK
VIEW
RELAXING

Least favorite rooms + <<Daylight is an important factor in why this is my least favorite room>>

- BATHROOM  NO WINDOW
LITTLE LIGHT = WINDOW/S
- HALLWAY  NO WINDOW
DARK
WASTE OF SPACE = PART OF OPEN FLOOR PLAN
- STORAGE ROOM  CRAMPED
NO WINDOW
LITTLE LIGHT = PART OF OPEN FLOOR PLAN

PROFESSIONALS - ARCHITECTS

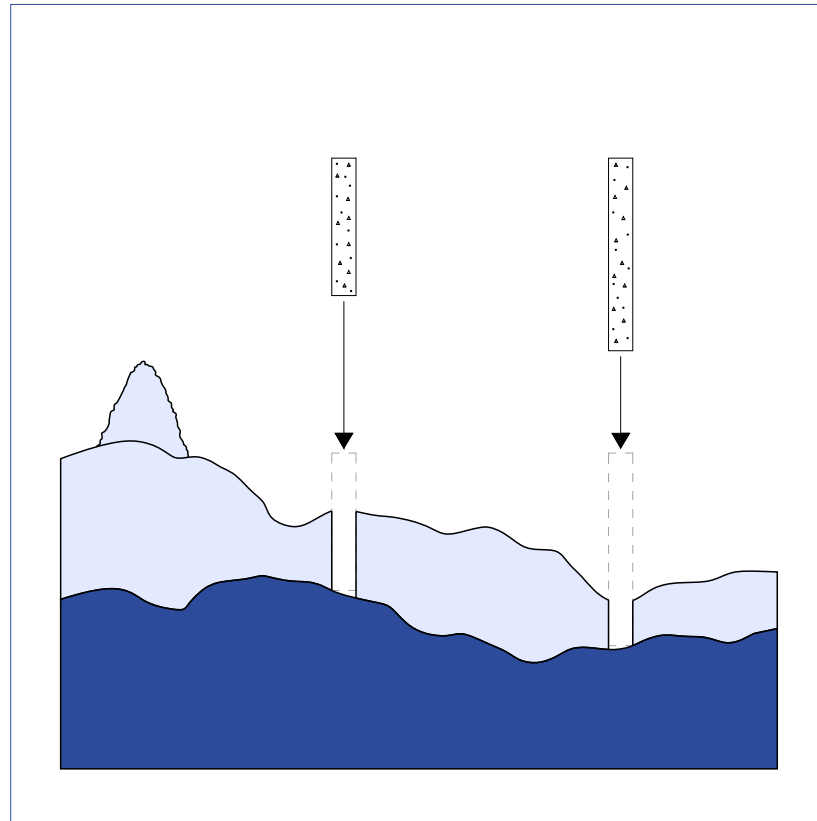
- **Observe light 24h**
- **Windows up to the slab**
- **Sun hits more horizontally in the North**
- **Qualities from all celestial directions**
- **Snow and reflection from it**

CASE STUDIES

- **Having windows placed mostly along the facade**
- **Open plan floor**
- **Angles/angled walls**
- **Construction/facade materials reflecting existing architectural language**

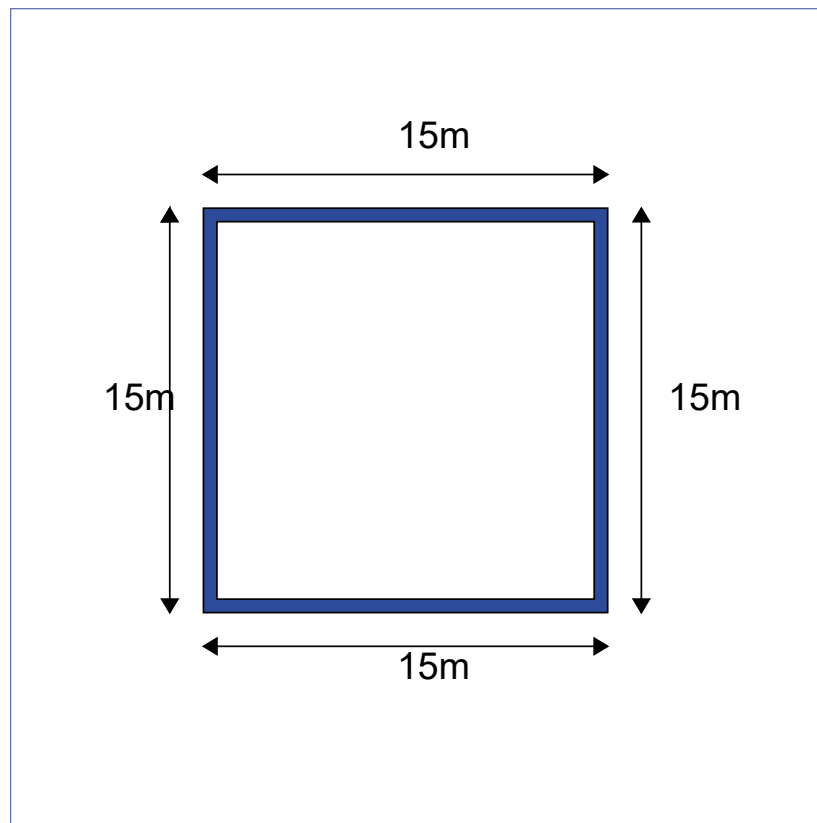
FOUNDATIONS

- Adaptation to the terrain



WALLS

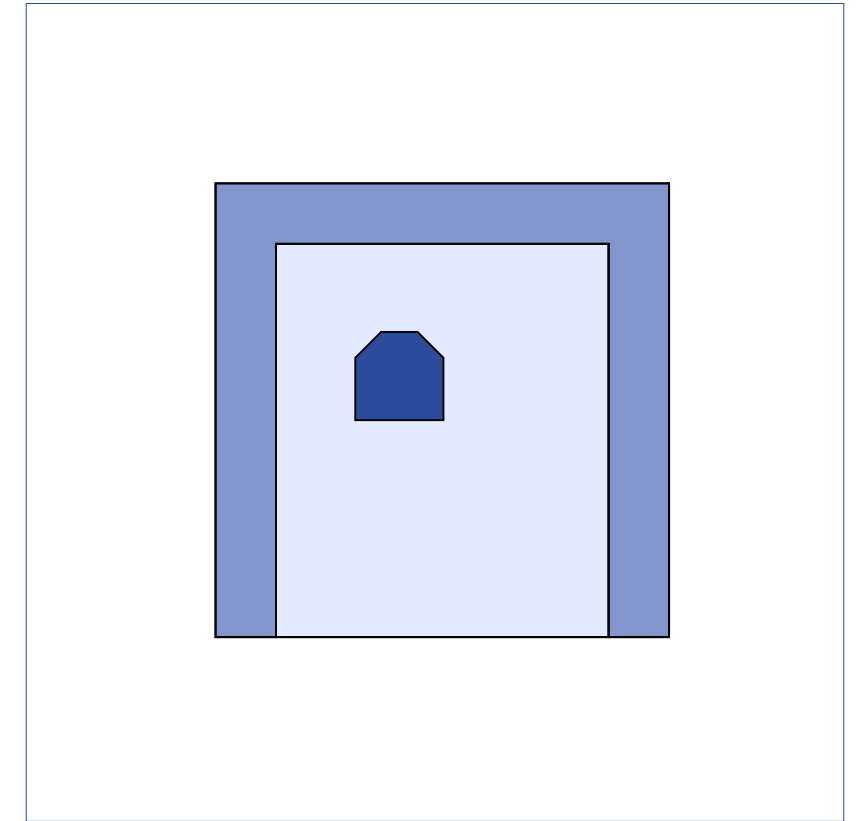
- Equal length of the walls
- Creates closer relationship to the movement of light



1 FLOOR PLAN

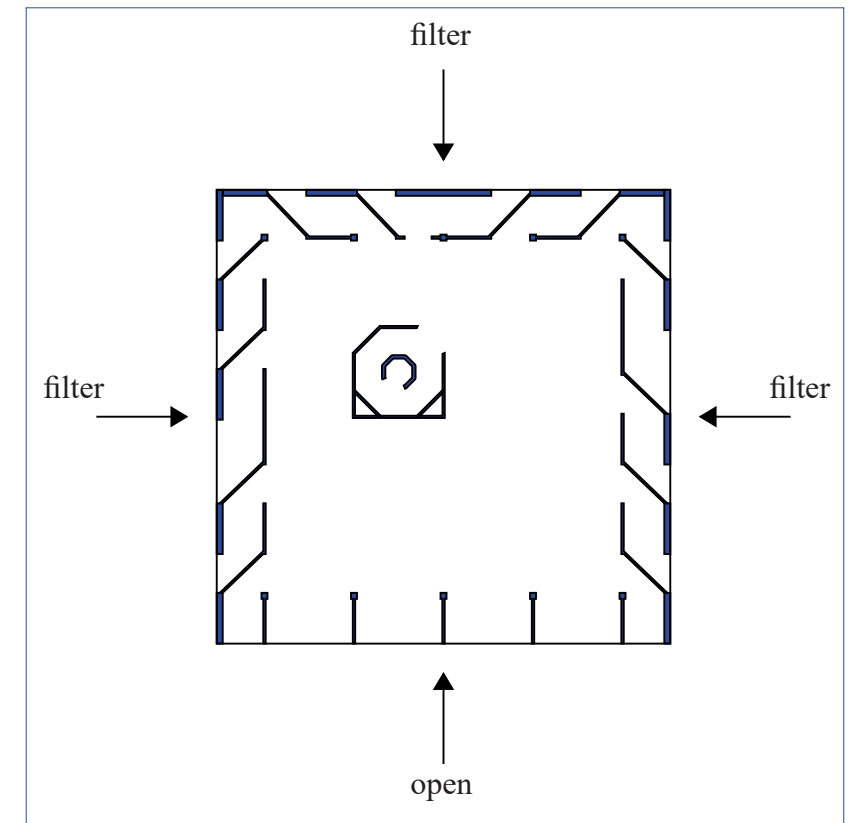
- Private
- Semiprivate
- Common space*

* Common space can become a more intimate one in relation with a niche



PERMEABILITY OF THE FACADE

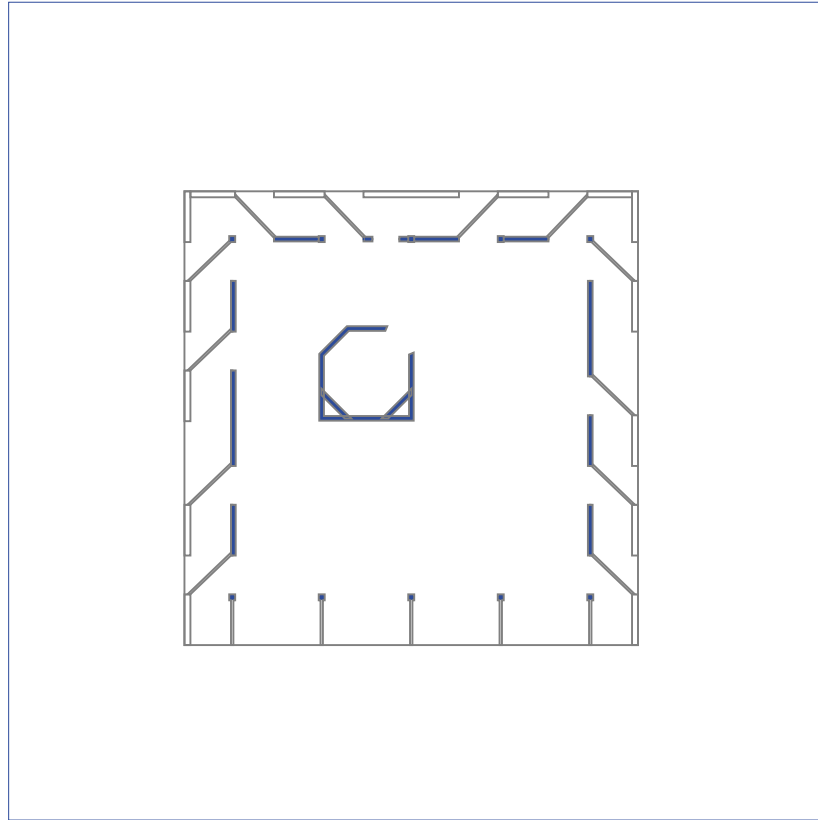
- 1 open facade
- 3 filter facades



1.2 - Diagrams

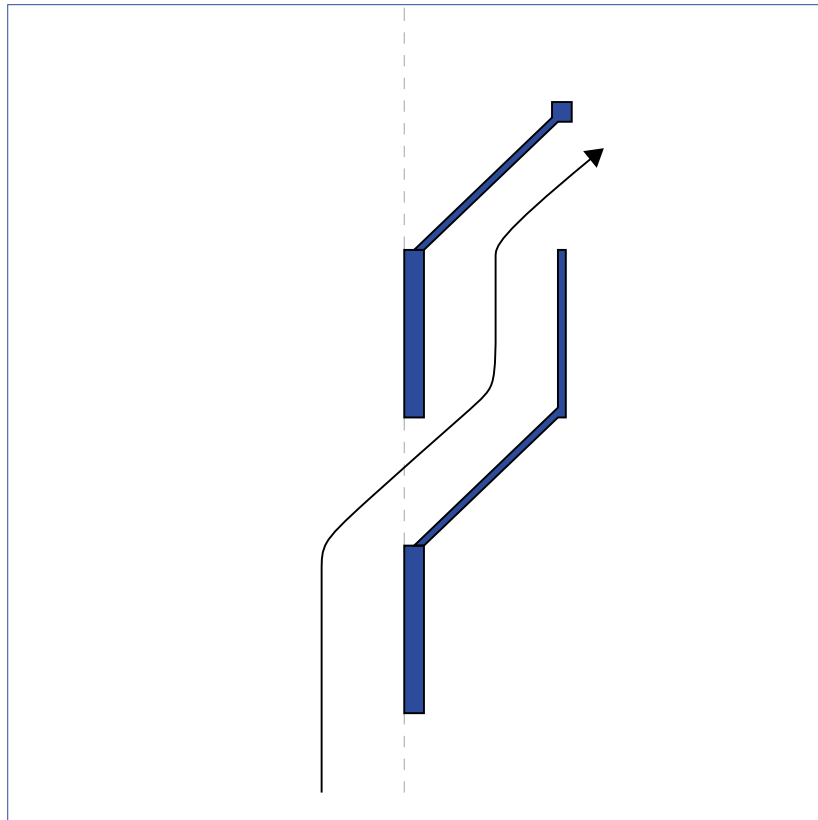
CONSTRUCTION

- Column structure with inner stiffening walls and bathroom
- Structure allows for rearrangement of partition/diagonal walls



NICHE

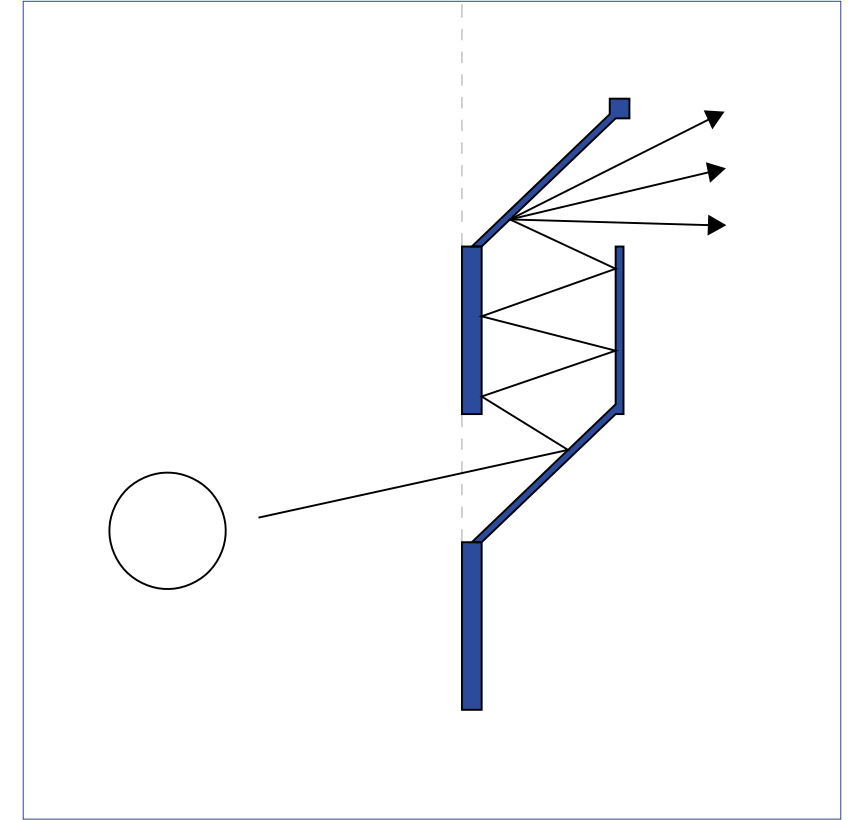
- Serve several functions
- 1- Capture and guide the light into to the common spaces



1.2 - Diagrams

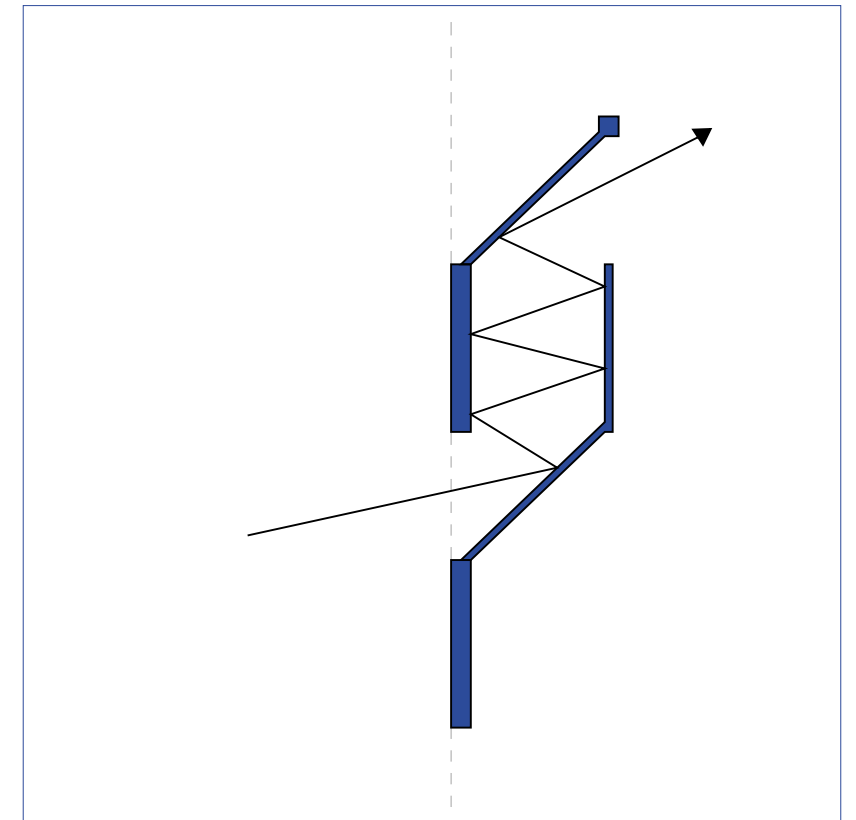
NICHE

- 2- Create ambient light at certain hours of the day



NICHE

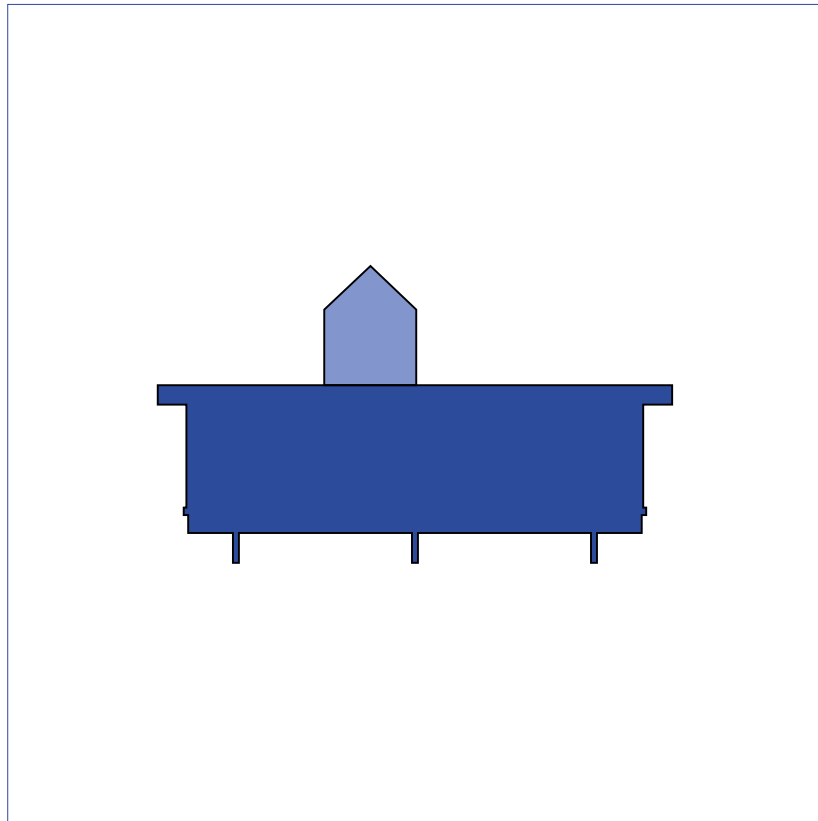
- 3- Filter the cold light through reflection within the niche before spreading filtered warm light into common spaces



1.2 - Diagrams

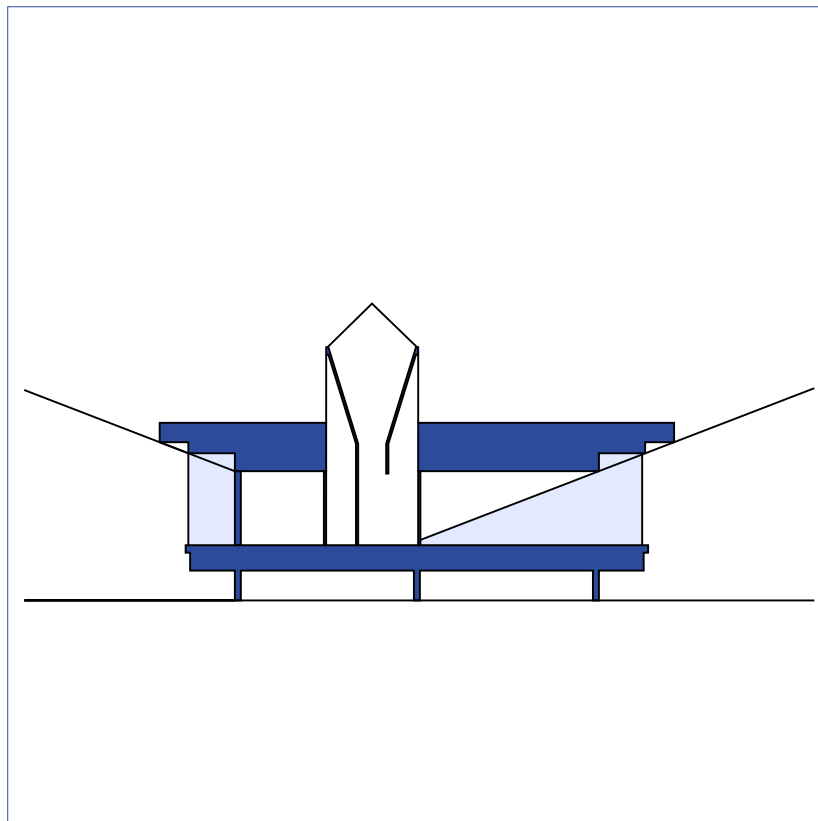
HEIGHT

- 1 storey high dwelling
- Prevents long shadows
- Part of the building that is elevated is mostly covered in glass for visual transparency



STAIR SYSTEM

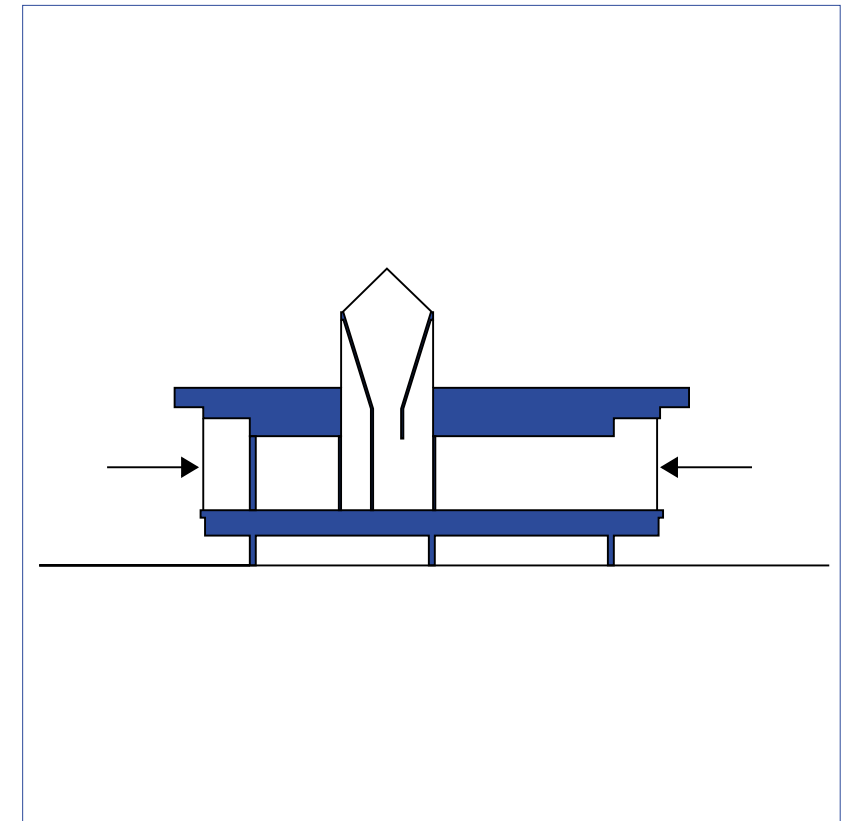
- Filter layer has 3m high ceiling
- Common spaces 2.4m
- Bathroom 8m
- Stair system allows to capture greater amount of light within the niches and prevents strong light from entering the common spaces
- Open facade captures all light during dark period



1.2 - Diagrams

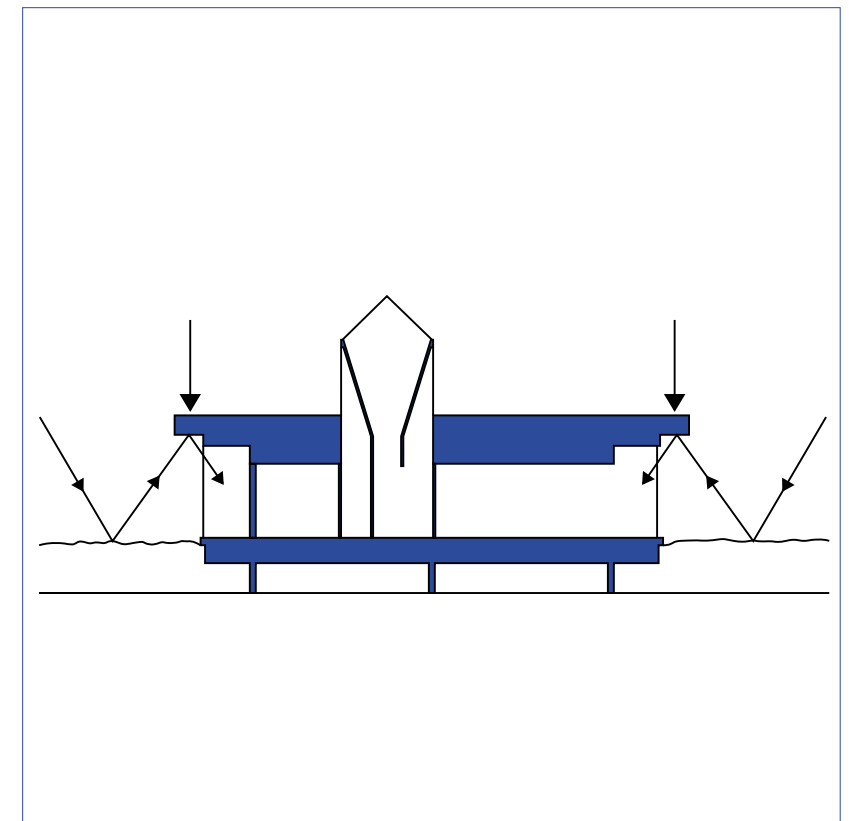
WINDOWS

- Windows from slab to slab to capture sky light and reflection from the snow on the ground



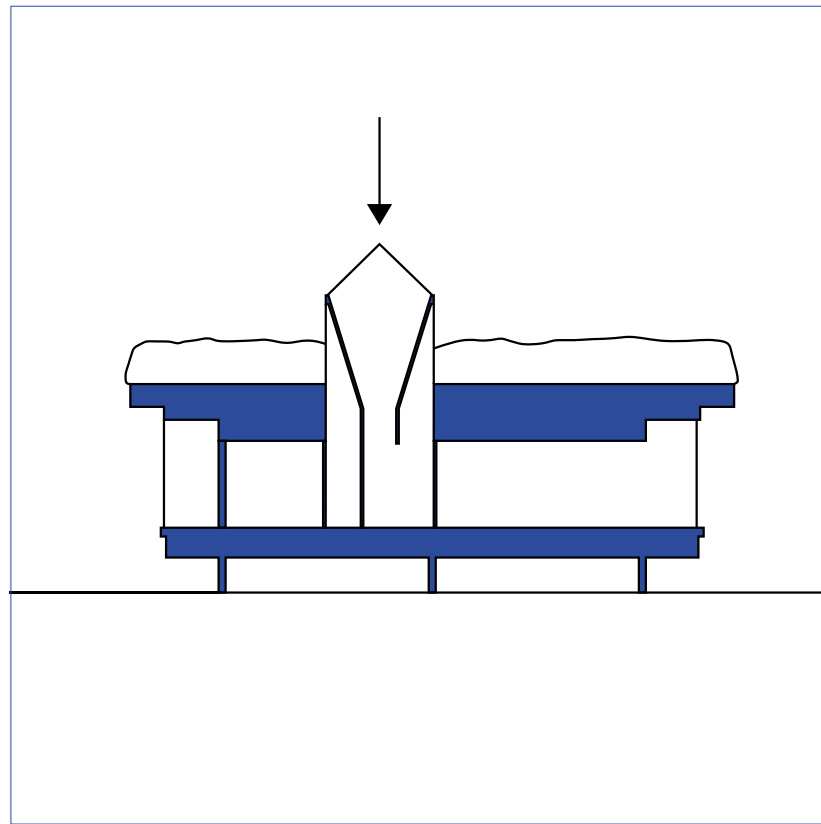
CANTILEVER ROOF

- Reflects light from the snow inside the building



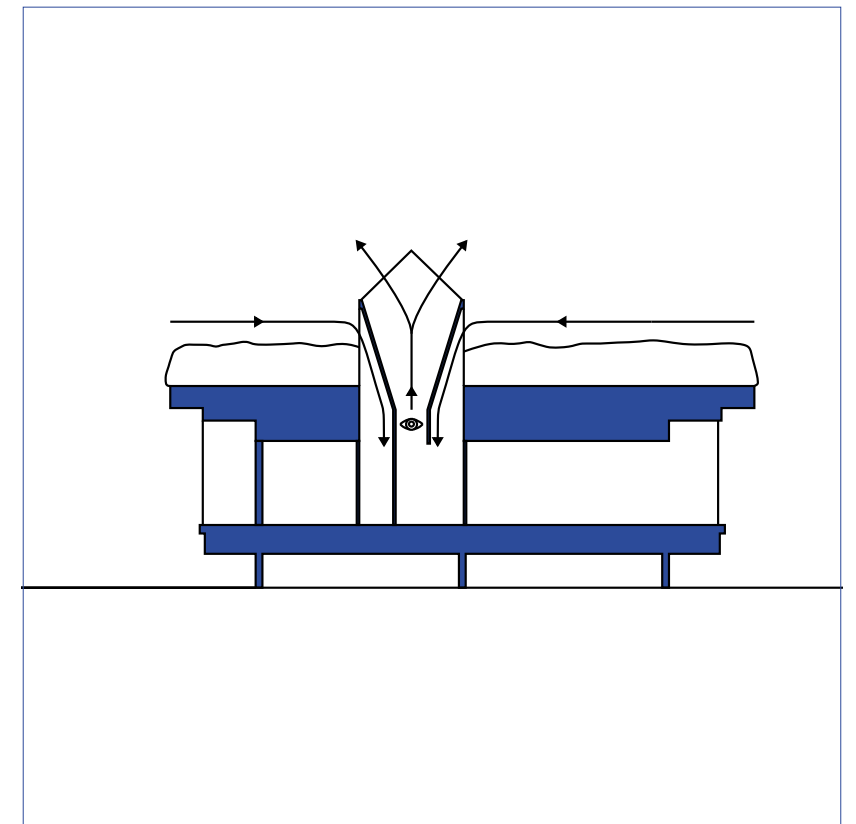
BATHROOM HEIGHT

- Due to amount of snow

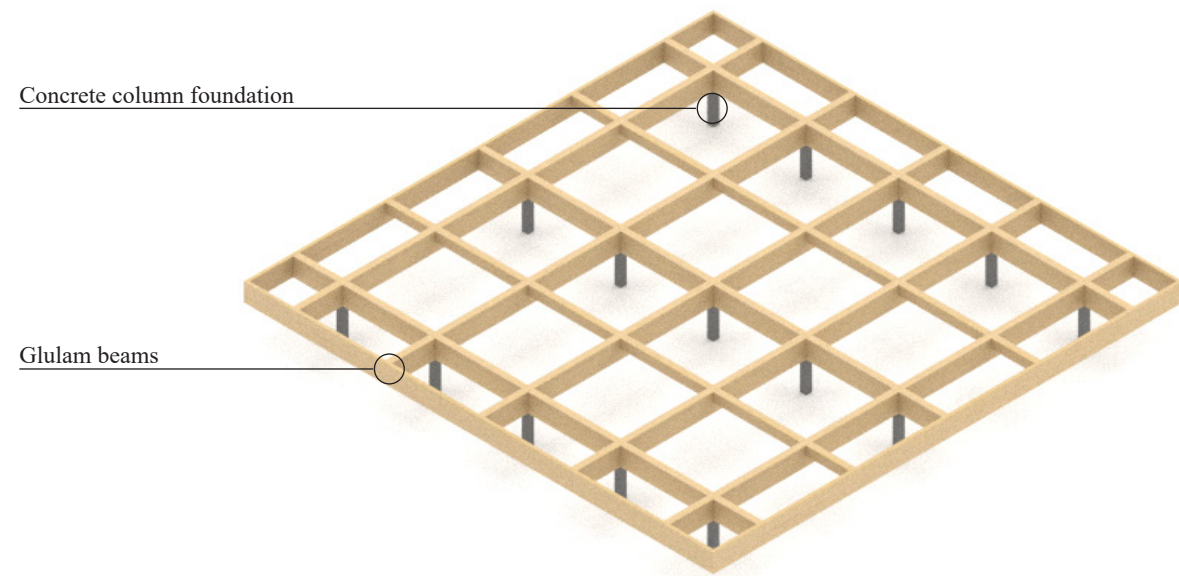


BATHROOM SHAPE

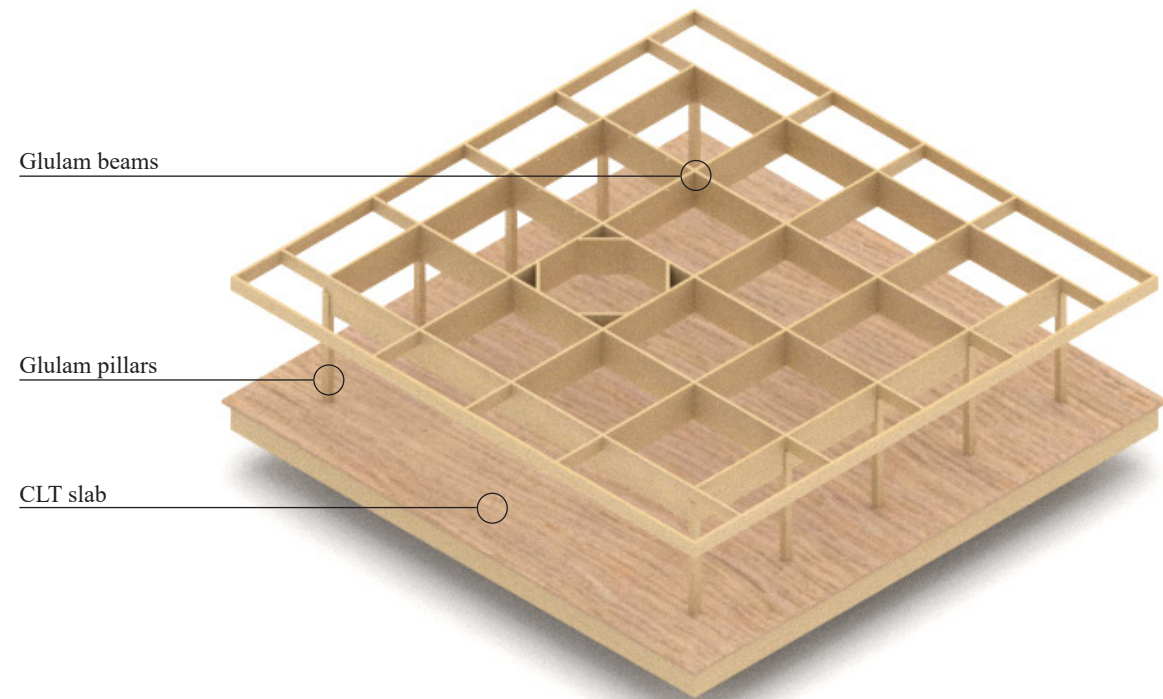
- Horizontal light from 360 degrees angle spread down to floor area
- Centered shower allows both to observe light and capture skylight



1.3 - Construction



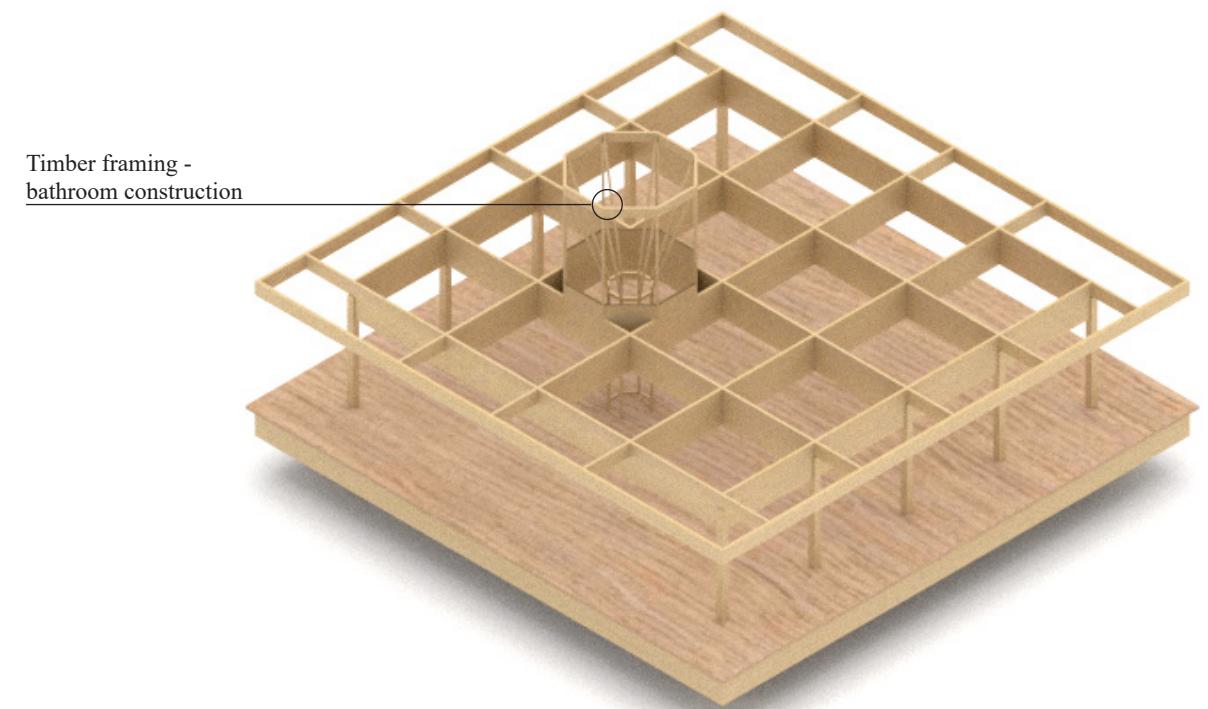
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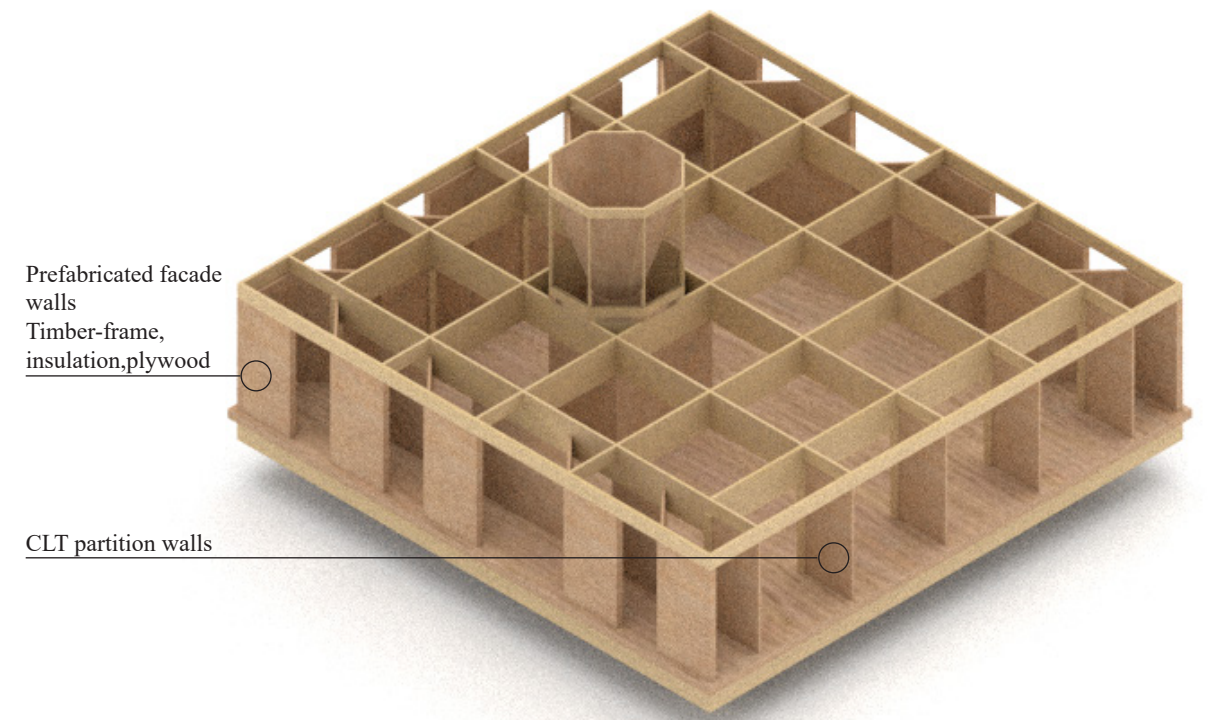
2

18

1.3 - Construction

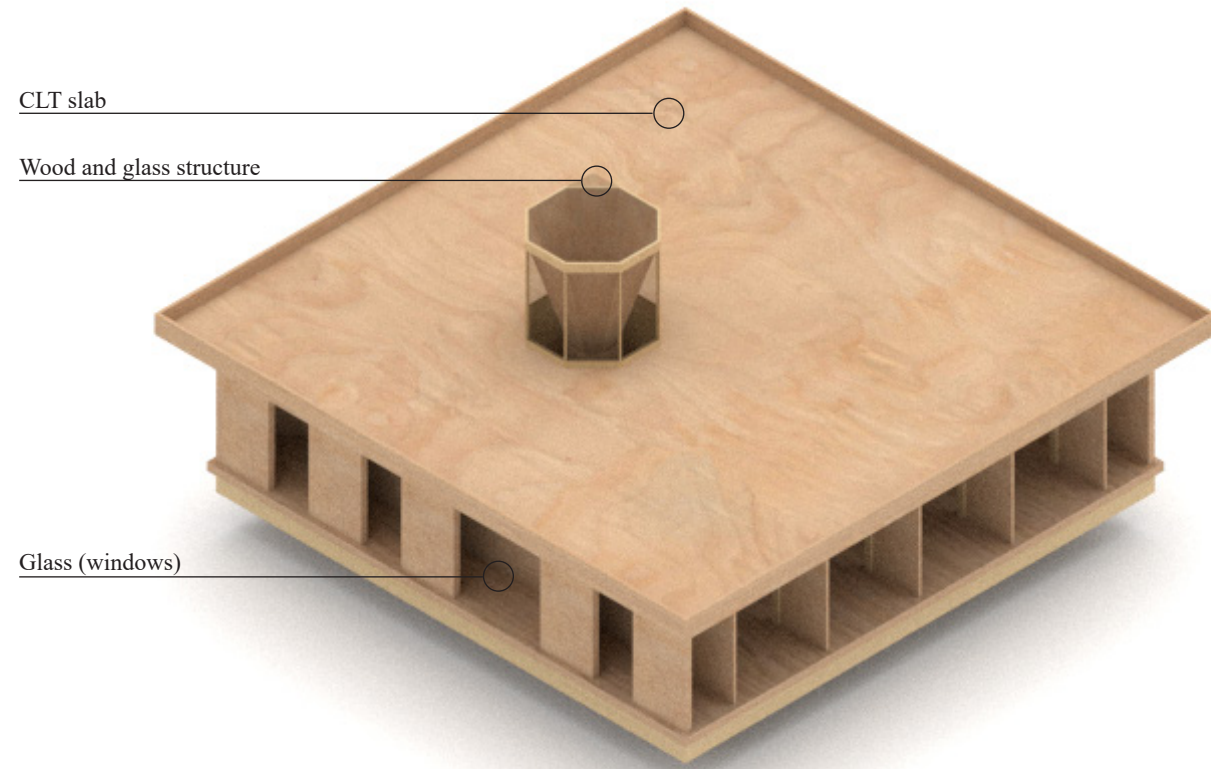


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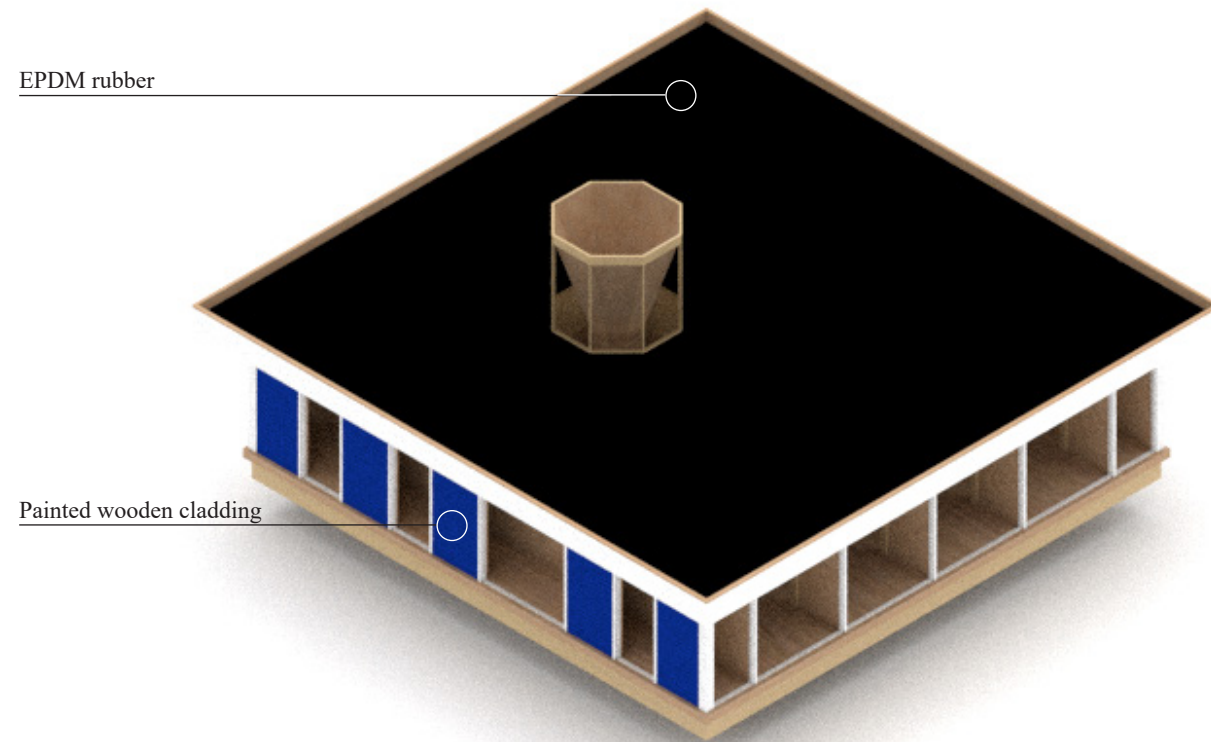


4

19



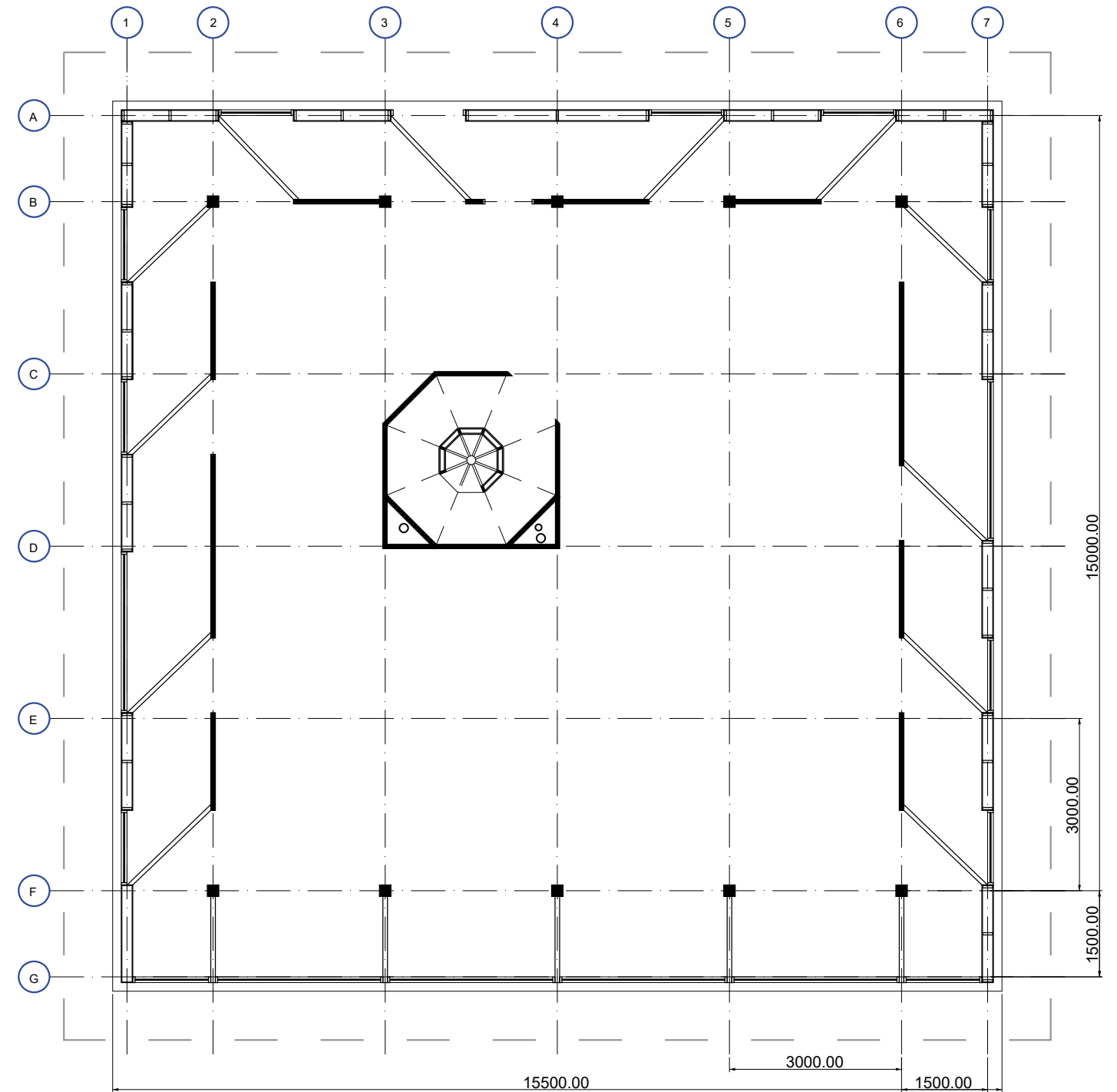
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6

20

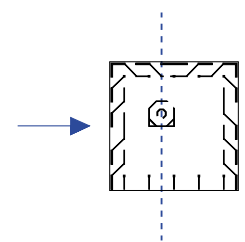
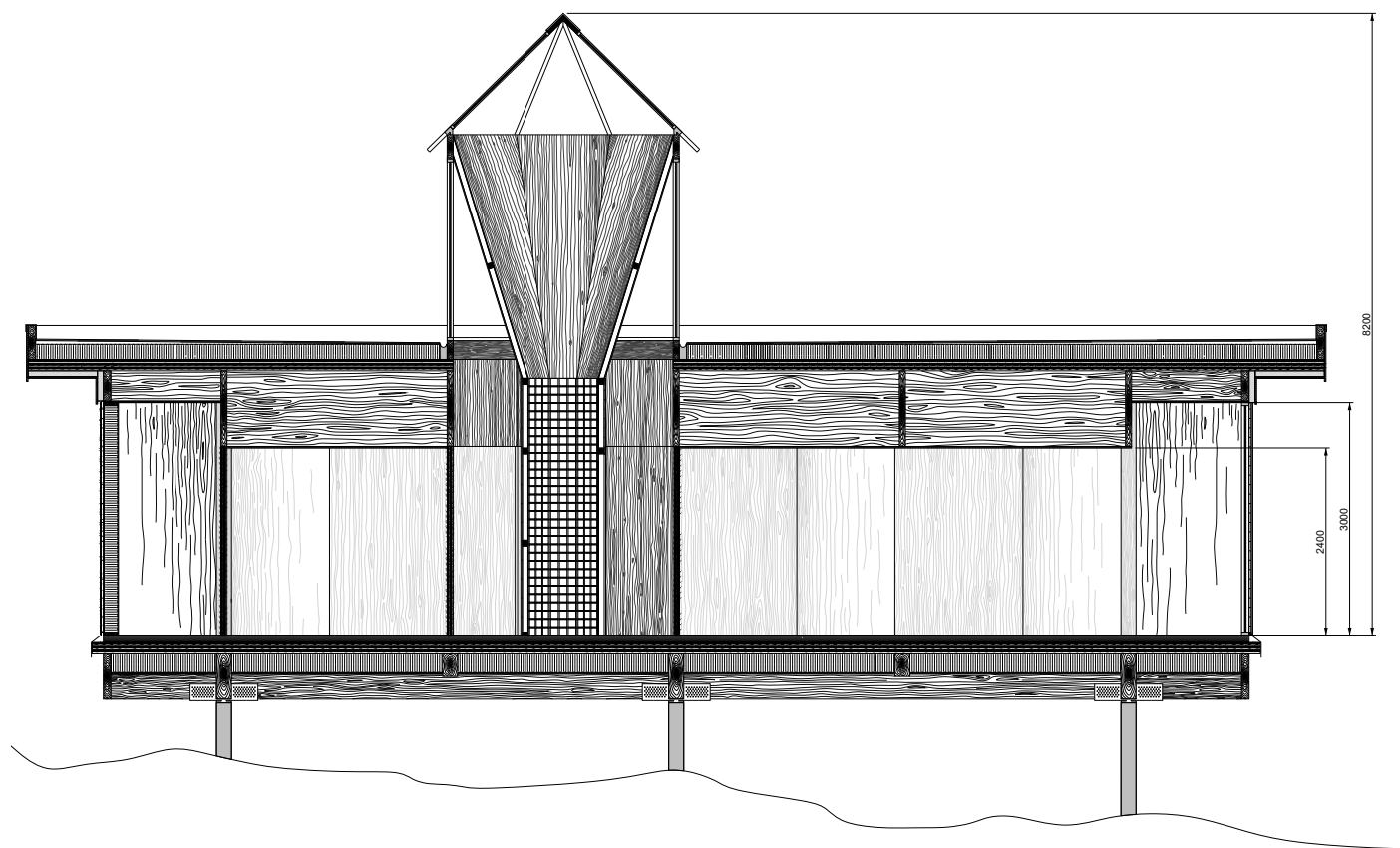
CONSTRUCTION PLAN



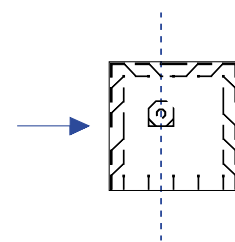
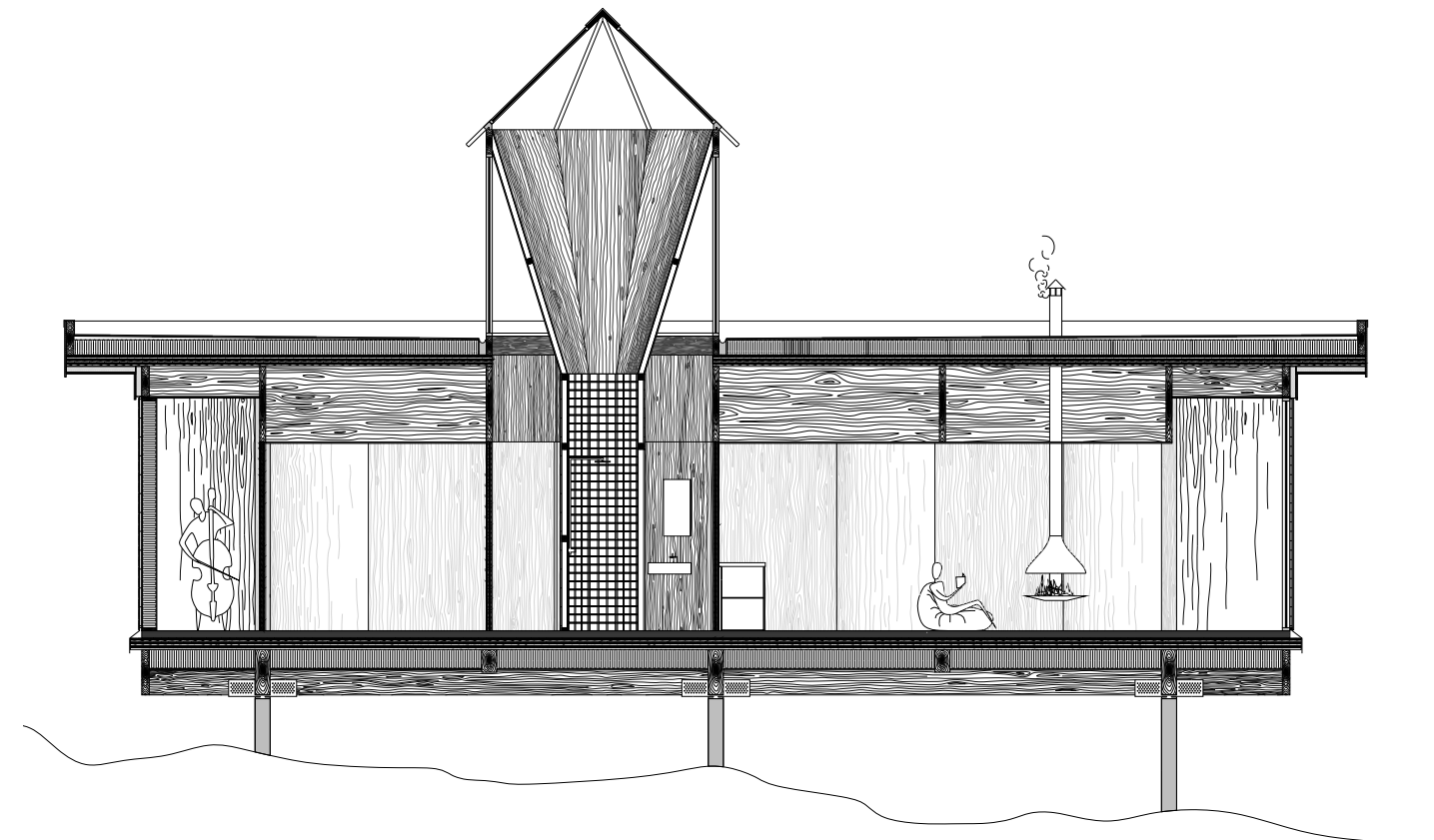
SCALE 1:100

21

SECTION

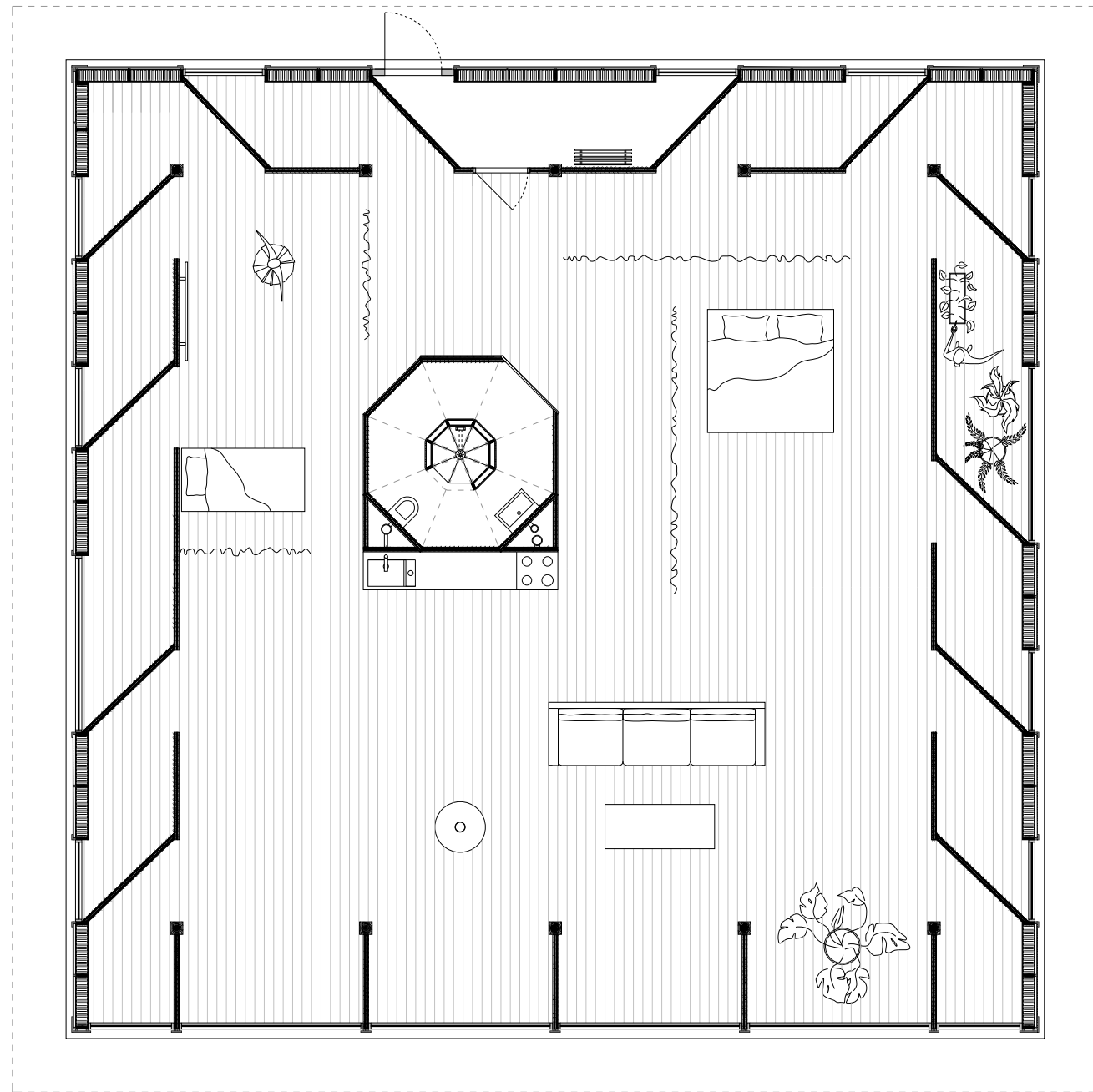


SCALE 1:100



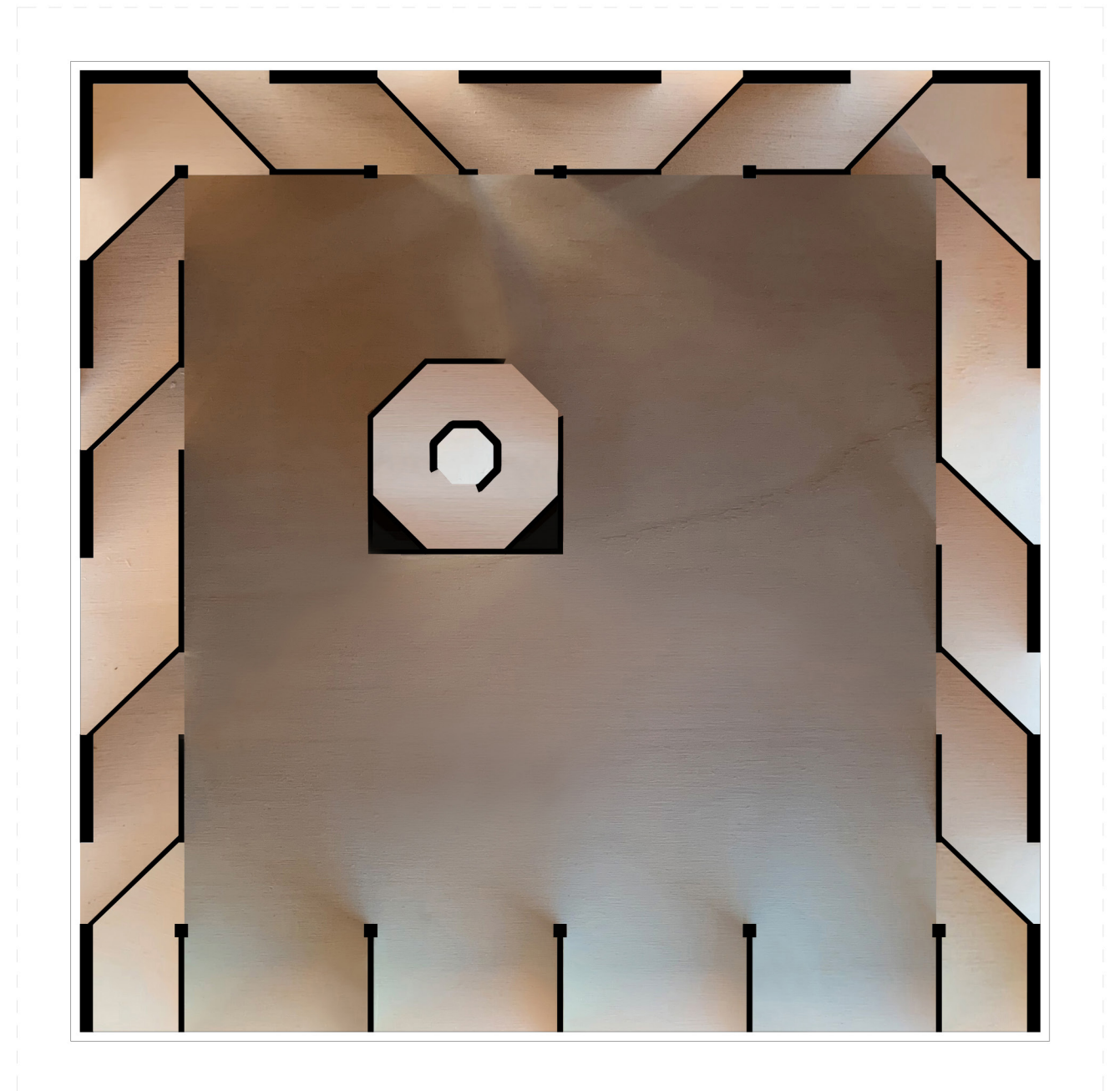
SCALE 1:100

PLAN - IMAGINARY LIFE SCENE



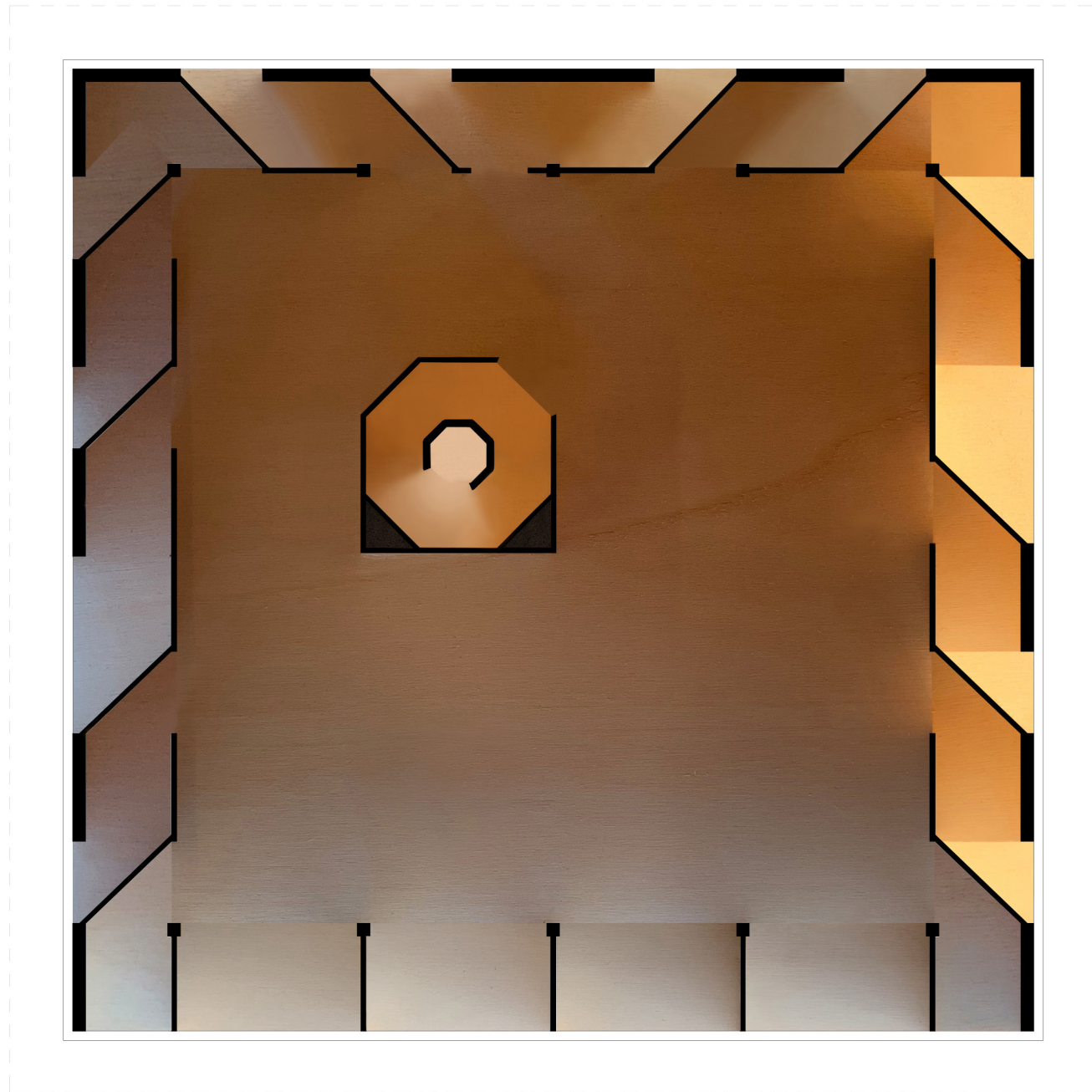
SCALE 1:100

PLAN - WINTER - SOLSTICE (MERIDIAN)



SCALE 1:100

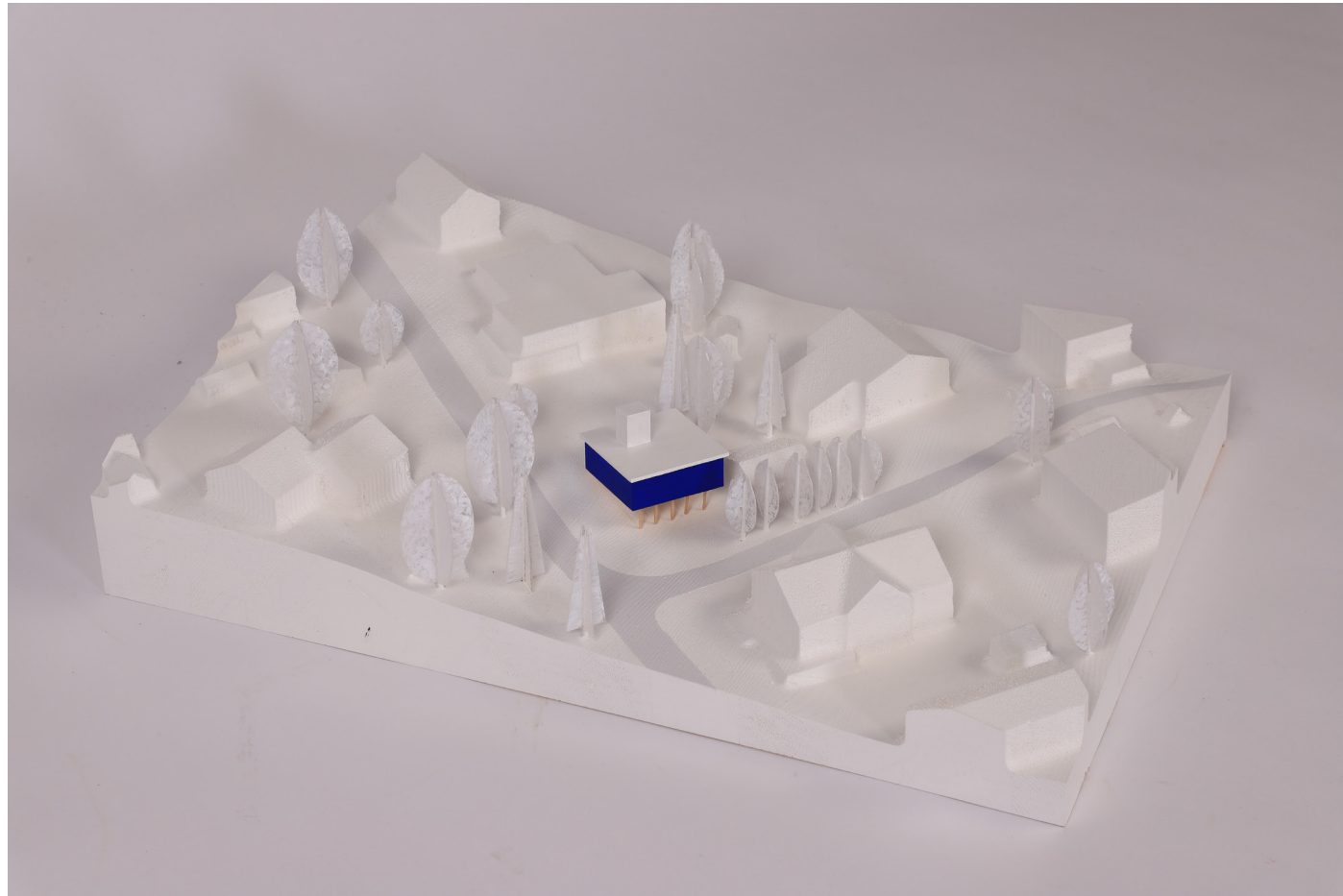
PLAN - SUMMER - SOLSTICE (MERIDIAN)



SCALE 1:100

1.6 - Specific site

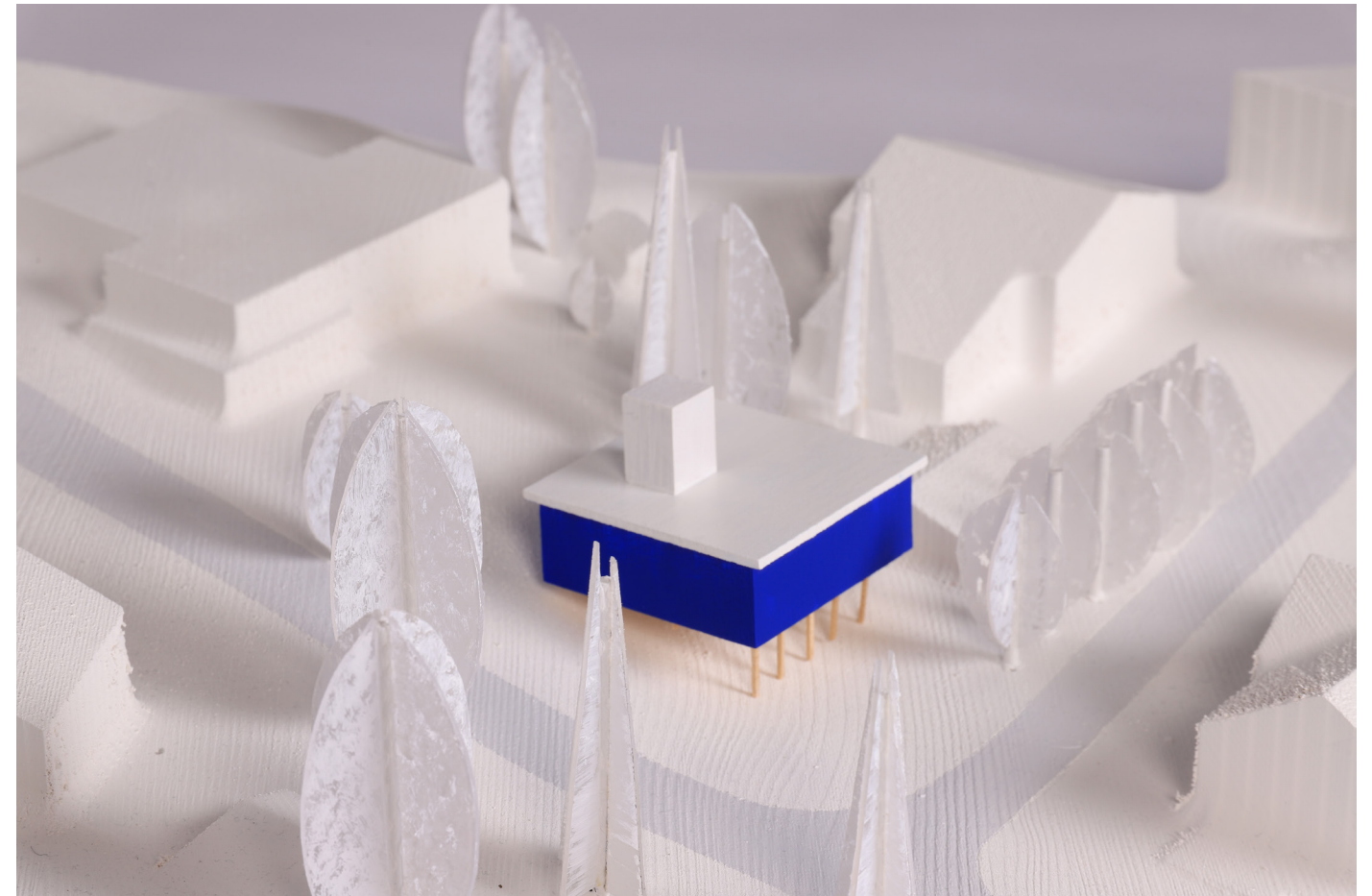
PICTURE OF THE PROJECT ON RANDOMLY CHOSEN SITE IN TROMSØ



MODEL SCALE 1:200

1.6 - Specific site

PICTURE OF THE PROJECT ON RANDOMLY CHOSEN SITE IN TROMSØ



MODEL SCALE 1:200



KITCHEN/LIVING - PINK LIGHT +
SNOW REFLECTION



KITCHEN/LIVING- PINK LIGHT +
SNOW REFLECTION



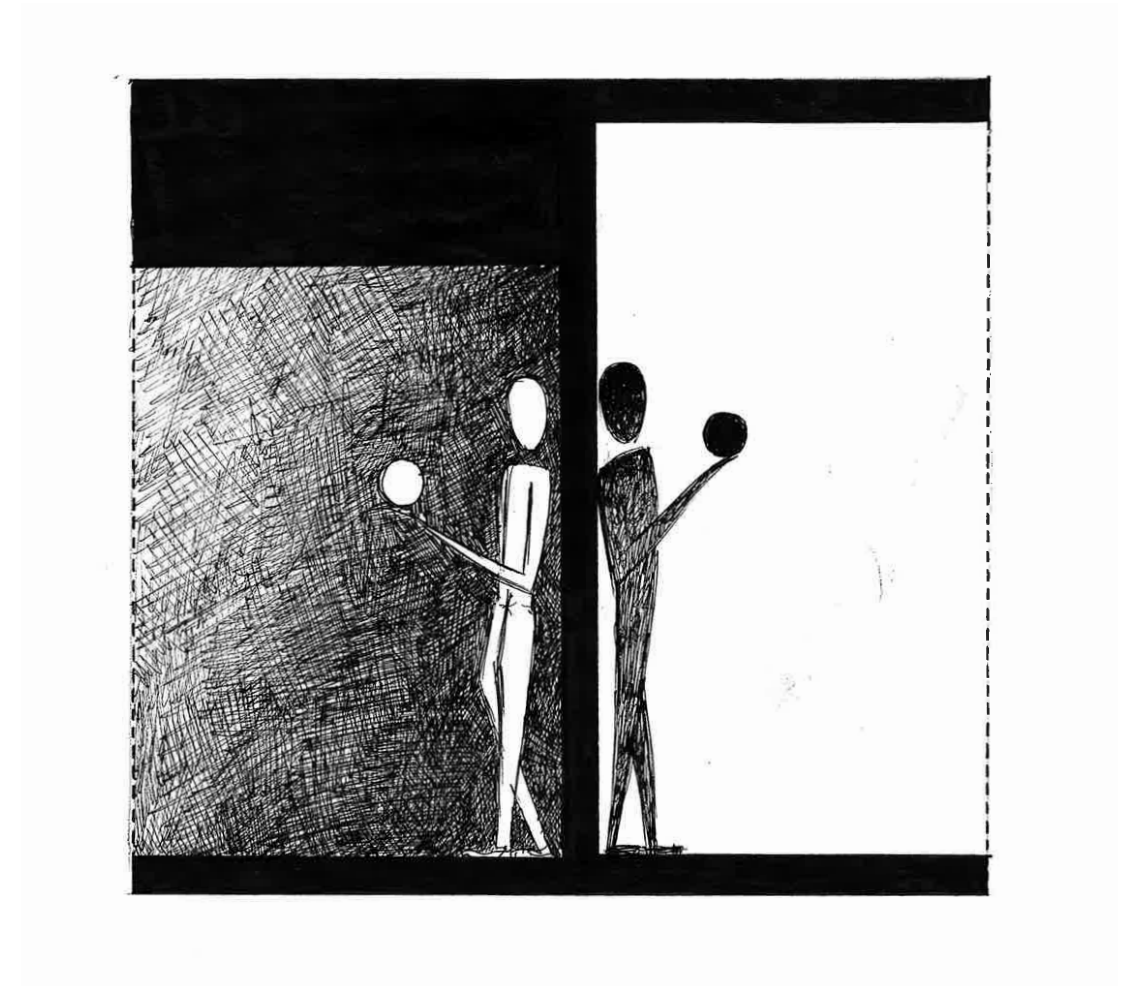
LIVING - OVERCAST DAY + SNOW REFLECTION



BATHROOM - OVERCAST DAY + SNOW REFLECTION



BATHROOM- SUNNY DAY



I'M IN SEARCH OF THE LIGHT - I'M IN SEARCH OF THE DARK



LIVING - SUNNY DAY



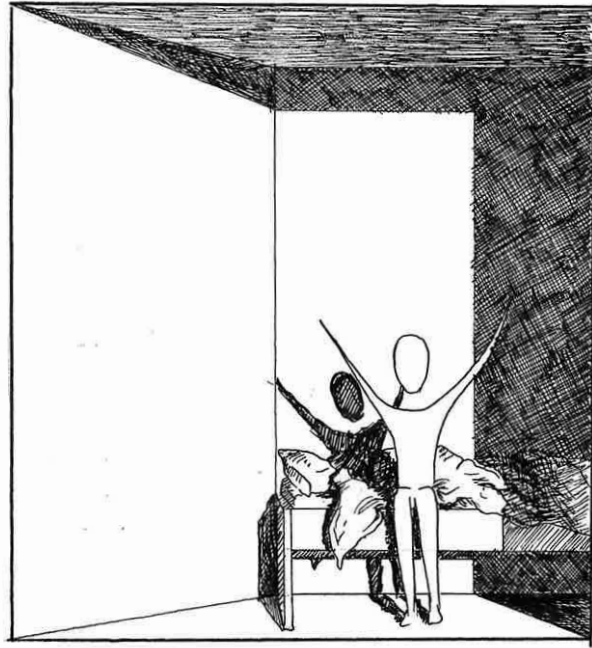
LIVING - SUNNY DAY (AMBIENT LIGHT)



LIVING - SUNNY DAY (AMBIENT LIGHT, DARKER)



LIVING - SUNNY DAY (AMBIENT LIGHT, DARKER)



SURVEY: FAVORITE ROOM AND WHY?
<<BEDROOM: WHERE ONE GET DIRECT LIGHT IN
THE MORNING, DURING SUMMER>>



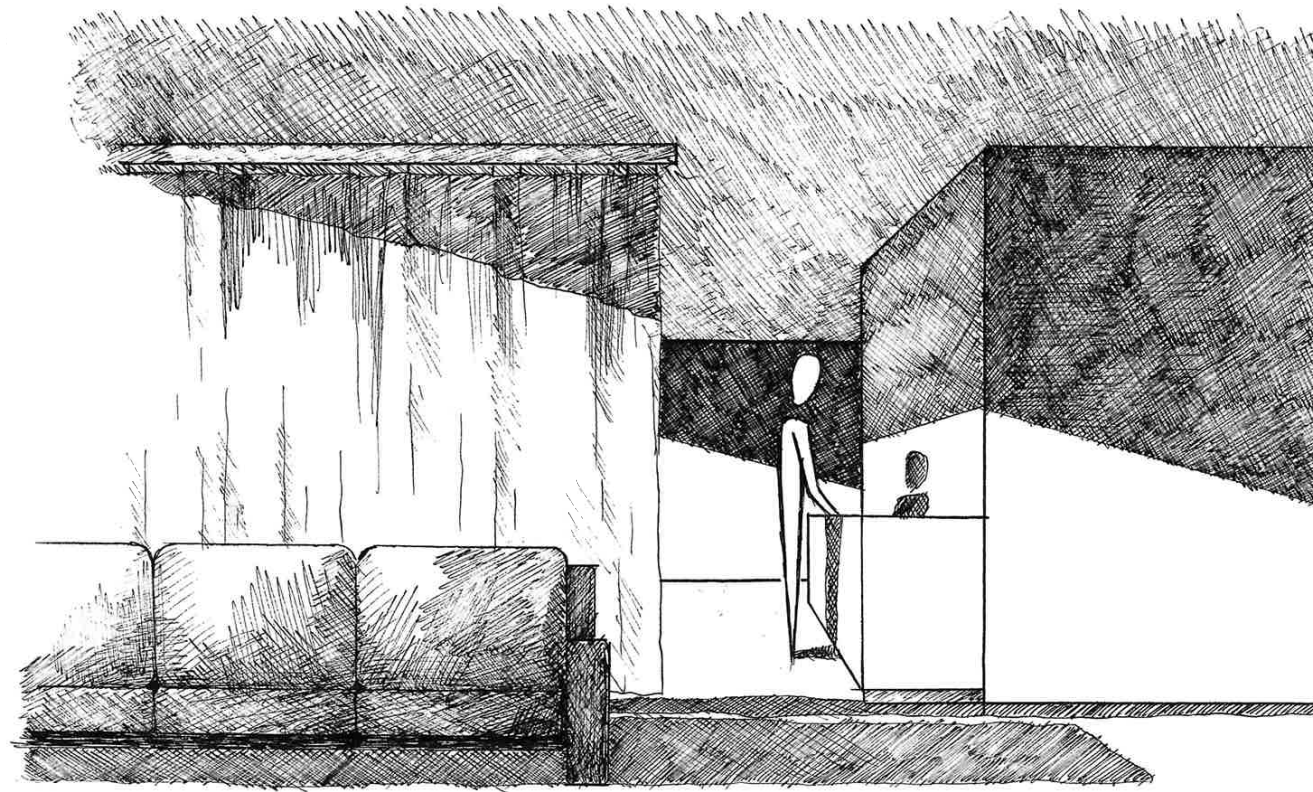
NICHE - SUNNY DAY



NICHE - OVERCAST DAY + SNOW
REFLECTION



LIVING/KITCHEN - SUNNY DAY
(MIDNIGHTSUN)



SURVEY: FAVORITE ROOM AND WHY?
<<LIVING+KITCHEN: BRIGHT, VIEW, SPACIOUS>>



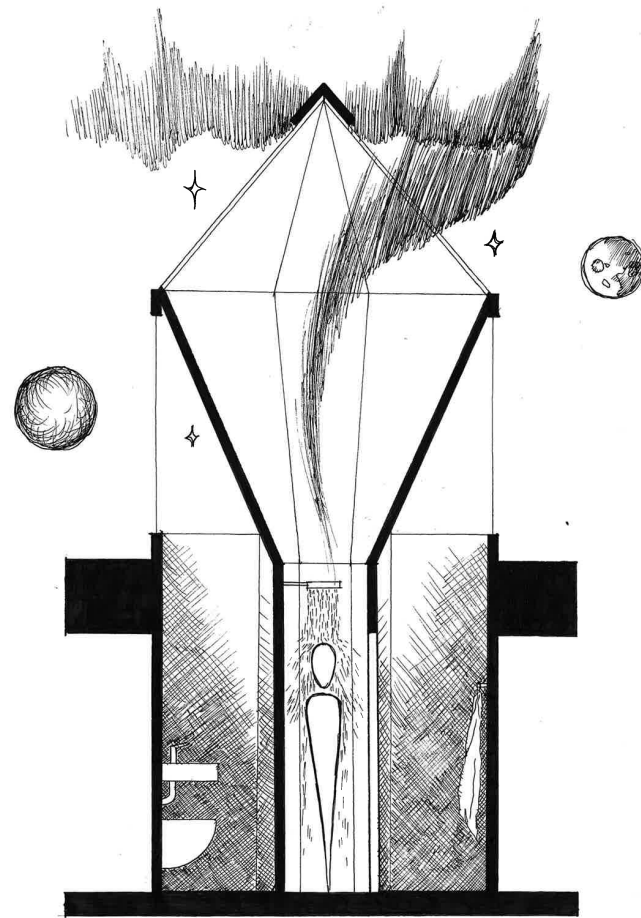
LIVING/KITCHEN - SUNNY DAY



LIVING/KITCHEN - SUNNY DAY



LIVING/ENTRANCE - SUN
RETURNING BACK AFTER DARK
PERIOD



SURVEY: LEAST FAVORITE ROOM AND WHY?
<<BATHROOM: LITTLE LIGHT, NO WINDOWS>>



SHOWER - BATHROOM - NORTHERN
LIGHTS



"DWELLING IN LIGHT"

ACKNOWLEDGEMENTS

I want to conclude by saying thank you to:

My supervisors Lisbeth Funck and Matthew Anderson for an amazing journey through these last semesters. All the interesting table talks, discussions during the reviews and last but not least the way you work.

The external supervisors: Christine Fontaine, Dagur Eggertsson and Lone Sjøli for constructive criticism to the project during the midterm reviews.

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Sakari Ekko for all the help you have given me in understanding how sun simulators work and can be built.

My partner, family and friends for being supportive, calling and keeping the spirit up.

Workshop staff for help and tips on how produce parts for all my models.

Dedicated to my mother and grandmother (Mimmi) for giving me this opportunity and inspiration for the project.

1.11 Sources

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northernnorway, <<Tromsø>>, by Unknown, read 31.08.23. <https://nordnorge.com/en/destinasjon/tromso/>

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STORE NORSKE LEKSIKON, <<TROMSØ>>, by Geir Thorsnæs; Trond Olav Svendsen and Lars Engerengen, read 09.12.23. <https://snl.no/Troms%C3%B8>

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PHOTOS & ILLUSTRATIONS
(CHAPTER 2: INTRODUCTION TO THE THEME - RESEARCH)

Fig. 1: Pedersen, David, *Paper model of solar demonstrator*.

Fig. 2: Ros M Rosa, Berthomieu Francis, *Stellar, solar and lunar demonstrator*.

Fig. 3: Ekko, Sakari, *How to build a big plywood demonstrator*.

Fig. 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 54, 56, 57, 59, 60, 62, 63, 64, 65, 72, 73, 74, 75, 76, 77, 78, 79: Pedersen, David

Fig. 24: Babb, David, <https://www.e-education.psu.edu/eme811/node/642>

Fig. 52: timeanddate, <https://www.timeanddate.no/astronomi/sol/norge/oslo>

Fig. 55: timeanddate, <https://www.timeanddate.no/astronomi/sol/@6541314?month=6&year=2023>

Fig. 58: timeanddate, <https://www.timeanddate.no/astronomi/sol/italia/milano?month=6&year=2023>

Fig. 61: Attinà, Luca, *Sun analysis in Milano*

Fig. 66: shademap, read 3.12.2023, <https://shademap.app/@69.64976,19.0285,9.73412z,1695465457648t,-0b,0p,0m!1697695845732!1697726996340,qdHJvbXPDuA==!69.6492!18.95532>

Fig. 67, 68, 69, 70, 71: Ekko, Sakari

Fig. 80: Anders Askevold, *Interiør fra en årestue*, Askevold, Anders. Maleri 1875. Nasjonalmuseet. 09.12.23, <https://www.nasjonalmuseet.no/samlingen/objekt/NG.M.01821>

Fig. 81: Groven, Harald, *Grønnegata 21-23, Tromsø*, https://no.wikipedia.org/wiki/Gr%C3%B8nnegata_%28Troms%C3%B8%29#/media/Fil:Gr%C3%B8nnegata_21-23,_Troms%C3%B8.JPG

Fig. 83: Fig. 83: Guillaume BXL, <https://hicarquitectura.com/2023/07/juliaan-lampens-villa-van-wassenhove-1973/>

Fig. 84: Fig. 84: Unknown photographer, <https://hiddenarchitecture.net/villa-van-wassenhove/>

Fig. 85: Fig. 84: Unknown photographer, <https://hiddenarchitecture.net/villa-van-wassenhove/>

Fig. 86: Schapochnik, Fernando, Flickr elyullo (CC BY), Samuel Ludwig, Maria Gonzalez, <https://www.archdaily.com/96824/ad-classics-convent-of-la-tourette-le-corbusier>

Fig. 87: Unknown photographer, <https://www.artchitectours.com/tour/la-tourette-corbusier/>

Fig. 88: From: *Cosmos of light: The sacred Architecture of Le Corbusier. 98*

Fig. 89: From: *Cosmos of light: The sacred Architecture of Le Corbusier. 101*

PHOTOS AND ILLUSTRATIONS
(CHAPTER 1: INTRODUCTION TO ARCTIC & TROMSØ)

Fig.1: Perspektivet Museum, *Måne over Tromsdalstinden*, Tromsdalen og Tromsdalstinden sett fra Tromsøya. 1955. <https://www.flickr.com/photos/perspektivmuseum/7087173365/in/album-72157634246871890/>

Fig.2: Pedersen David, <<FULL MOON DURING POLAR NIGHT>>. Scan of aquarelle painting.

Fig.3: Pedersen David, <<POLAR NIGHT>>. Scan of aquarelle painting.

Fig.4: Pedersen David. <<POLAR DAY-MIDNIGHTSUN>>. Scan of aquarelle painting.

Fig.5: Pedersen David. <<AURORA BOREALIS - DURING POLAR NIGHT>>. Scan of aquarelle painting.

Fig: 6, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28 and 29: Pedersen David. Field trip august 2023.

Fig: 7, 8, 9, 10, 11, 16 and 17: Pedersen David. Private trip december 2021.

