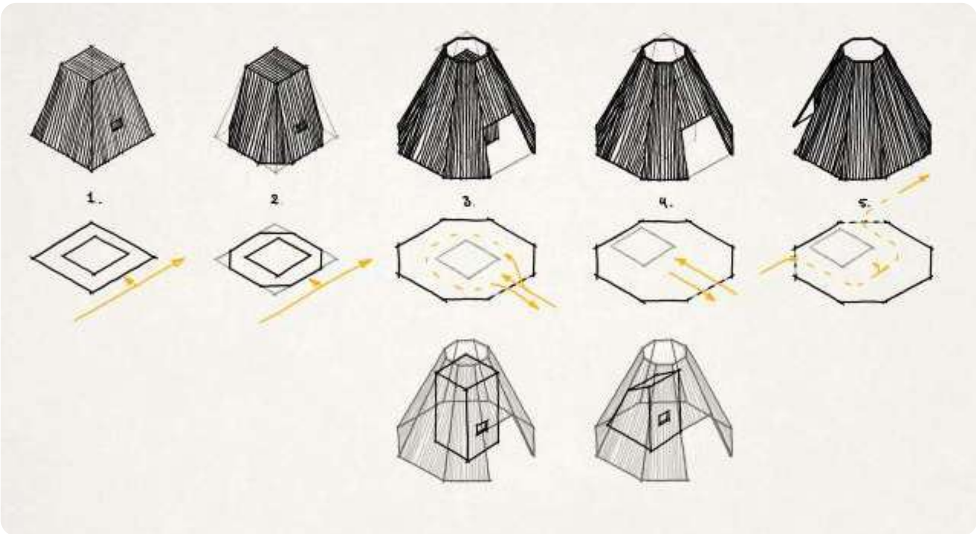
Lávvu

Team 4A

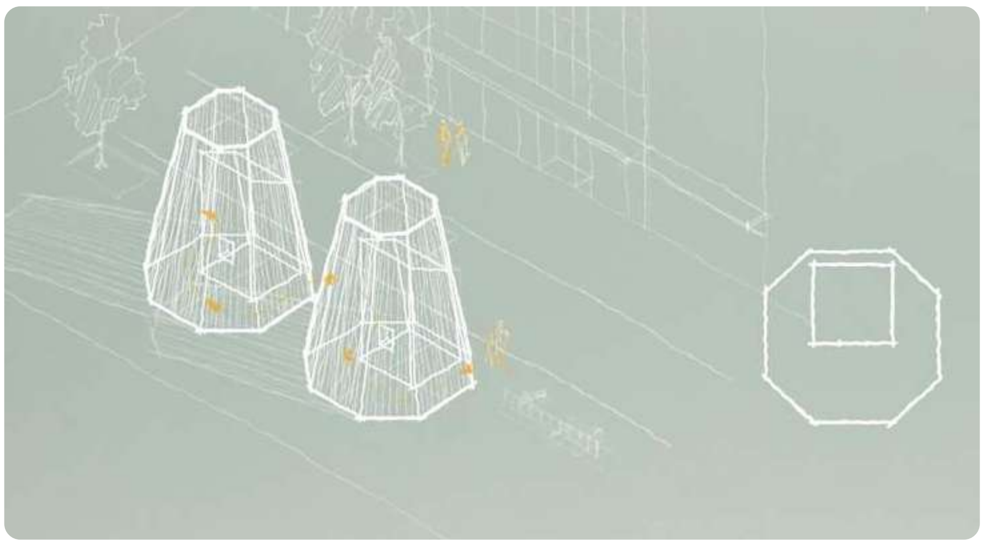
Ice Box Challenge
Sweden 2025

Architecture

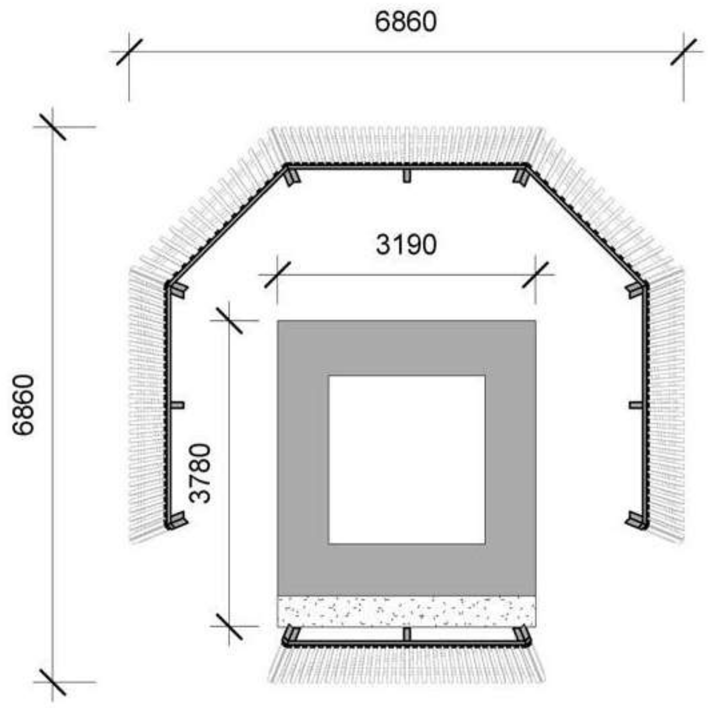
We are proud to present the contribution to the Ice Box Challenge 2025. The design combines tradition, innovation, and sustainability to meet the demands of a Nordic climate and passive house standards. Inspired by the northern climate and building traditions with sustainable innovation, the goal is to broaden the perception and viability of passive houses. Innovative construction solutions were developed, and materials for the boxes were carefully selected, exploring various shapes to optimize thermodynamic conditions and airflow.

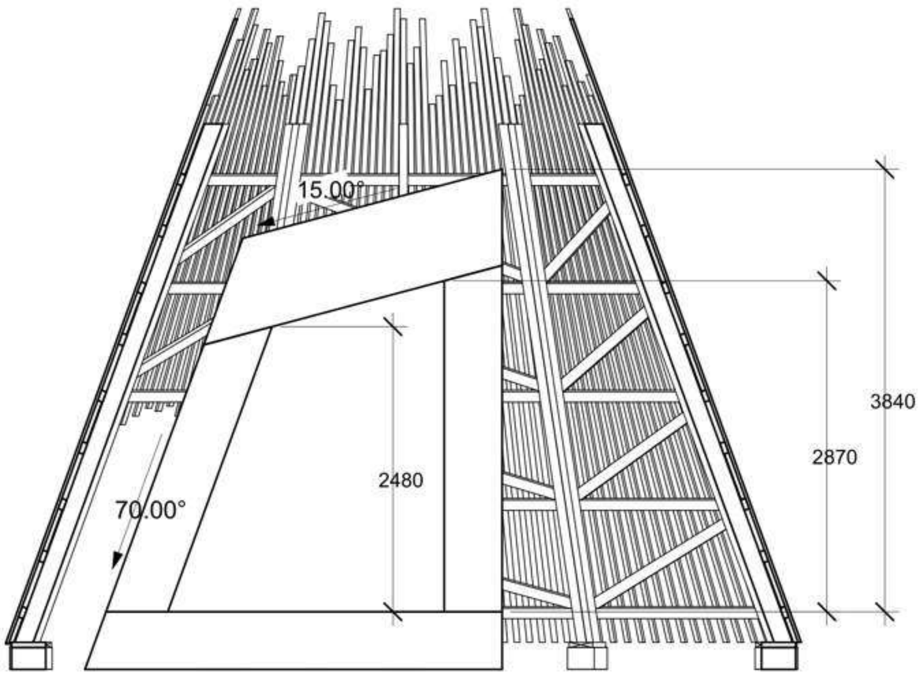


Concept development



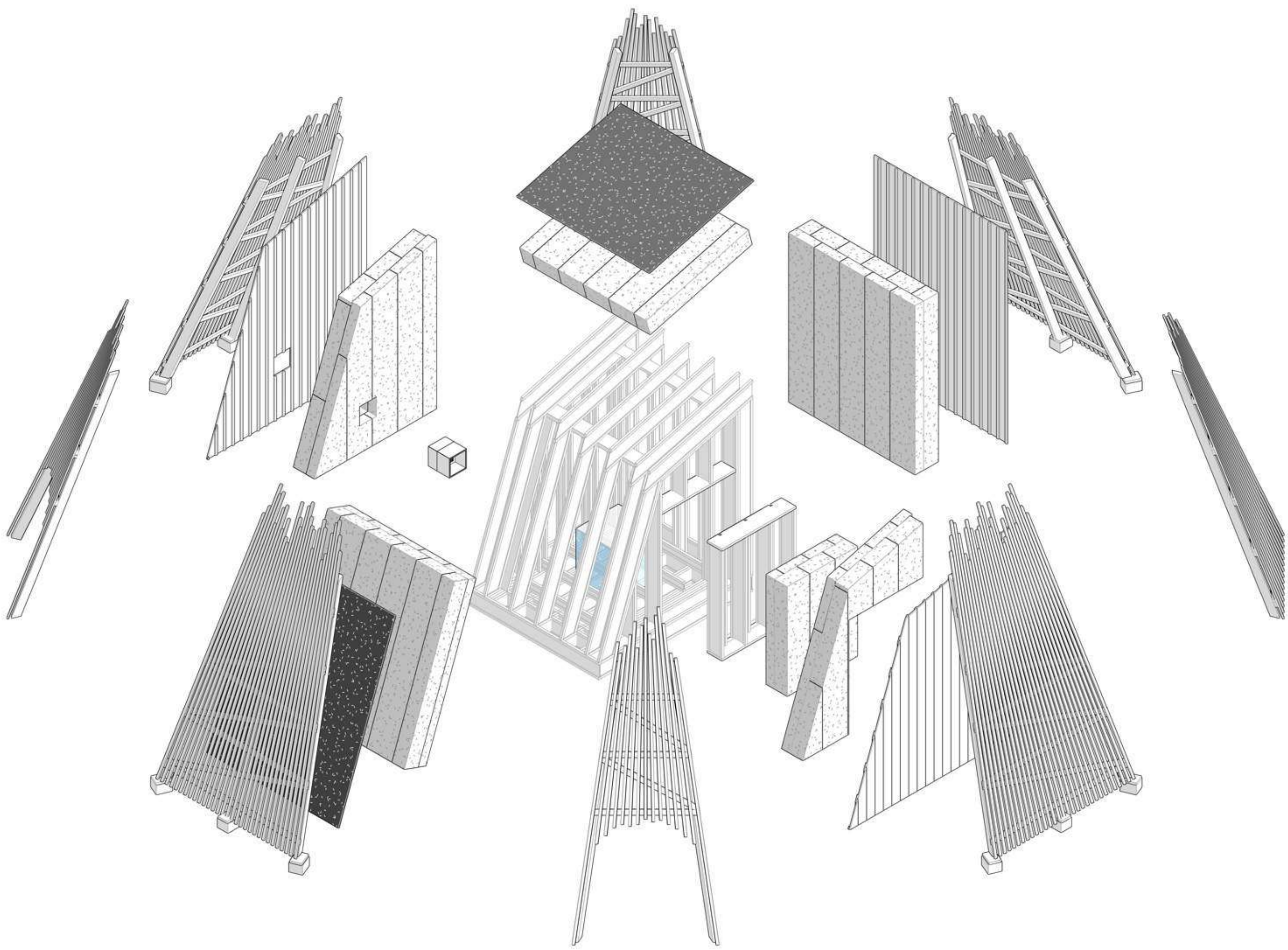
Placement at exhibition site





Sections with measurements (mm)

Constructability



By using Masonite Beams' lightweight timber frames in combination with cellulose insulation from iCell, structure that is both energy- and space efficient was achieved. By alternating two framing layers with loose wool, thermal bridges through the box were minimized.

Simple and traditional techniques were employed to facilitate implementation into the project. The framing system for both boxes is carefully planned to allow easy reference to the model during the building process.

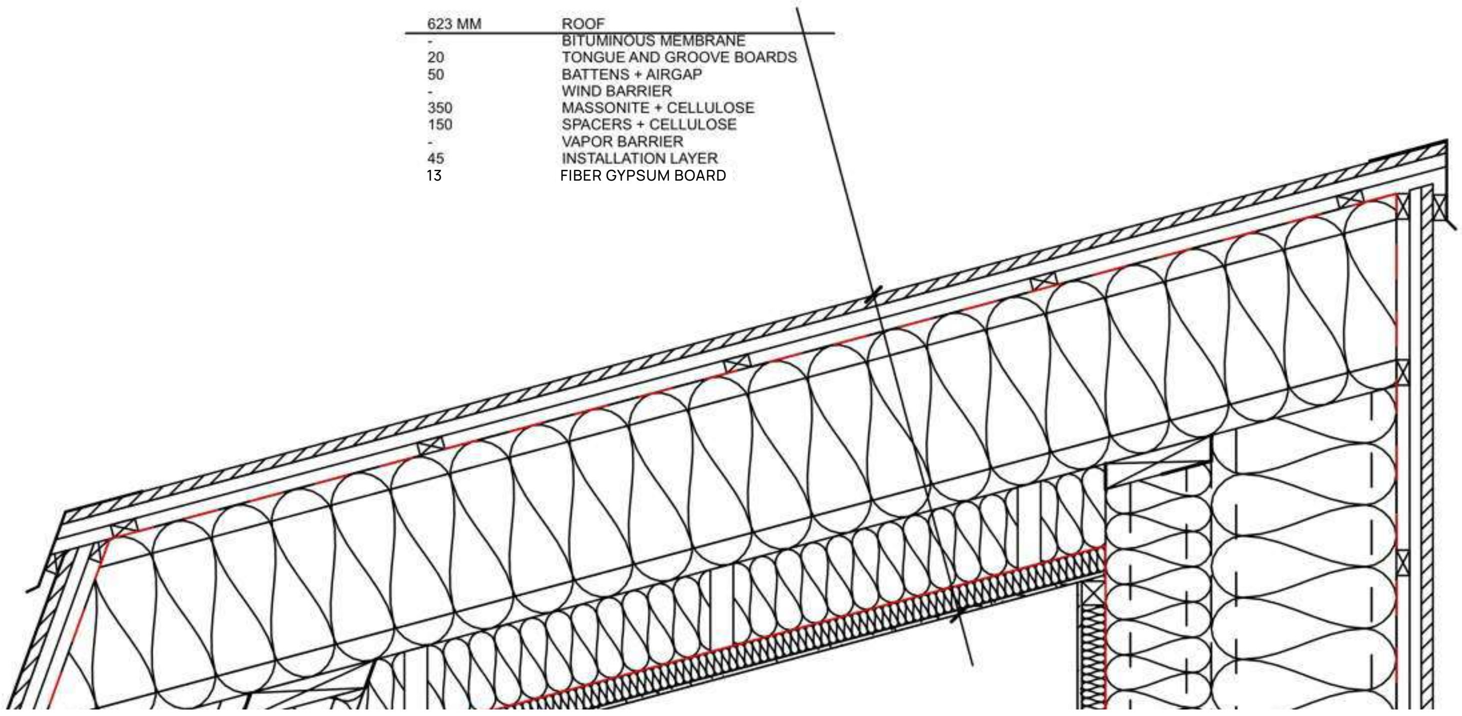
Deconstructability

Sustainability and reuse have been key priorities throughout the project. It was important for us early on to learn how reuse is applied in today's construction industry and integrate this knowledge into our project. As you can see in the exploded view, we have incorporated a detachable part that makes it easy to insert the ice cube and disassemble for reuse later.

In collaboration with the municipality and the County Administrative Board, it has been ensured that the competition entries can be repurposed as wind shelters and overnight cabins for field staff in national parks after the competition.

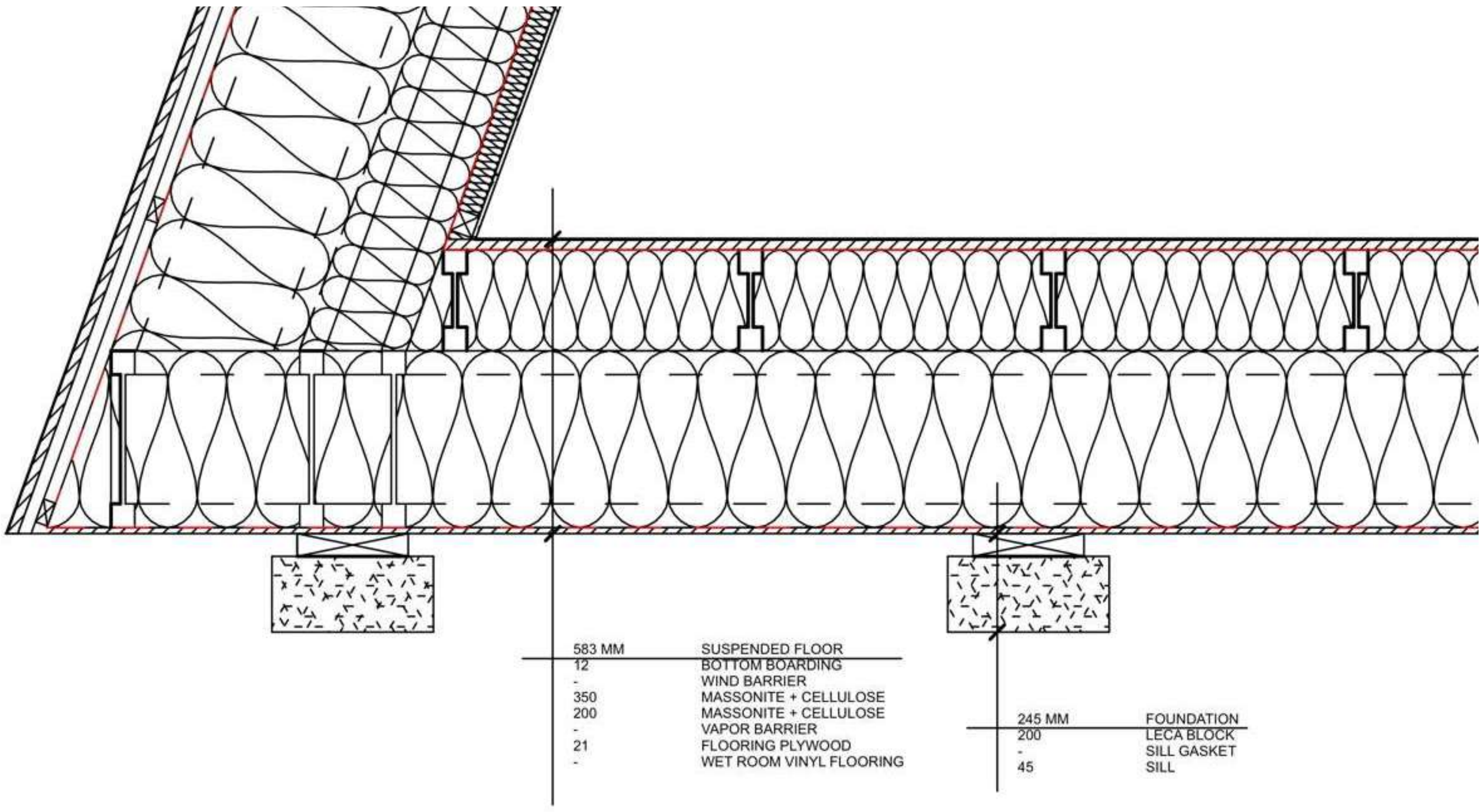
Details

Passivehouse



Roof detail

The roof has a 15-degree slope and is constructed with three insulating layers. The outer layer is made of Masonite beams, which act as a lid and extend over all four walls to minimize thermal bridges at the outer corners. The middle layer is fastened to the outer layer using spacer sleeves and is specifically designed to eliminate thermal bridging. Beneath this, a vapor barrier is placed, followed by an installation layer, which allows for future reuse by providing a surface where lamps and other equipment can be attached.

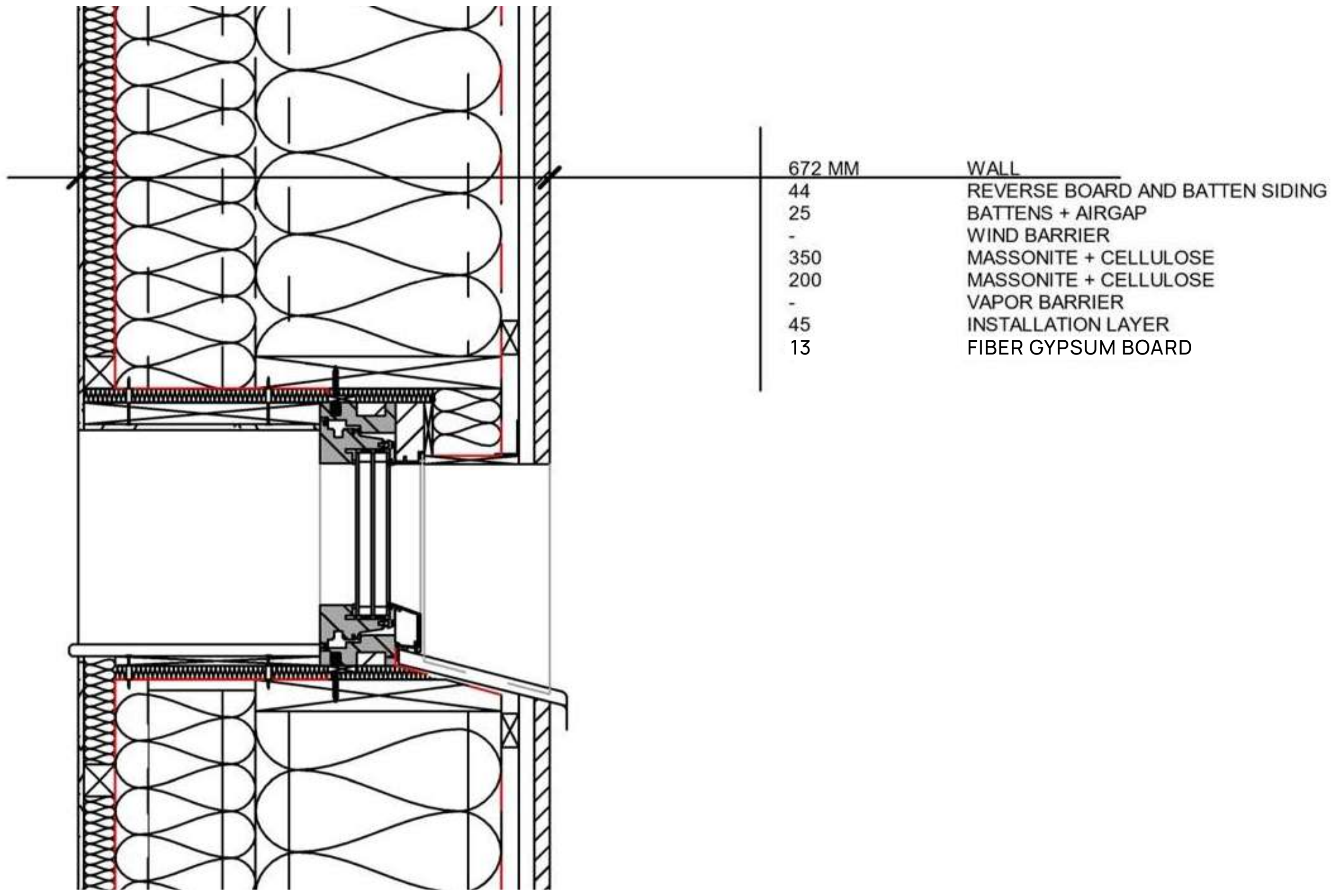


Foundation and floor detail

The floor is constructed with masonite beams and two layers of insulation. The lower layer covers the entire bottom, while the inner layer is placed within the four walls. This design minimizes thermal bridging. The foundation is made up of concrete footings, which elevate the structure above the ground and allow for proper ventilation.

Details

Passivehouse



Wall and window detail

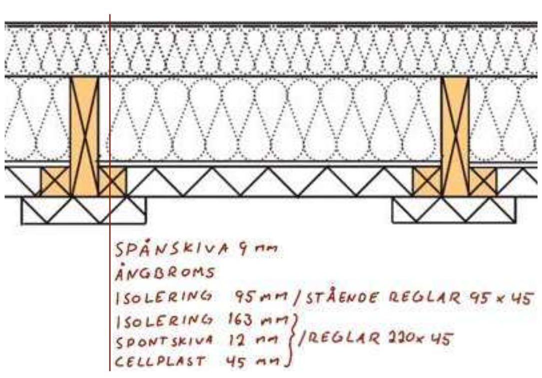
Thermal conductivity

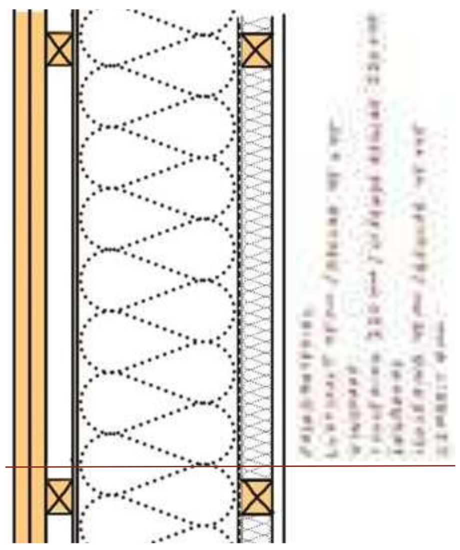
	(W/(m·K))
BOTTOM BOARDING	0.140
VAPOR BARRIER	N/A
FLOORING PLYWOOD	0.140
WET ROOM VINYL FLOORING	0.200
BATTENS	0.120
WIND BARRIER	N/A
MASSONITE	0.130
CELLULOSE	0.039
VAPOR BARRIER	N/A
FIBER GYPSUM BOARD	0.250

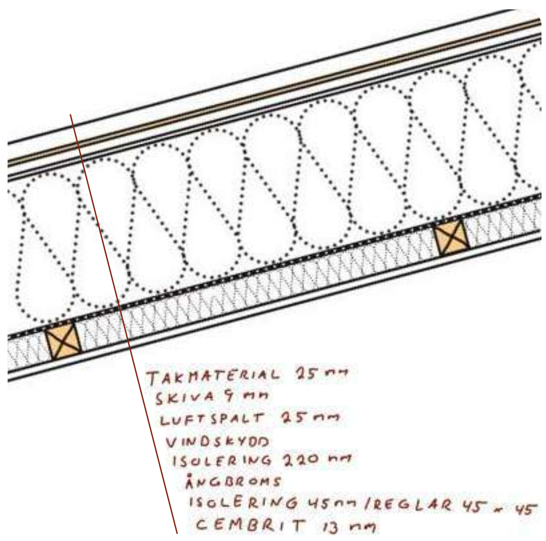
The wall is constructed with three layers of insulation. The inner layer serves as an installation layer, allowing for drilling into the wall for future reuse without compromising the vapor barrier and airtightness. The two outer layers consist of masonite beams and loose-fill insulation, with the studs arranged in an overlapping pattern to minimize thermal bridging.

In addition, distance sleeves have been incorporated for both the window reveal and the upper reveal to further minimize thermal bridging. The window itself is designed to meet passive house standards, with an argon layer and a low U-value to provide enhanced insulation. Proper fastening is crucial to maintain airtightness and ensure the overall efficiency of the building envelope.

Code Compliant







Examples inspired by Träguiden

The BBR box is constructed in accordance with BBR standards, following the guidelines outlined in Träguiden. Minor modifications have been made to adapt to the design, but the functionality and properties remain unchanged.

Materials

Roofing felt

The choice of roofing material was roofing felt, as it offers several practical advantages. It is easy to install, allowing us to complete the installation independently. Additionally, roofing felt is simple to repair and replace, making it a suitable choice for future reuse.

Particle board

Particleboard is used as a stable and durable subfloor to provide a solid foundation for securing the flooring. Additionally, it helps distribute the weight from the load point to the surrounding floor joists.

Facade paneling

An inverted wooden cladding panel treated with iron vitriol. With a modern, sleek appearance and practical use, the unique panel arrangement makes an additional air gap behind the cladding, improving ventilation and moisture management, without increasing the wall thickness.

Vinyl flooring

Vinyl flooring was chosen for its waterproof properties, ensuring that it won't damage the floor underneath. This durability makes it a practical choice for future reuse, as it can withstand moisture and continues to perform well over time.

Vapor barrier

Intello plus, taped with tescon vana
A vapor barrier from Proclima has been selected to ensure that moisture movement can occur within the box. This is essential since the box is intended for reuse in a cold climate. The vapor barrier is designed to remain unbroken at all times, providing a continuous and complete seal.

Windproofing membrane

Roof and wall: Solitex mento 3000 connect
Foundation: Solitex adhero 3000
The windproofing membrane is sourced from Proclima, with different types selected based on the specific components to ensure the correct properties and functionality. The membrane is also designed to be fully enveloping around the box, providing comprehensive protection.

Passivehouse Specific

Fiber gypsum board

Fiber gypsum boards are more water-resistant than standard gypsum boards, allowing for reuse without replacing moisture-damaged wall cladding. They are also a more climate-friendly alternative to other moisture-resistant materials.

Masonite Beams

Masonite beam was chosen for its ability to reduce material usage while maintaining structural integrity. Its design helps minimize thermal bridging, improving overall insulation efficiency.

Cellulose isolation

ICell insulation was selected due to its eco-friendly composition, derived from recycled newspaper produced from spruce and pine. The loose-fill form minimizes the risk of thermal bridging when used in conjunction with the Masonite beam. Furthermore, the hygroscopic properties of cellulose aid in moisture evaporation and reduce skin irritation, improving overall workability.

Anti-fungal treated plywood

The floor incorporates anti-fungal treated plywood to prevent moisture-related damage to the foundation. This treatment enhances durability by reducing the risk of mold, rot, and other humidity-induced issues. Since the boxes are intended for outdoor reuse, this material choice helps ensure a long lifespan and sustained structural integrity.

Code Compliant Specific

Extruded polysterene

Extruded polystyrene (XPS) is used at the base of the BBR box, as it complies with standard regulations while also providing moisture resistance similar to the treated plywood. This helps prevent humidity-related issues, contributing to a durable and long-lasting construction.

Gypsum board

The interior of the BBR box is lined with gypsum board in accordance with Swedish building standards.

Reused Materials

Reused materials have been chosen wherever possible to promote sustainable development and minimize the carbon footprint of the box. By prioritizing the use of locally sourced materials, transportation distances are further reduced, contributing to a lower environmental impact. Additionally, the concept has been kept open for an extended period, allowing for adaptations to the project as needed based on the materials available at the time. This flexibility ensures the incorporation of the most sustainable options while responding to changing availability and environmental considerations throughout the project's lifecycle.

While prioritizing the use of reclaimed materials, specific requirements for the selected products are also adhered to. For instance, materials have been avoided if their condition could impact the air tightness of the box. Furthermore, materials in poor condition that could potentially reduce the longevity of the box have not been chosen. Ensuring both sustainability and functionality remains a key factor in the decision-making process.

Wood framing

Wood framing is sourced as residual material from a local company and comes in various dimensions. It is used as studs in thinner sections where suitable dimensions for lightweight beams are unavailable.

Expanding tape

Swelling tape, sourced as residual material from a local company, is used around windows and the removable wall to minimize thermal bridges.

Code Compliant Specific

Stone wool

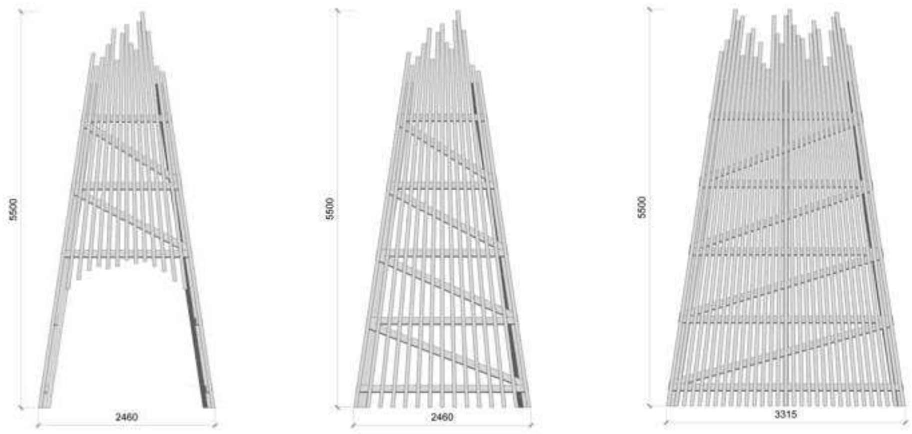
The stone wool is surplus material in the form of small pieces from a local company. Before it is sent from us, another local company processes the pieces into loose fill. Loose fill is used to more easily minimize thermal bridges, especially for inexperienced builders like us.

Sámi Kåta

Future reuse

Construction

The outer shell consists of 8 components, each comprising two parts: an inner load bearing structure and an outer panel. Together, the shell is composed of 16 components that are assembled on-site using screws and bolts. During installation, the 8 inner load bearing parts are first assembled, establishing a structural framework. Following this, the outer panel elements are seamlessly attached, completing the enclosure.



Architecturally, the braces in the inner structure alternate direction, creating a dynamic rhythm with mountain-like silhouettes for observers inside and outside. This pattern, along with the vertical panel alignment, mirrors the natural contours of mountains and forests, embodying the project's harmony with nature.

Function

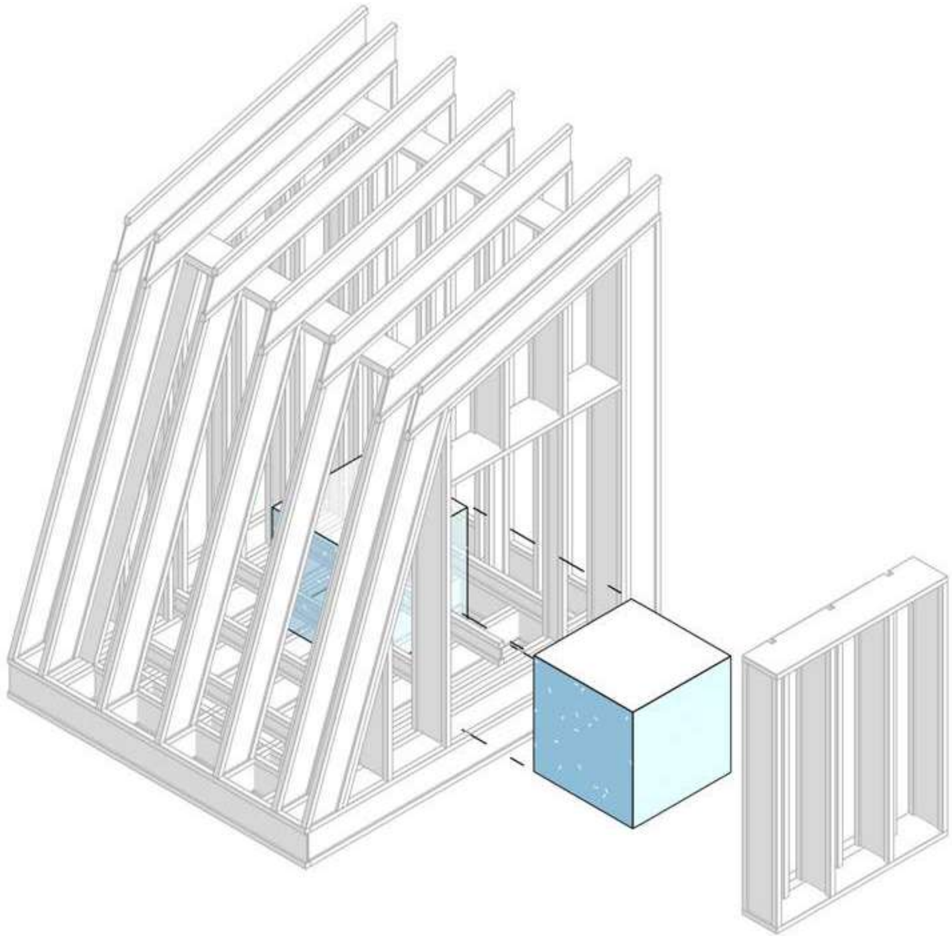
This sequential assembly approach not only enhances the shell's mountability but also significantly improves its dismountability, enabling easy disassembly and facilitating the reuse of the shell structures for the two boxes. This design strategy supports sustainable construction practices by maximizing material lifecycle and minimizing environmental impact.

All materials were reused from local projects, reinforcing our commitment to circular construction. The shells act as reflectors and sunshades, improving insulation for the ice cube—a concept further validated by the Ice Box Challenge in Sydney, where a similar approach proved highly effective.

Reuse

A key inspiration from the Sámi kåta (Lávvu) is its ability to be dismantled and relocated without leaving a trace, an approach incorporated into our design. That is why residual materials are used for the whole structure and ensured that the structure can be repurposed as wind shelters in the local area.

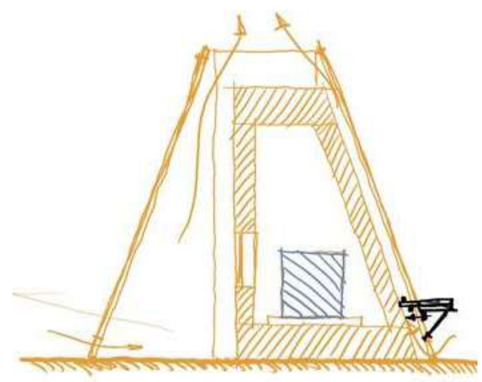
Ice Cube



Ice insertion and placement

In order to facilitate the placement of ice inside the finished box, a dedicated opening has been planned in one of the walls. Through this opening, the entire ice block can be easily inserted and positioned as required. The wall panel that covers the opening will be pre-built to ensure the box can be sealed easily as soon as the ice is in place. When it becomes necessary to remove the ice block, this panel can be quickly taken off again to provide full access to the inside.

As the boxes are intended for reuse later, the opening will allow the boxes to be combined into a bigger volume and the code compliant box will have two of these panels where one will be replaced with a door. The original panels will then be donated for educational purposes.



Transportation

The two boxes will be constructed in their entirety at the workshop and transported by truck to the exhibition area. Because of the outer shell's substantial size, it will be divided into 16 modules, which can then be easily assembled on site. Once the challenge is completed, plans are in place to reuse both the shells and boxes locally, thereby minimizing transportation distances.

Environment

U-Value

Passivehouse	U_m= 0.071 $m^2 \cdot k/W$
Code compliant	U_m= 0.3 $m^2 \cdot k/W$

The process began by determining the individual layers and how they would be combined. Once the layer configurations were set, various configurations were tested to achieve a U-value that matched the target value. Challenges arose with the available thicknesses of building components, which influenced the calculations. Through iterative testing and adjustments, an optimal solution was found that met the required U-value while considering the practical constraints of material thicknesses.

Footprint

	A1-A5	B6
Passivehouse	8523.6 kg CO_2e	1128.6 kg CO_2e
Code compliant	10106.1 kg CO_2e	10619.1 kg CO_2e

The climate footprint was calculated by considering the use of recycled materials to reduce environmental effects, particularly for the passive house box. Despite the walls, roof, and floor being more than twice as thick in the passive house, the overall climate impact remained lower compared to the BBR box. This was achieved by prioritizing the use of reused materials, which significantly reduced the carbon footprint, demonstrating that even with increased thickness, sustainable material choices can lead to a lower environmental impact.

Air Impermability

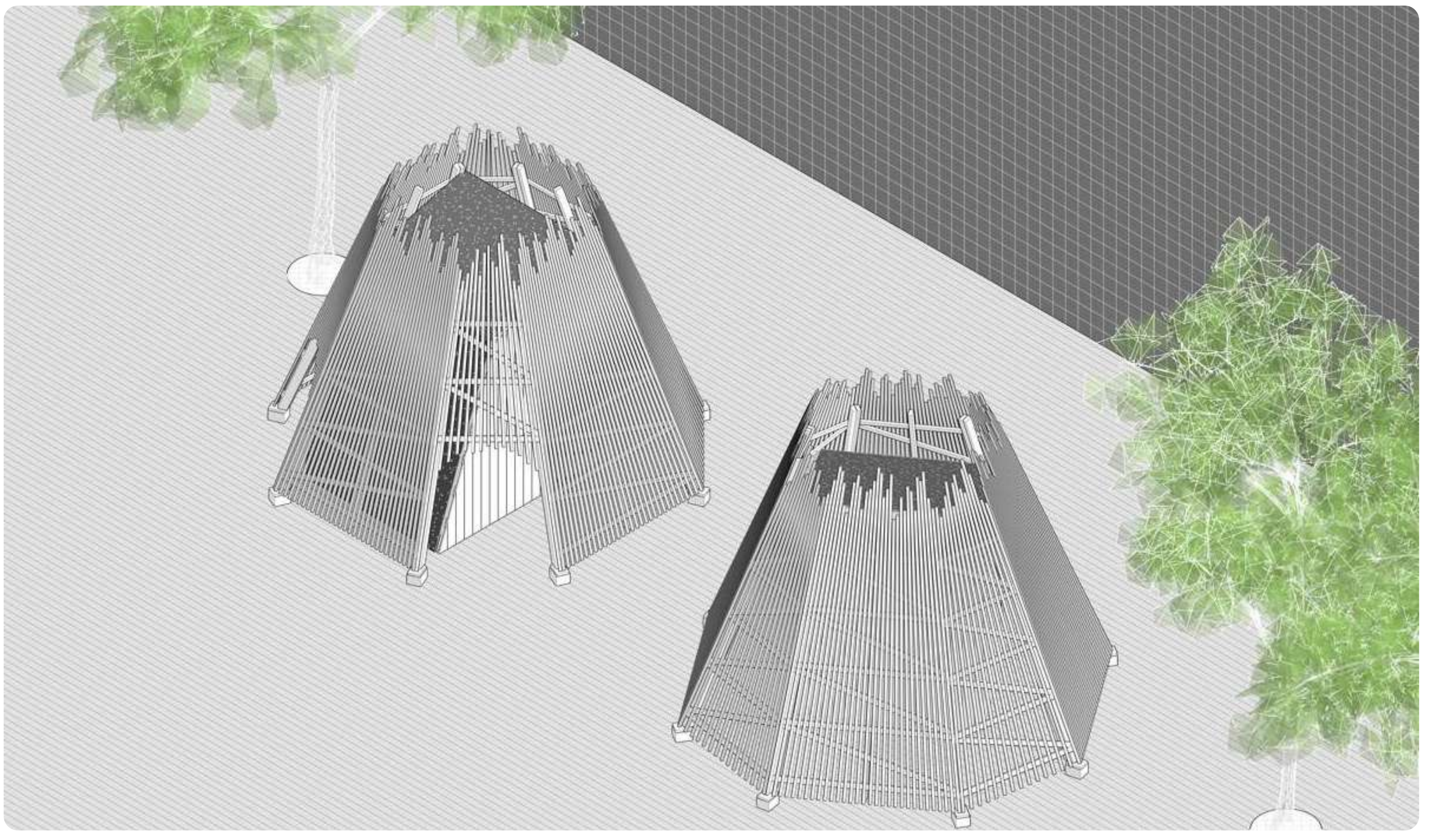
Air tightness in the passive house box has been meticulously planned. Experts were consulted to understand the best practices for achieving optimal air tightness. As a result, materials were selected specifically for their ability to maintain a tight seal, and the box was designed to be as airtight as possible. This approach led to the creation of a fully enclosing layer within the box’s first insulation layer, ensuring that no air can penetrate the box. Additionally, fastening methods were carefully reviewed and chosen to guarantee the box remains completely sealed. This is primarily achieved through the use of tape, which avoids puncturing the material. These combined efforts ensure optimal air tightness and enhance the overall energy efficiency of the passive house box.

Marketing Activities

On the final day, we have planned several activities to attract attention to our project. We will organize an exhibition in collaboration with a local design center, where our solutions will be showcased to the public. This year is also an anniversary for our program, where we will have the opportunity to showcase our project to the alumns, students and professors from our university.

To enable wide participation during the opening of the boxes, we will rent a nearby venue and invite both the public and businesses in coordination with the university's and the municipality's communications departments.

Furthermore, we have already devised plans for the reuse of one of the shells. The location for the other shell will be chosen by the local community through a vote, via QR code in cooperation with the municipality. This drives engagement and raise awareness to the project.



Placement on the exhibition site

Inspired by the past, built for the future.