Ice Box Challenge - Sweden 2025

Team 5 - Presentation

IceBox Challenge

IG PH INTRESSEGRUPP PASSIVHUS

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Intro

The **Ice Box Challenge** is a global initiative and contest that for the past 18 years has gathered students from all over the world to **raise awareness of sustainable and high-performance buildings** (passive houses).

In **2025**, the contest is taking place for the first time in **Sweden** with six student teams competing and showcasing their proposals for a sustainable & energy-efficient mini-house.

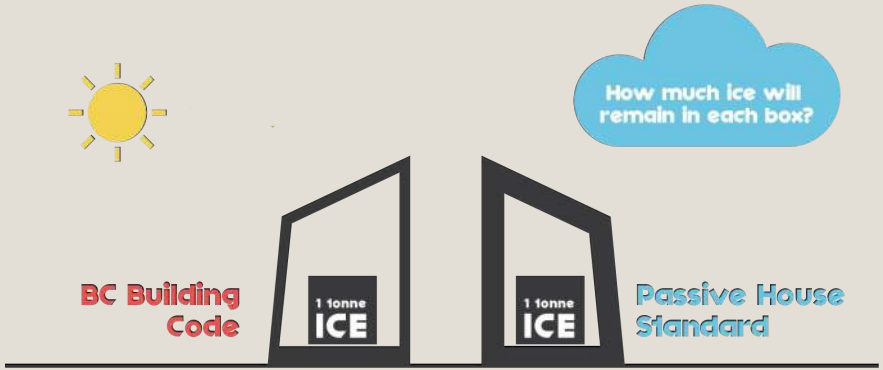
Ice box Challenge US 2023 - Pratt Institute

What is it about?

In the Ice Box Challenge each team designs and builds **2 mini-houses**: one according to the current Swedish building regulations (BBR), and one according to the international Passive House standard (Passive House institute Darmstadt).

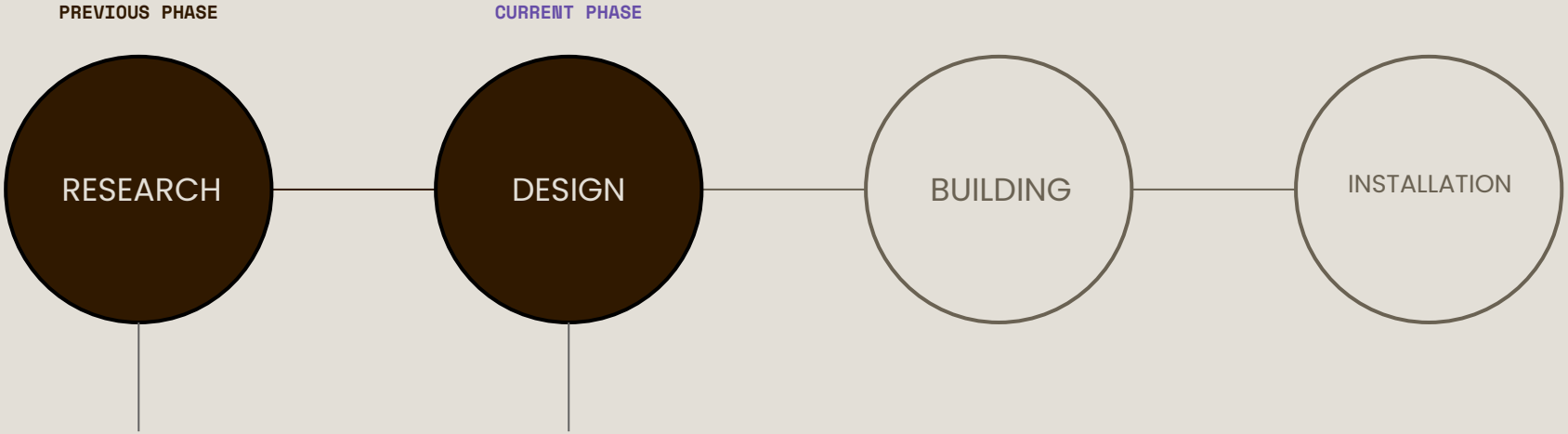
Later on, a tonne of ice is placed inside each house for a month during the summer period.

Finally, on **June 6 2025**, the boxes will be opened to compare how much ice has melted.



Review

Current state



Approach

Octagonal shape

Our design easily reduces thermal bridges and creates an interesting aesthetic.

Circularity

Lower carbon footprint by using reclaimed materials that can be recycled or reused again after the challenge.

Educational

By using our boxes and social media to highlight the issues with current day building standards and the benefits of building passive houses.

Community Outreach

Site

A carefully selected location that is highly visible and accessible, with a significant flow of people.

Social Media

Engaging with social networks like Instagram and LinkedIn through posts, highlights, and quizzes.

Broadcast Media

We will invite local and national media to broadcast the competition. On the final day, we will ensure media presence to cover the event.

Activities

School classes will have the opportunity to visit the boxes, where we will organize engaging activities related to passive house construction.

To encourage repeat visits, we will also host competitions. For example, QR codes will be placed on the boxes, allowing visitors to scan and access competition forms instantly.

Open Lectures

We will have open lectures at the university which will be open to everyone who is interested of learning more about passive house building.

School Visits

We will visit schools to present and talk about our work and educate and inspire the youth to help build the future by engineering.

Design

- Appealing Aesthetics
- Overall Dimensions
- Choice of Materials
- Robust Structural Design
- Fulfilling Energy Requirements
- Modular design
- Designed for re-use and disassembly




Appealing Aesthetics

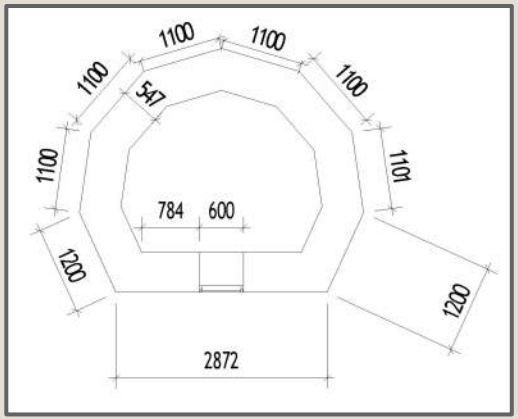
- Octagonal shape
  - Inspired by Simone's round house
- Green roof
  - As the Swede's say: "Grönt är skönt!" (green is nice)
- Use of colour and facade boards
  - Facade boards painted with our university's colour and logo
- Measuring of ice inside the box

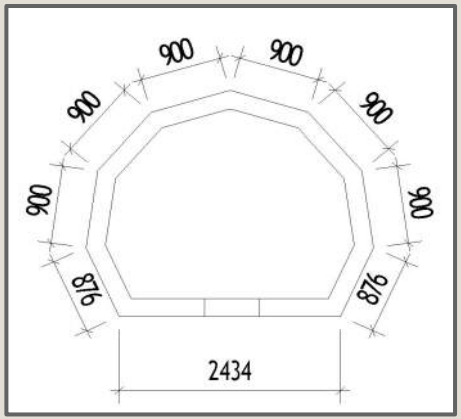
Creating a harmonious and inviting space for the people passing by or come to visit the boxes.

Overall Dimensions

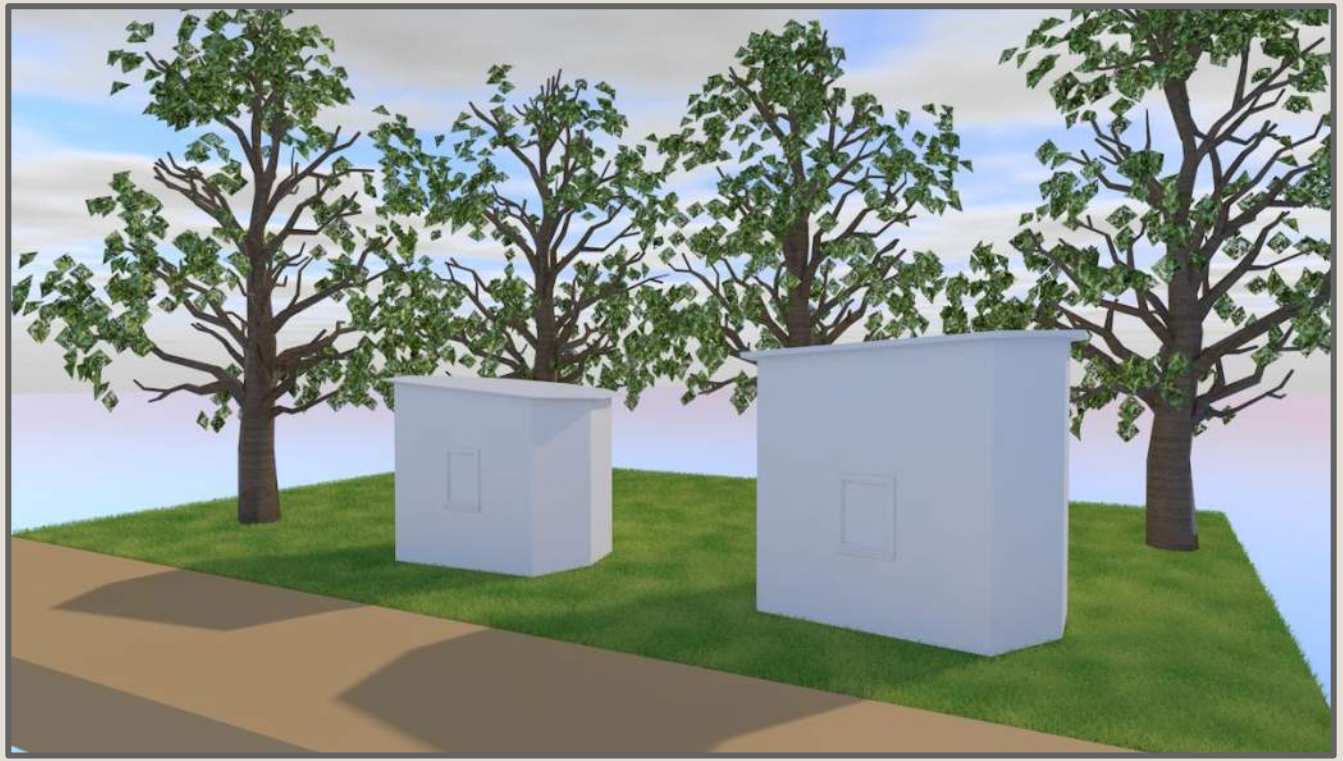
Passive House Box (PH Box)
- Building height: 3.5 meters
- Slab area: 9.5 sqm
- Inner floor area: 5 sqm
- Inner volume: 10.275 cbm
- Window 0,6m x 0,8m

BBR Standard Box (BBR Box)
- Building height: 2.9m
- Slab area: 6.4 sqm
- Inner floor area: 5 sqm
- Inner volume: 10.275 cbm
- Window 0,6m x 0,8m

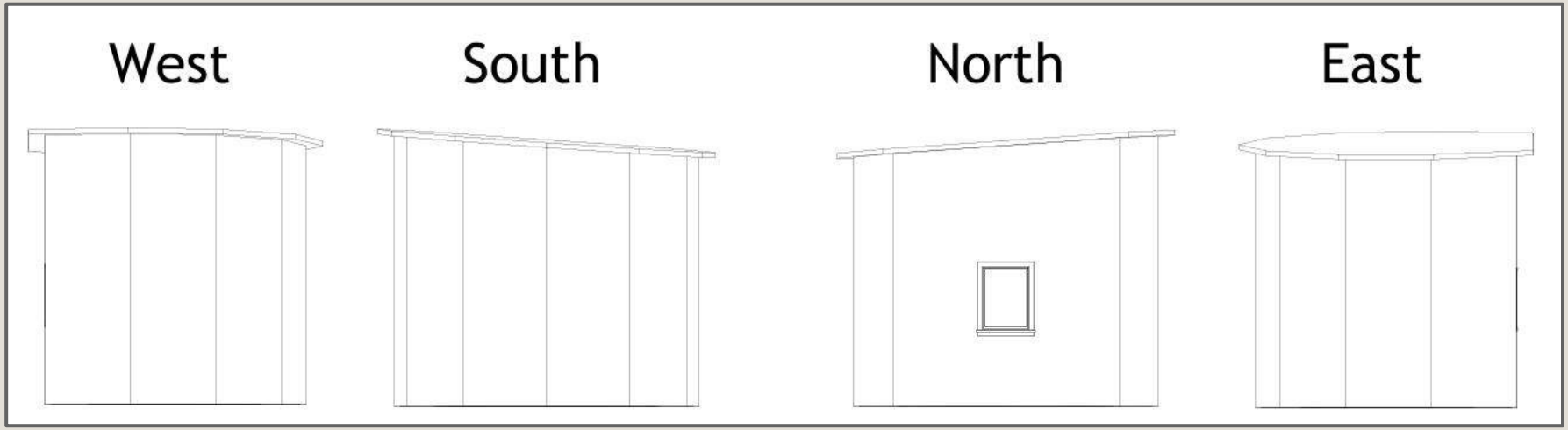




Mass Model



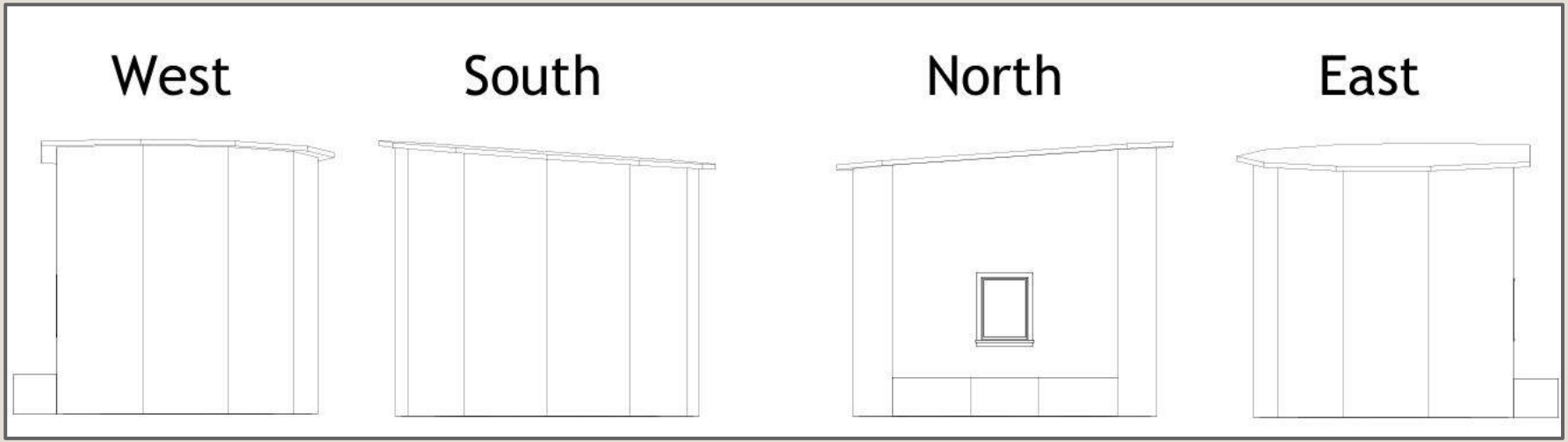
Elevations (PH)



BBR box has same design but smaller dimensions as could be seen in previous slide.

Elevations (PH)

With sitting bench



Here can be seen the elevation views with a sitting bench included. The sitting bench will not be part of the climate envelope (this would be hard to construct thermal-bridge free), but it will be freestanding and attached to the facade and slab in such a way that it looks like it is part of the construction.

Choice of Materials

BBR Box: Traditional building materials

PH Box: Innovative materials

SWISSPEARL

VegTech

SÖDRA

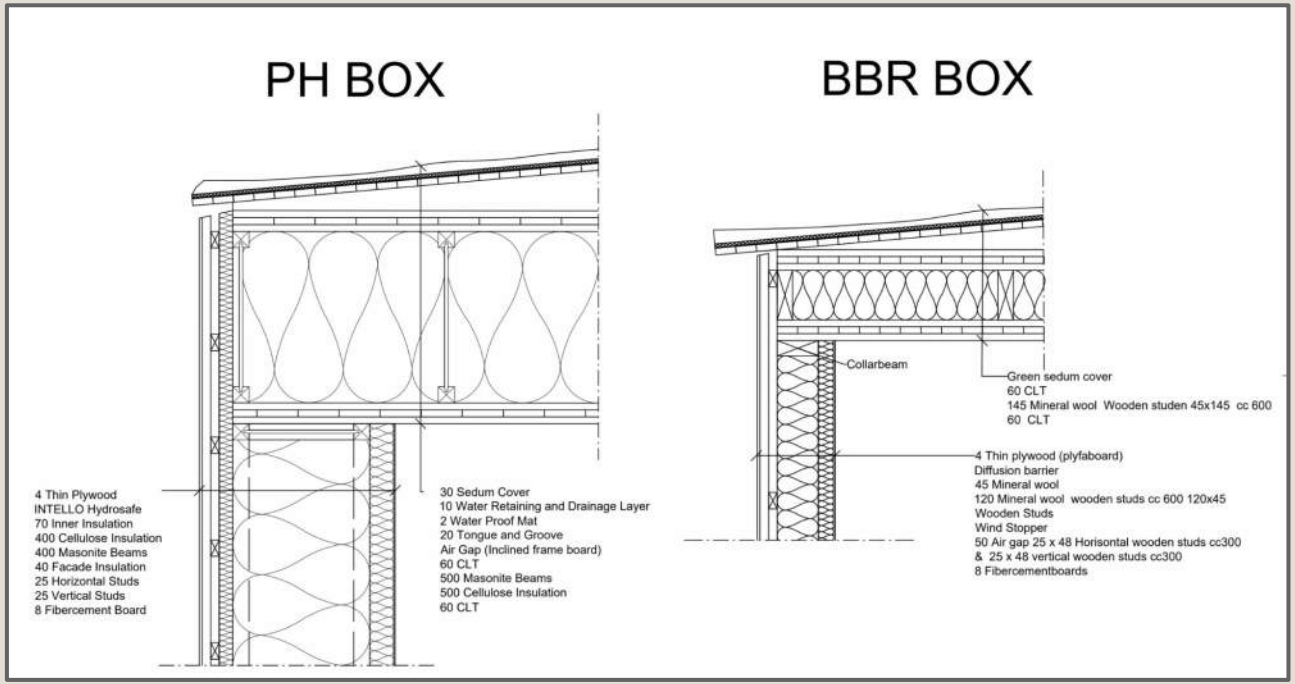
MASONITE BEAMS

smartwin

pro clima®

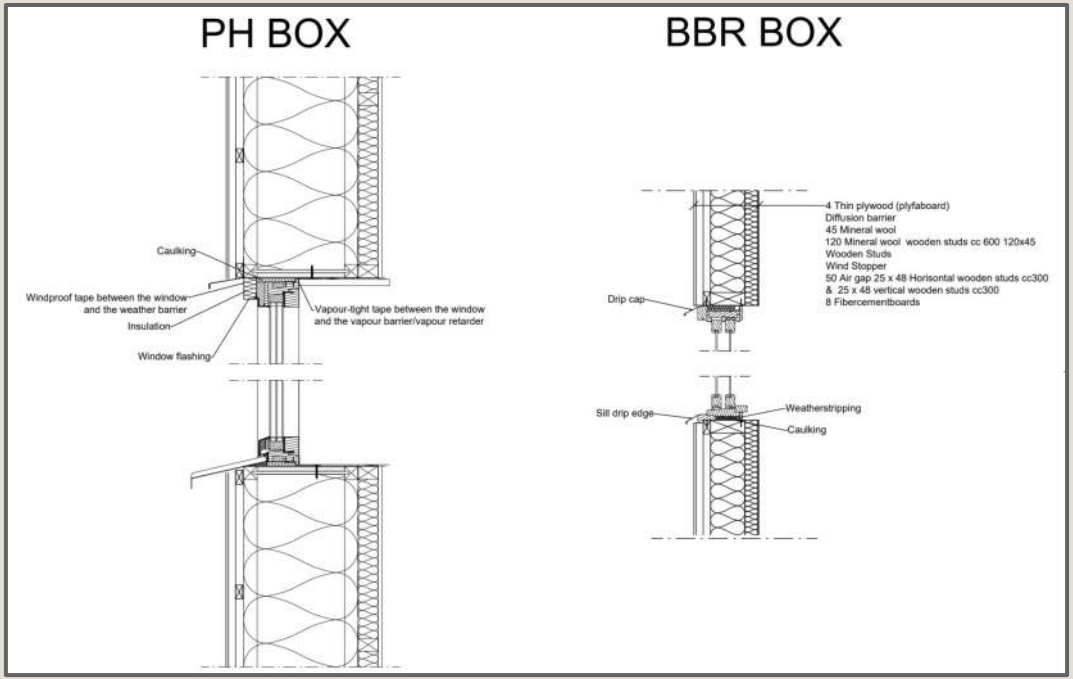
iCell
livsstil för grön energi

Structural Design: Roof



PH Box has more insulation

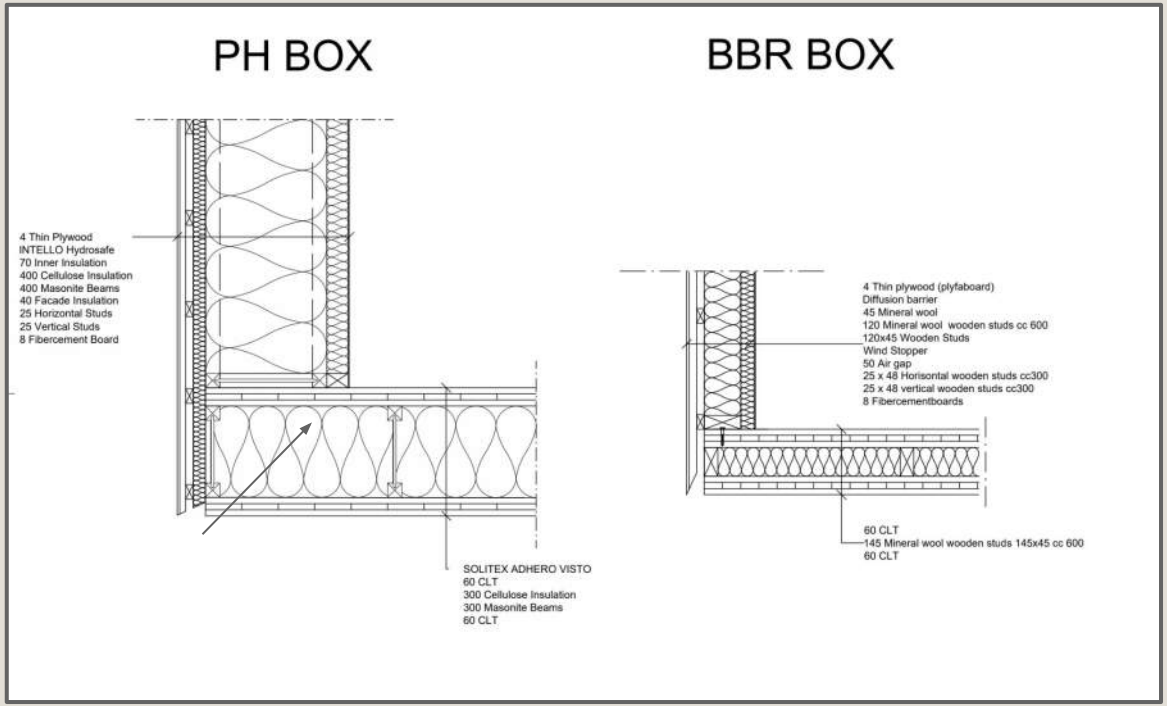
Structural Design: Window



smartwin

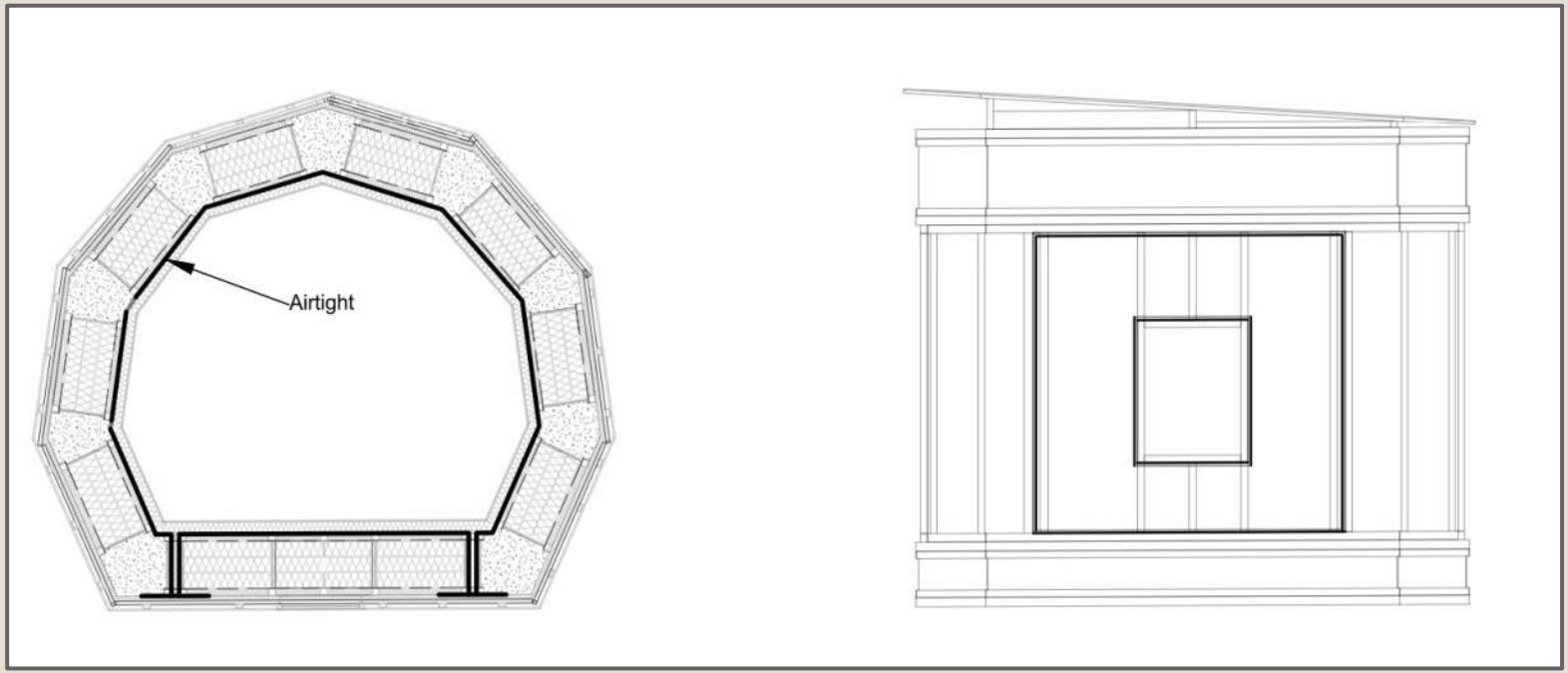
PH Box has engineered studs compared to regular studs

Structural Design: Floor



PH Box eliminates thermal bridges

Structural Design



pro clima®

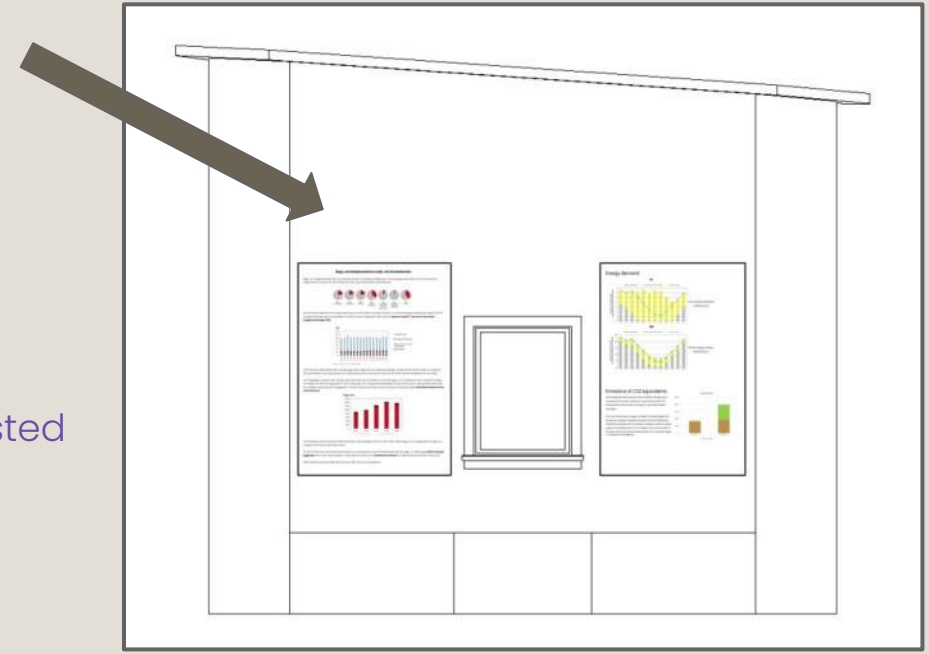
PH Box plan to make the detachable door airtight

Educational focus

Posters with information about:

- Icebox challenge
- Building sector environmental impact
- Sustainable building
- Passive House

Purpose is to get more people interested and aware of the issues with current building traditions



Energy requirements

PH Box

- Criteria of Passive House building
- Requirements energy demand: 15 kWh/(m2 a)
- Airtightness
- Thermal bridge free
- Highly insulated
- Window placed facing North

BBR Box

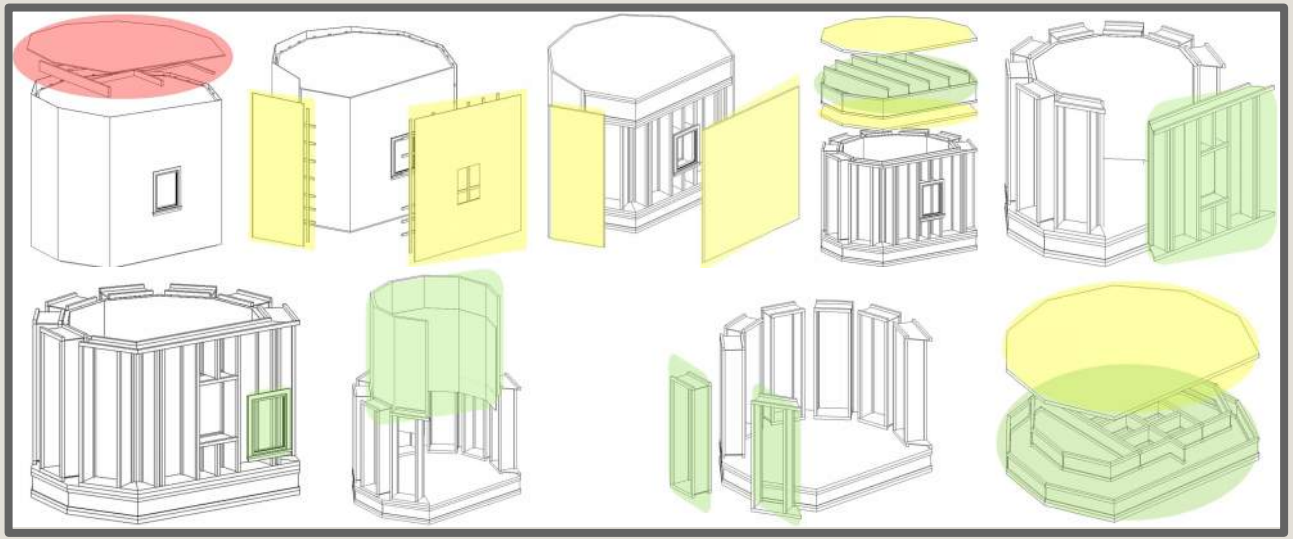
- Criteria of BBR building codes
- Requirement energy demand: 95 kWh/(m2 a)
- Standard thermal bridges

Conclusions

Stricter requirements for the PH Box, regarding thermal bridges, energy demand and form.

Designed for Disassembly

Green: components that can be re-used again immediately
Yellow: components that might be able to be re-used again
Red: components that can't be re-used again



We have a well-structured plan for disassembly when the time arises.

Energy & CO2

U-values

U-values describe the thermal transmittance of a material or assembly, it is commonly used to describe how well insulated a building is. A lower U-value indicates a better insulated building. For example, a wall with total thickness 350mm can have a U-value at about 0,137 , but this is heavily influenced by choice of materials. To describe the total building envelope's thermal performance, an average value is calculated, Um.

Energy consumption

The Swedish construction and property sectors' energy use mainly consists of energy for heating. Therefore, it is of interest to analyse the boxes' respective heating demands. In Sweden, the construction and real estate sector's energy use consists mainly of energy for heating. The average energy use for heating and hot water in Swedish single-family homes was 93.2 kWh per square meter in 2023.

Emissions

Emissions in terms of CO2 equivalents are used to determine the boxes' climate impact. CO2 equivalents is unit of measurement that standardises the climate impact of different greenhouse gases.

Basis for the calculations

The scaled box

In order to get realistic results, the boxes were scaled up to 100 square meters floor area equivalents, meant to represent a single-family house case.

PH Box

The annual heating demand for the PH box is calculated according to PHPP (Passive House Planning Package) methodology.

BBR Box

The primary energy number (primärenergitalet) is calculated according to BBR rules.

U-Values

PH

Assembly	U-value [W/(m²K)]
Wall	0,073
Roof	0,080
Floor	0,128
Window (0,6 x 0,8)	0,63

BBR

Assembly	U-value [W/(m²K)]
Wall	0,233
Roof	0,249
Floor	0,314
Window (0,6 x 0,8)	0,9

Insulation thicknesses

Assembly	PH	BBR
Wall	510mm	165mm
Roof	500mm	145mm
Floor	300mm	95mm

Through having a lot more insulation in the PH box, a lot lower U-values are achieved compared to the BBR box.

U-Values

PH Box

Assembly	U-value [W/(m²K)]
Wall	0,073
Roof	0,080
Floor	0,128
Window (0,6 x 0,8)	0,63

Unscaled box Um approx. 0,093
Scaled box Um approx. 0,098

Estimated % ice melted after 1 month: 34%

Based on the climate envelope's Um-value, the latent heat of fusion of ice, and the weather forecast for May 2025 (day/night averages). Heat spikes or dips were not taken into consideration for the calculation.

U-Values

BBR Box

Assembly	U-value [W/(m²K)]
Wall	0,233
Roof	0,249
Floor	0,314
Window (0,6 x 0,8)	0,9

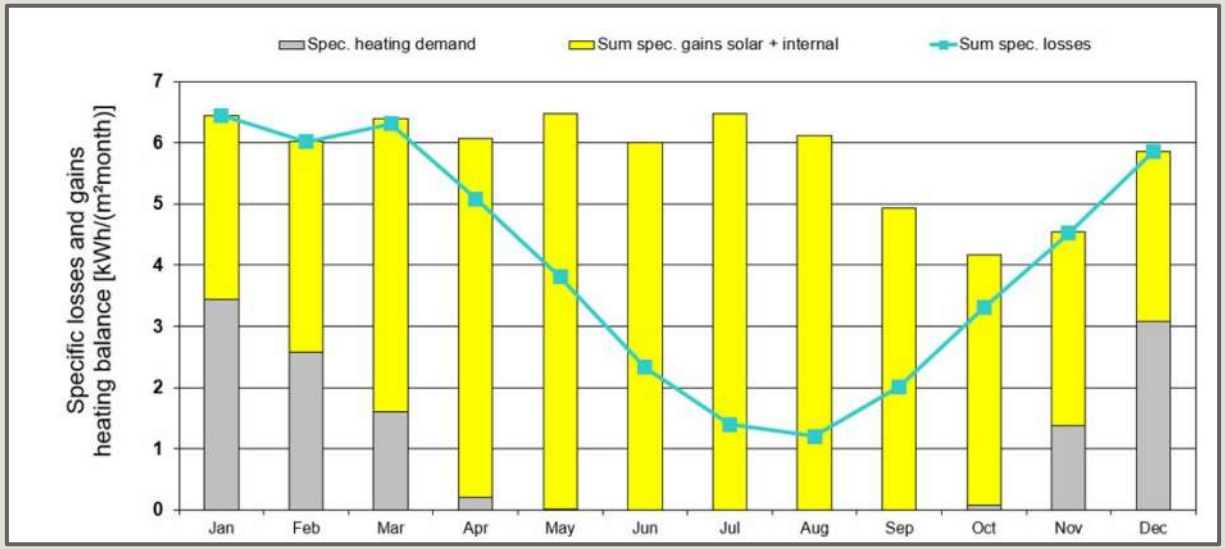
Unscaled box Um approx. 0,261
Scaled box Um approx. 0,283

Estimated % ice melted after 1 month: 72%

Based on the climate envelope's Um-value, the latent heat of fusion of ice, and the weather forecast for May 2025 (day/night averages). Heat spikes or dips were not taken into consideration for the calculation.

Energy consumption

PH Box

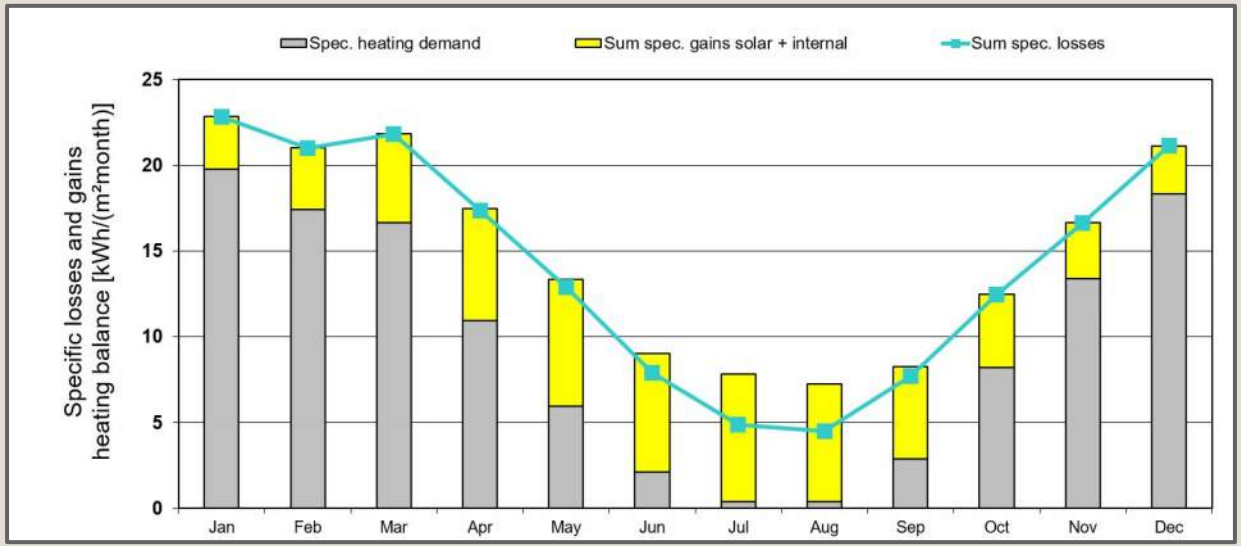


Annual Heating Demand: 13 kWh/(m^2 a)

No need for specific heating during period May-Sep. Can reduce need for specific heating by making use of solar and internal gains.

Energy consumption

BBR Box



EP_pet: 91 kWh/(m^2 a)

Less specific gains from solar and internal sources, higher need for specific heating.

Emissions

Main materials

PH Box

Insulation	iCell cellulose
Load bearing	Masonite Beams
Facade	Re-used fibercementboards
Roof cover	Sedum
Window	Smartwin

BBR Box

Insulation	Stone wool
Load bearing	Timber frames
Facade	New fibercementboards
Roof cover	Sedum
Window	Normal

Innovative and reclaimed materials for PH box, traditional materials for BBR box.

Emissions

Embodied CO2 calculation

PH Box

Stage	A1-A3	A4	A5	Total A1-A5	B6
Kg CO2e	6248,8	773,4	580,7	7602,9	1128,6

BBR Box

Stage	A1-A3	A4	A5	Total A1-A5	B6
Kg CO2e	8272,8	687,2	362,1	9322,1	10619,1

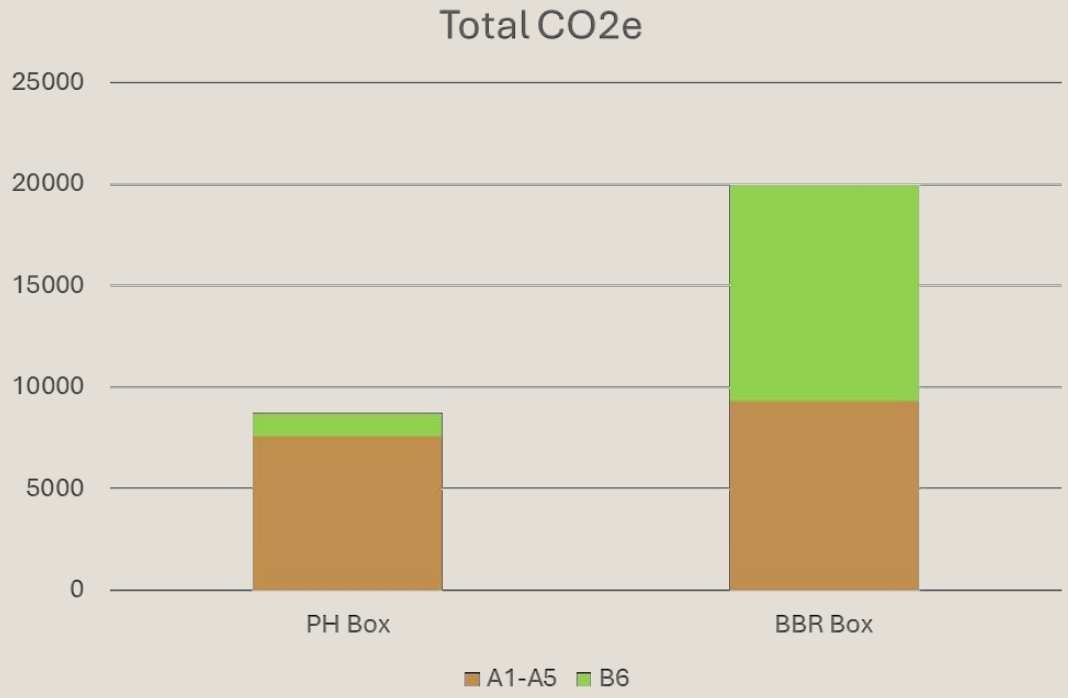
A1-A5: phases regarding the production phase.

B6: phase regarding operational energy when the building is in use.

PH Box has main emissions in phases A1-A5 whereas the BBR box has almost as high emissions in A1-A5 as in B6.

Emissions

Summary



Even though the PH box has a lot more insulation, through use of innovative and re-use of materials, it ends up having less CO2 emissions than the box built according to current day Swedish standards.

SITE

The area we have chosen is

- Well visited, there is a large pedestrian walkway right by the site
- Very close to the city centre and central station
- Close to a playground
- The site is in a park with a lot of greenery, the boxes' design will nicely complement the area

NEXT STEPS

FEEDBACK

01

We will take feedback into consideration and make necessary adjustments.

BUILD

02

We will build our Ice Boxes in the lab, while also starting to focus more on social media and community outreach.

INSTALL

03

The Ice Boxes are installed on site and the ice is inserted.

MEASURE ICE

04

The Ice Boxes are opened and the ice measured.

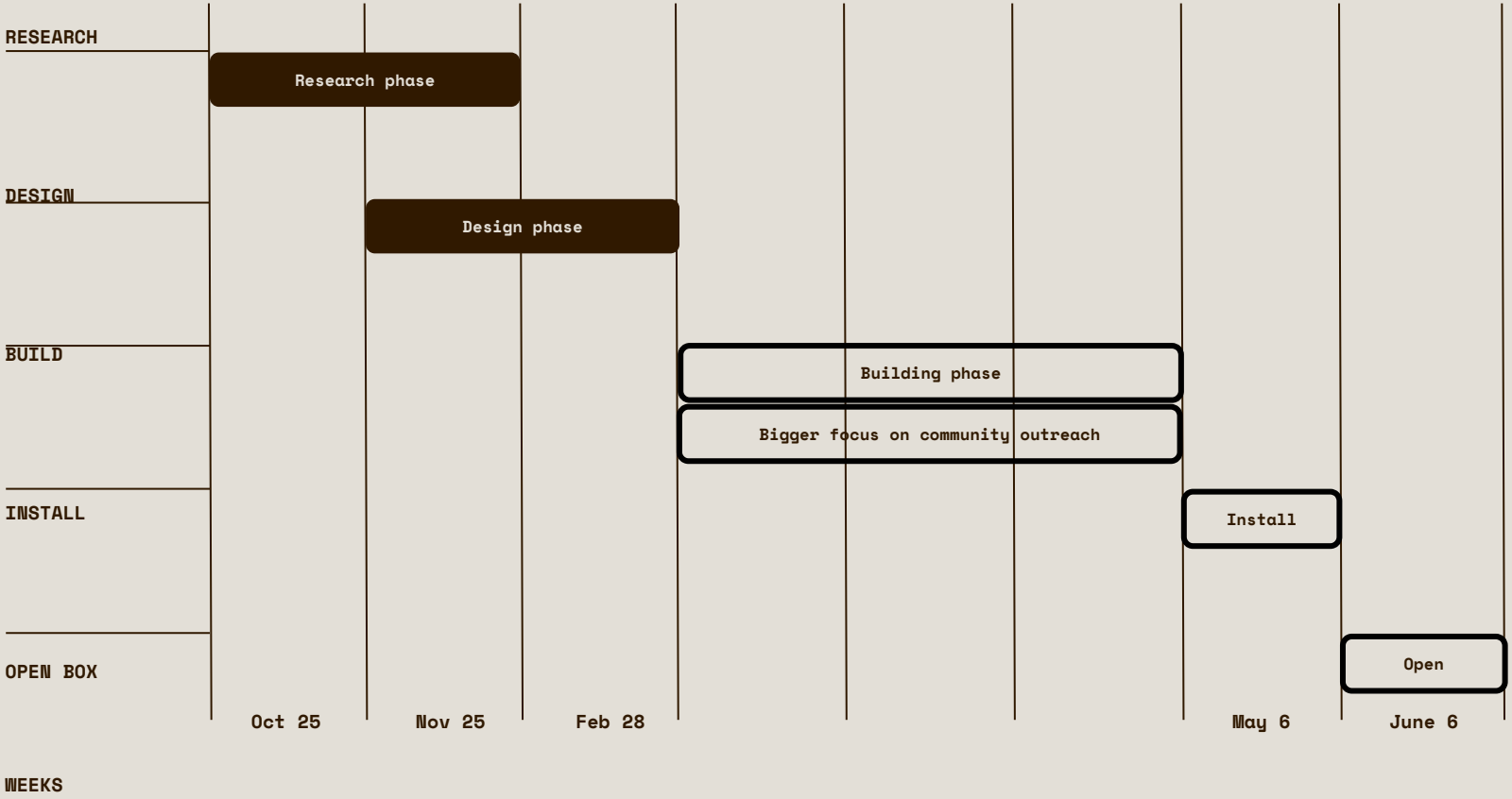
DISASSEMBLY AND RECYCLING

05

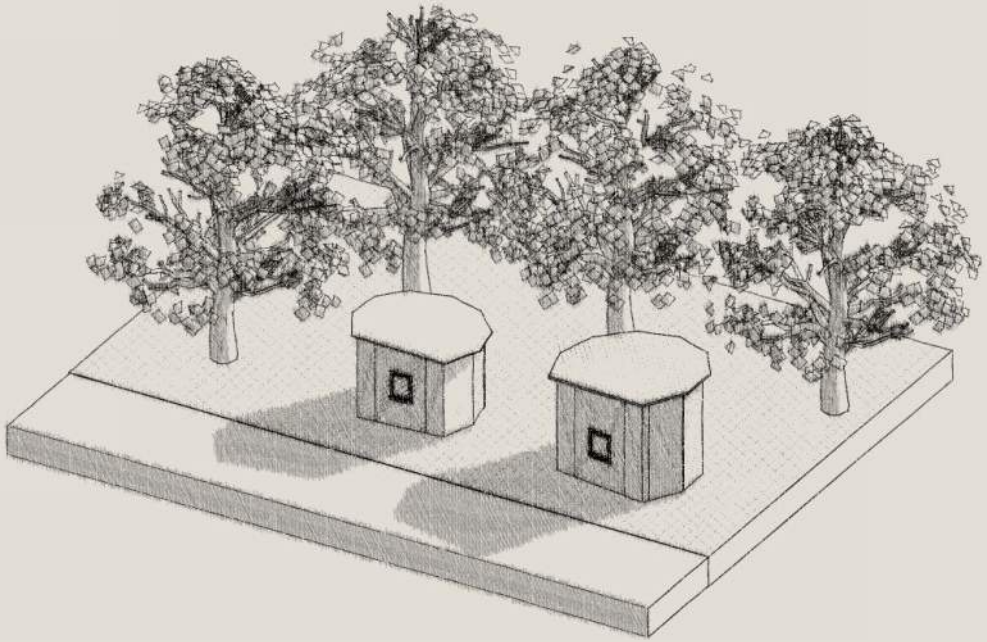
The Ice Boxes are opened and the ice measured. The Ice Boxes are then disassembled and materials prepared for re-use or recycle.

Overview

Brief overview of main events in the timeline from the project's start to finish



Thank You!



TEAM 5 2025-02-25

Thank you for partaking in our presentation. We look forward to building and sharing with you all our submission for the Ice Box Challenge 2025.