Hampens Hus *Timber and hemp structures*

THEME DAY ON BIOBASED BUILDING MATERIALS

NOVEMBER 26TH 2025

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structured environment
structural and civil engineers

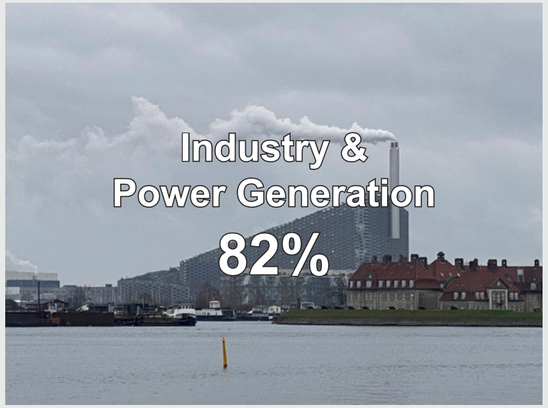
SE offices

SE KK
Tokyo, Japan
1999

SE Ltd
London, UK
2009

SE ApS
Copenhagen, Denmark
2018

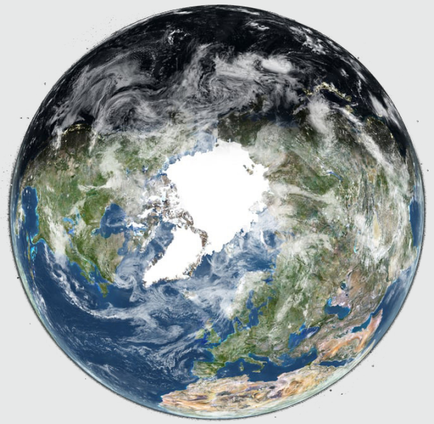
Emission sources ▼



Absorbtion mediums ►

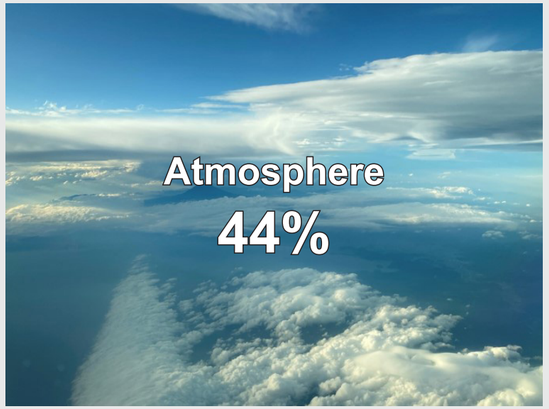
Emissions = Absorption capacity

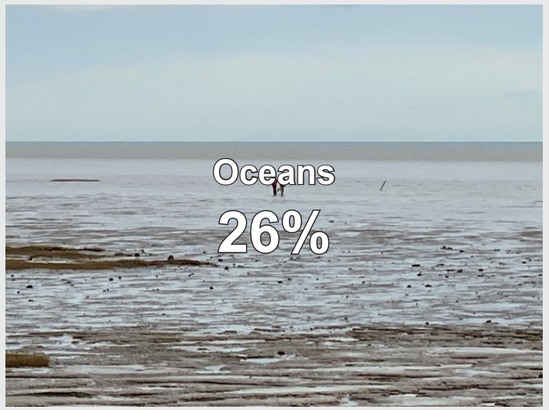
Current emissions:
42 billion tons CO_2 / year



Emissions that the Earth can sustainably absorb:
2.51 billion tons CO_2 / year

42 billion tons CO_2 ≠ 2.51 billion tons CO_2





Balance between CO_2 emission and absorption as of 2023

What measures should the structural engineer take ?

First continue to do what they should always be doing – designing safely, but with efficiency, economy and elegance – the “three E’s”.

minimize materials
minimize energy use
maximize re-cycling and re-use (minimize waste)
develop new materials/techniques

} **Apply to building design**

“MEAN, LEAN, GREEN”

The responsibility of a structural engineer

What we should always be doing – designing safely, but with efficiency, economy and elegance – the “three E’s”.

Minimize materials, producing a non-wasteful structural design by: Assessing loads accurately and rationally; Selecting structural Materials appropriate to required function and low CO_2e materials where possible; Aiming to use biobased and natural materials where they can replace processed materials; Optimizing the efficiency of each member by using hybrid members.

Minimize energy use, reduce or eliminate wasteful production and operations processes by: Choosing construction methods that could reduce energy consumption or emissions; Considering the transport of materials and effort involved in site assembly; Aim to design for pre-assembly in the factory; Canvassing for comments from contractors; Designing a building for a long lifespan and make renovations and re-purposing easily achievable.

Maximize re-cycling and re-use to minimize waste, first of all by preserving existing buildings where they have any inherit value. If a building can not avoid demolition, each material should be repurposed for and appropiate use in other building structures or similar and up-cycled if possible.

Develop new materials and techniques by: Considering use of materials from other fields in building (e.g. aluminium, plastic); Re-thinking the composition of traditional materials (e.g. CLT, rammed earth); Combining different materials to make hybrids (e.g. composite floor deck, fibre-reinforced concrete; Develop new materials: either fundamentally new or using recycled materials (e.g. recycled plastic, recycling of organic waste).

“MEAN, LEAN, GREEN”

structured environment
structural

Minimize materials!

and quantify emissions **during design!**

Produce non-wasteful structural designs:

1. **Assess loads accurately and rationally.**

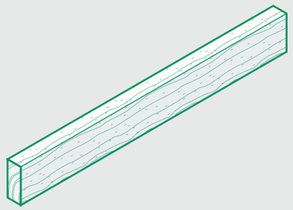
2. **Select structural materials appropriate to their required function (use low CO_2e materials where appropriate).**

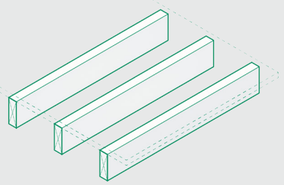
3. **Optimize the efficiency of each member by using hybrid members.**

4. **Focus especially on getting high efficiency in floor structures and foundations.**
   (Since their area is large even the reduction of slab thickness by a few millimeters can have a great impact on embodied CO_2e).

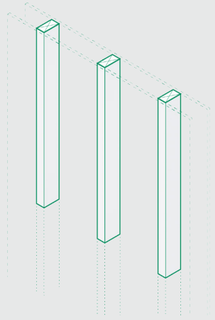
Timber products / formats

Cut Timber





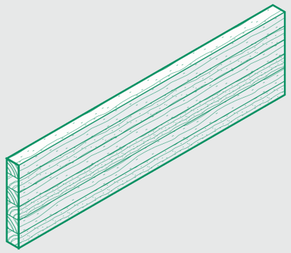
FLOOR JOISTS

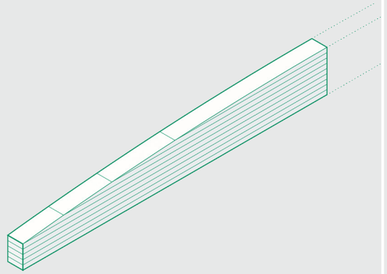


WALL COLUMNS

Glu-Lam

Glued laminated timber



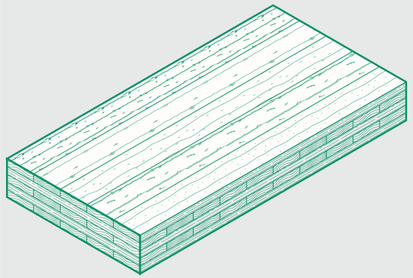


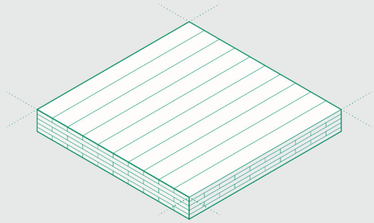
LONG BEAMS

LARGE COLUMNS

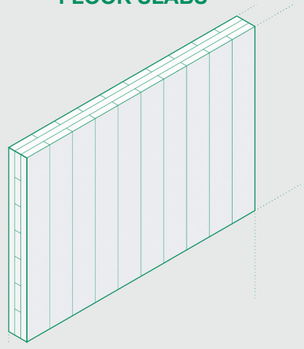
CLT

Cross-laminated timber



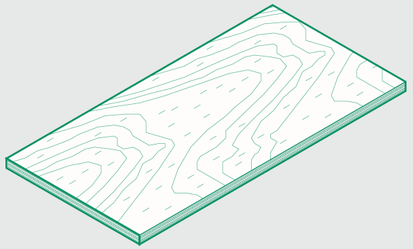


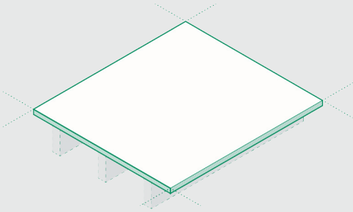
FLOOR SLABS



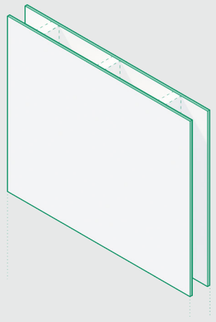
WALLS

Plywood





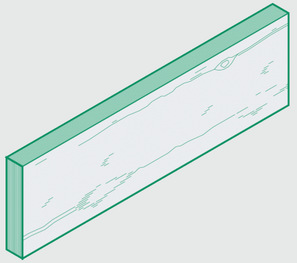
FLOOR DECKS

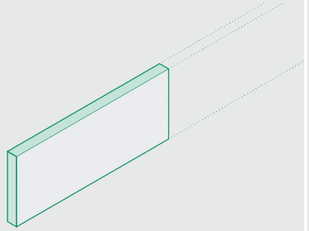


WALLS SKINS

LVL

Laminated veneer lumber



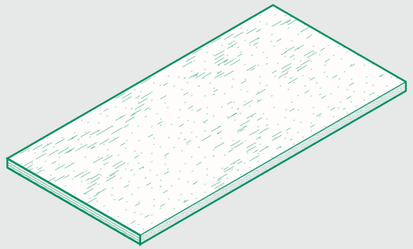


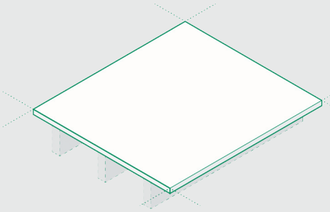
DEEP BEAMS / JOISTS

WALL-COLUMNS

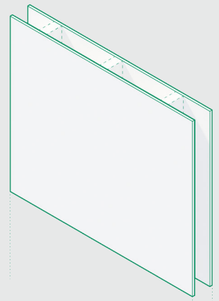
OSB

Oriented strand board





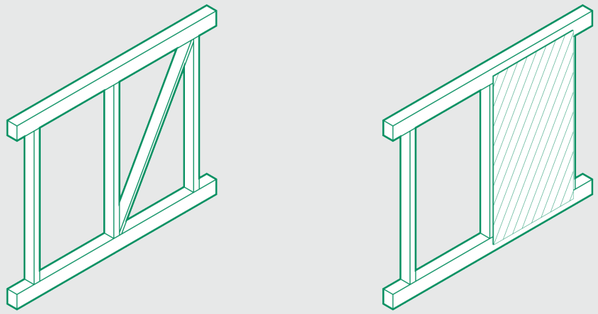
FLOOR DECKS / WALLS SKINS



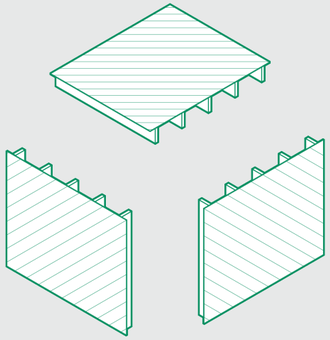
structured environment
structural and civil engineers

Timber system design

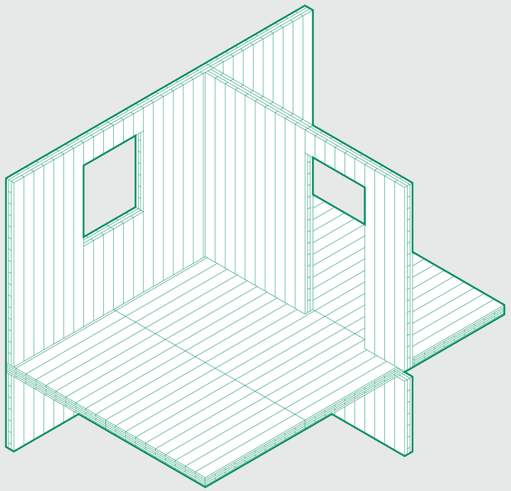
Post and beams + braces or walls



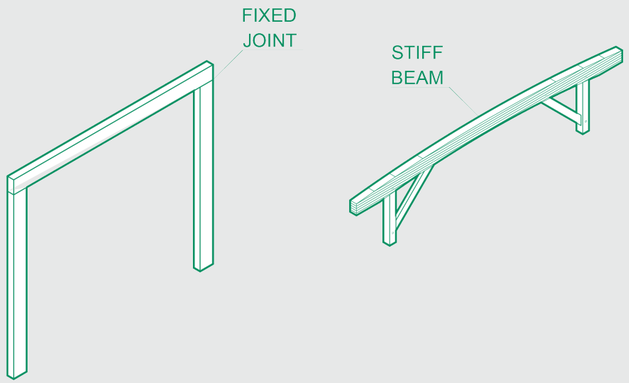
Panel construction



Mass timber (CLT)

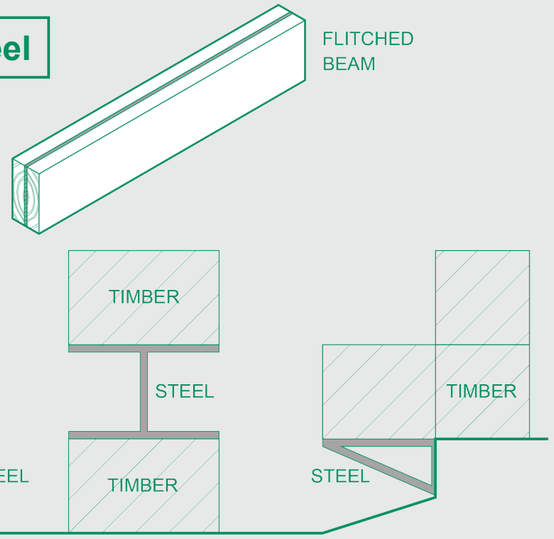


Moment frames

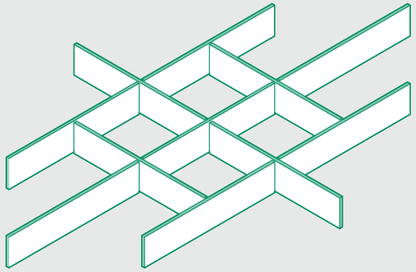


Timber + steel

Partial beams or fames, struts, flitched beams



Reciprocal systems



Hampens Hus

2025

Nykøbing Falster, Denmark

A house built with timber, interlocking joints and stabilizing hemp-lime and hemp boards.

Laboratory and teaching facilities, **120 m²**

Client: **Guldborgsund Kommune**

Architect: **nikolova/aarsø**

Exterior rendering

Hampens Hus

2025

Nykøbing Falster, Denmark

A house built with timber, interlocking joints and stabilizing hemp-lime and hemp boards.

Laboratory and teaching facilities, **120 m²**

Client: **Guldborgsund Kommune**

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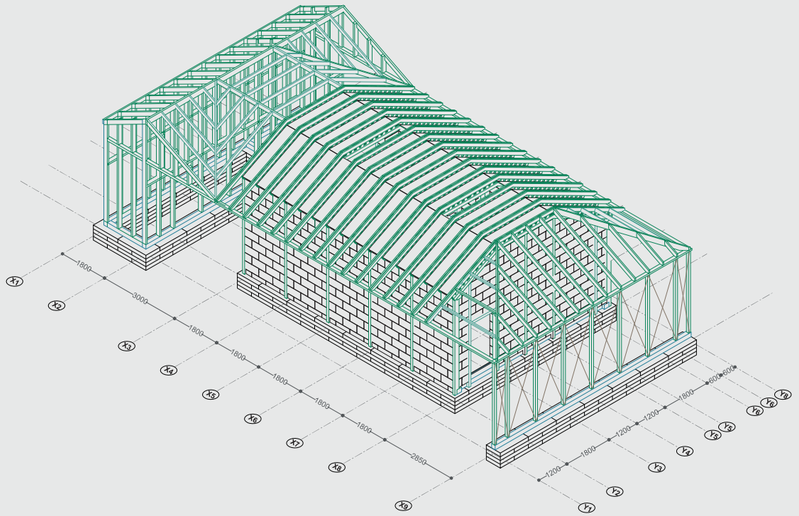
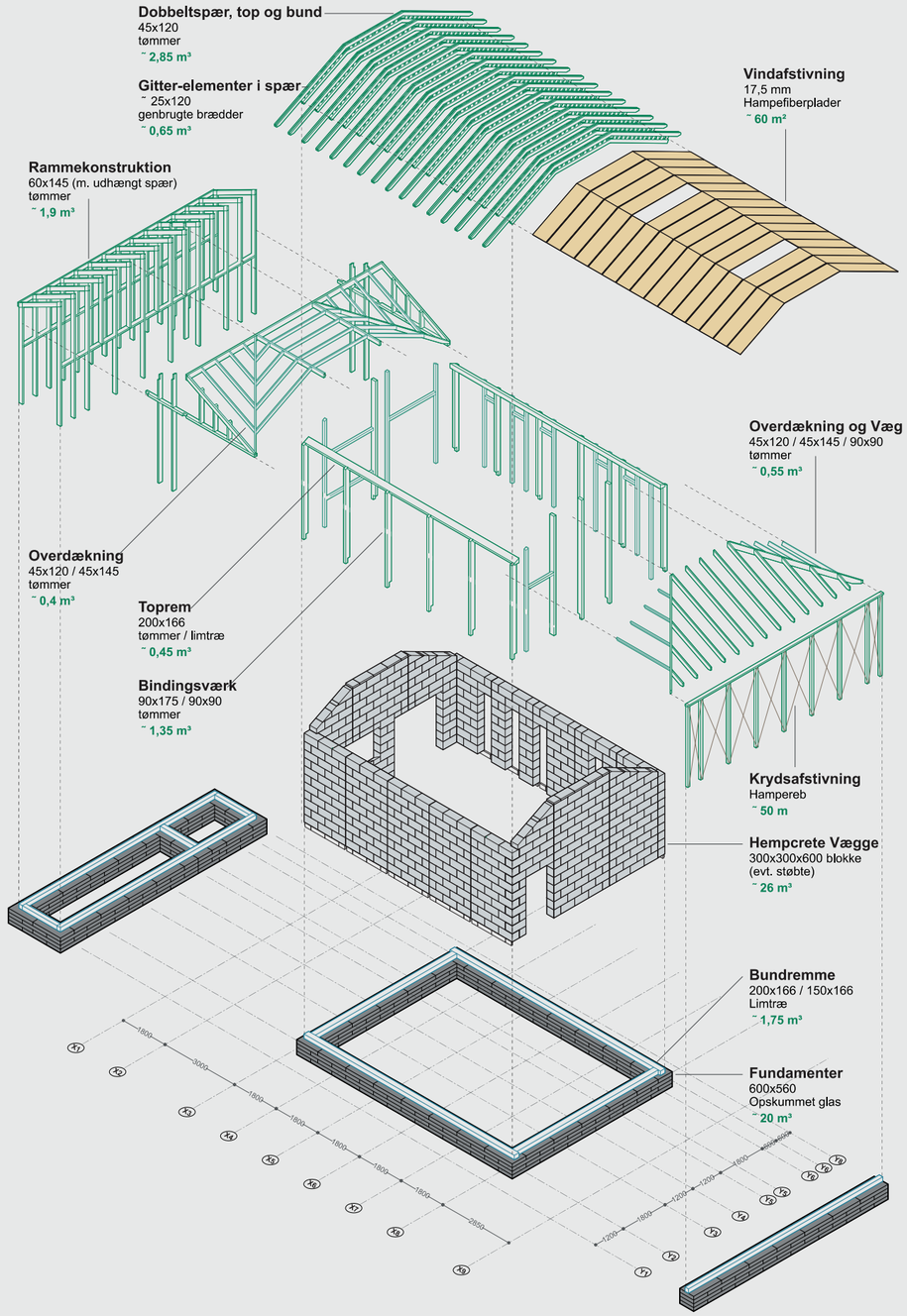
Exterior rendering

structured environment
structural and civil engineers

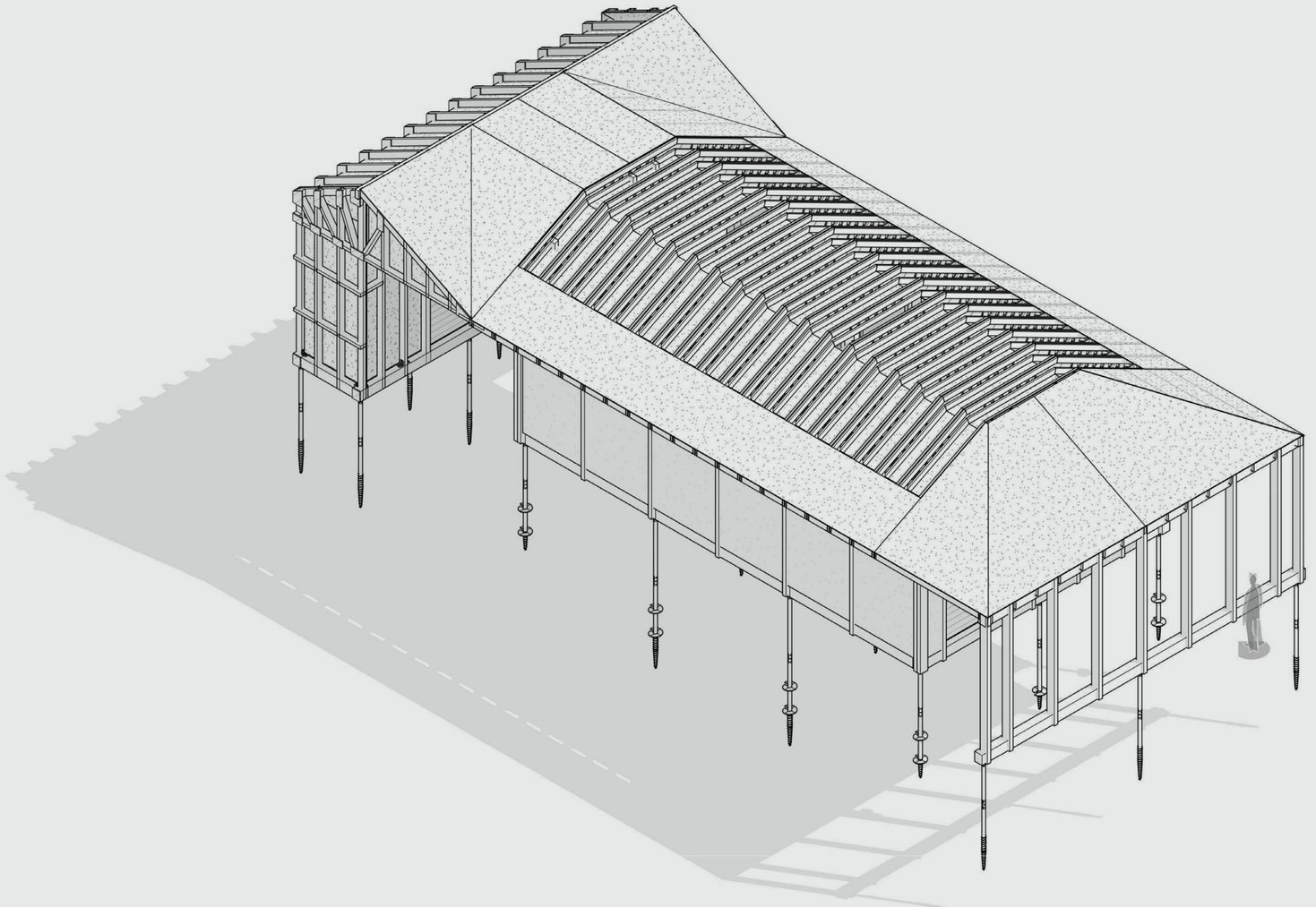
sketch
Structural scheme
Early concept



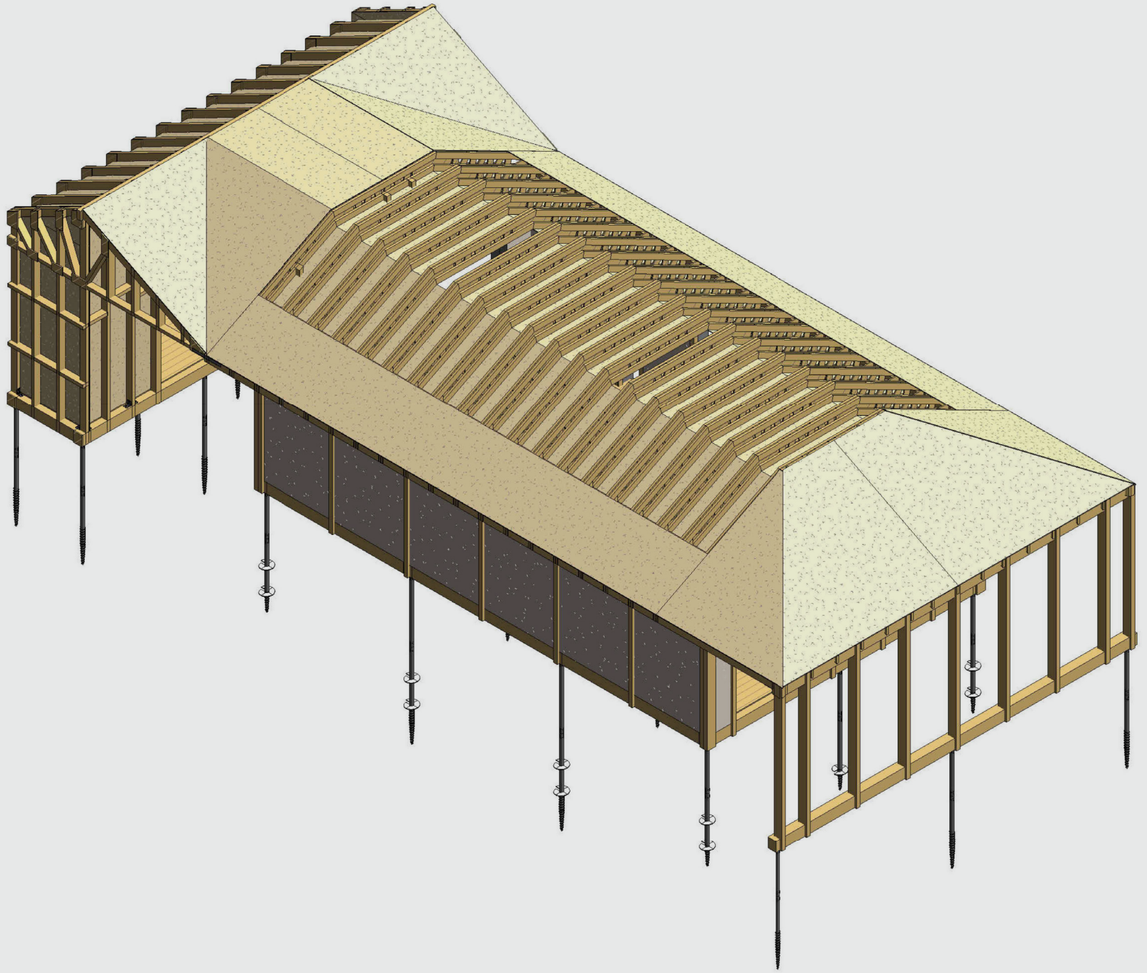


sketch
Structural scheme
Early concept

structured environment
structural and civil engineers



3D model
Structural system
Full structure



3D model
Structural system
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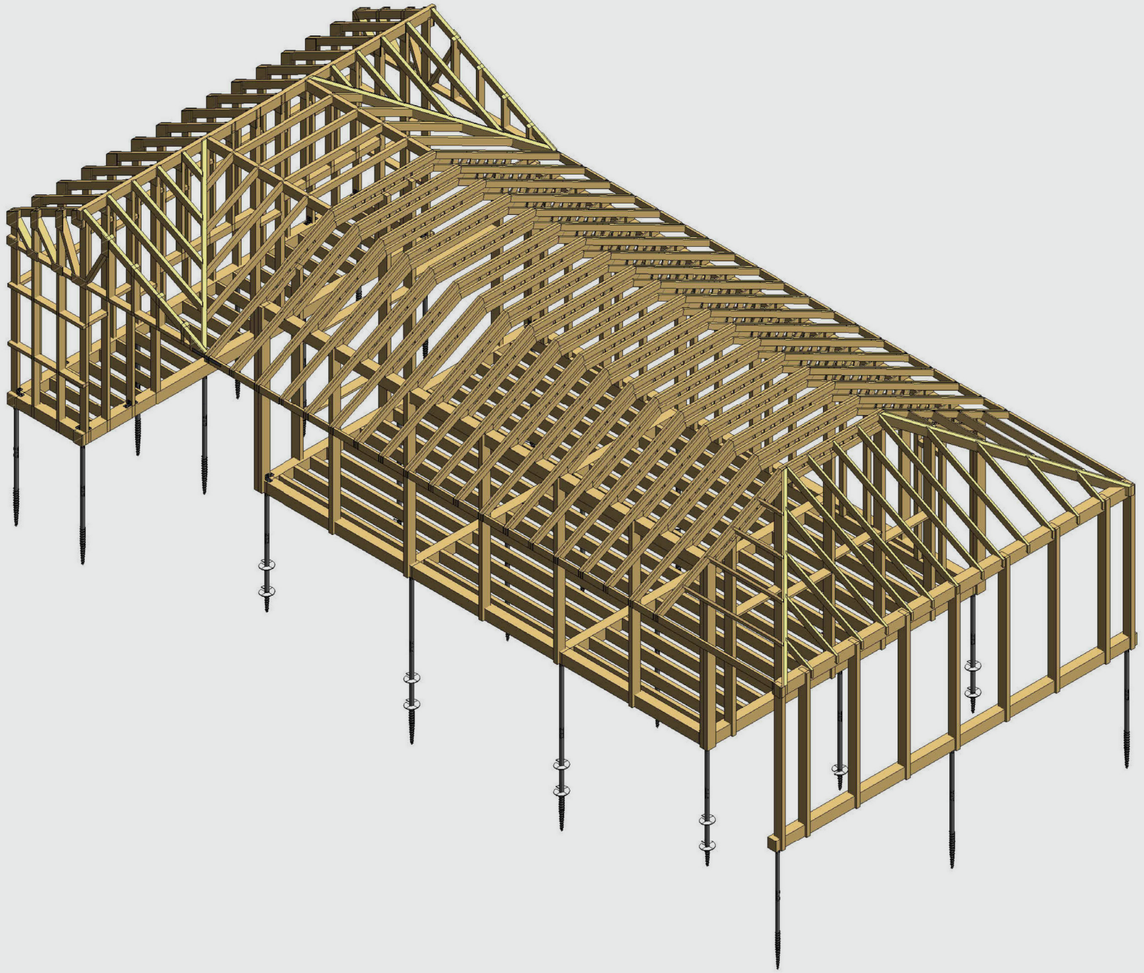
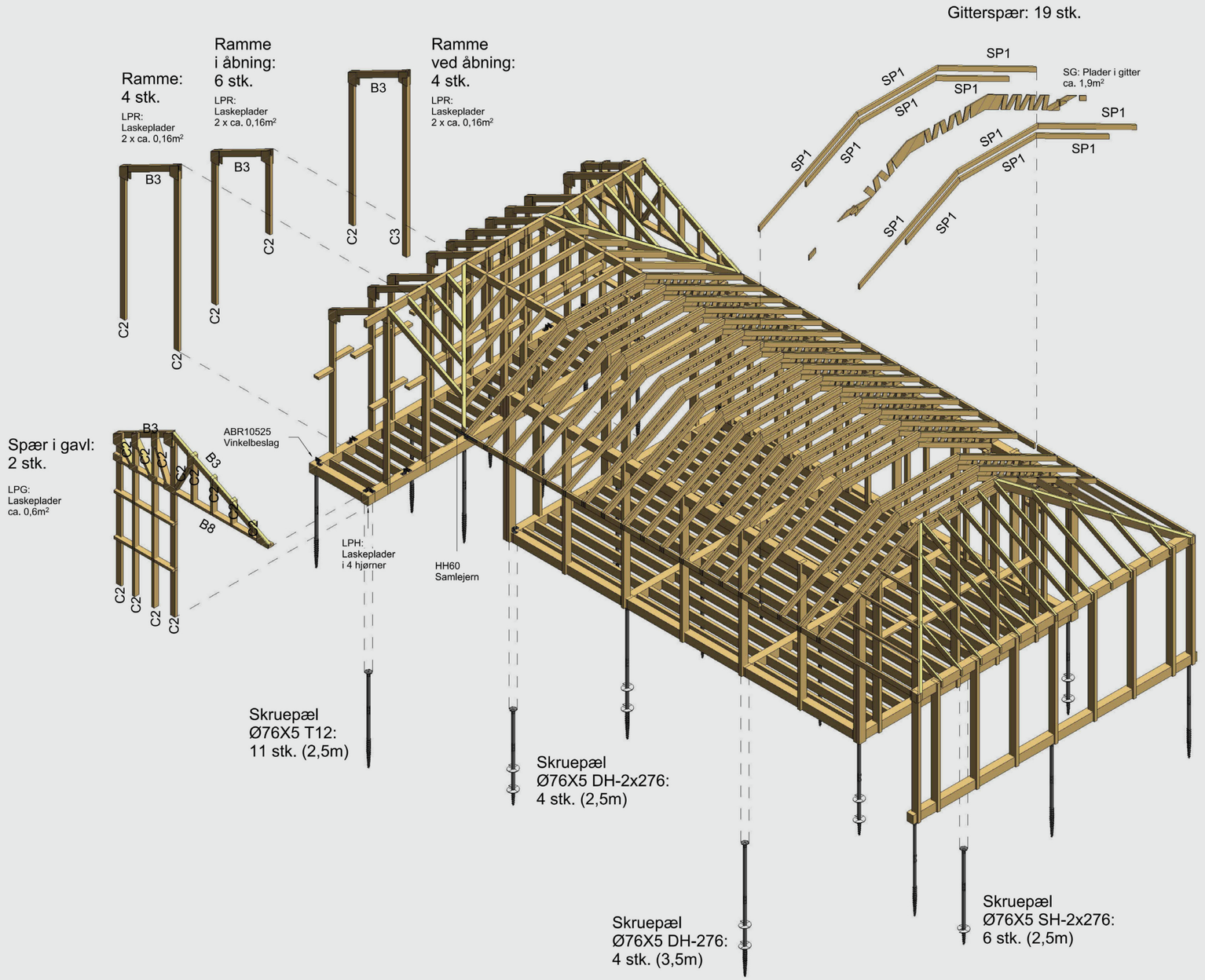
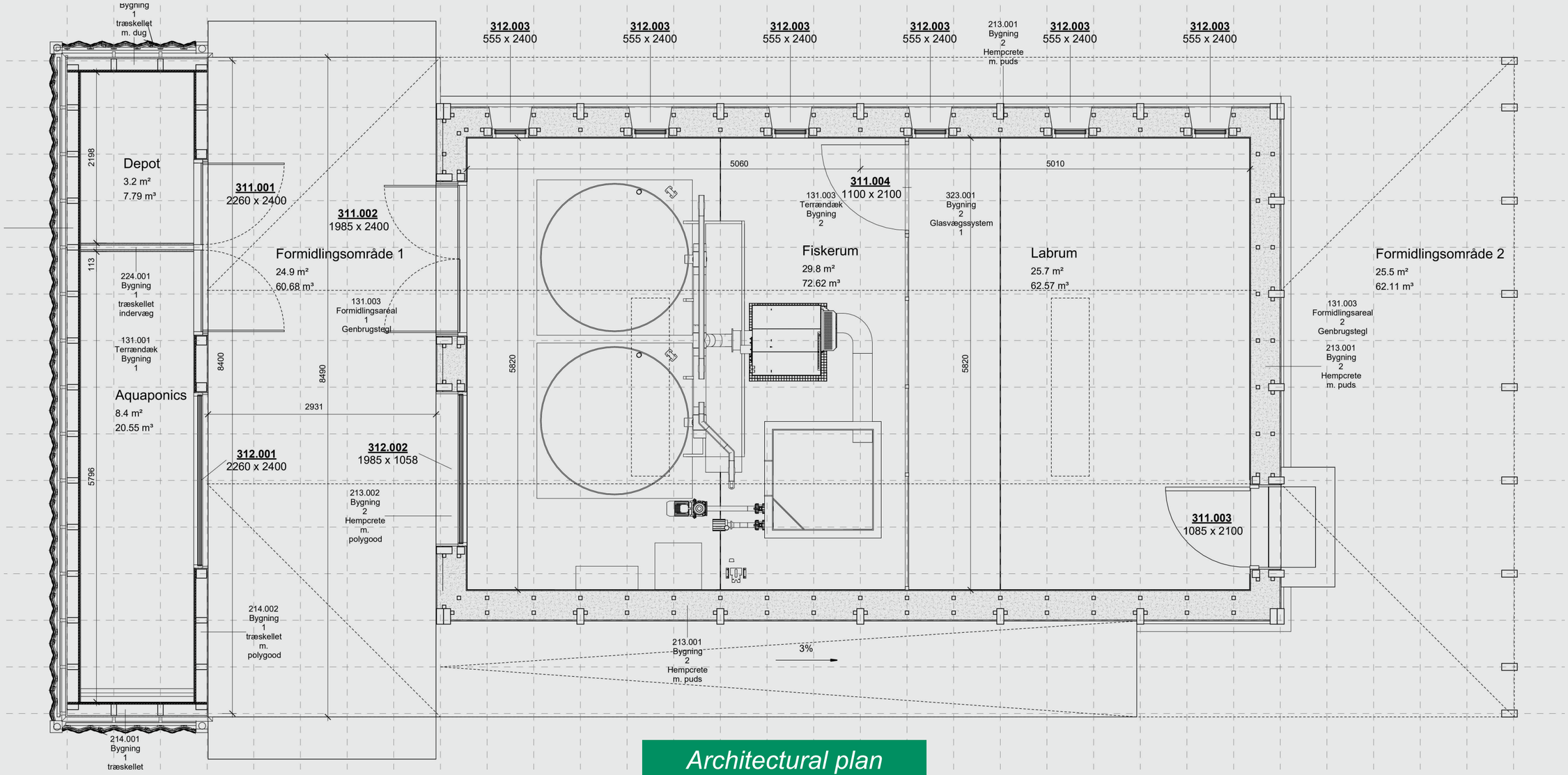


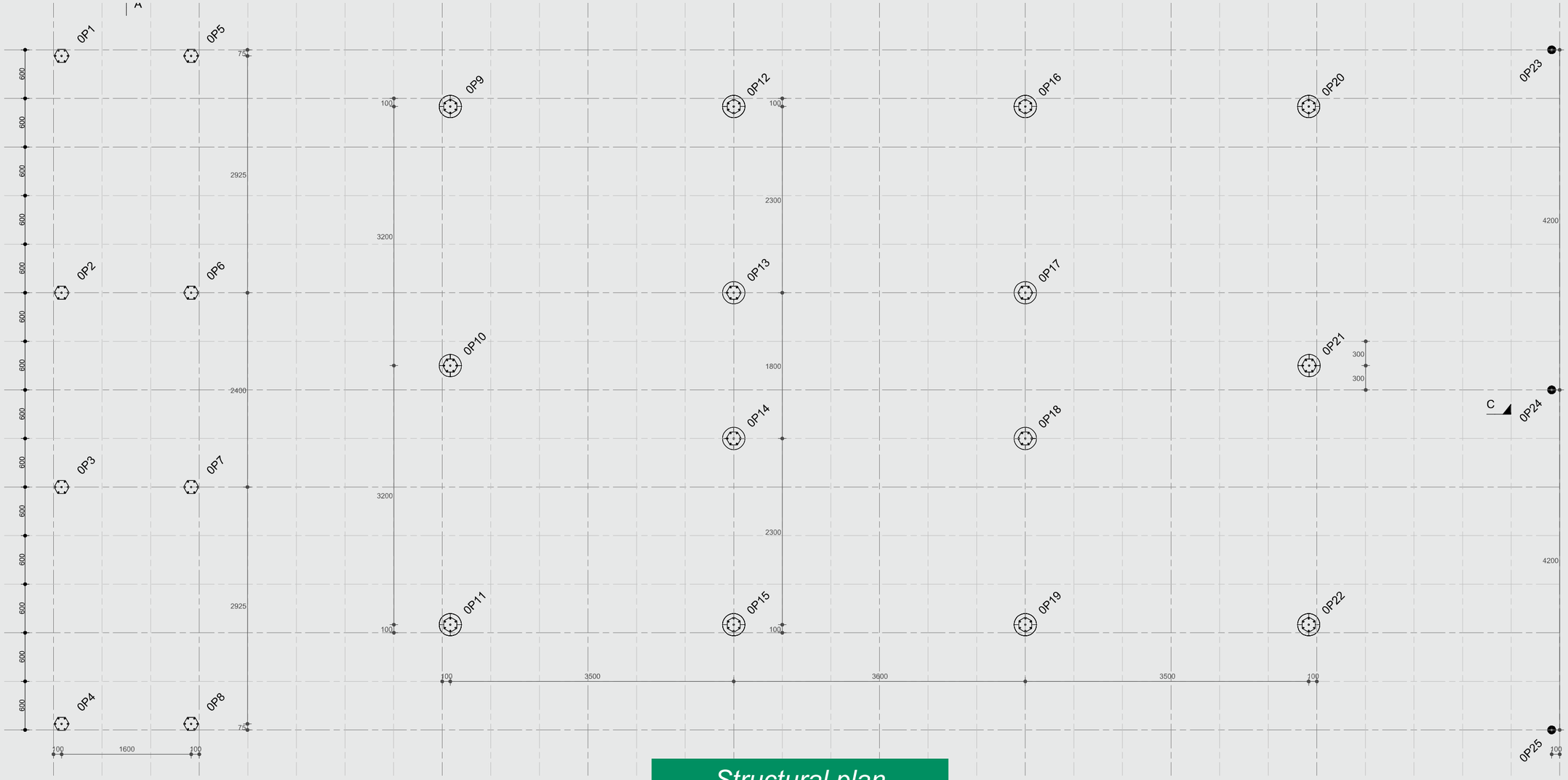
3D model
Structural system
Timber frame



3D model
Structural system
Exploded frames

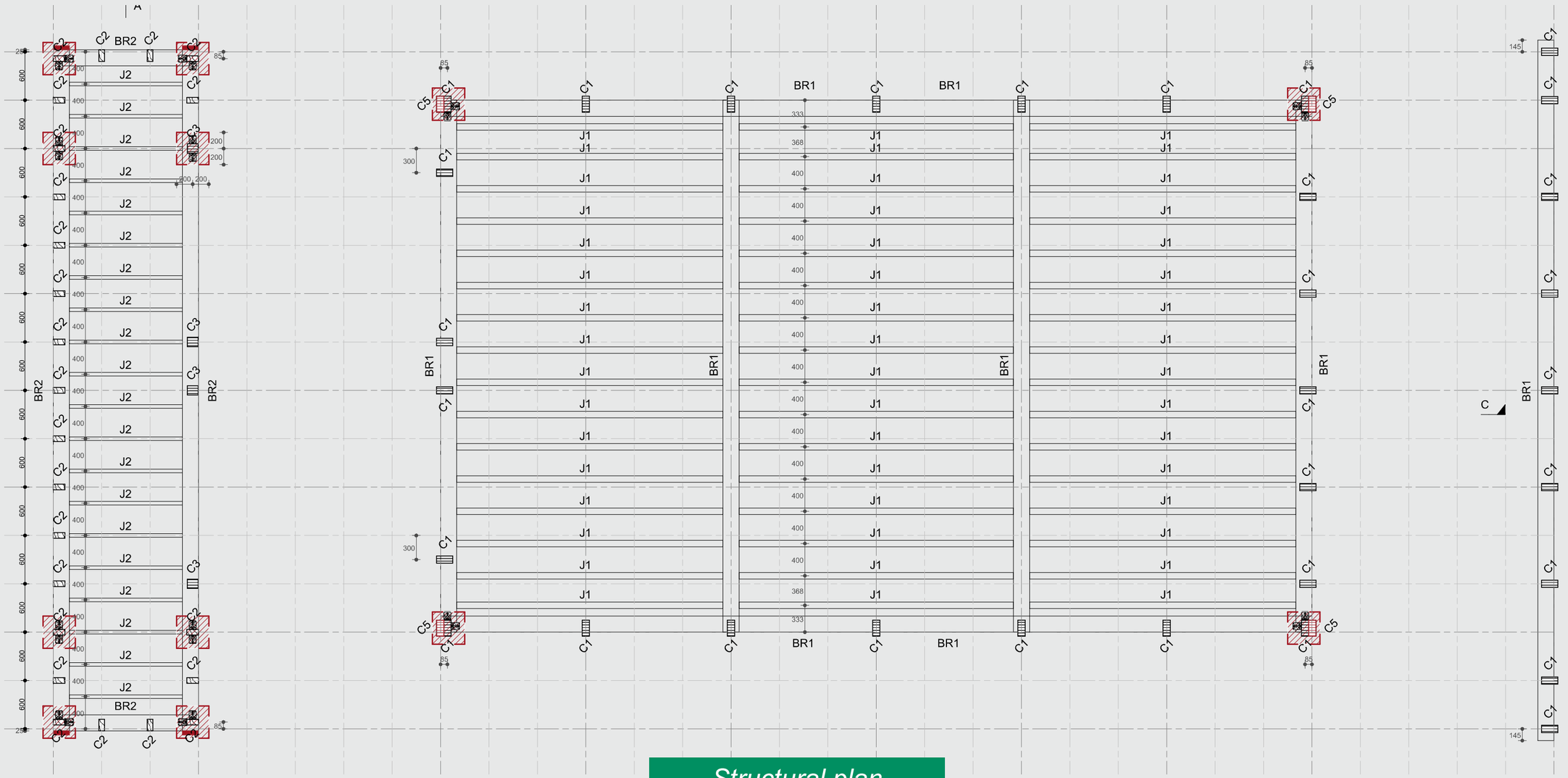


Architectural plan
Ground floor

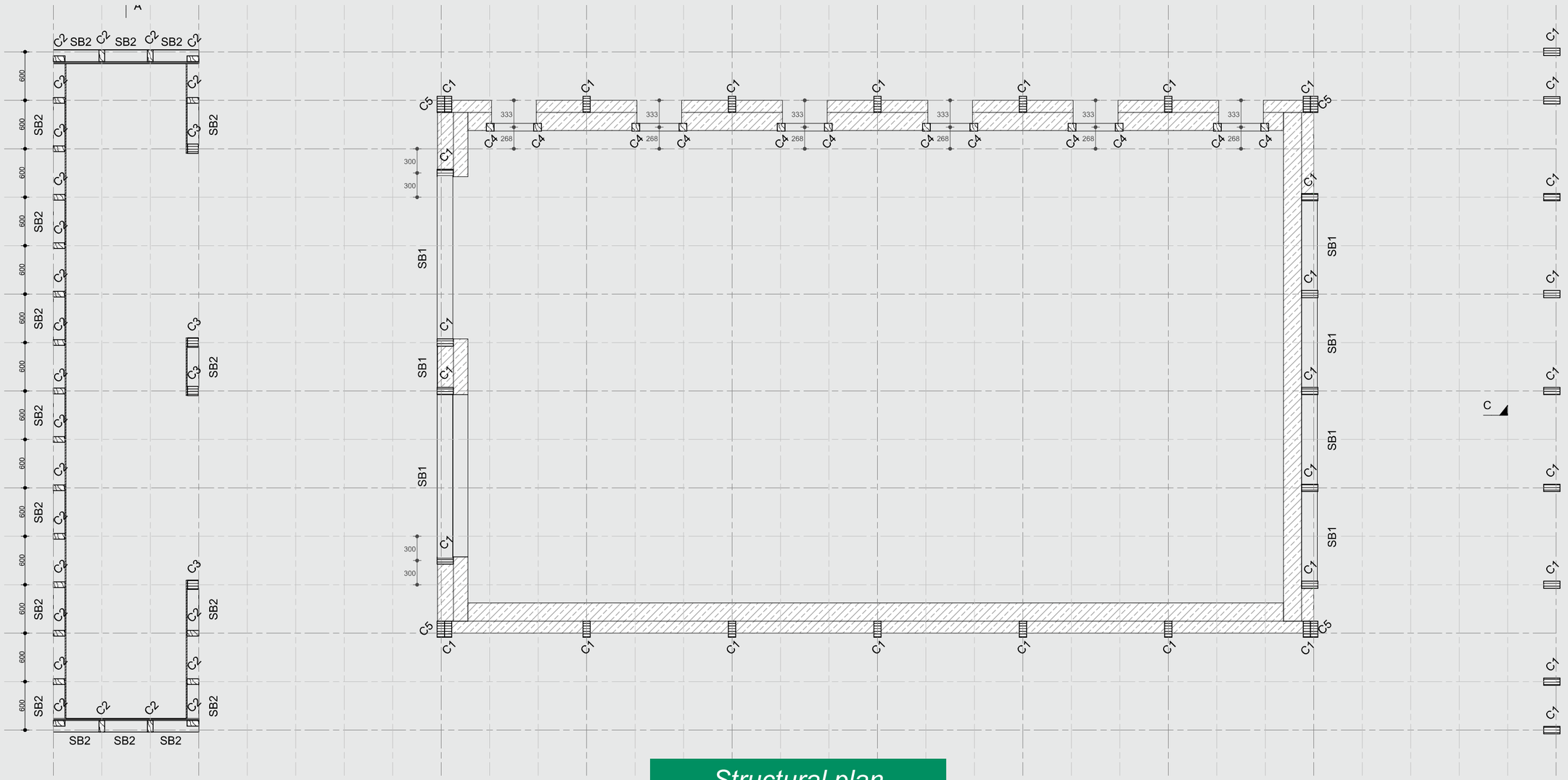


Structural plan
Screw pile foundation

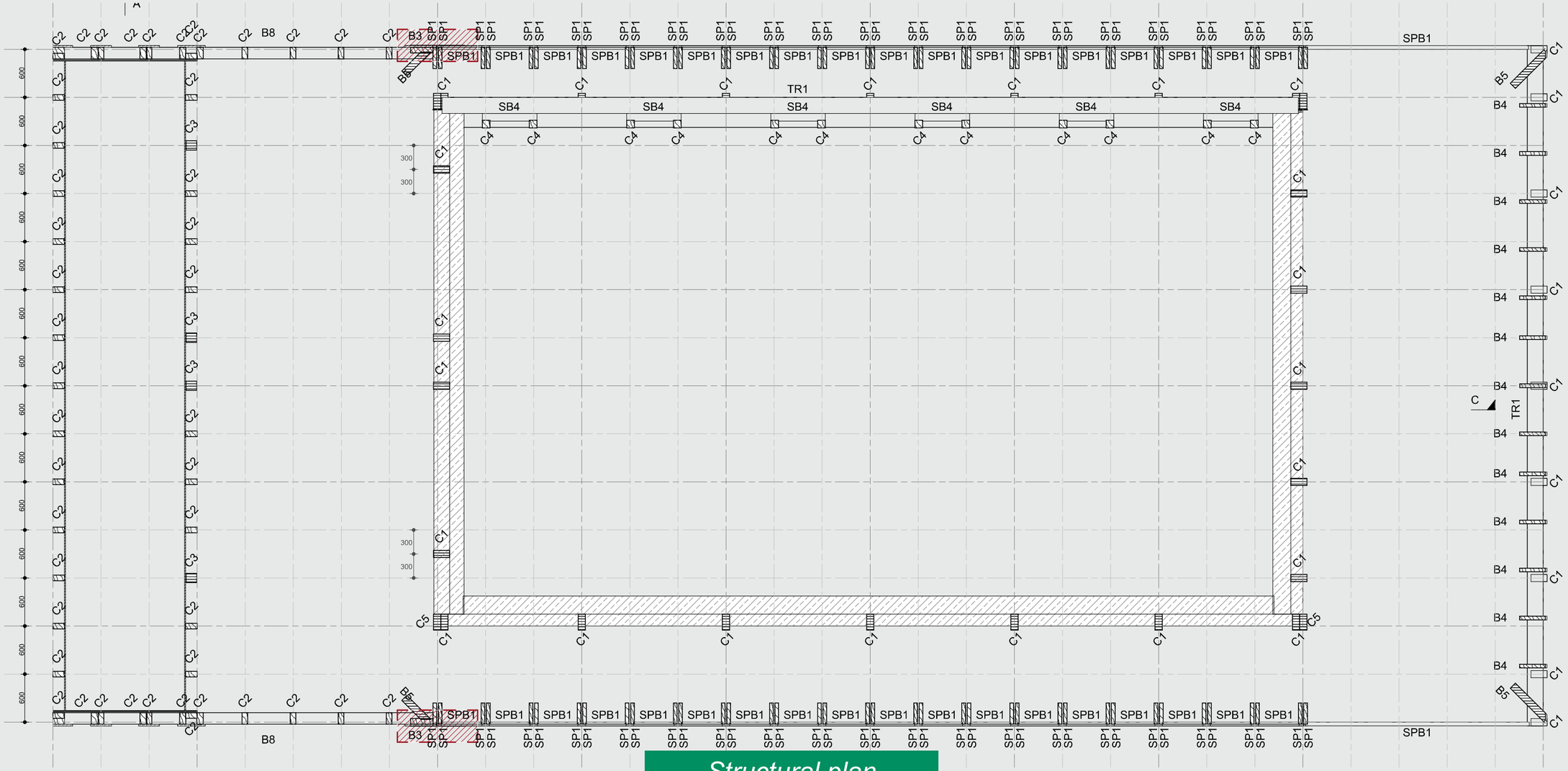
structured environment
structural and civil engineers



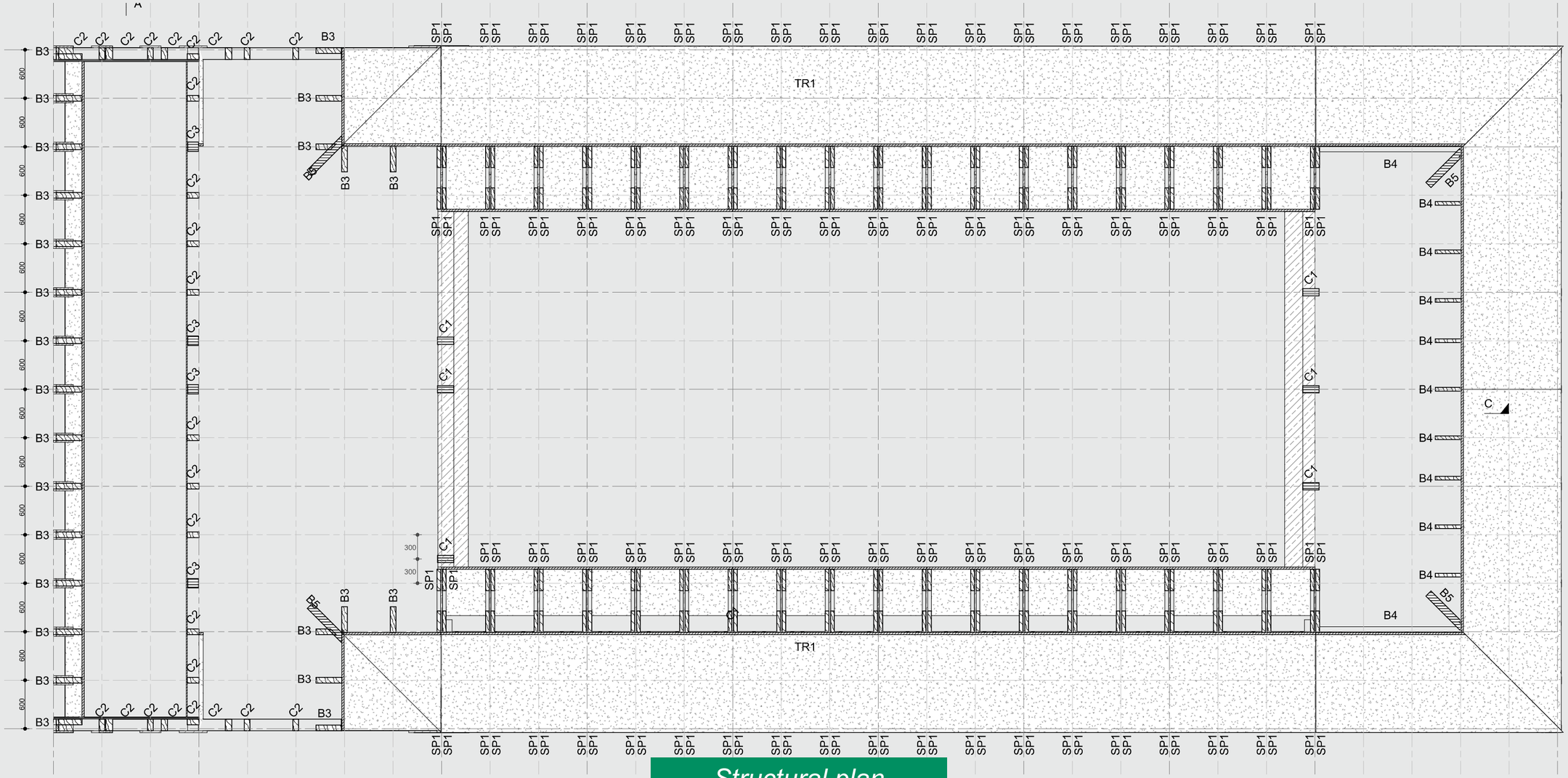
Structural plan
Floor structure



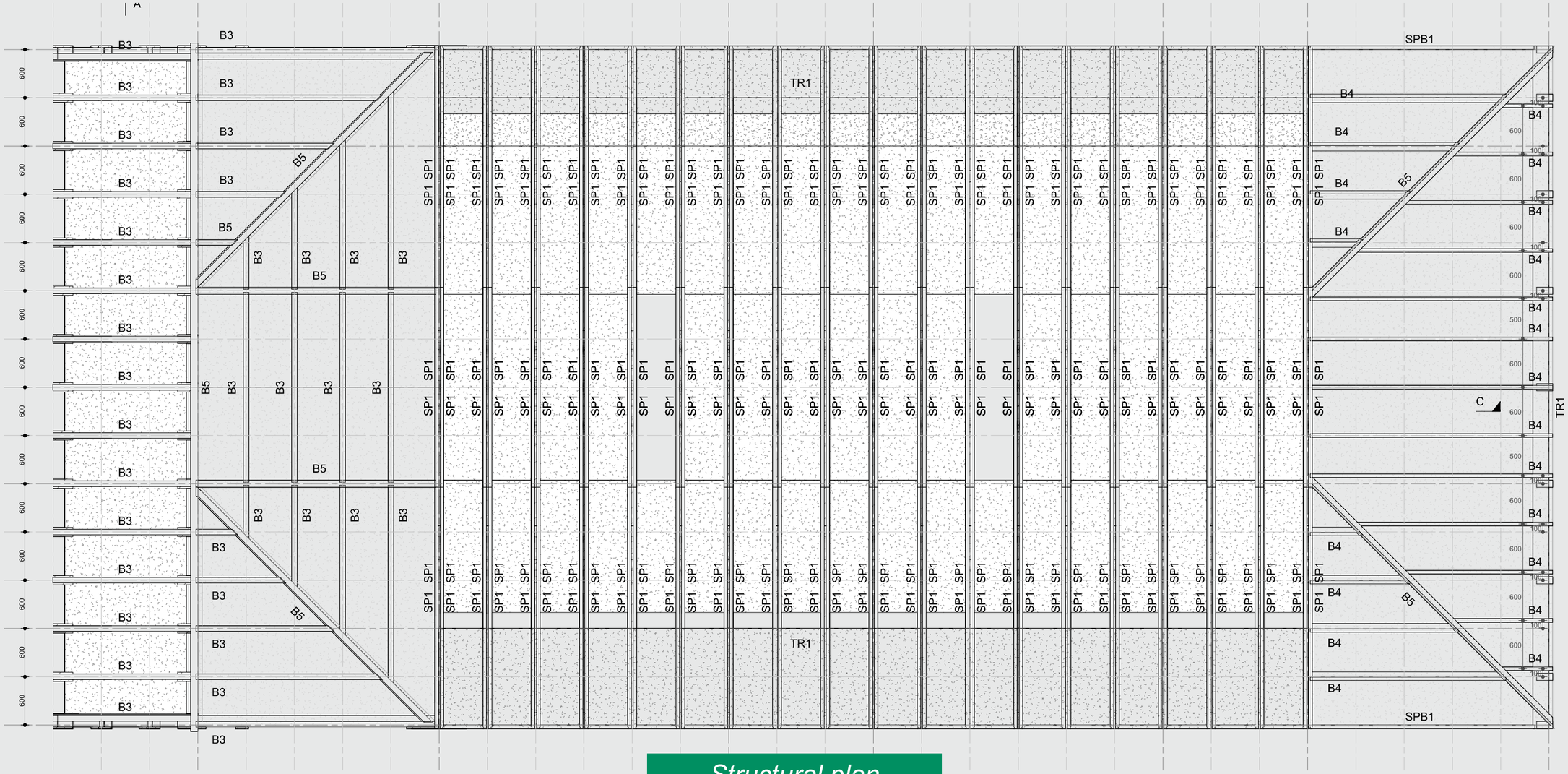
Structural plan
Walls and posts



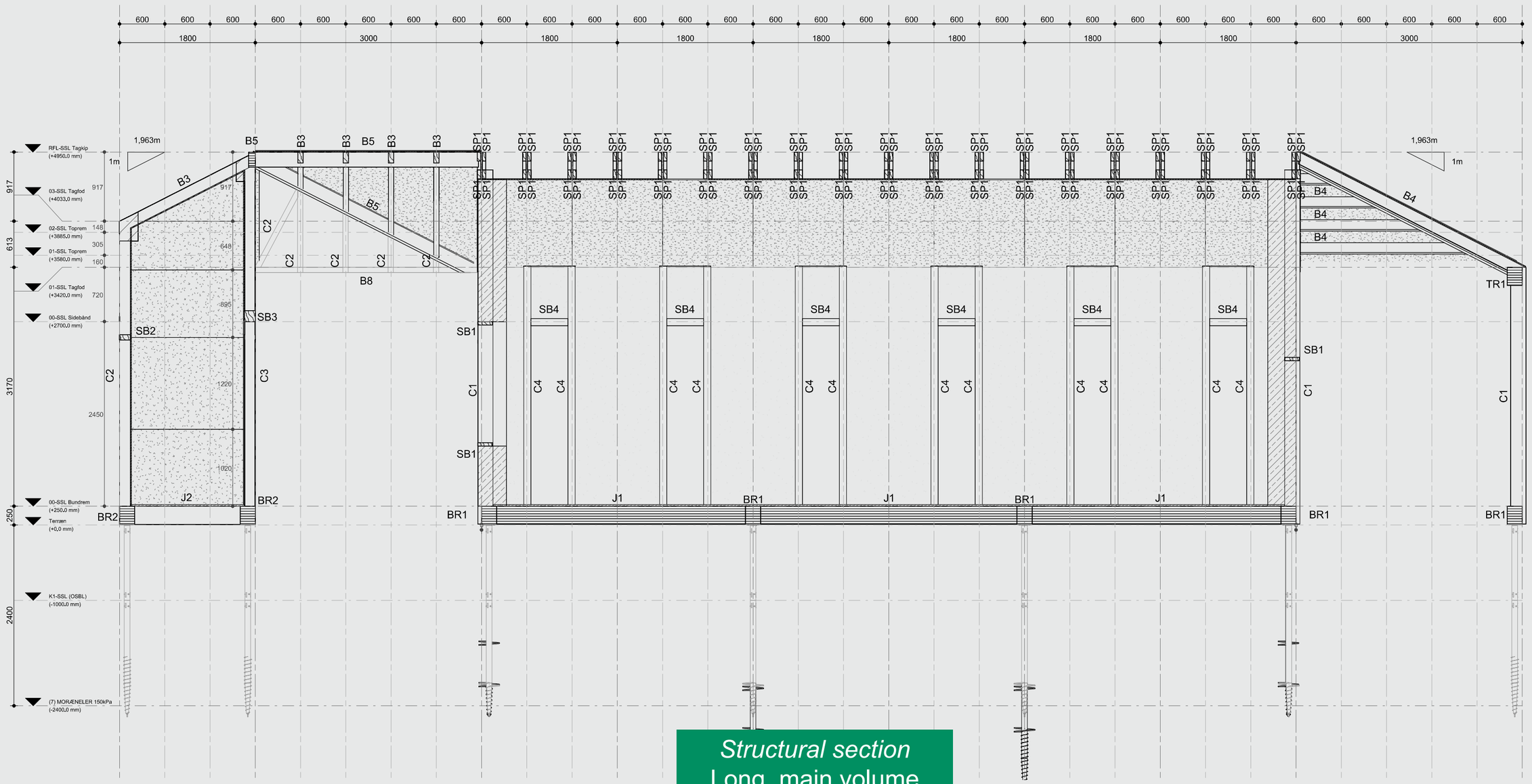
Structural plan
Low eaves



Structural plan
High eaves

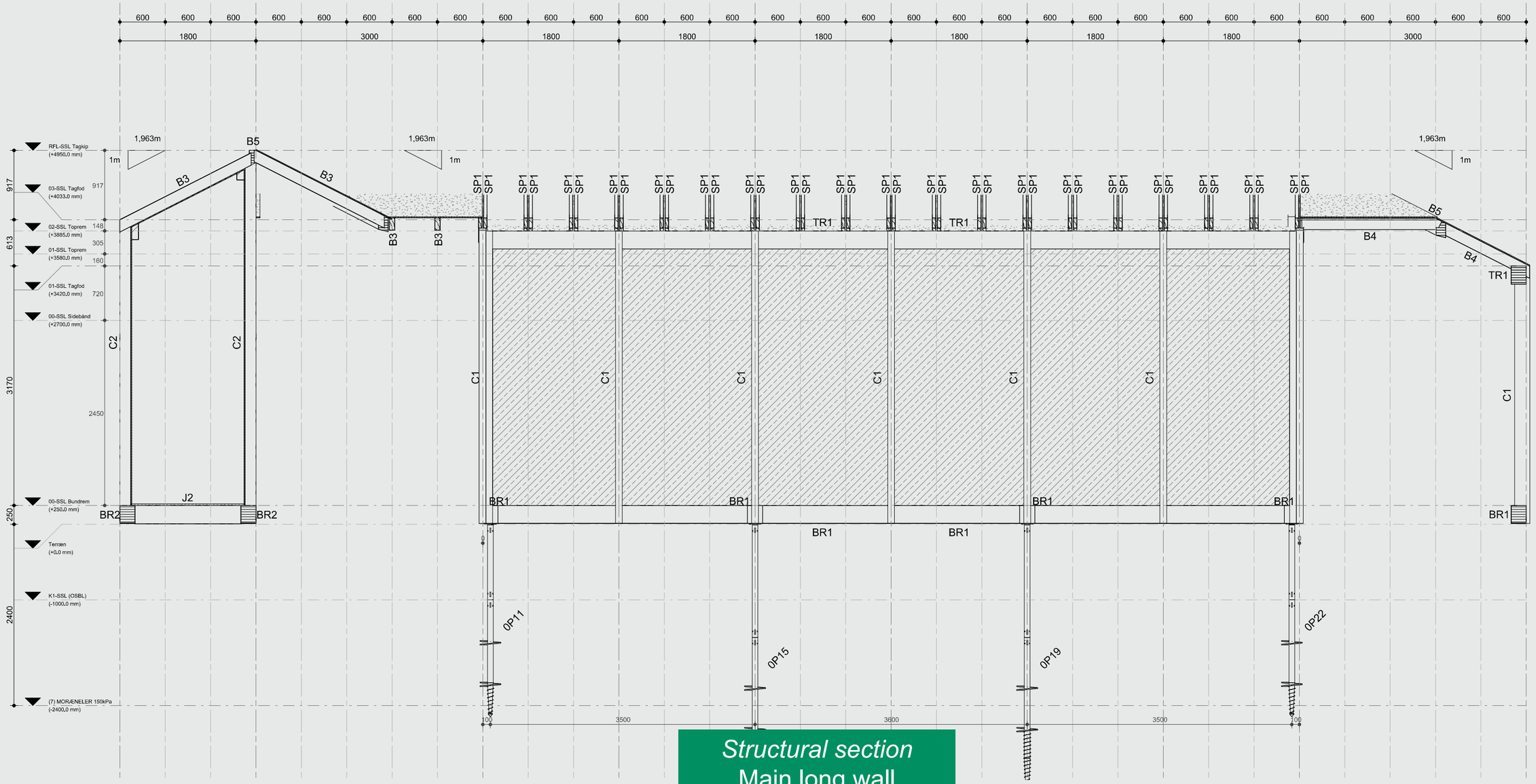


Structural plan
Roof structure



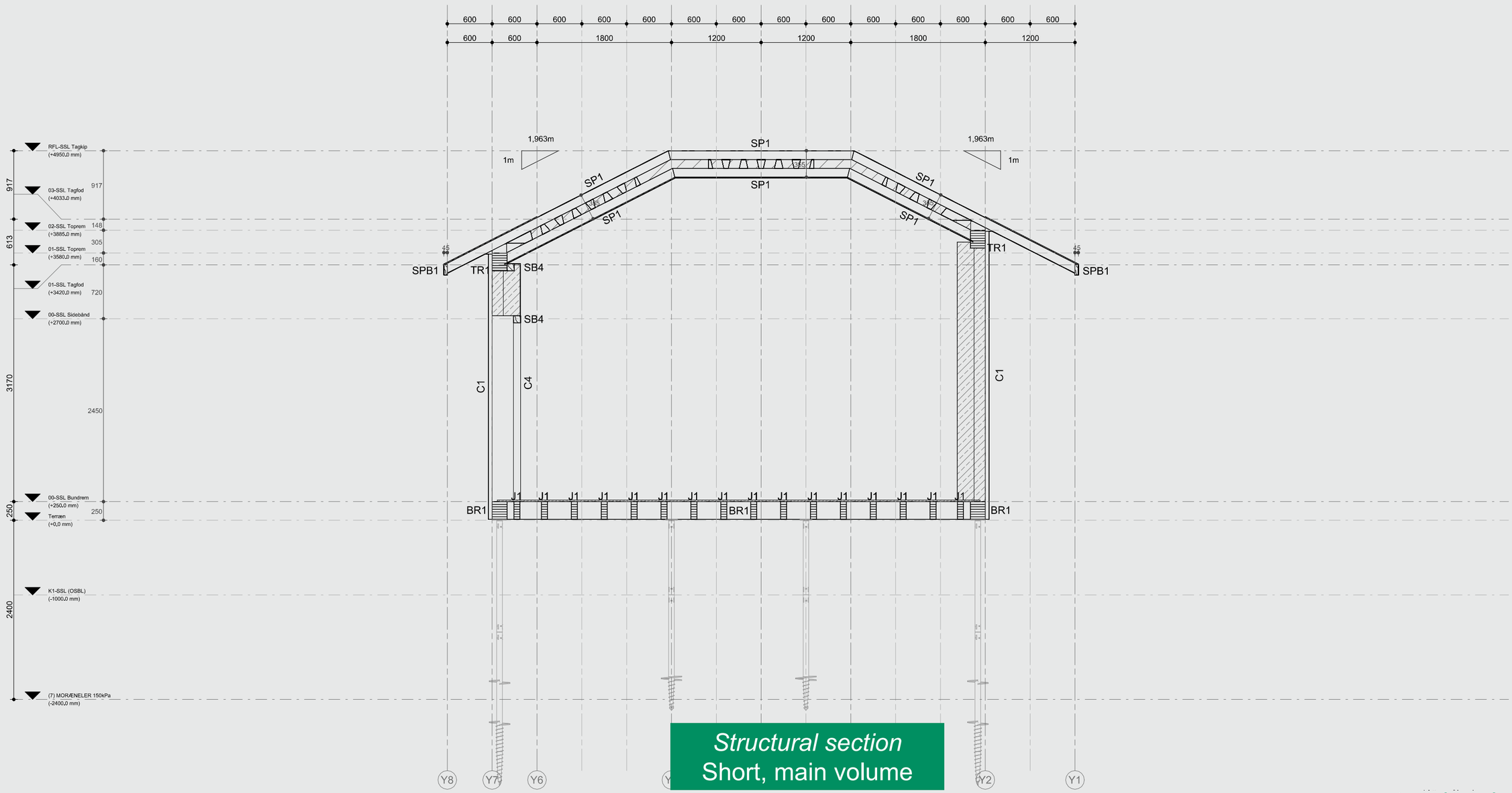
Structural section
Long, main volume

structured environment
structural and civil engineers



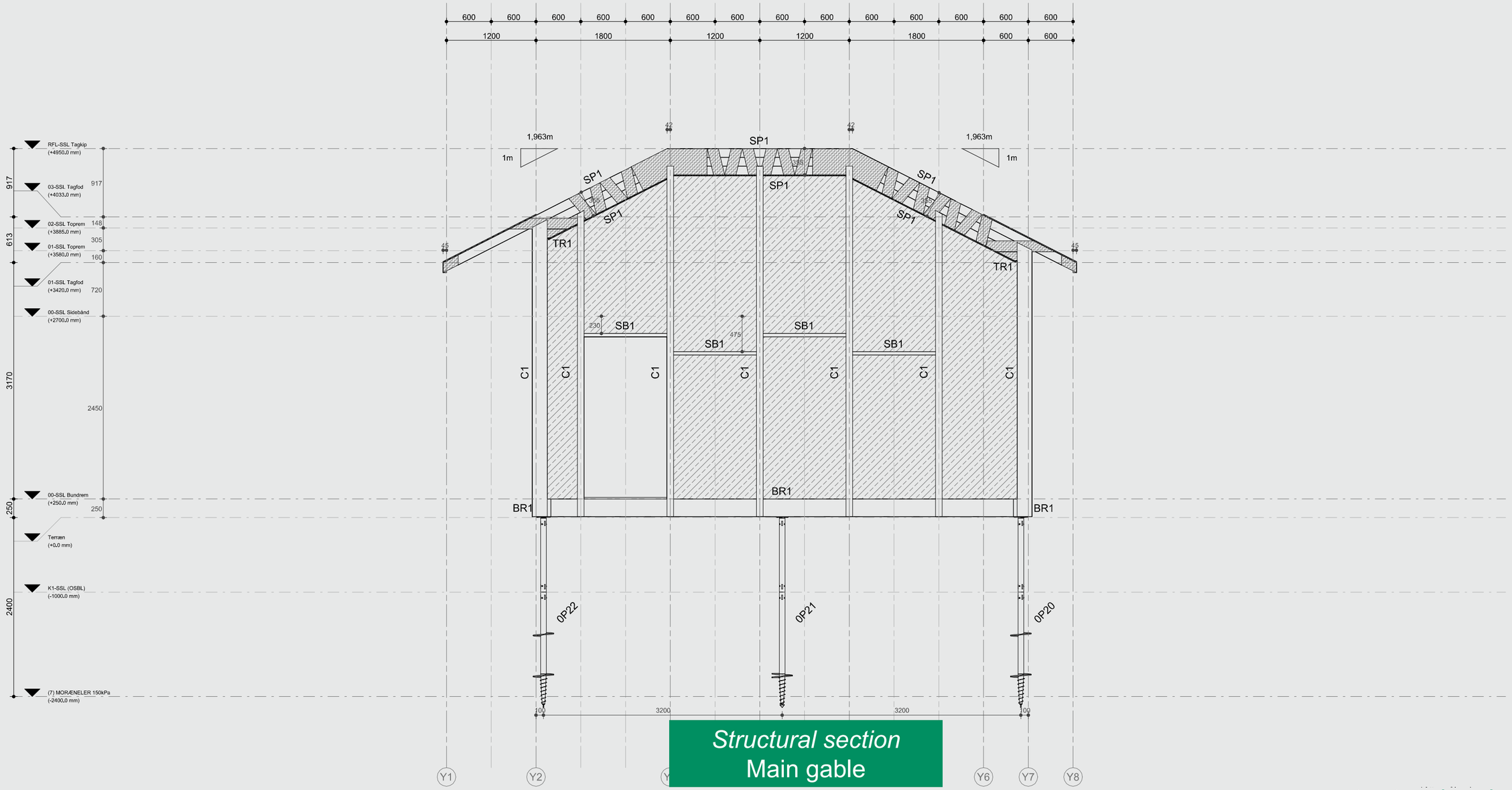
Structural section
Main long wall

Structural section
Secondary shear wall

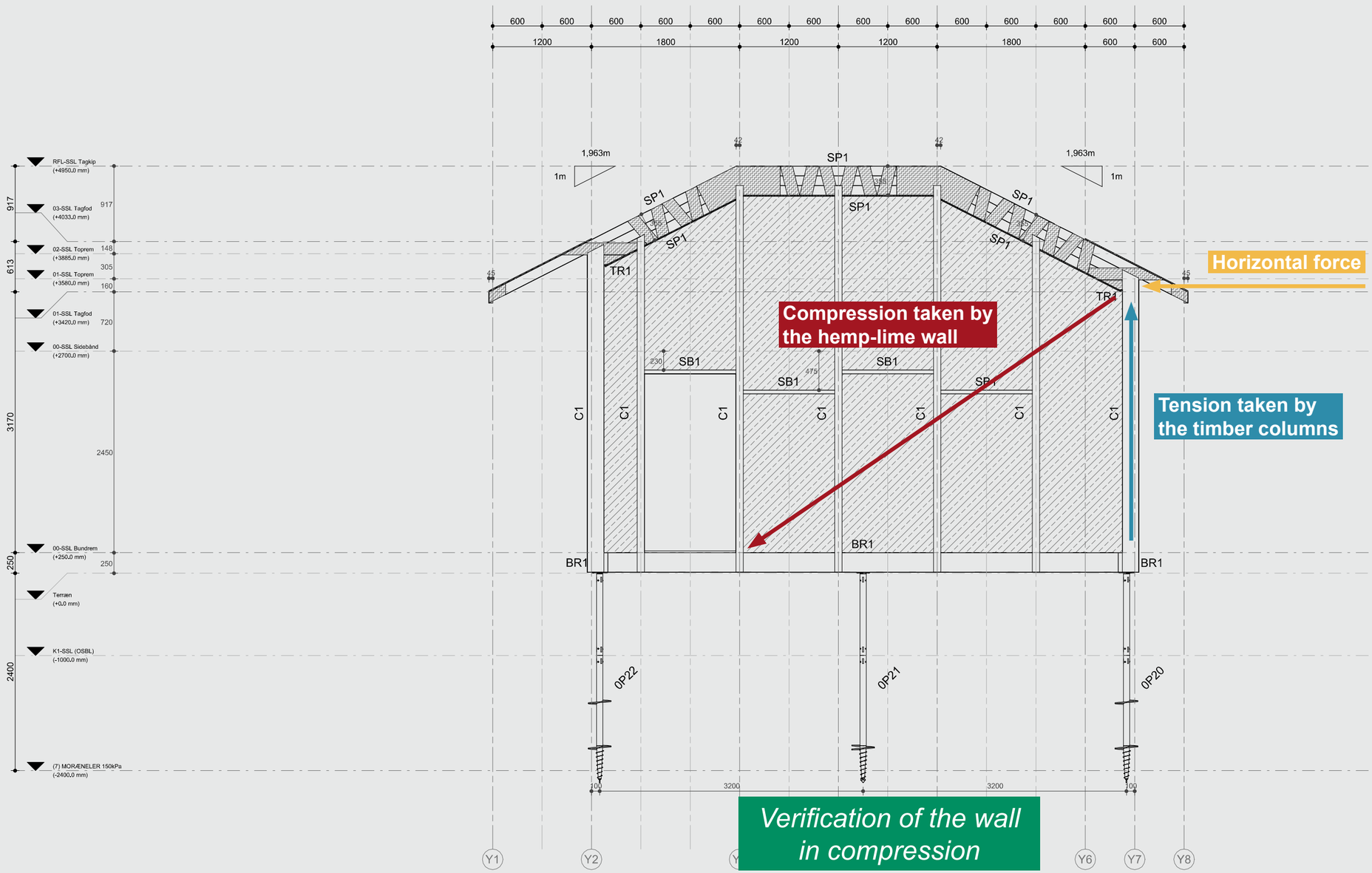


Structural section
Short, main volume

structured environment
structural and civil engineers



Structural section
Main gable



Horizontal force

Compression taken by the hemp-lime wall

Tension taken by the timber columns

Verification of the wall in compression

structured environment
structural and civil engineers

”Arken”
Warehouse
exterior

Karl Hilding Brosenius

Boro-hus, trähusfabrik, Landsbro (1946)

Sverige / Sweden

jonkopingslansmuseum.se

”Arken”
Warehouse
interior

apx. 35m span
nailed truss
from reclaimed
timber pieces

Karl Hilding Brosenius

Boro-hus, trähusfabrik, Landsbro (1946)

Sverige / Sweden

jonkopingslansmuseum.se

Building frames

Transporting the truss

Workers standing on a truss

Kaija & Heikki Siren
Servin mökin (1952)

Suomi / Finland

docomomo.fi

Servin mökin
nailed truss from timber pieces

Servin mökin
Restaurant hall interior

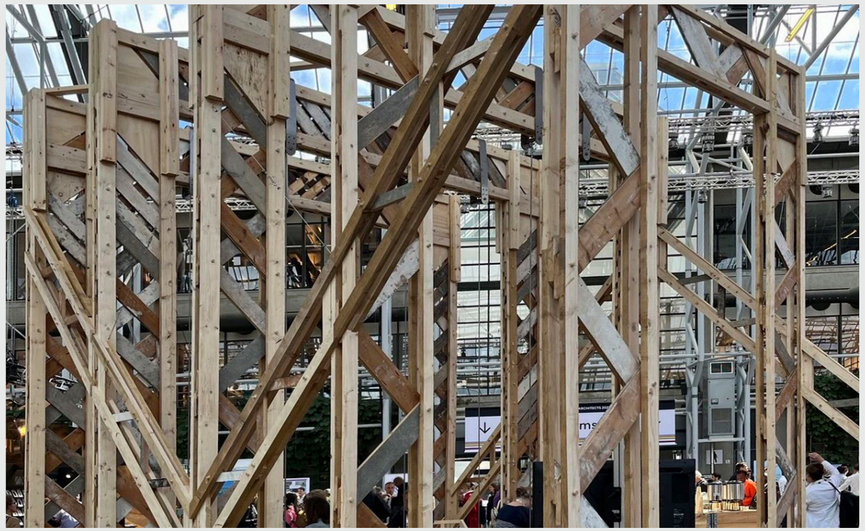
Loaded beam mock up

Xan Browne & Olga Popovic Larsen (Royal Danish Academy)

Structural waste to wooden beams (2022-2023)

Danmark / Denmark

Structurally optimized beam system from reclaimed timber pieces



Xan Browne & Olga Popovic Larsen
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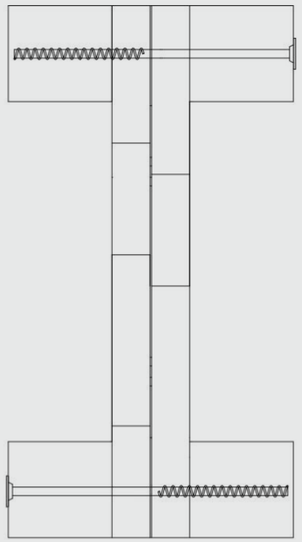
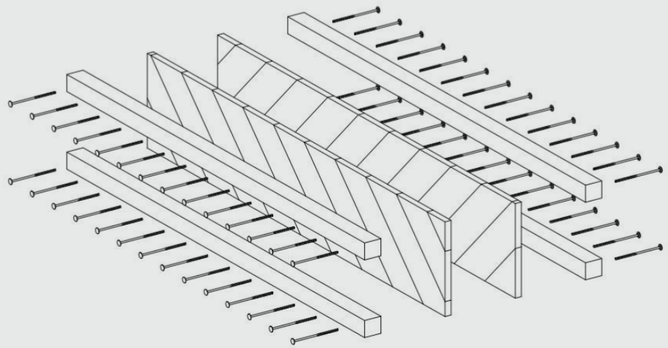
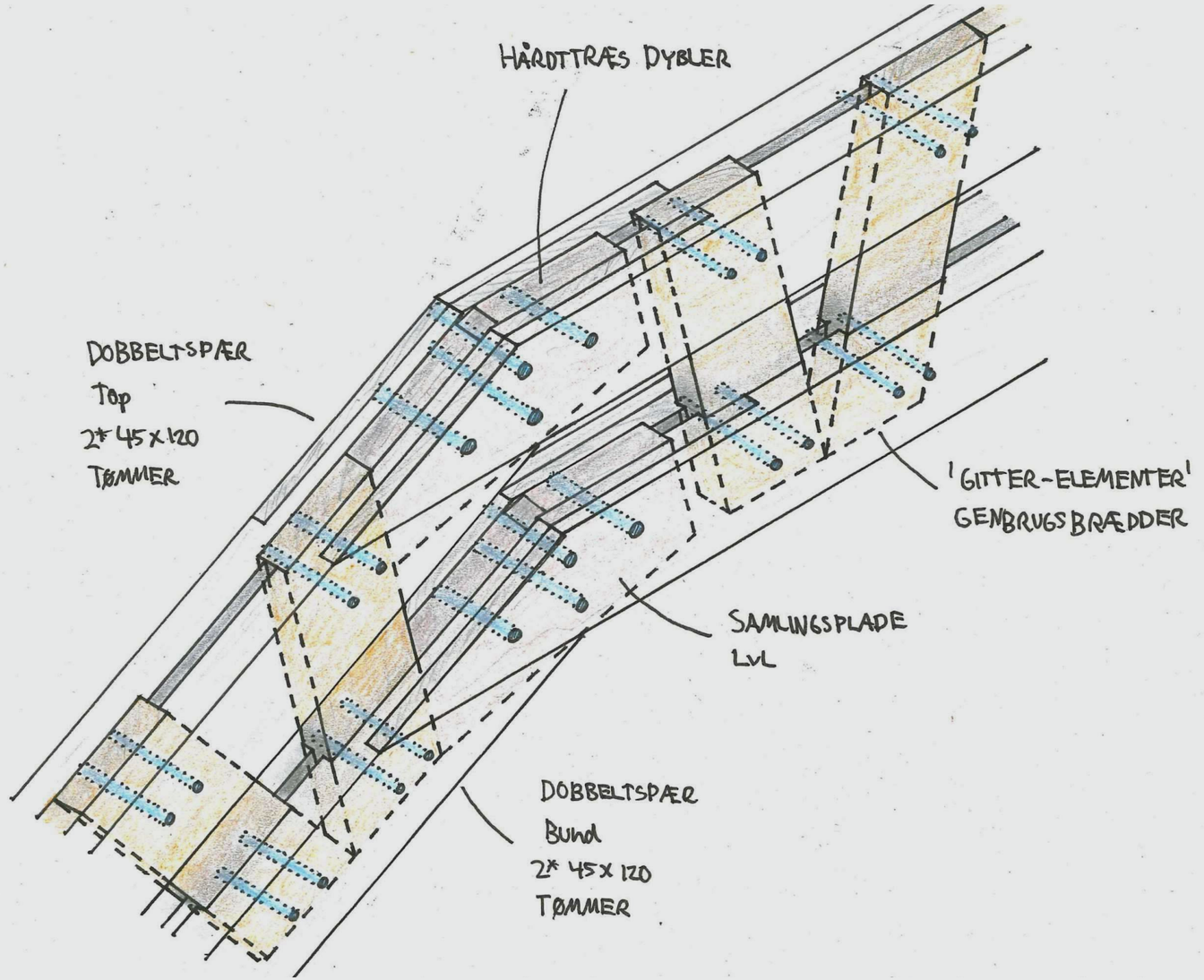
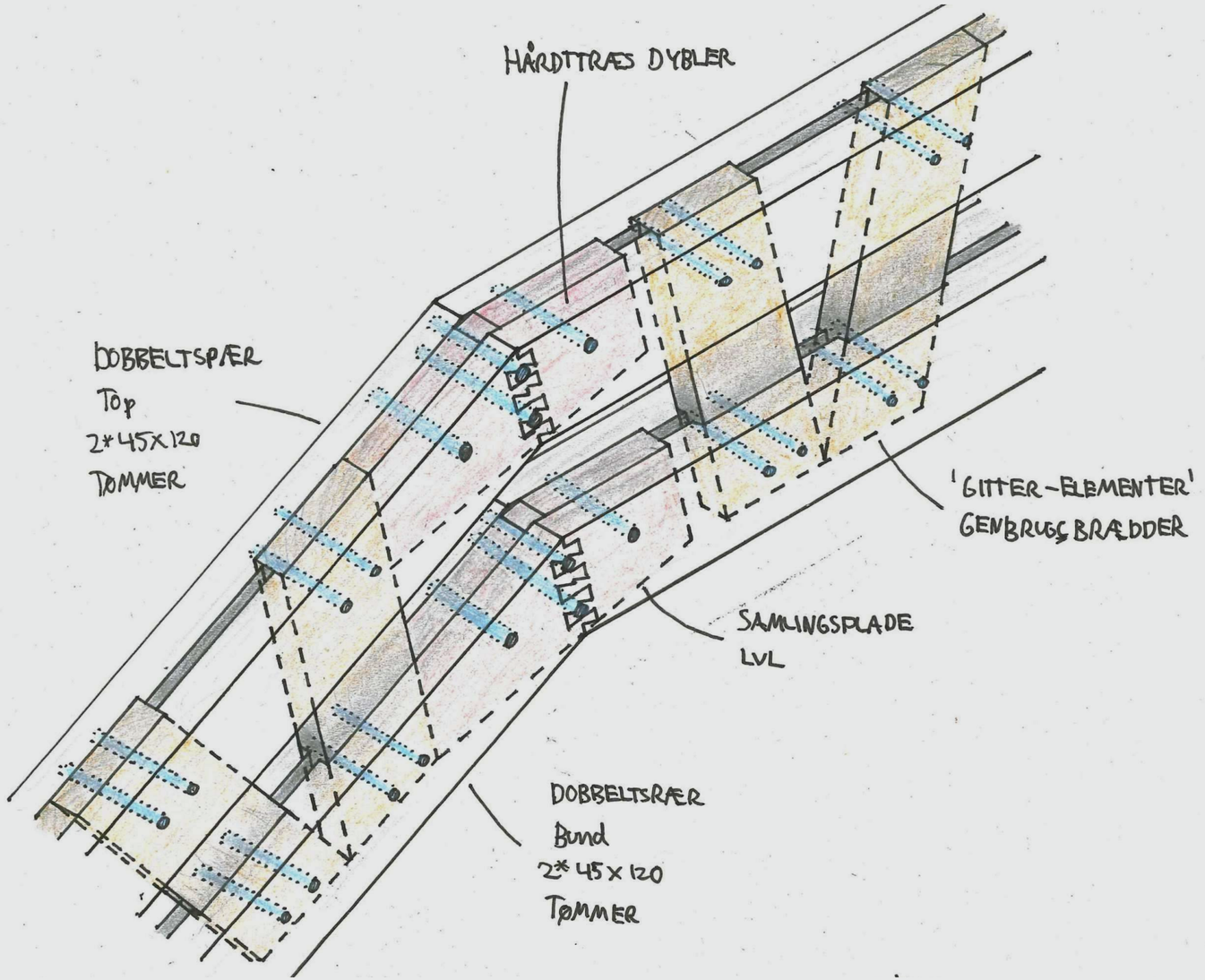




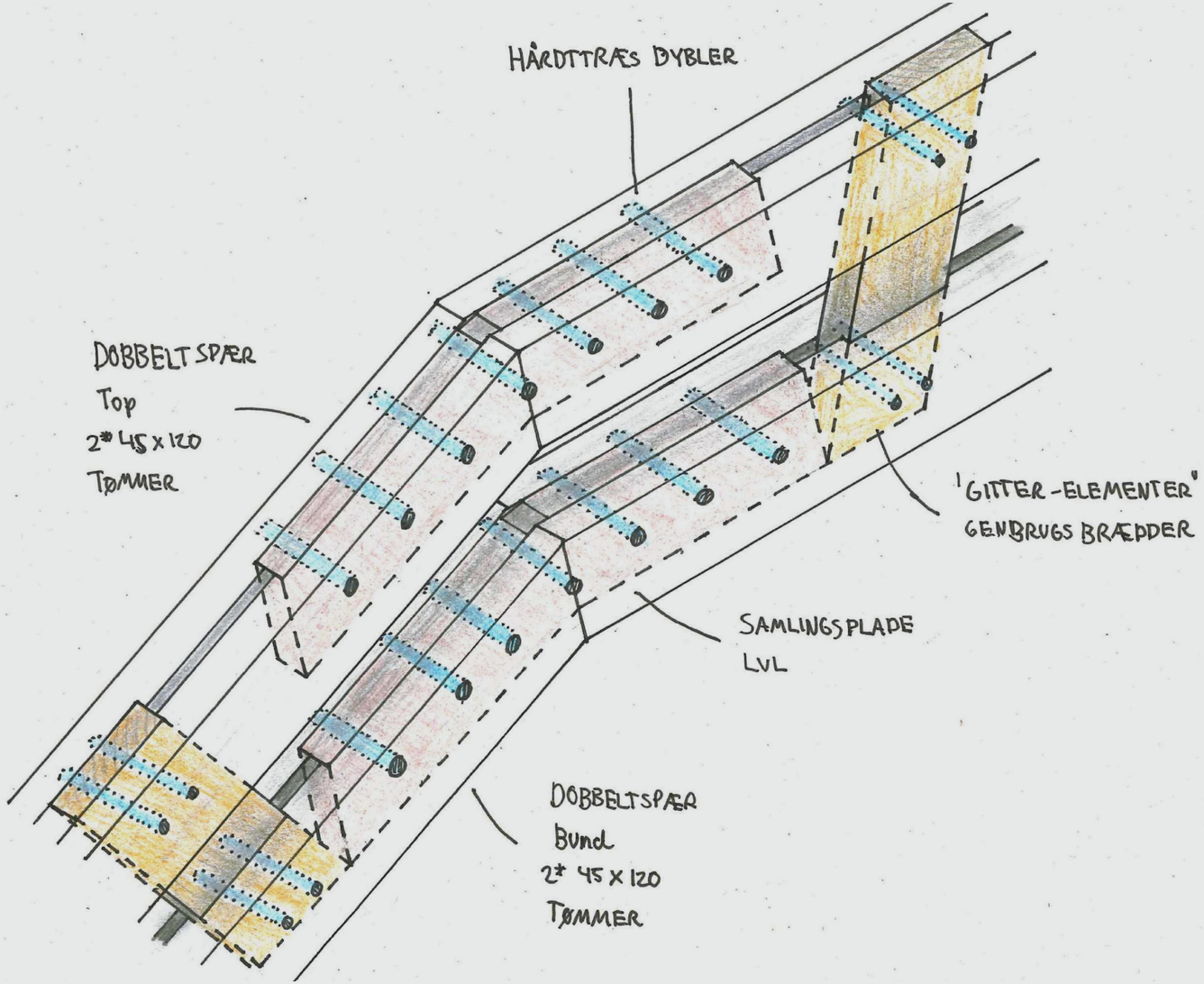
Diagrams:
Beam system from reclaimed timber pieces



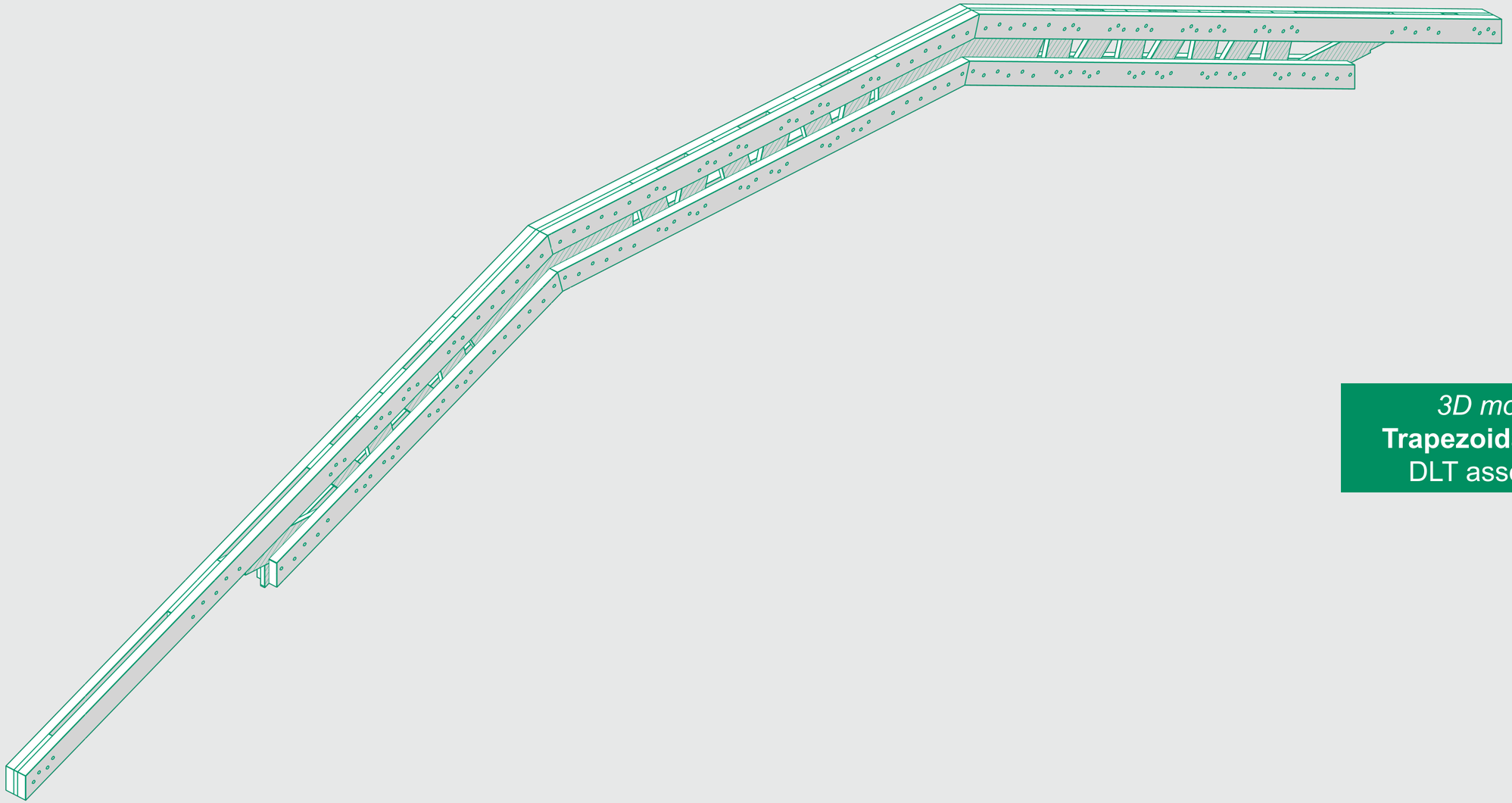
sketch
Moment Joint
Multi-overlap



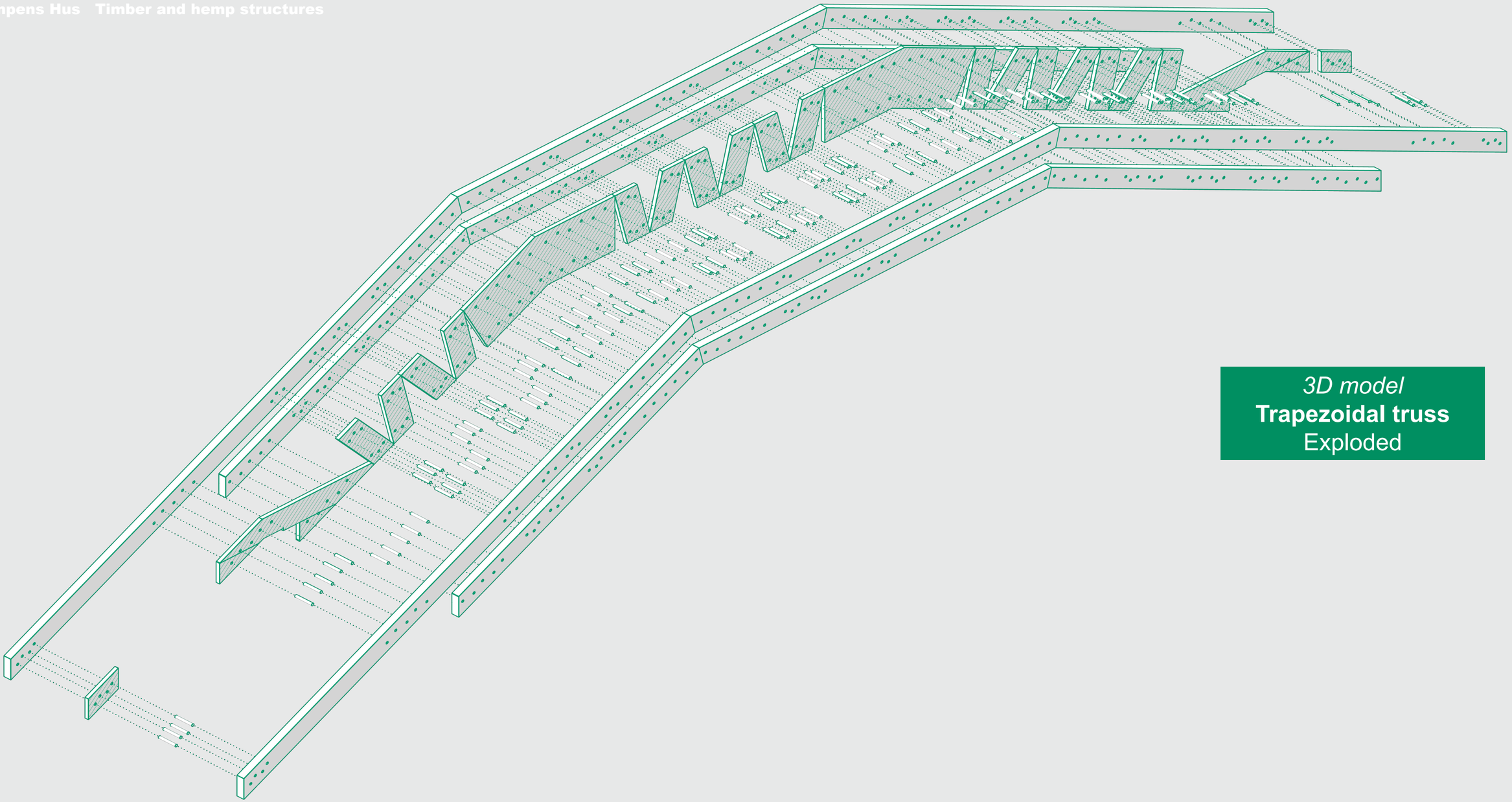
sketch
Moment Joint
Finger joint, overlap



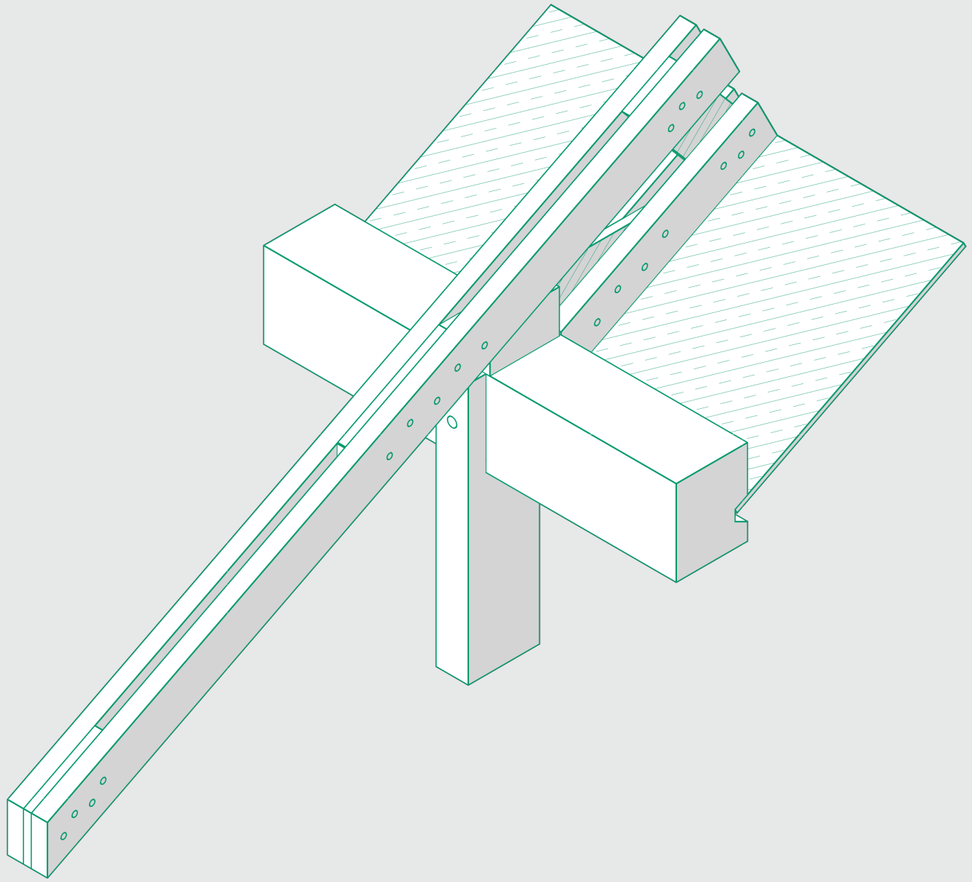
sketch
Moment Joint
Long overlap



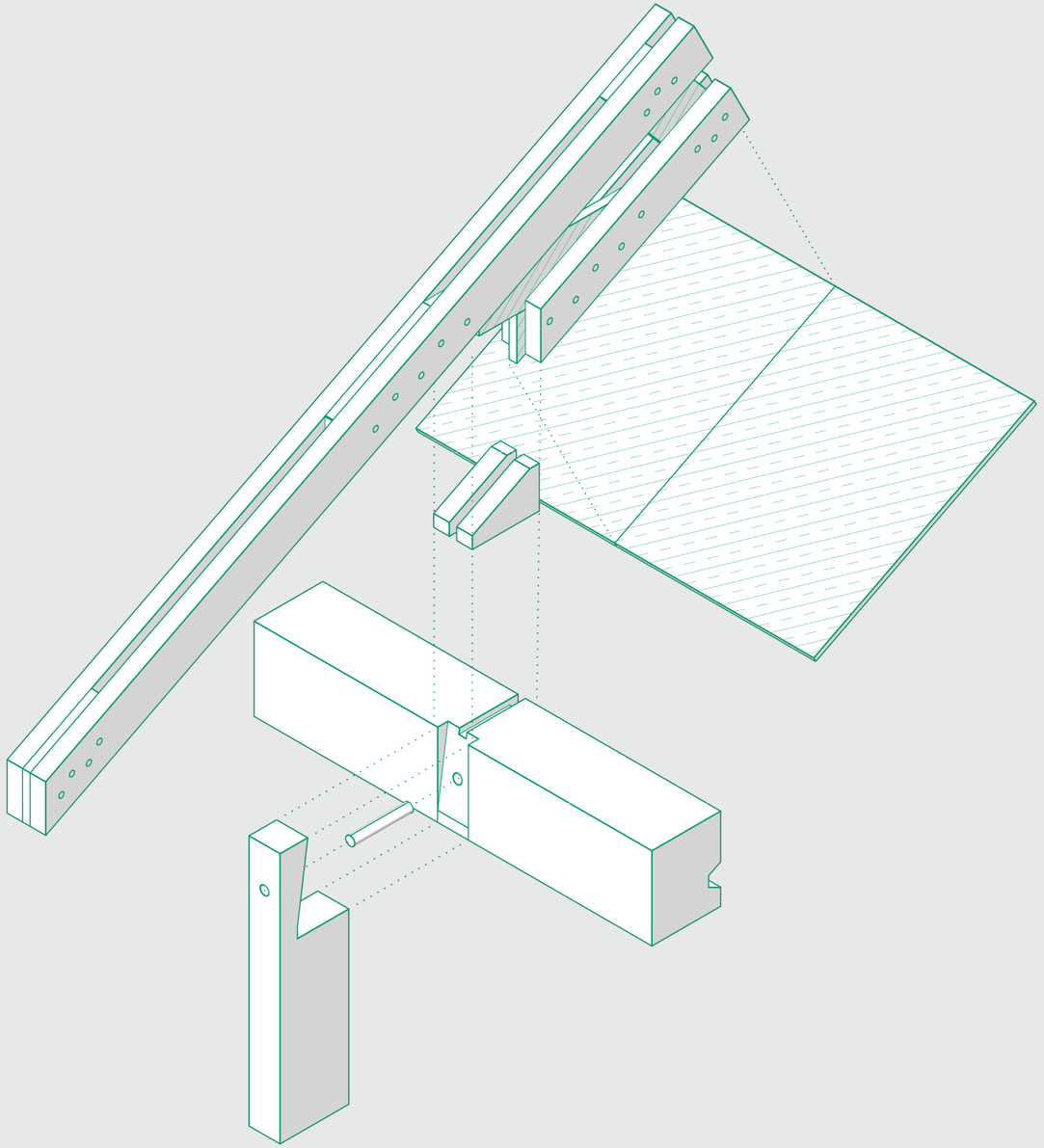
3D model
Trapezoidal truss
DLT assembly



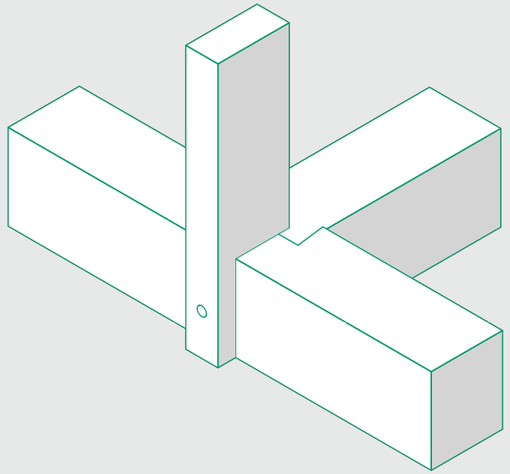
3D model
Trapezoidal truss
Exploded



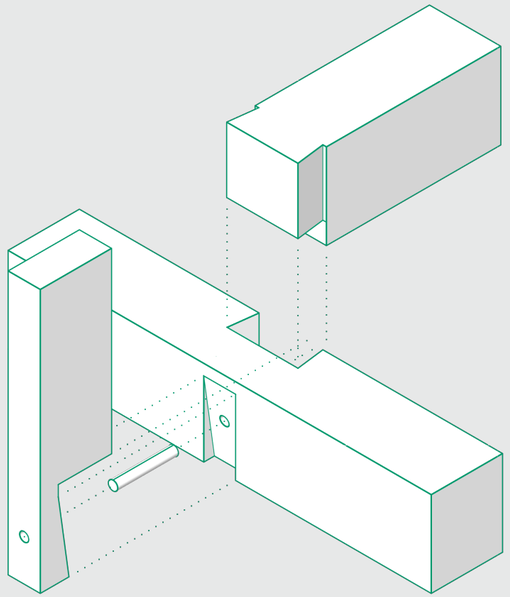
3D model
Eaves detail
Interlocking joint



3D model
Eaves detail
Interlocking joint



3D model
Footing detail
Interlocking joint



3D model
Footing detail
Interlocking joint

Construction progress

Construction progress

Construction progress

structured environment
structural and civil engineers

Construction progress

Hampens Hus Timber and hemp structures

Construction progress

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Thank you!

Low-carbon structures

a 28 year WIP

As structural engineers we are responsible within the structures we design for about 10% of global greenhouse gas emissions.

These are quantified as ‘embodied carbon’ for each material, which is influenced by how the materials are produced, transported, and installed.

Engineers should be concerned about designing structures with low embodied carbon. We believe that total global emissions could easily be reduced by about 3% by properly using the technology that we already have and by doing our job properly.

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structured environment
structural and civil engineers

Hampens Hus

Hampens Hus bygges som et fysisk fix-punkt og living-lab, hvor alle interesserede inviteres til at opleve et diffusionsåbent hus med mindst 8 forskellige hampebaserede materialer – fra gulv til tagplader.

Hampens Hus bygges hos Center for Erhvervsrettede Uddannelser Lolland-Falster som omdrejningspunkt for etablering af nye lokale værdikæder baseret på dyrkning og forarbejdning af hamp.

For at sikre en hurtig omstilling til flere biobaserede byggematerialer er det vigtigt, at de nye materialer inddrages i uddannelser på alle niveauer. Hampens Hus er derfor en del af CELF erhvervsskole og –gymnasium.

Læs mere her: bioguldborgsund.dk/hampenshus

Eksterne partnere i forbindelse med byggeriet:

nikolova/aarsø · ADSERBALLE & KNUDSEN & S En del af CG Jensen Holding · structured environment rådgivende ingeniører se · DTU · birkelink

Hampens Hus får medfinansiering fra EU Interreg North Sea, Realdania og Boligfonden Kuben.
De lokale partnere i værdikædeprojektet Building Based on Bai based (BBoBB) er CELF, Agrovi, Business Lolland-Falster og Guldborgsund Kommune

CELF · Agrovi Den bedste løsning på jorden · Business Lolland-Falster · GULDBORGSUND