Working with the future.
Life long design strategies.

Manja van de Worp
IABSE Future of design
21/09/2023

I am a structural engineer and Architect

_____

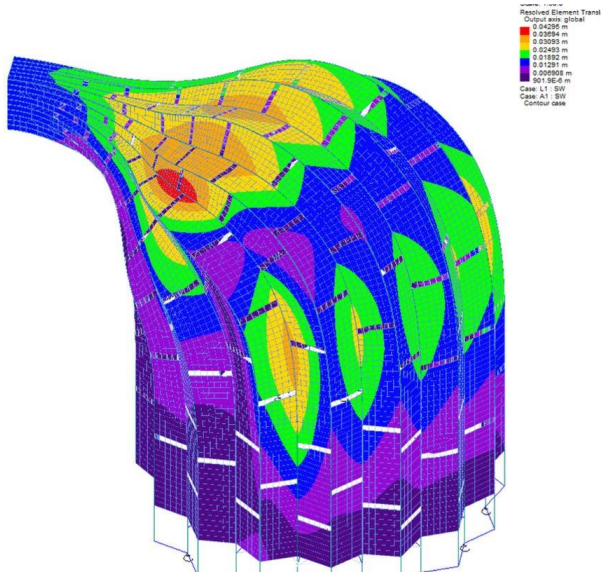
And I love to design beautiful things

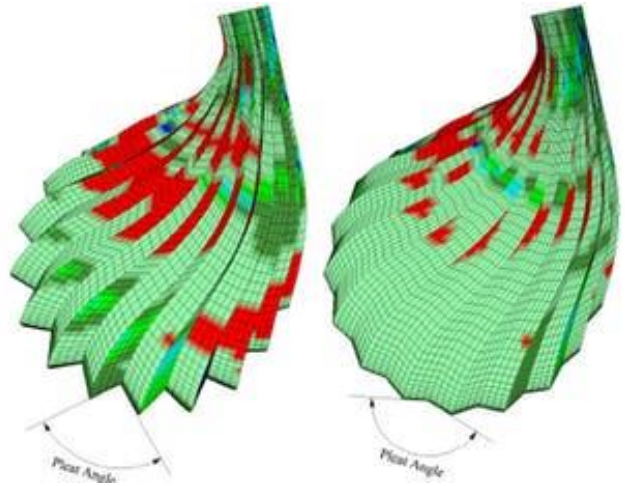
FAR (Michael Schöner), 2019
commissioned by Nina Yashar (Nilufar)
“SWIRL”, 2019

Not because their structural efficiency

or because they are the most pure

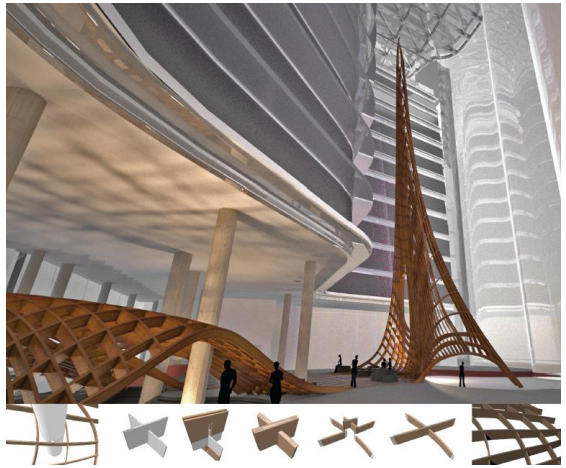
… but because of their integration of <u>geometry,</u> <u>structure and fabrication</u>

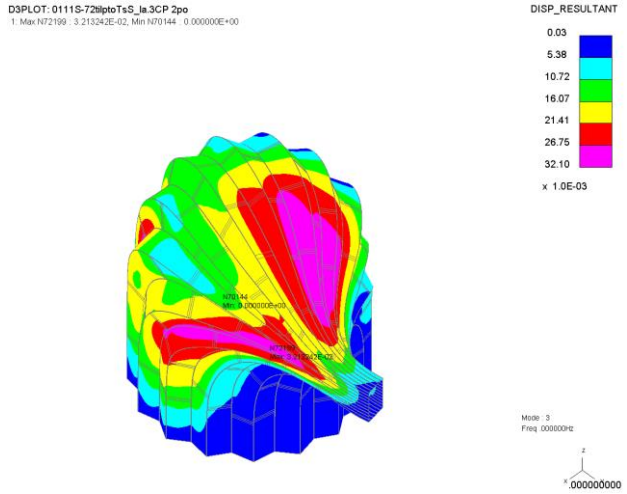


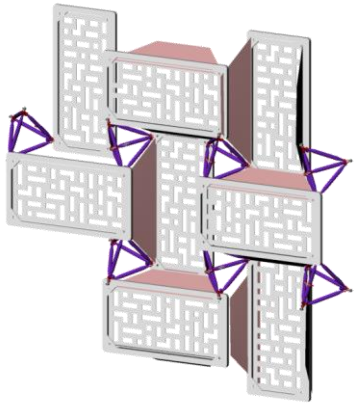


This is where the magic is !

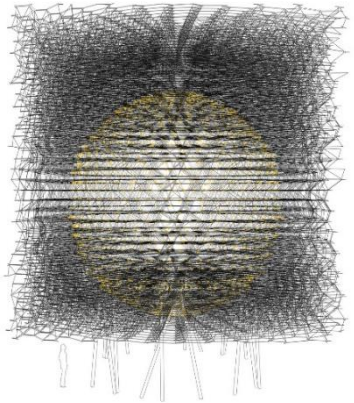
Arup Advanced Geometry Unit

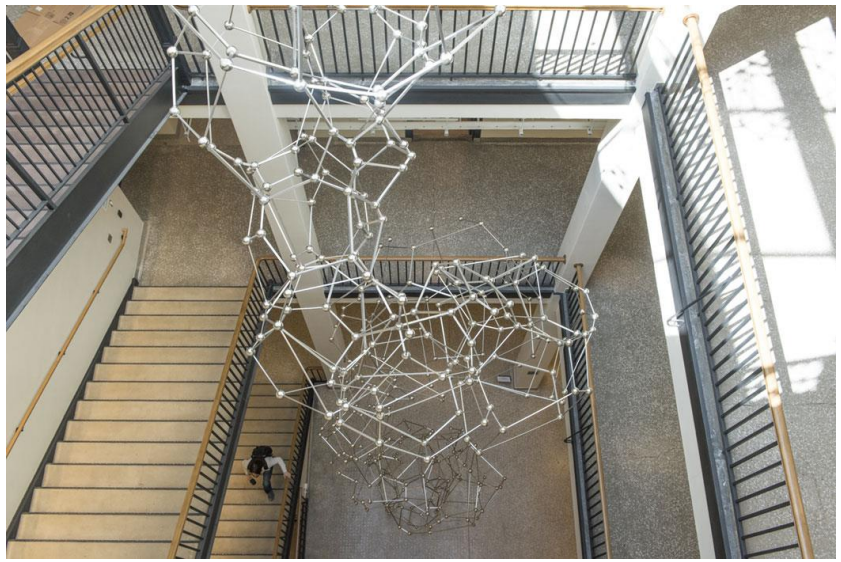






Collaborate (Simmonds Studio)

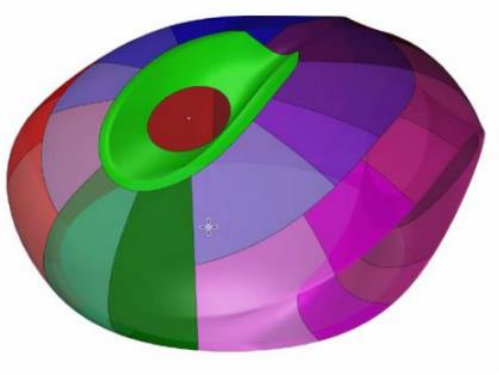


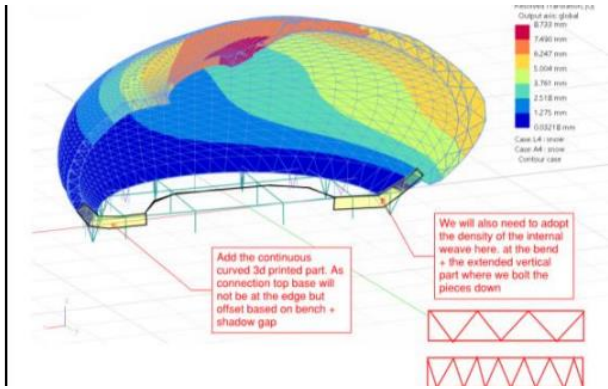


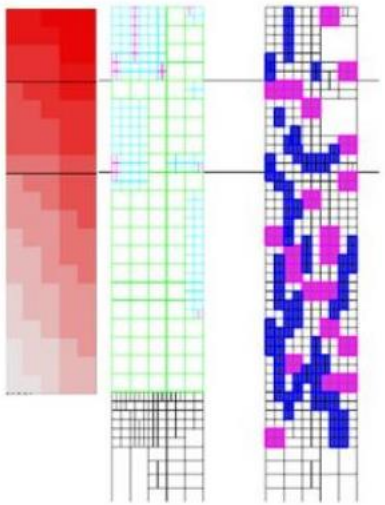
Structure Geometry Fabrication

YIP

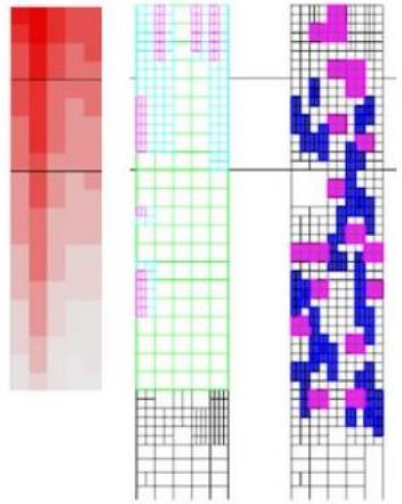
Furniture -------- >>>> Highrise towers







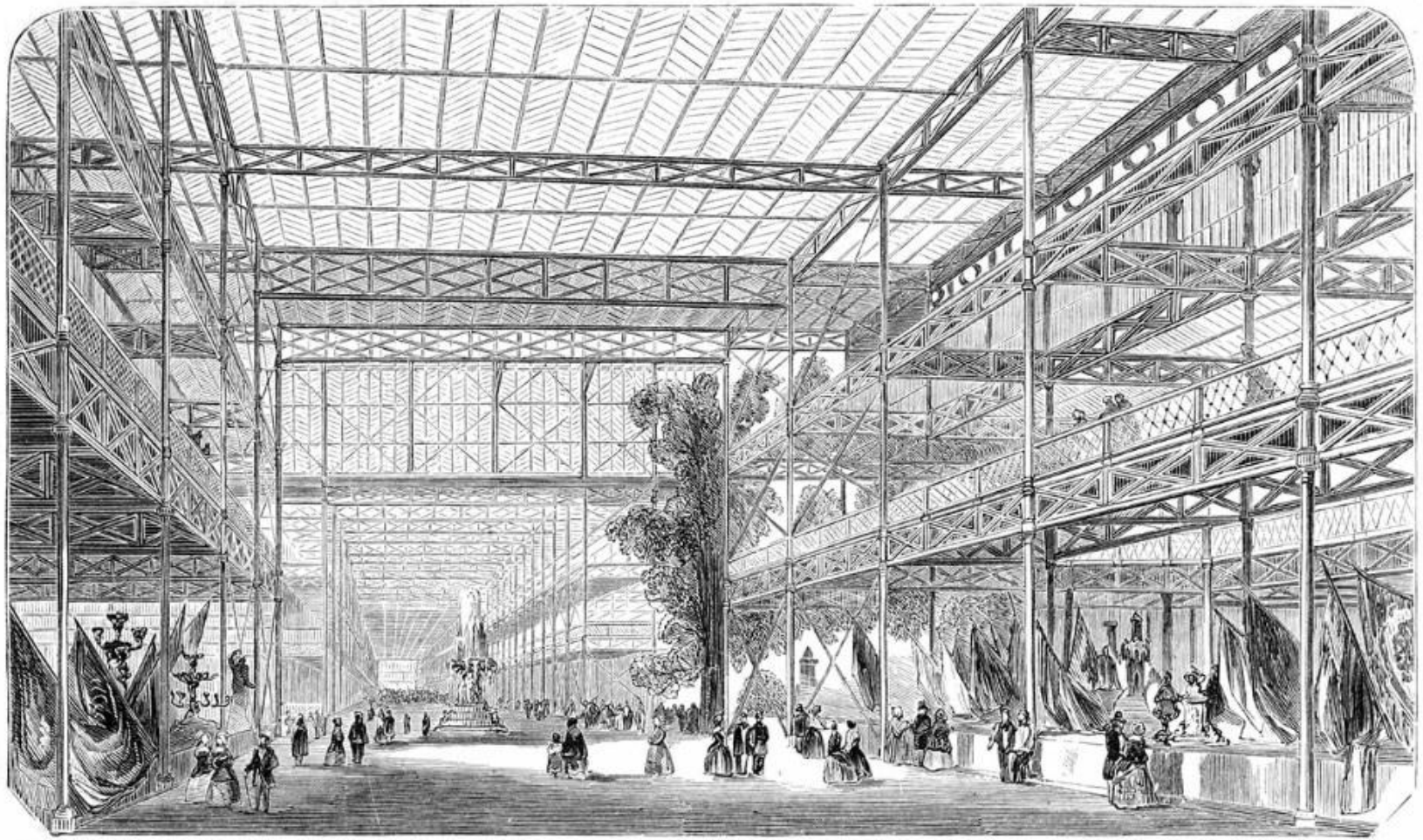
West Facade

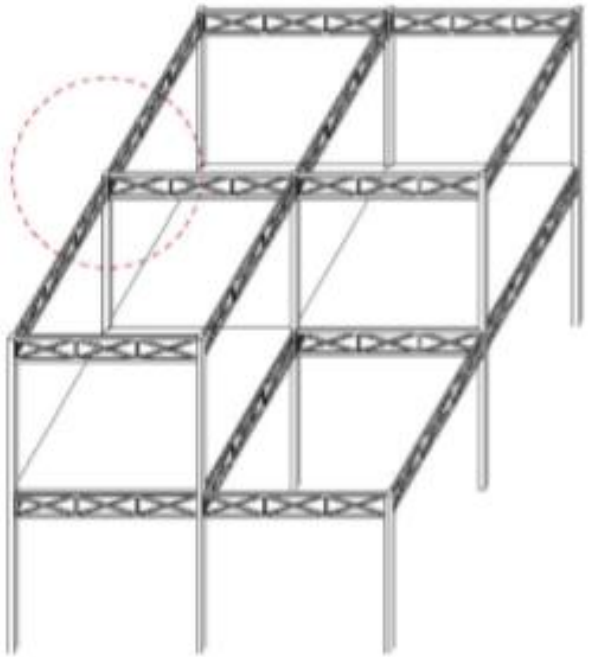


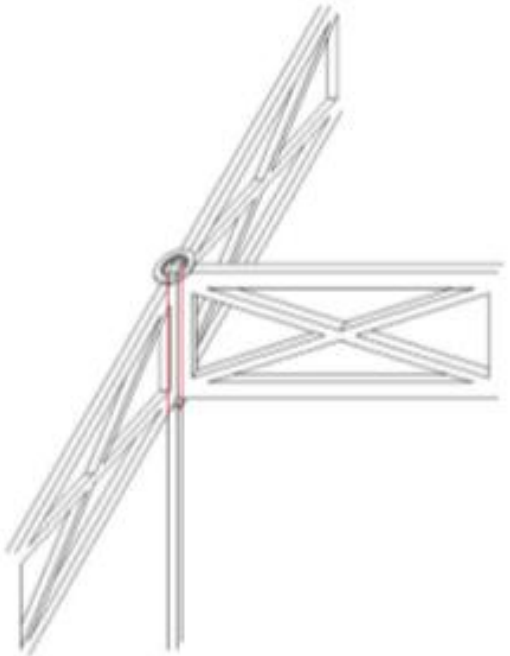
East Facade

I pursue “Life long” design _____

Ensuring we build a better future

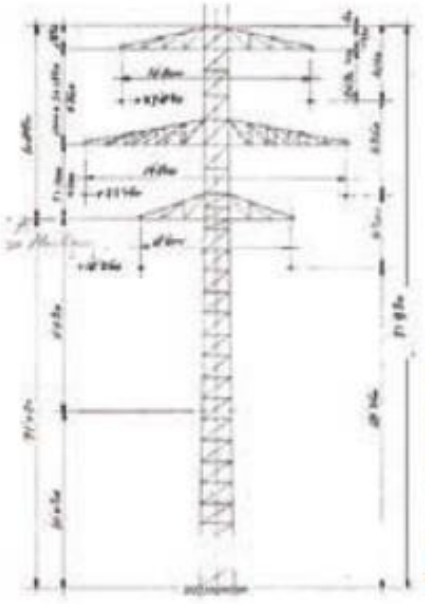


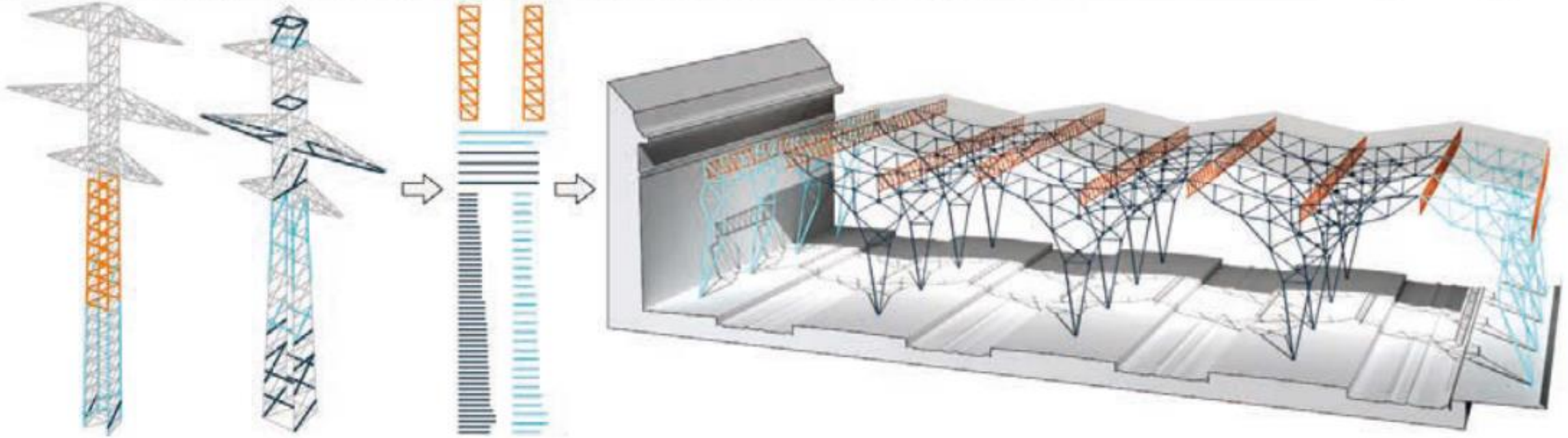




Designed for multiple states and location (Hyde park to sydenhanm)

Crystal Palace – Joseph Paxton



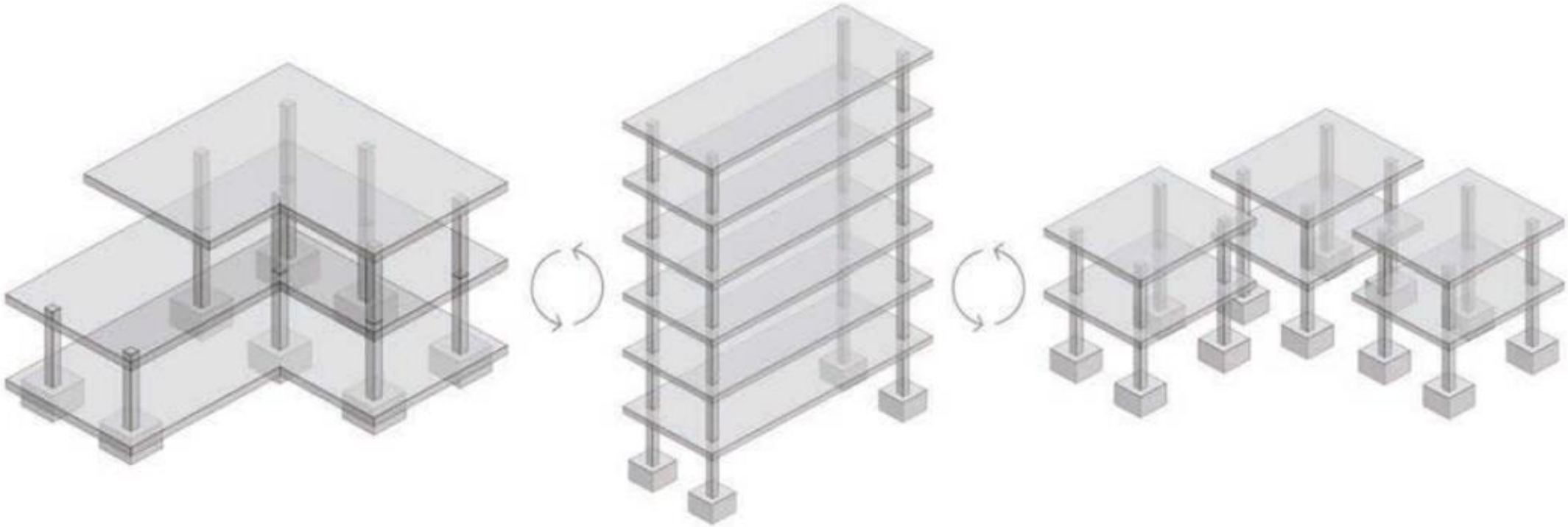


Schematic view of train station roof truss made of electric pylon parts, after layout optimisation

A strategy of Reuse was more common in the past than today

MD: Dry connections – and a smart system.

Laing O'Rourke



Possibilities for life long adaptation _____

Non-destructive ever-reshaping of structural system as vision

There can be a hierarchy in it’s parts.

The NEST zurich

"The concept of the NEST platform is as captivating as it is simple: to bring together research and industry in a **Living Lab**, and incorporate the feedback from the testers into the evolution of the prototype applications. The NEST accelerates the transfer of knowledge and technology in the field of climate and energy-optimized building technologies and represents an important milestone on the way to digital construction. »

What are the parts that we assemble, disassemble and are can be reused?

Kajima Corporation Buildings
Demolition Method Japan 2013

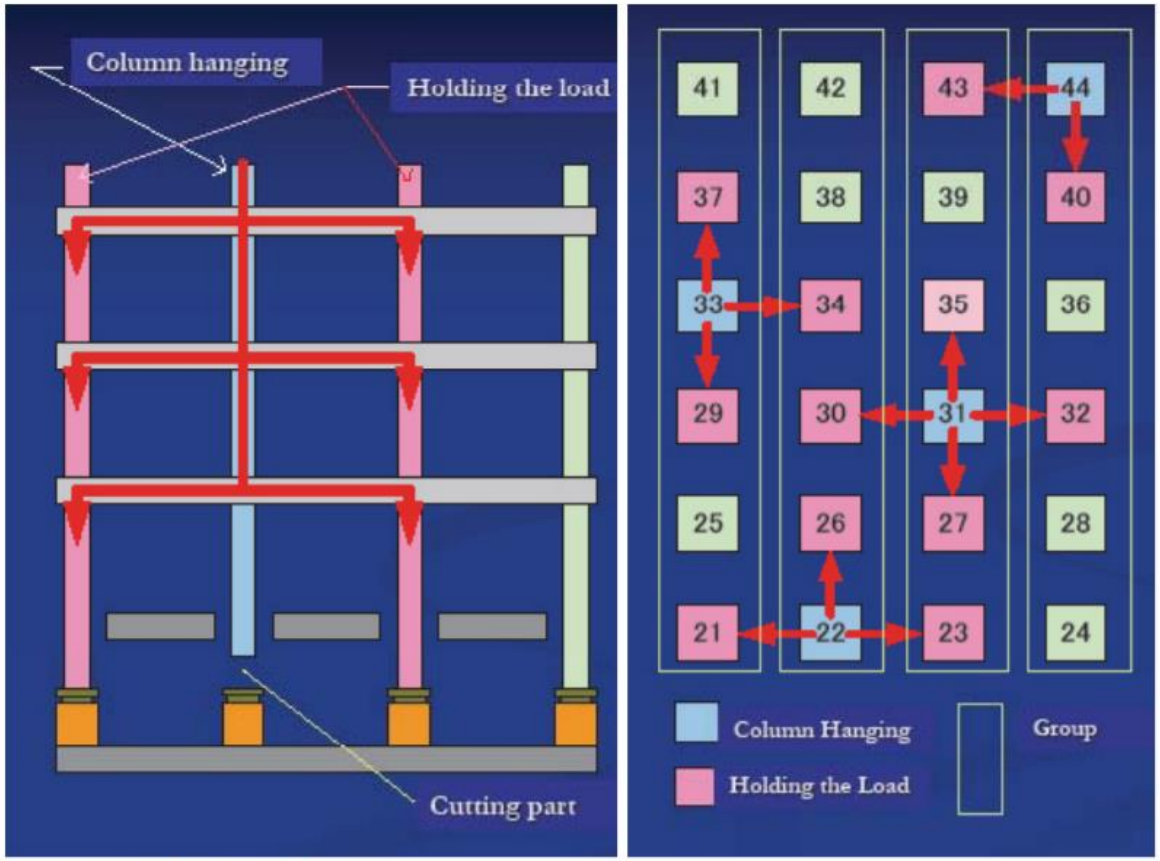


Figure 9. Cutting Columns © Kajima

The impact of weight, size and material on reusability.

Ensamble studio – cyclopean house

Cyclopean House / Ensamble Studio

Courtesy of Ensamble Studio

Off the shelve parts – all balanced structurally.

Ensamble studio – hemeroscopium house

All are examples of “life long” design, extending the life of structures

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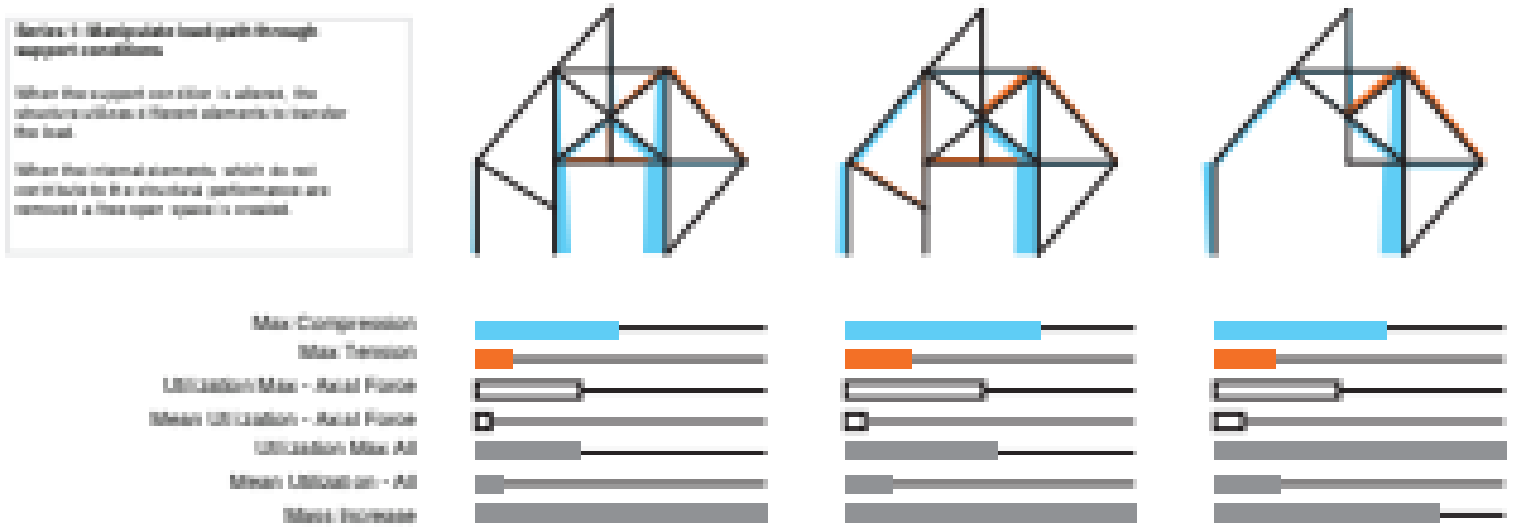
In my work I have been mainly involved with 2, 3 and 4

The order of priority:

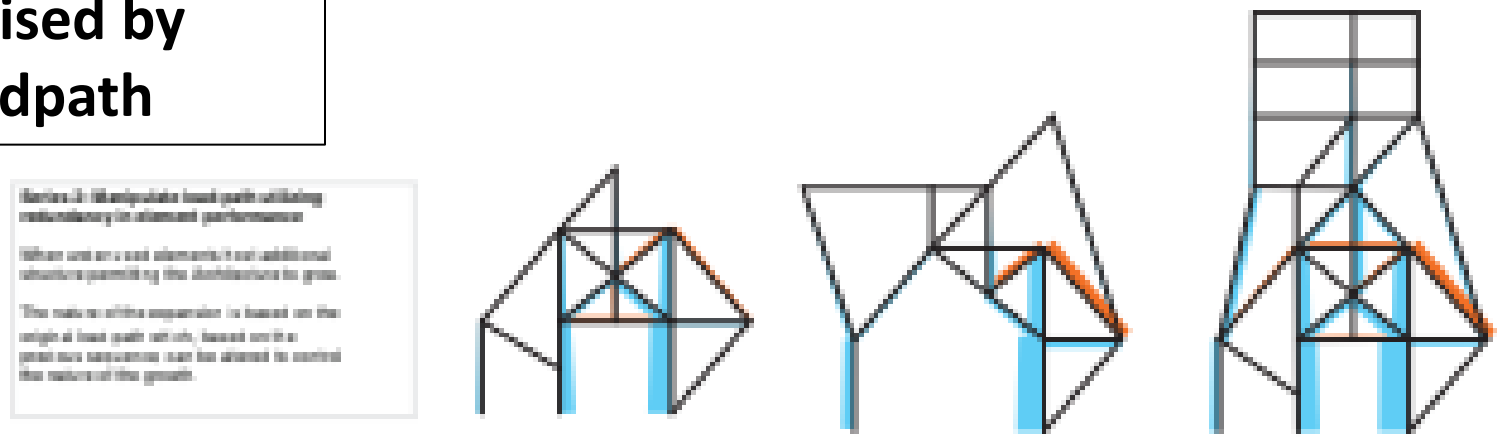
1) **on-site reuse,** i.e. keep parts in use in their original system (renovation, repurposing)
2) **repair, maintain or refurbish**
3) **onsite component reuse,** i.e. disassemble components from their system and reuse them in new systems
4) **Reprocess or recycle the material, or remanufacture the component.**

RUBENS STRUCTURES

Between on-site reuse (1) and onsite component reuse (3)



Keep elements the same, but use under utilised by changing loadpath



Planned move of the building

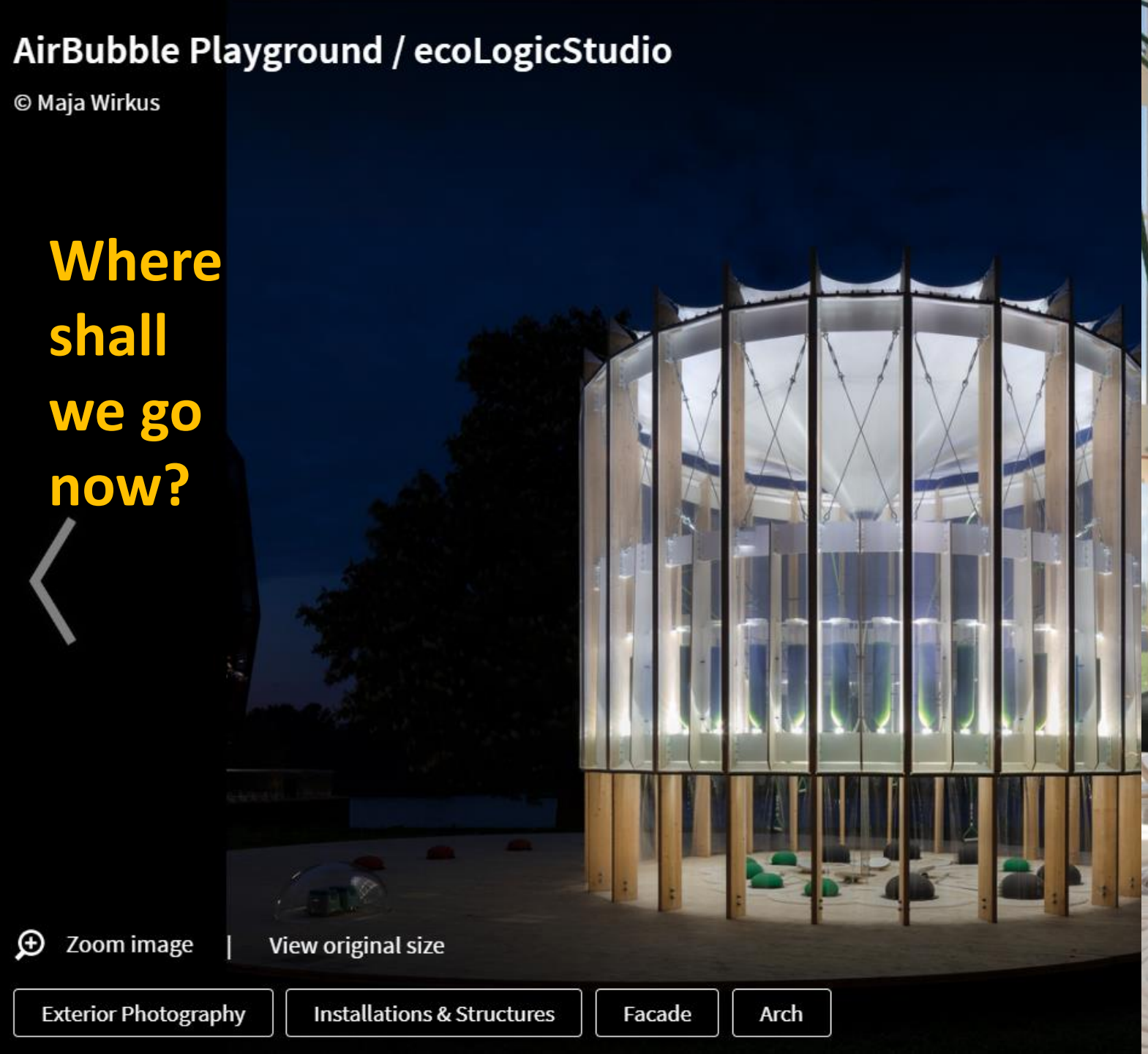
onsite component reuse, (3)

AirBubble Playground / ecoLogicStudio

AirBubble Playground / ecoLogicStudio

© Maja Wirkus

Where shall we go now?



Zoom image | View original size

Exterior Photography | Installations & Structures | Facade | Arch

MINKA

AJGA
Tallweg Eng. NY USA
YIP

Develop structures like product design [K.O.P.]

onsite component reuse, (3)

Reprocess or recycle the material, or remanufacture the component. (4)

Recycled plastic + move

the structure will be hermetically closed for colder climates

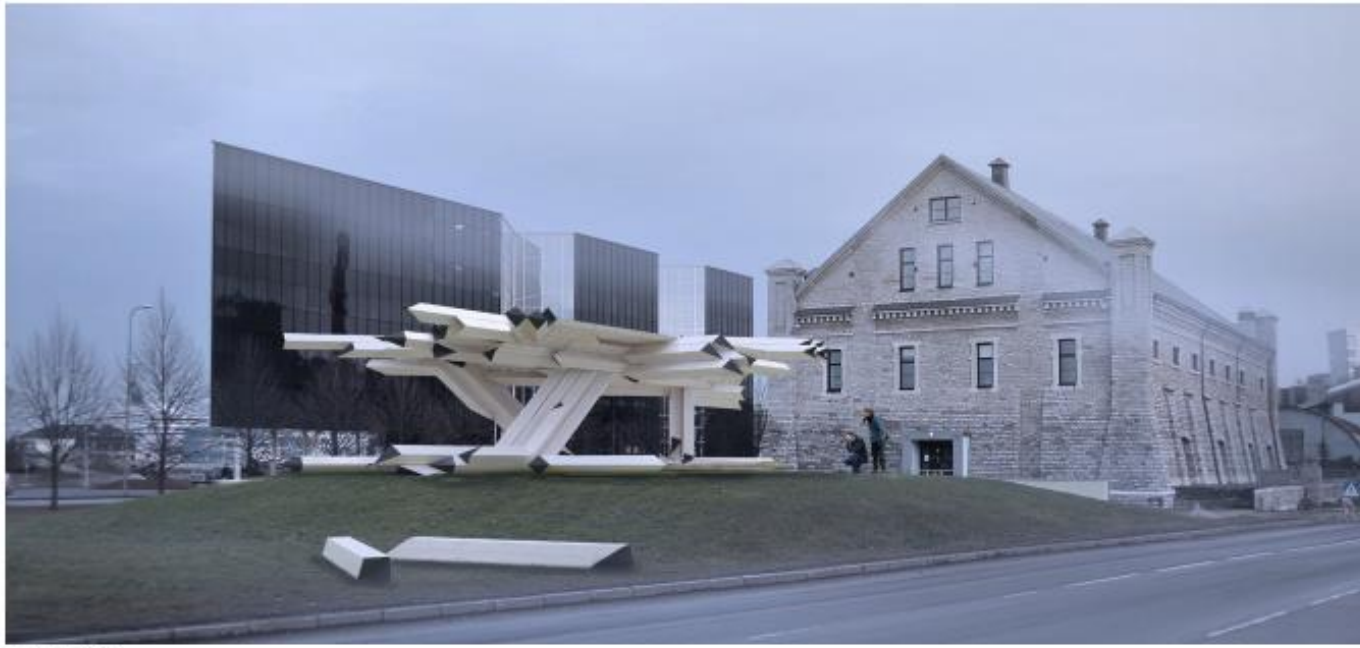
1. LIFE LONG – a new approach to optimisation is needed

TAB

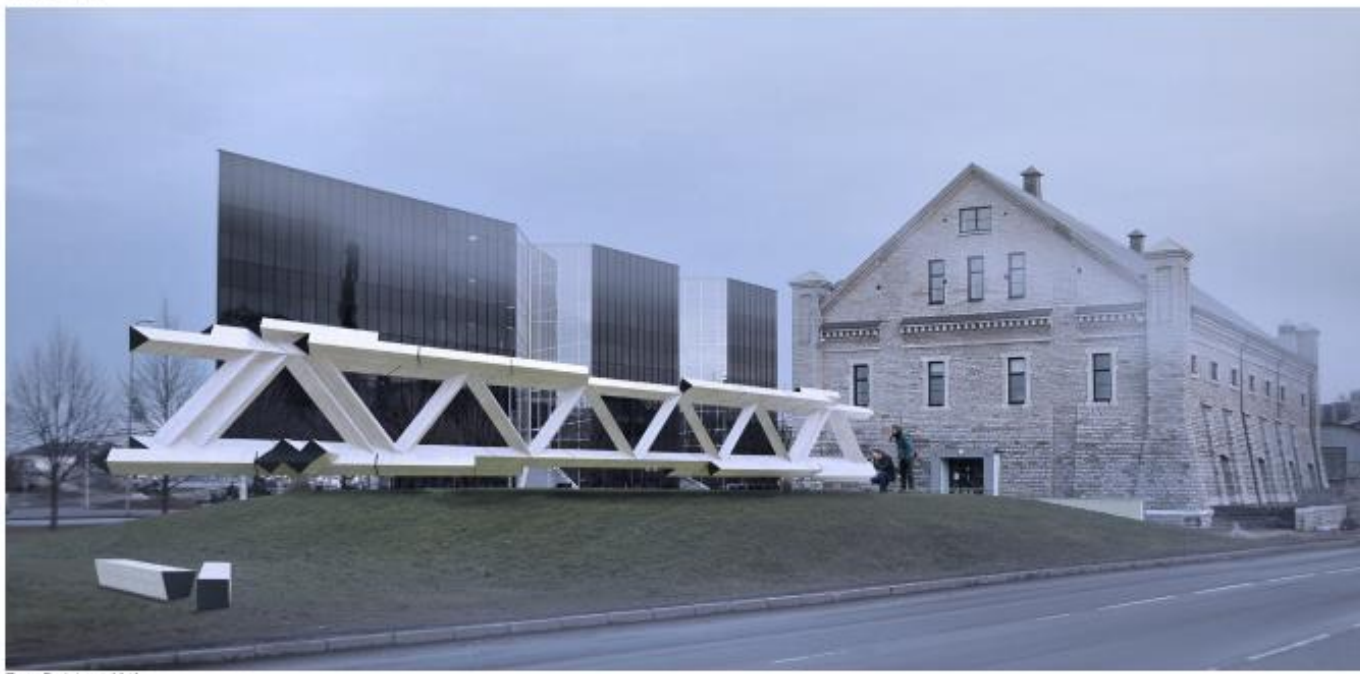
TALLINNA ARHITEKTUURIBIENNAAL
TALLINN ARCHITECTURE BIENNALE

Tallinn Architecture Biennale 2017: BioT.A.llinn
Installation Programme Competition

BRIEF



House nr1, 2017



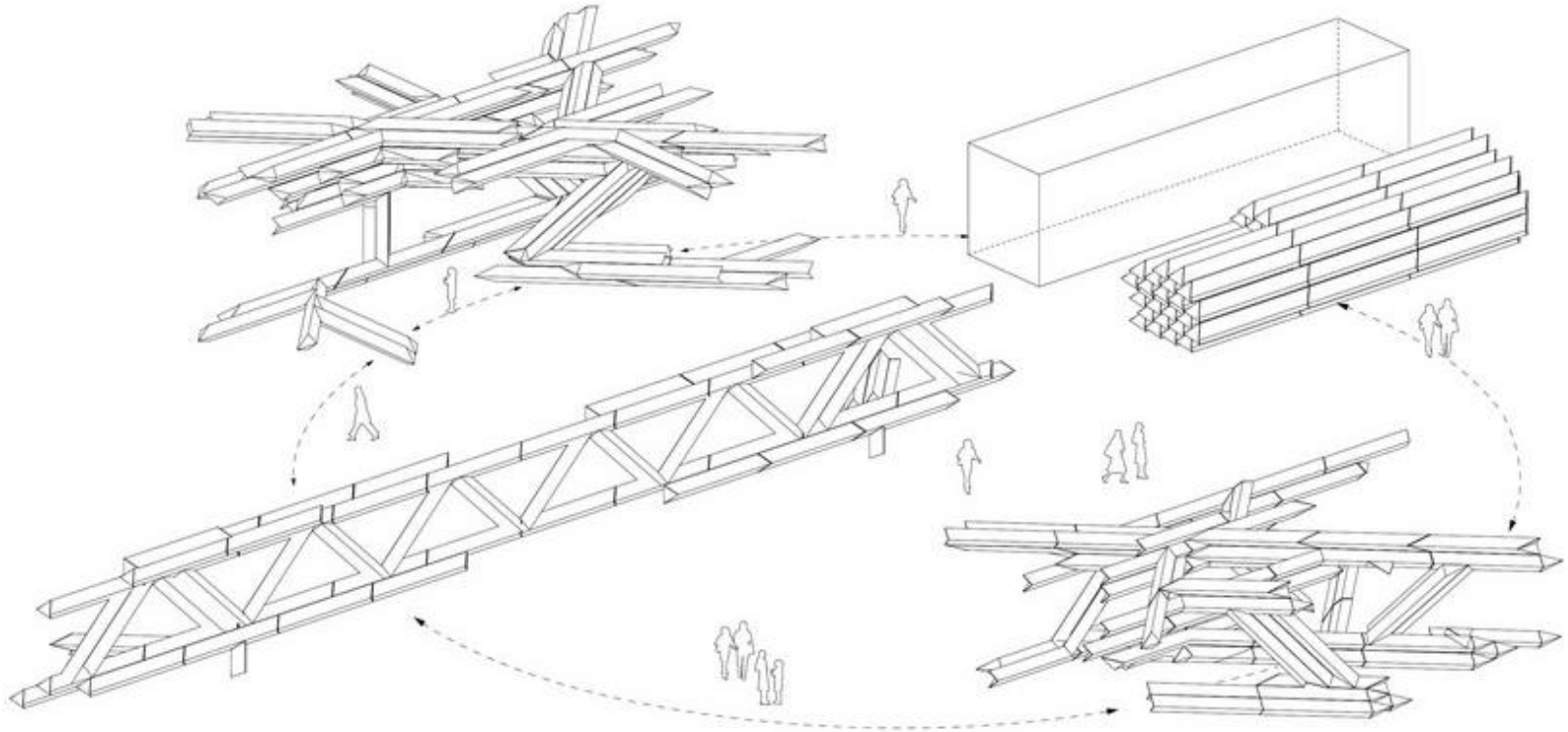
Truss Prototype, 2018

Competition entry

Rubens structures

A different lightness through multiplicity of performance

Dis- and re-assembly
= Future proof 2



A different kind of lightness

[*Skinny vs. Rubens*]

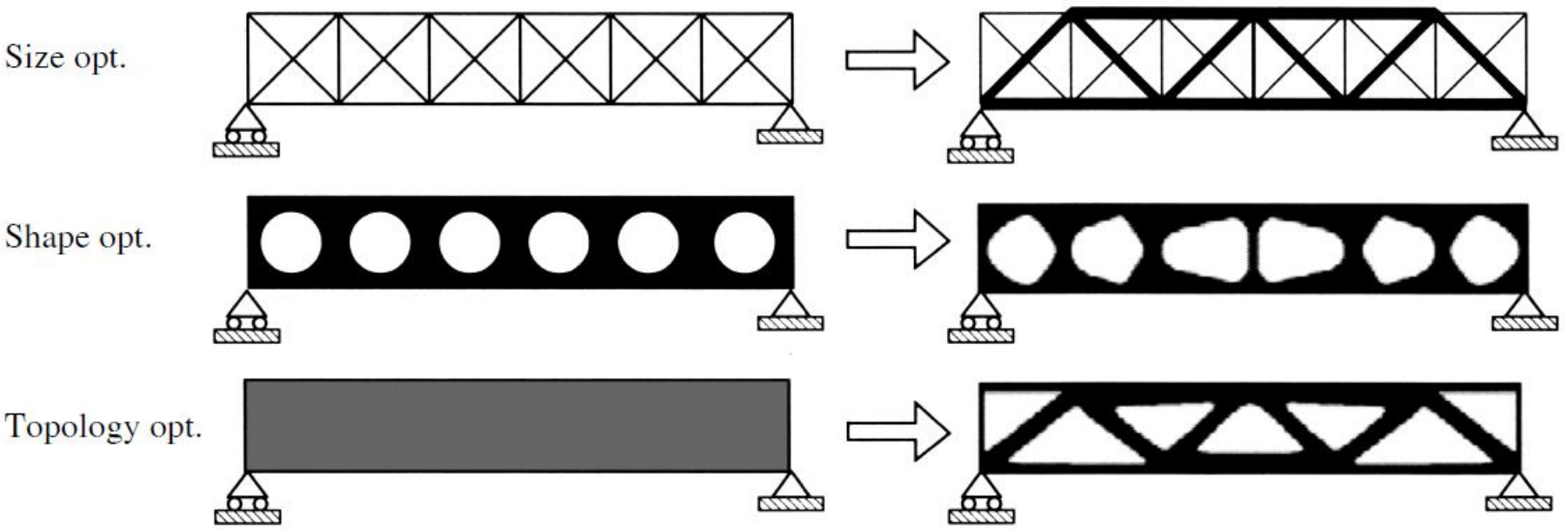
op·ti·mi·za·tion

/ˌäptəməˈzāSHən/

noun

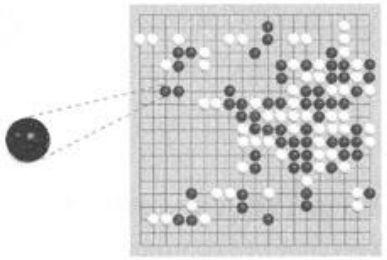
1. the action of making the best or most effective use of a situation or resource:
   "companies interested in the optimization of the business"

Powered by Oxford Dictionaries

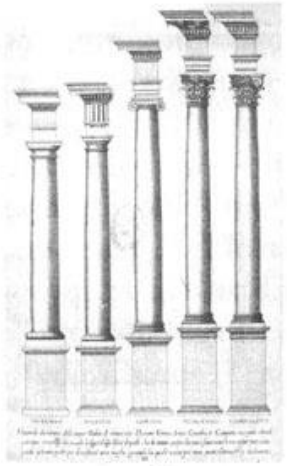


Difference in Kind

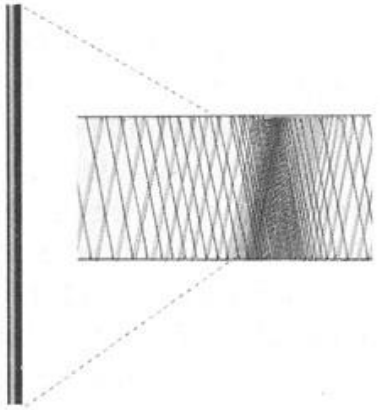
Difference in Degree



Kind / degree: Structurally a different way of thinking



Chess/Orders:
Stable Meaning



Go/Meshwork:
Contextual Relationships

Ability to reuse beyond initial scope

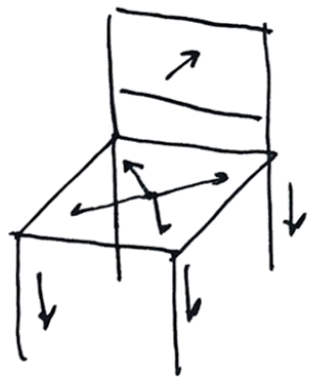
Reiser + Umemoto: Atlas of Novel Tectonics

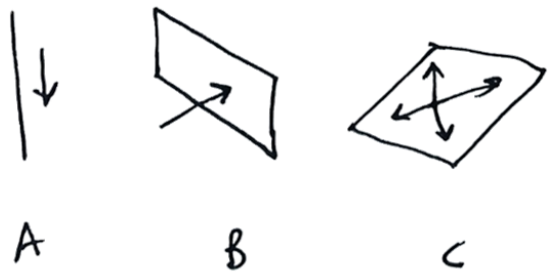
Chess: each element has specific performance in the whole

Go: Role defined by location and connection to neighbours

Reiser + Umemoto: Atlas of Novel Tectonics

One element – one behaviour

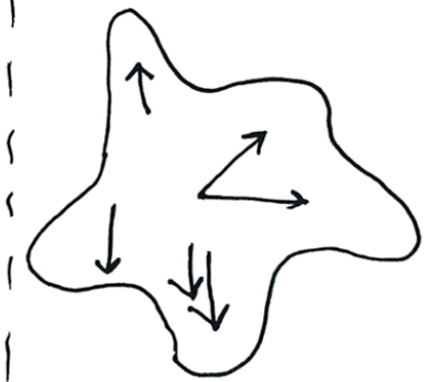


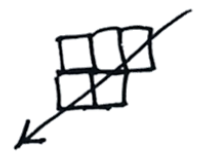


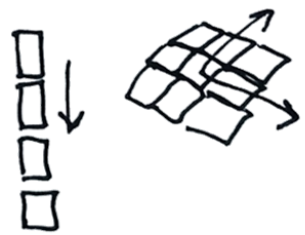
1 TYPE

1 PERFORMANCE

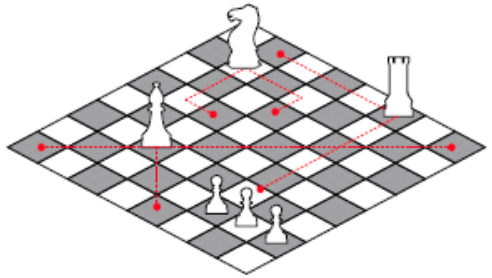
Discrete elements

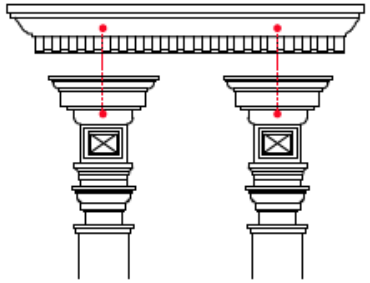


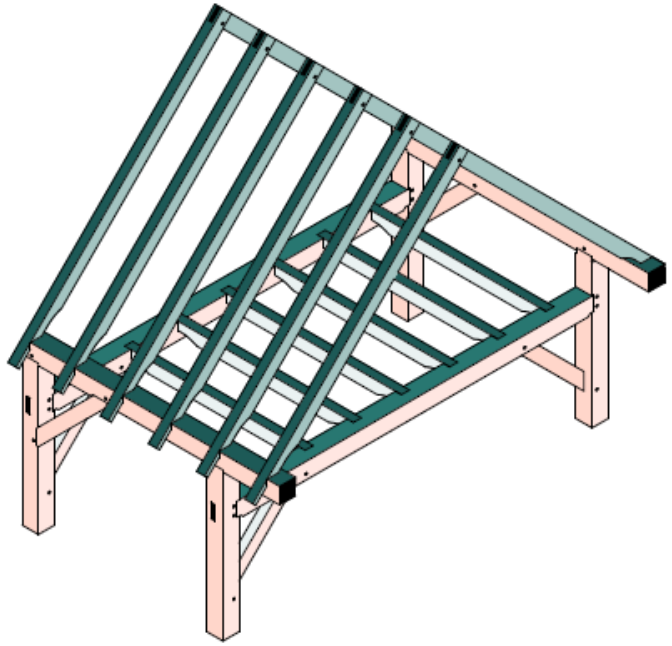




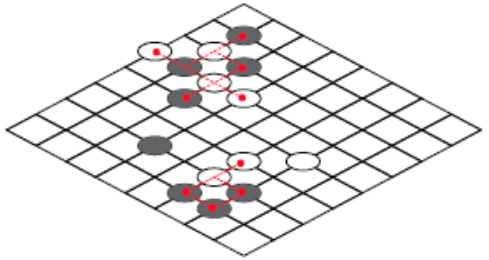
CLUSTER
+
FORM
+
CONTROL POINT

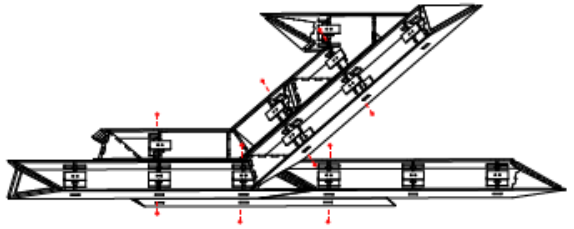


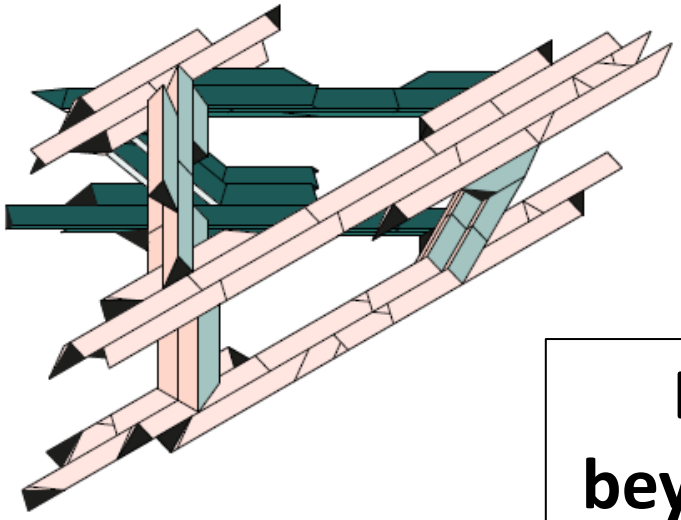




Chess: each element has specific performance in the whole

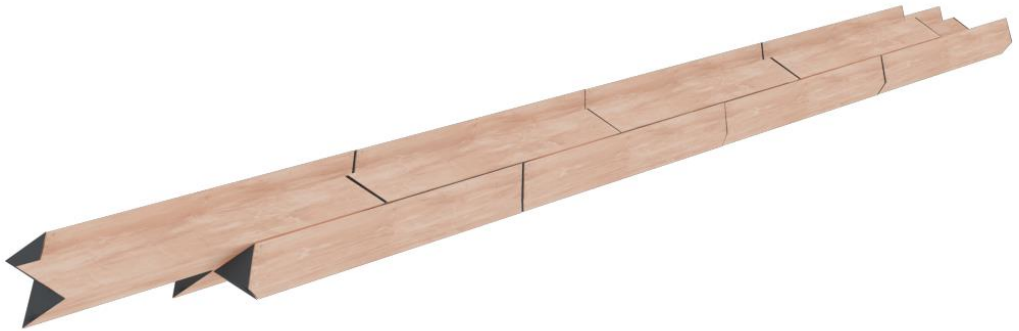


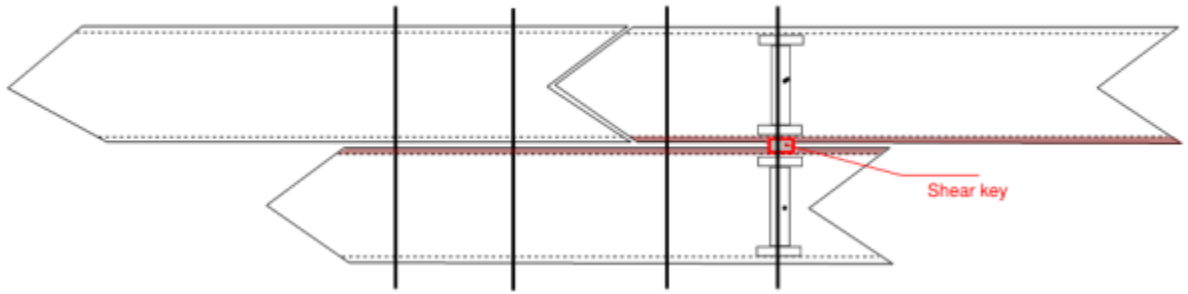




Go: Role defined by location and connection to neighbours

DARE to reuse beyond initial scope





“beam” consisting out of small elements

Potential re-assembly off the same elements in anoter location as a big truss-like structure

Fig. 10 3D digital model + physical 1:1 of the knee part internal cross section

Max ~ 3 kNm bending in knee component
We can simplify this component as an I profile, see build-up in fig 10 and cross section capacity

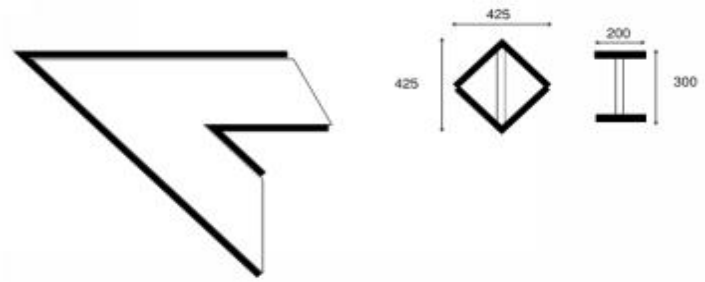
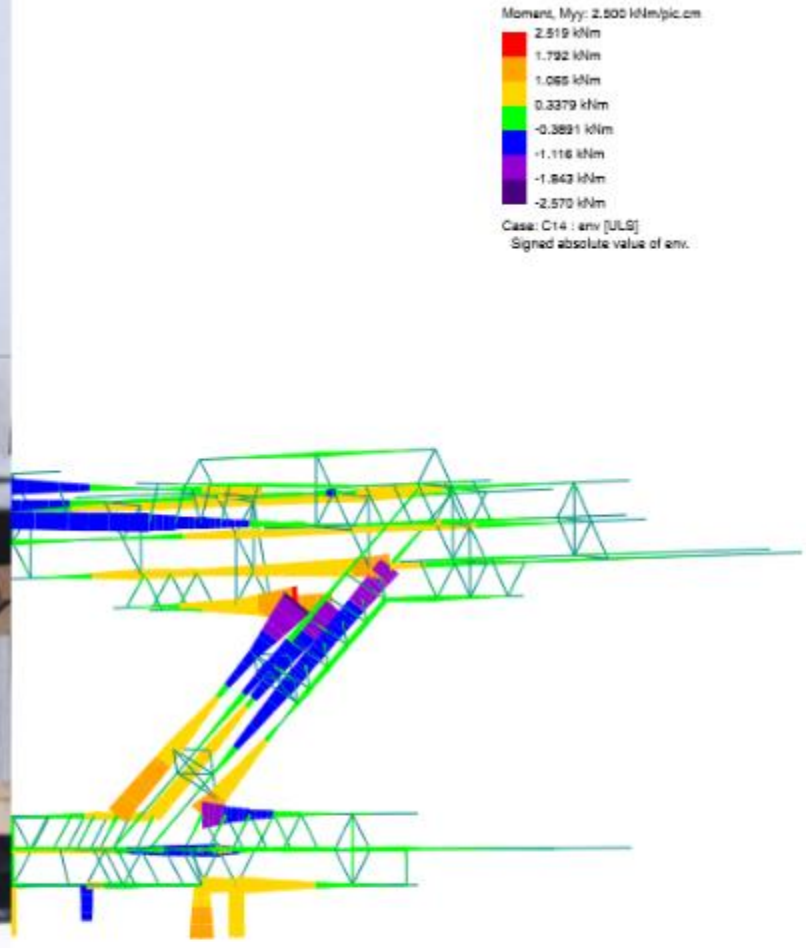


Fig. 11 Knee part in elevation & representative cross section

Blocks in Tallinn



How do we analyse this?

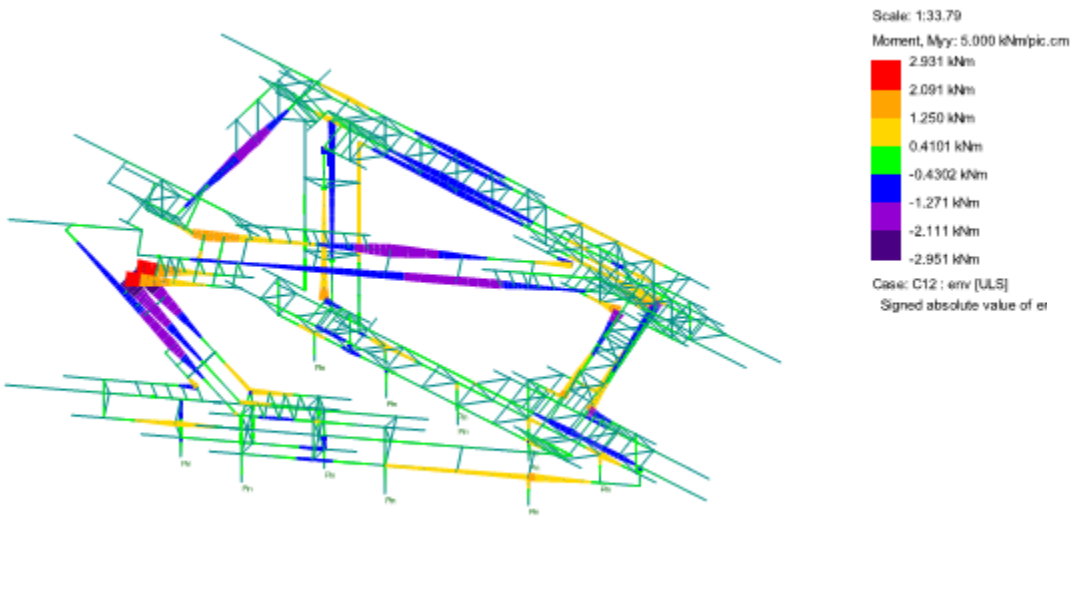


Fig. 6 Myy in main "beam elements"

4.2.1 Bending check staggered bolted beam

Span 8 meters

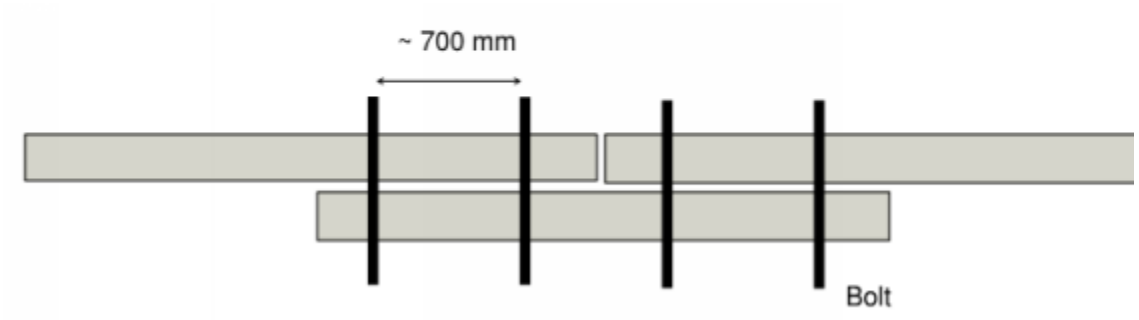
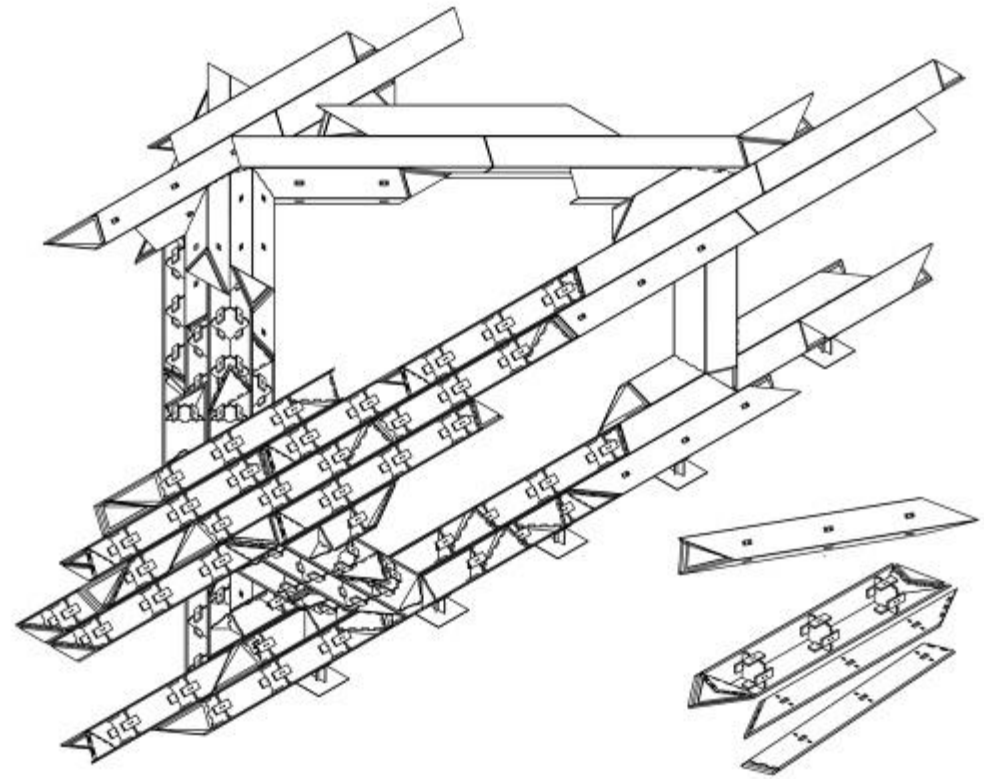
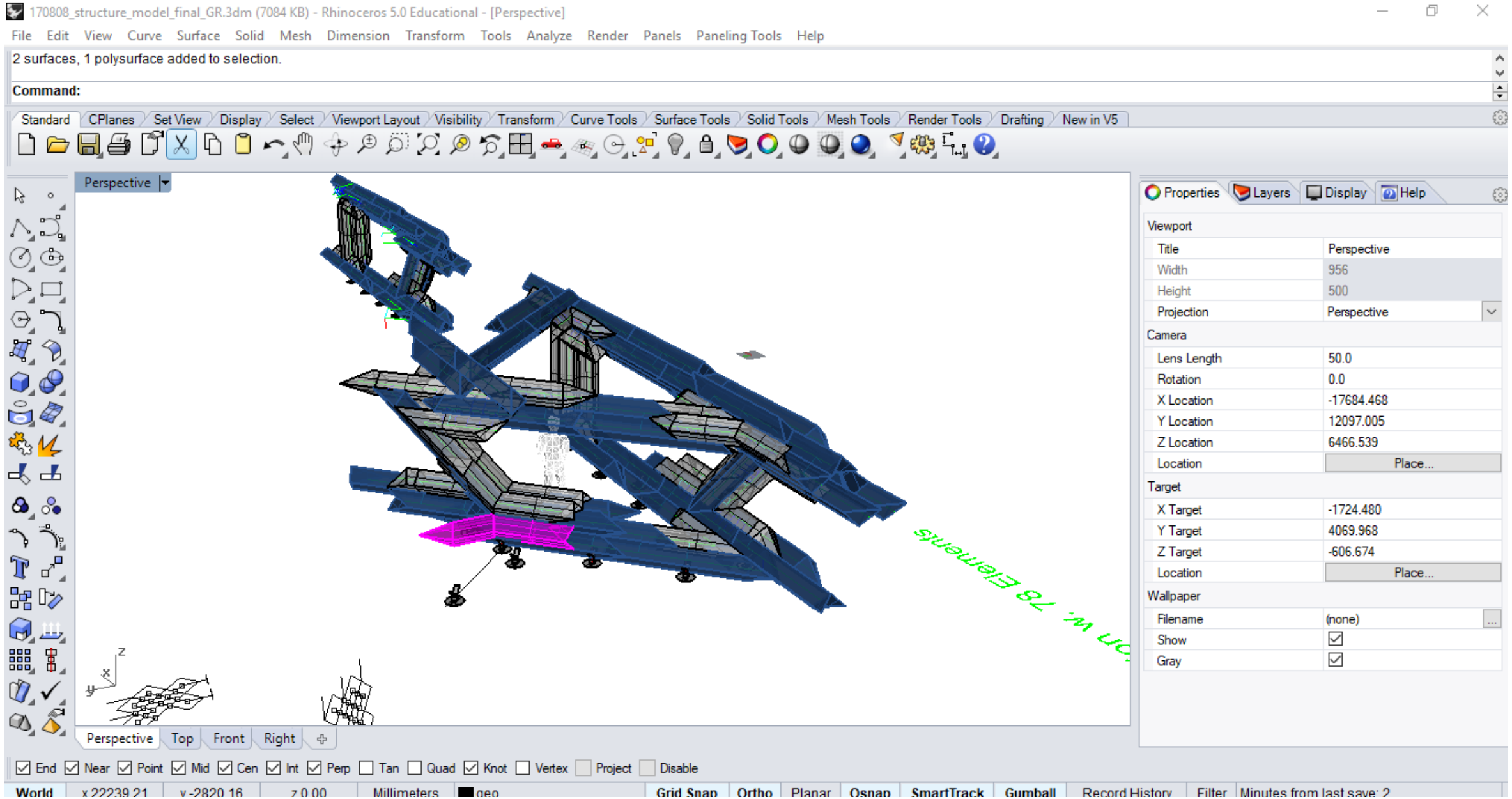


Fig. 7 Beam staggered configuration.



local performance _ to define a domain



When you change location – forces might change if stiffness changes

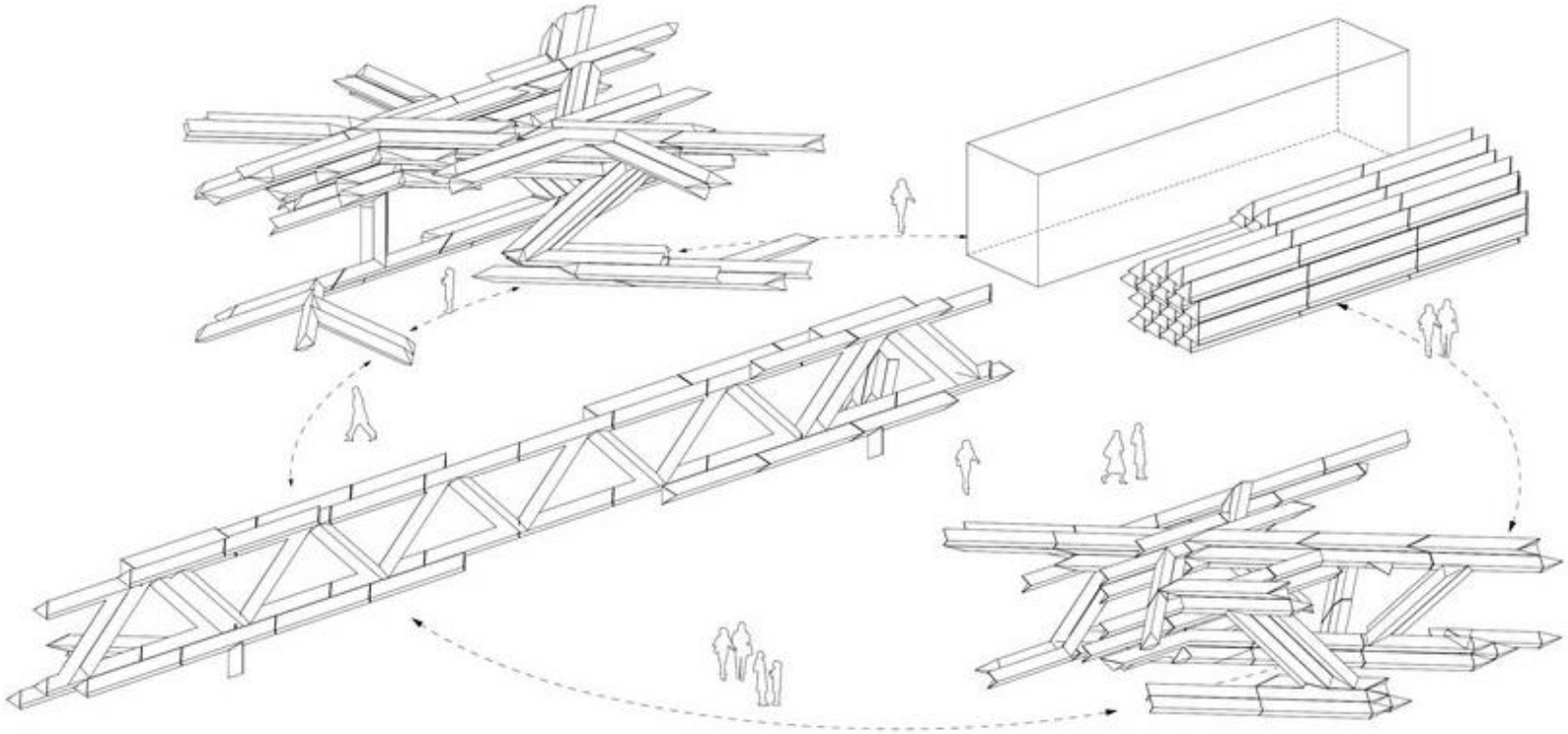
You don't design 1 element, but the nature of the clusters and global response

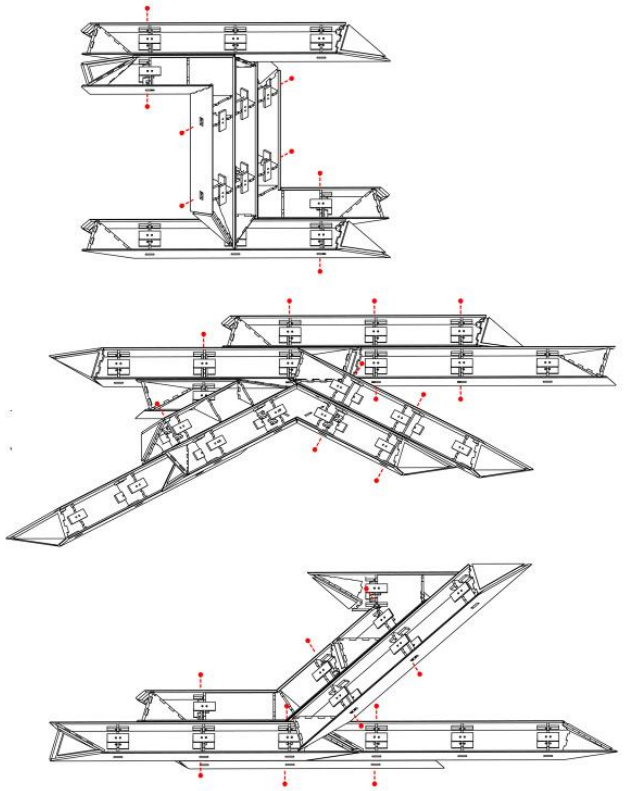
“Configuration 1”

Are we ready for the next design = configuration of elements?

PARAMETRICALLY:

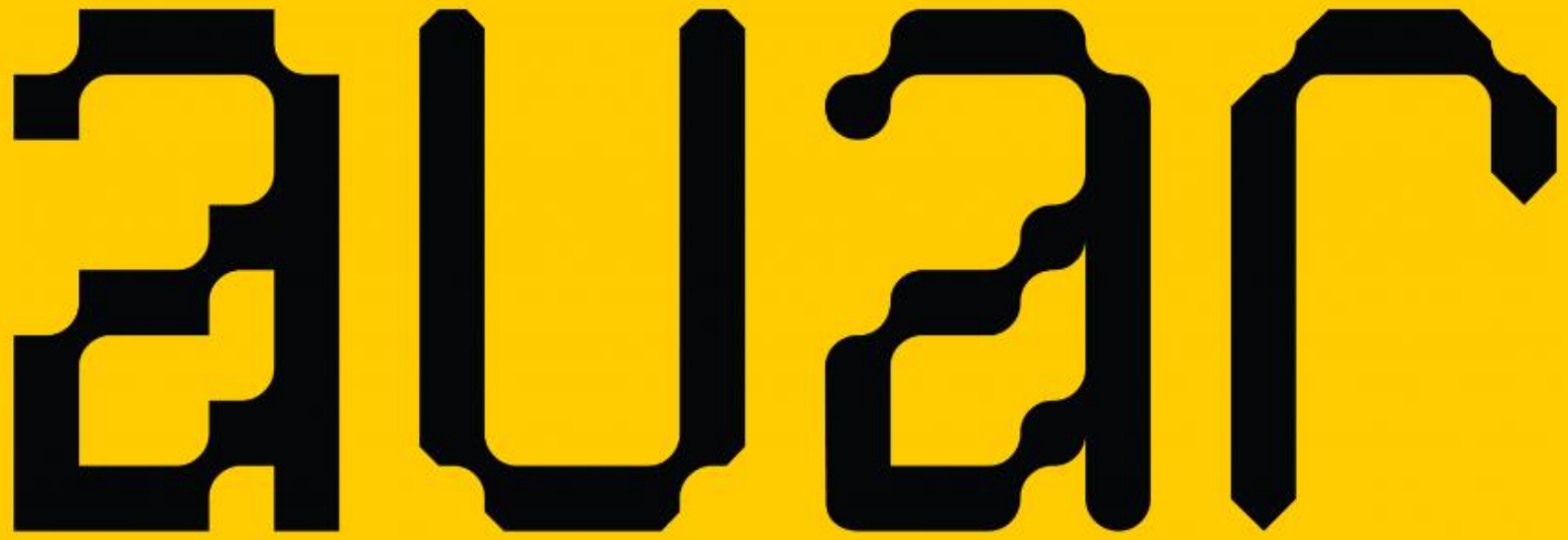
LINK CLUSTERING OF ELEMENTS TO STRUCTURAL PERFORMANCE





But it didn’t stop there:

Royal academy of art London



Automated Architecture

AUAR (pronounced ‘our’) is revolutionizing house building using automation

Lets change block and start - AUAR

Bristol – community centre UK

Openings in the plywood blocks ensured access to tighten the bolts.

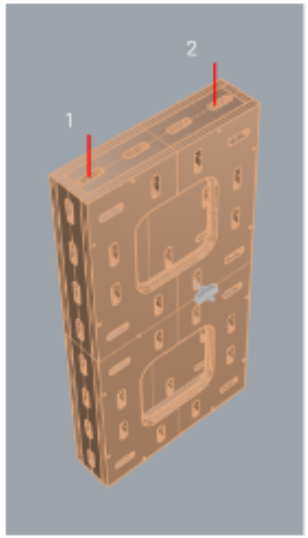
400 mm
To spread load -
located at cenre

Only 2 connectors
Weight 1 block ~ 20 KG

Option A
2 panel span - 2 connection

with ~ 180 - 200 kg the single connected structure is assumed to fail.

As we want to increment the loading, this will be best to test



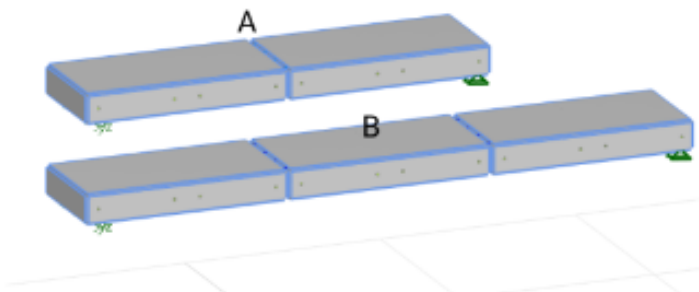
If we connect all 4 connection between the elements

We can resist for a 3 panel span - up to 300 kg
It depends how many people you have to load the structure.
It will take a little longer to test, but it will give us more data.

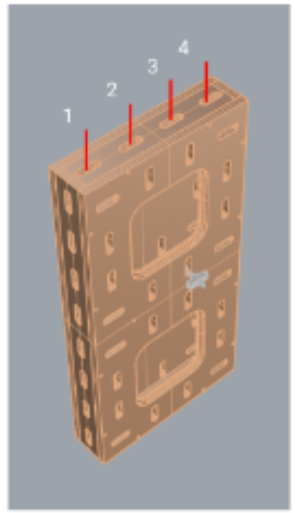
Option B - all 4 connections
3 panel span

Can take up to 300 kg estimated Easier perhaps to photograph and test the connections

But if you don't intend to make all 4 connections, I would test option A



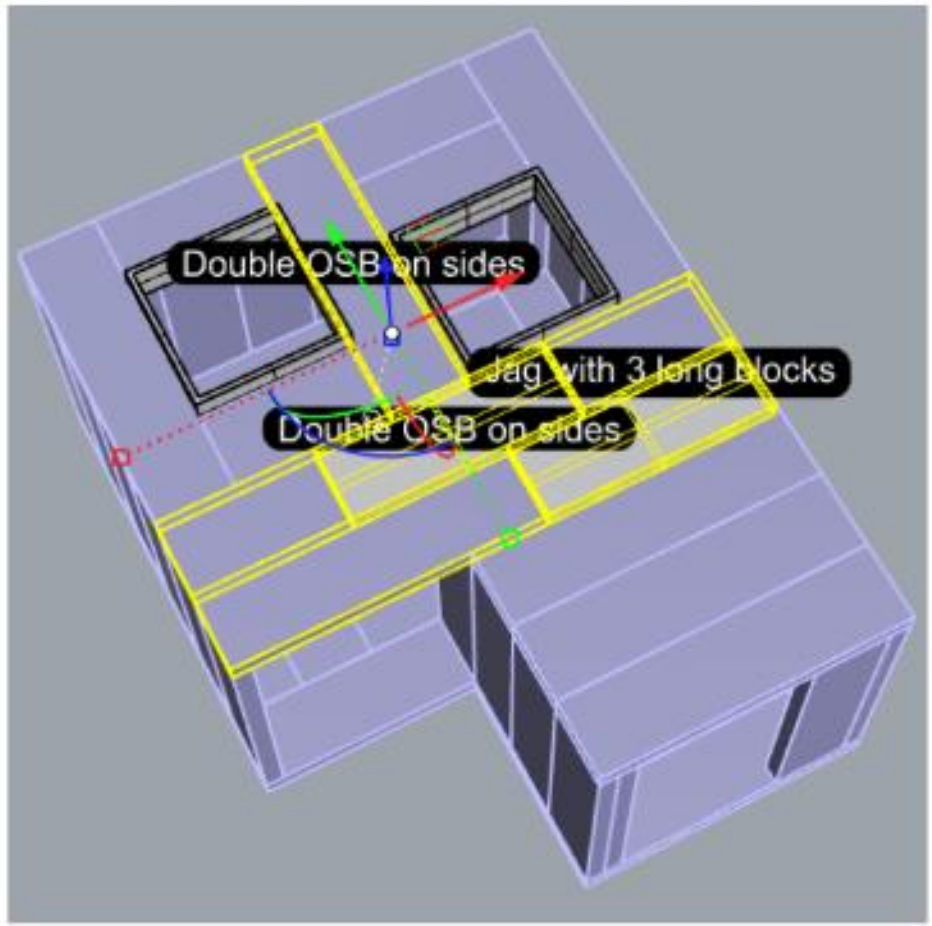
Max 6.7 kN based on 150 depth (mollie test) - so this has been assumed the max tension here as well, yet I assume it to be less



Manja van de Worp
YIP structural Engineering
London

AUAR uses robotics and automation to complete customizable prefab dwelling unit in Bristol

AUAR Ridley road –
block configuration and block specification



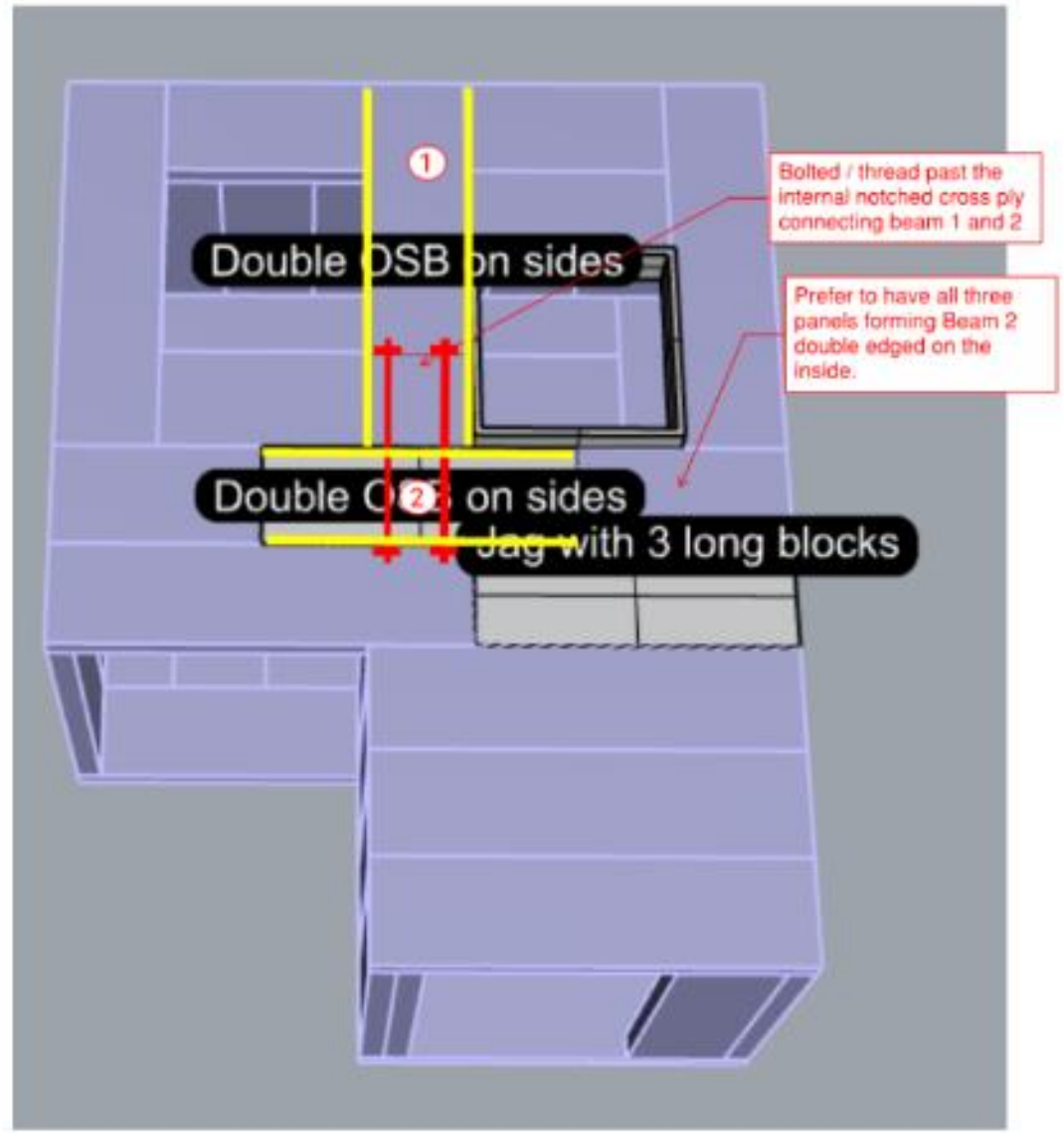


Fig. 1. Visual of design plus roof block configuration


No clowd

https://automatedarchitecture.io

Automated Architecture ltd

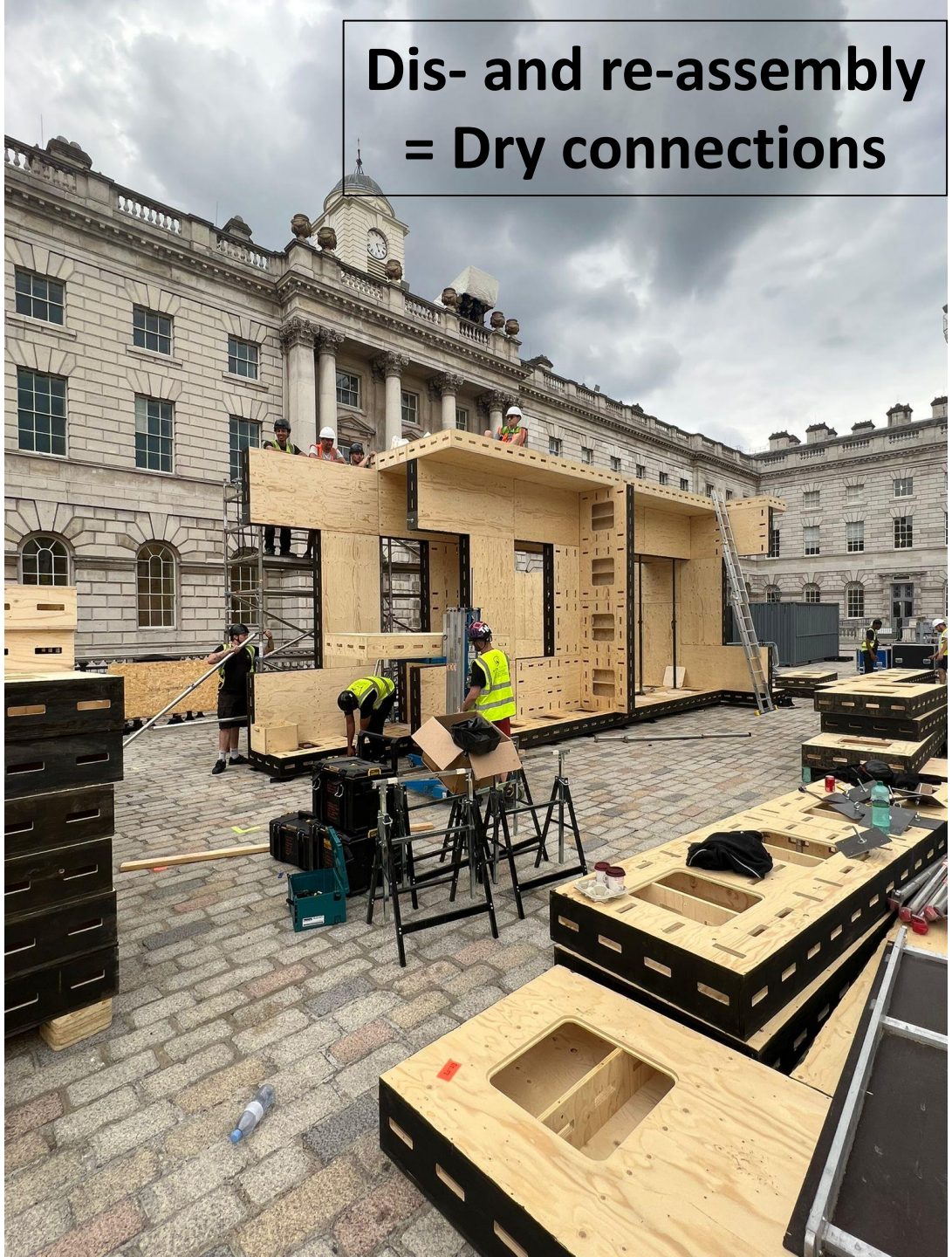
AUAR (pronounced 'our') is revolutionizing house building using automation · We are providing the world's first robotically assembled dwellings · We empower ...

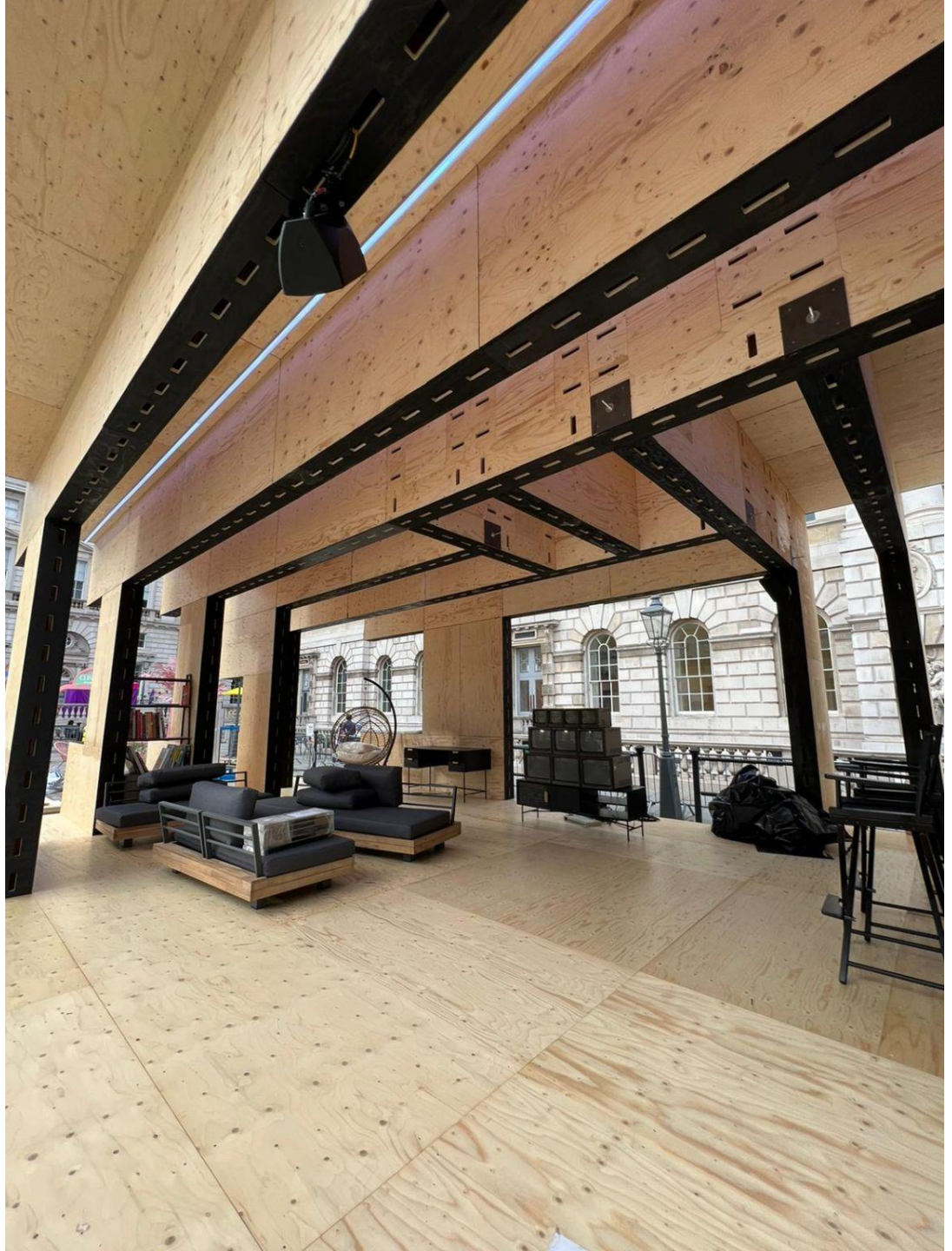
AUAR at Somerset house – This bright land festival

Fig. 9 Test 2 – support spanning beam Somerset House structure – THIS BRIGHT LAND

Fig. 10 Cable within block to provide tensile capacity at bottom of the beam

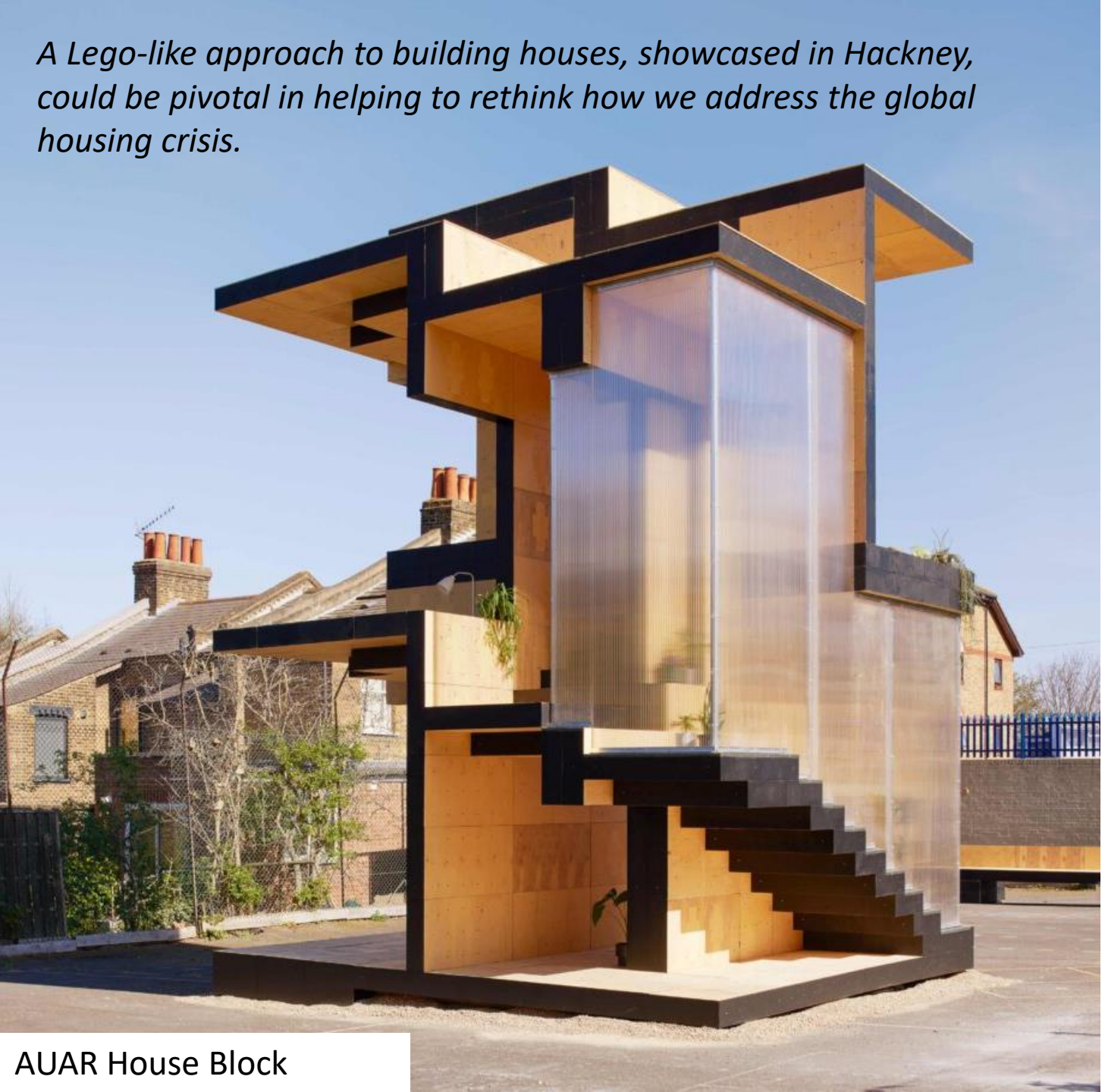
Dis- and re-assembly
= Dry connections



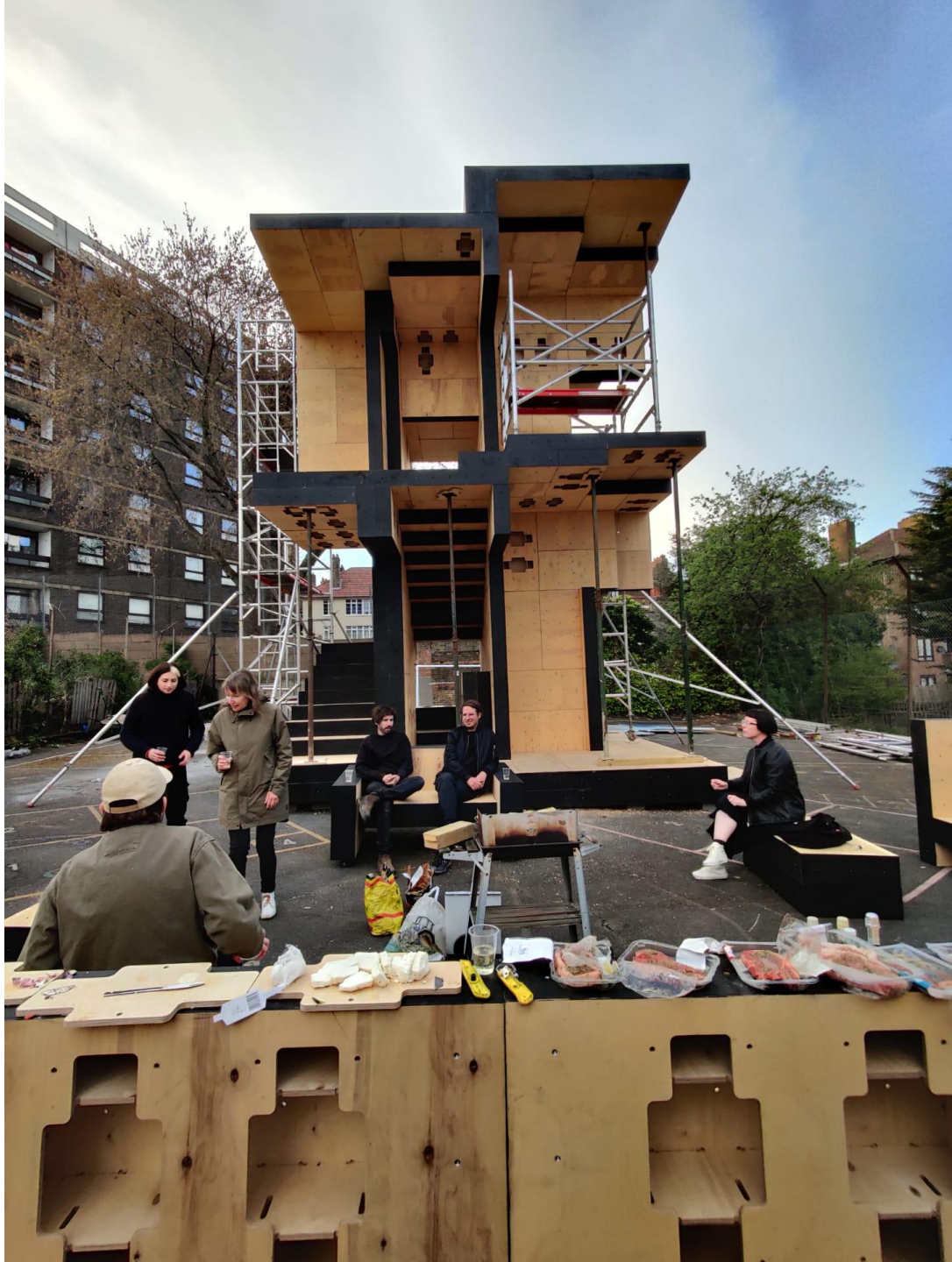


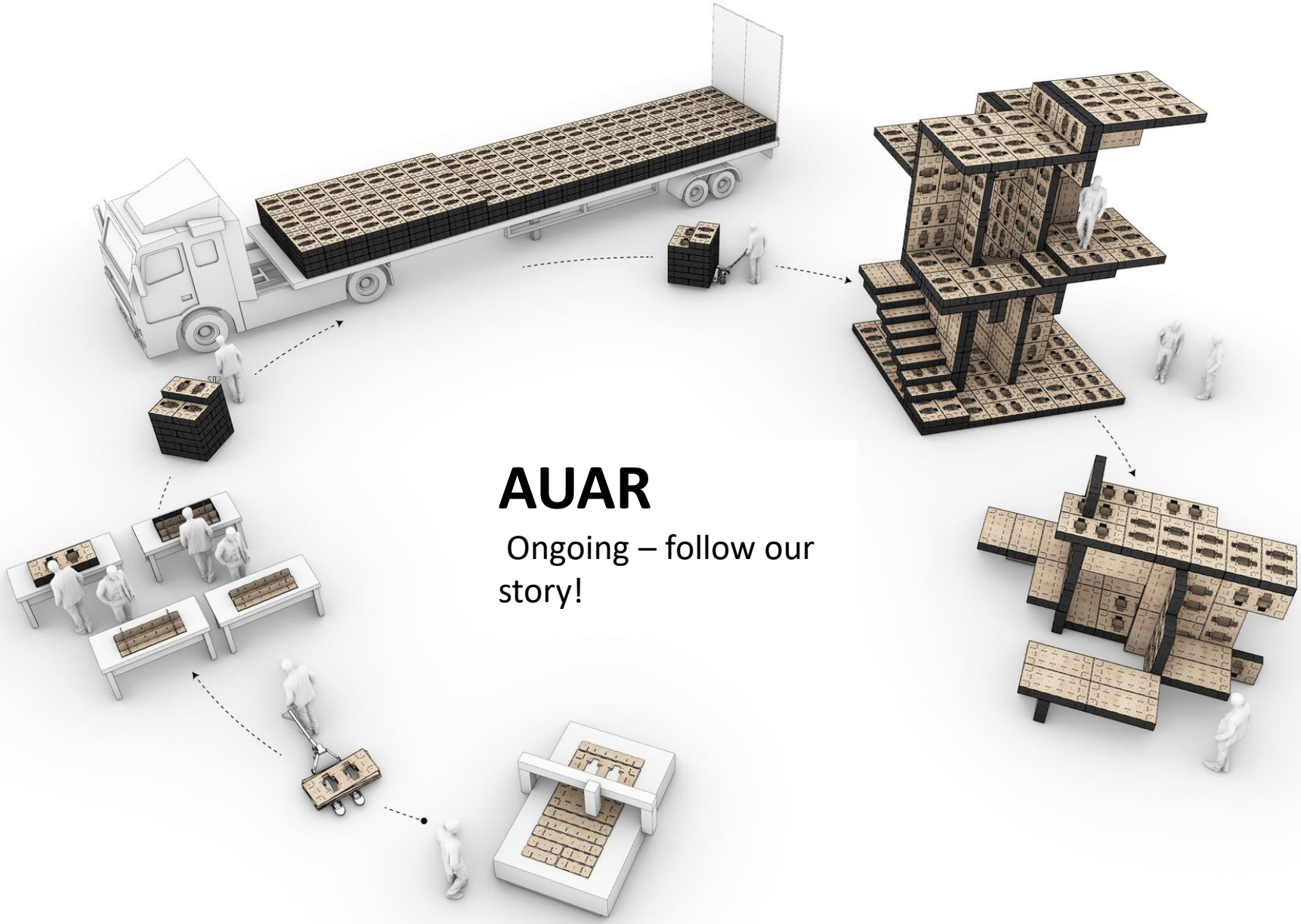

CREW CHIEF
ALPHA

A Lego-like approach to building houses, showcased in Hackney, could be pivotal in helping to rethink how we address the global housing crisis.



AUAR House Block





AUAR

Ongoing – follow our story!

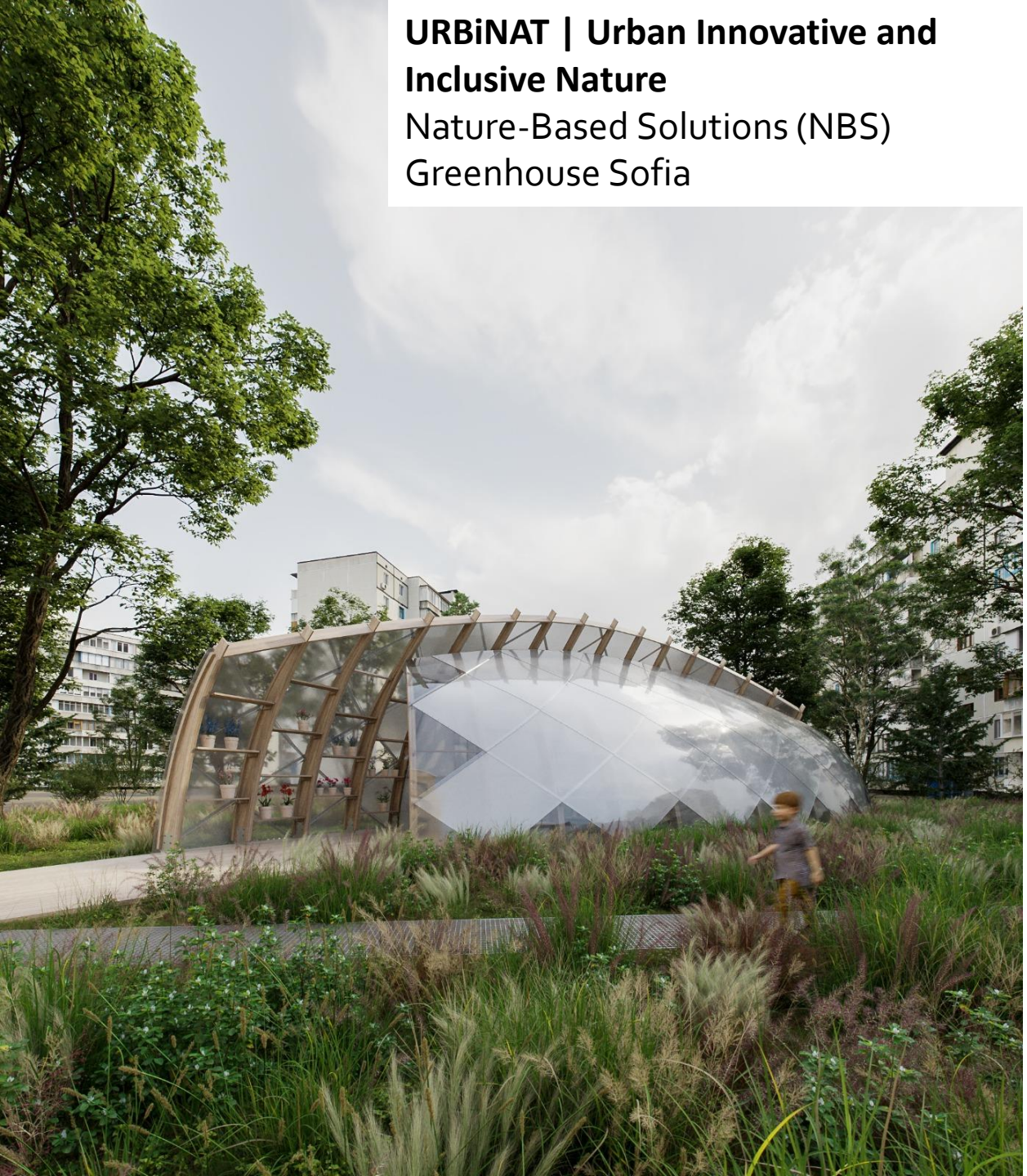
2. LIFE LONG –

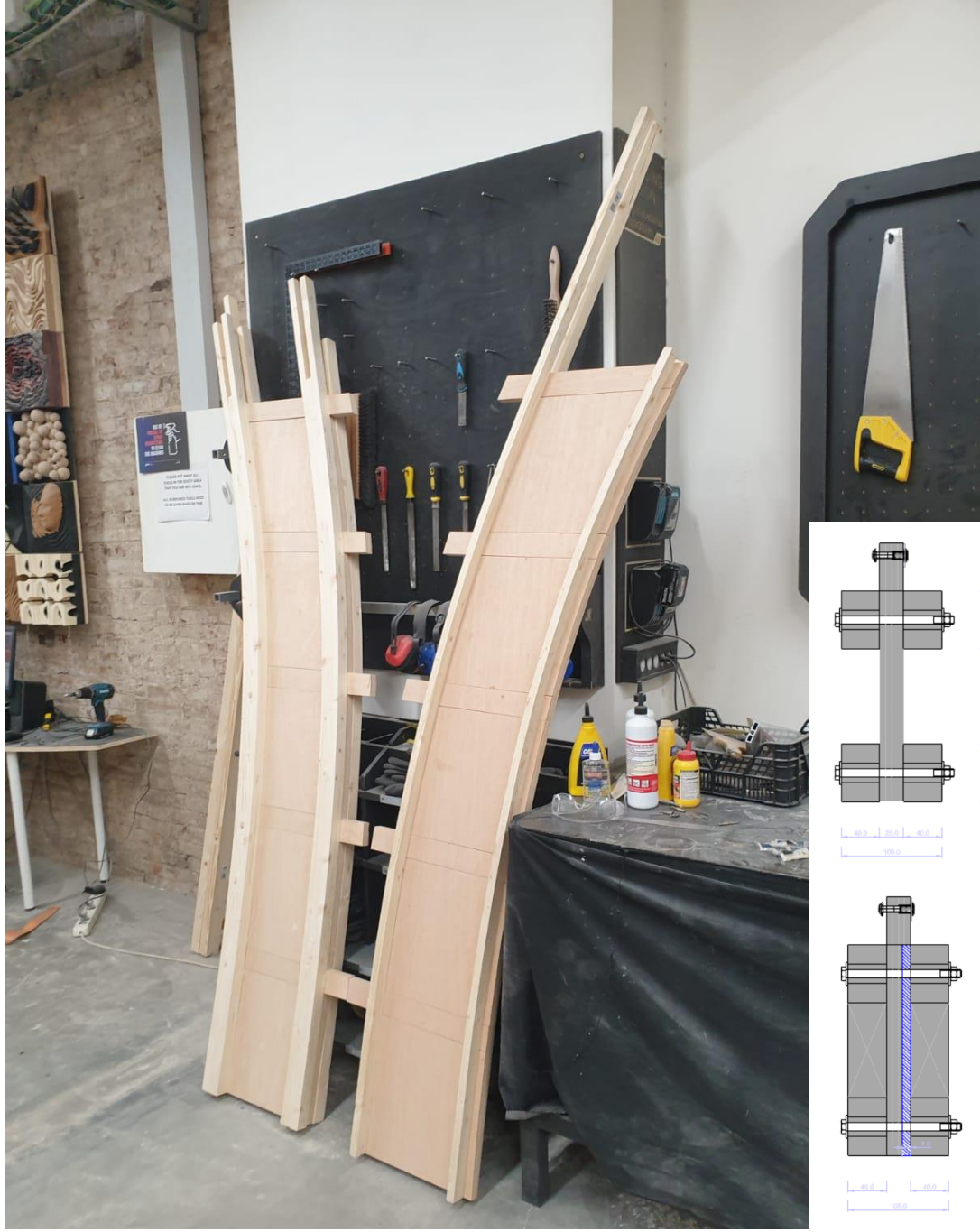
exploring use + reuse of window frames

URBiNAT | Urban Innovative and Inclusive Nature

Nature-Based Solutions (NBS)

Greenhouse Sofia





Prototyping different ways of rib build-up. STR + FAB

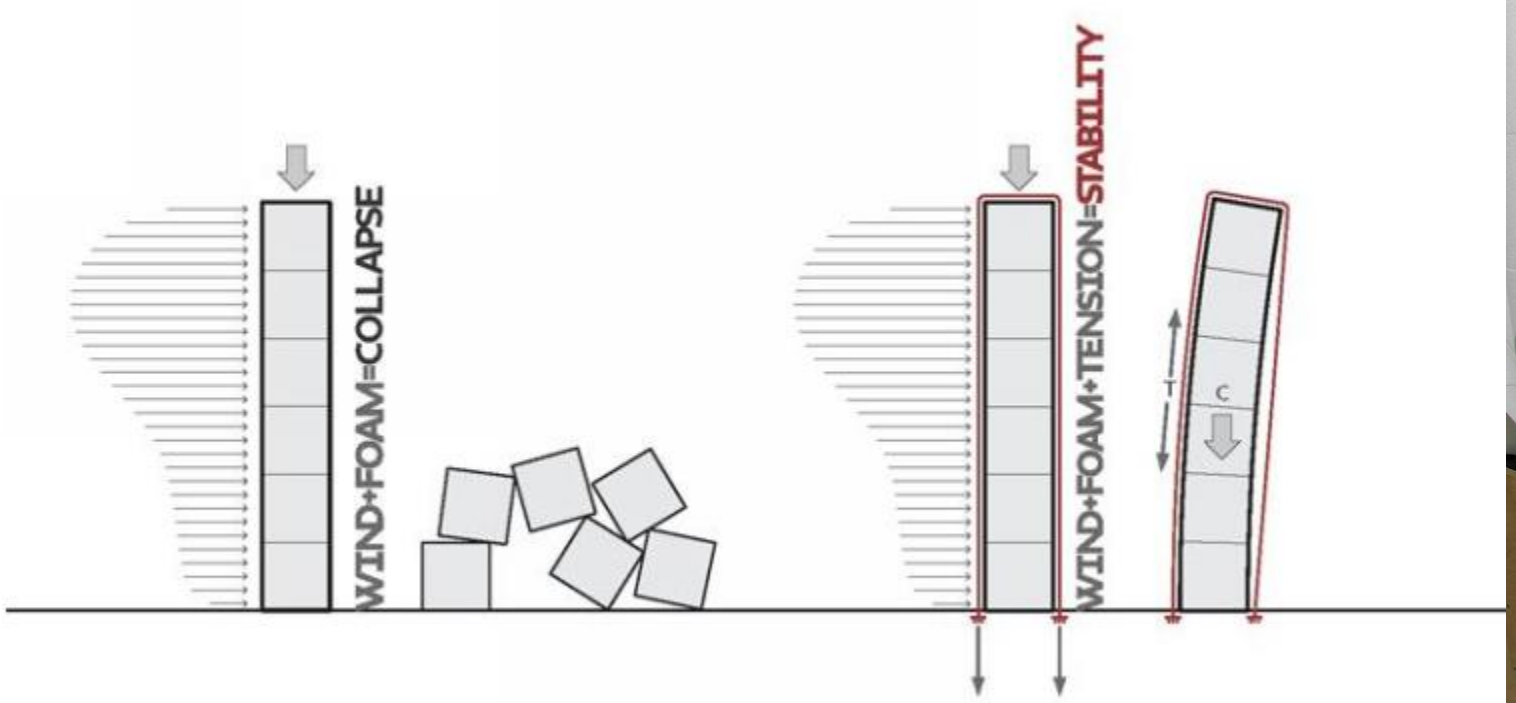
Prototyping a rib using the recycled window frames

Bespoke timber I section + recycled window frame Just need a little more time!

3. LIFE LONG –

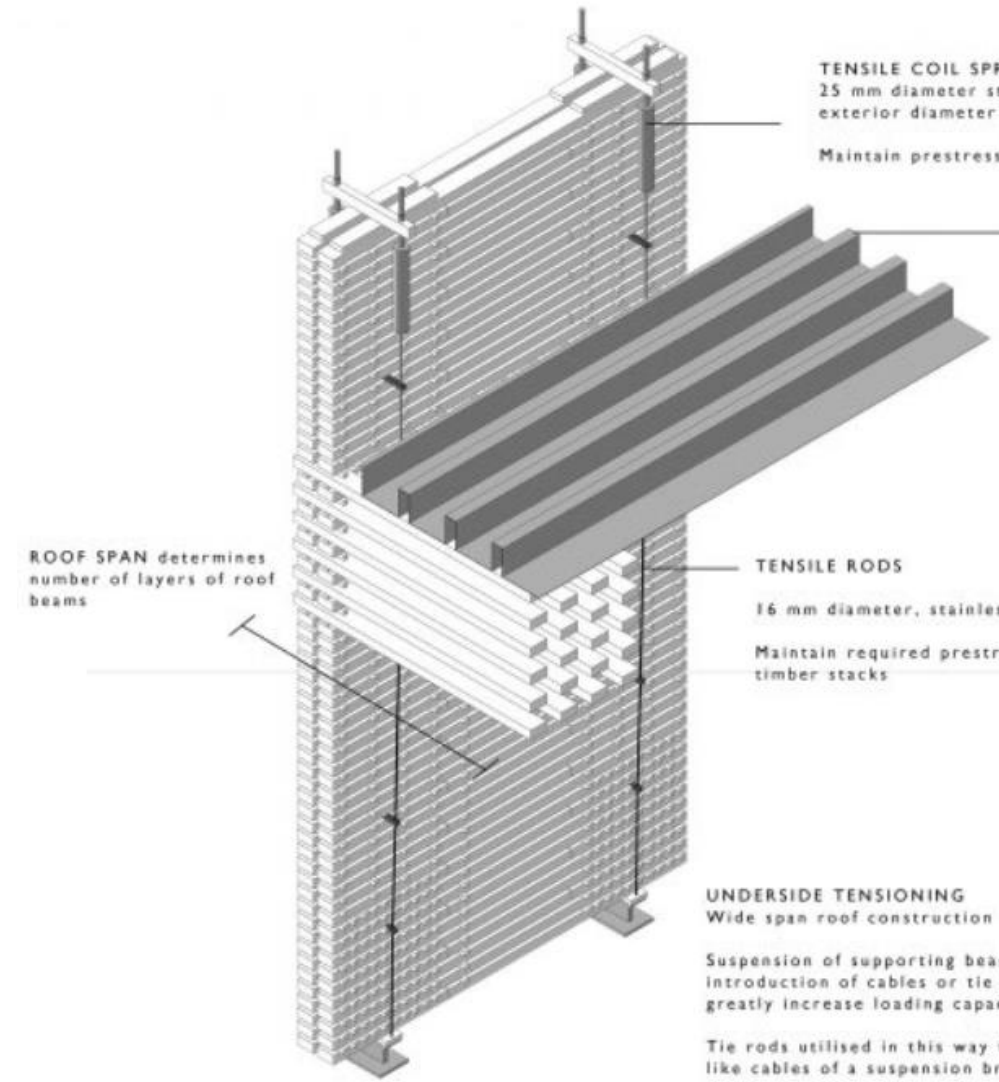
exploring the power of the cable

Matter Design – Periscope tower



Structural cable principle

Peter Zumthor



TENSILE COIL SPRINGS
25 mm diameter steel rods, 20 windings, exterior diameter of 130 mm

Maintain prestressing of timber stacks

PREFABRICATED METAL CHANNELS
2 or 3 mm galvanised metal

Narrow Channels formed from standard 1250 mm wide sheets, folded and slotted into each other

Metal channels spout accumulated rainwater according to incline of terrain

ROOF SPAN determines number of layers of roof beams

TENSILE RODS

16 mm diameter, stainless steel

Maintain required prestressing of timber stacks

UNDERSIDE TENSIONING
Wide span roof construction

Suspension of supporting beams through introduction of cables or tie rods greatly increase loading capacity

Tie rods utilised in this way function like cables of a suspension bridge

FOUNDATION
Steel base plates achored in upright position into foundation pads

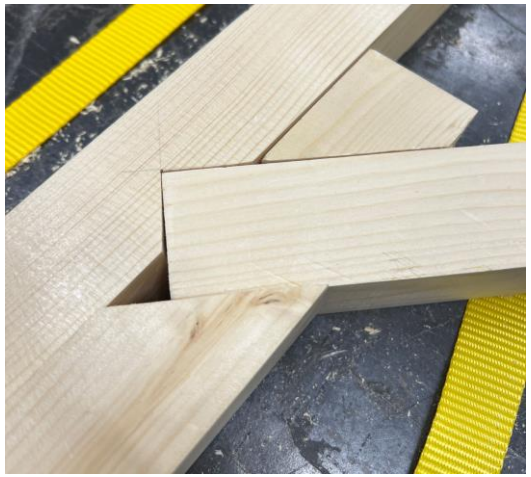
Stacked walls rest on steel base plates, serve as lower fastening points for tension points

Peckham – Franks Bar
Practice Architects

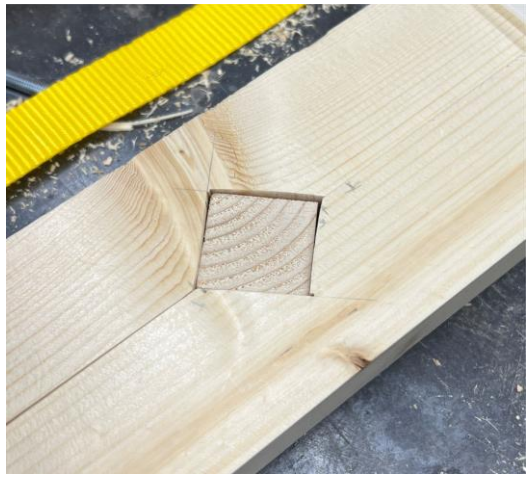
Overtreders W constructs hotel cabin from locally sourced materials secured with straps

Truss to XXX

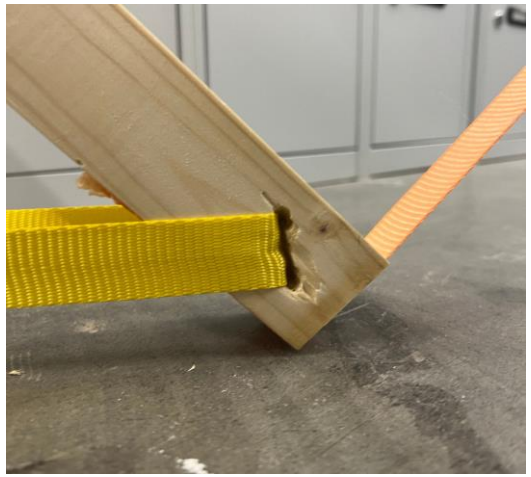
Truss on 1 plane Working on tension connected by ratchet belts



1_ Notch

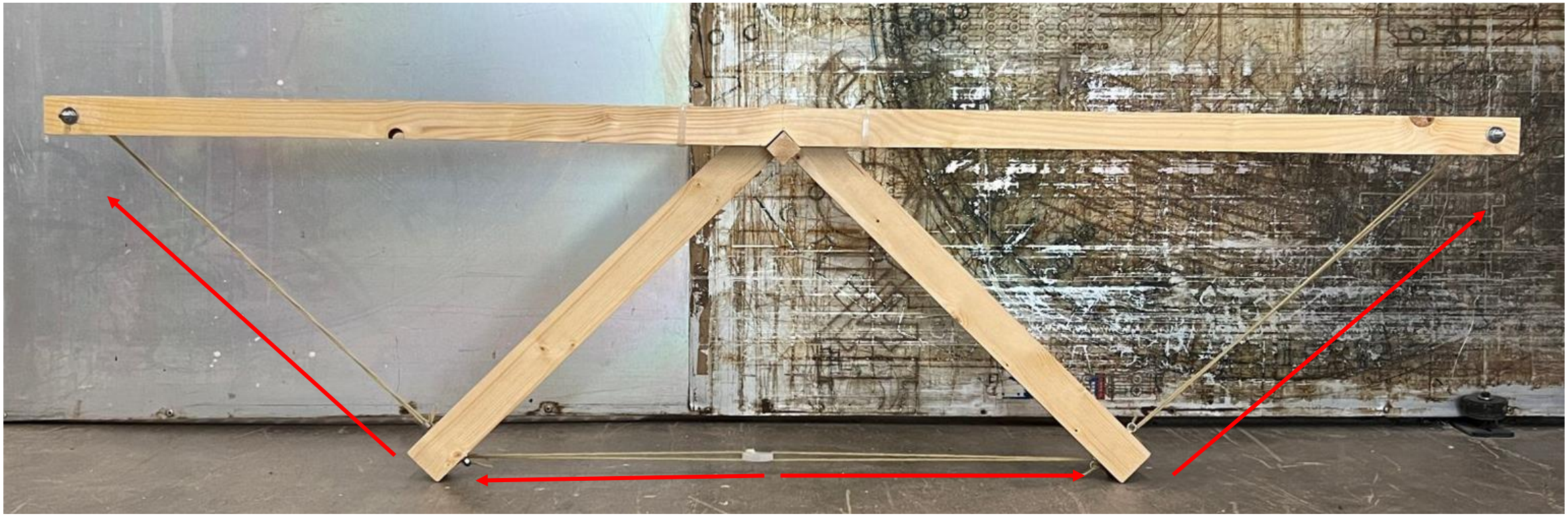


2_ Shear key

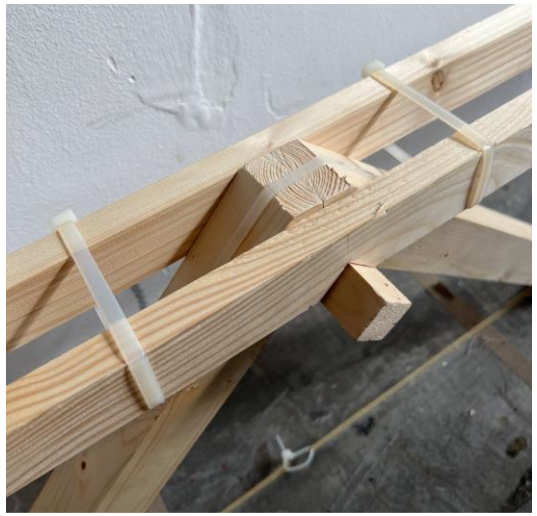


3_ Belt Tie

Packing straps, ratchet belts
v



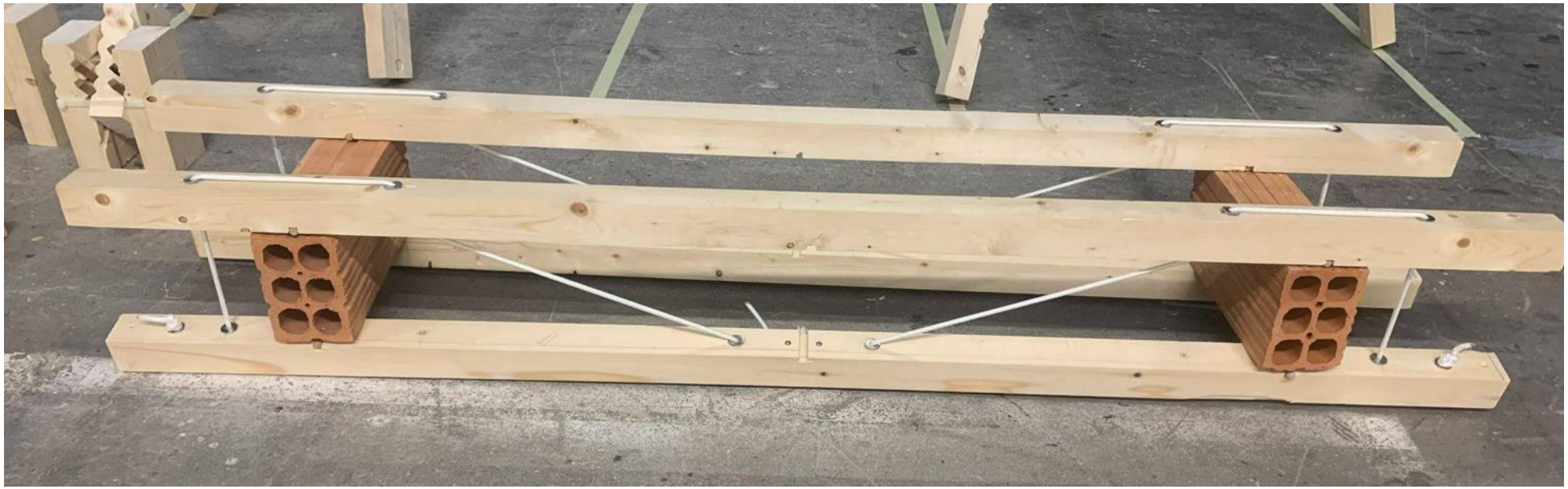
Shear key



Zip tie

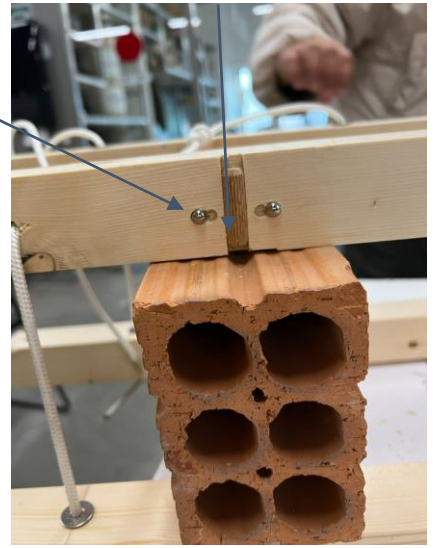
Metal threaded rod

Truss Timber+Bricks



Dowel functioning as a shear key

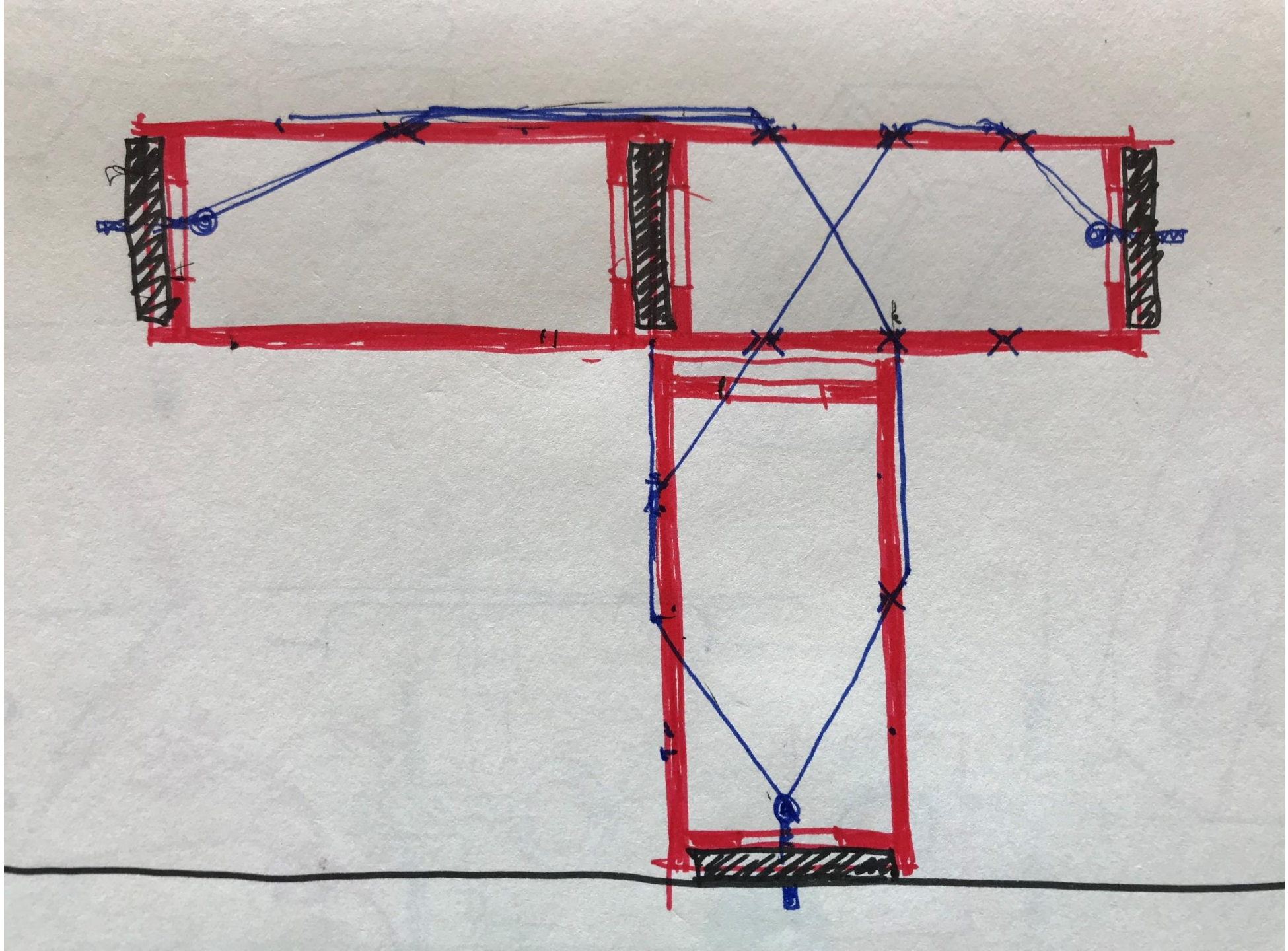
Ball bearings

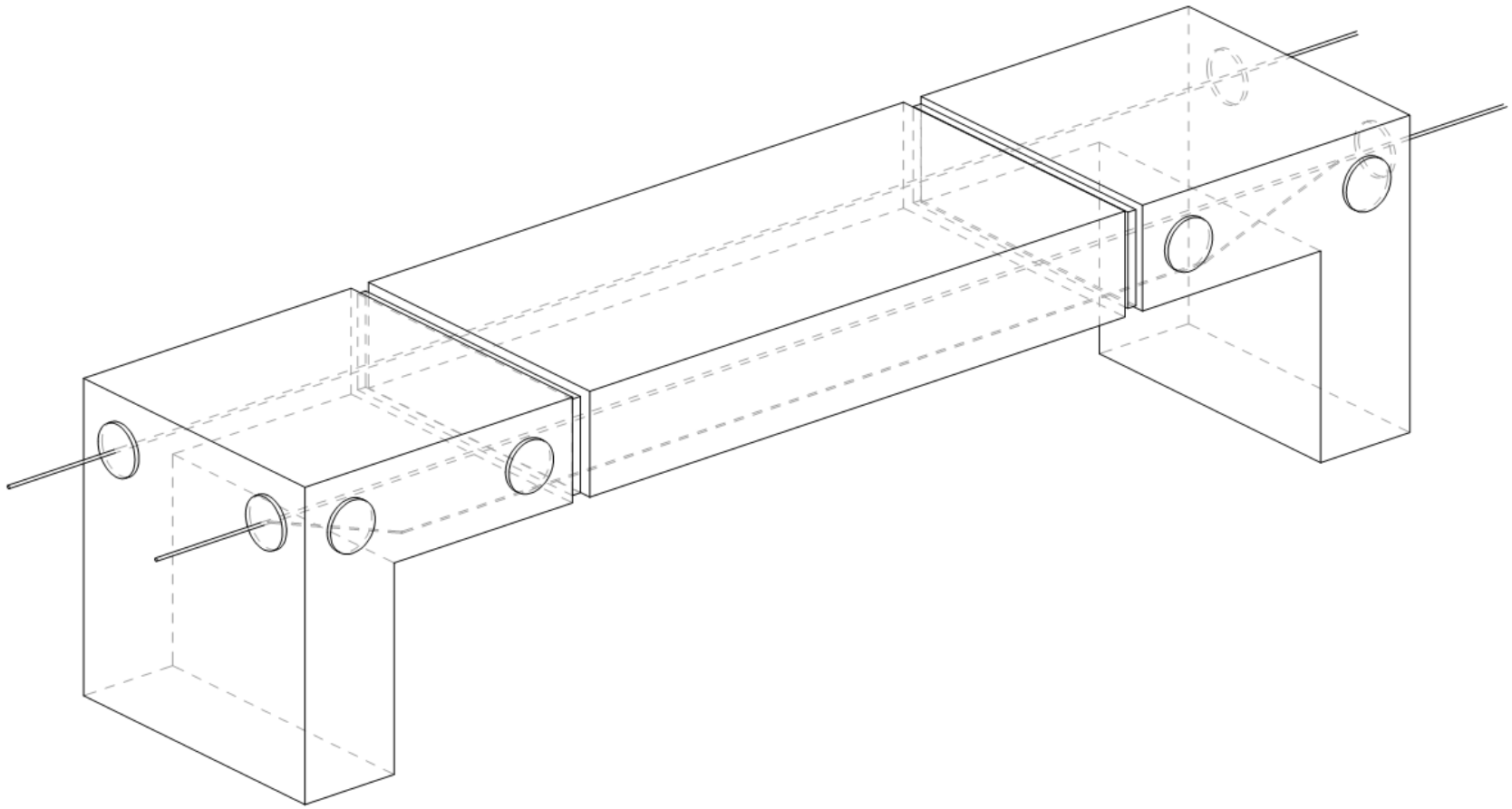


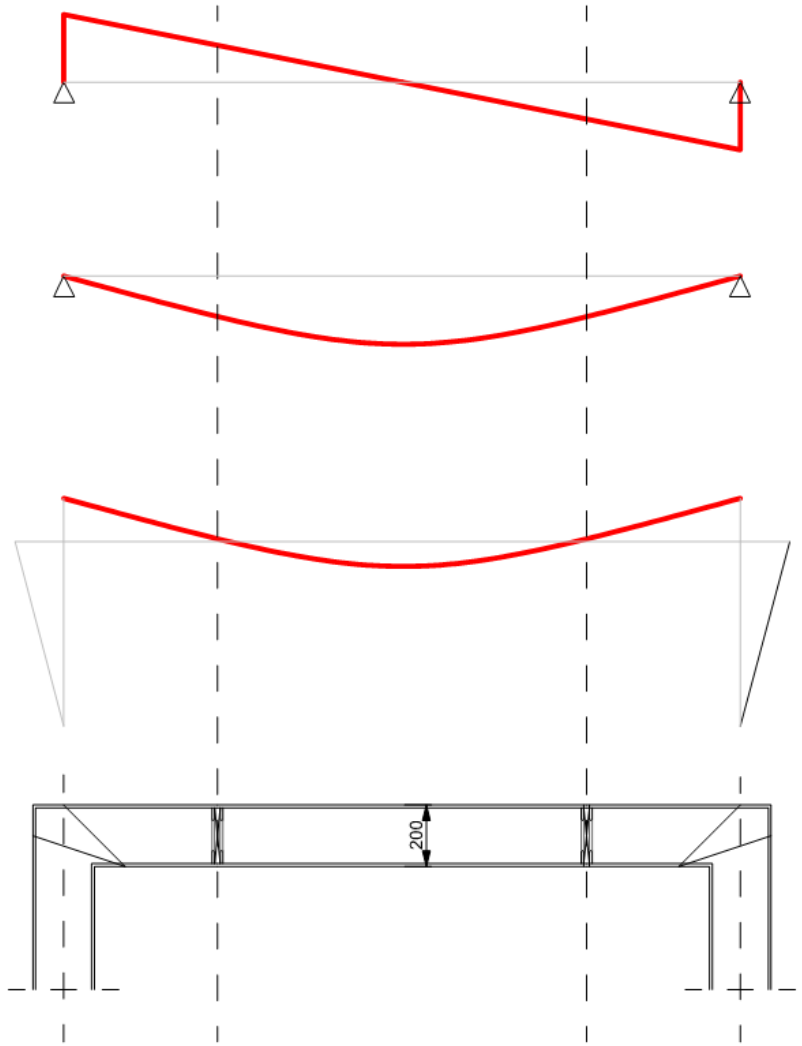
CONNECTION

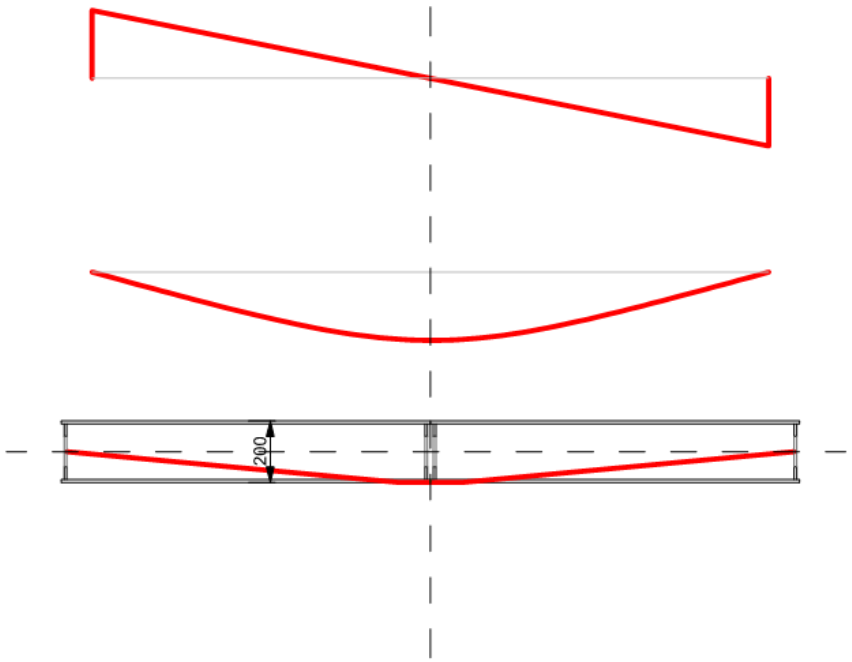
- Dry connections to be able to reuse
- Dry structural enhanced connections
- Learning from toys
- Hands on model making

Tom Westwood - Waught Thistleton



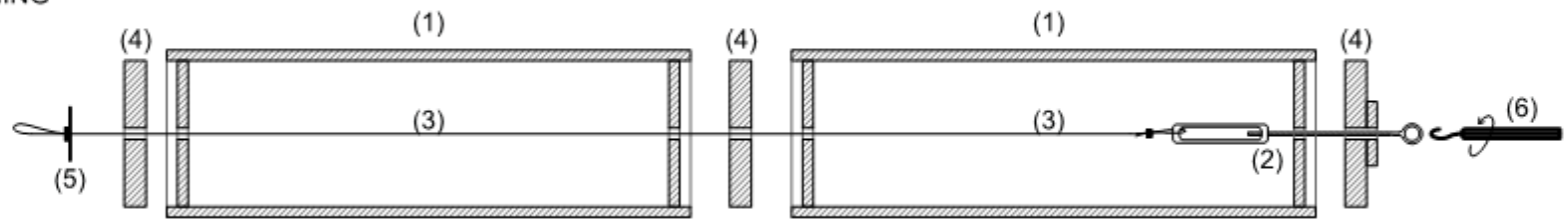






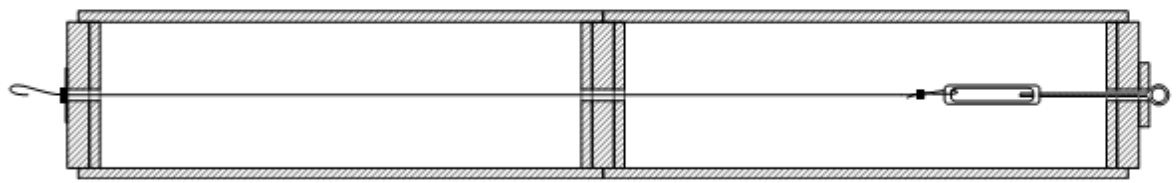
Structural diagram

TWO ELEMENTS
PRIOR TO TENSIONING



(1) CNC Cut plywood element, (2) Tension screw, (3) Tension cable, (4) Shear key, (5) Crimp, (6) Tensioning tool

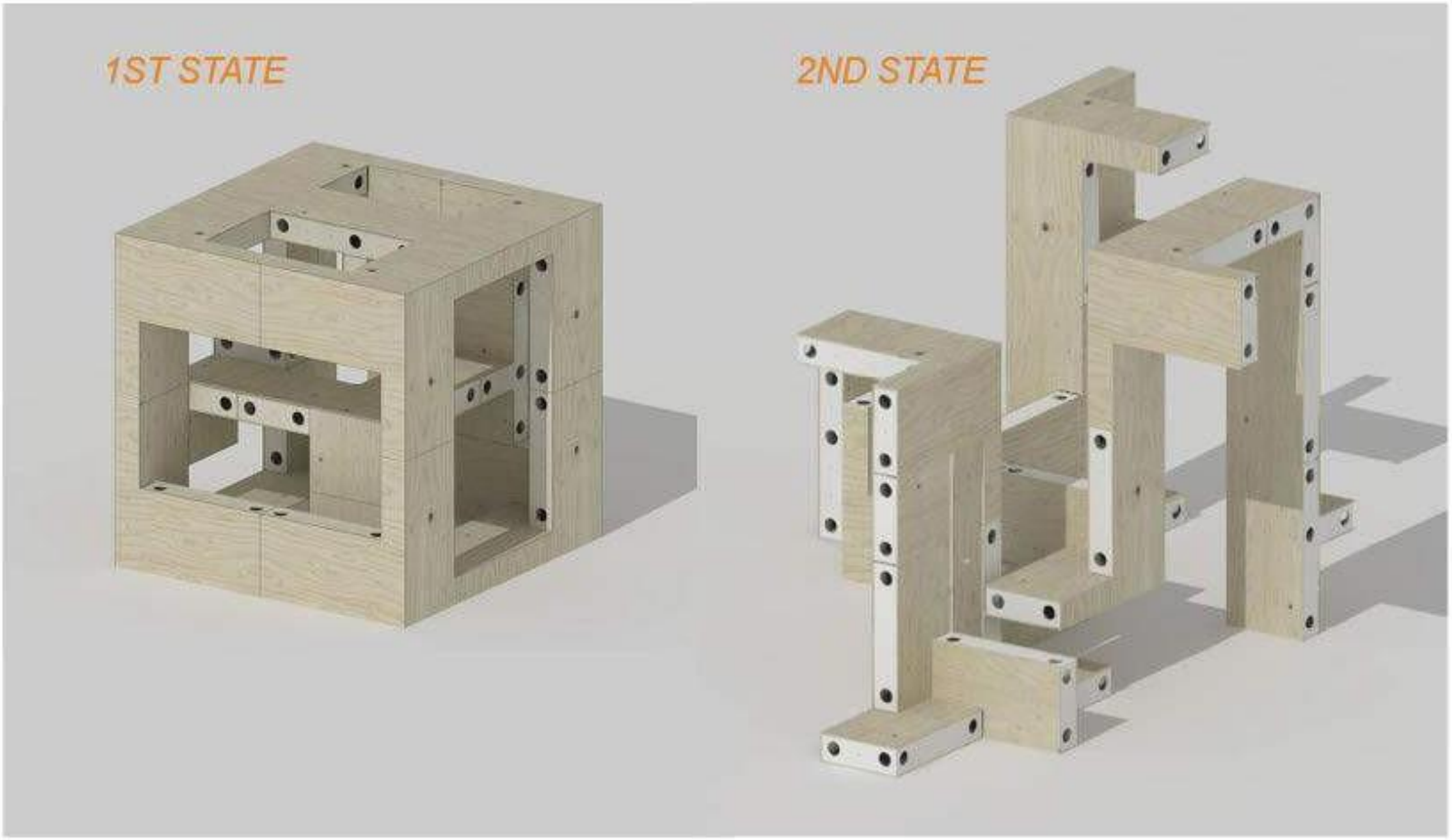
TWO ELEMENTS
POST-TENSIONED



Thinktank.


10 days –
collaborative thinking + planting seed for relevant discussion about flexible housing system design

From London to Kopenhagen



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Working with the future.
Life long design strategies.

Manja van de Worp
IABSEE