



# POST-BEAM + SLAB

Case Studies of 'The Black & White Building' and 'Heartwood'

MARIIA ILINA, FRASER PLAXTON, YAQI LIAO, ENRICO BERTA

# CASE STUDY INFORMATION



## THE BLACK & WHITE BUILDING

Location: Hackney, London, UK  
Architects: Waugh Thistleton Architects  
Type: **7-floor Office Building**  
Area: 4,480m<sup>2</sup>  
Year: 2022



## HEARTWOOD

Location: Seattle, WA, USA  
Architects: Atelier Jones (w/ Timberlab)  
Type: **8-floor Affordable housing**  
Area: 6,500m<sup>2</sup>  
Year: Ongoing

## ADVANTAGES

**01** **Flexibility**, re-use and circularity on assembling and disassembling.

**02** **Less weight comparing with steels:** It has compressive strength like concrete with 66% less weight

**03** Ability to have **exposed timber elements** within residential units in a post and beam system.

**04** **Larger spans** compared to other residential projects or Flexibility of post locations.

## DISADVANTAGES

**01** **Dynamic criteria on timber floors:** thicker CLT slabs – not for structural reasons

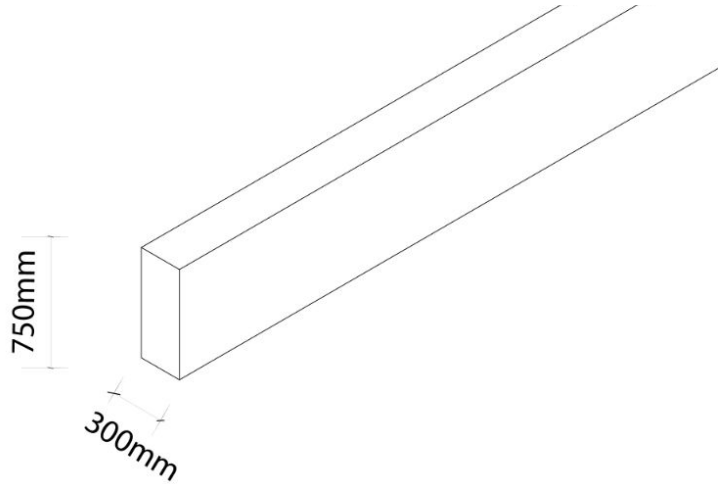
**02** **Larger dimensions of the elements**

**03** **Construction process:** temporary lateral bracing, number of elements that need a crane + connections

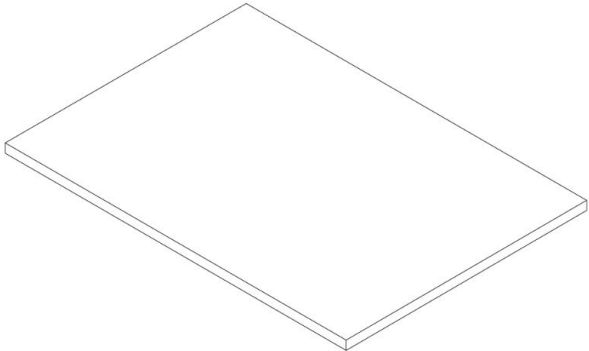
**04** **Drop beams** add complexity to the system (HVAC, MEP, clear height), compared to flat plate.

# STANDARD AND UNIQUE ELEMENTS

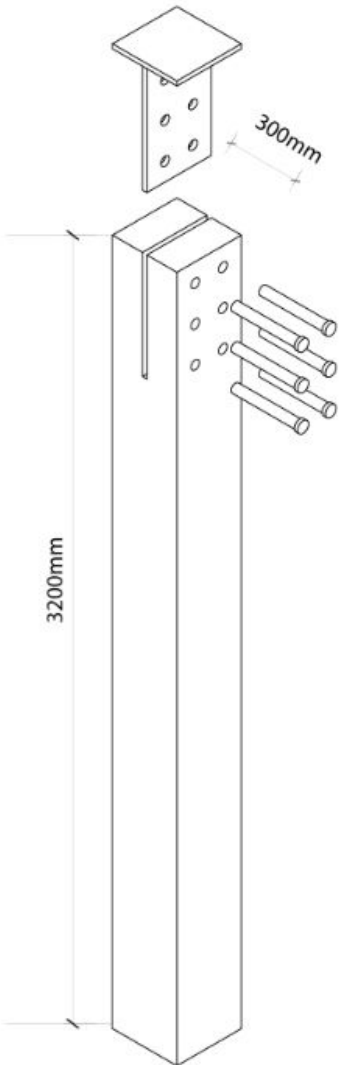
## THE BLACK & WHITE BUILDING



**LVL Beam BauBuche GL75**  
450\*650mm\*5m

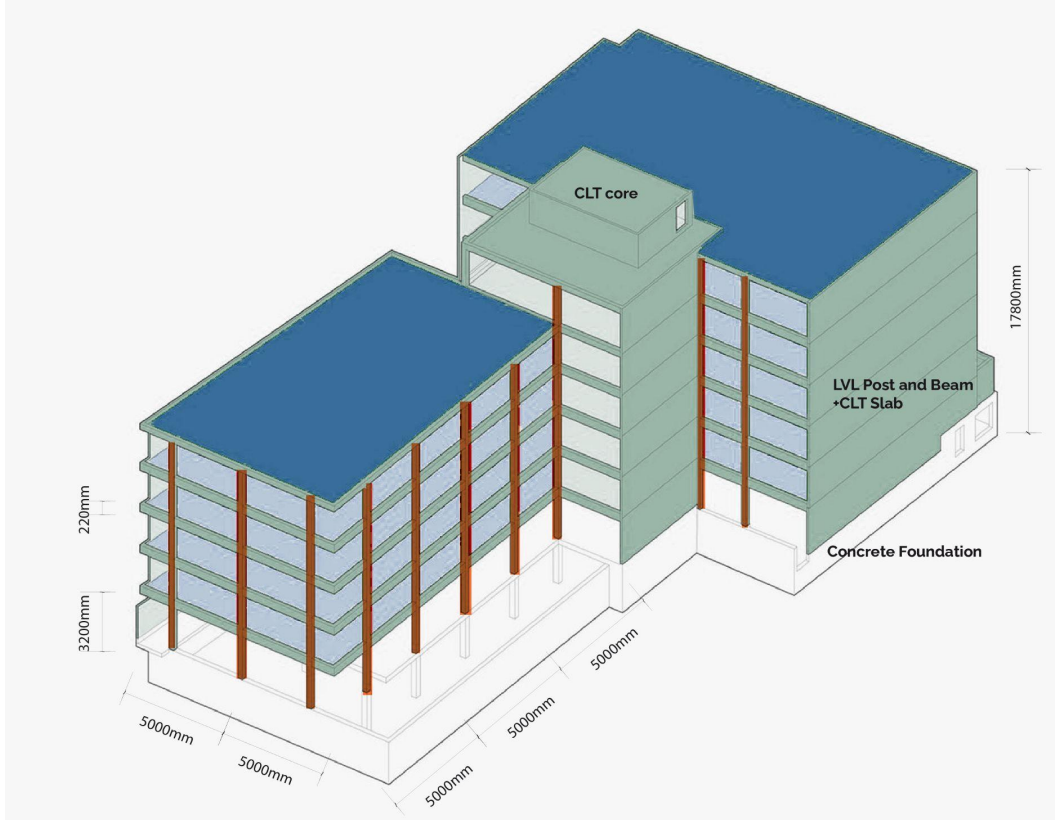


**CLT Floor Slab**  
7 layers 220mm thickness



**LVL Post**  
350\*350mm\*3.2m  
13,000 steel screws

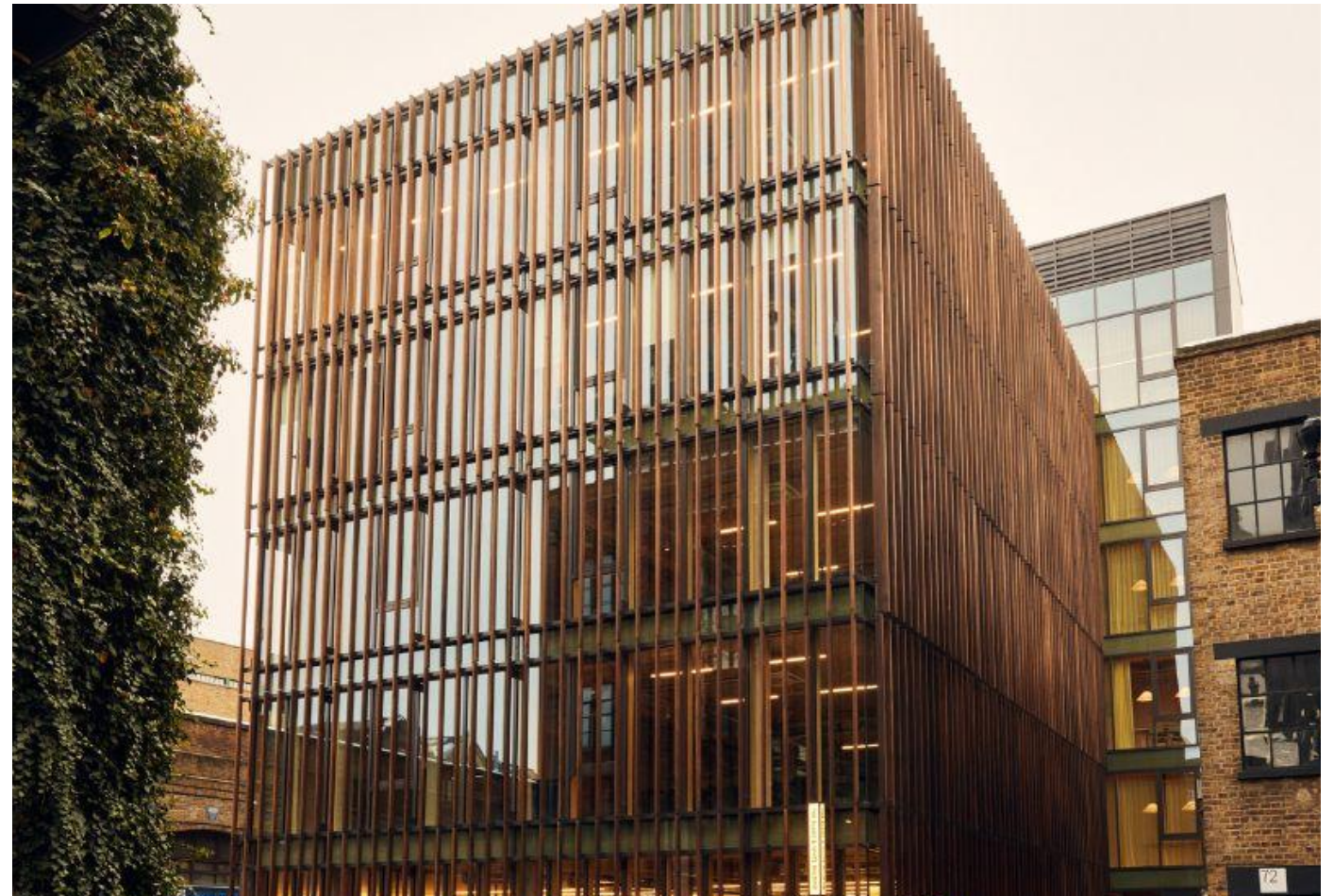
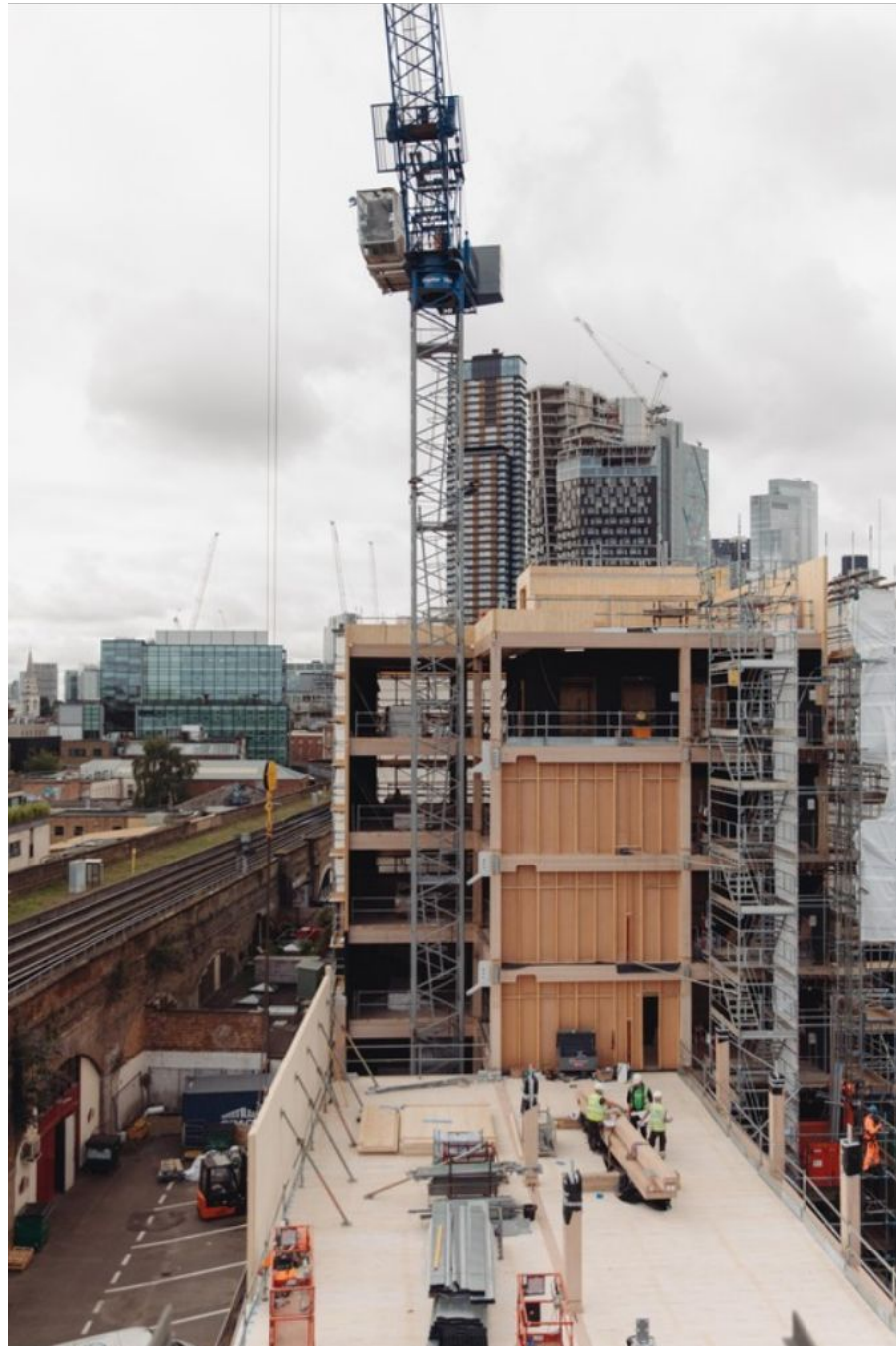
**Standard element:** Prefabricated in factory and every piece arrives on a truck labelled with where it should go.



- LVL Post**
- LVL Beam**
- CLT Slab**

# STANDARD AND UNIQUE ELEMENTS

## THE BLACK & WHITE BUILDING



### **Core(unique): CLT**

It is constructed as a solid box entirely from CLT, so is incredibly strong.

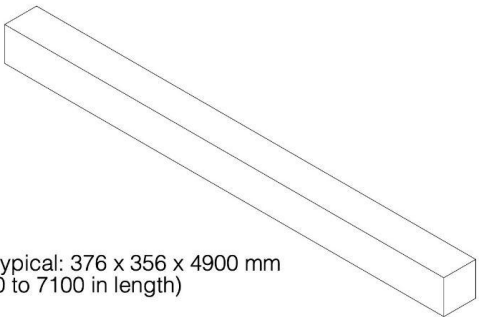
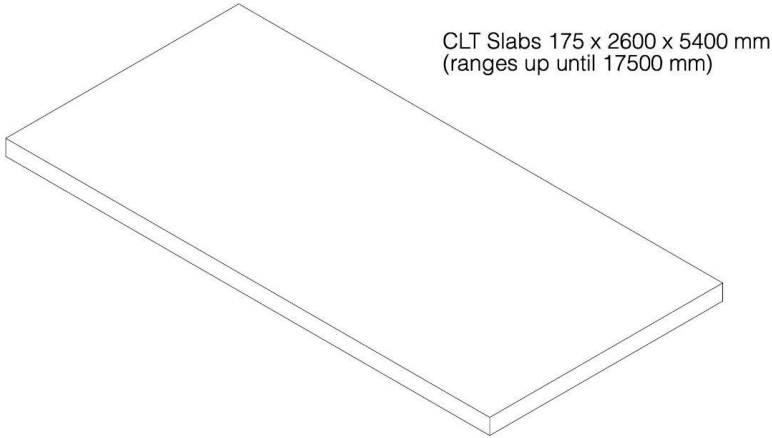
### **Façade(unique): glulam curtain walling & tulipwood solar shading**

On the outside vertical, thermally modified tulipwood louvres provide solar shading.

Source: <https://www.theofficegroup.com/stories/design/behind-the-scenes-the-black-white-building>

# STANDARD AND UNIQUE ELEMENTS

## HEARTWOOD



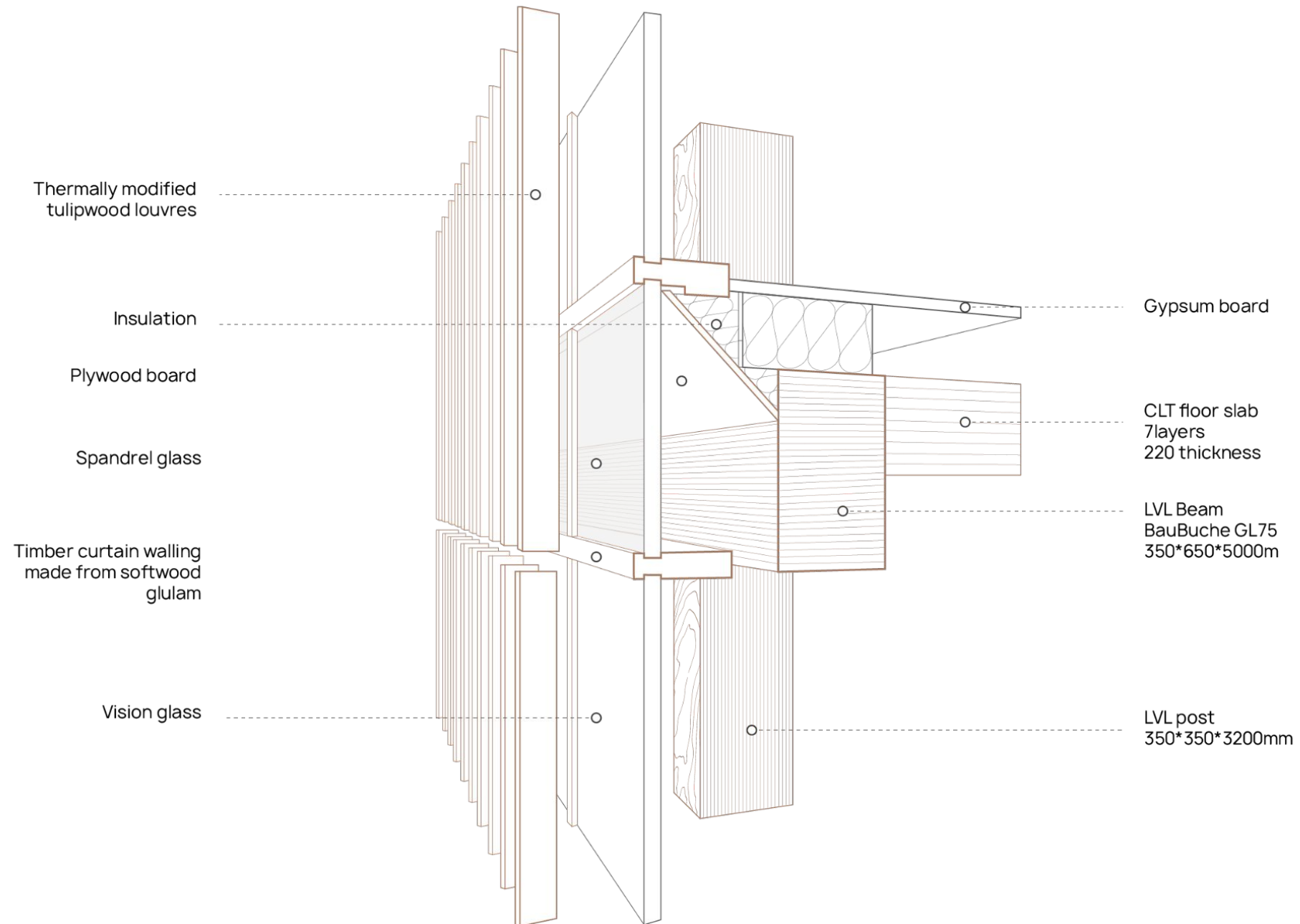
### NOTES

- CLT Slabs: 5-ply required to provide 2-way spanning action to optimize spacing between beams & meet acoustic+fire-rating requirements
- All exposed glulam beams + posts are upsized from structural requirements (by approx. 100mm per exposed face) to account for char depth as prescribed in IBCC - 1.5" (38mm) per hour effective char depth



# FLOOR AND WALL STRUCTURE

## THE BLACK & WHITE BUILDING



# FLOOR AND WALL STRUCTURE

## THE BLACK & WHITE BUILDING



ARK-E 4014 Industrial Wood Construction



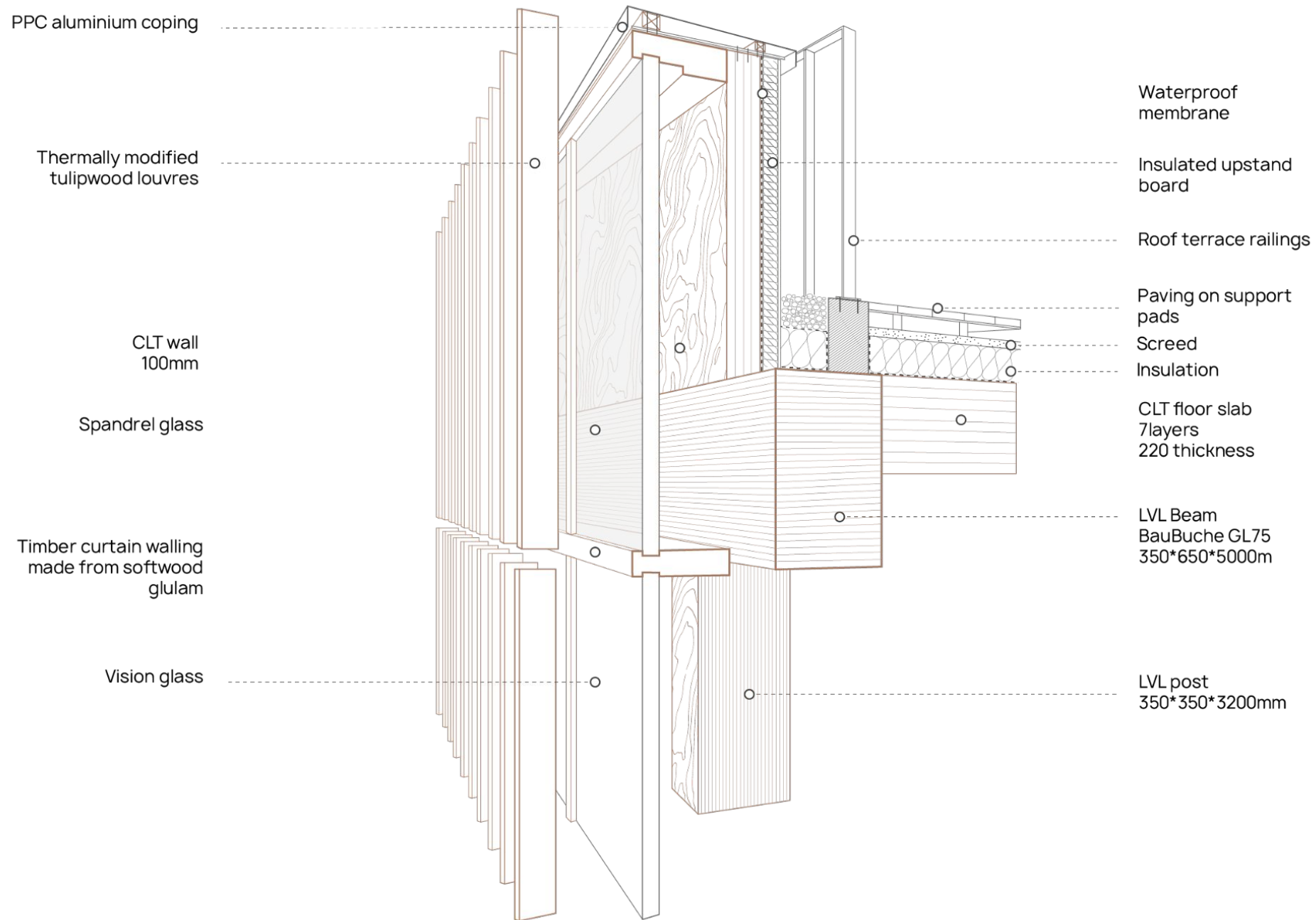
Post-Beam+Slab

Maria, Fraser, Yaqi, Enrico



# ROOF STRUCTURE

## THE BLACK & WHITE BUILDING



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## THE BLACK & WHITE BUILDING



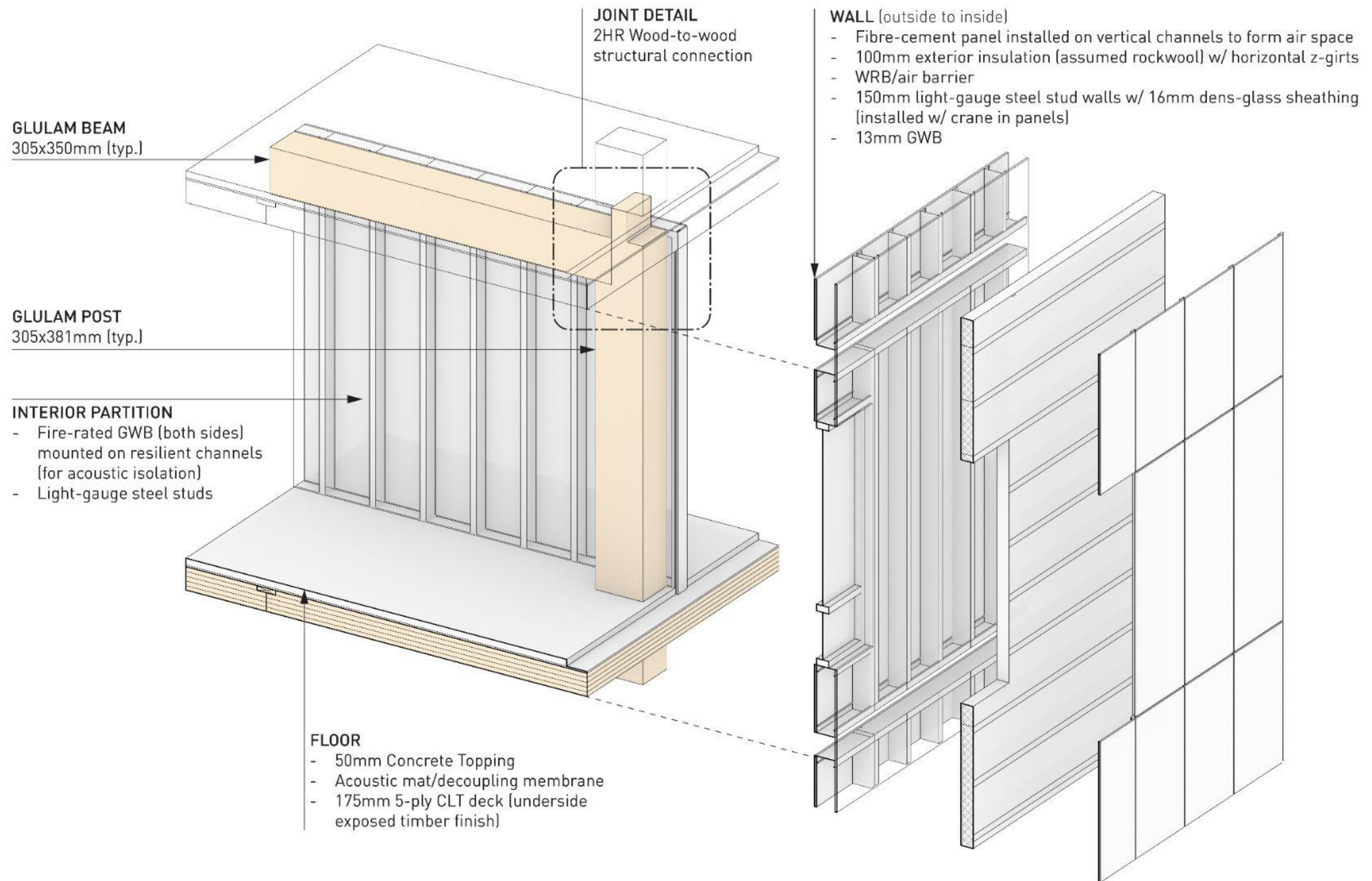
ARK-E 4014 Industrial Wood Construction

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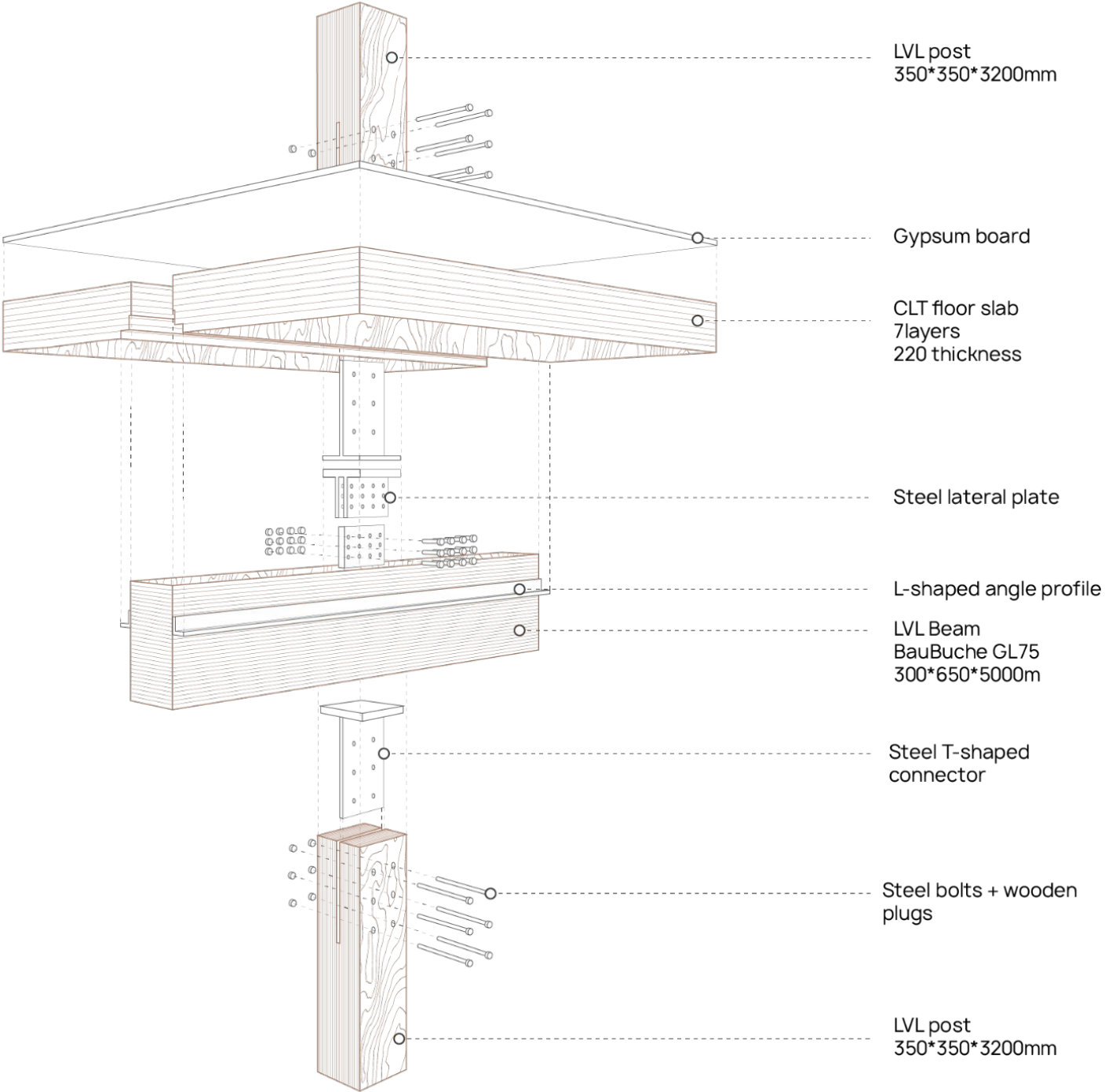
# FLOOR AND WALL STRUCTURE

## HEARTWOOD



# TYPICAL JOINTS

## THE BLACK & WHITE BUILDING



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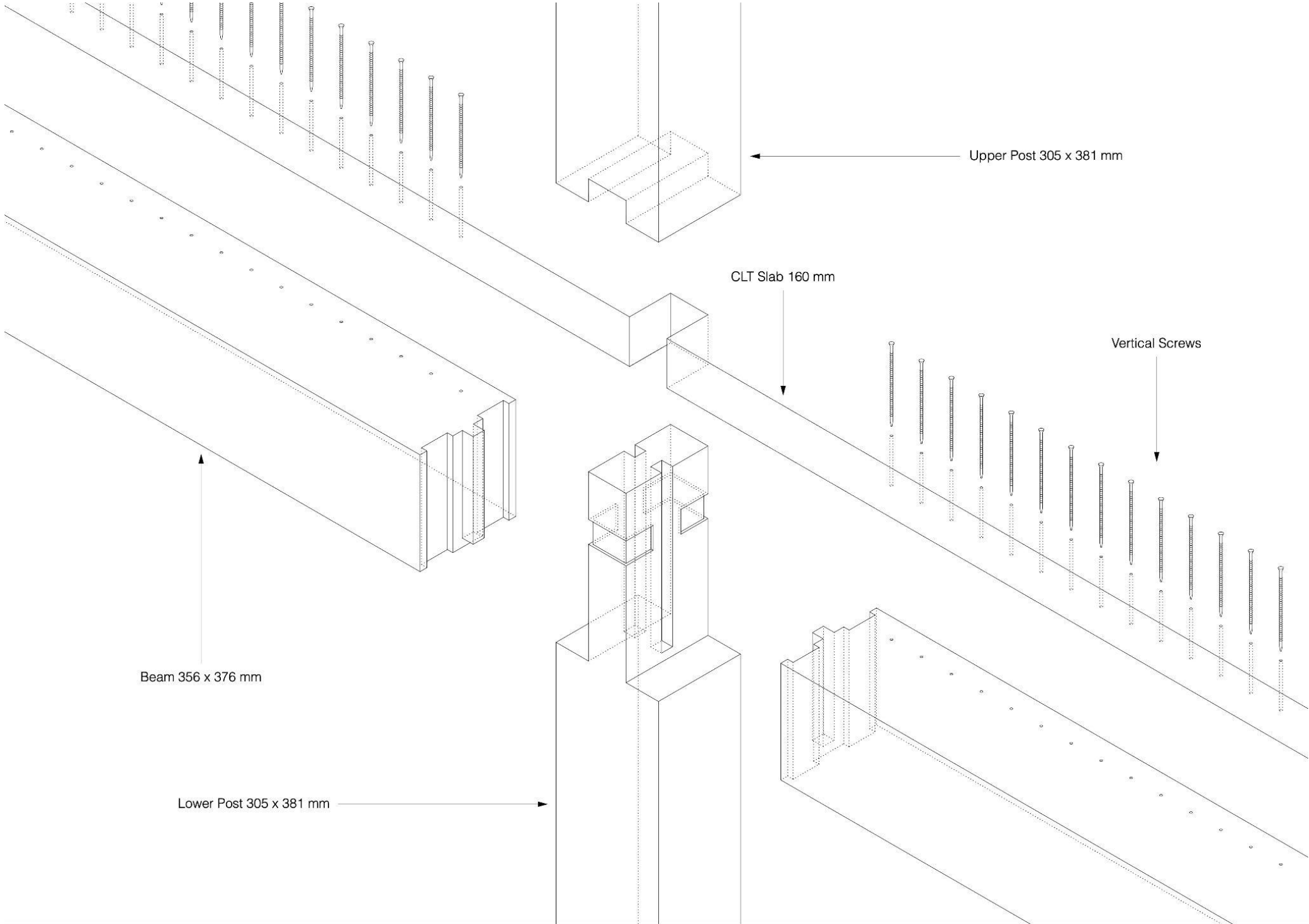
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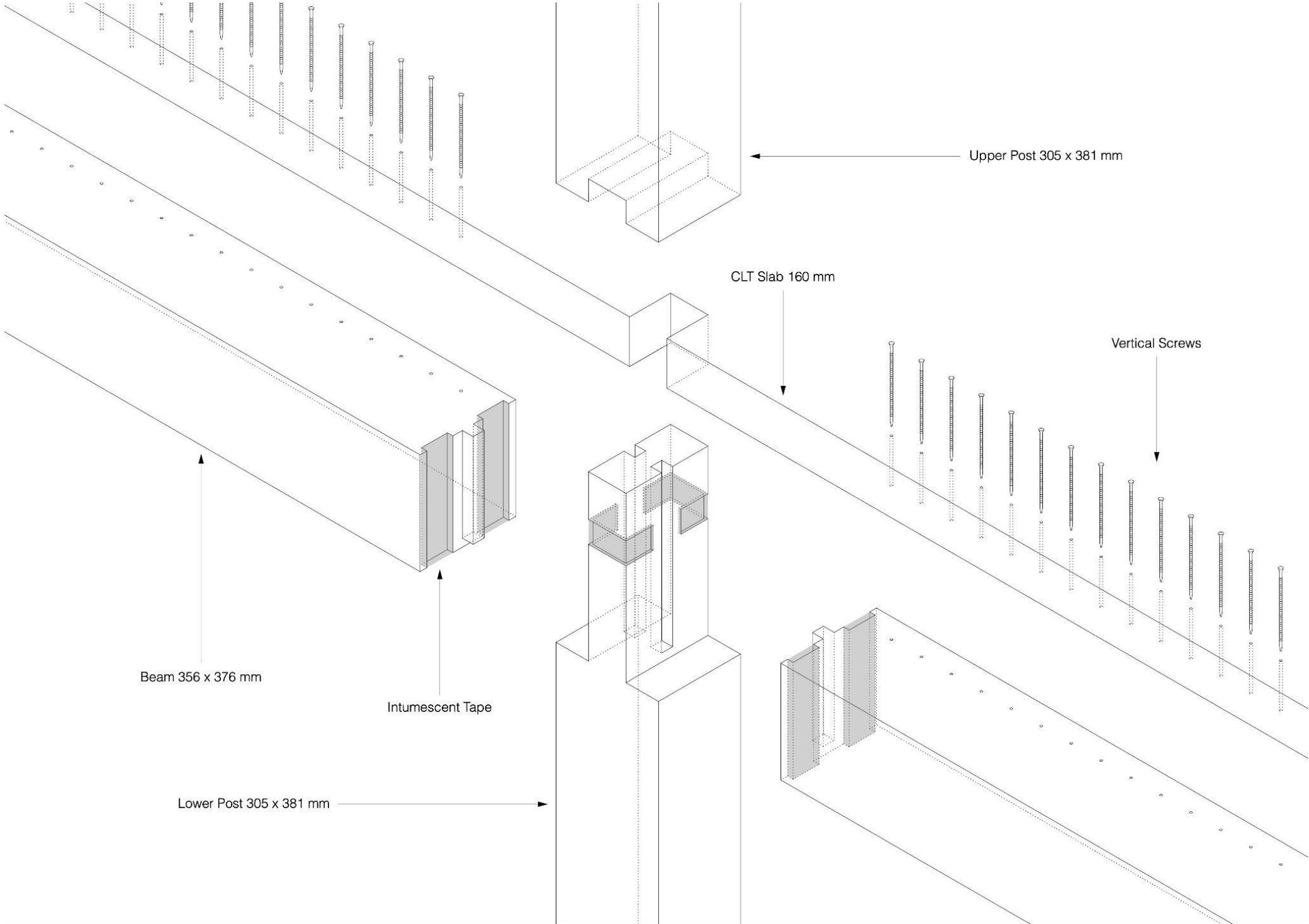
# TYPICAL JOINTS

## HEARTWOOD



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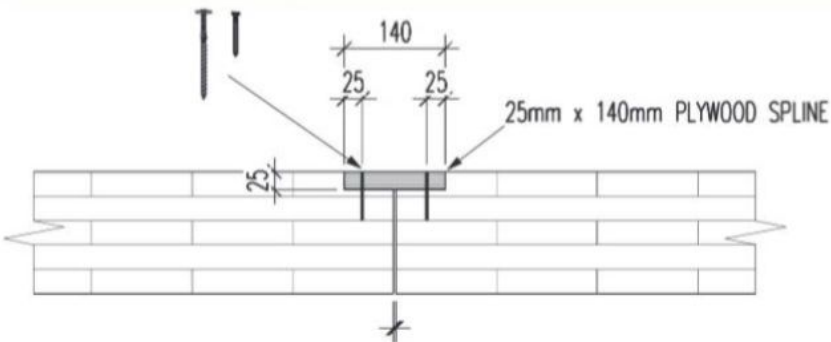
## HEARTWOOD



# TYPICAL JOINTS

## HEARTWOOD

- Continuous plywood splines, nailed into CLT dadoes with ring shank nails, transfer in-plane forces between panels. Partially threaded screws transfer vertical shear across panel joints and ensure a flush panel-to-panel fit.
- Steel staples, fastened to the CLT floor plates with partially threaded screws and bolted to cast-in embed plates, drag diaphragm forces into the core(s).



ARK-E 4014 Industrial Wood Construction

Post-Beam+Slab

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# TYPICAL JOINTS

## HEARTWOOD



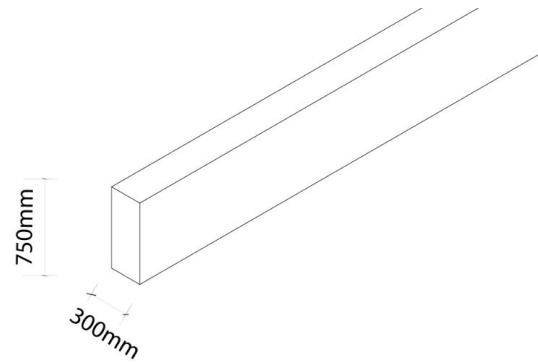
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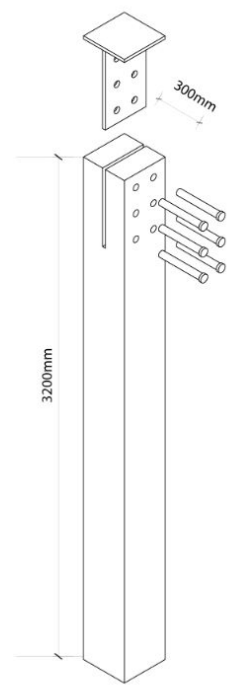
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# TRANSPORTATION AND SIZE OF ELEMENTS

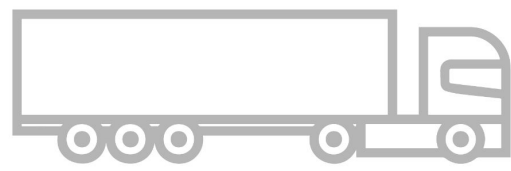
## THE BLACK & WHITE BUILDING



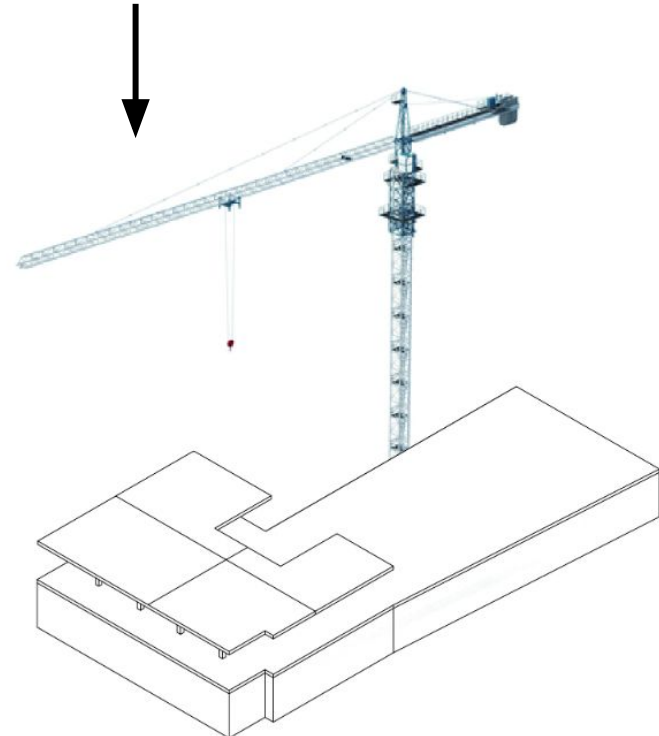
**LVL Beam BauBuche GL75**  
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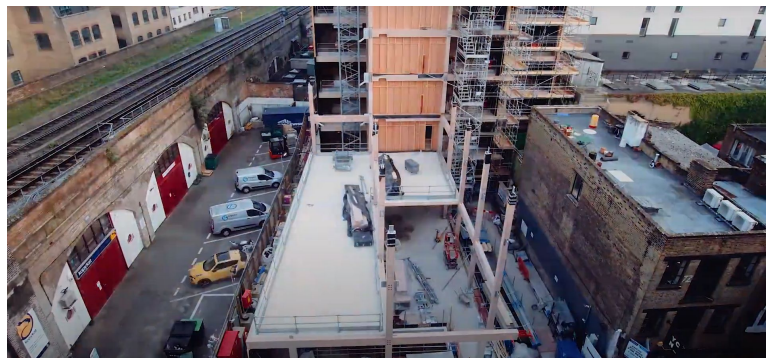
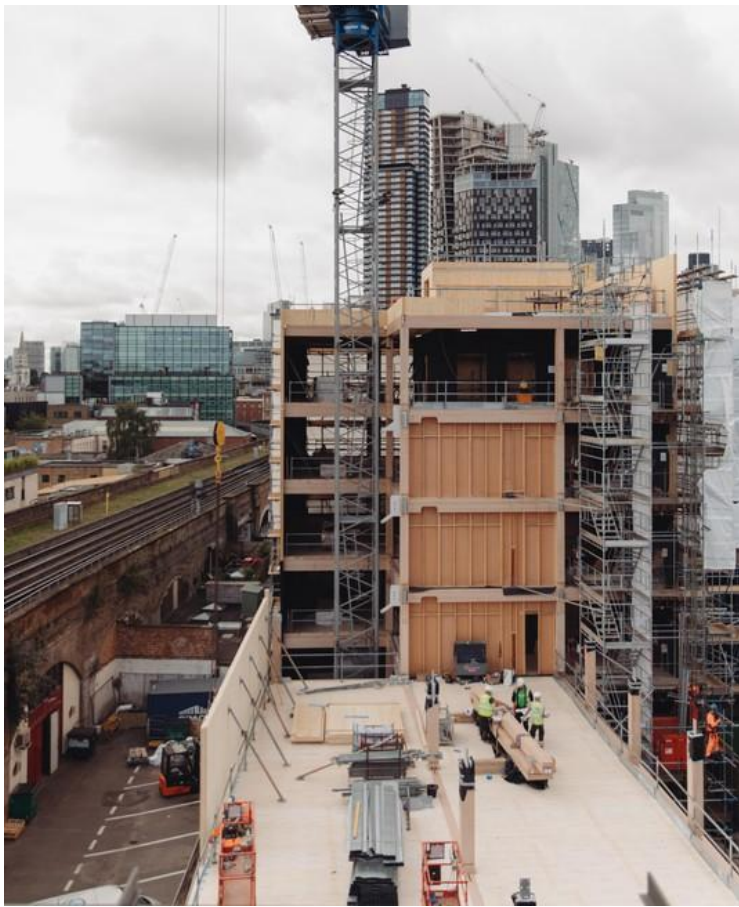
**LVL Post**  
350\*350mm\*3.2m  
13,000 steel screws



Every piece arrives on a truck  
labelled with where it should go.



**CLT Floor Slab**  
7 layers 220mm thickness  
Assemble on site

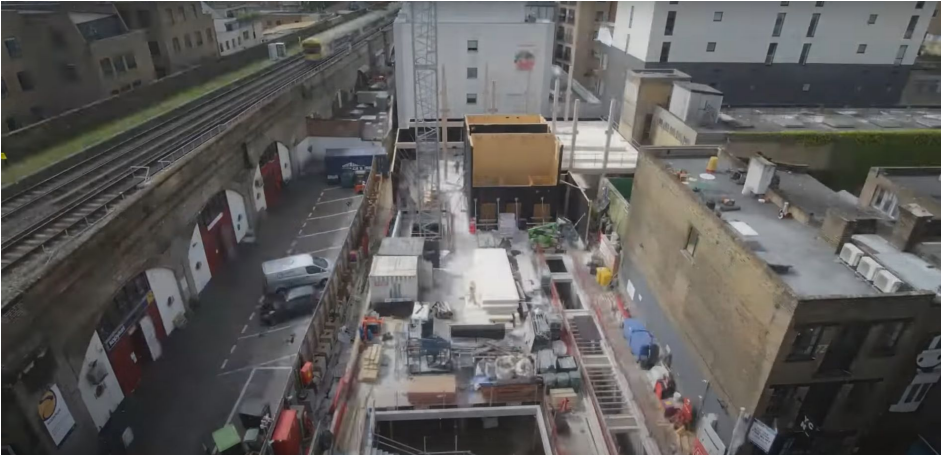
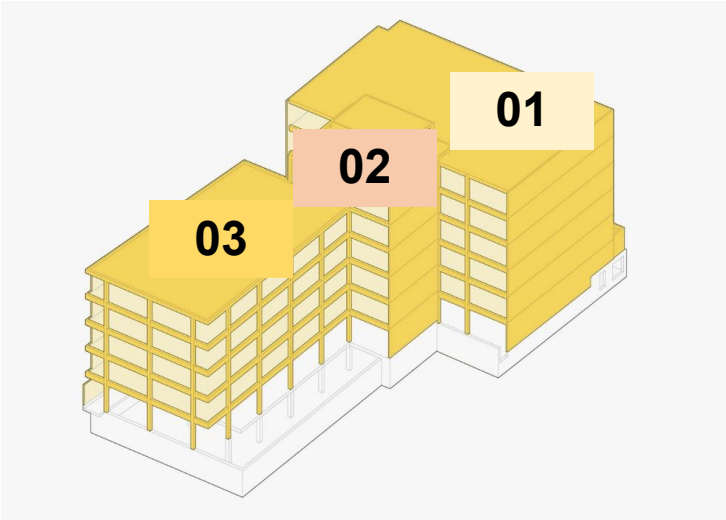


The frame went up in 16 weeks with six men, and you don't have a concrete gang or steel fixers.

# TRANSPORTATION AND SIZE OF ELEMENTS

## THE BLACK & WHITE BUILDING

Logistics meant the rear wing was built first, then the core and then the front.



**01**

After Foundation:  
Rear wings and cores



**02**

Between two and three lorry-loads of timber arrived each week, with the frame and slabs loaded onto the lorry in the right sequence for erection.



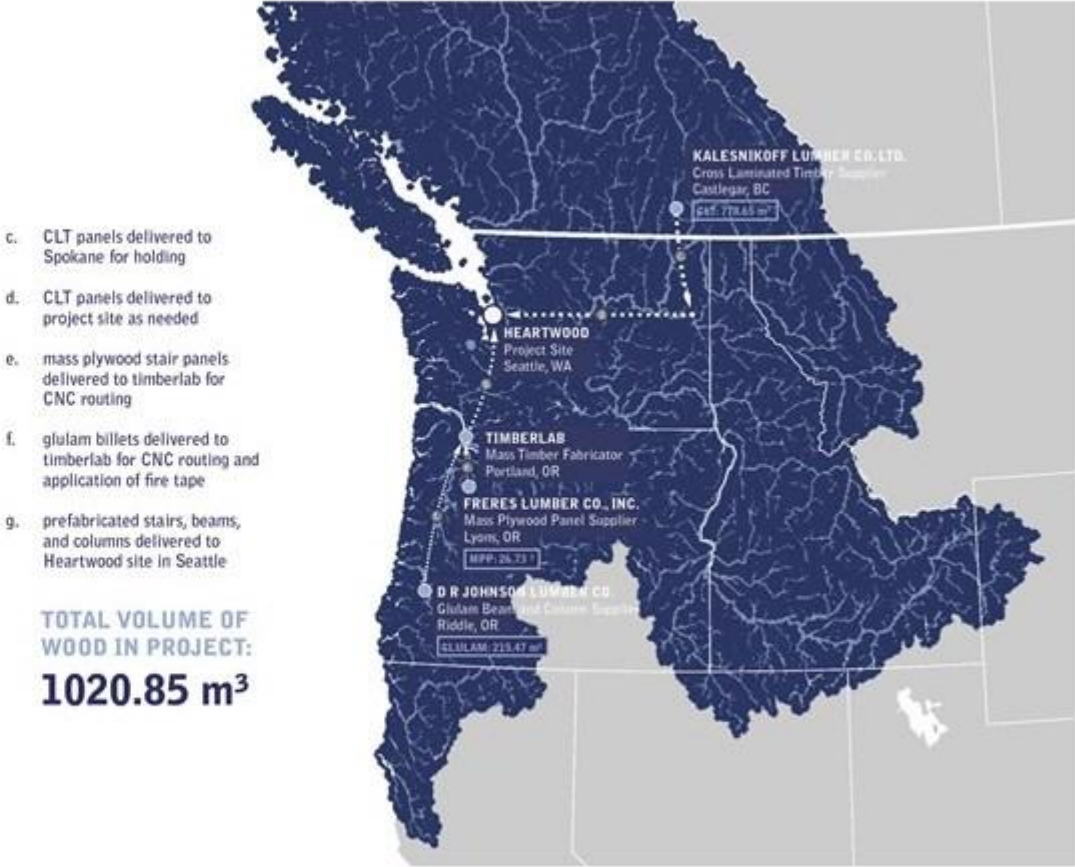
**03**

The front and facade

<https://www.youtube.com/watch?v=GxXgOTUksbo>

# TRANSPORTATION AND SIZE OF ELEMENTS

## HEARTWOOD



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## HEARTWOOD



08.24.2022



09.09.2022



09.28.2022

# RESTRICTIONS

## THE BLACK & WHITE BUILDING



1. All elements designed in BIM -high requirement on assembling and manufacture



2. Because compliance is not performance based, we had to make the timber floors fit the properties of concrete floors, so we had to use thicker CLT slabs – **not for structural reasons but to meet the dynamic criteria.**

# RESTRICTIONS

## THE BLACK & WHITE BUILDING



“We started [the frame] in May, which was the fourth wettest May on record.”

Water can get between the layers, causing the affected area to swell up, which unfortunately happened at the Black & White Building.

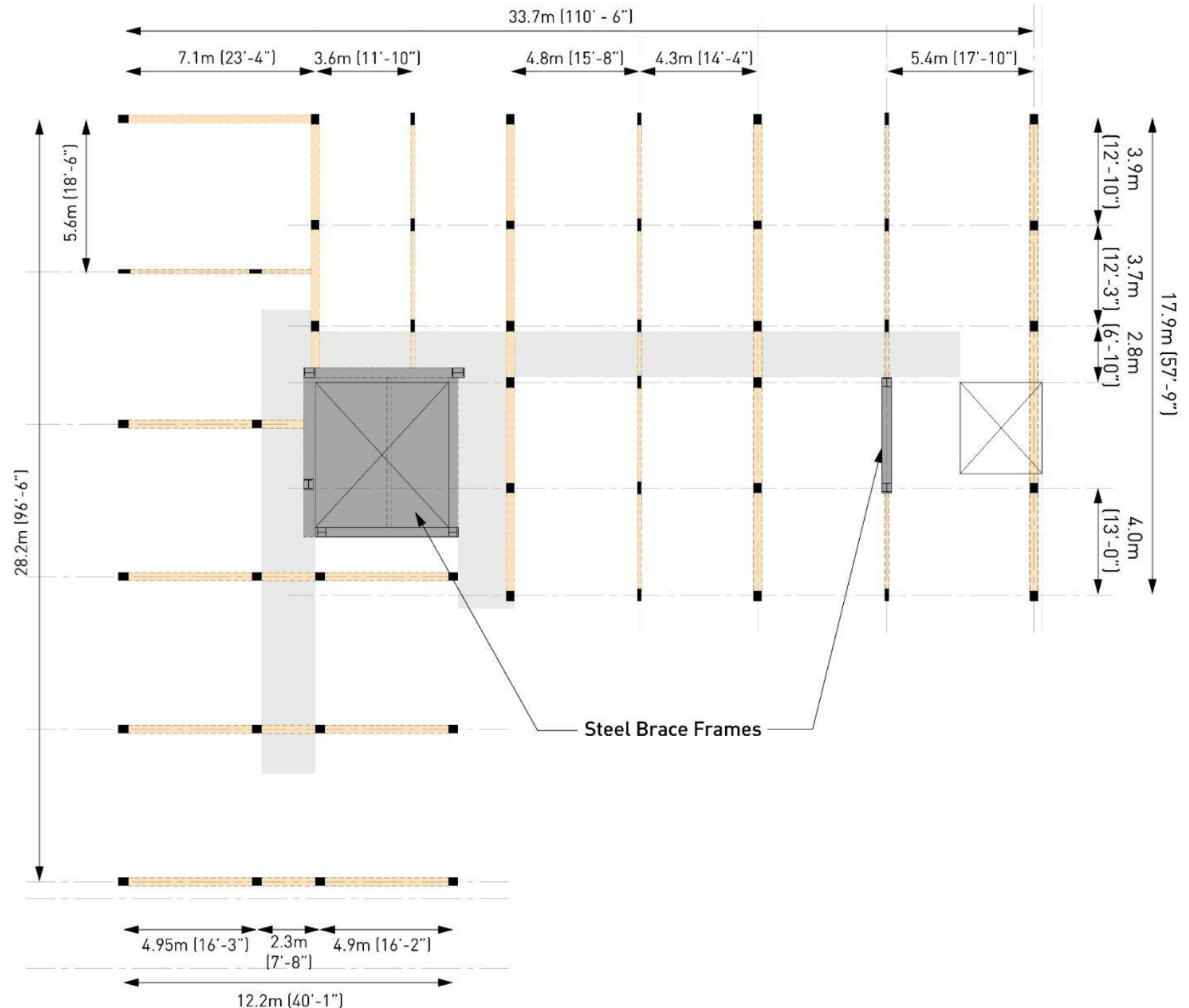
# RESTRICTIONS

## HEARTWOOD

Post & Beam Layout [Typical Plan]

### NOTES

- 5-PLY CLT (6-7/8") TYPICAL SPANS: 14-17ft (4.2-5.2m)
- Grid is dictated by the maximum panel spans in order to ensure beams span in only one direction perpendicular to facade + corridor
- Large steel brace frame required at building core (and secondary location) to satisfy lateral resistance requirements in seismic zone





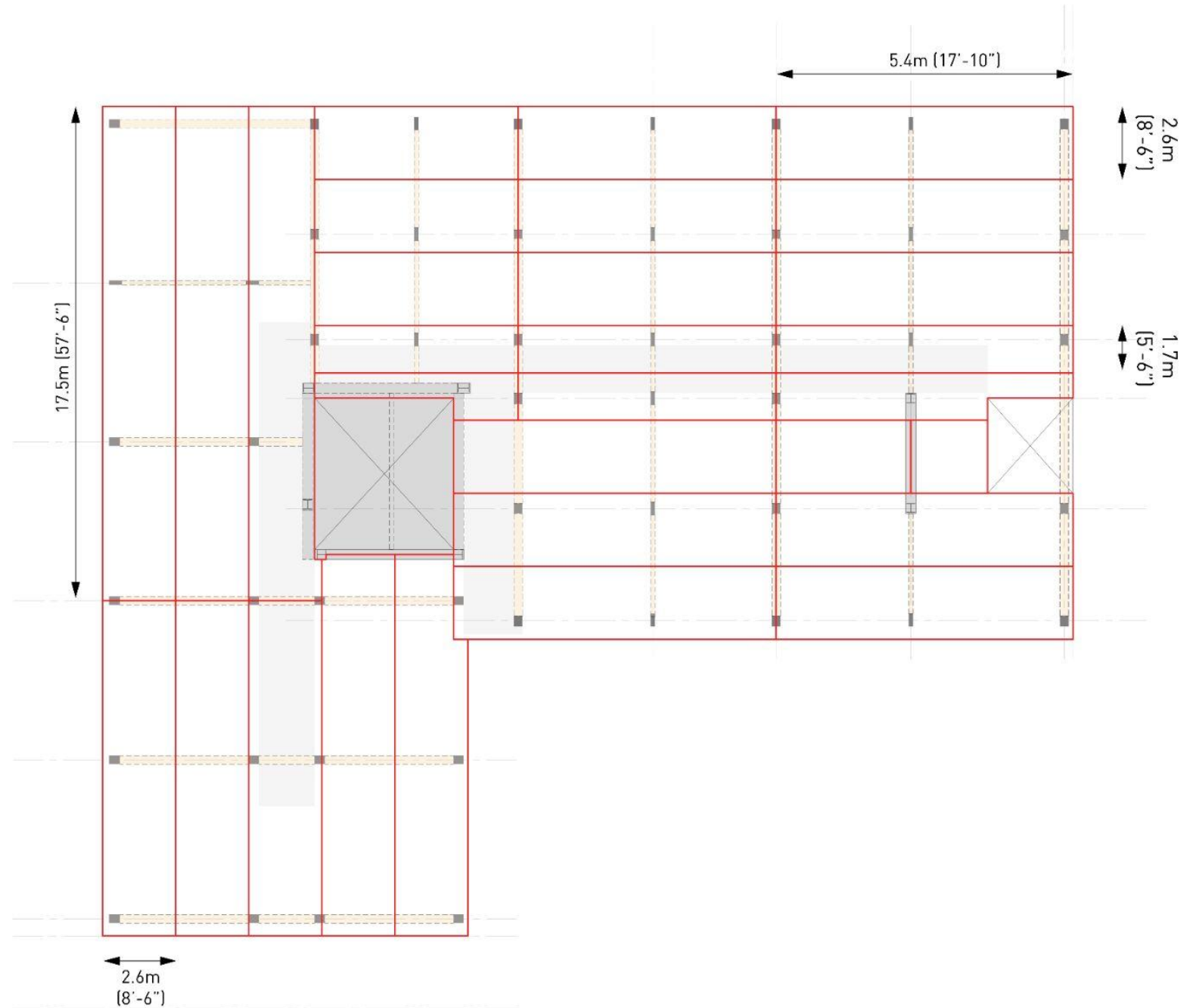
# RESTRICTIONS

## HEARTWOOD

### CLT Deck Layout [Typical Plan]

#### NOTES

- Building design does not achieve optimal grid size for structural efficiency - unit layout and count to meet developer pro-forma superceeded
- CLT panel layout was optimized to make use of maximum panel lengths where possible to minimize transportation costs (from Kalesnikoff - BC) & crane/installation speed on site
- Post & beam system allows for overhang of CLT decks at building perimeter to provide bearing for exterior frame walls while keep edge posts exposed



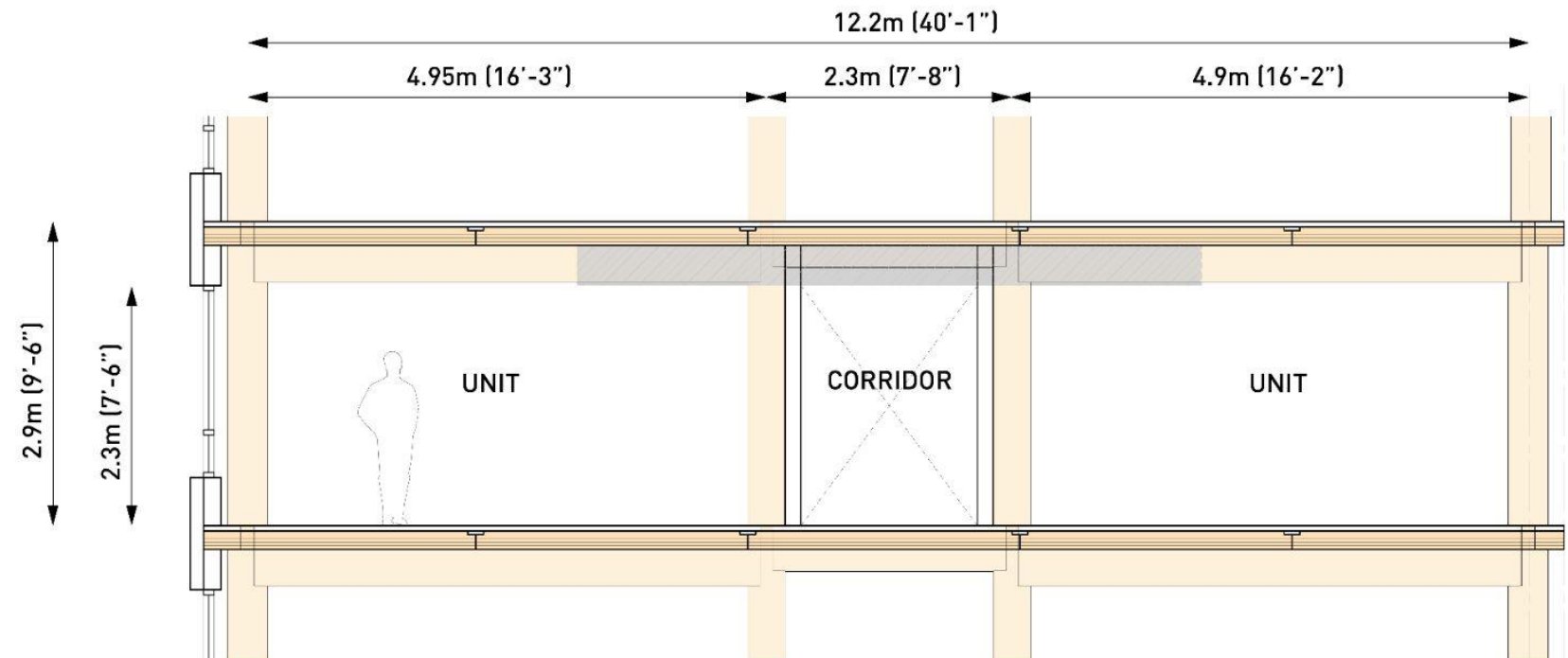
# RESTRICTIONS

## HEARTWOOD

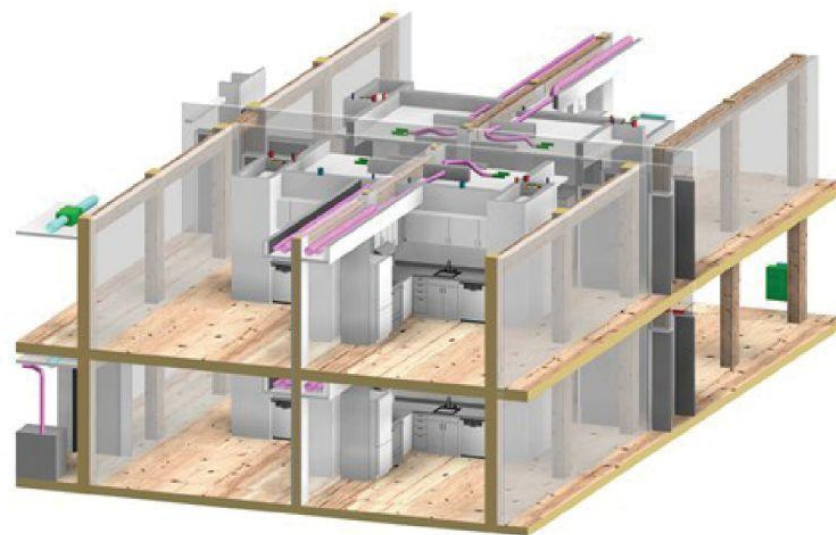
### Building Section

#### NOTES

- Design of units and advancement of BIM coordination with MEP and Structural teams reduced the amount of concealed spaces required to serve each unit and maximized the amount of exposed wood in the units
- Shallow beam at mid-span/corridor provides zone for routing of ducts/pipe without compromising clear height



01 Typical Floor-to-Floor Condition



02 Axonometric of MEP Coordination (drawing by Atelier Jones Architect)



03 Site Photo of post-beam + deck installation

# INNOVATIONS

## THE BLACK & WHITE BUILDING



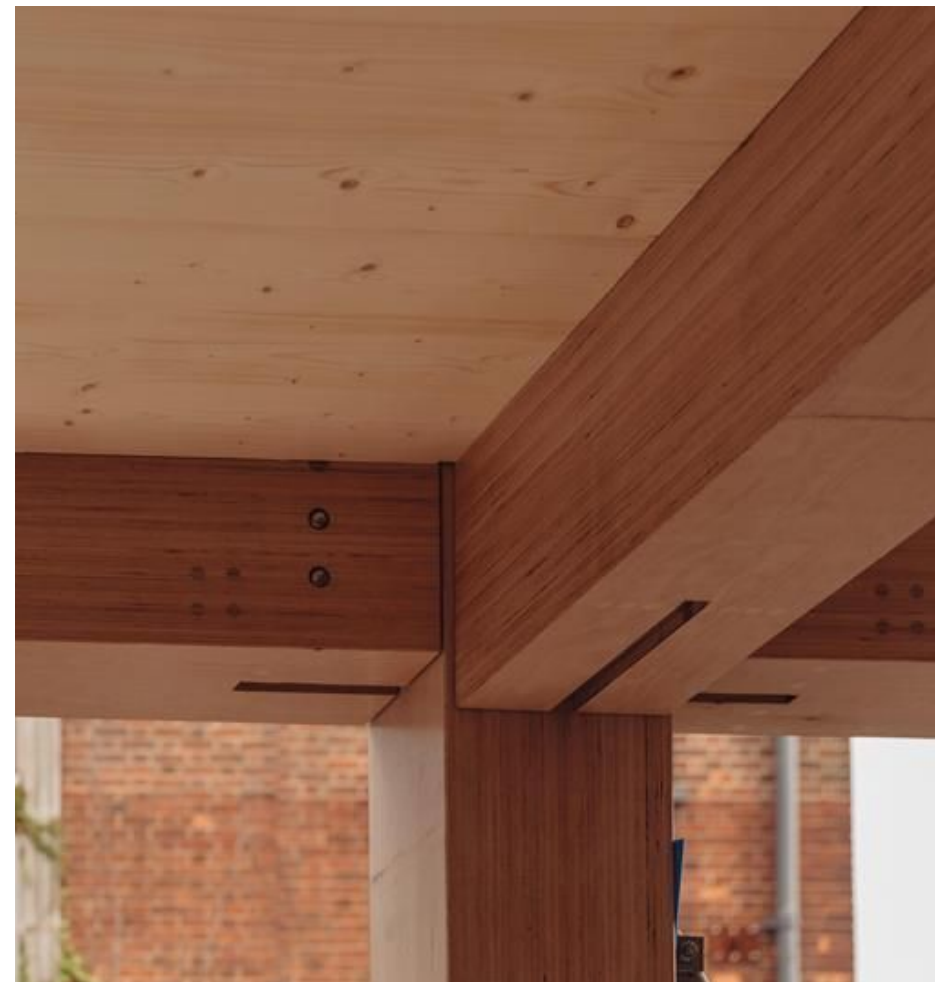
There's less than a tonne of steel in the whole thing, 13,000 screws hold up the buildings.

<https://www.ft.com/content/b58b6690-20d4-4628-8e90-845df601d8c0>

### Minimise the depth of the beam:

Crucially for an office, and unlike glulam, BauBuche can have notches cut into it for service runs, further reducing the space needed for services.

<https://www.building.co.uk/buildings/the-new-black-and-white-building-a-clear-case-for-timber/5115027.article>

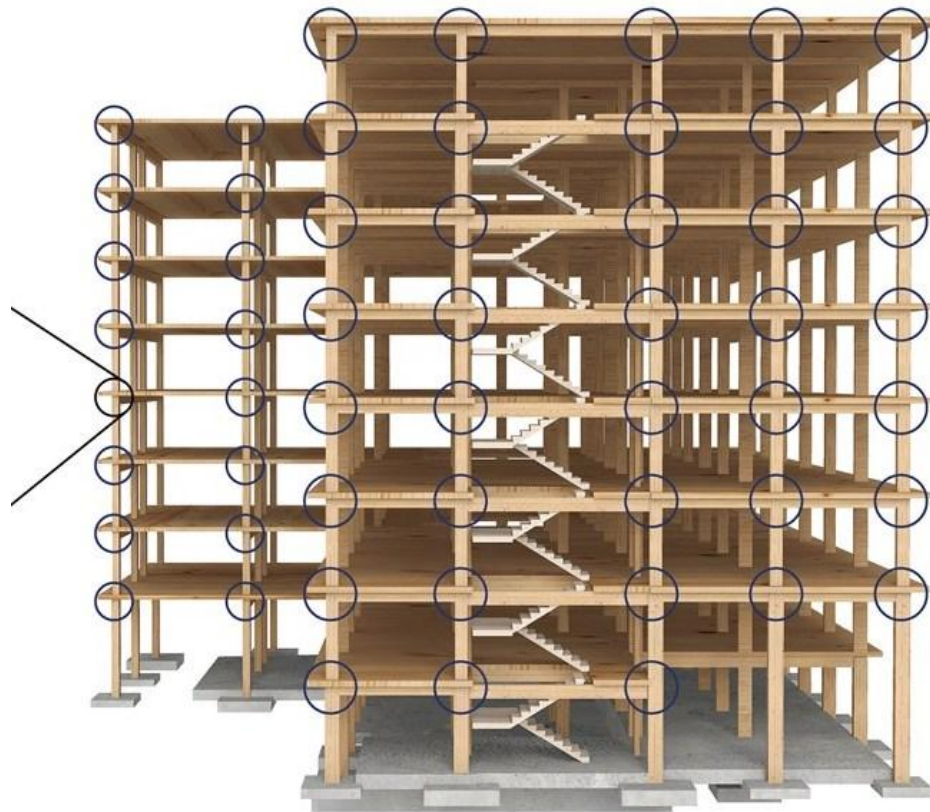


# INNOVATIONS

## HEARTWOOD

### PROOF OF CONCEPT WOOD-TO-WOOD 2HR FIRE RATED JOINT

- The all-wood connection eliminates carbon intensive and expensive steel connections at 410 instances of this critical joint, saving an estimated 11% of the overall structural package cost
- Intumescent tape was placed into CNC routed recesses in glulam columns and beams, thereby advancing wood prefabrication technologies during off-site fabrication in order to expedite on-site assembly

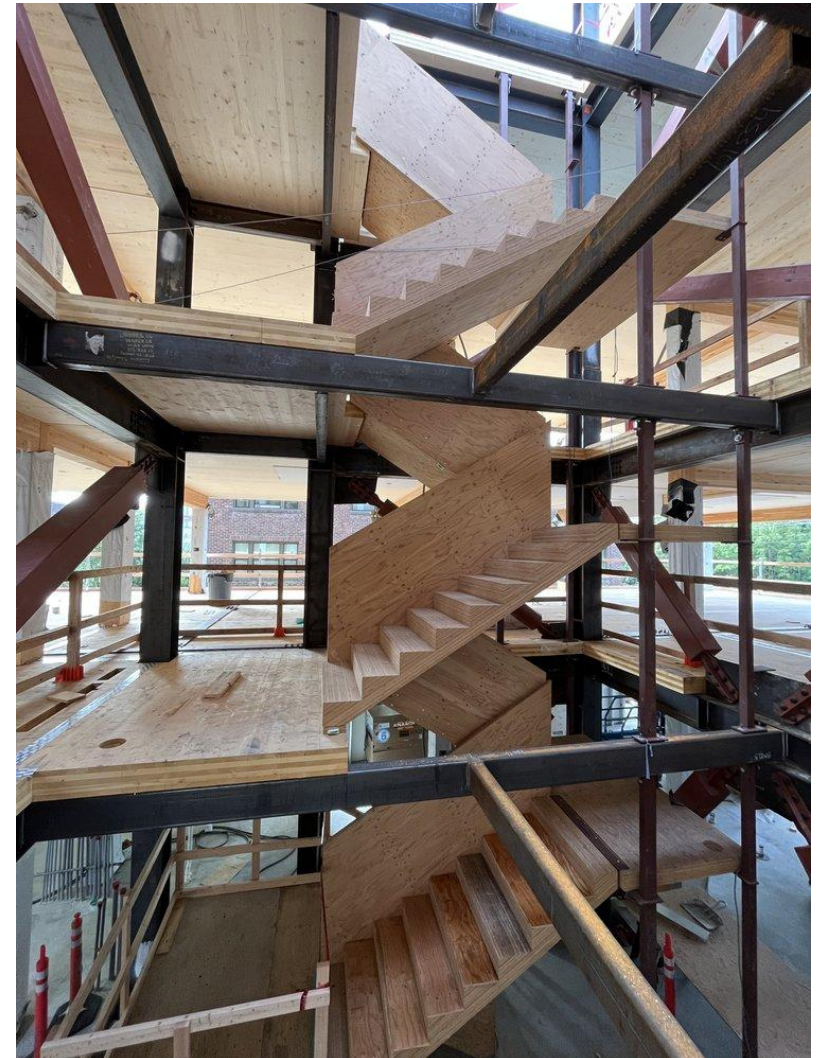
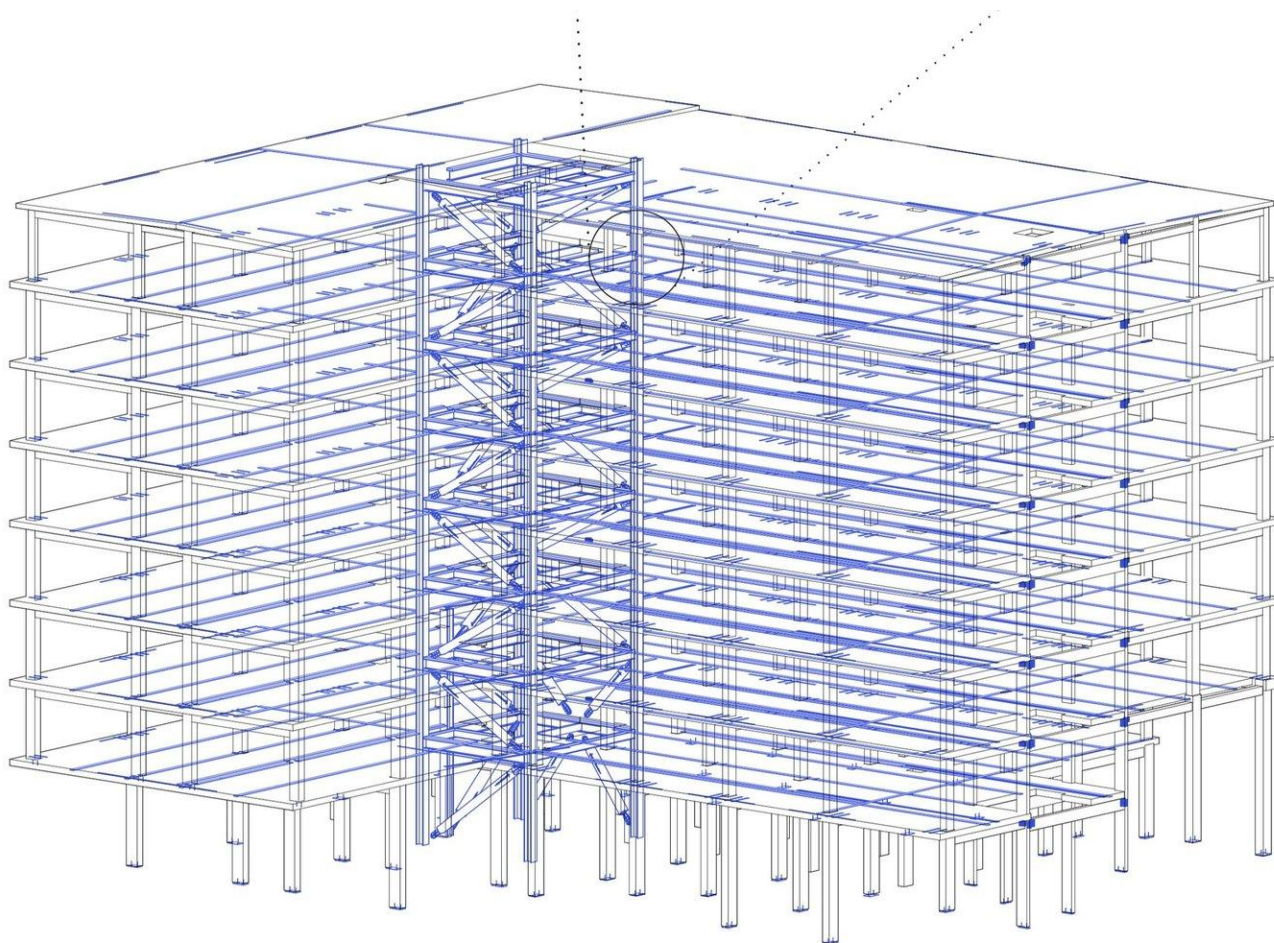


# INNOVATIONS

## HEARTWOOD

### STEEL BRACED FRAME & DRAG STRUT LATERAL SYSTEM

- The superstructure consists of prefabricated mass timber carrying the gravity loads with a steel BRB (buckling restrained braced) frame core and steel drag struts on a concrete slab-on-grade and grade beam foundation. The prefabricated steel BRBs provide the necessary lateral support for the building sited in the seismically-rich PNW region.
- The volume of wood is approx. 3.5 times the volume of concrete and steel combined



# SOURCES

## **THE BLACK & WHITE BUILDING:**

<https://waughthistleton.com/black-white-building/>

<https://www.eocengineers.com/building-magazine-the-new-black-white-building-a-clear-case-for-timber/>

<https://www.youtube.com/watch?v=2zPZBL46CfY>

<https://www.youtube.com/watch?v=o00cHkJR2ik>

<https://www.building.co.uk/buildings/the-new-black-and-white-building-a-clear-case-for-timber/5115027.article>

## **HEARTWOOD:**

<https://timberlab.com/projects/heartwood>

<https://swinerton.com/project/heartwood/>