Image source: Architectus

Barker College Maths Hub

Excellence in Timber Design
Commercial Buildings

Kieran Hayes

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CPEng MIEAust NER, Passiv Haus Designer

XLAM™

Project team

Client: Barker College

Architect: architectus

Builder: Buildcorp

Structural Engineer: TTW Taylor Thomson Whitting

CLT Supplier: XLAM

Glulam Supplier: HESS

Mass Timber Installer: SAVCON


Image source: TTW

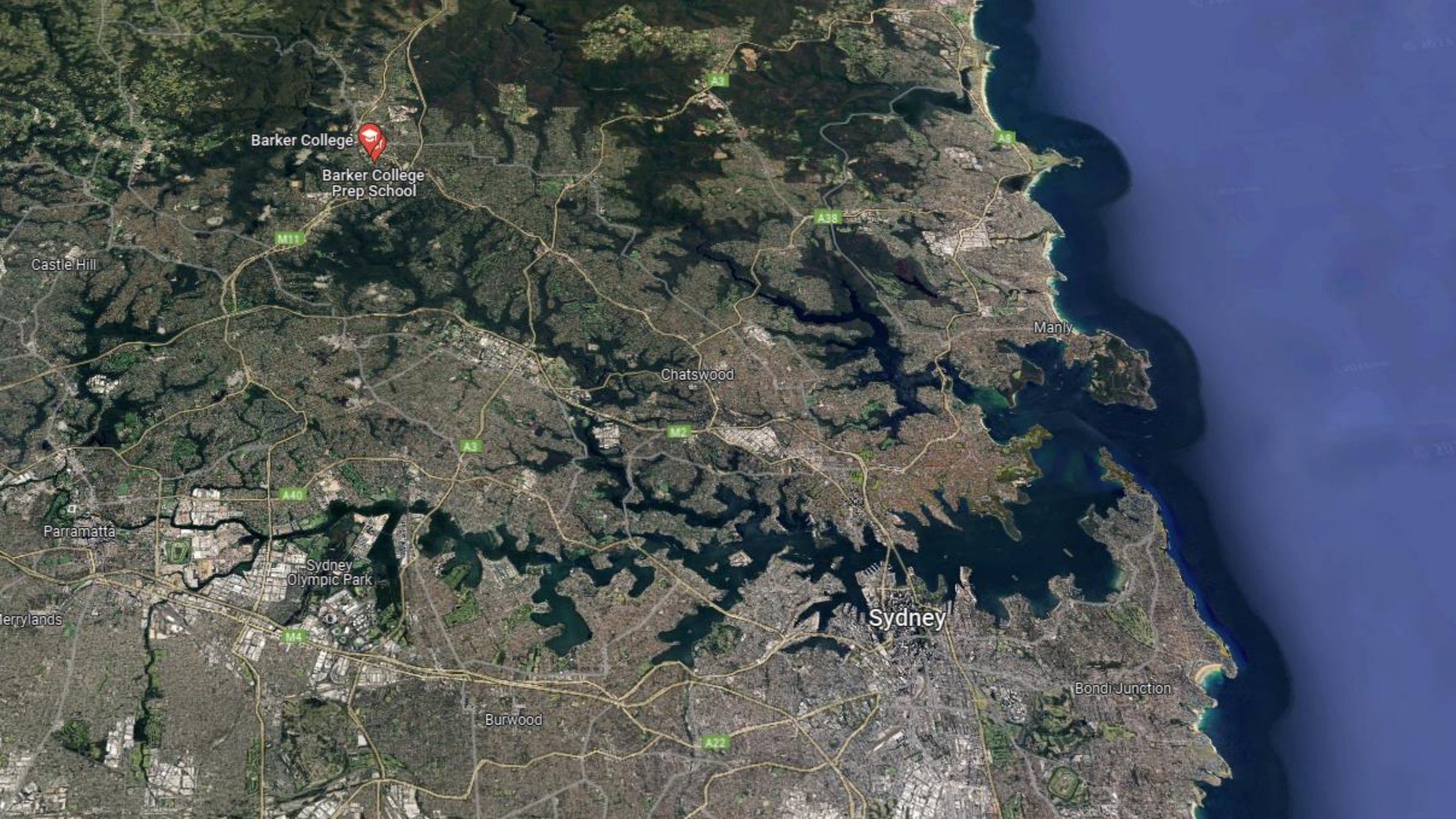

Barker College
Barker College Prep School
Castle Hill
Chatswood
Manly
Parramatta
Sydney Olympic Park
Sydney
Bondi Junction
Burwood
M11
A3
A38
M2
A40
M4
A22

Image source: HESS

The building’s drawcards include;

- A Dining Commons
- Shaded boardwalk for meals and gatherings,
- A Maths Courtyard for outdoor learning,
- And breakout spaces for student-led small group activities.

Structural materials

- Concrete GF and Level 1
  - Driven by durability requirements and transfer beam
- Mass Timber Level 2 and Roof including bracing and core

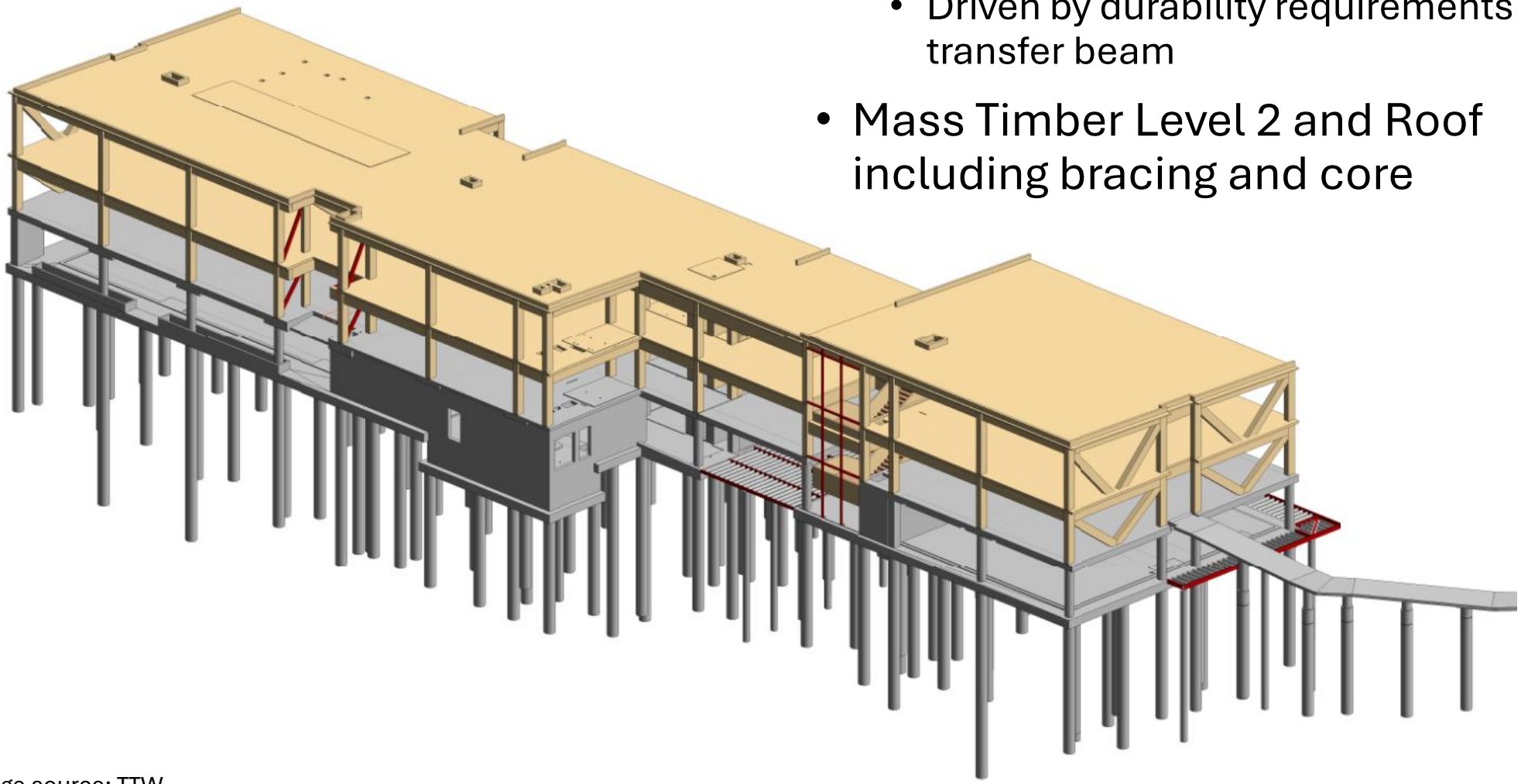


Image source: TTW

Building features

- A contemporary geometric façade expresses the language of mathematics
- An indigenous artwork above the main entrance is illuminated in the evening like the night sky
- The timber structure is exposed from within, deepening the connection to nature while reducing the building’s carbon footprint.

Image source: Barker College

Origin of timber

Architectus proposed a hybrid timber framed building at concept stage which established themselves with a point of difference

Biophillia

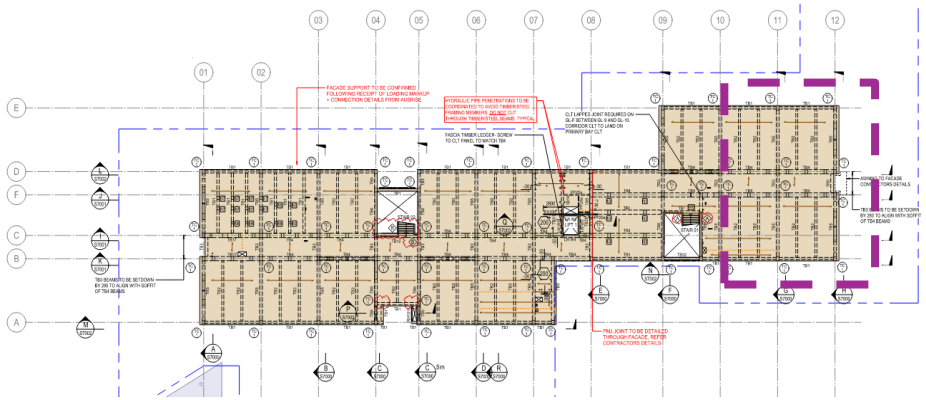
The architecture is designed to bring the benefits of biophilia to the school community

Sustainability

- “**26% reduction in upfront carbon** compared to a concrete framed building
- **Reduction of 1,092TC02eq**, which can be likened to that produced by 130 homes annually,” Stephen Surjan, Buildcorp

Image source: Architectus

Structural floor system



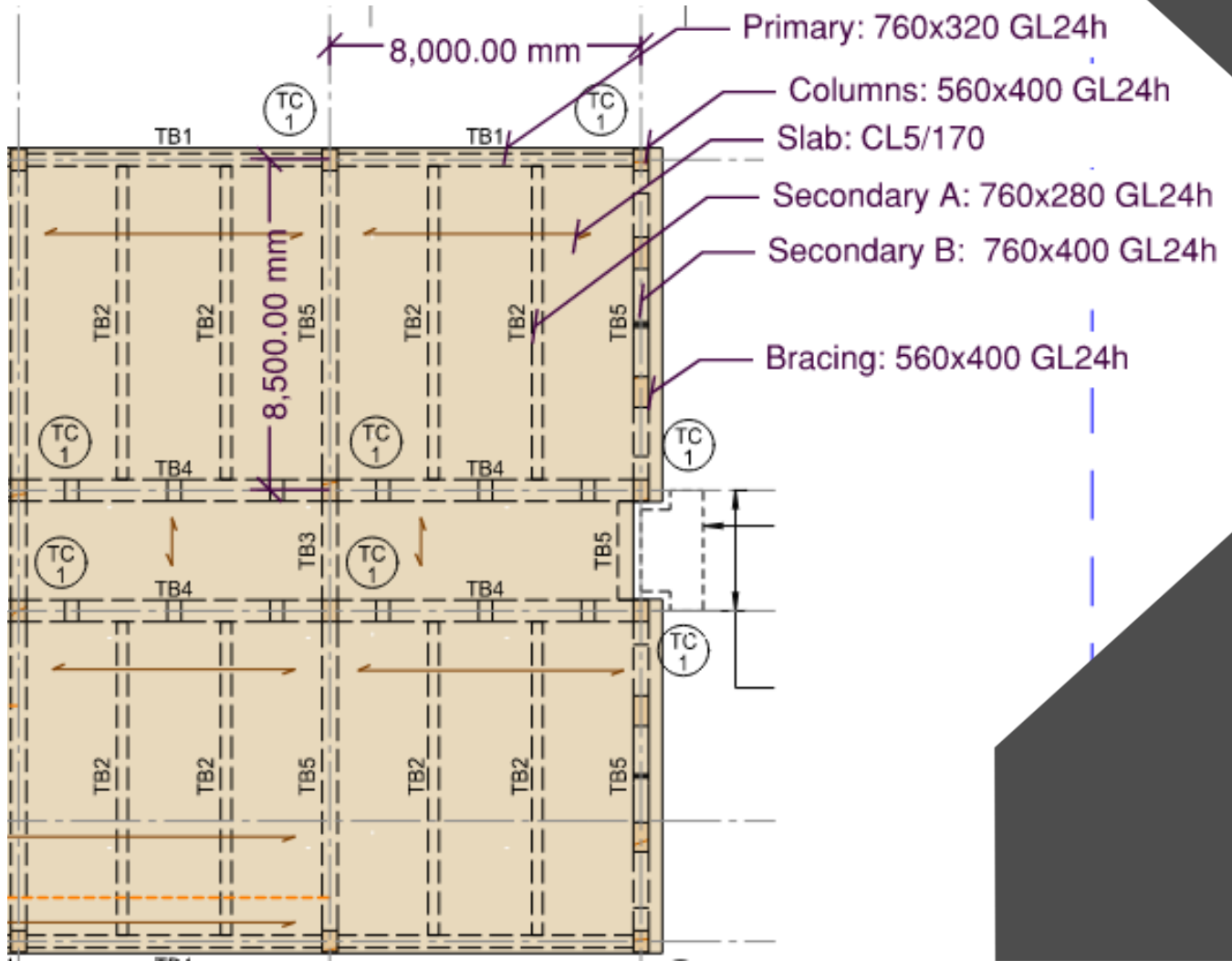


Image source: TTW

Structural system – lateral

- Complex shape required a detailed lateral design

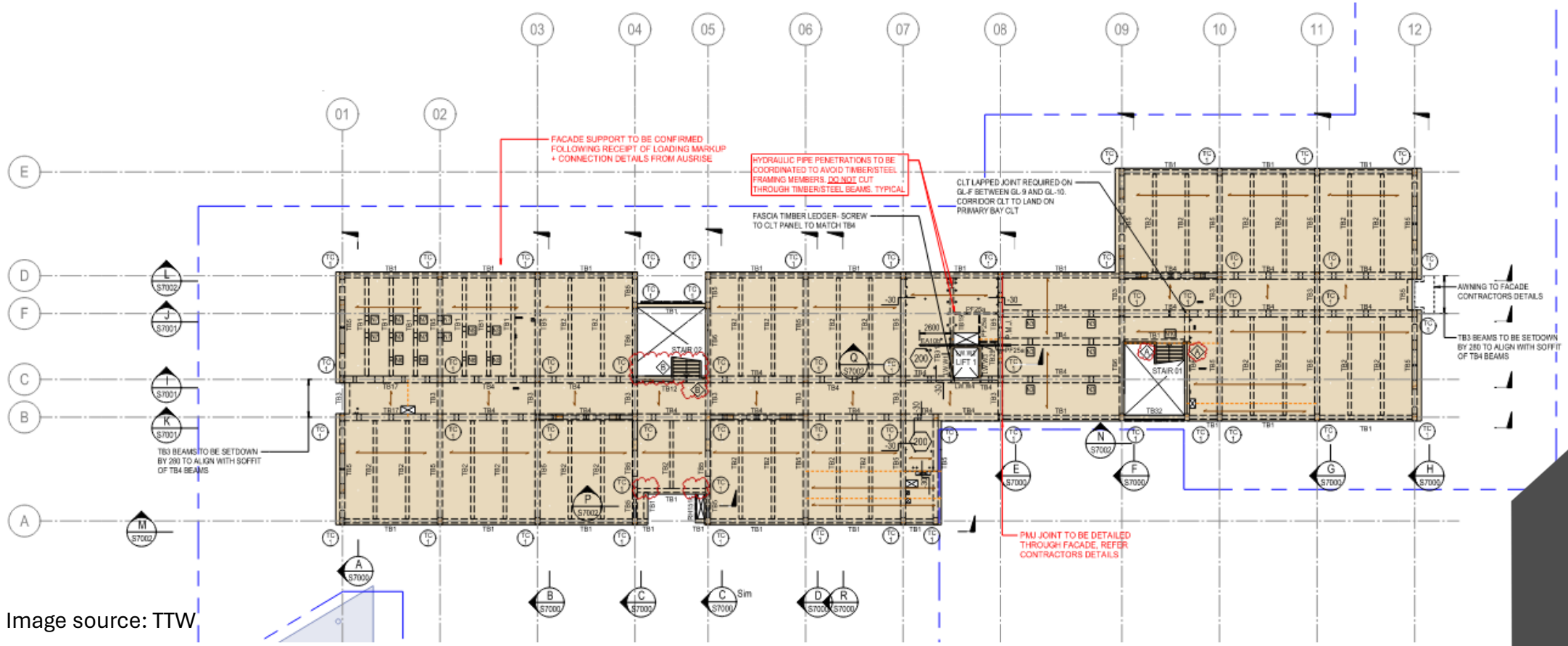


Image source: TTW

Stairs – Architectural and structural

Image unavailable for publish

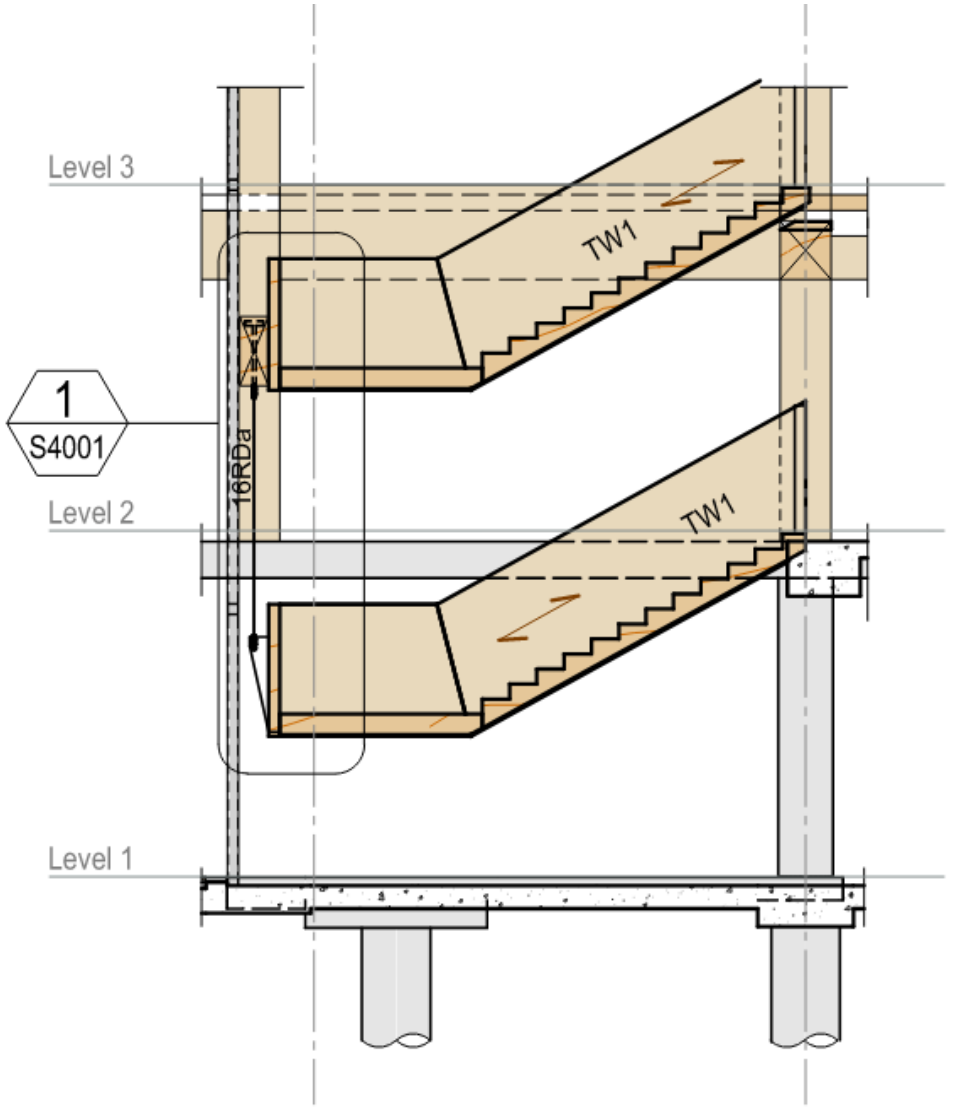
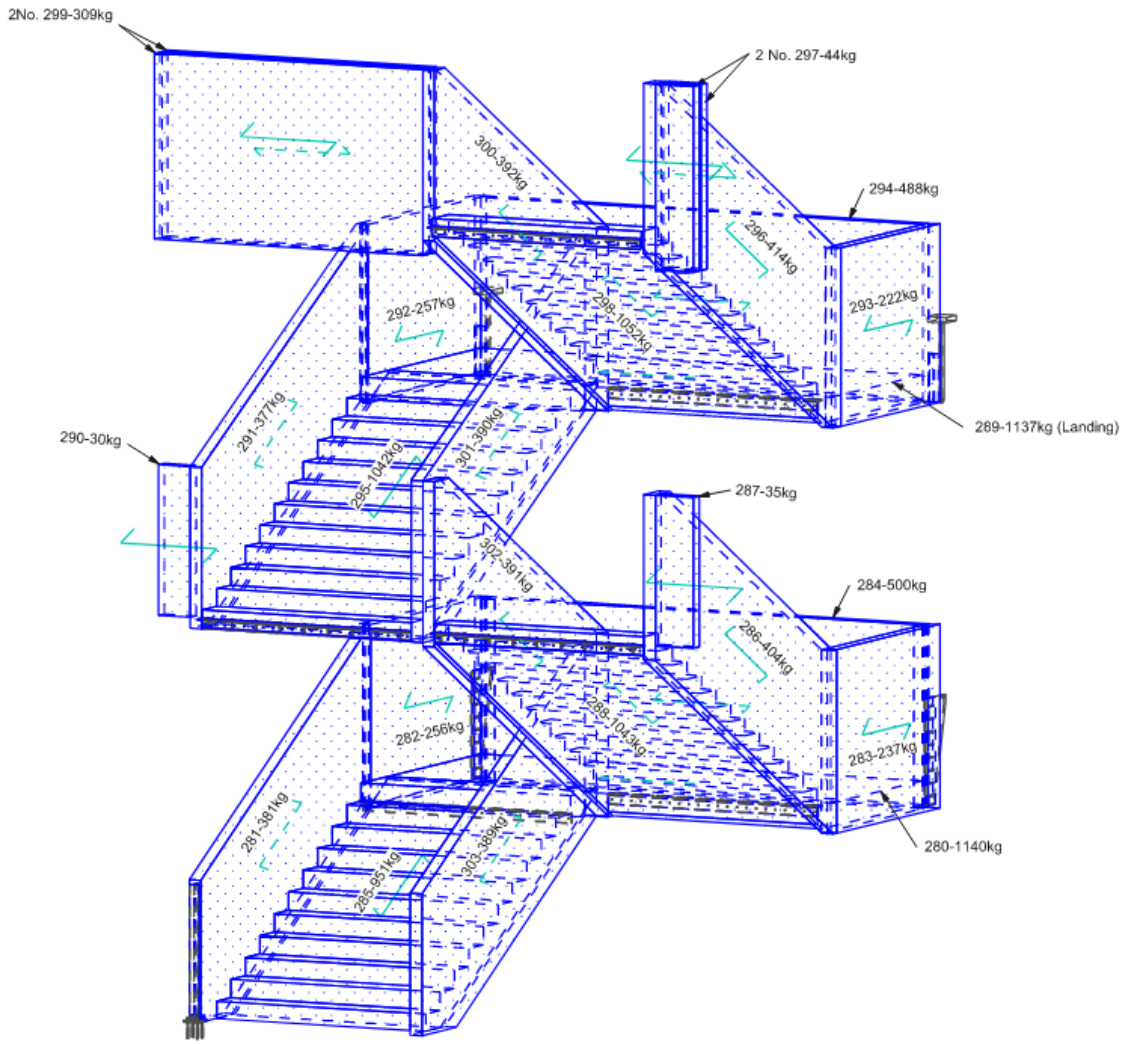


Image source: TTW

Stairs - XLAM shop drawing



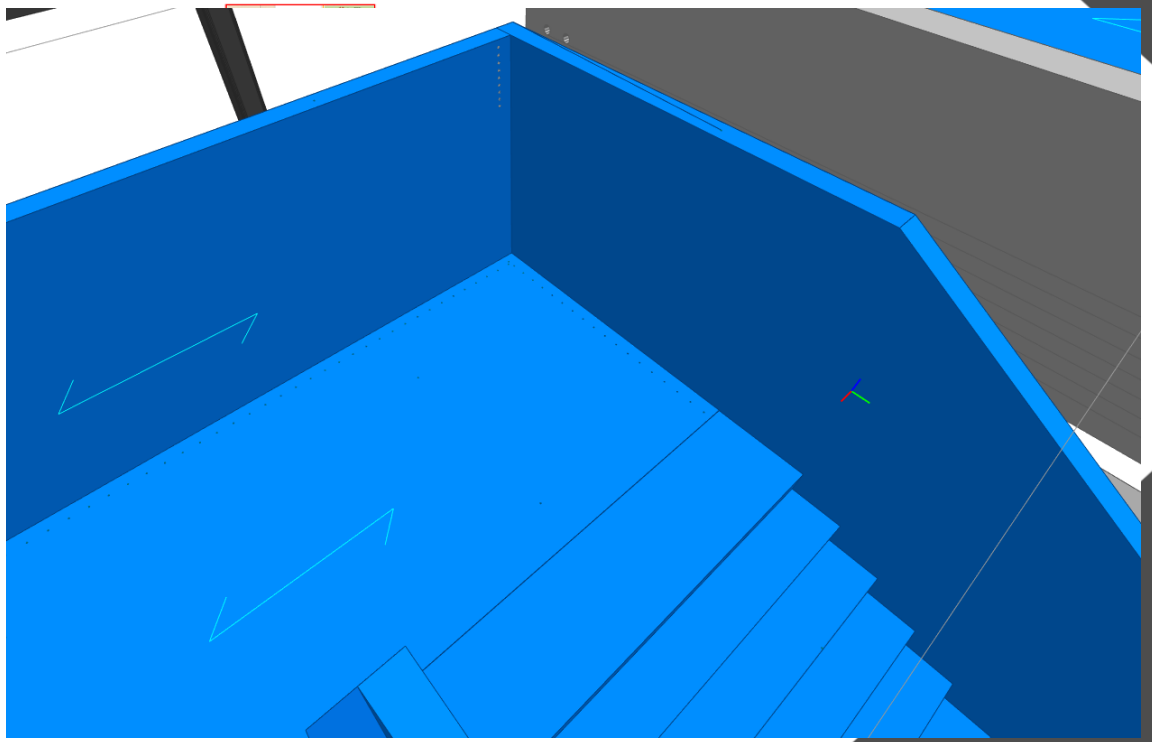


Image source: XLAM

Stairs: Savcon installation

Image source: Savcon

Image source: Architectus

Supply - Glulam

- Wood species: Spruce
- Volume: 600 m^3 glued laminated timber
- Scope of Services: Planning, Production, Component Delivery
- Transported in 40-foot containers
- Glulam was pre-coated at the factory
- And most of the necessary steel parts have already been assembled.

Supply - CLT

- The **473.9m3 of CLT** used on Barker College Maths Hub Shores was sourced from PEFC certified, sustainable softwood plantations in Southern NSW, Australia and can be **regrown in 44 minutes**. 1*
- XLAM CLT is Declare certified as being **Red List free**, free from adhesive polyurethane formaldehyde and 100% recyclable at the end of life. 4*
- XLAM CLT **panels are optimised by feedstock** strength across their depth, using stronger MGP10 timber in the outer lamellas and lower strength MGP6 timber in the internal layers.
- The feedstock for XLAM CLT is cut by Hyne at their Tumbarumba mill, and the CLT is manufactured at XLAM's factory in Barnawartha. Both companies are a **great supporter of regional employment**, with over 608 people employed across Hyne's 10 sites. On top of that, every direct job at our regional sites supports a further 2 jobs in the local community. 5*

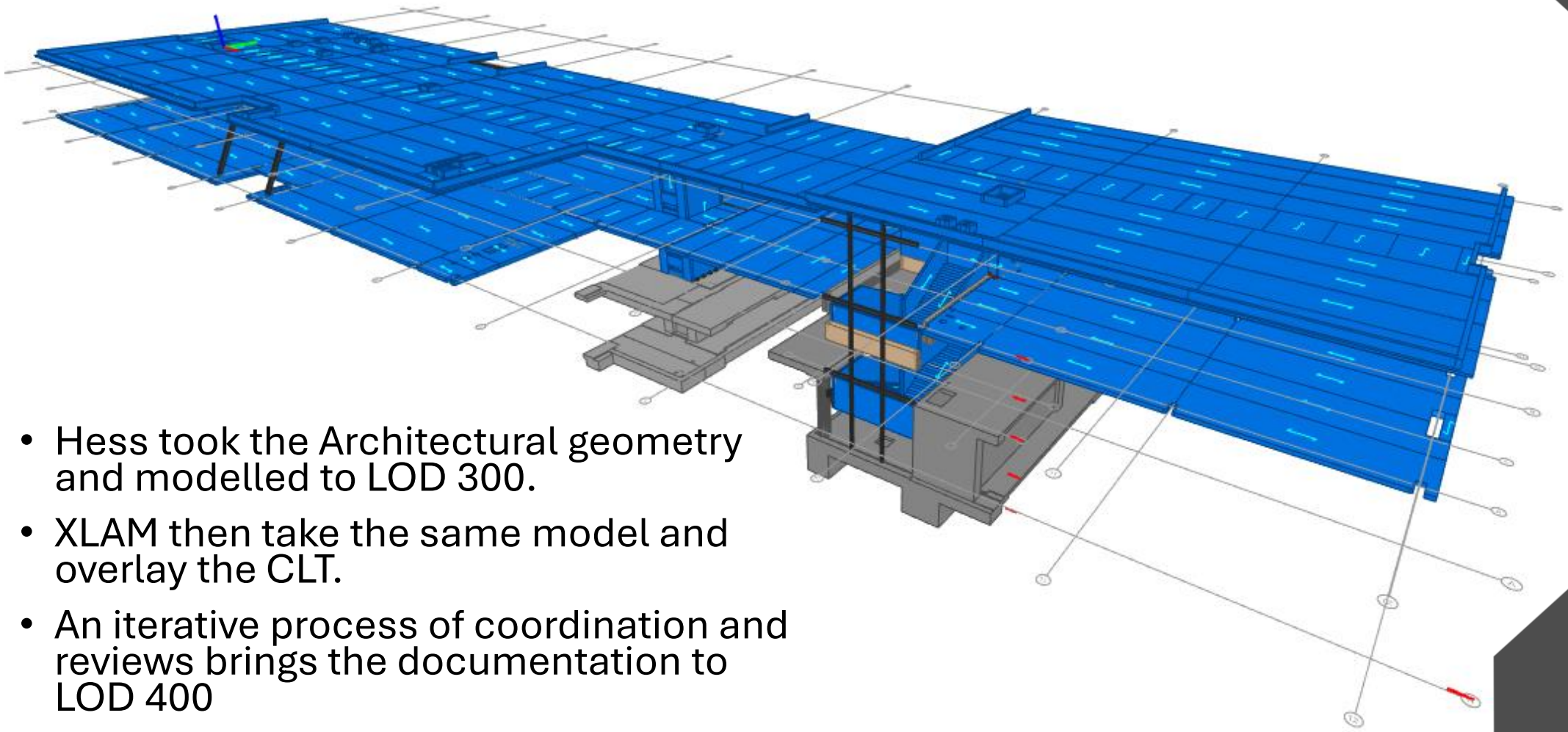
Feasibility & Advisory

Design & Engineering

Planning & Permits

Logistics, Installation & Onsite

Shop drawing CLT



- Hess took the Architectural geometry and modelled to LOD 300.
- XLAM then take the same model and overlay the CLT.
- An iterative process of coordination and reviews brings the documentation to LOD 400
- This model feeds the CNC

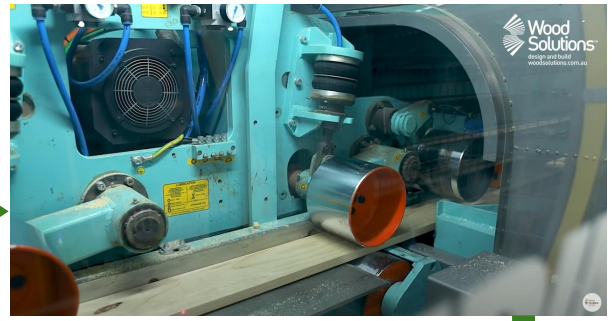
Image source: XLAM


DFMA

How is CLT is made

Image source: XLAM

Summary of CLT manufacture process



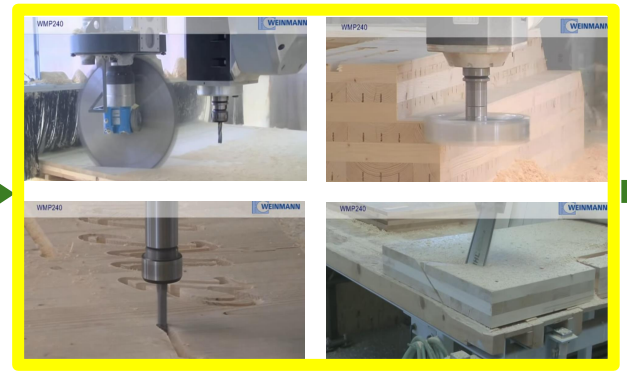
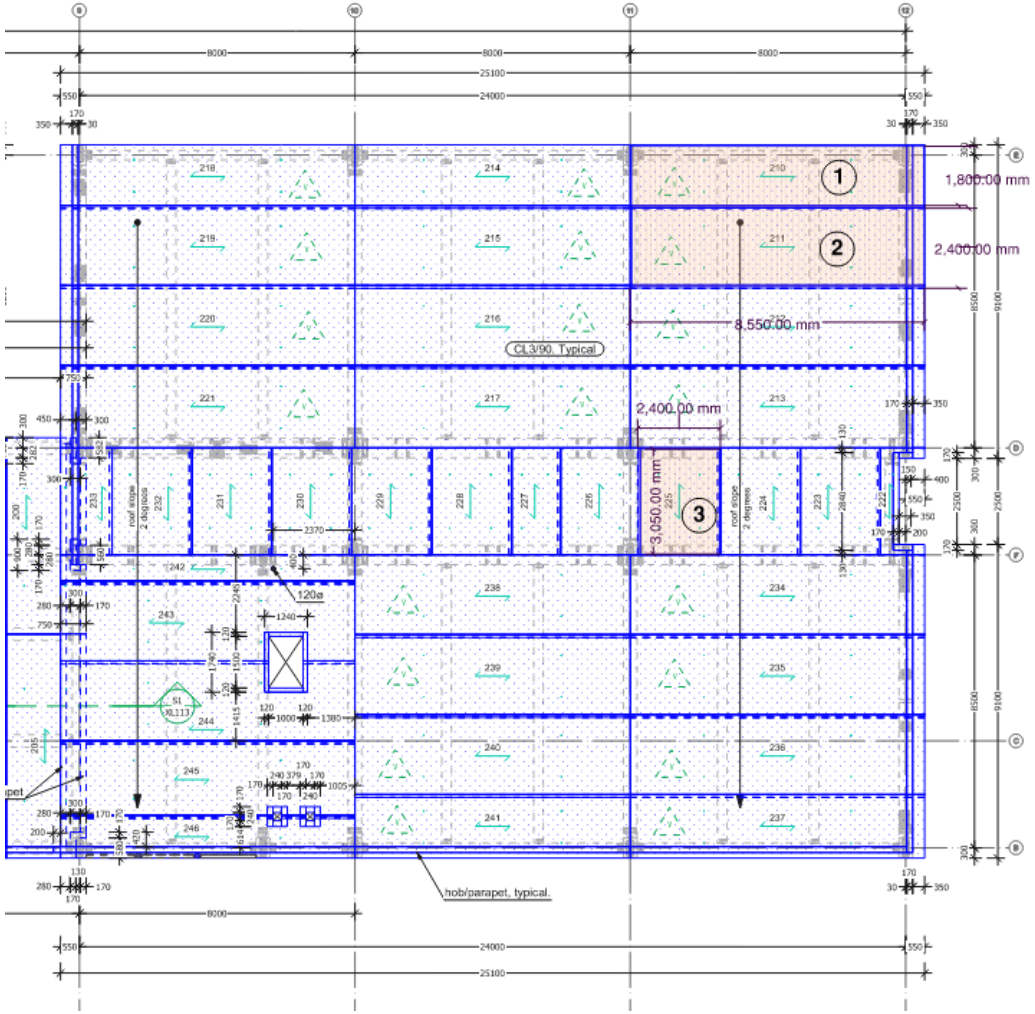
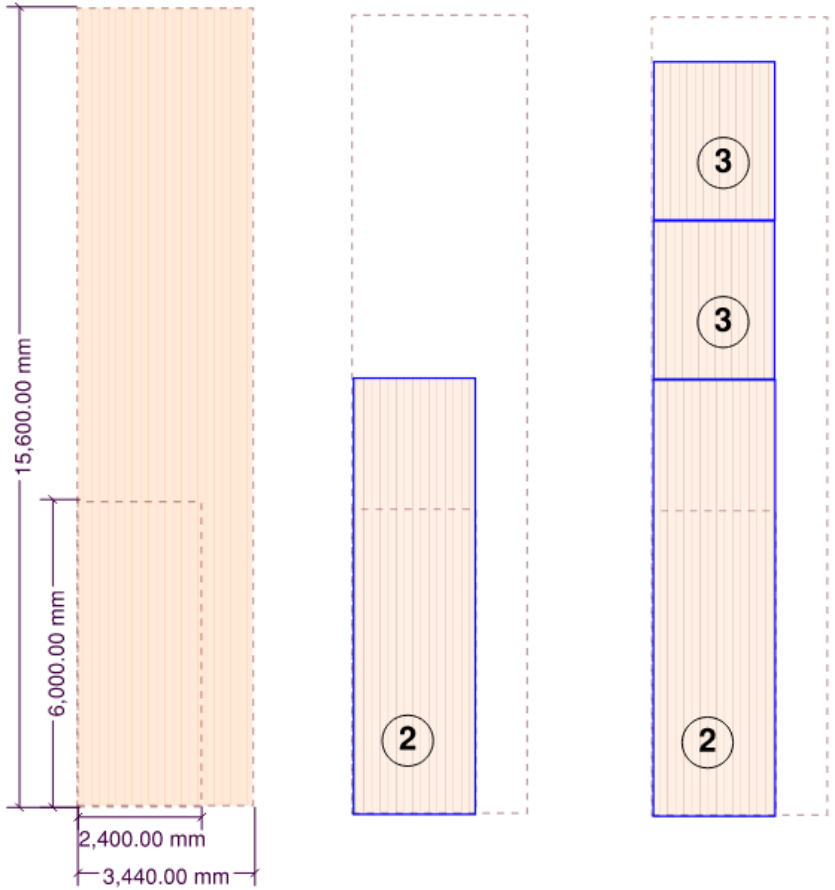


Image source: XLAM

Manufacture efficiencies

Waste = 5%
Billet efficiency = 36%



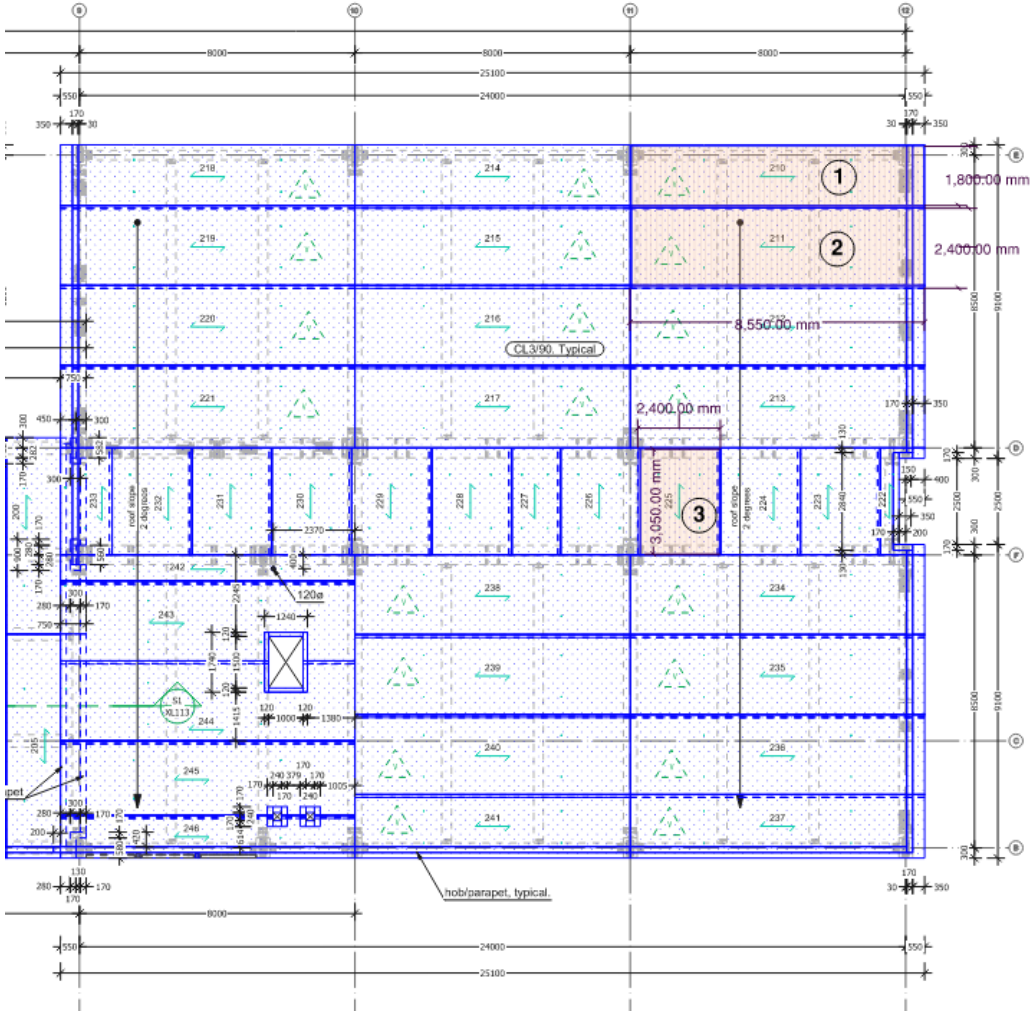


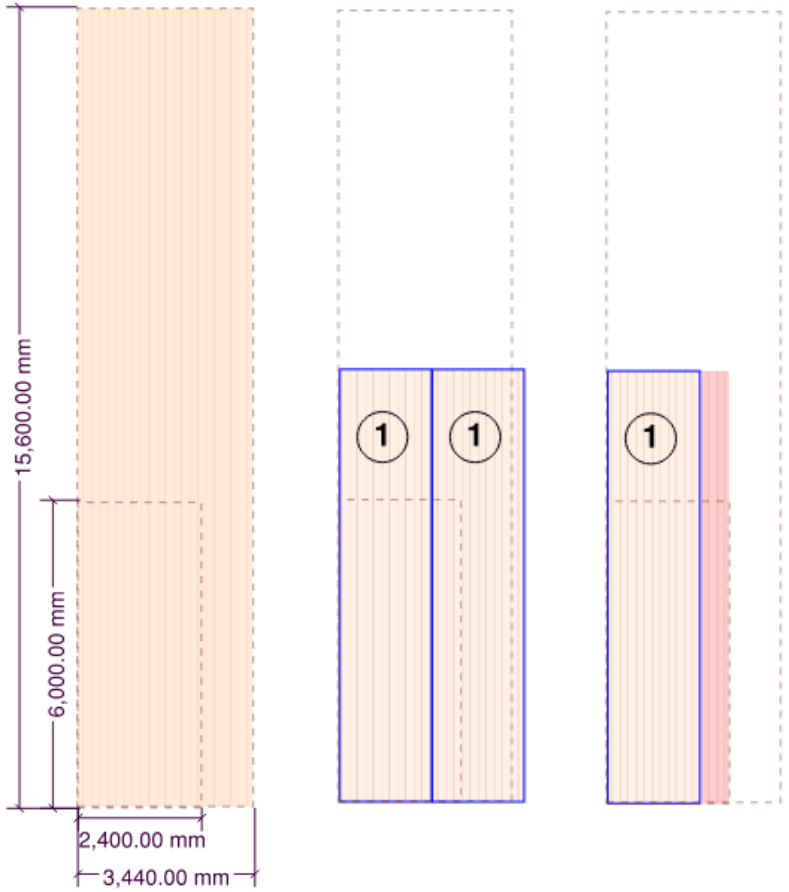
Waste = 4%
Billet efficiency = 63%

- Big panels = *less billets, less lifts, less QA checks, lower cost*

Image source: XLAM

Manufacture efficiencies





Waste = 27%
Billet efficiency = 26%

*Note – nesting of panels is shown as an example only and not representative of the actual panelisation for Barker College Maths Hub.

Image source: XLAM

Manufacture efficiencies – CNC

- Understand tooling = *Cut to +- 2mm tolerance*
  - Pre-drilling can't be performed at an angle
  - At Barker college they could only drill a 6mm diameter pilot hole, 5mm deep as a starting point
- Avoid panel flipping = *20 minutes per flip*

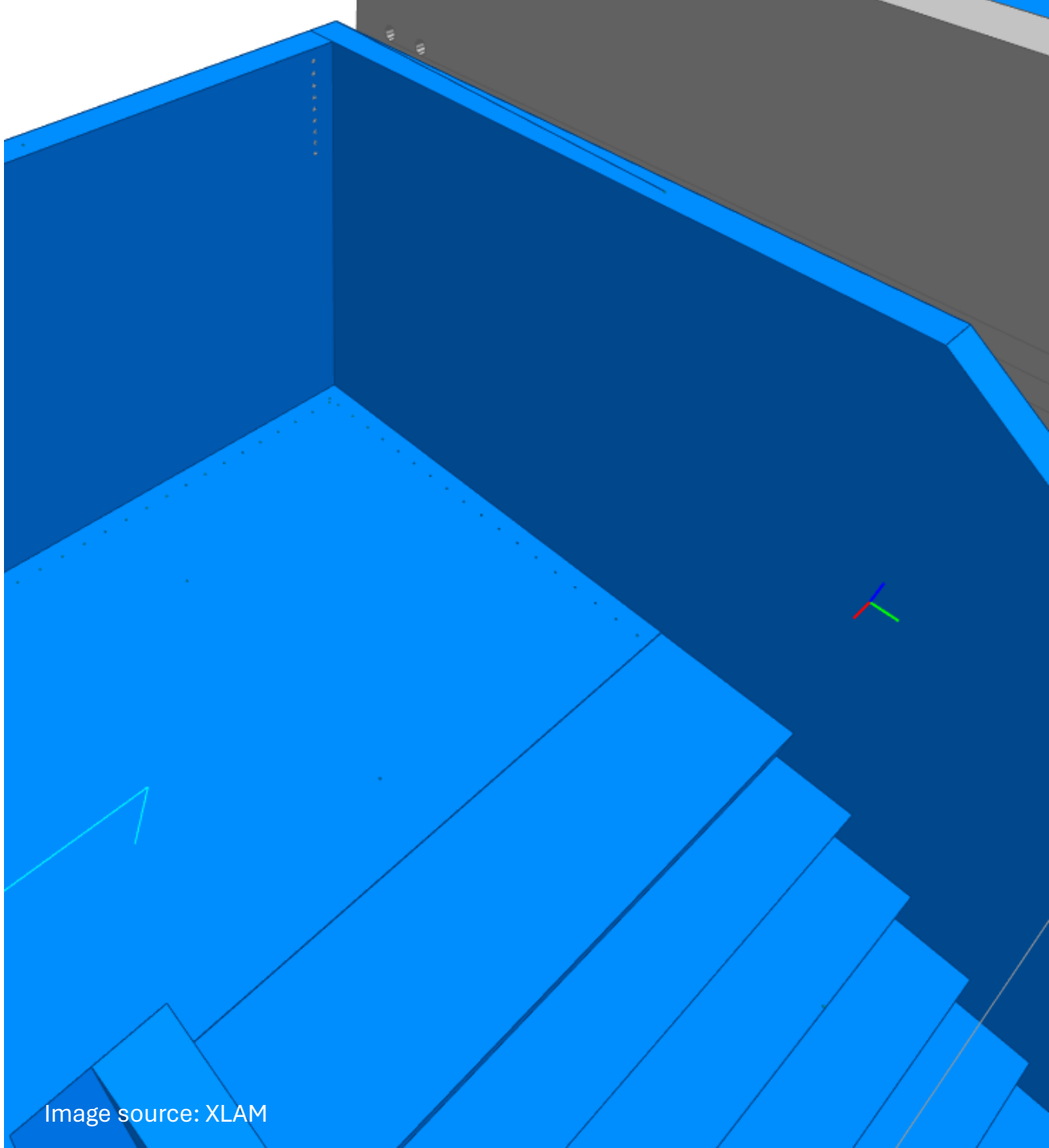


Image source: XLAM

Shop drawing - transportation

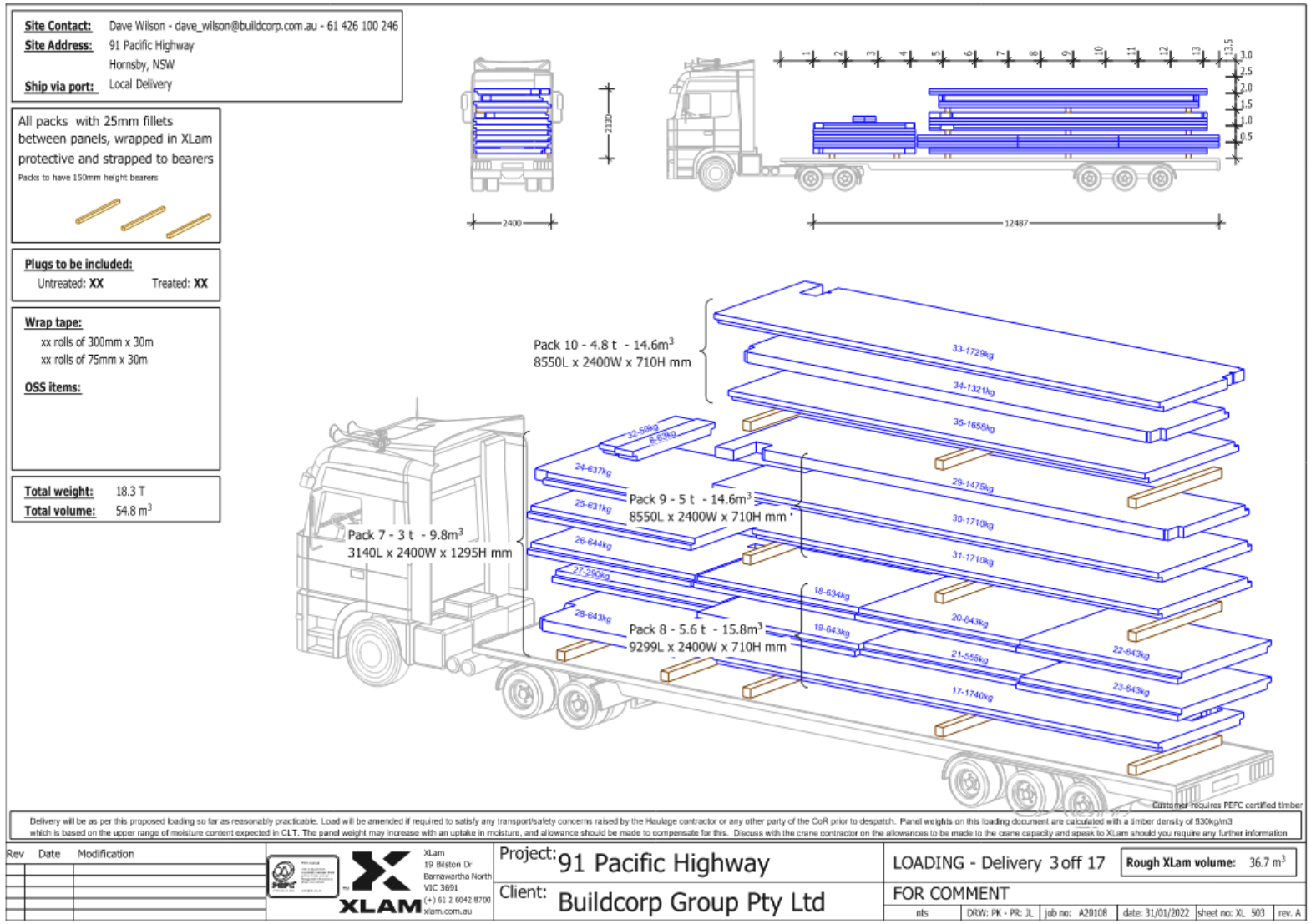


Image source: XLAM

Designing for transport

- Understand transport limitations of your route
- Overseas shipping constrained by container sizes
- Within Australia, larger panels are generally still more cost effective

Table 4 - Travel Times

Location	Day	Up to 3.1 m wide and/or 19.0 m long	Up to 3.1 m wide and/or 19.1 m - 22.0 m long	3.2 m - 3.5 m wide and/or 22.1 - 25.0 m long
Wharf Roads, Hume, Princes and Western **Freeways**	Any day	At all times	At all times	At all times
Rural Areas	Any day	At all times	At all times	Sunrise - sunset
Princes Highway through Geelong Urban Area	Any day	At all times	At all times	9.00 am - 4.00 pm 6.30 pm - 7.00am
Melbourne and Geelong Urban Areas	Monday - Friday (not public holidays)	At all times	9.00 am - 4.00 pm 6.30 pm - 7.00 am	9.00 am - 4.00 pm 6.30 pm - sunset 11.00 pm - 6.00 am
	Saturday, Sunday and public holidays	At all times	11.00 pm - sunset	11.00 pm - sunset

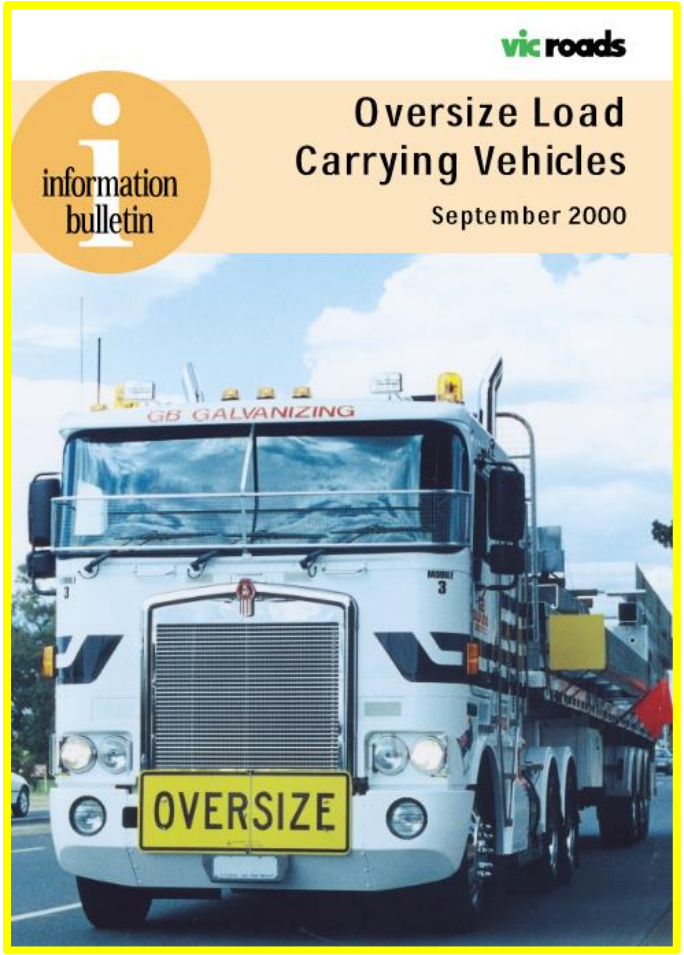


Image source: Vic Roads

Transportation – Barker College

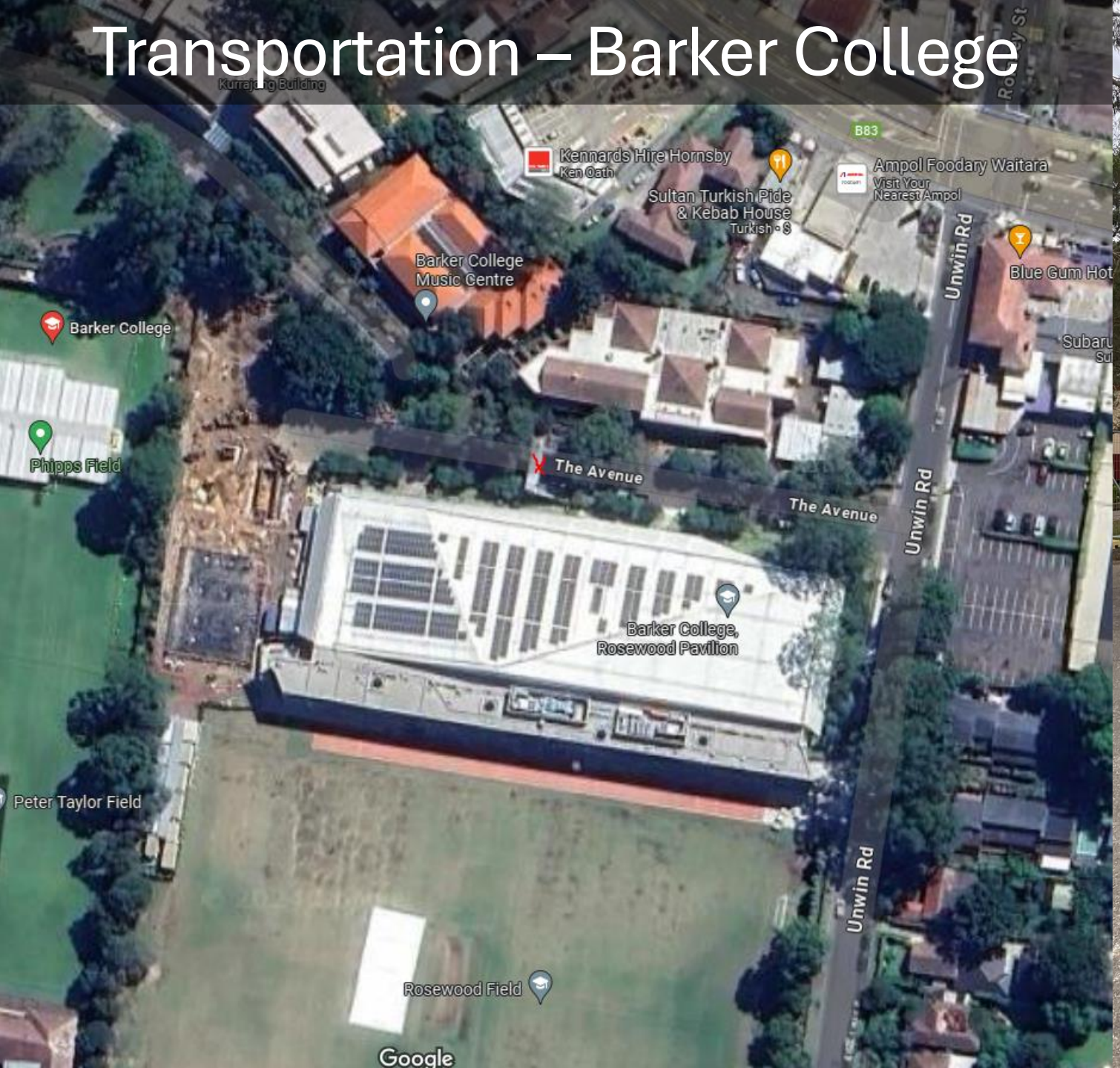


Image source: Savcon

Assembly

- The demanding lateral system required complex glulam connections
  - Big double knife plates and lots of bolts
  - Dowell connections were all prefabricated leaving only bolted connections on site
- Sequencing
  - The central section of the building had to be constructed first
  - Access was reasonably hard and therefore installation was relatively slow. But still completed in 11 weeks!
  - When panels start changing directions it gets harder
- Weather
  - There was a fair bit of rain but no moisture related issues for the timber
  - The roof was on a 2degree pitch and all joints were double taped.

Image source: Savcon

Image source: Savcon

Advanced Timber Construction Industry: A Review of 350 Multi-Storey Timber Projects

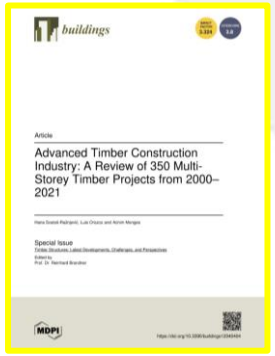
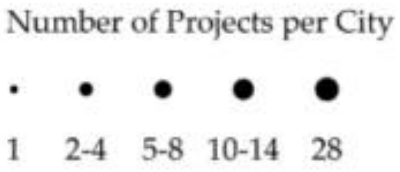


Image Source: Advanced Timber Construction Industry: A Review of 350 Multi-Storey Timber Projects from 2000–2021 by Hana Svatoš-Ražnjević



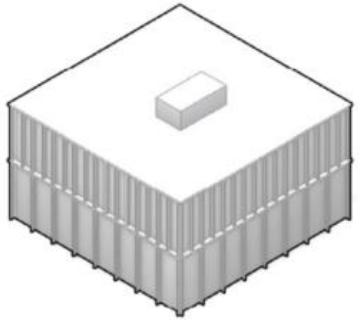
- Study of 350 contemporary multi-storey timber building projects from 2000 to 2021
- Assesses quantitative and qualitative data including structural system, material, program, massing, spatial organisation.
- Draws a parallel between architectural characterises and their relation to structural systems in timber

Review of 350 Multi-Storey Timber Projects

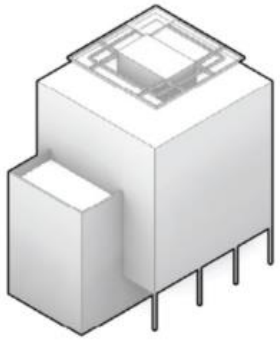
76.3%
ORTHOGONAL

19.7%
SEMI-ORTHOGONAL

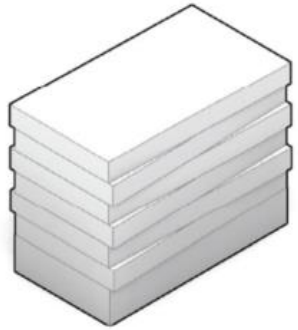
4%
OTHER



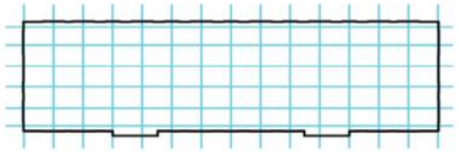
79.7%
REGULAR

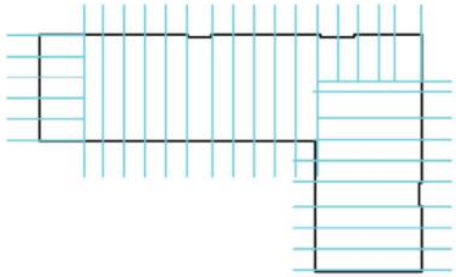


16.6%
INCREMENTAL HEIGHTS

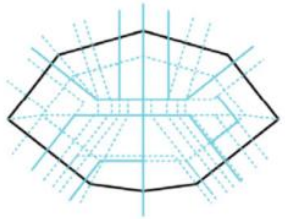


3.4%
FLOORPLATE VARIATIONS

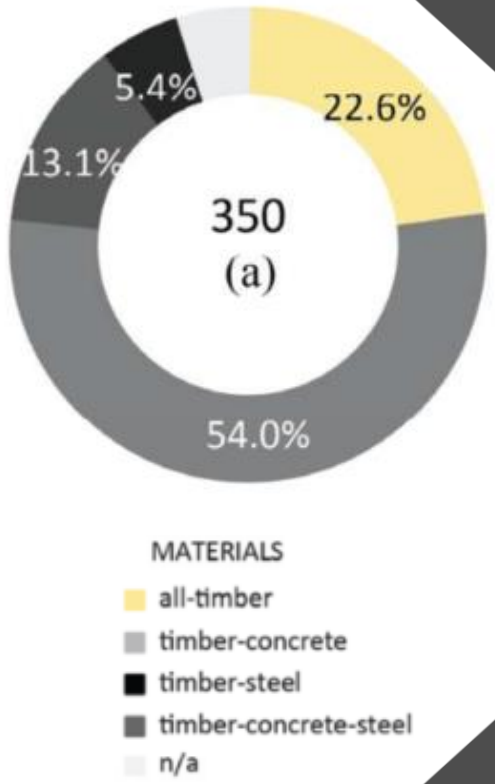




98.9%
GRID,
GRID-BASED, LINAR ARRAY



1.1%
IRREGULAR



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