NLT | Nail-Laminated Timber

something old, something new

StructureCraft

Brian Woudstra
Business Development Engineer

Session Description

The session will provide a general overview into mass timber construction, looking at the application of multiple engineered wood products as well as the particular use of NLT in the construction of North America's largest modern wooden structure - T3 Minneapolis, the next generation timber office building.

Also discussed will be North America's newest mast timber product, Dowel Laminated Timber (DLT): the only All-Wood mass timber product which can be used as pre-fabricated floor, wall, and roof elements. Unique to this mass timber product are the numerous possibilities for architectural refinements, acoustic and other machining profiles that are easily integrated directly into exposed surface of the panels.

This session will also cover pushing the limits and possibilities in tall wood construction, building engineering and technologies that are making pre-fabricated timber structures viable in terms of cost, efficiency and jobsite safety. Included will be the process involved in designing Framework, North America's tallest All-Wood CLT building at 12 stories with a special focus on its seismic test performance.

Learning Objectives

By attending this session, participants will learn about:

1. The design and construction of North America's largest modern wooden structure featuring the use of mass timber, and why wood was selected over traditional concrete and steel.

2. The design concepts featuring a variety of prefabricated mass timber products, including NLT, GLT and CLT, as well as Dowel Laminated Timber (DLT) - the latest mass timber product manufactured from all-wood products, without metal fasteners or resins.

3. Learn about the structural and fire performance of heavy timber elements and assemblies.

Who is StructureCraft?

StructureCraft

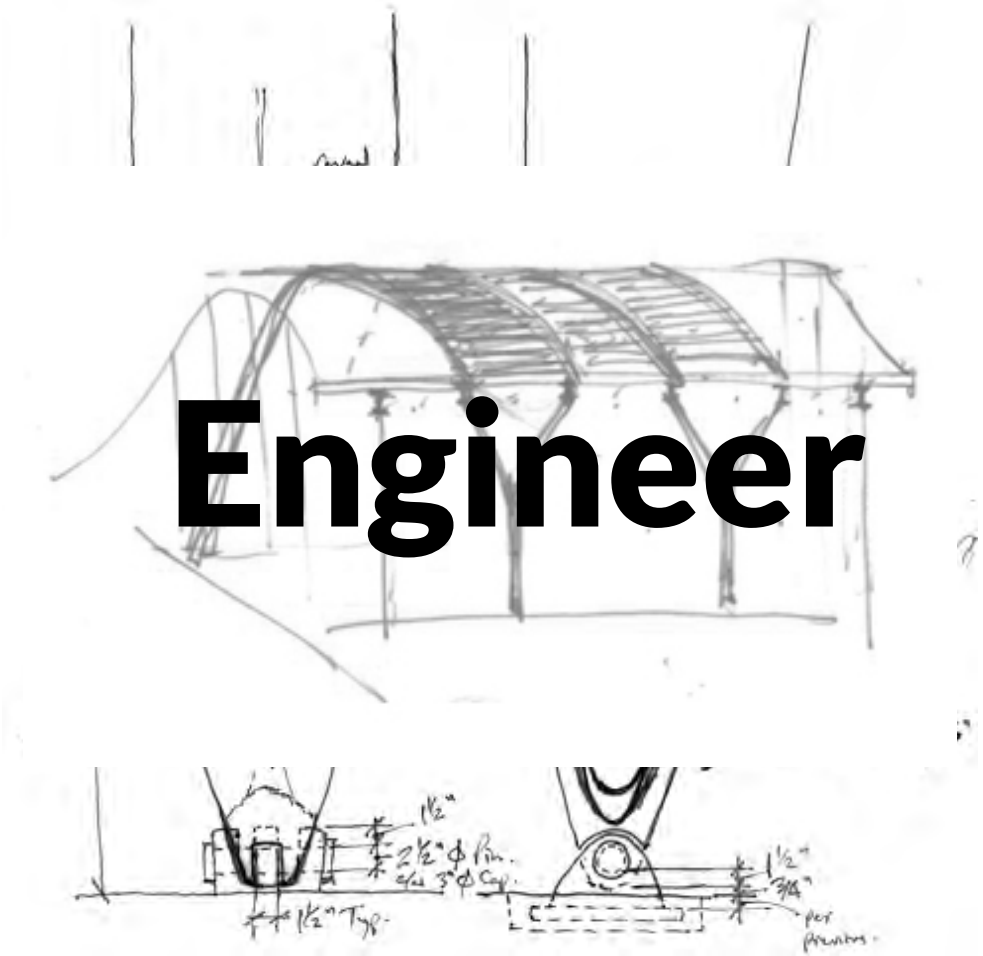
StructureCraft:

your project delivery partner for Timber Design and Construction

Engineering, Fabricating, and Installing
Signature Timber Structures since 1998.

Who is **StructureCraft**?

StructureCraft



Engineer

→

Buil
d

2010 Olympics – Speed Skating Oval Roof

VANCOUVER | BC

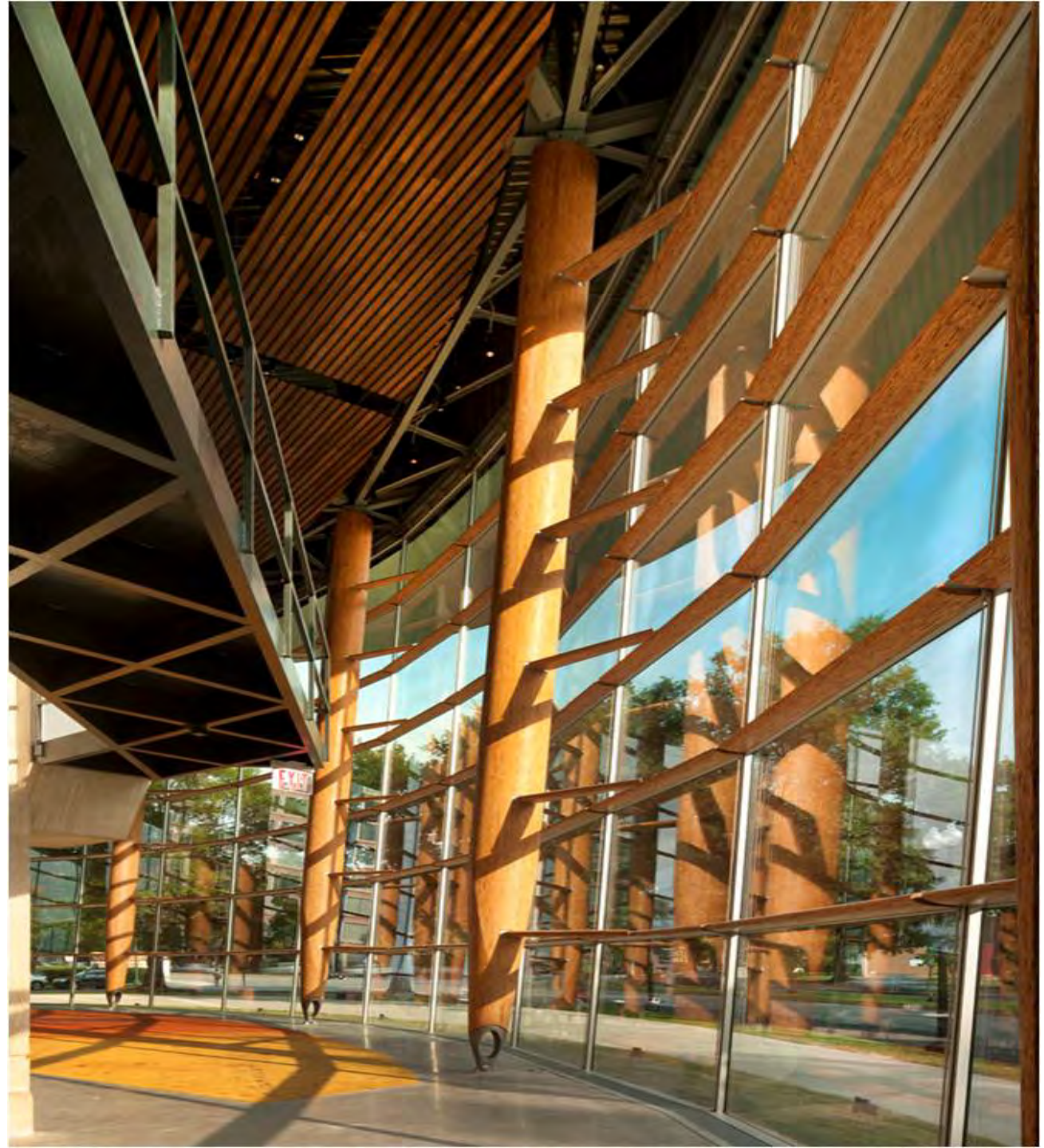
Cannon Design


RICHMOND
OLYMPIC OVAL

Arena Stage Theater Façade

WASHINGTON | DC

Bing Thom Architects

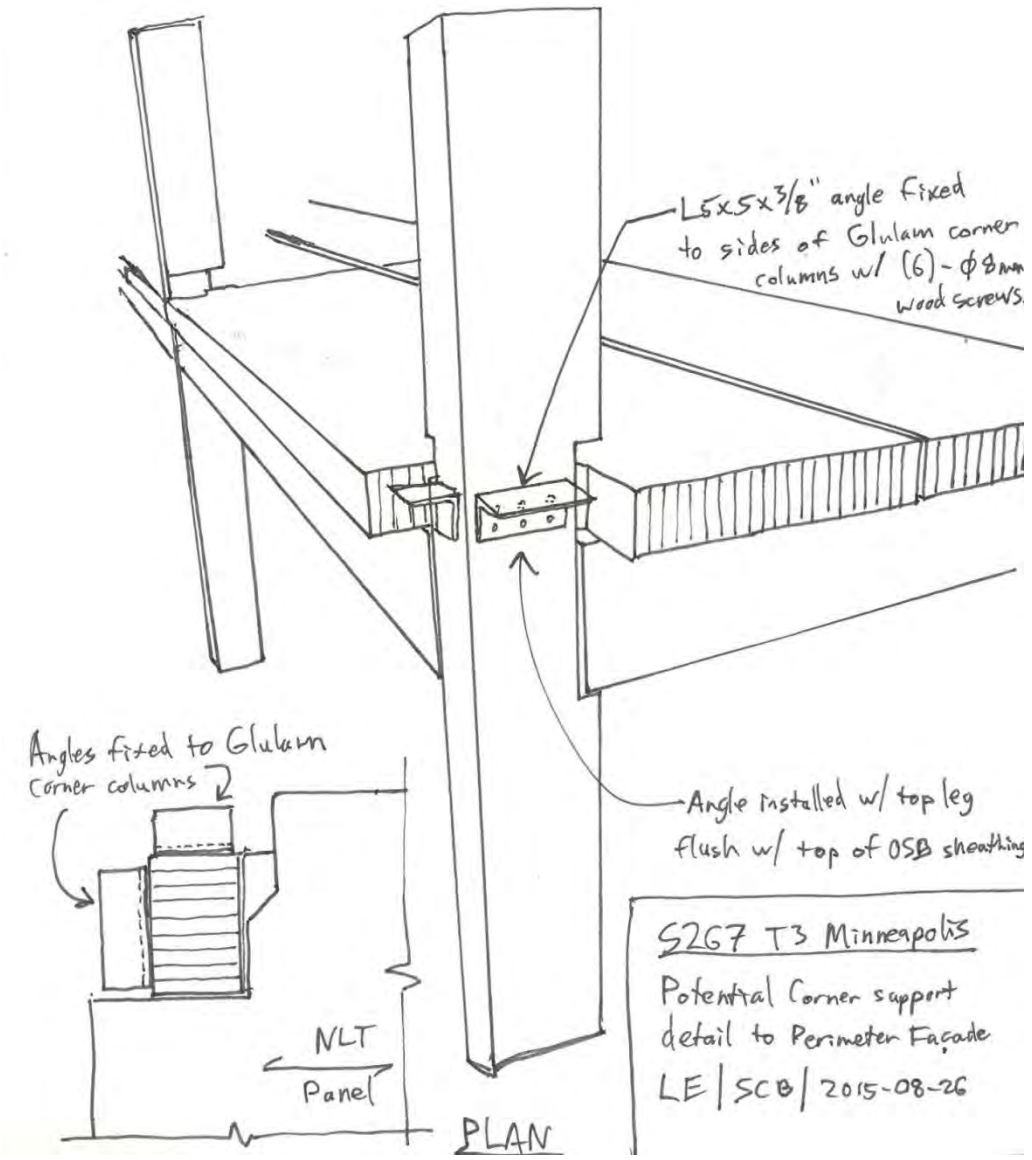

EXIT

VALUE WE BRING

StructureCraft

Our experienced and integrated delivery team

Team of in-house **timber engineers** specialized in designing efficiently with wood



VALUE WE BRING

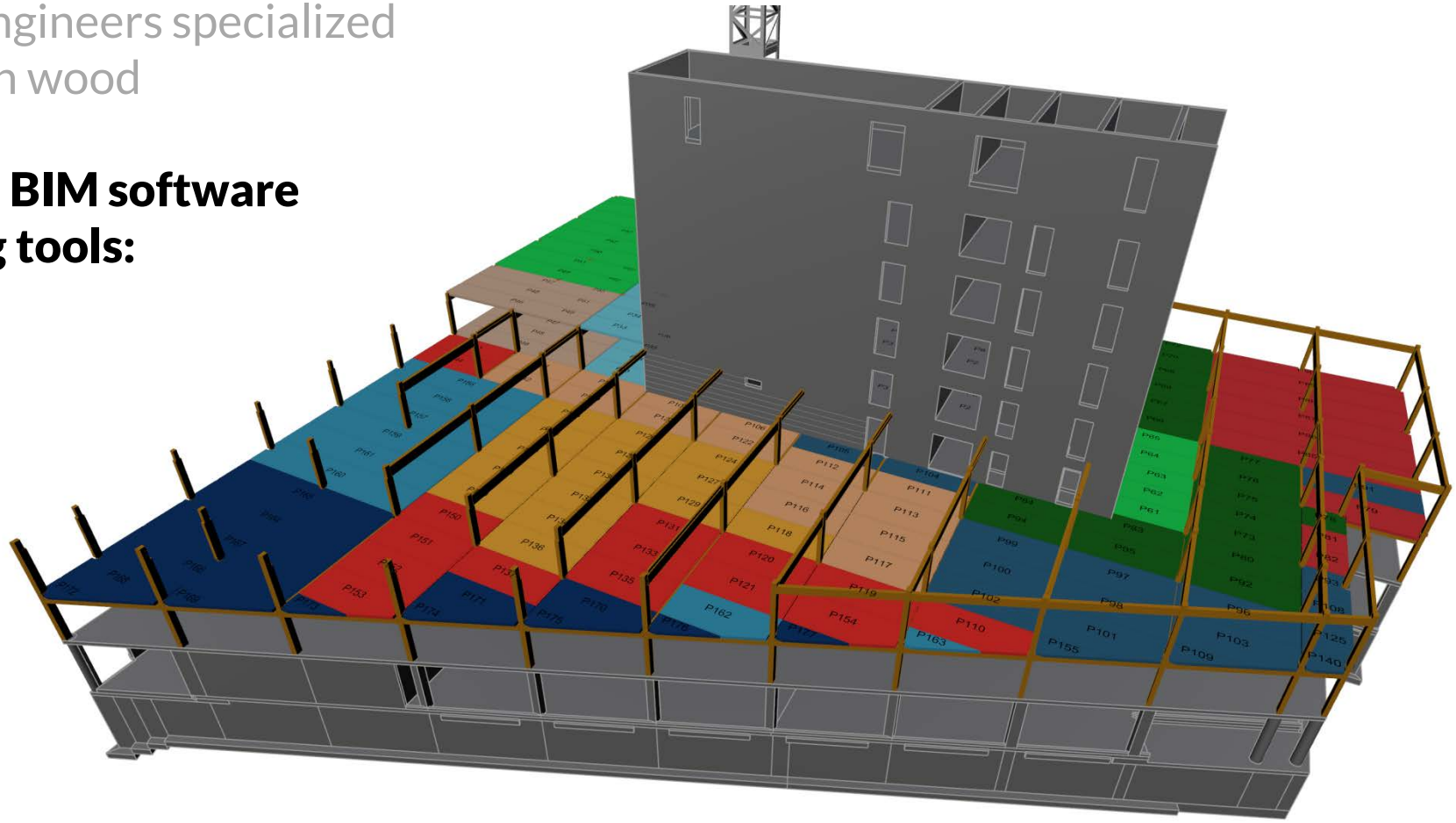
StructureCraft

Our experienced and integrated delivery team

Team of in-house timber engineers specialized in designing efficiently with wood

3D modelers proficient in BIM software and parametric modelling tools:

- **Cadwork**
- **HSBCad**
- **Rhino/Grasshopper**
- **Revit**



VALUE WE BRING

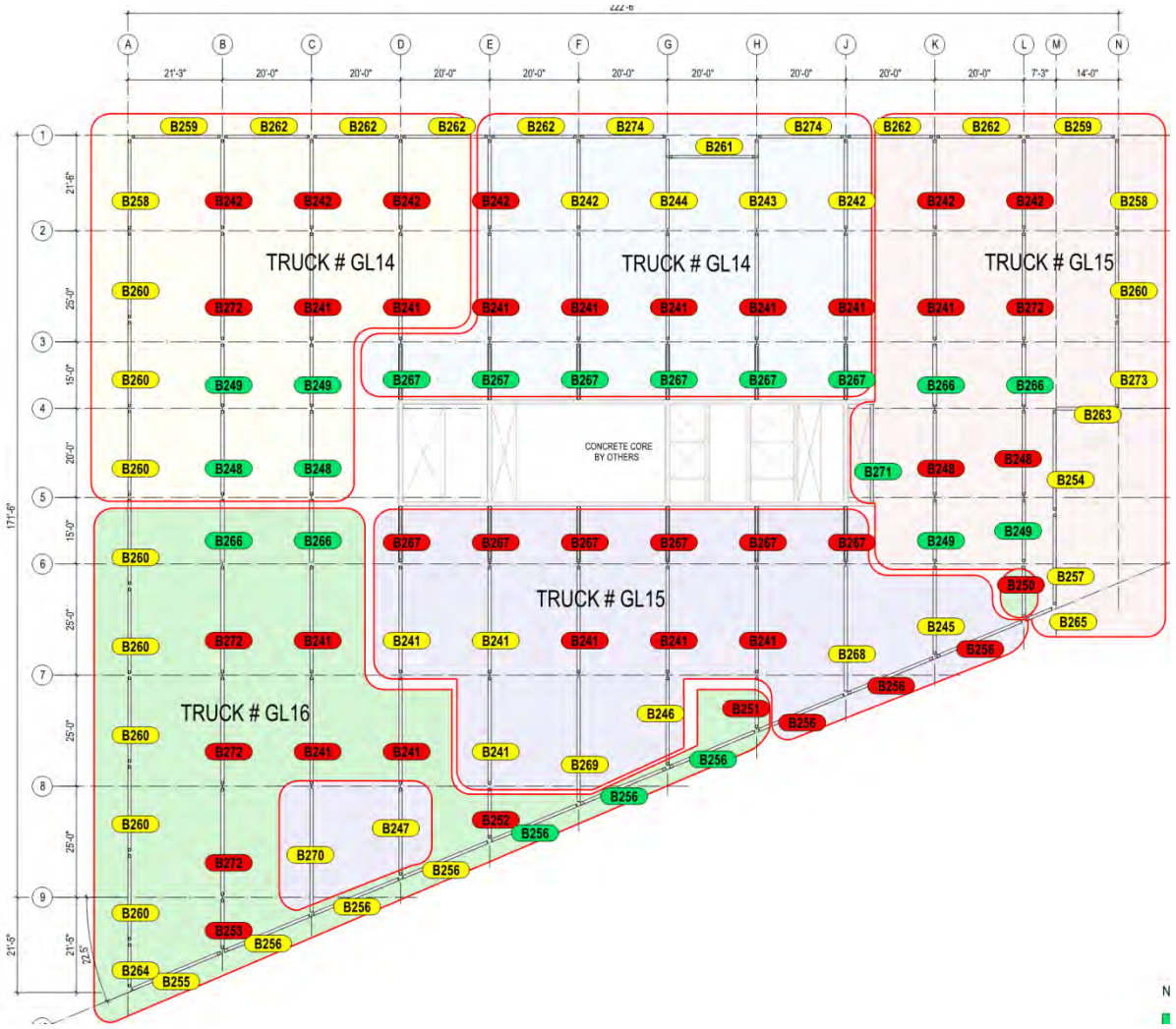
StructureCraft

Our experienced and integrated delivery team

Team of in-house timber engineers specialized in designing efficiently with wood

3D modelling team proficient in BIM software and parametric modelling tools

Project managers proficient in **scheduling** and **coordinating** all logistics



VALUE WE BRING

StructureCraft

Our experienced and integrated delivery team

Team of in-house timber engineers specialized in designing efficiently with wood

3D modelling team proficient in BIM software and parametric modelling tools

Project management team proficient in scheduling and coordinating all logistics

Experienced **timber fabricator-installers** and efficient **site management** team

VALUE WE BRING

StructureCraft

An experienced and integrated delivery team

Intimate knowledge of **North American** and **European supply chain of mass timber products**

- Capacity
- Pricing
- Quality
- Dependability

What Is **MASS TIMBER?**

Glue Laminated Timber

GLT

Laminated Veneer Lumber

LVL

Parallel Strand Lumber

PSL

Laminated Strand Lumber

LSL

Common Types of **MASS TIMBER**

Cross Laminated Timber

CLT

Nail Laminated Timber

NLT

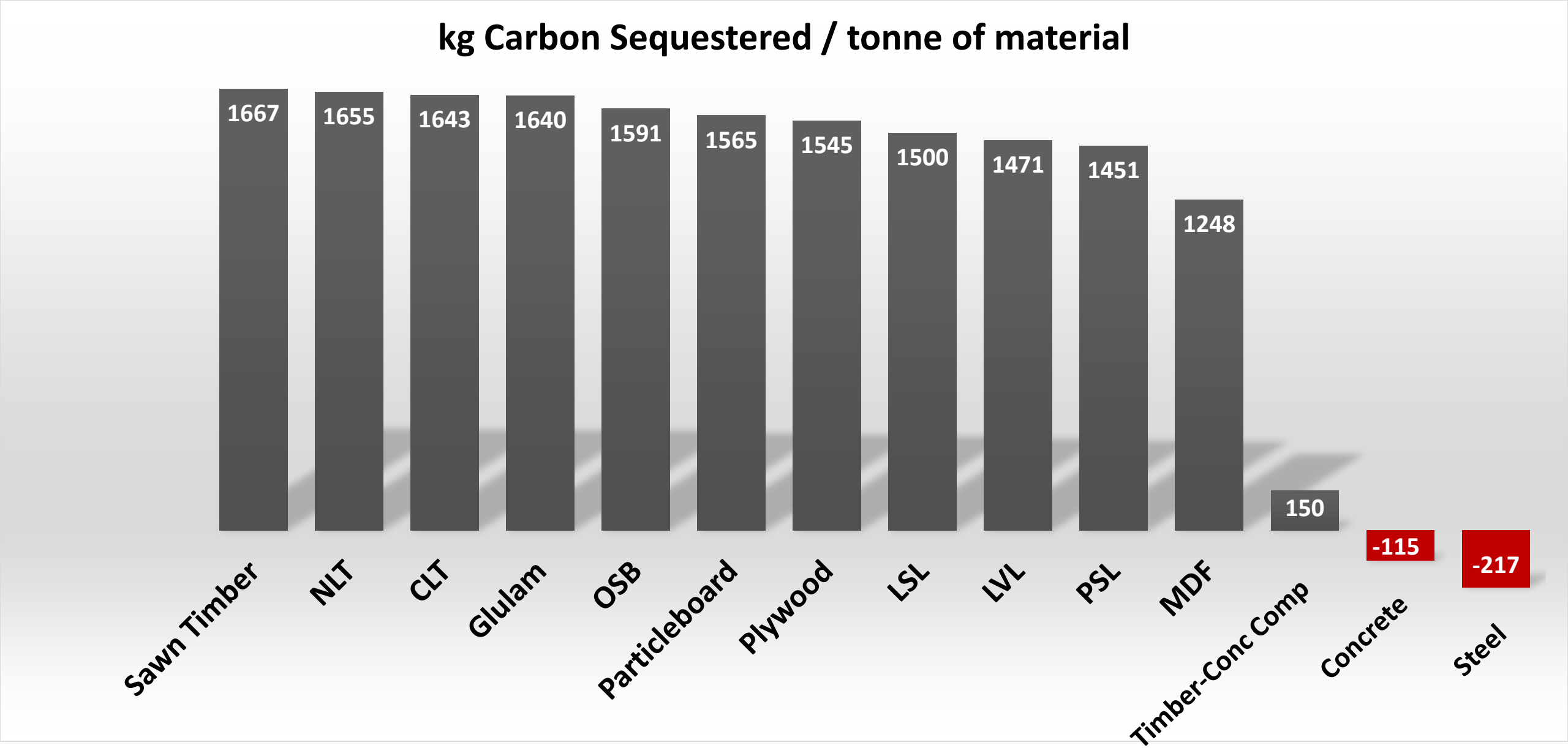
Timber-Concrete Composite

TCC

StructureCraft

Dowel Laminated Timber

DLT



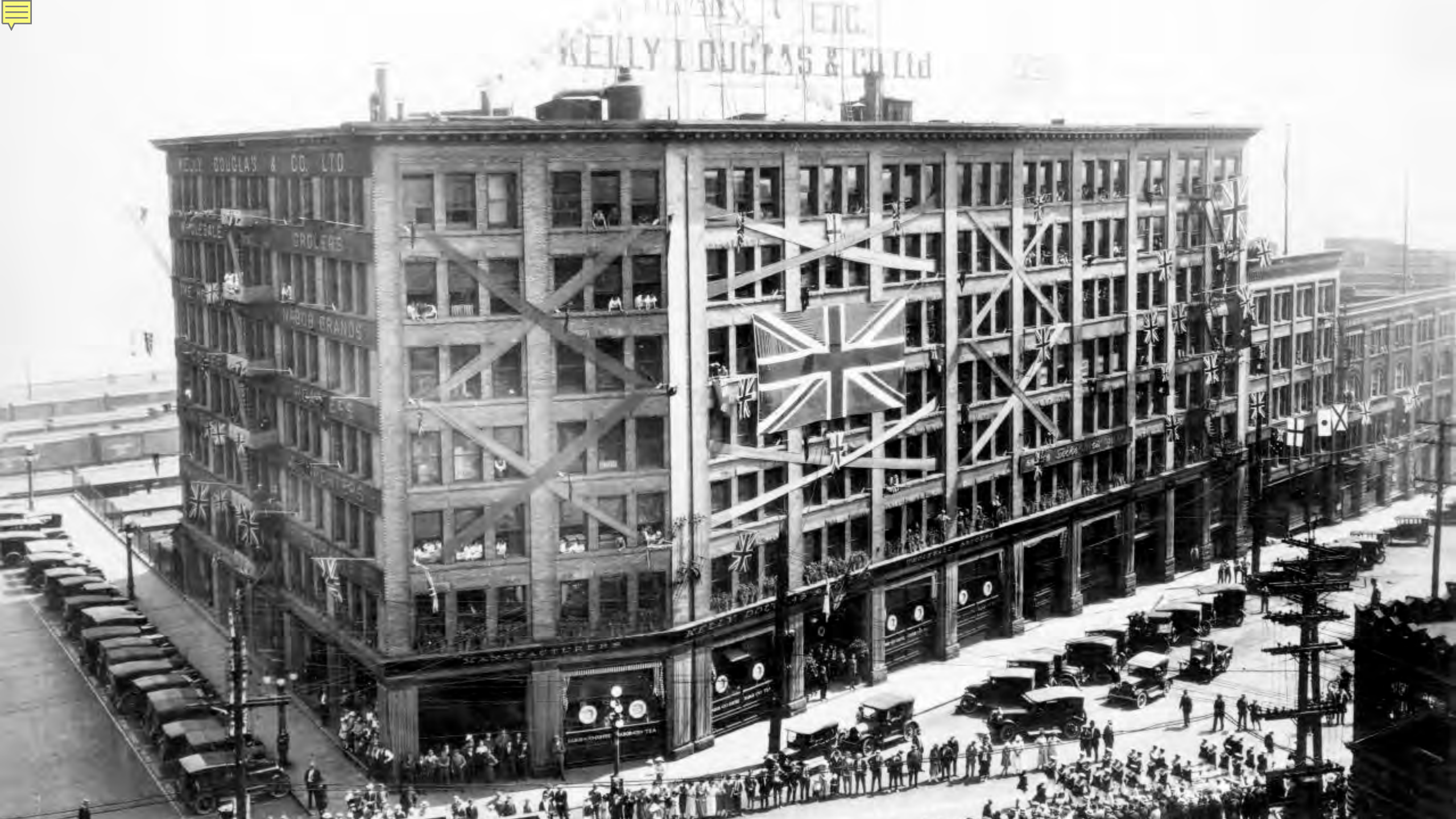
Athena Sustainable Materials Institute

Canadian Products Carbon Content

MASS TIMBER

NLT

HISTORY


KELLY DOUGLAS & CO LTD
KELLY DOUGLAS & CO. LTD
WHOLESALE
GROCERS
MAPLE LEAF BRANDS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WWW.FIVEOCLOCKSTUDIO.COM


T3 | Minneapolis, Minnesota

T3 – Team

- **Hines –** Developer
- **Michael Green Architecture –** Design Architect
- **DLR Group –** Architect
- **MKA –** Structural Engineer
- **StructureCraft –** Design-Assist-Build delivery partner for the timber structure

T3 – Why wood?

www.t3NorthLoop.com **“Timber – Transit – Technology”**

“We love **old brick & timber warehouses**. We love the feel of them, the **originality**, and the entrepreneurship that lives inside their bones.
They are **cool places** to collaborate, create, and innovate.

Unfortunately, these buildings lack good natural light, are drafty, noisy, and have outdated HVAC systems.

So we asked ourselves, why can’t we solve these problems by selecting an authentic location, surrounded by heritage buildings, and construct a brand new, vintage building?

All the charm of an old brick & timber building, with none of the downsides. ”


NOW LEASING


NOW LEASING


United Rentals


United Rentals
SJ12

GLULAM FABRICATION

T3 – Glulam Stats

- **Glulam –** European White Spruce
- **Over 1000 CNC’d pieces**
- All steel connections **pre-installed** into Glulams


Auftrag: 185648
232
B9

MASS TIMBER PANELS

T3 – NLT Panel Stats

- **1100 NLT mass timber panels** - covers over 3 football fields
- Much of the NLT uses lumber from trees killed by the mountain pine beetle
- **1.4 million lineal feet of 2x8** – more than from Earth to the International Space Station
- Panels fabricated in Winnipeg and shipped down to Minneapolis


TOLKO


HAULRITE
ENVIRONMENTAL
222-5269


5103T34/3/P546
/T34/4/P567


5/72
5/69/T32
5/68/T32

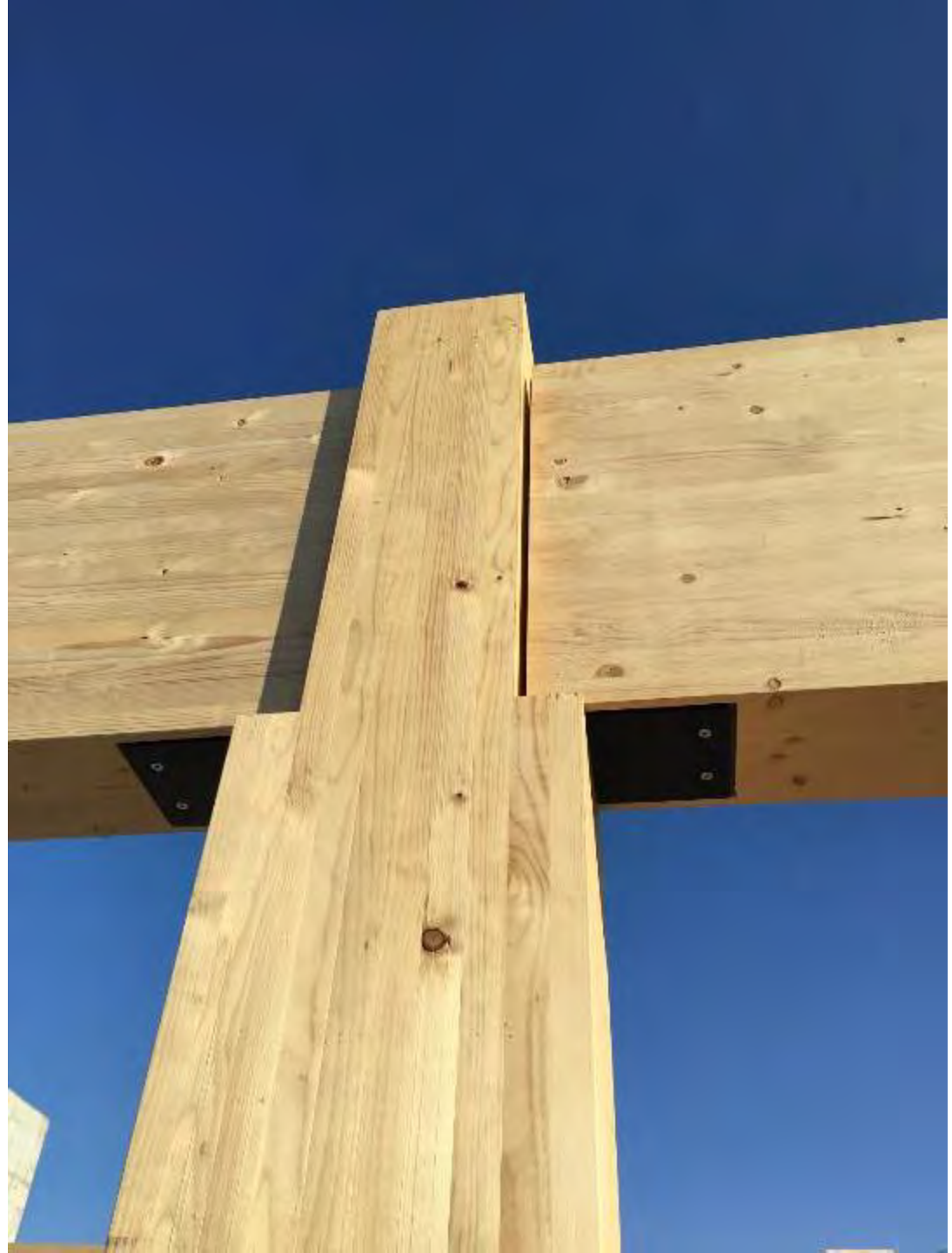

A201-1
A202-1
A202-9
A201-5
A202-1
A202-2
A202-4
A202-3
A211
A202-8
A202-7
A211-2
A202-6
A202-5
53QF1708
www.shadowlines.com
Shadow
LINES


B/48/T4/5/P641

T3 – Install Statistics

- **9.5 weeks -** Install duration (crane time)
- **1.5 weeks** per **30,000 sqft floor**
- **9 man crew –** StructureCraft supervisors alongside local union labor
- Concrete core went up simultaneously with the timber structure


NOW LEASING
Link-Belt




ION PLAZA

Glue Laminated Timber

GLT

Laminated Veneer Lumber

LVL

Parallel Strand Lumber

PSL

Laminated Strand Lumber

LSL

Cross Laminated Timber

CLT

Nail Laminated Timber

NLT

Timber-Concrete Composite

TCC

Why did the team choose NLT?

1. **Structural efficiency**
2. Fire Performance
3. Cost-effective
4. Local materials
5. Large panels → **Fast Erection**

Why did the team choose NLT?

CLT

GLT

NLT

Why did the team choose use NLT?

CLT

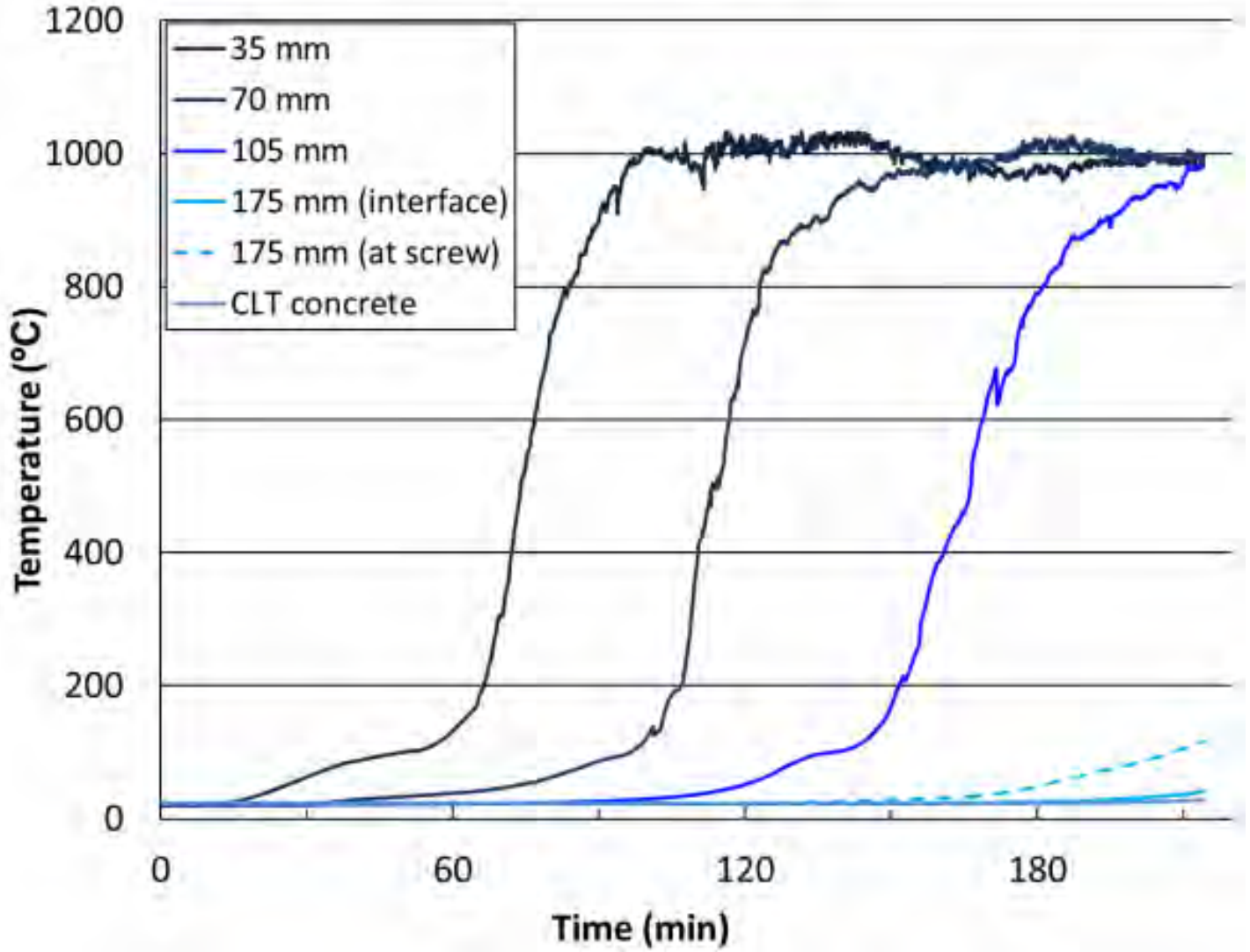
GLT

NLT

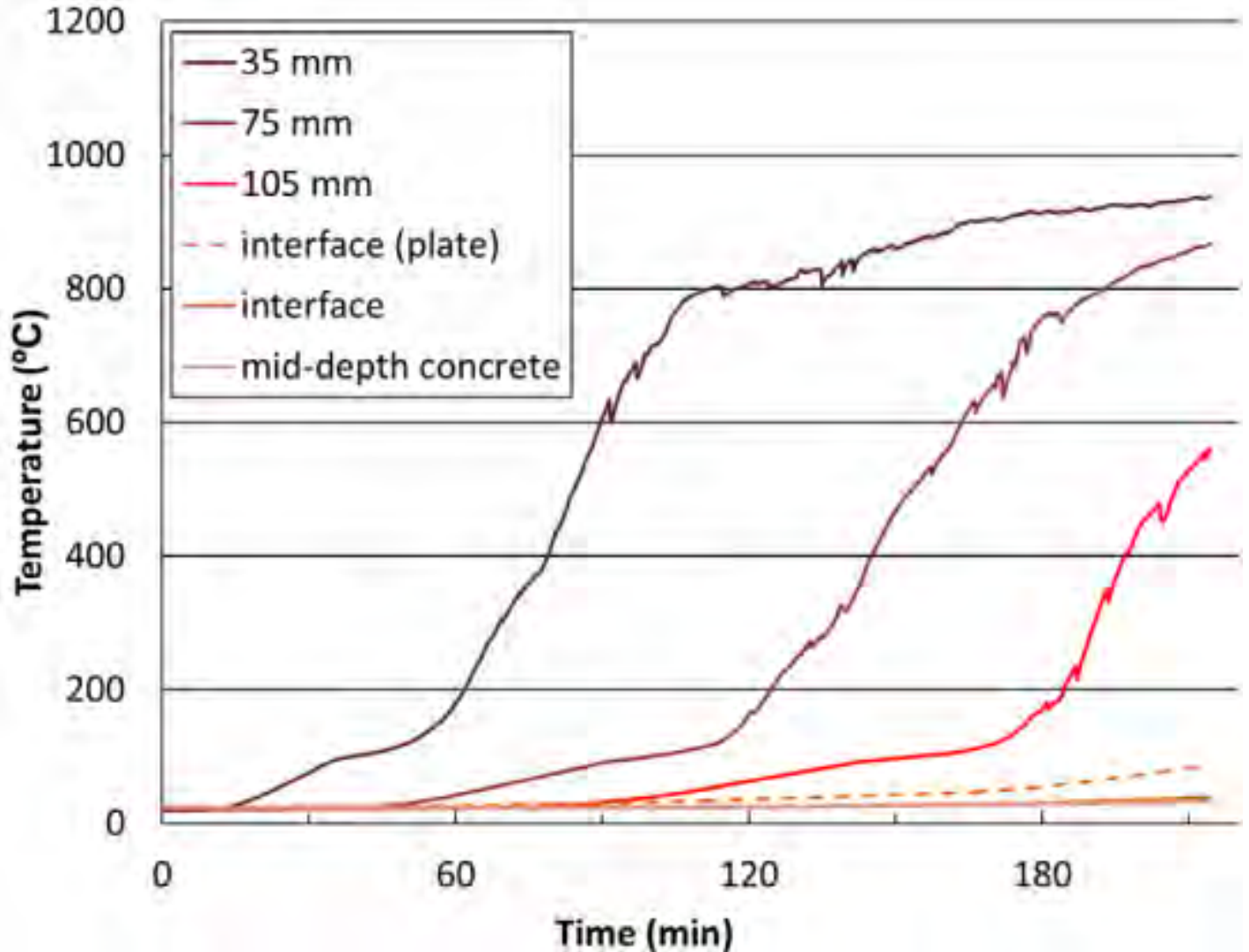
Why did the team choose NLT?

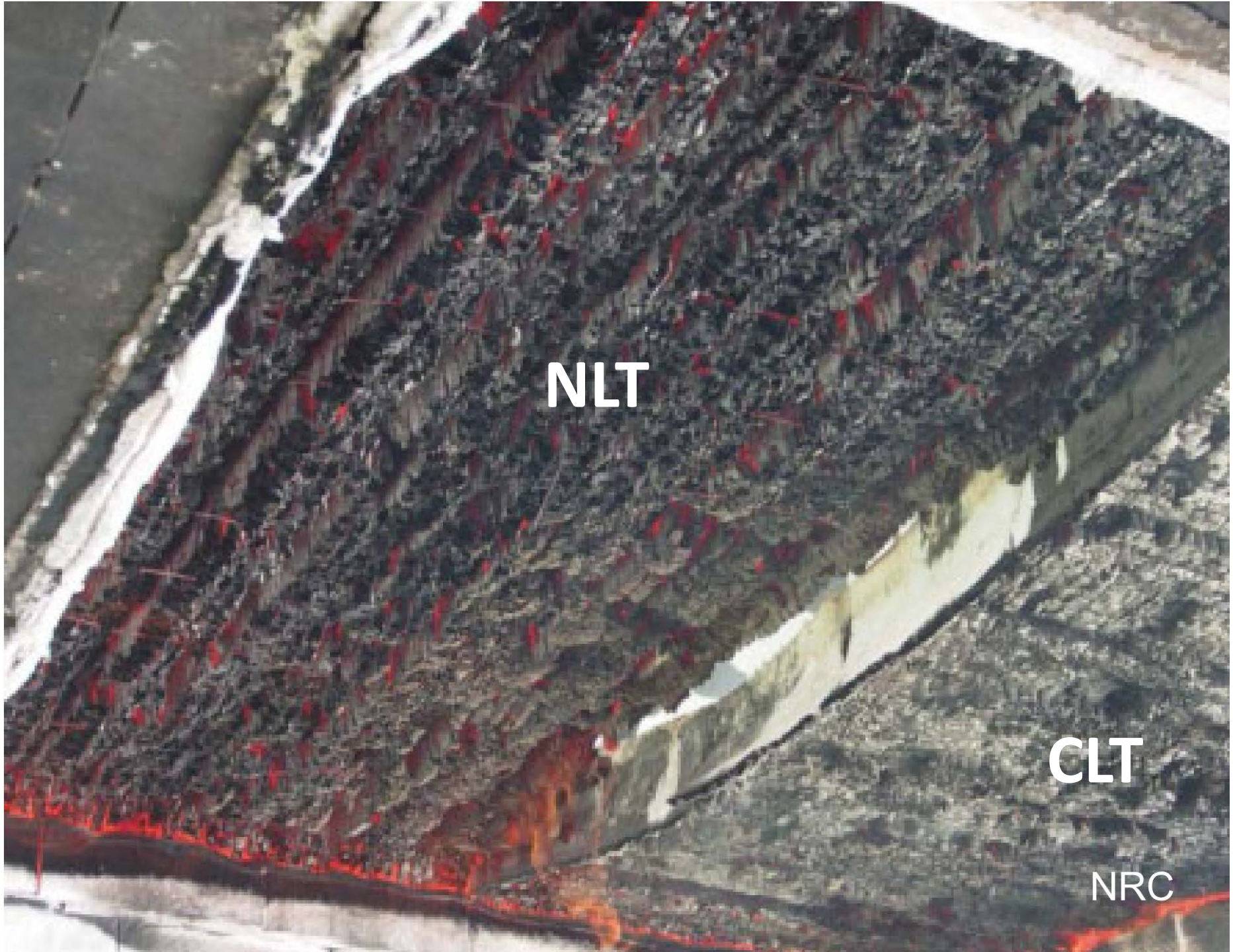
1. Structural efficiency
2. **Fire Performance**
3. Cost-effective
4. Local materials
5. Large panels → **Fast Erection**

5-ply CLT (c/w composite concrete topping)



2x8 NLT (c/w composite concrete topping)




NLT
CLT
NRC

Both assemblies lasted over 3hrs!

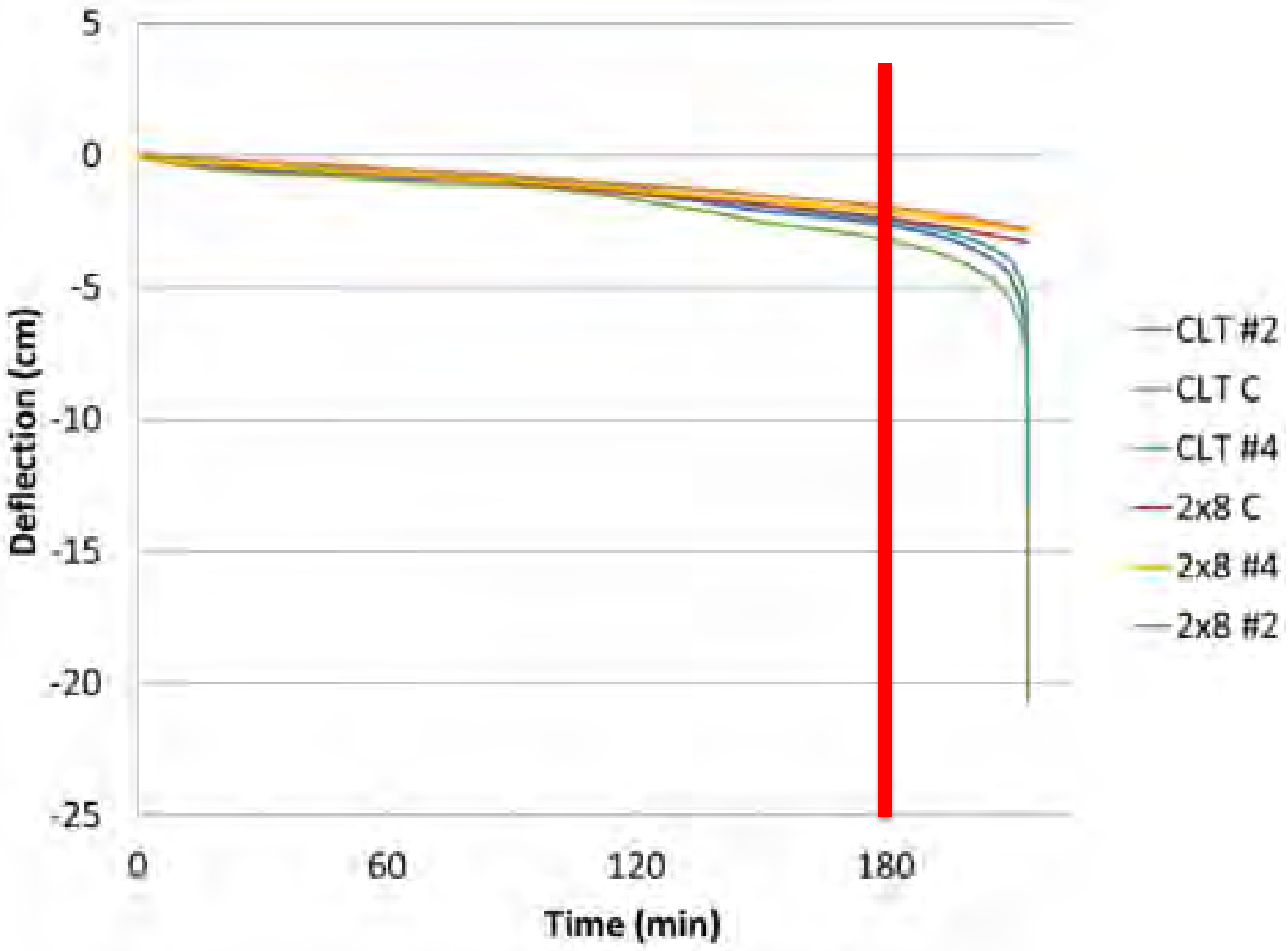


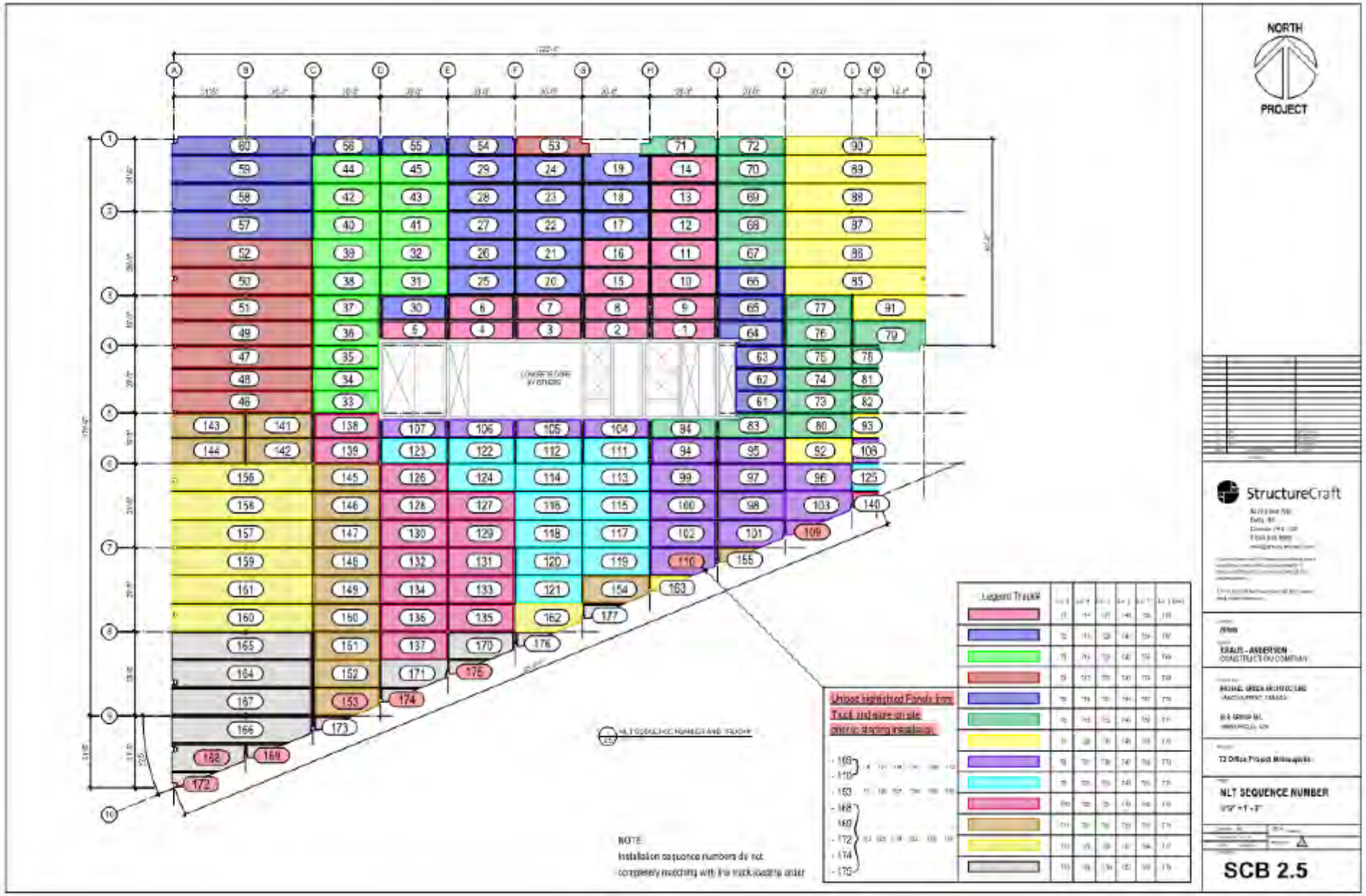
Figure 16 Deflections

Why did the team choose NLT?

1. Structural efficiency
2. Fire Performance
3. **Speed of Installation**
4. **Aesthetics**
5. **Cost-effective**
6. **Sustainable**

Speed – kit of parts!

Erection Techniques



COLUMN BRACING:
UNIQUE DETAIL. SEE DRAWING E6.4.0.

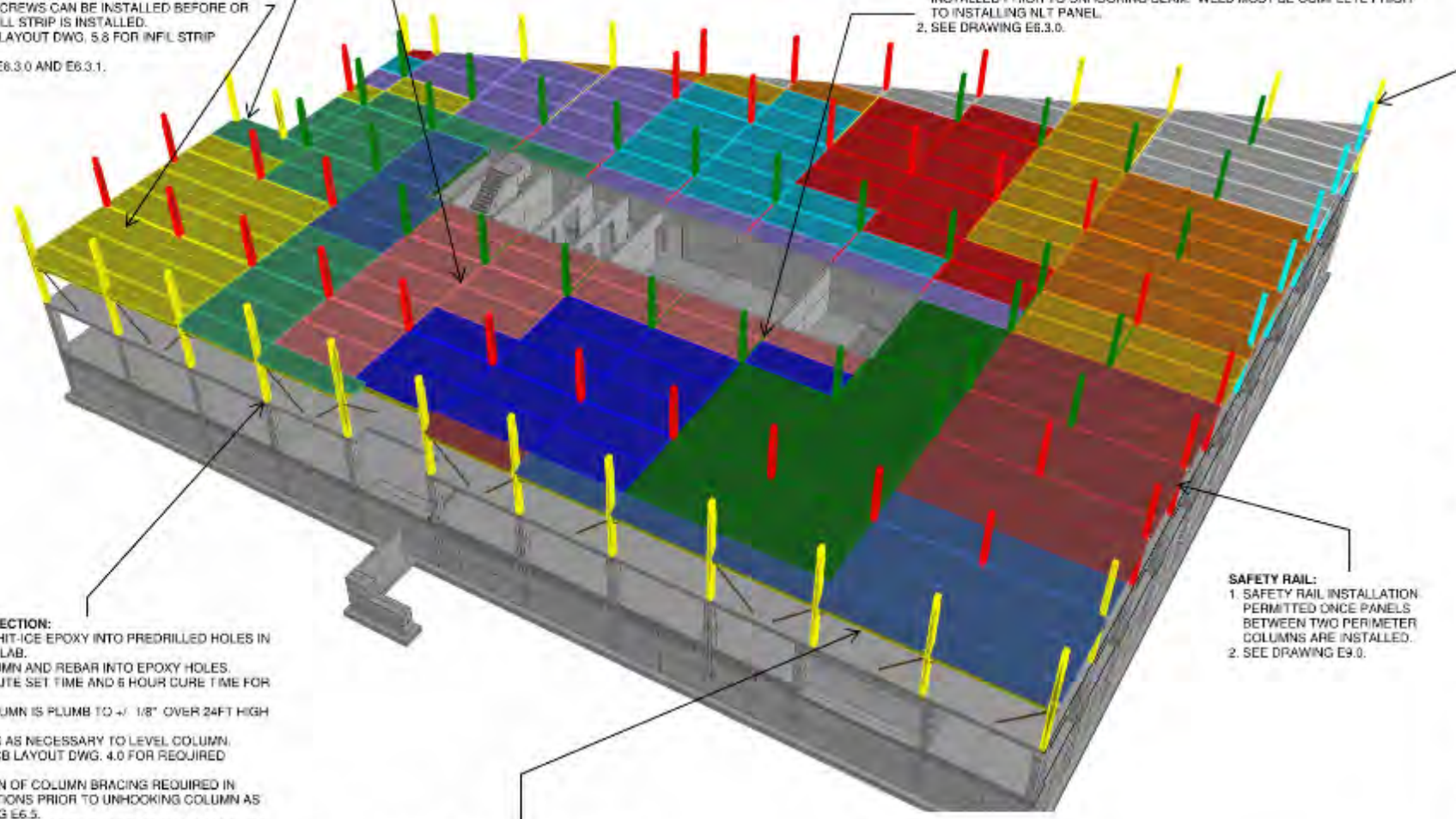
NAIL LAMINATED PANELS:
1. ENSURE (2) VGS 9x450mm SCEWS ARE INSTALLED PRIOR TO WALKING ON PANEL OR ATTACHING TO FALL PROTECTION ANCHOR POINTS.
2. ENSURE REMAINING (2) VGS 9x450mm SCREWS ARE INSTALLED PRIOR TO REMOVING COLUMN BRACING.
3. VGS 9x450mm SCREWS CAN BE INSTALLED BEFORE OR AFTER OSB INFILL STRIP IS INSTALLED.
4. REFER TO SCB LAYOUT DWG. 5.8 FOR INFIL STRIP DETAILS.
5. SEE DRAWING E6.3.0 AND E6.3.1.

GLULAM BEAM-TO-COLUMN INTERIOR CONNECTION:
1. ENSURE TBS 6x80mm SCREW IS INSTALLED ON EACH END PRIOR TO UNHOOKING BEAM.
2. ENSURE THRU-BOLT IS INSTALLED PRIOR TO LANDING SISTER BEAM.
3. SEE DRAWING E6.3.0.

GENERAL NOTES:
1. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH SCB LAYOUT DRAWINGS.
2. DO NOT ERECT COLUMNS, BEAMS OR PANELS IF WIND SPEED EXCEEDS 20 MPH.
3. FOLLOW ALL GUIDELINES AND DETAILS AS SPECIFIED IN ERECTION DOCUMENTS.
4. ERECTION SEQUENCING DRAWINGS ARE ORGANIZED AS PER TRUCK SEQUENCING FOR A TYPICAL FLOOR LEVEL. THE SAME SEQUENCING AND ERECTION NOTES APPLY TO ALL SEQUENTIAL FLOORS.

GLULAM BEAM-TO-CORE CONNECTION:
1. WELDED DRAG STRAP PLATE DOES NOT NEED TO BE INSTALLED PRIOR TO UNHOOKING BEAM. WELD MUST BE COMPLETE PRIOR TO INSTALLING NLT PANEL.
2. SEE DRAWING E6.3.0.

COLUMN BRACING:
UNIQUE DETAIL.
SEE DRAWING E6.4.0.



COLUMN CONNECTION:
1. PLACE HILTI HIT-ICE EPOXY INTO PREDRILLED HOLES IN CONCRETE SLAB.
2. LOWER COLUMN AND REBAR INTO EPOXY HOLES. NOTE 45 MINUTE SET TIME AND 6 HOUR CURE TIME FOR EPOXY.
3. ENSURE COLUMN IS PLUMB TO +/- 1/8" OVER 24FT HIGH COLUMN.
4. PLACE SHIMS AS NECESSARY TO LEVEL COLUMN. REFER TO SCB LAYOUT DWG. 4.0 FOR REQUIRED SHIMS.
5. INSTALLATION OF COLUMN BRACING REQUIRED IN BOTH DIRECTIONS PRIOR TO UNHOOKING COLUMN AS PER DRAWING E6.5.
6. TAKE CARE NOT TO BUMP COLUMN AFTER PLACEMENT. UNTIL EPOXY HAS SET, COLUMN CAN BE EASILY PUSHED OUT OF PLUMB WITH A BEAM OR SIMILIAR.
7. SEE DRAWING E6.2.

GLULAM BEAM-TO-COLUMN EXTERIOR CONNECTION:
1. ENSURE BEAM IS SET FLUSH TO OUSIDE OF GLULAM COLUMN ON BOTH ENDS.
2. ENSURE MIN. (1) VGS 9x160mm SCREW IS INSTALLED ON EACH END PRIOR TO UNHOOKING BEAM.
3. SEE DRAWING E6.3.0.

SAFETY RAIL:
1. SAFETY RAIL INSTALLATION PERMITTED ONCE PANELS BETWEEN TWO PERIMETER COLUMNS ARE INSTALLED.
2. SEE DRAWING E9.0.

COLUMN BRACING GENERAL NOTE:
NO COLUMN BRACING TO BE REMOVED UNTIL SCREWS FOR ALL NLT PANELS IN A CLEAR PATH BACK TO THE CORE HAVE BEEN INSTALLED. BEAMS CONNECTED TO THE CORE MUST HAVE DRAG STRAP WELDED TO THE CORE PIOR TO THE REMOVAL OF ANY BRACING IN A DIRECT LINE TO THE CORE.

REV.	DESCRIPTION	DATE
1	IFC	15-12-16
A	IFA	15-11-12

ISSUED

StructureCraft

Hines

KRAUS - ANDERSON CONSTRUCTION COMPANY

MICHAEL GREEN ARCHITECTURE
VANCOUVER BC, CANADA

DLR GROUP INC
MINNEAPOLIS, USA

TJ Office Project Minneapolis

INSTALL SEQUENCE PERSPECTIVES

E7.0.0

Aesthetics


Cost Effective


Sustainable
130,000 ft3 wood = 3200t Carbon

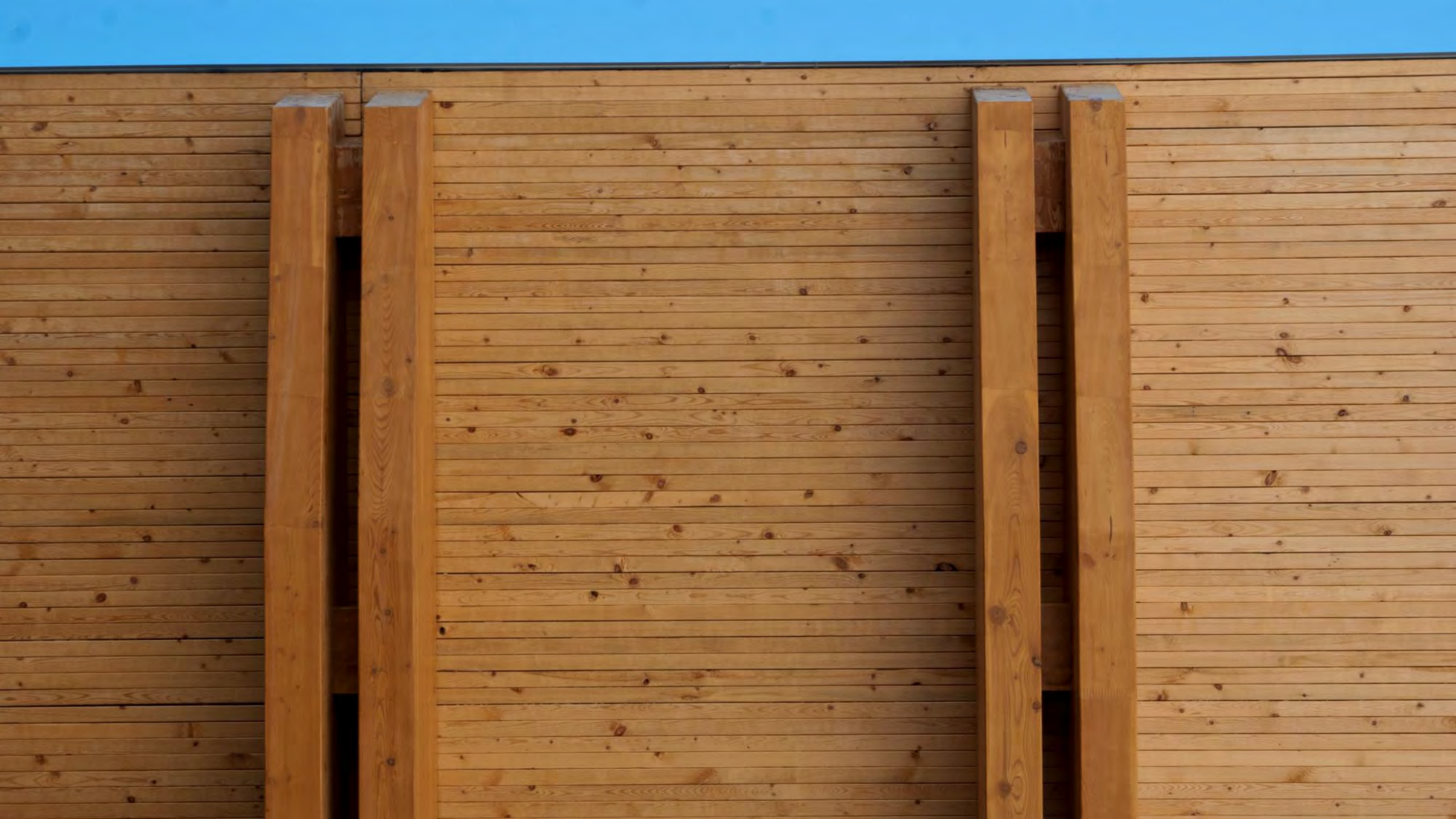
INSPIRATION

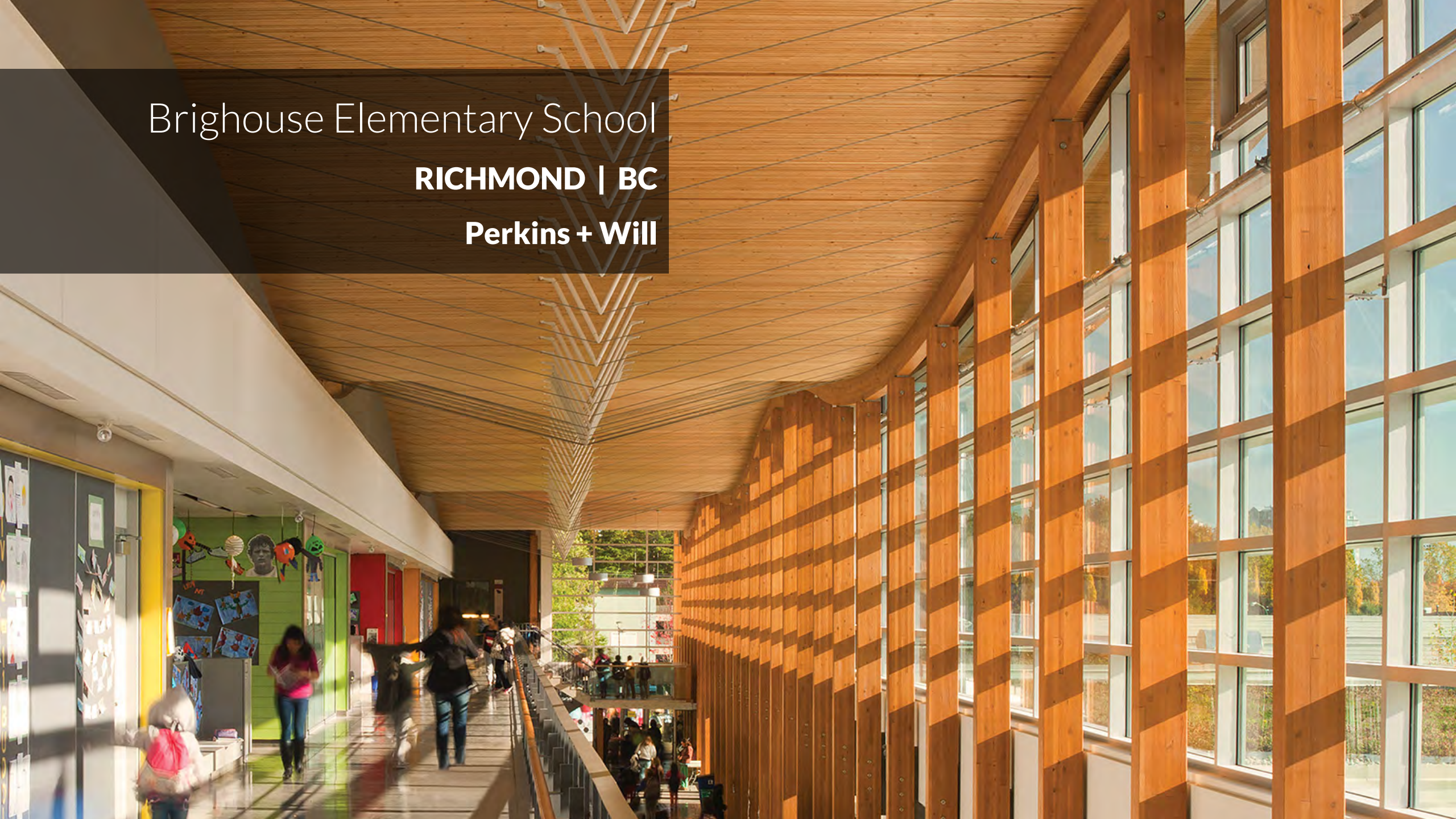
Chilliwack Secondary School

Chilliwack | BC

Dialog


CHILLIWACK SECONDARY SCHOOL
46363





Brighouse Elementary School

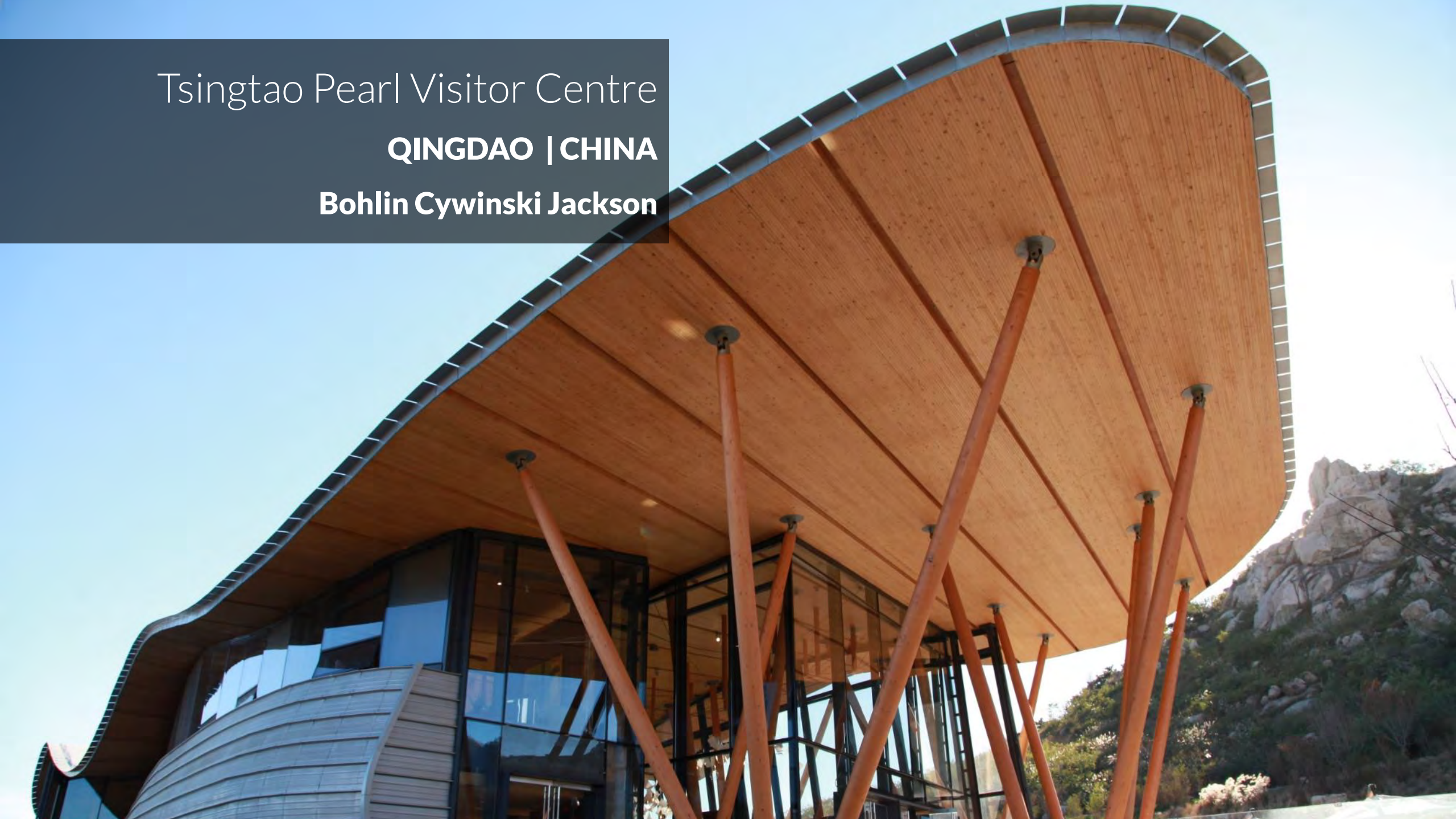
RICHMOND | BC

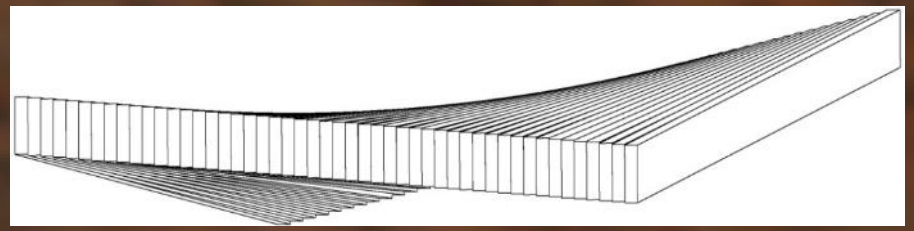
Perkins + Will

Tsingtao Pearl Visitor Centre

QINGDAO | CHINA

Bohlin Cywinski Jackson






上海思卡福

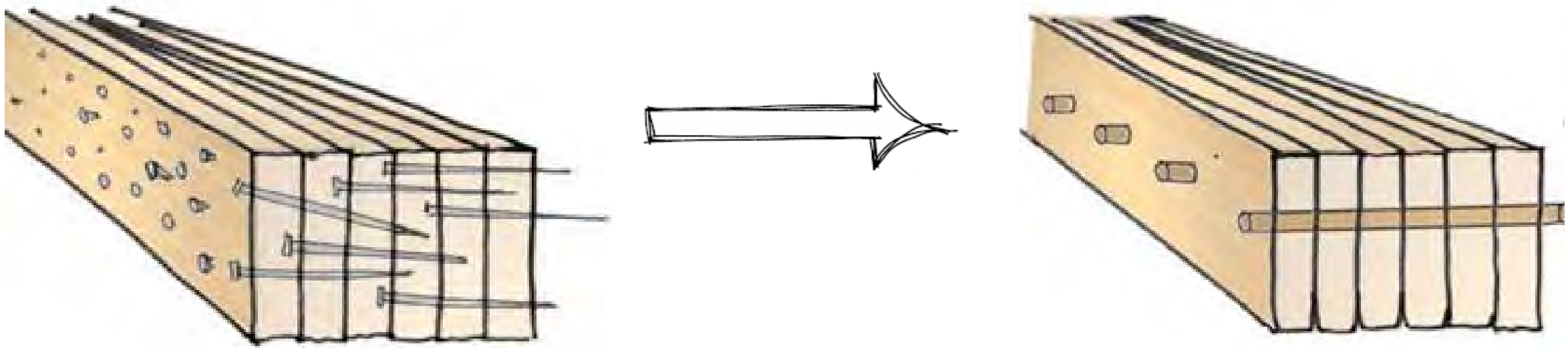
Dowel Laminated Timber

DLT

Why a new mass timber product?

NLT

DLT



DLT - History |

ETH zürich

1970s

Brettstapel - “Stacked Elements”

Julius Natterer, ETH Zurich

DLT - History |

1990s

Dübelholz - “Dowelled Timber”

Pirmin Jung, Tschopp Holzbau, Switzerland

Dowel Laminated Timber

DLT

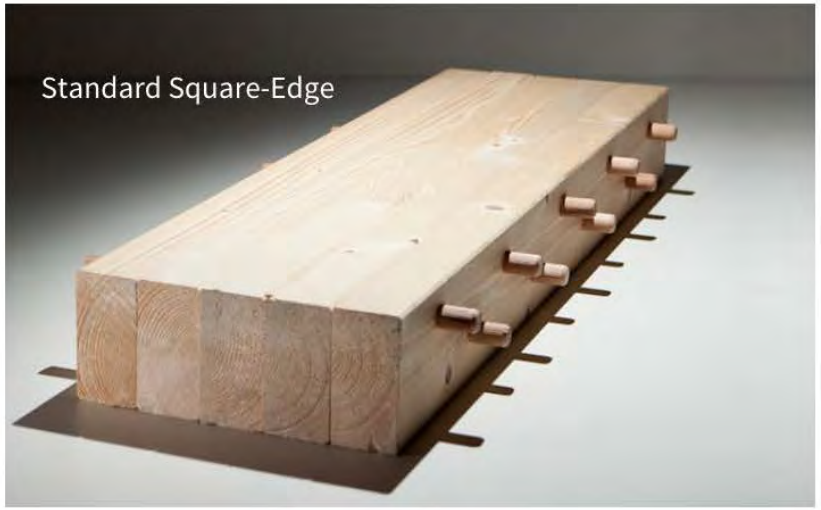
Why Automate?

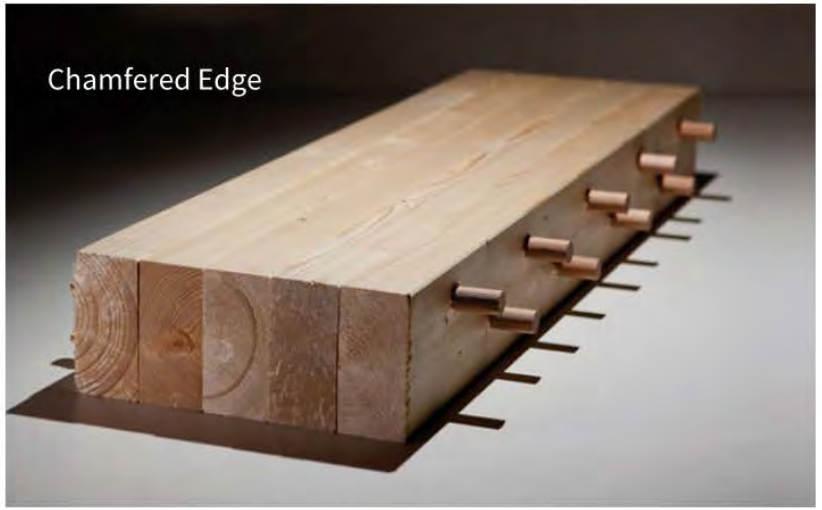
Dowel Laminated Timber

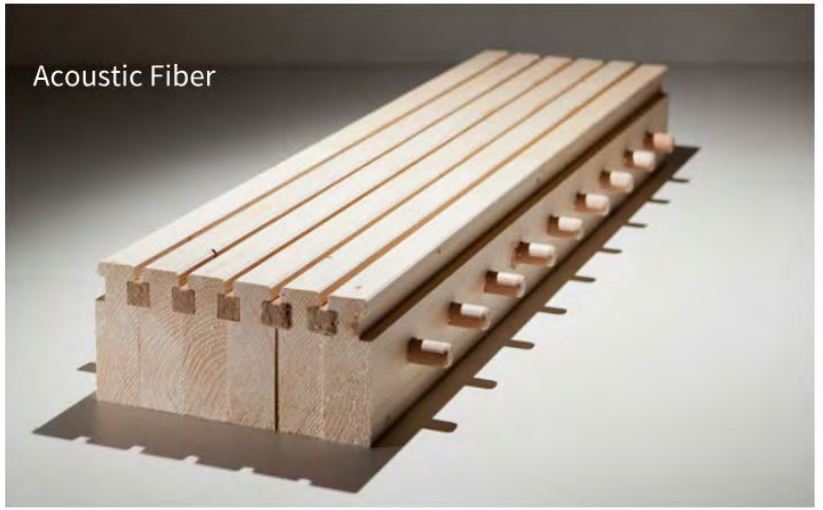
DLT

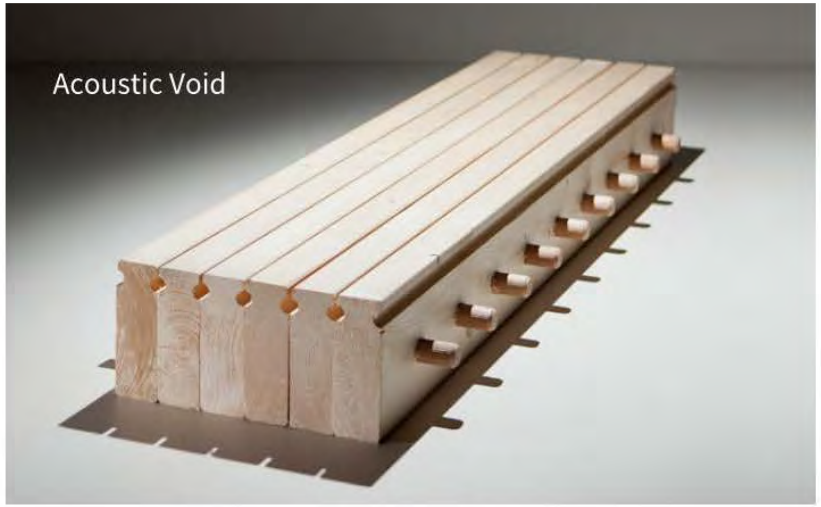
Versatility

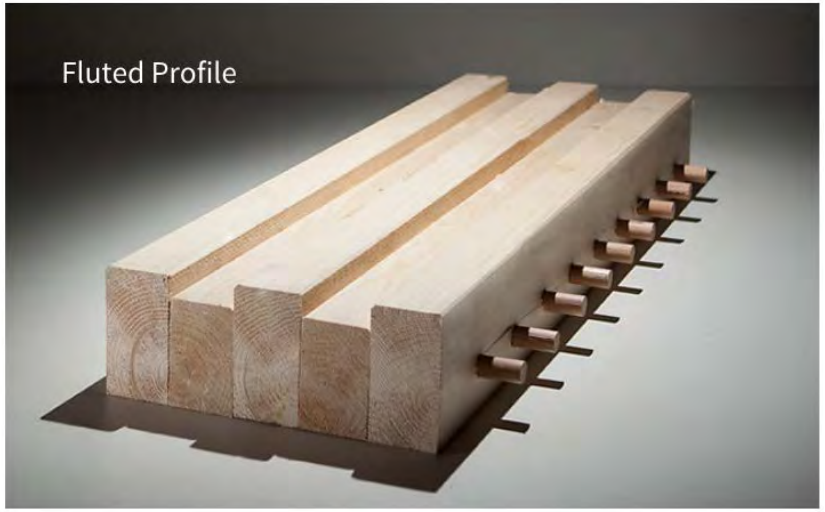
DLT Profiles







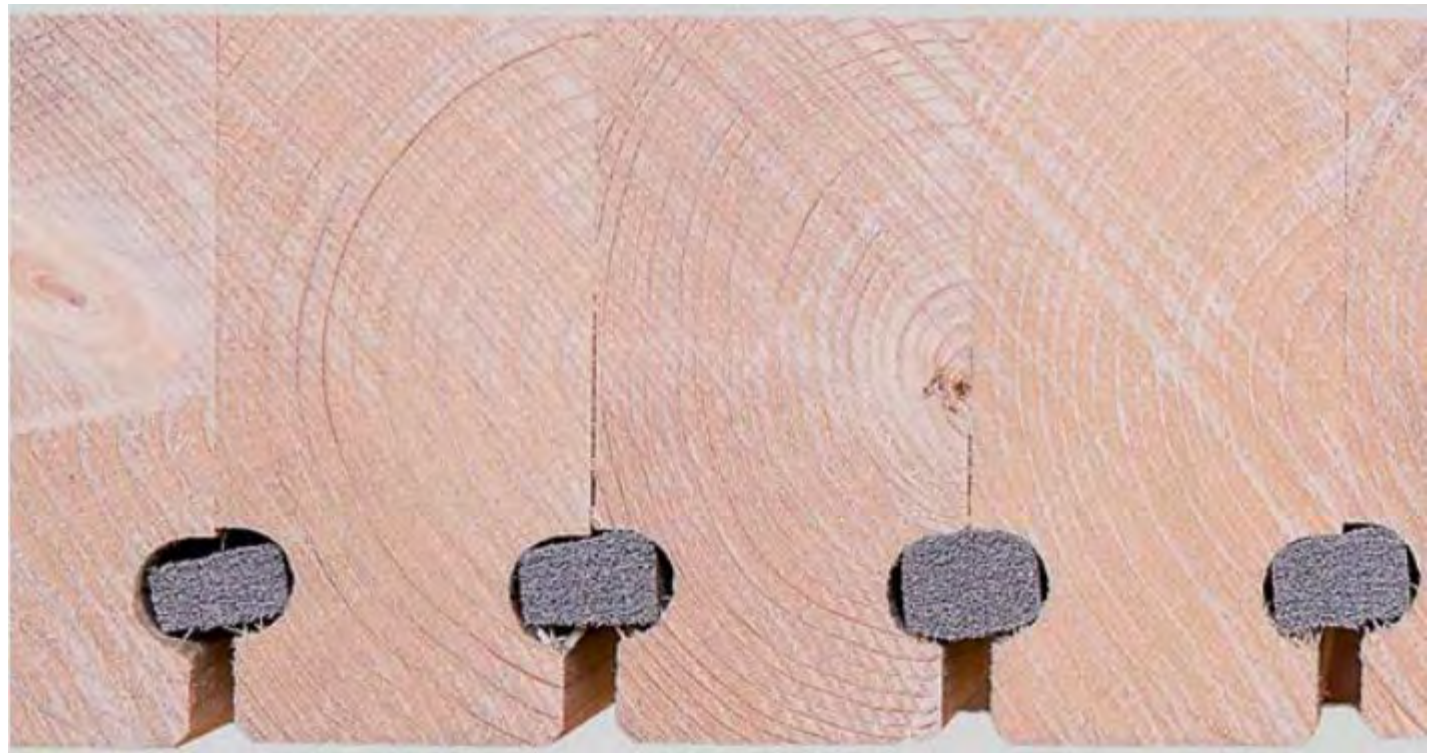




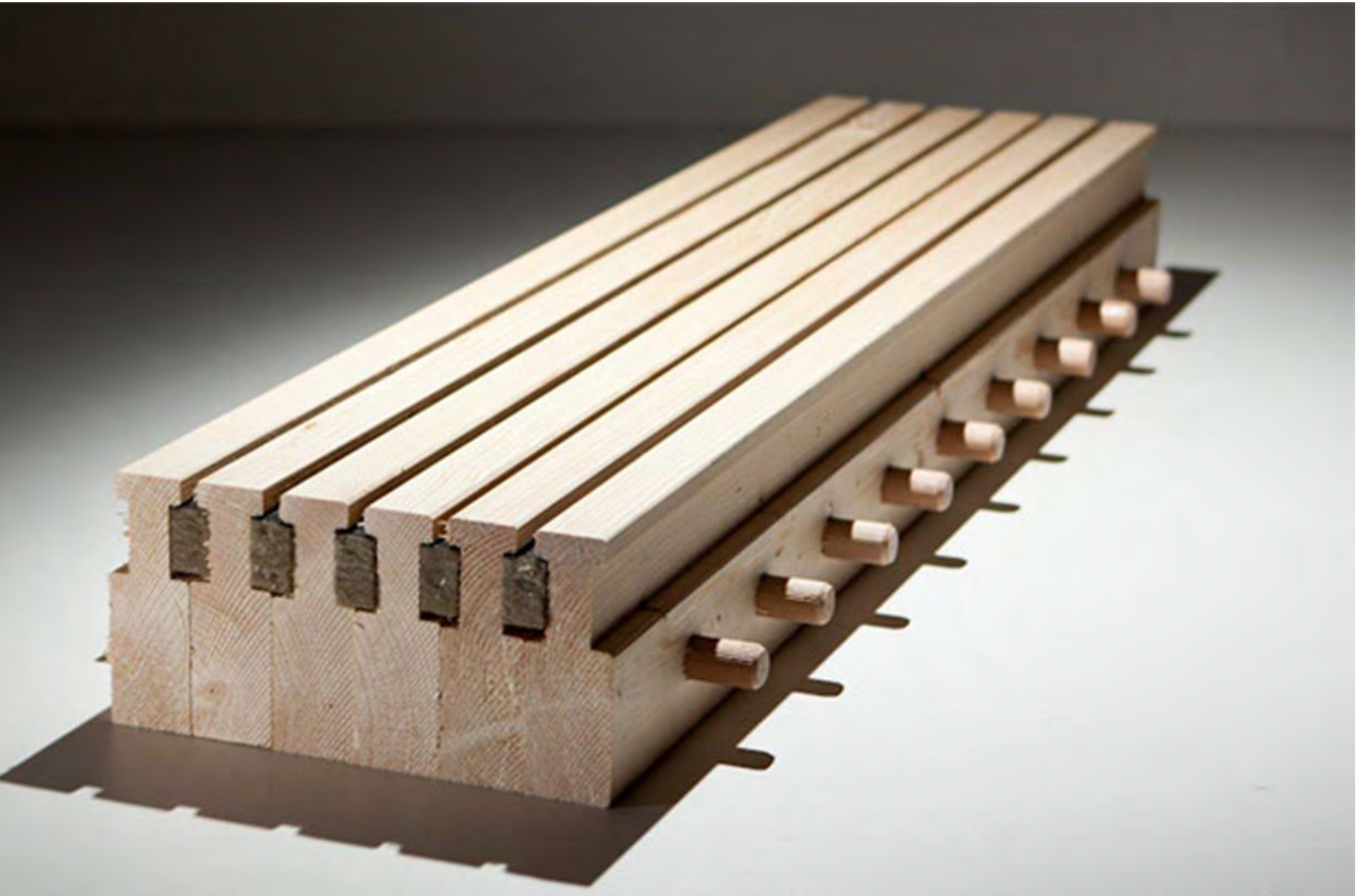
Dowel Laminated Timber

DLT

Acoustics



Acoustics | DLT



NRC = 0.2 - 0.8

Advantages | DLT

- All Wood Product
- No Off-Gassing from Glue
- No Nails
- Lowest Carbon Footprint
- Easily CNC’d

Roofs

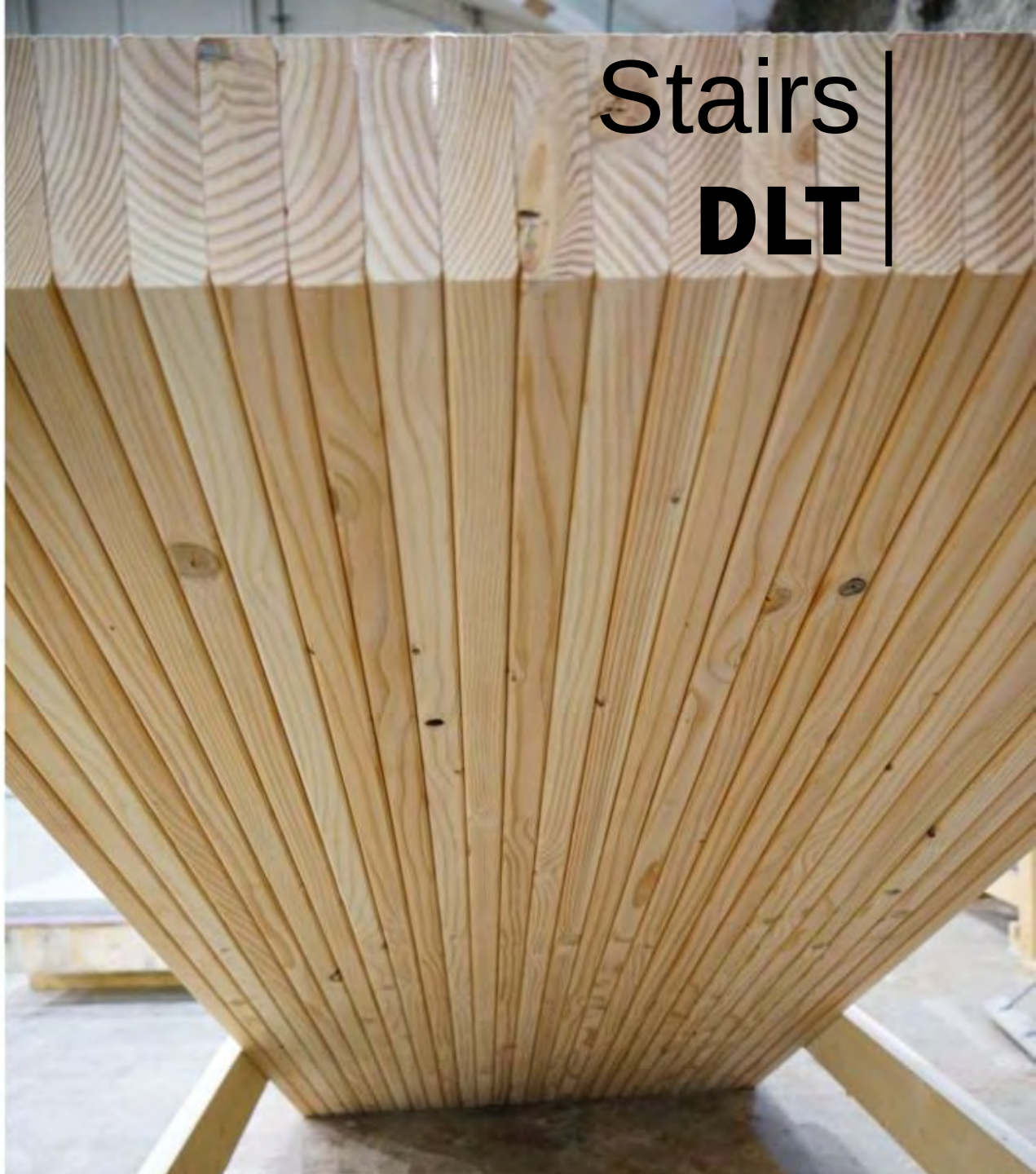
DLT

Floors

DLT

Walls

DLT

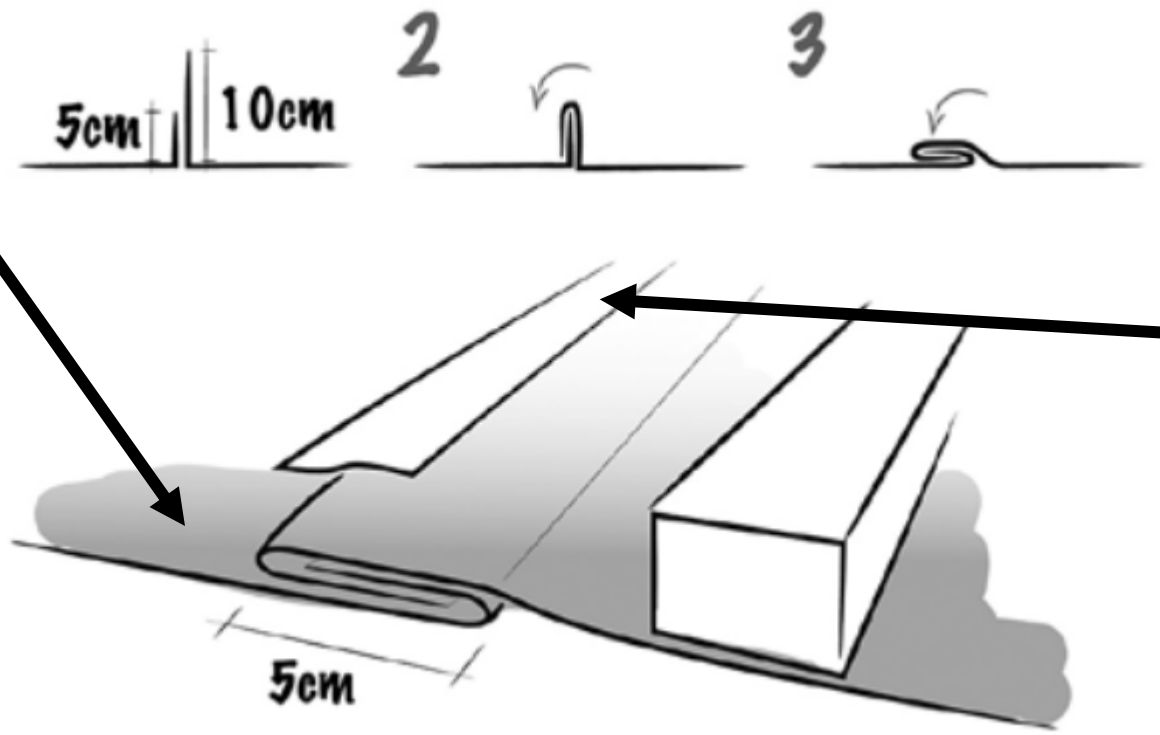


Stairs
DLT


RIDGID

Weather Protection

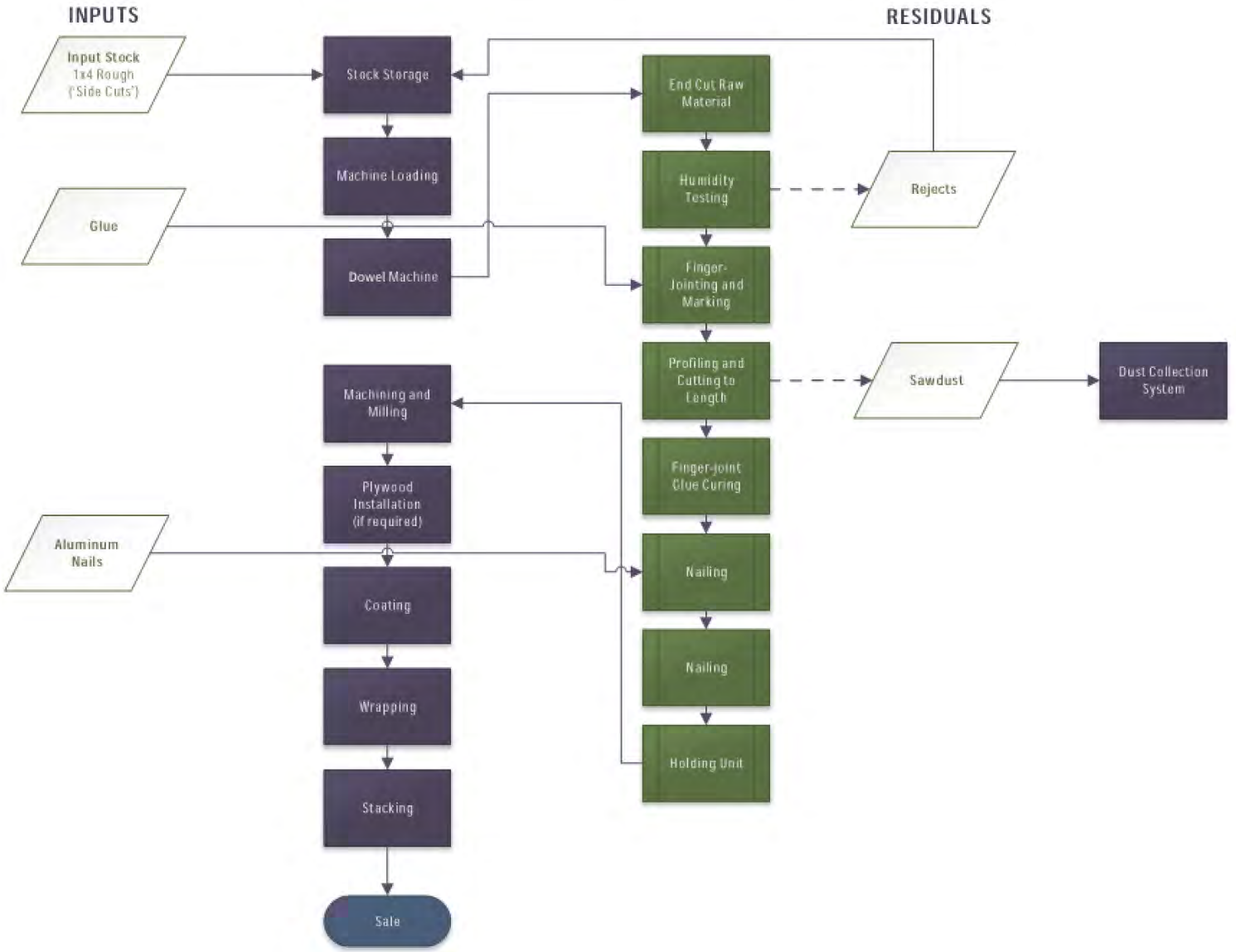
DLT




rothoblaas
rothoblaas

Manufacturing Process

DLT



DLT Machinery Line

Optimizing Saw

cuts out defects of the lamination stock

Optimising Saw → Fingerjointer → Profile Moulder → Dowel Machine → Panel Planer → CNC Machine

DLT Machinery Line

Structural Finger Jointer

The only glue used in the making of the timber panels

Optimising Saw → **Fingerjointer** → Profile Moulder → Dowel Machine → Panel Planer → CNC Machine

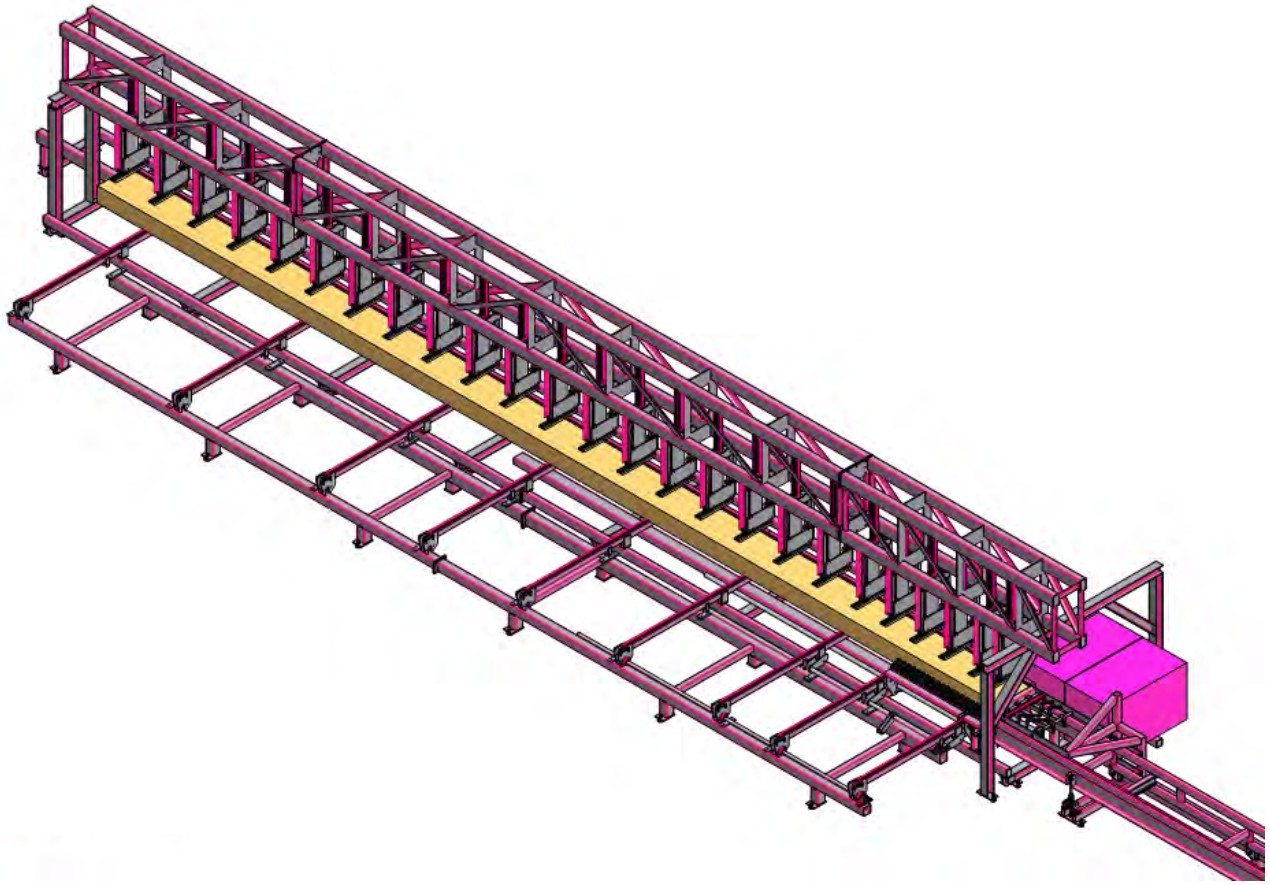
DLT Machinery Line

Profile Moulder

Cutter heads ‘square up’ the board and give any desired profile to the bottom

Optimising Saw → Fingerjointer → **Profile Moulder** → Dowel Machine → Panel Planer → CNC Machine

DLT Machinery Line



Dowel Machine

Producing panels up to 5ft wide x 60ft long

Optimising Saw → Fingerjointer → Profile Moulder → **Dowel Machine** → Panel Planer → CNC Machine

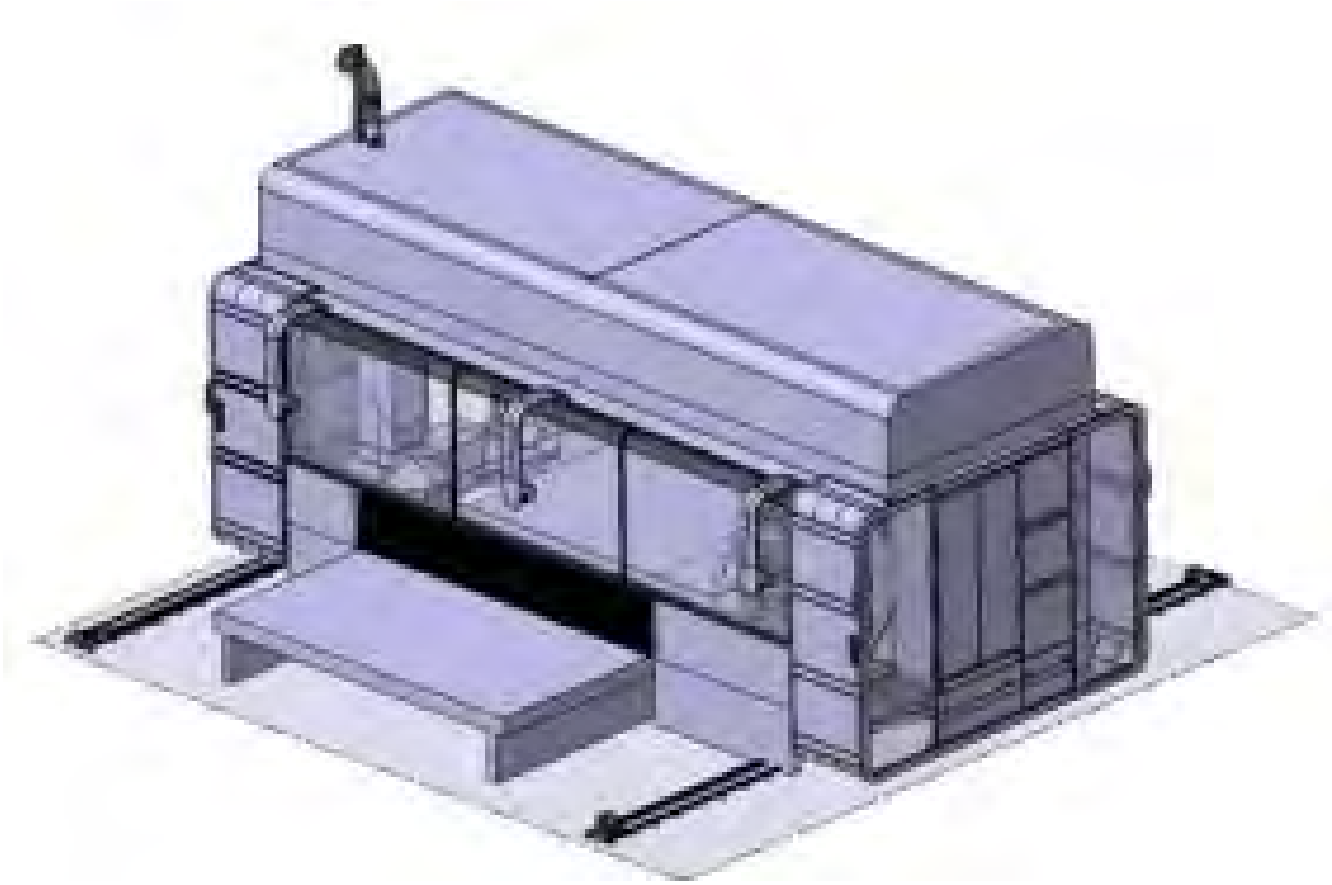
DLT Machinery Line

Panel Planer

4-sided planer squares up each panel

Optimising Saw → Fingerjointer → Profile Moulder → Dowel Machine → **Panel Planer** → CNC Machine

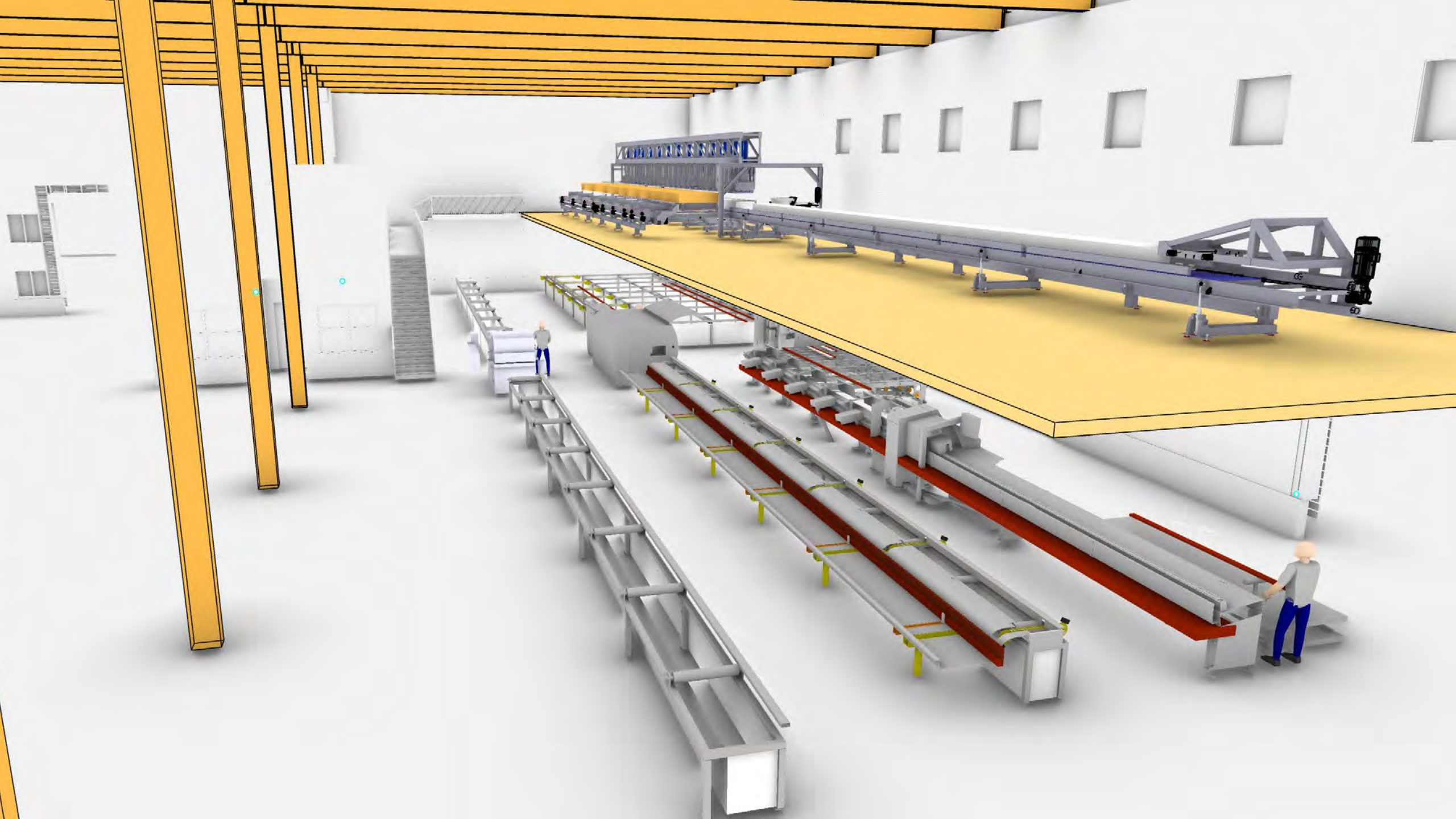
DLT Machinery Line

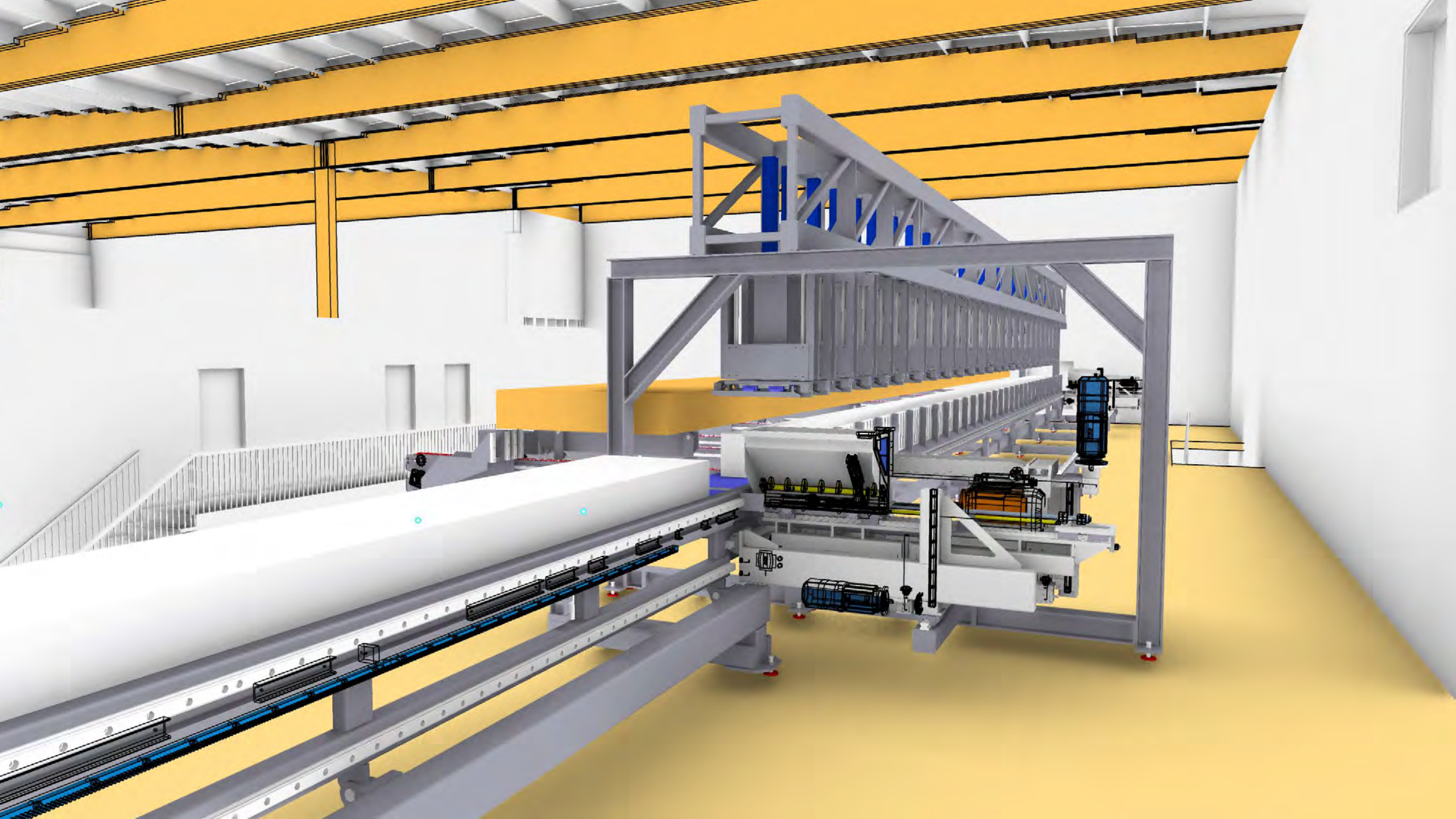


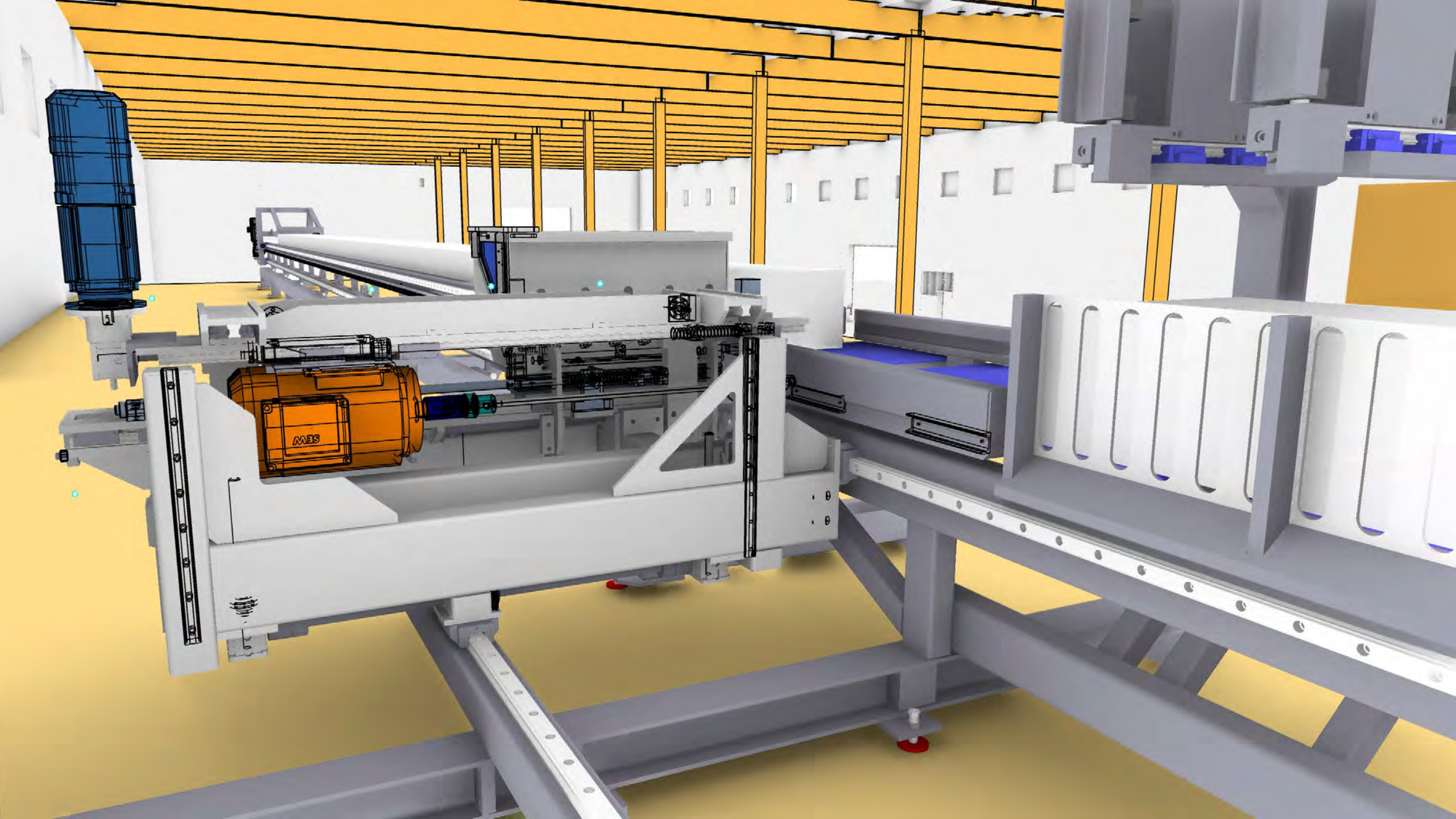
CNC Machine

5-axis gantry machine

Optimising Saw → Fingerjointer → Profile Moulder →
Dowel Machine → Panel Planer → **CNC Machine**






SEW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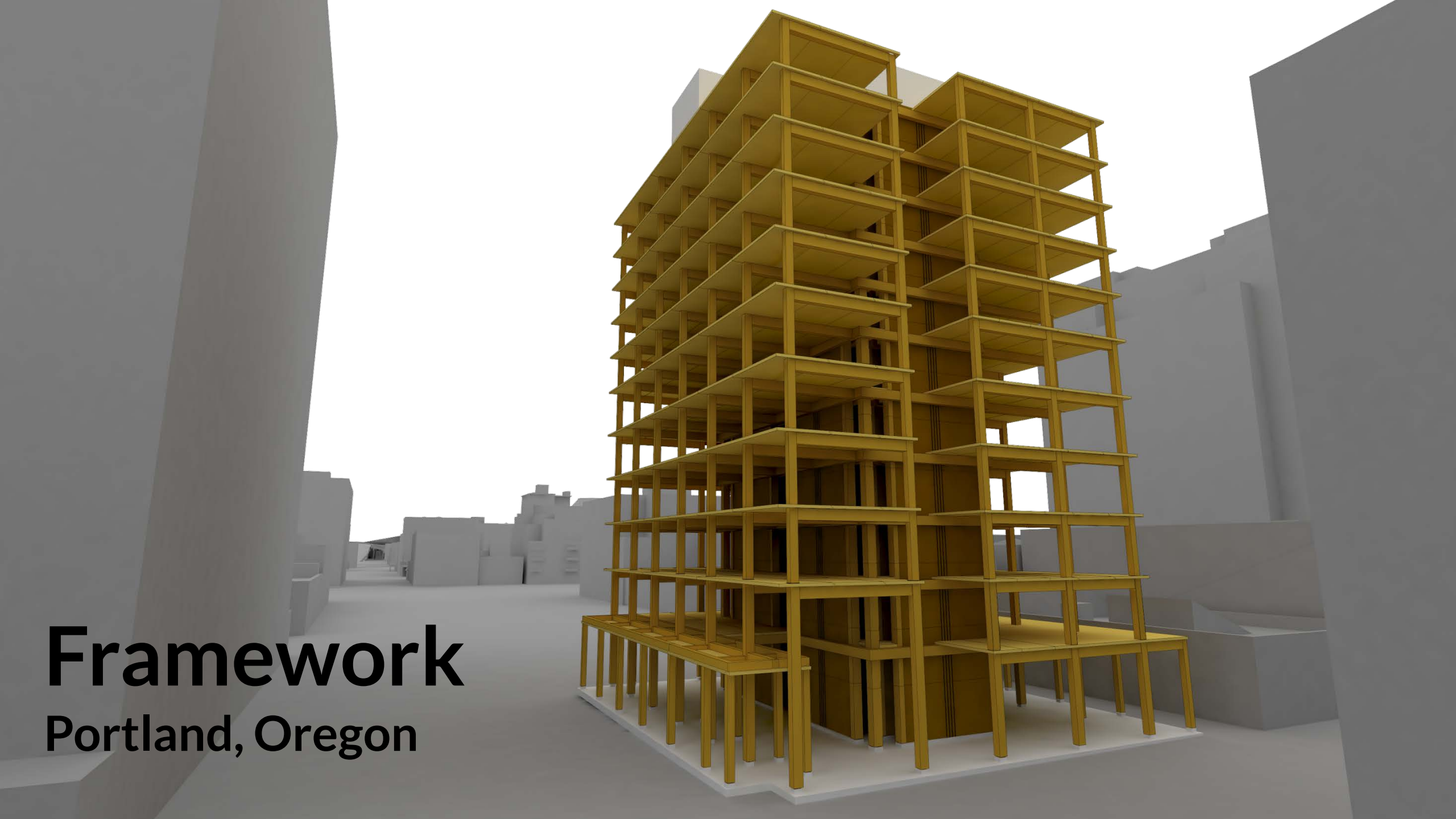
StructureCraft

New Facility
Abbotsford, BC

THE NEAR FUTURE


Framework
Portland, Oregon

Framework – Team

- **Project^ –** Developer
- **LEVER Architecture –** Architect
- **KPFF –** Structural Engineer
- **Walsh Construction –** General Contractor
- **StructureCraft –** Design-Assist-Build delivery partner for the timber structure

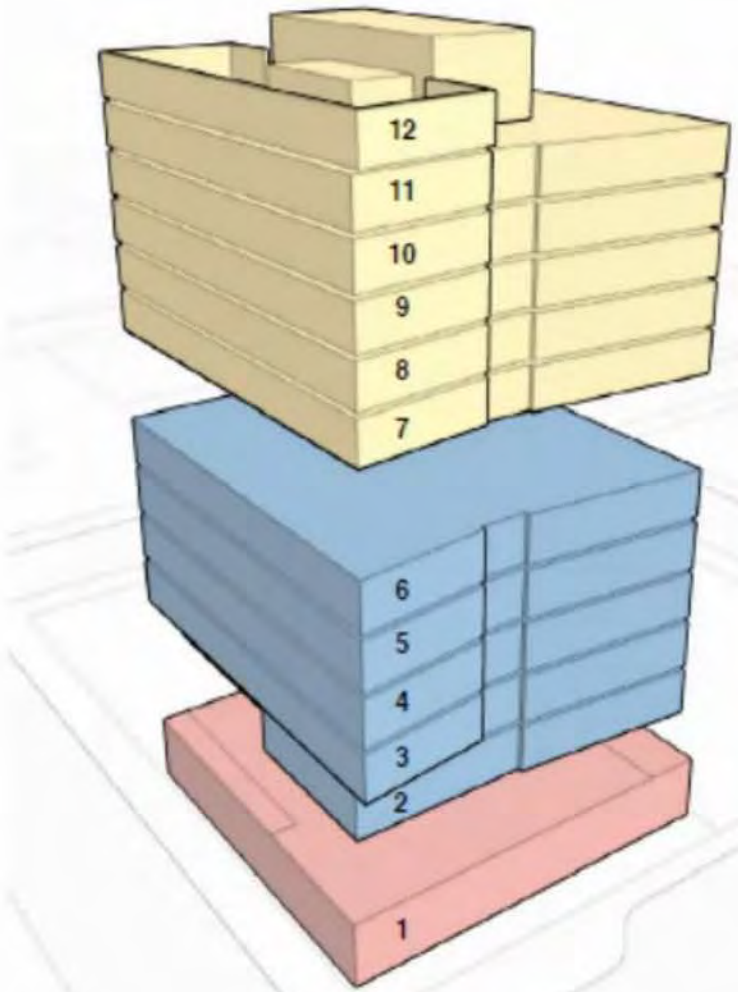
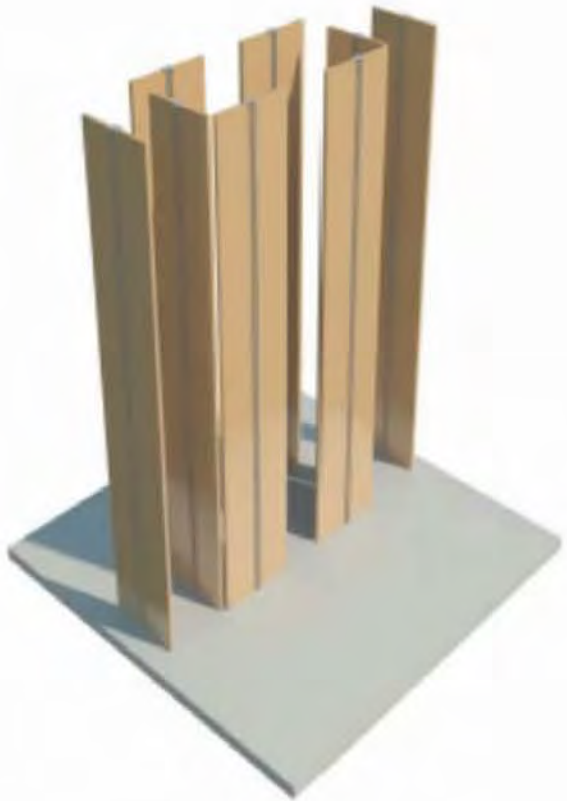


Image 26: Building Program

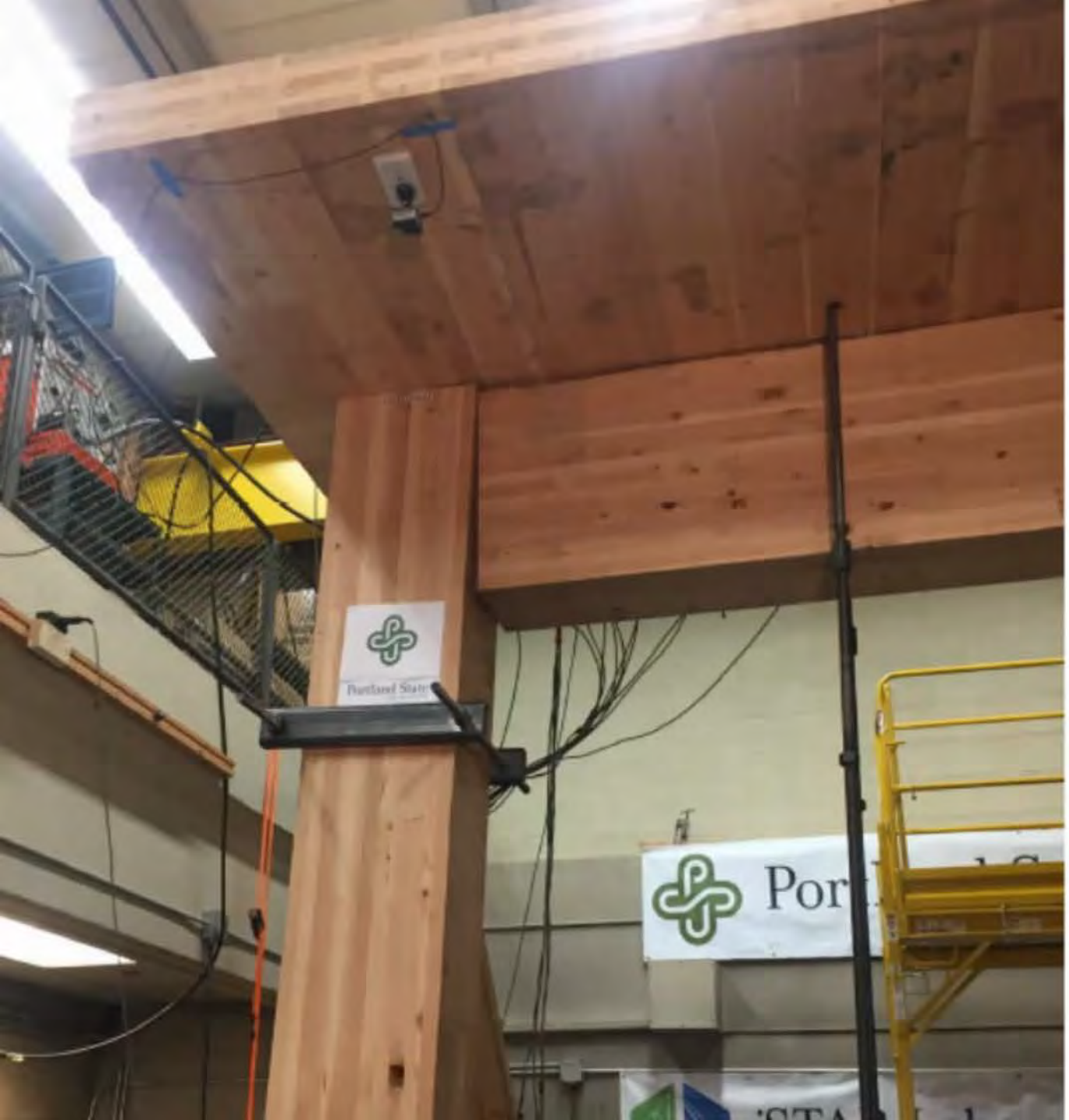
Level	Use
12	Roof Deck
7-11	Affordable Housing
4-6	Spec Offices
3	Beneficial Bank Offices
2	Albina Bank Offices
2	Community Room
1	Albina Bank Branch
1	Spec Retail Kiosk

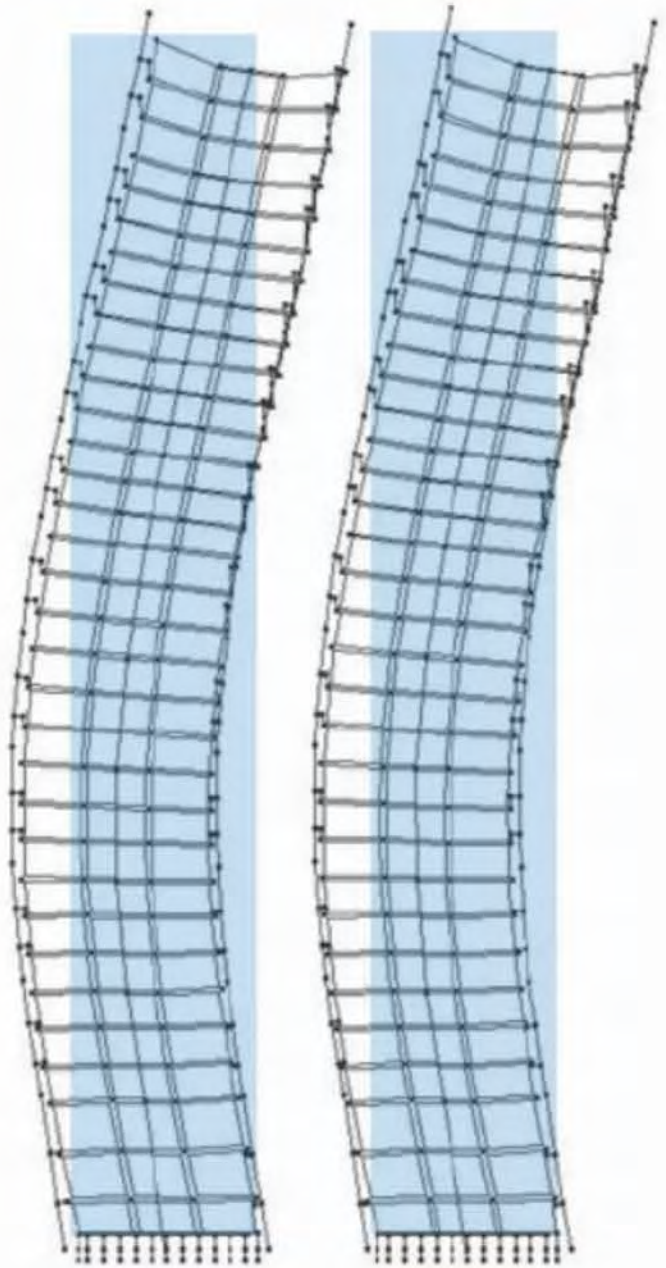
Framework Firsts

- **Tallest** all-mass-timber building in North America
- First high-rise with **exposed wood** in North America
- First **post-tensioned rocking CLT** core system in the world
- First project carrying out **fire tests** on exposed glulam connections, CLT and glulam beam-floor assembly in North America
- First mass timber structure which meets a **2hr fire rating** in NA



RESILIENT / LOW DAMAGE DESIGN:
POST TENSIONED CLT ROCKING WALL



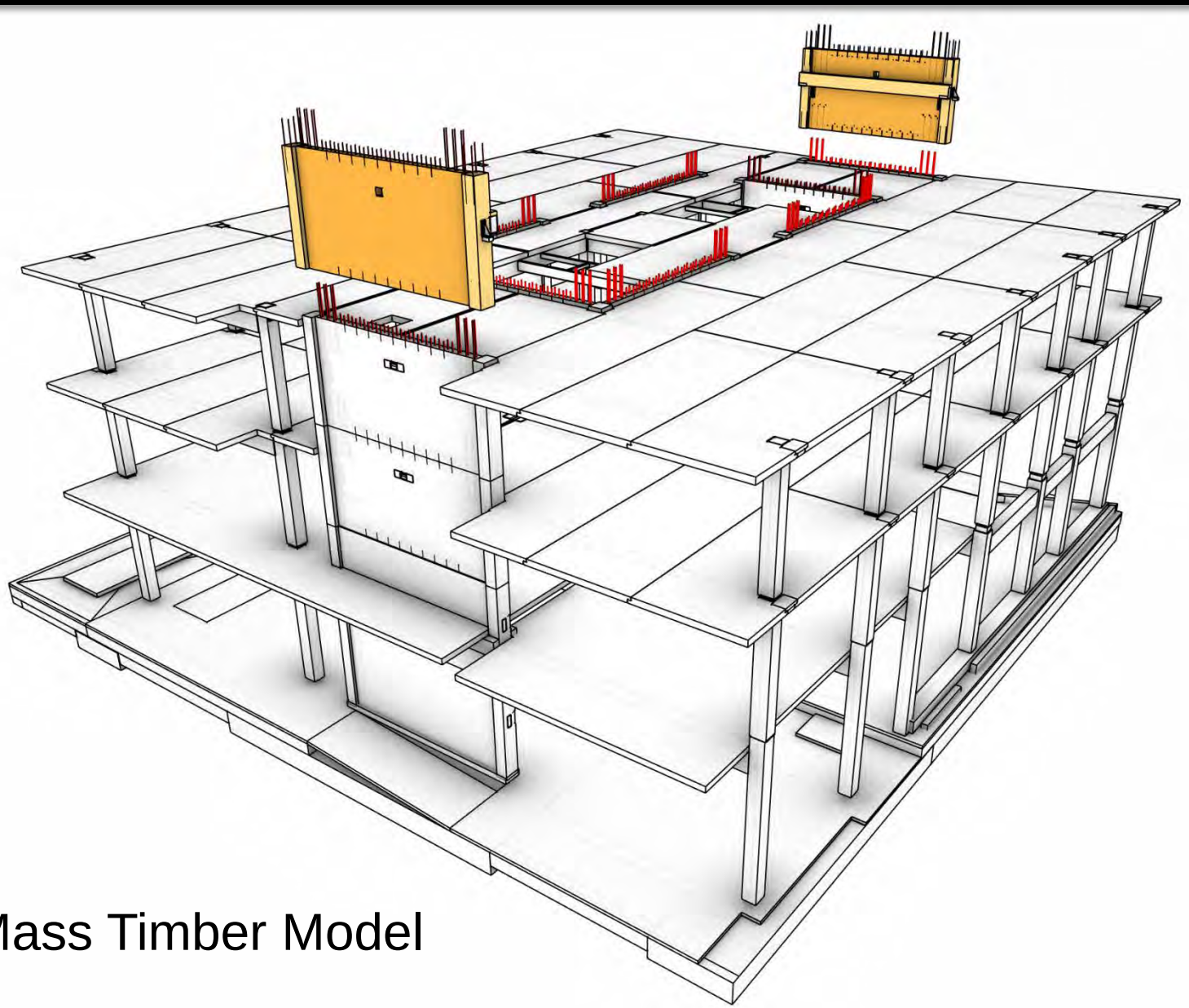


2-HOUR RATED MASS TIMBER BEAM/COLUMN ASSEMBLY

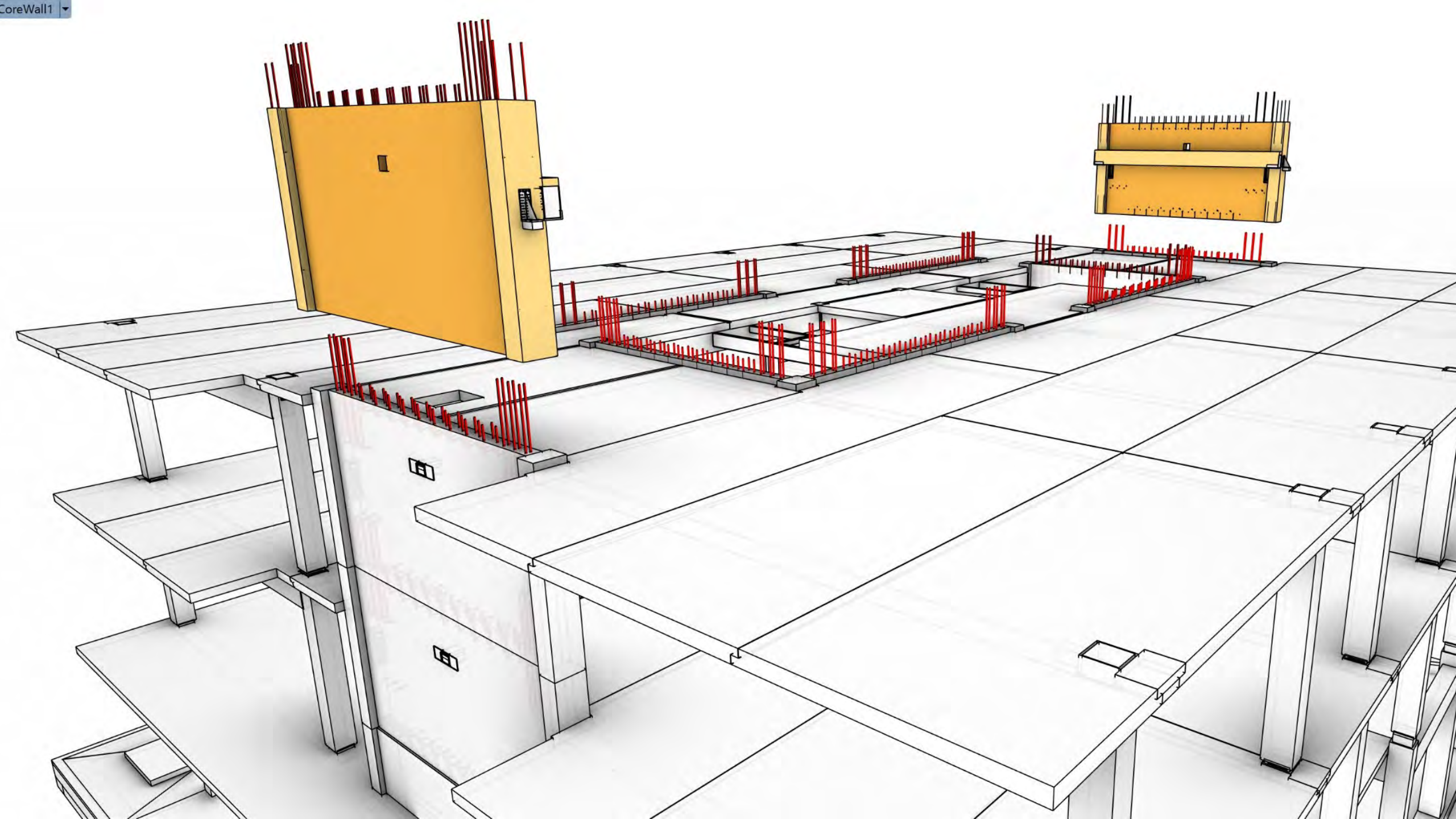
FRAMEWORK TOWER, PORTLAND OR

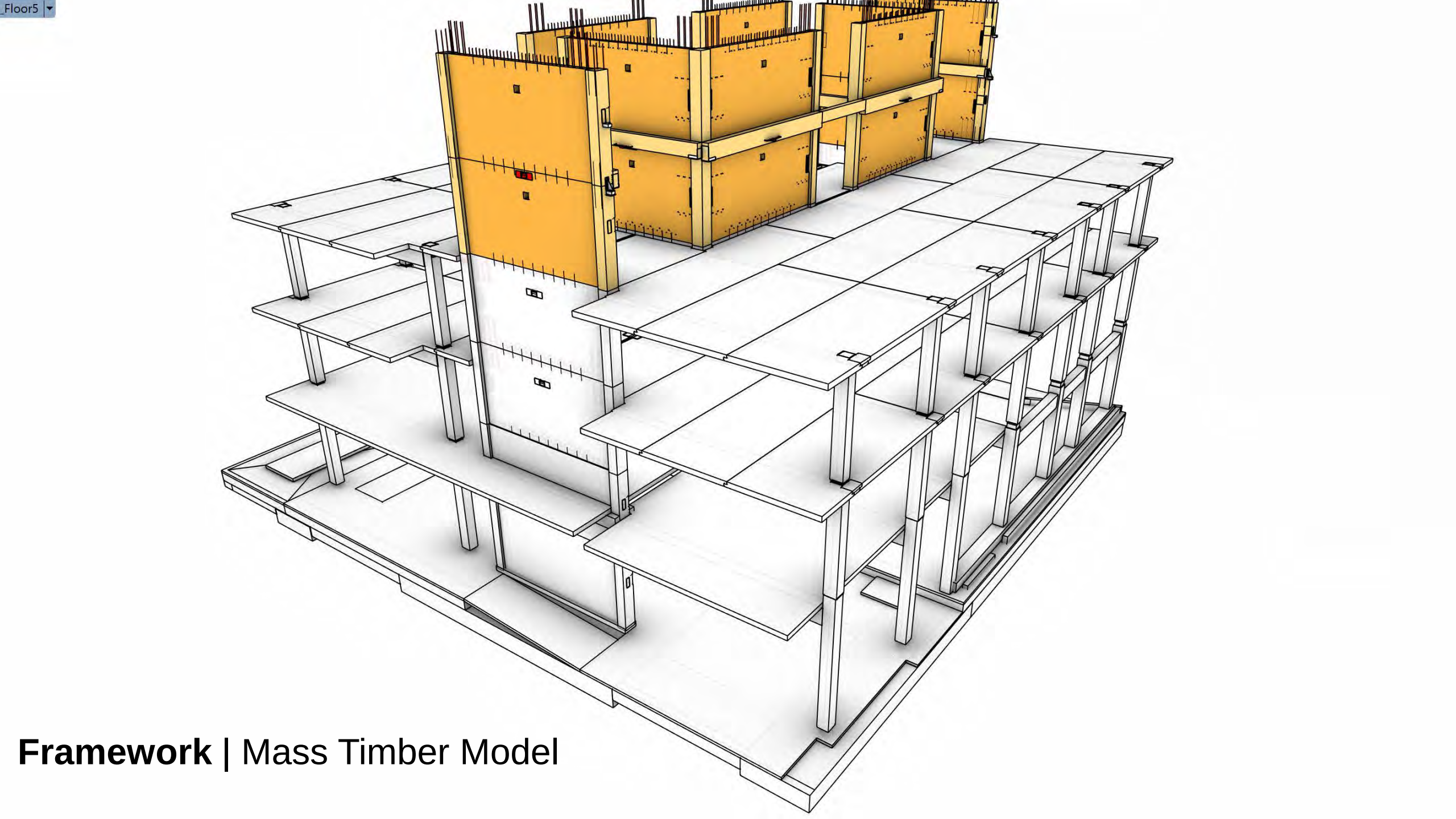
rendering: LEVER Architecture

Erection Strategy – single-height core wall panels

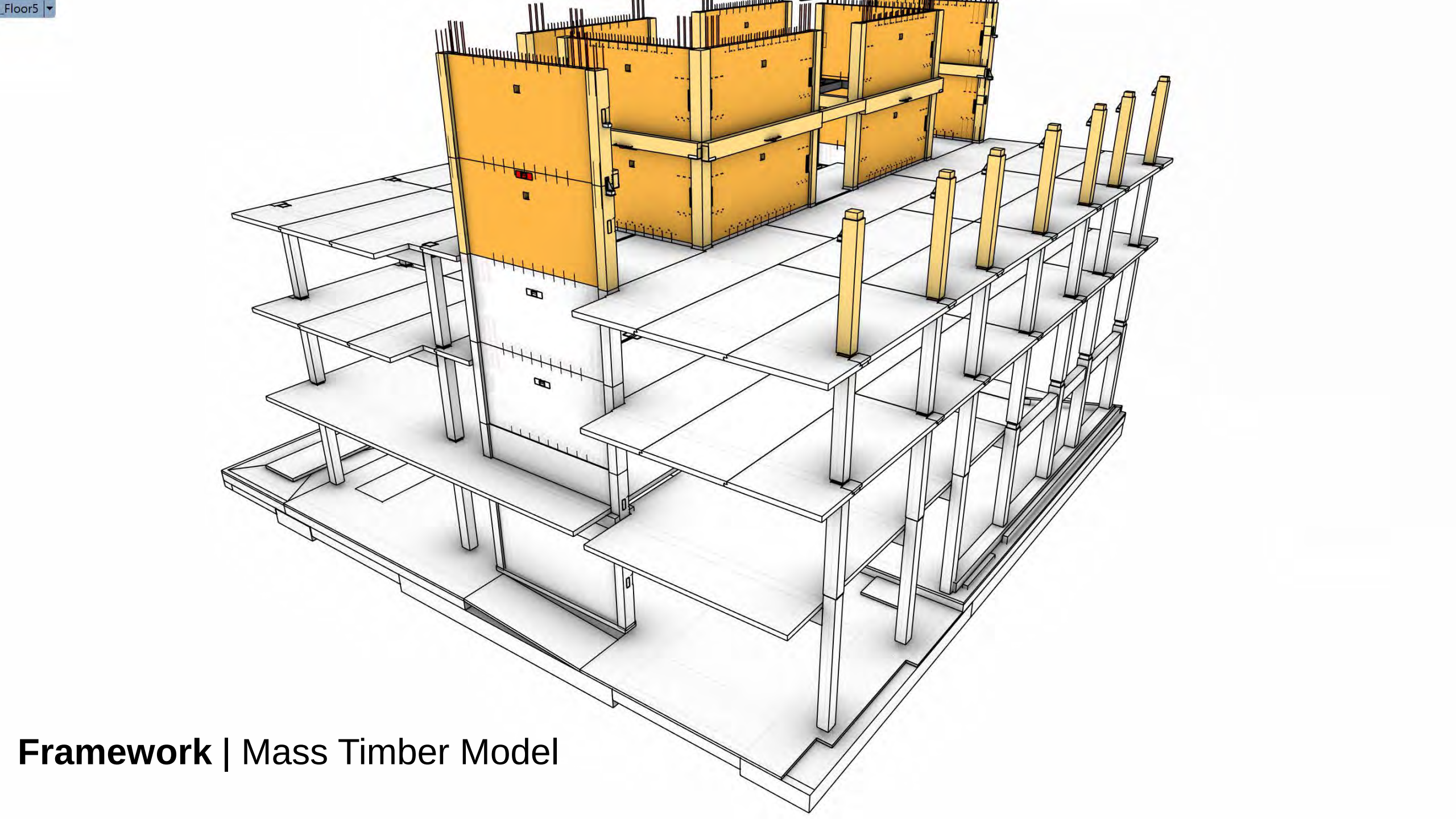


Framework | Mass Timber Model

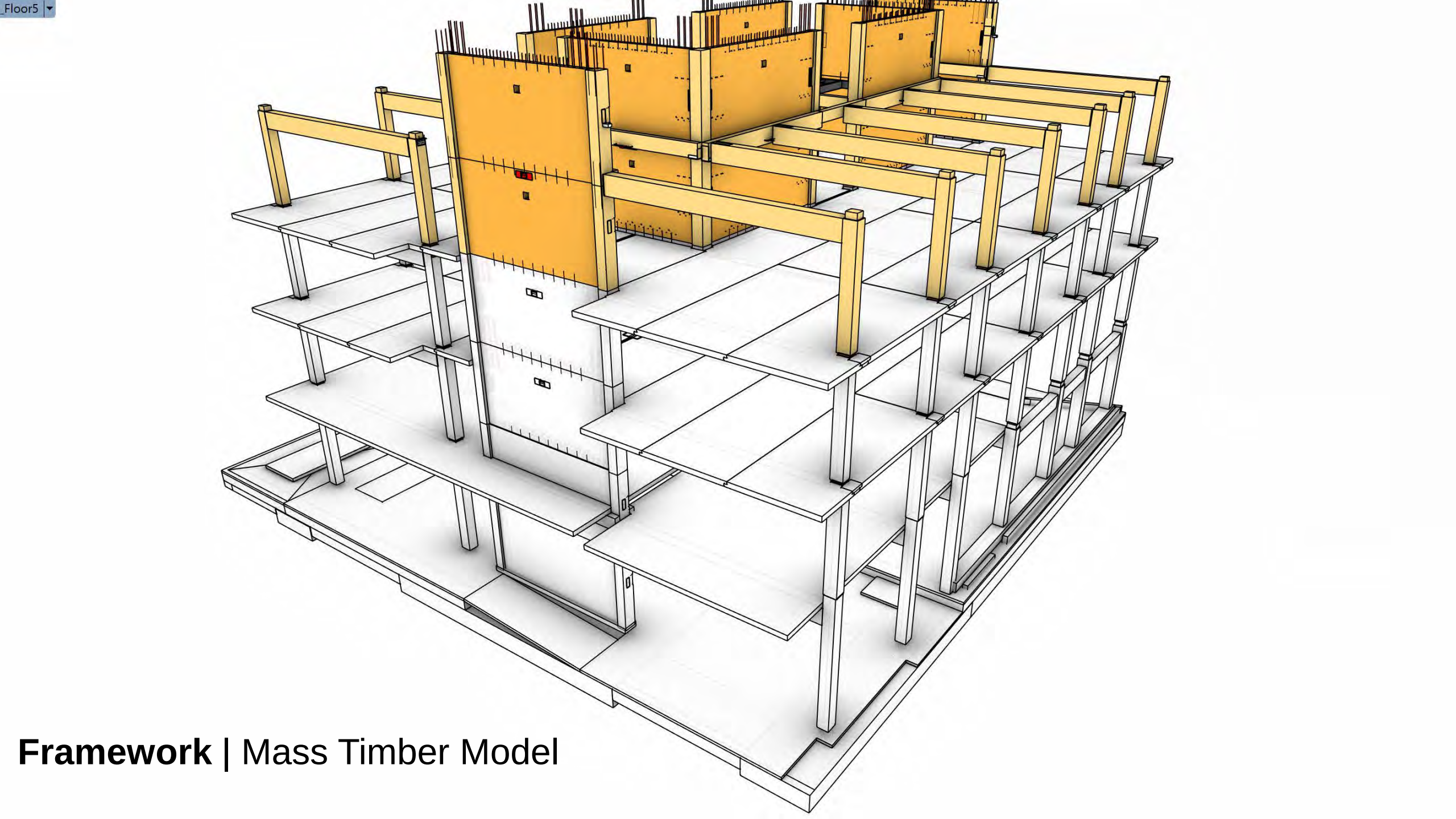

CoreWall1



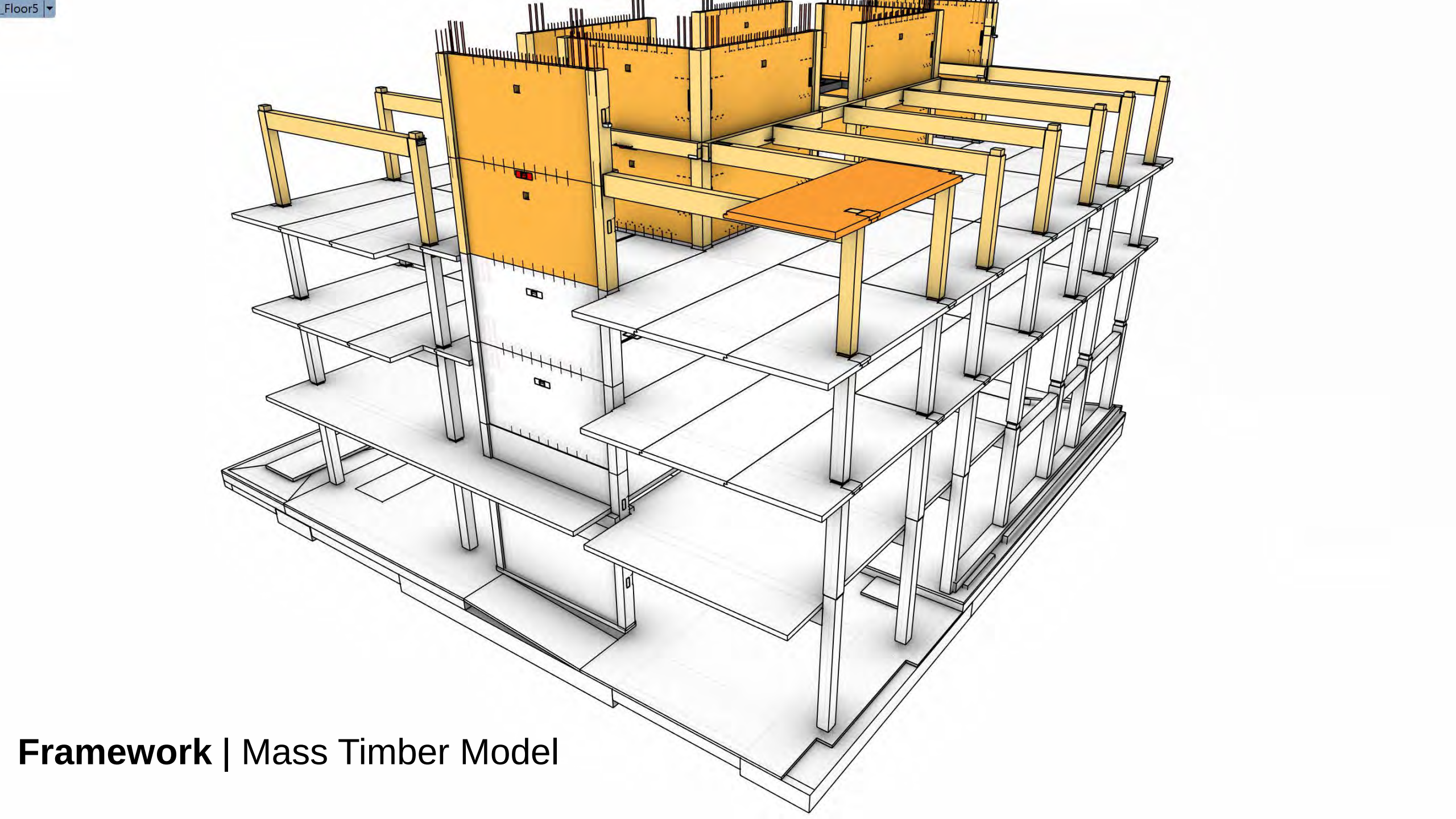
Framework | Mass Timber Model



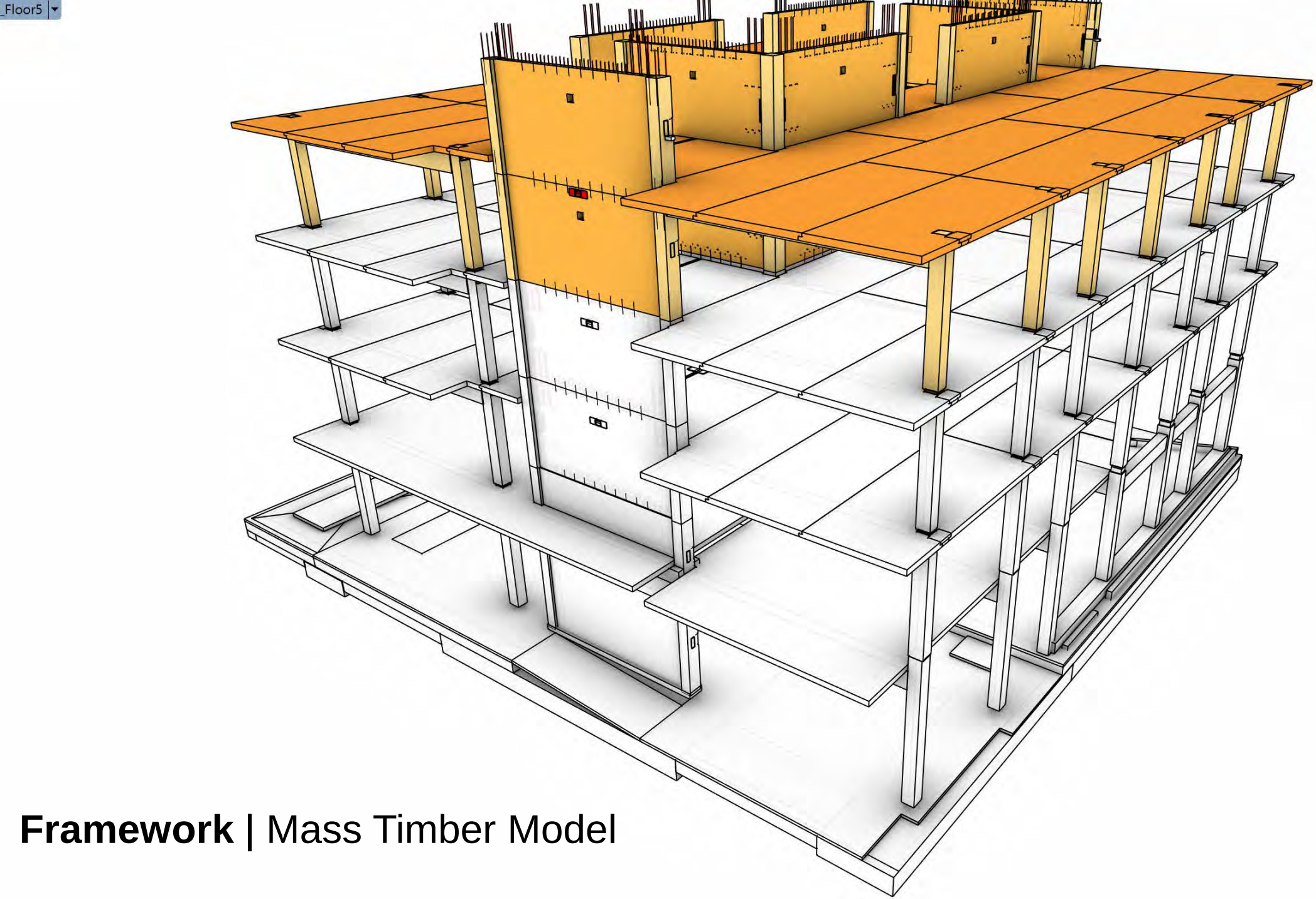
Framework | Mass Timber Model



Framework | Mass Timber Model



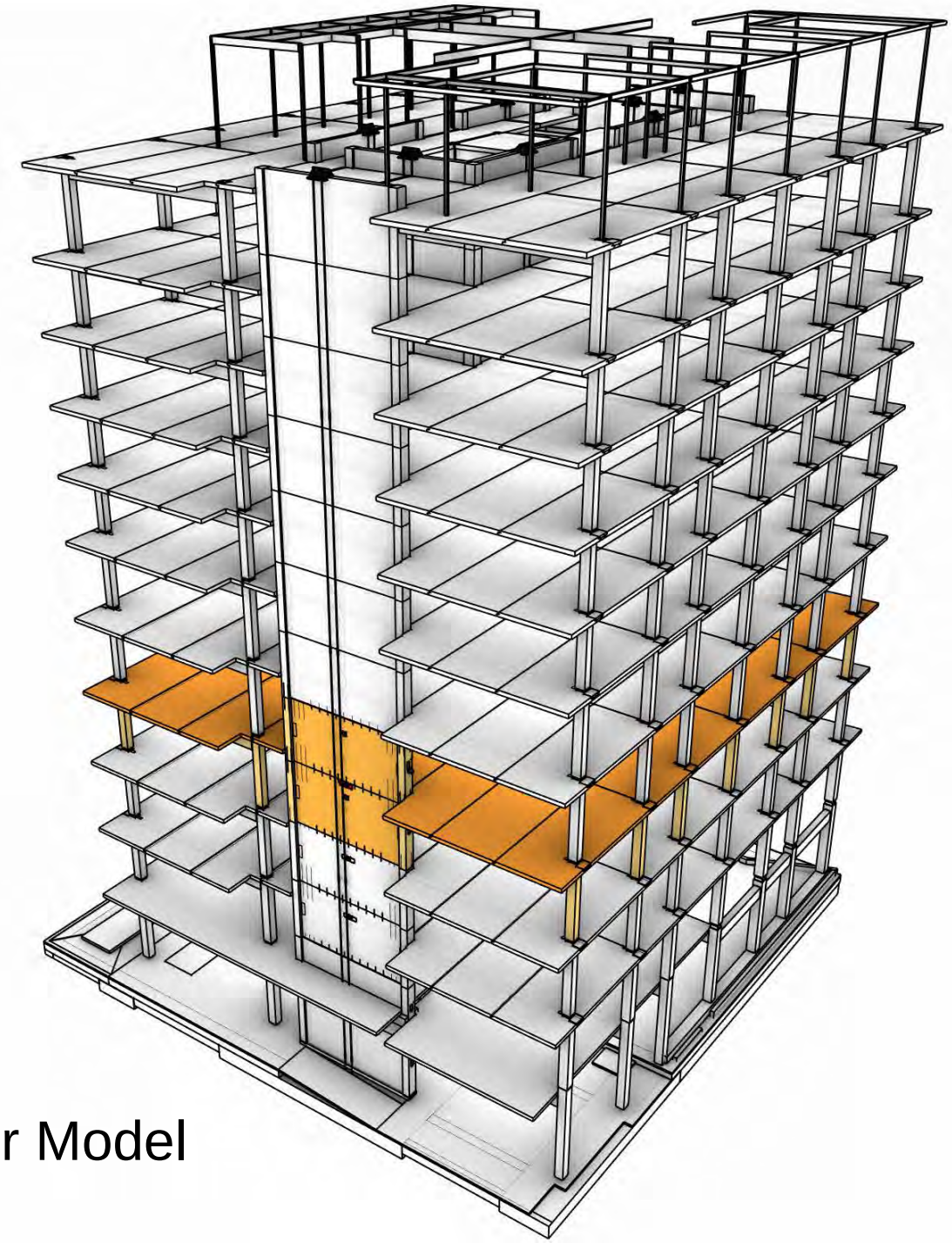
Framework | Mass Timber Model



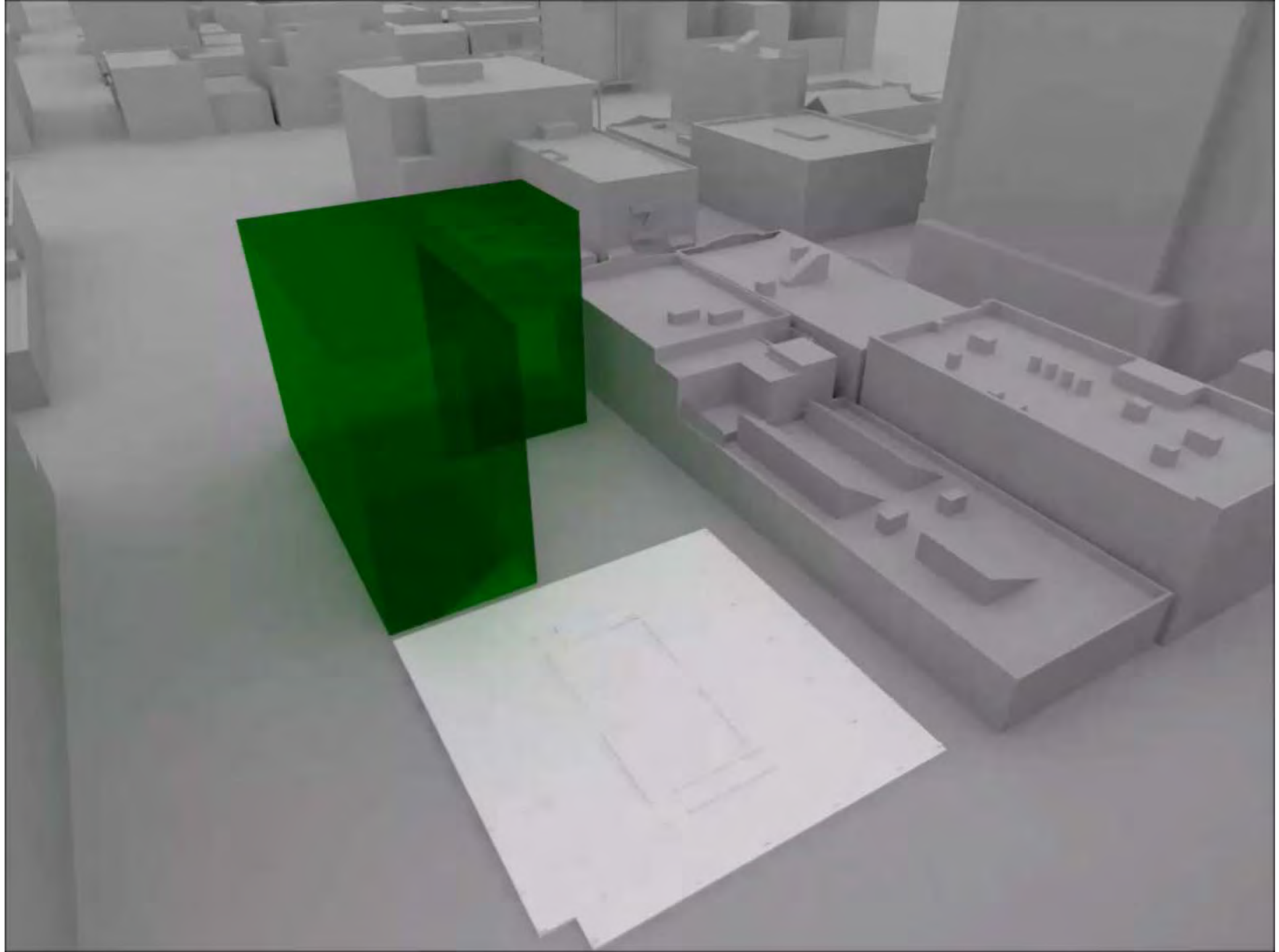
Framework | Mass Timber Model

Framework | Mass Timber Model

_Overall



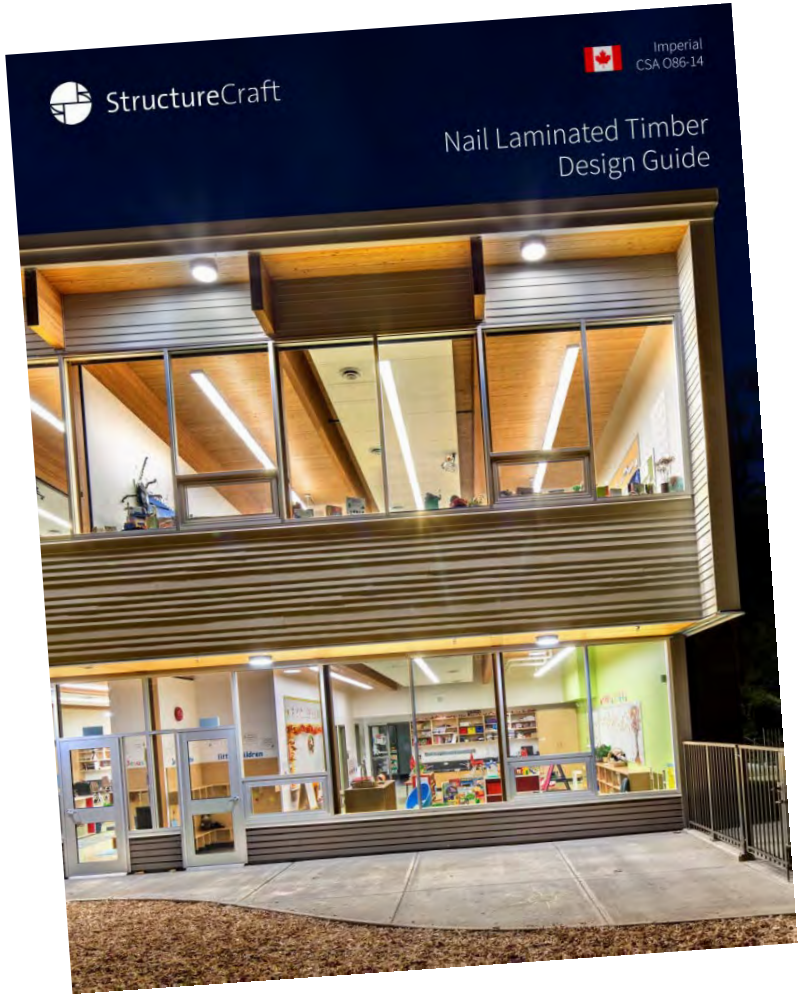
Framework | Mass Timber Model



StructureCraft

NLT & DLT

something old, something new



Questions?