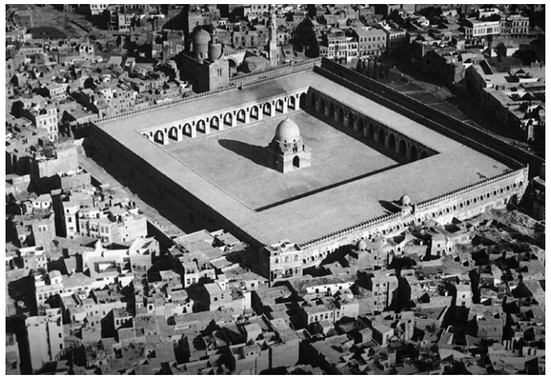
MISSISSIPPI WORKSHOP / THE ALL-WOOD BUILDING

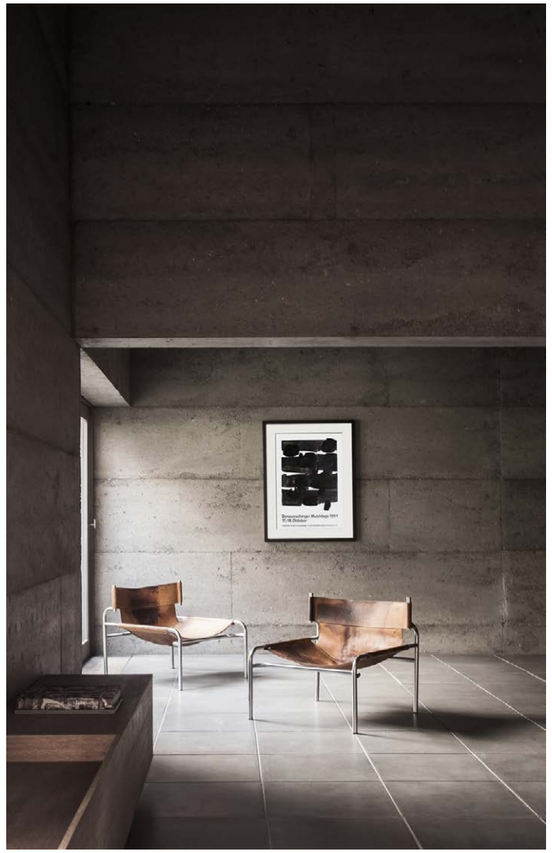
WAECHTER ARCHITECTURE

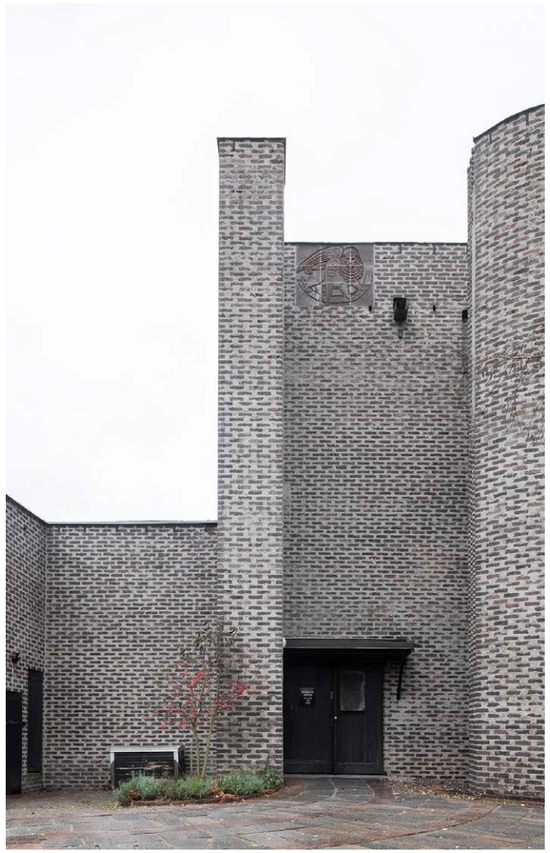
Our vision and mission can be summarized in a word—Clarity.

We believe that architecture is at its best when buildings are legible, when they make sense, and when they elegantly serve their purpose.

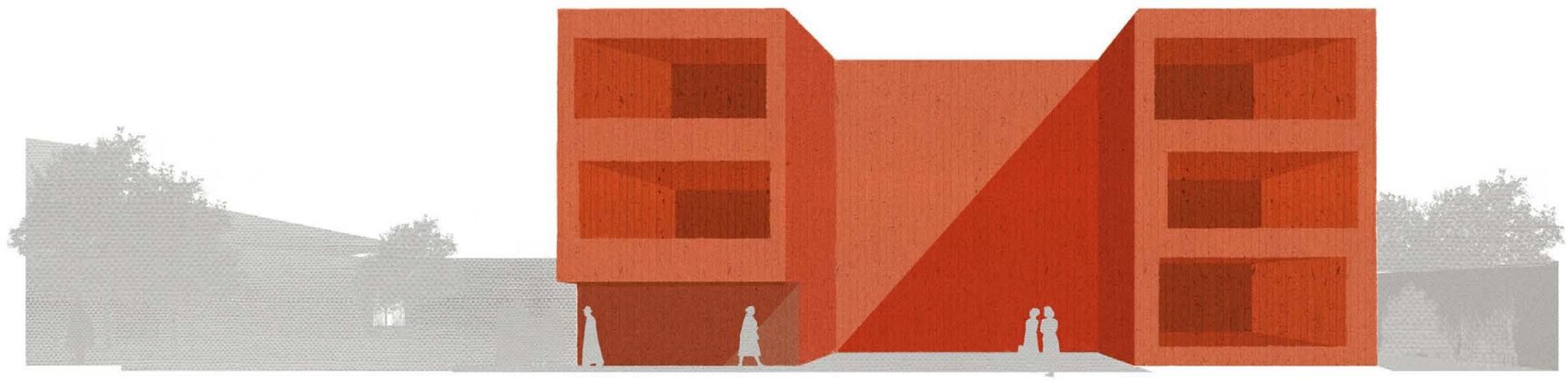
Clarity isn’t just a style or formal vocabulary, it’s an experience that yields a feeling of calm, assurance, and limitless possibility.





PROJECT OVERVIEW



CONTEXT

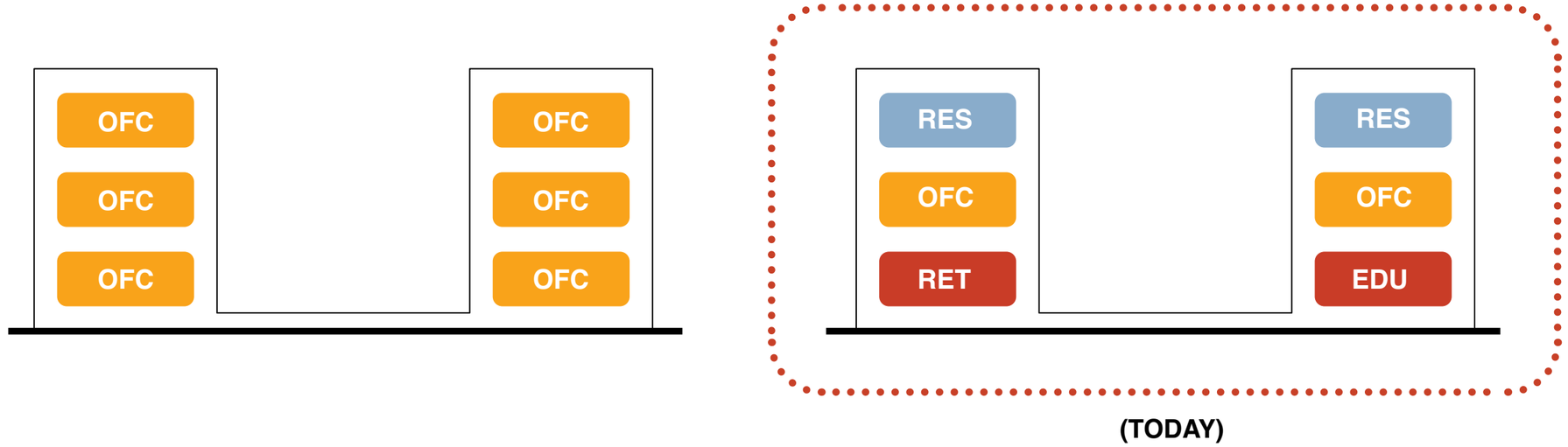

N HAIGHT AVENUE
N COMMERCIAL AVENUE
N KERBY AVENUE
N BORTHWICK AVENUE
N ALBINA AVENUE
N MISSISSIPPI AVENUE
N MICHIGAN AVENUE
N MISSOURI AVENUE
N MONTANA AVENUE
N INTERSTATE AVENUE
N MARYLAND AVENUE
I-5 FREEWAY
N BLANDENA STREET
N SKIDMORE STREET
N MASON STREET
N SHAVER STREET
N GOING STREET

Portland Archives, A2009-009.1025


HOTEL
OPEN
CAFE
McMENAMINS
COCKTAIL
BAR
VACANCY


mother foucault's bookshop
GLIFFORD
527

ORGANIZATION AND PROGRAMMING CONCEPTS



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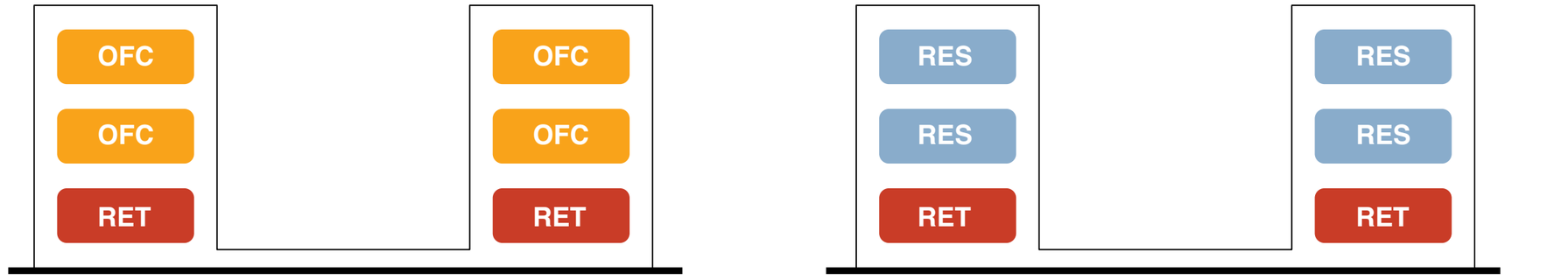
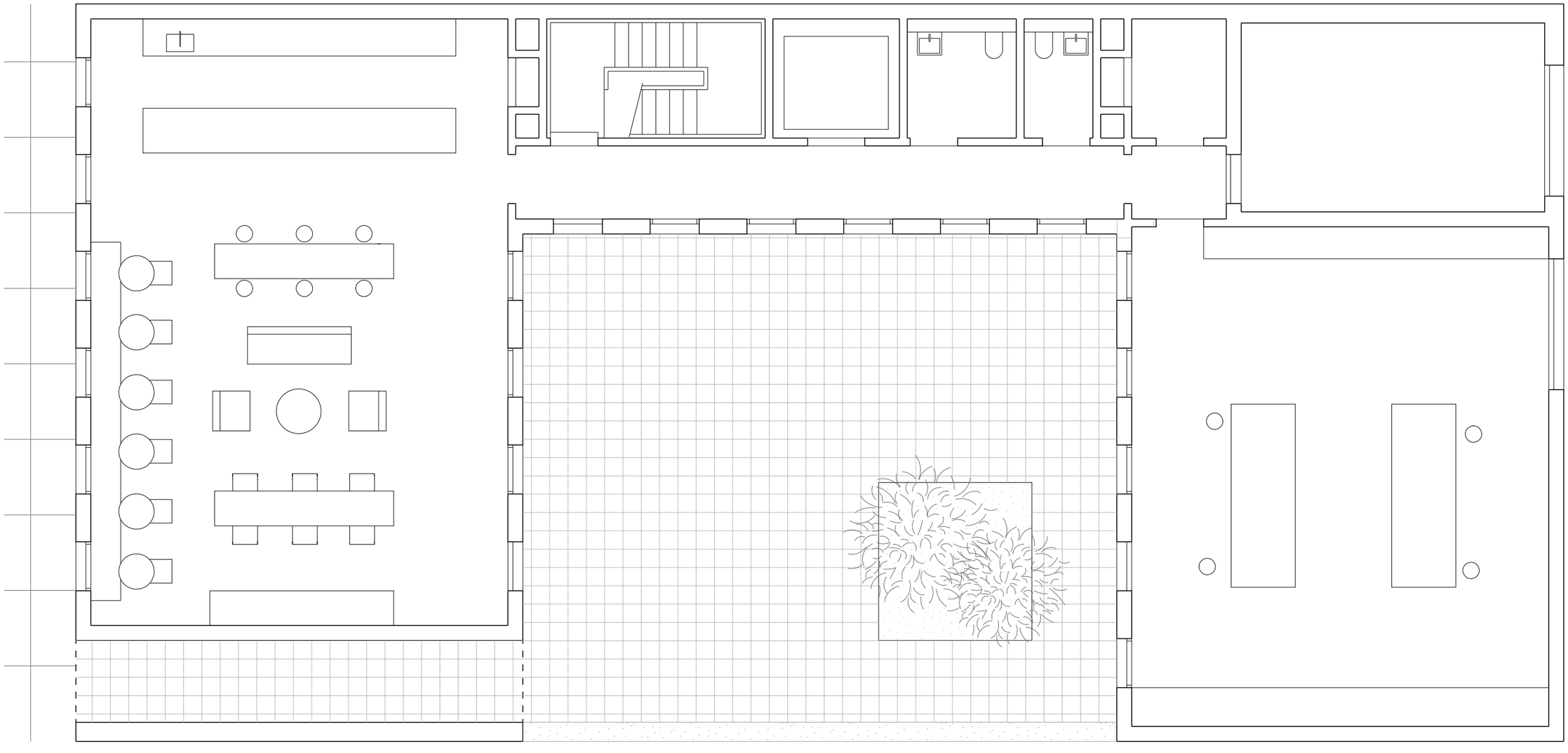


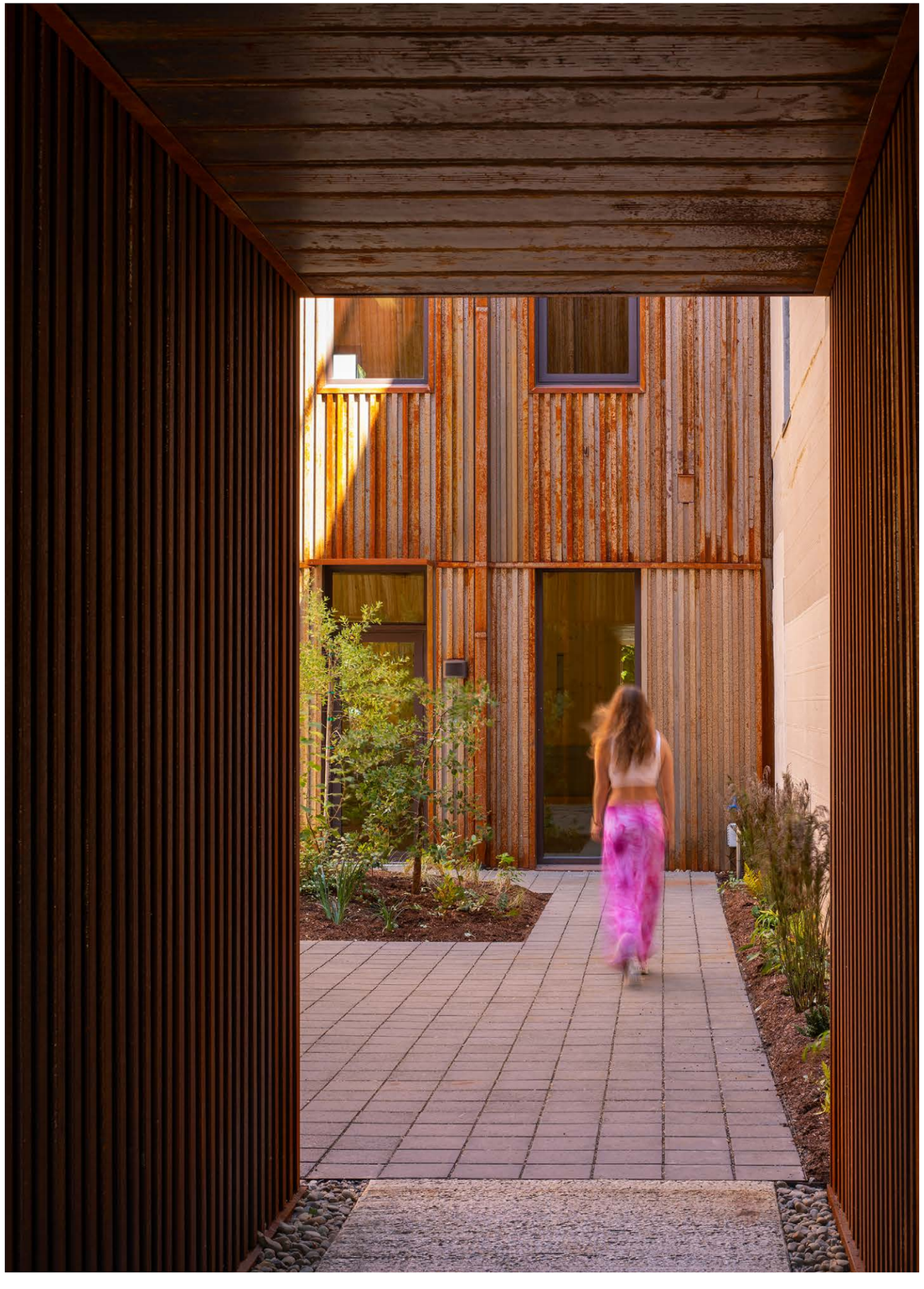
OFFICE

RESIDENTIAL

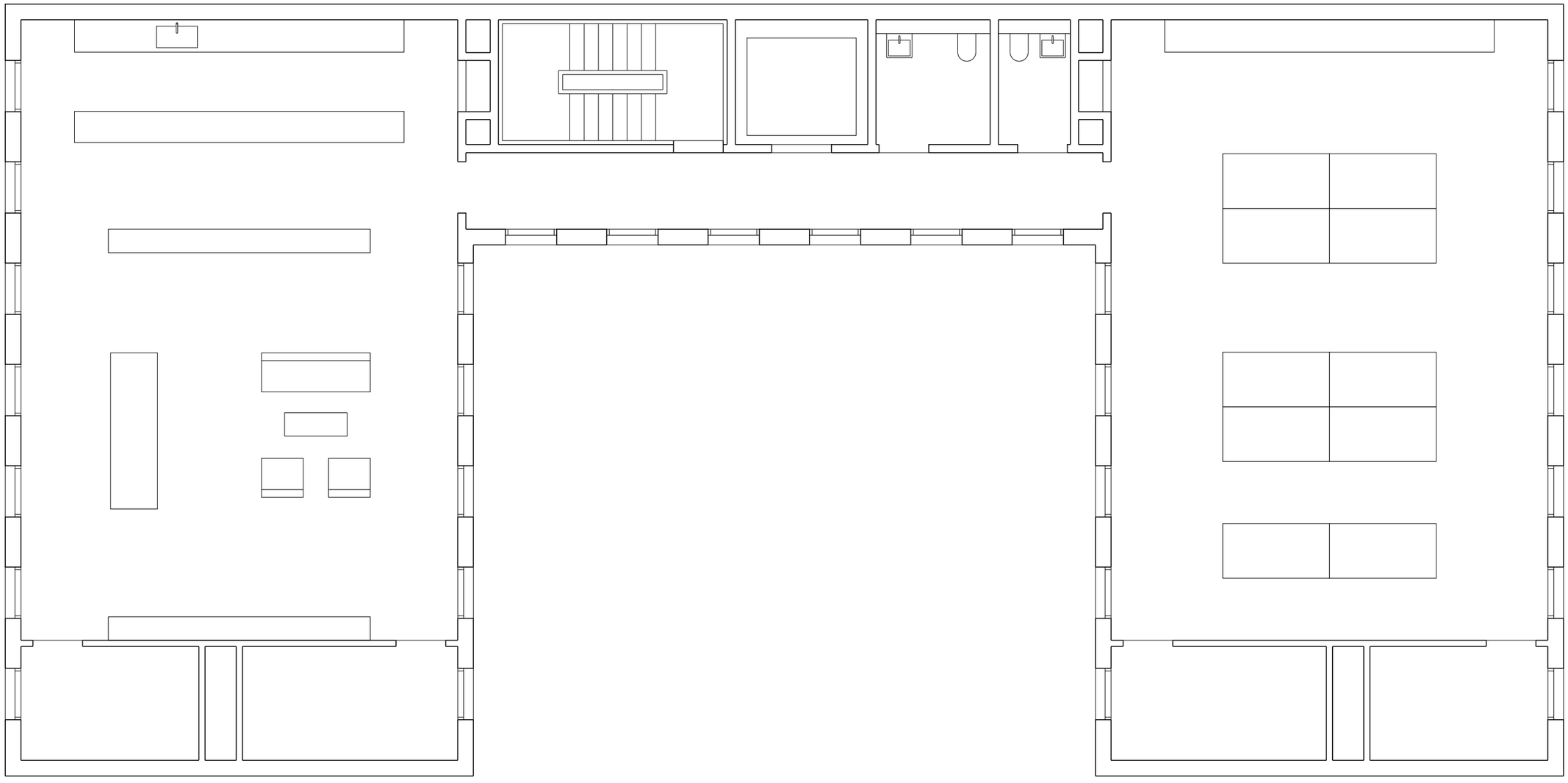
RETAIL / WORKSHOP / EDUCATION



FIRST FLOOR PLAN



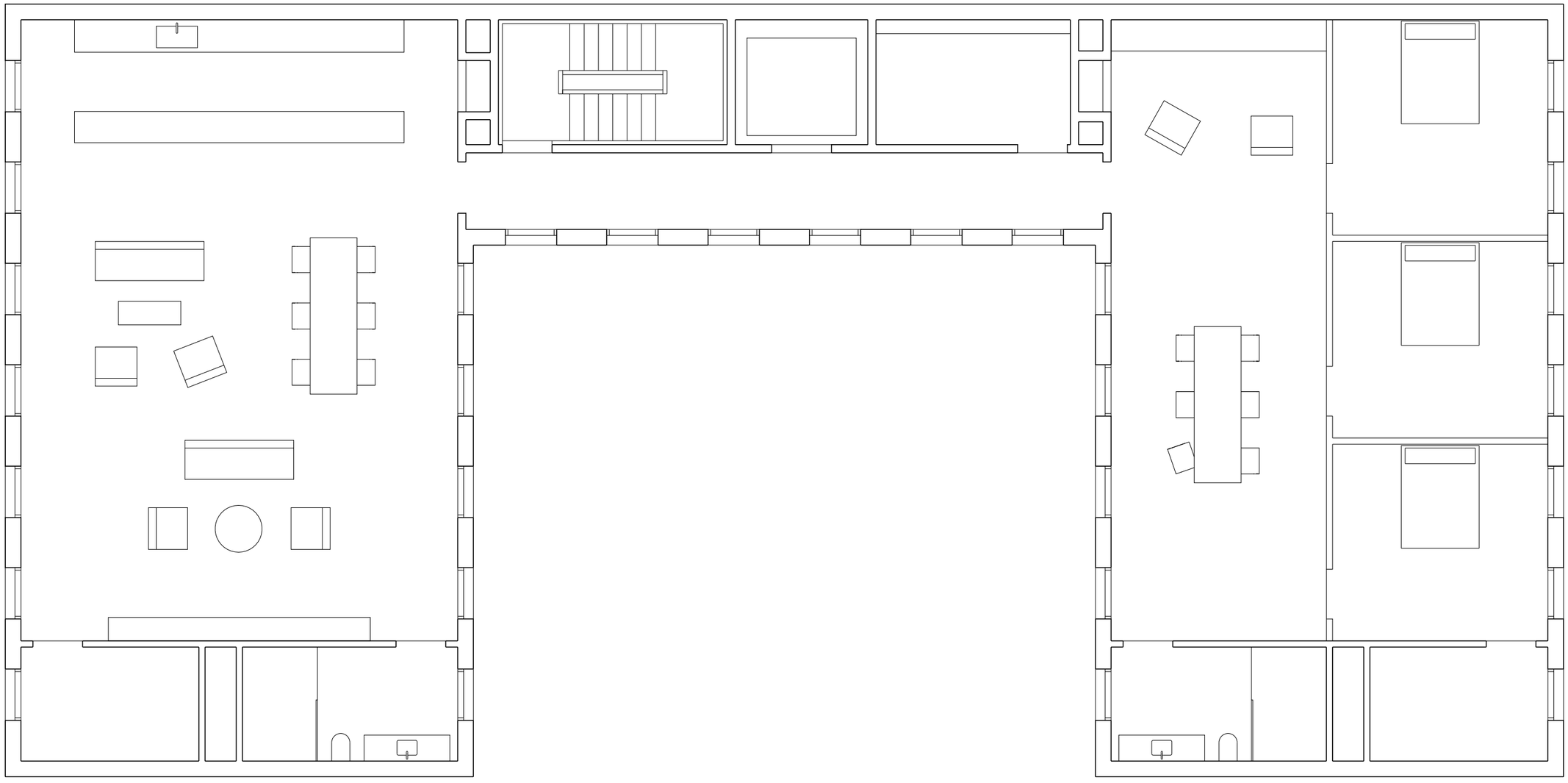

WAECHTER
WORKSHOP



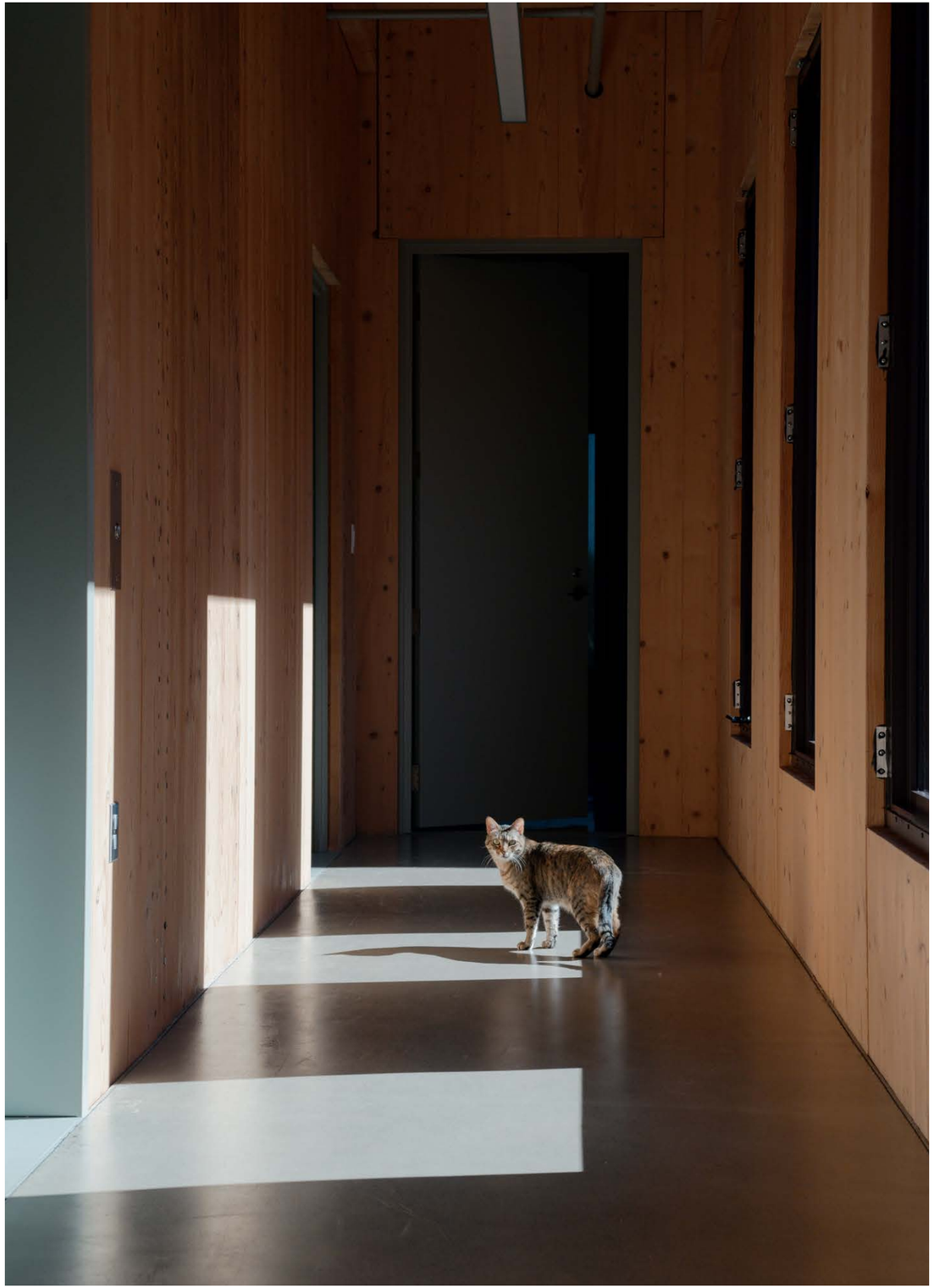
SECOND FLOOR PLAN


DELL


WINTER LIGHT FESTIVAL
February 2-10, 2024
Call for Architecture, Design & Creative Firms



THIRD FLOOR PLAN



MATERIAL SYSTEMS

CROSS-LAMINATED TIMBER

PRODUCT DESCRIPTION

KLH® CLT is a versatile building material characterized by its dimensional stability and accuracy, and its high level of prefabrication. KLH® solid wood panels are used for wall, floor slab, and roof elements.

The biaxial qualities of CLT provide a multitude of opportunities for exciting architectural designs. KLH® elements can be combined with most building materials and structural systems to produce exciting and innovative design arrangements. By utilizing CLT in a bearing wall system, the thicknesses of floor and wall elements can be minimized to achieve an increase in building volume over traditional framed bearing wall and dropped-ceiling systems.

KLH® superstructures are erected by knowledgeable construction companies, typically using a mobile crane. An average of 25 minutes is required to place each element, depending on the complexity of the structure and site conditions. Erection of CLT for a detached residential dwelling of average size and complexity typically takes approximately 1-2 days. Erection crews are usually made up of four workers and a crane operator, and typical panel-to-panel connections are made with long wood screws and simple tools.

MAXIMUM DIMENSIONS AND PRODUCED WIDTHS

Maximum panel length	54´-2˝
Maximum panel width	9´-8˝
Maximum panel thickness	1´-8˝
Produced widths	7´-10˝ / 8´-2˝ / 8´-11˝ / 9´-8˝
Minimum production length	27´-1˝ – in 2˝ increments

MANUFACTURE

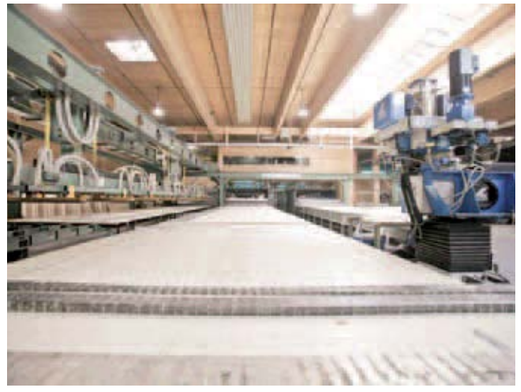
KLH® solid wood elements are made up of a least 3 layers of lumber boards that are arranged perpendicular to each other and glued together under high pressure. Depending on the project requirements, we can supply PEFC and FSC® C119602 -certified panels on request.

By cross-laminating the lumber boards, swelling and shrinkage are restrained, providing excellent dimensional stability of the finished product. In accordance with ANSI/APA PRG 320, only kiln dried lumber with a moisture content of 12% (+/- 2%) is used in KLH® CLT.

The fabrication process is subject to internal and external quality control by authorized third party auditors.

PEFC or FSC® C119602 - certified lumber stock is graded and sorted according to grade and surface quality.

Cross-laminated timber is produced on a just-in-time basis



Formaldehyde-free adhesive is used for laminating the individual layers

State-of-the-art CNC cutting machines facilitate both simple and highly complex patterns according to project requirements.

ADHESIVES AND LAMINATION PROCESS

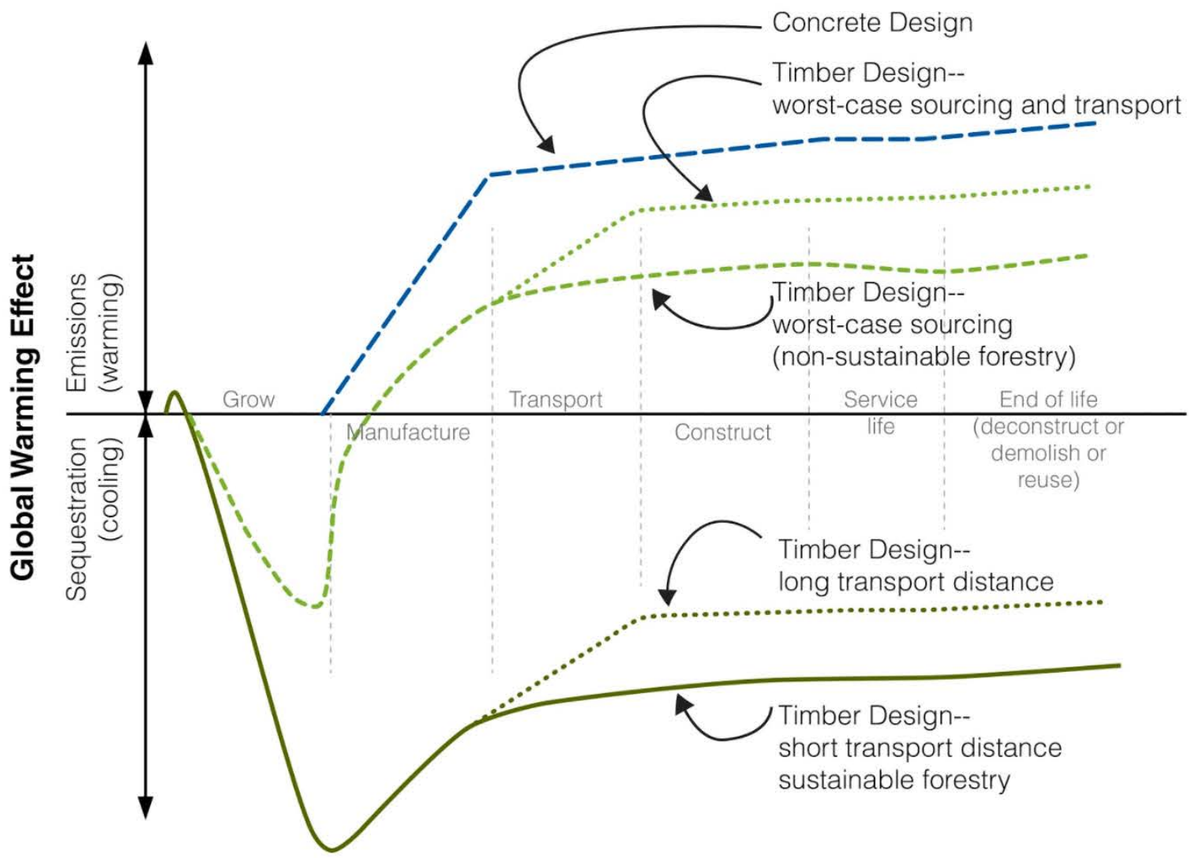
Only VOC-free and formaldehyde-free PUR adhesives are used in accordance with ANSI 405 and CSA 0112.10.

Adhesive is applied automatically over the entire surface at approximately 0.03 lbs/ft2 per joint. Combined with a laminating pressure of 87 psi, KLH® CLT is manufactured to consistently high standards of strength and quality.

Furthermore, production takes place in a highly controlled manufacturing environment where temperature and humidity are continuously monitored and consistently maintained, ensuring the specified moisture content of both lumber stock and finished product.

More information about the adhesives used may be found at www.henkel-adhesives.de.

CARBON EMISSIONS
MATERIAL, SOURCING & TRANSPORT



Comparison of carbon emissions between timber design and concrete design over lifecycle of structural materials in a 12-story tower.

ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	KLH Massivholz GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KLH-20190027-ICA1-EN
Issue date	06.05.2019
Valid to	05.05.2024

KLH cross-laminated timber panels

KLH Massivholz GmbH

Institut Bauen und Umwelt e.V.

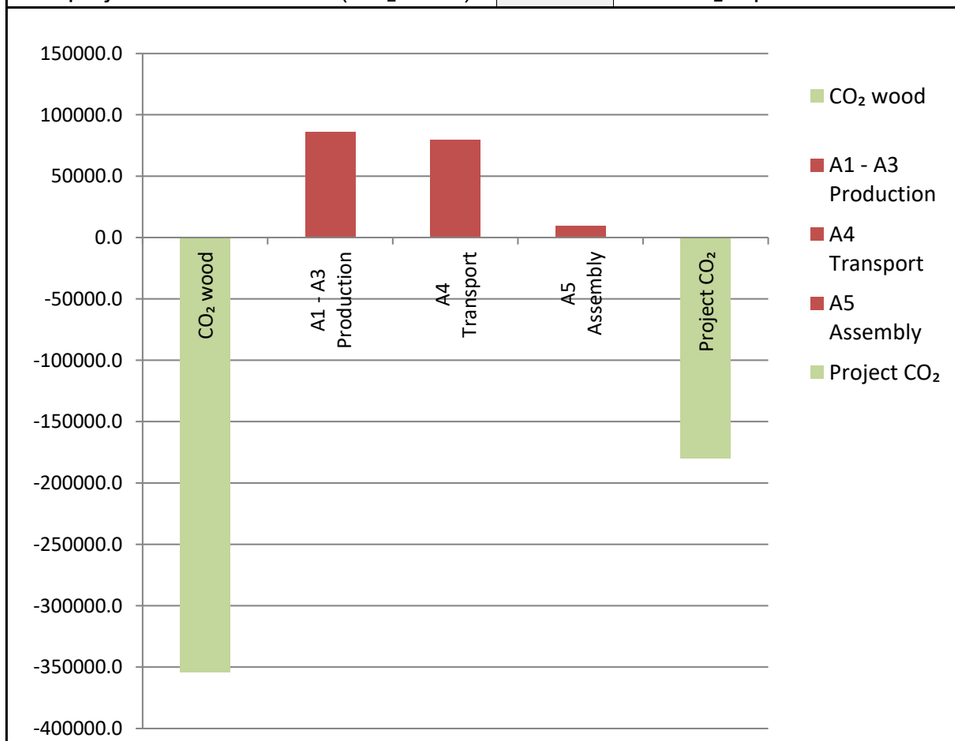
www.ibu-epd.com / https://epd-online.com

KLH

CARBON LCA

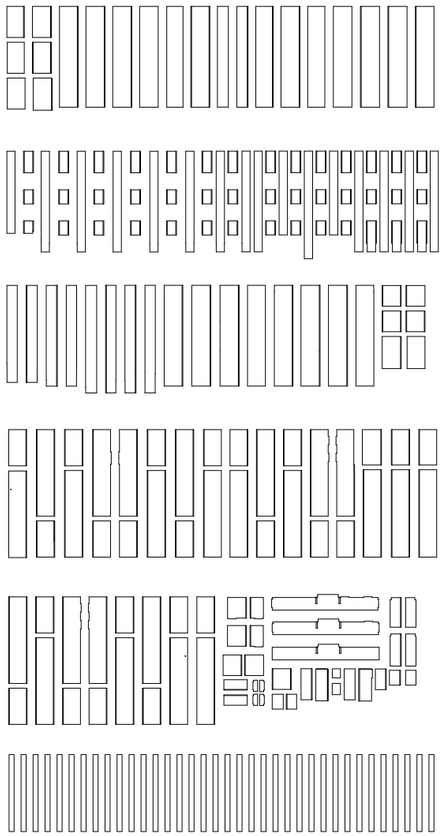
Project Name / Number	Mississippi	
Date	19/02/2021	
Country of construction	United States	
Volume of KLH® - CLT elem	446	[m³]
Transport by Truck	1100	[km]
Ship	9090	[nm]

This project produces a total of (A1-A5)	174.4	tons **CO_2** equ.
This project stores a total of (CO_2 wood)	-354.1	tons **CO_2** equ.

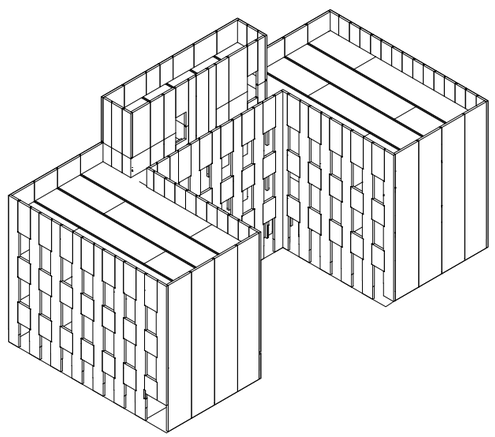


After Assembly (stage A5) the projects footprint results in a total of	-179.7	tons **CO_2** equ..
Regrow time (in Austrian forests, considering actual sawn timber)	15.3	minutes

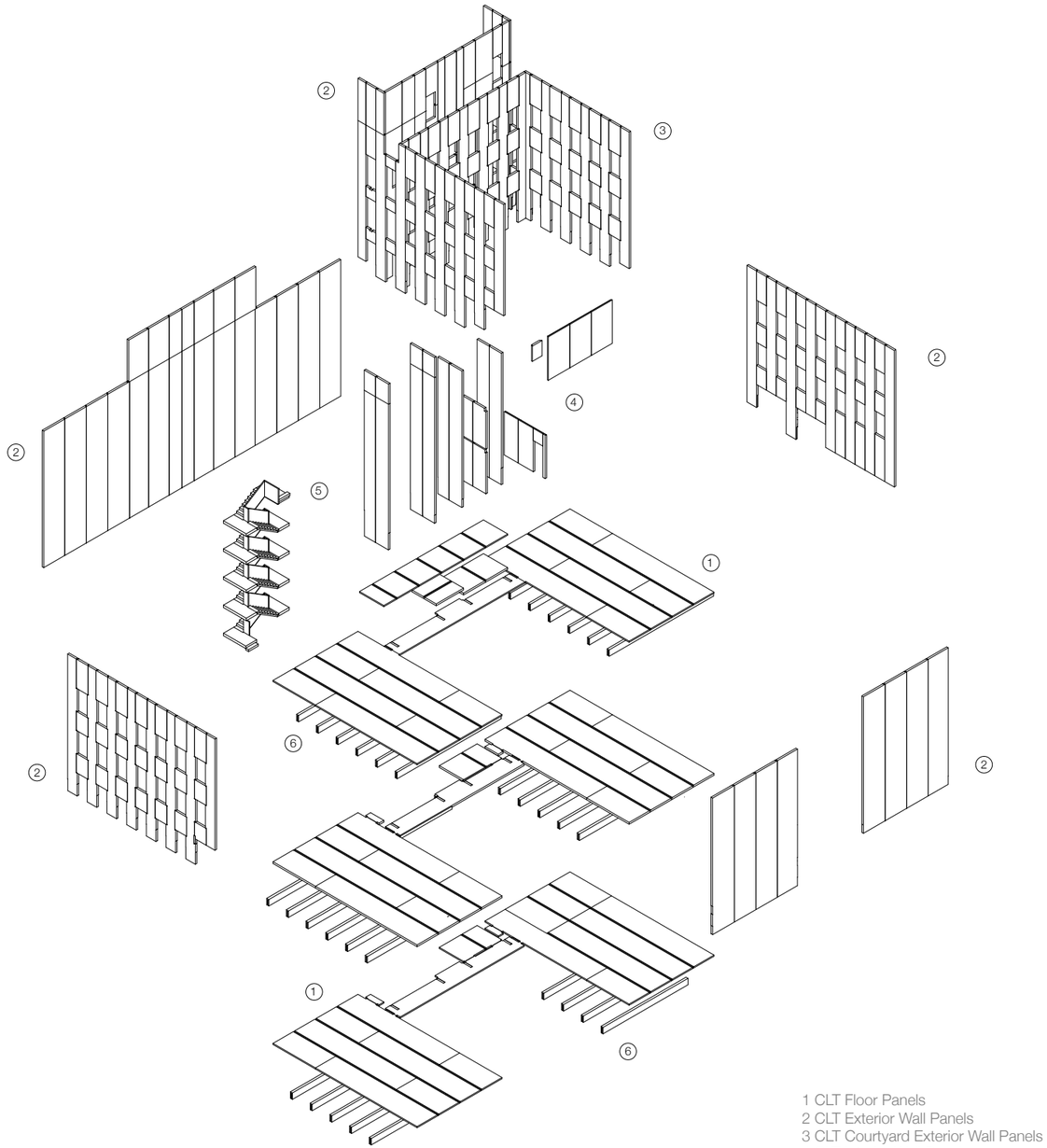
All values are based on the KLH® EPD that was verified by external assessment and the data quality was checked before public release. The calculation of the background data is based on the ecoinvent database. All standards and literature are stated in the EDP document, which is available on www.klh.at



Building Parts



Building Whole



Building Assembly

105-03s-01-TL
Nsi-(Isi)

105-03s-01-TL
Isi-(Isi)

160-05s-1-TL
Nsi-(Isi)

160-05s-1-TL
Isi-(Isi)

105 3s 1 TL

105 3s 1 TL

160 5s TL

160 5s TL

2 Wall Panel Layup Types
CLT-100 SCALE: N.T.S.

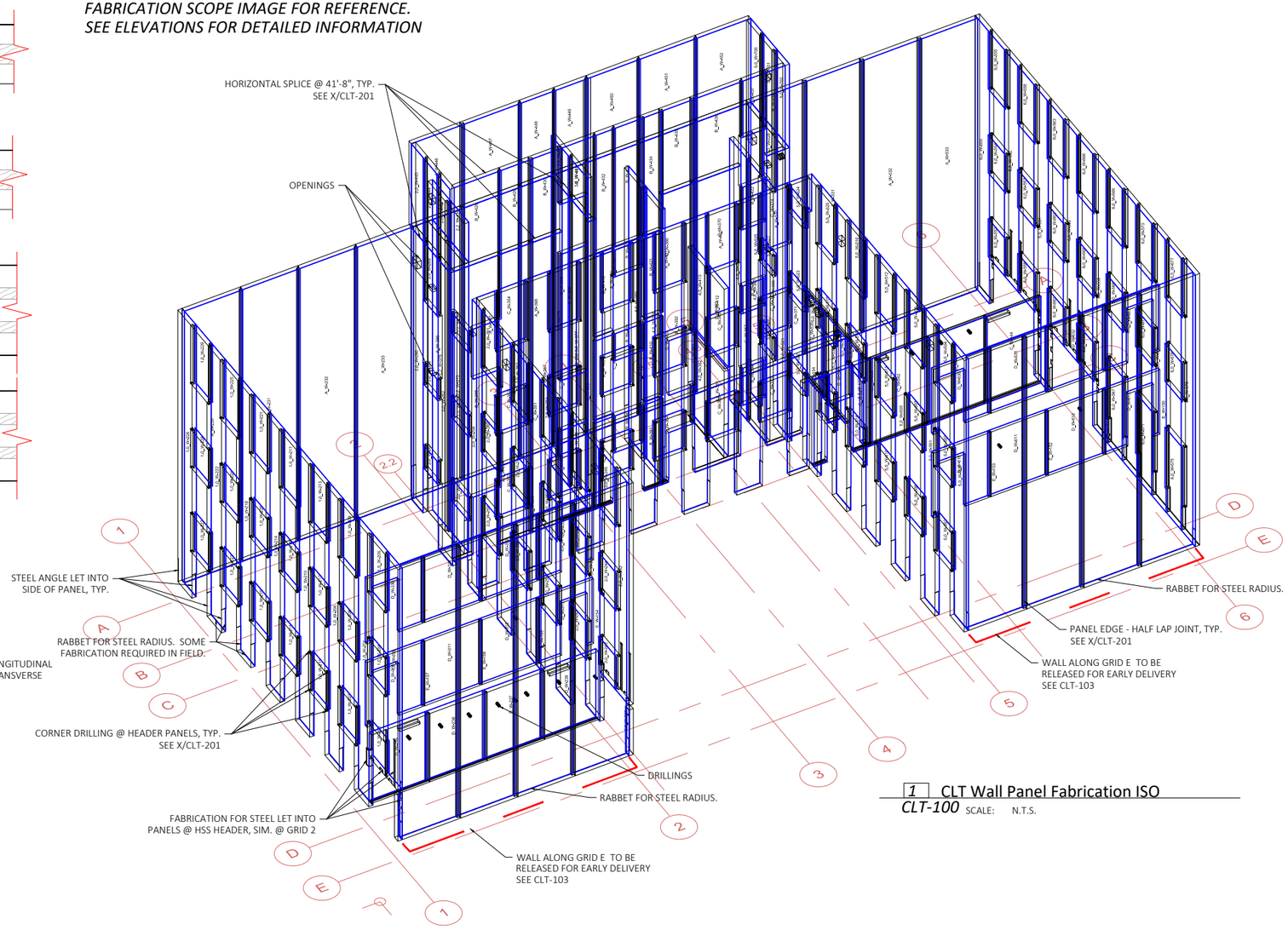
A_W-3

105-03s-01-TL
Nsi-(Isi)

- GRIDLINE DESIGNATION
- WALL - 3-DIGIT NUMBER
- PANEL THICKNESS
- # LAYERS
- LAYUP VERSION
- PANEL LAY-UP TYPE
  TL- VISIBLE LAMELLA IS LONGITUDINAL
  TT- VISIBLE LAMELLA IS TRANSVERSE
- VISIBLE LAMELLA ORIENTATION (STRENGTH DIRECTION)
- SURFACE QUALITY TOP (NON-VISIBLE FACE)
- SURFACE QUALITY BOTTOM (VISIBLE FACE)

Panel Label

FABRICATION SCOPE IMAGE FOR REFERENCE.
SEE ELEVATIONS FOR DETAILED INFORMATION



1 CLT Wall Panel Fabrication ISO
CLT-100 SCALE: N.T.S.

QUALITY ASSURANCE:

- *STORE PANELS IN CONDITIONED AND HUMIDITY CONTROLLED ENVIRONMENT.*
- *KLH RECOMMENDS END GRAIN SEALER ON PANEL EDGES TO MINIMIZE MOISTURE ABSORPTION AND PREVENT VISIBLE CAPILLARY ACTION IN WOOD END GRAIN.*
- *ALL STEEL COMPONENTS SHOULD BE PRIMED, POWDER COATED, ~~OR STAINLESS STEEL.~~*
- *DO NOT CUT OR WELD STEEL NEAR PANELS WITHOUT FIRST PROTECTING FROM FERROUS STAINING.*
- *APPLY MOISTURE (AND INSECT WHERE APPROPRIATE) BARRIER BETWEEN PANEL EDGE AND SILL PLATE.*
- *SHIM UNDER SILL ELEMENT. DO NOT SHIM DIRECTLY UNDER PANEL.*
- *REMOVE EXCESS WATER AND MINIMIZE EXPOSURE TIME FOR BEST RESULTS.*

PROJECT NOTES:

- *VERIFY DETAILS FIT FIELD CONDITIONS AND OTHER CONSTRUCTION SYSTEMS.*
- *ALL CONNECTIONS ARE APPROXIMATE, AND TO BE REVIEWED AND APPROVED BY STRUCTURAL ENGINEER.*
- *SPRUCE SPLINE BOARD MATERIAL TO BE PROVIDED BY KLH.*
- *FASTENERS AS NOTED ON S-7.1 /S-7.2 / S-7.5 /S-7.6 TO BE PROVIDED BY KLH.*
- *RICON CONNECTORS FOR GLULAMS TO BE PROVIDED BY KLH.*
- *ALL OTHER STEEL CONNECTIONS TO BE PROVIDED BY OTHERS*
- *STRUCTURAL STEEL TO BE PROVIDED BY OTHERS.*

DRAWING NOTES:

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6. All openings and notches have routed corners (standard radius = 20mm), unless noted or instructed otherwise. Square corners to openings and notches less than 500mm wide will have to be cut on site by installation team.
7. X: Elevation title, XXX: Drawing No. Y:Section title, YYY: Drawing No
8. Installation of KLH super structure to be strictly in accordance with project related OSHA requirements. Please refer to installer for this information.

WET STAMP & DATE:

FABRICATION DRAWING APPROVAL

- ☐ Material Order Approved
- ☐ Approved With Comments
- ☐ Submit Specified Items
- ☐ Revise and Resubmit
- ☐ No Exception Taken
- ☐ Field Notes Required
- ☐ Not Reviewed
- ☐ Rejected

Signing below releases these fabrication drawings for production. Changes to panel specifications, quantity, or size, delays in approval, or changes after approval may add to the cost and / or cause delay. Approval of these drawings constitutes an understanding that all other drawings are superceded by these drawings with regard to the delivered CLT scope.

Approved by: _____

Date: _____

KLH
240 N Broadway
Suite 308
Portland, OR 97212

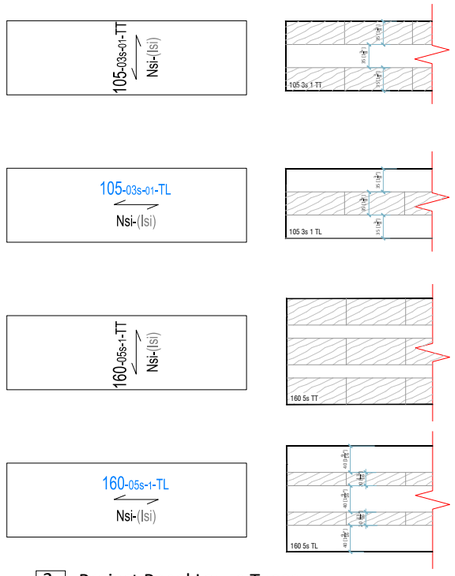
T: 1 971.998.5705
E: michael.hahn@klhusa.com

REV	DESCRIPTION	DATE	
3	Third Issue	06.16.2020	MH -
2	Grid E Release	06.08.2020	MH WA
1	Second Issue	05.26.2020	MH WA
0	First Issue	05.13.2020	MH WA
			BY CHK

PROJECT
USA_245-E
Waechter - Mississippi Wall E
4236 N Mississippi Ave.
Portland, OR 97217

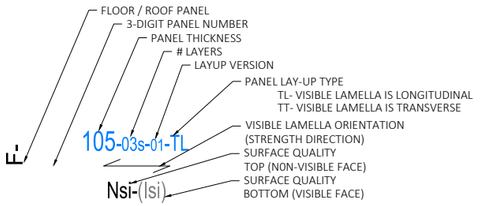
DRAWING TITLE
CLT Wall Panel Fabrication ISO

STATUS	SCALE
GRID E RELEASE	AS NOTED
DRAWING NO. CLT-100	REV. 3



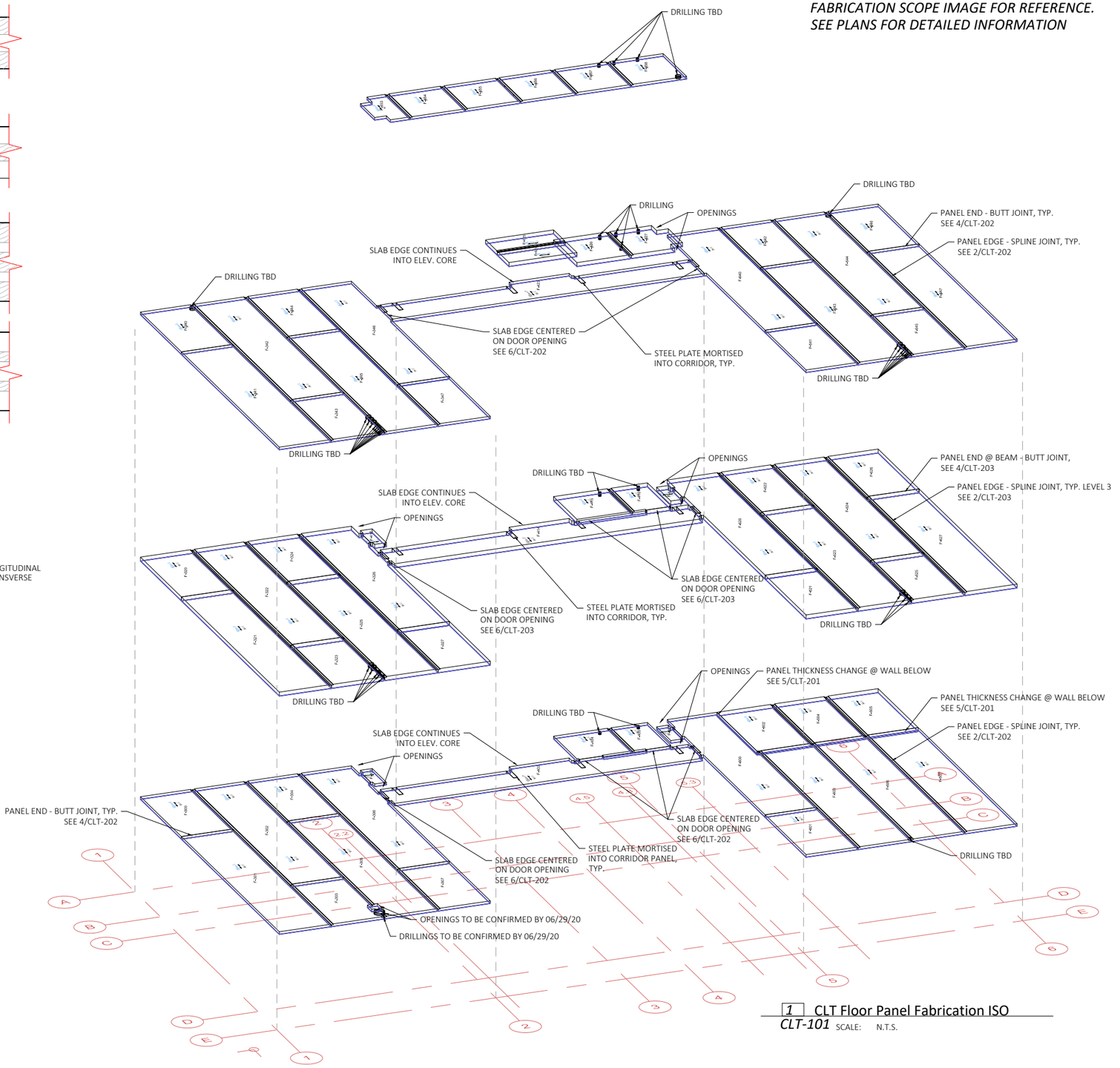
2 Project Panel Layup Types

CLT-101 SCALE: N.T.S.



Panel Label

FABRICATION SCOPE IMAGE FOR REFERENCE.
SEE PLANS FOR DETAILED INFORMATION



1 CLT Floor Panel Fabrication ISO

CLT-101 SCALE: N.T.S.

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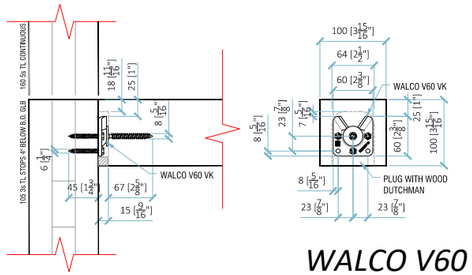
PROJECT
USA_245-E
Waechter - Mississippi Wall E
4236 N Mississippi Ave.
Portland, OR 97217

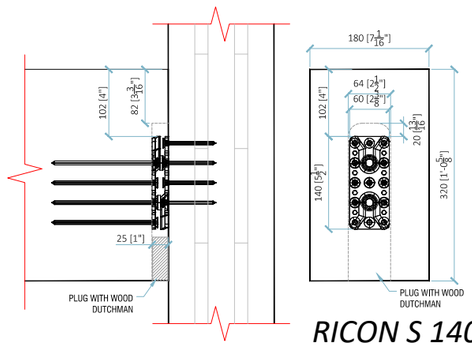
DRAWING TITLE
CLT Floor Panel Fabrication ISO

STATUS	SCALE
GRID E RELEASE	AS NOTED
DRAWING NO. CLT-101	REV. 3



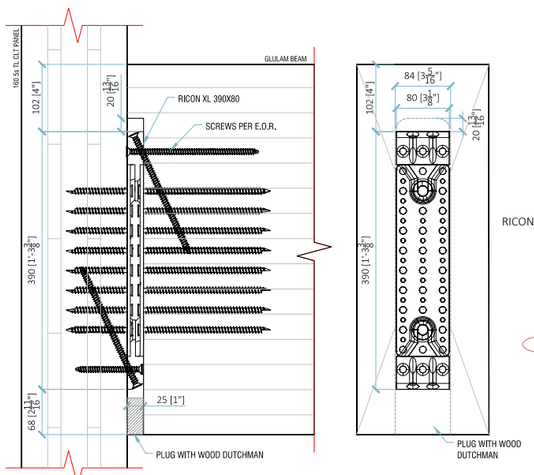
WALCO V60

2 Ceiling Joist Connector
CLT-102 SCALE: 3" = 1'-0"



RICON S 140X60

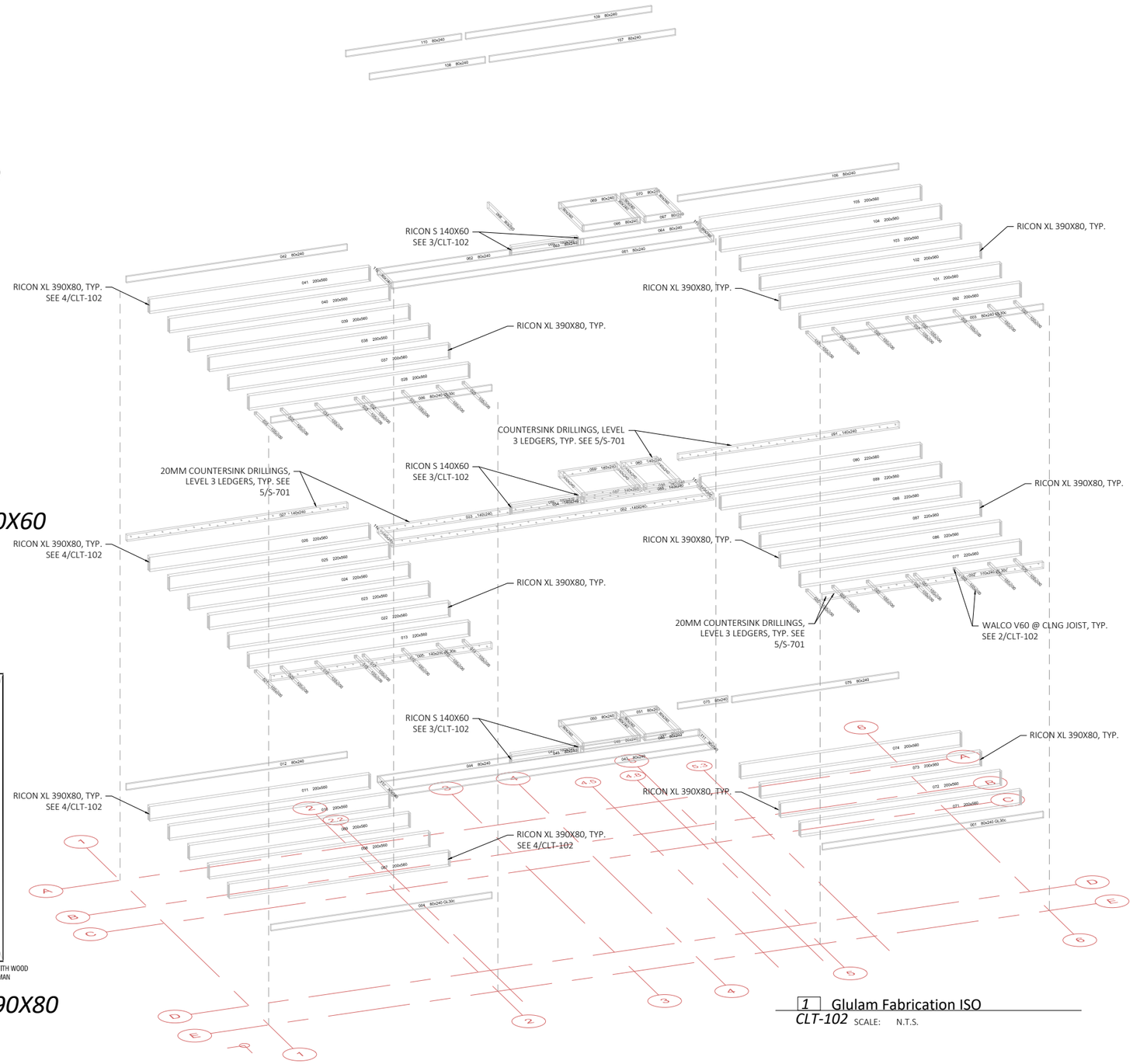
3 Elevator Beam Connector
CLT-102 SCALE: 3" = 1'-0"



RICON XL 390X80

4 Typ. Beam Connector
CLT-102 SCALE: 3" = 1'-0"

FABRICATION SCOPE IMAGE FOR REFERENCE.
SEE PLANS FOR DETAILED INFORMATION



1 Glulam Fabrication ISO
CLT-102 SCALE: N.T.S.

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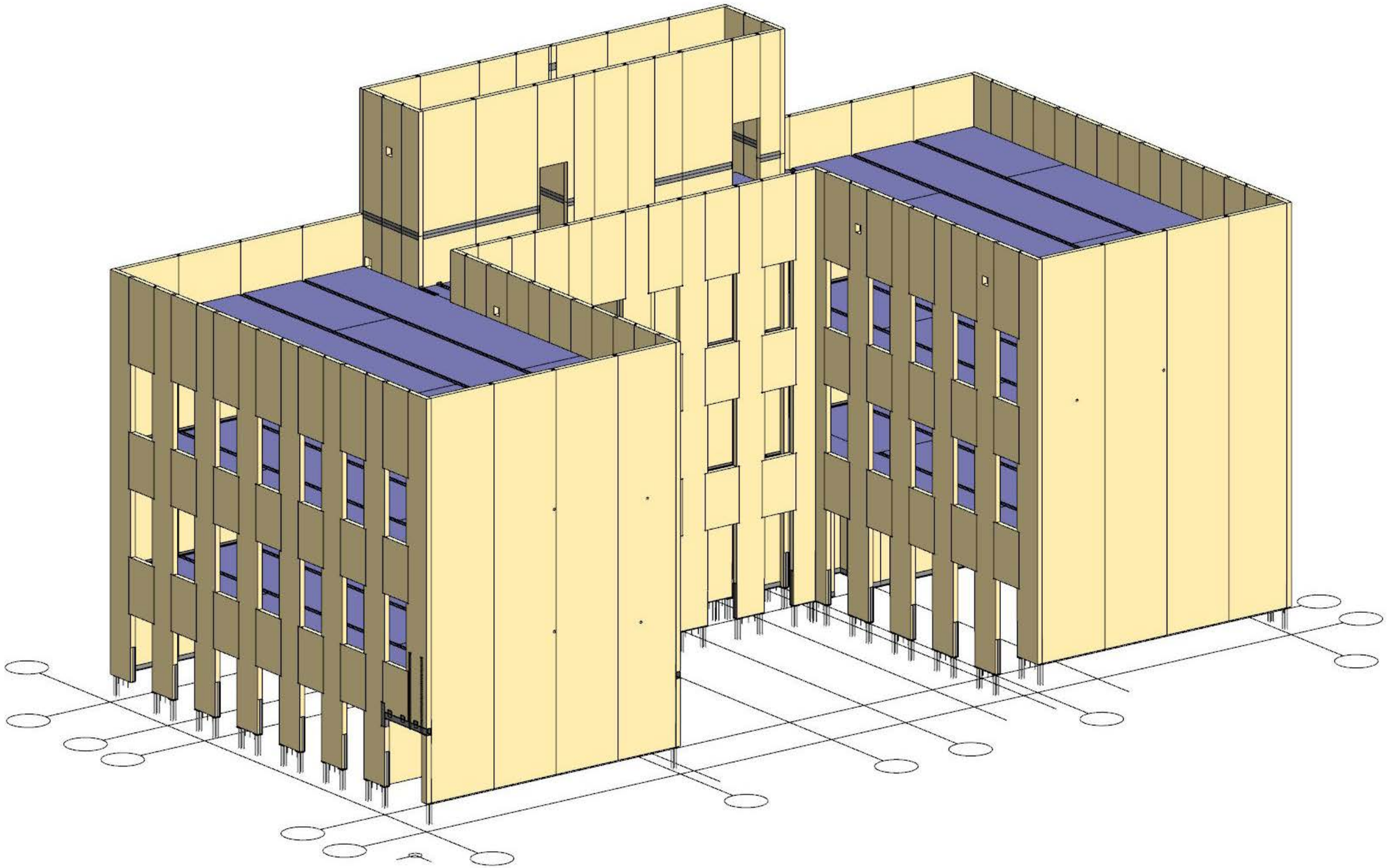
PROJECT
USA_245-E
Waechter - Mississippi Wall E
4236 N Mississippi Ave.
Portland, OR 97217

DRAWING TITLE
Glulam
Fabrication ISO

STATUS	SCALE
GRID E RELEASE	AS NOTED
DRAWING NO. CLT-102	REV. 3

SHOP DRAWING MODEL



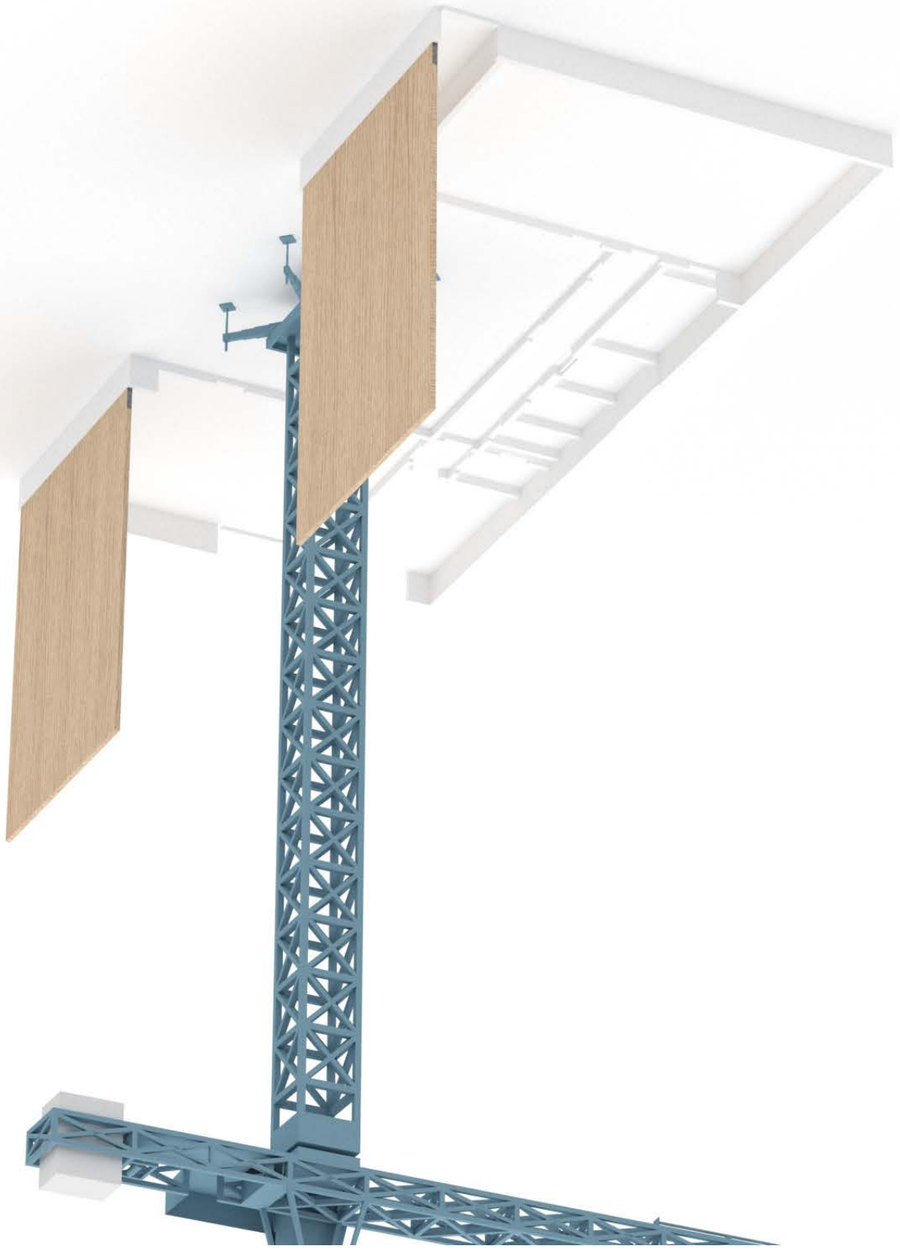
Courtesy KLH Massivholz GmbH

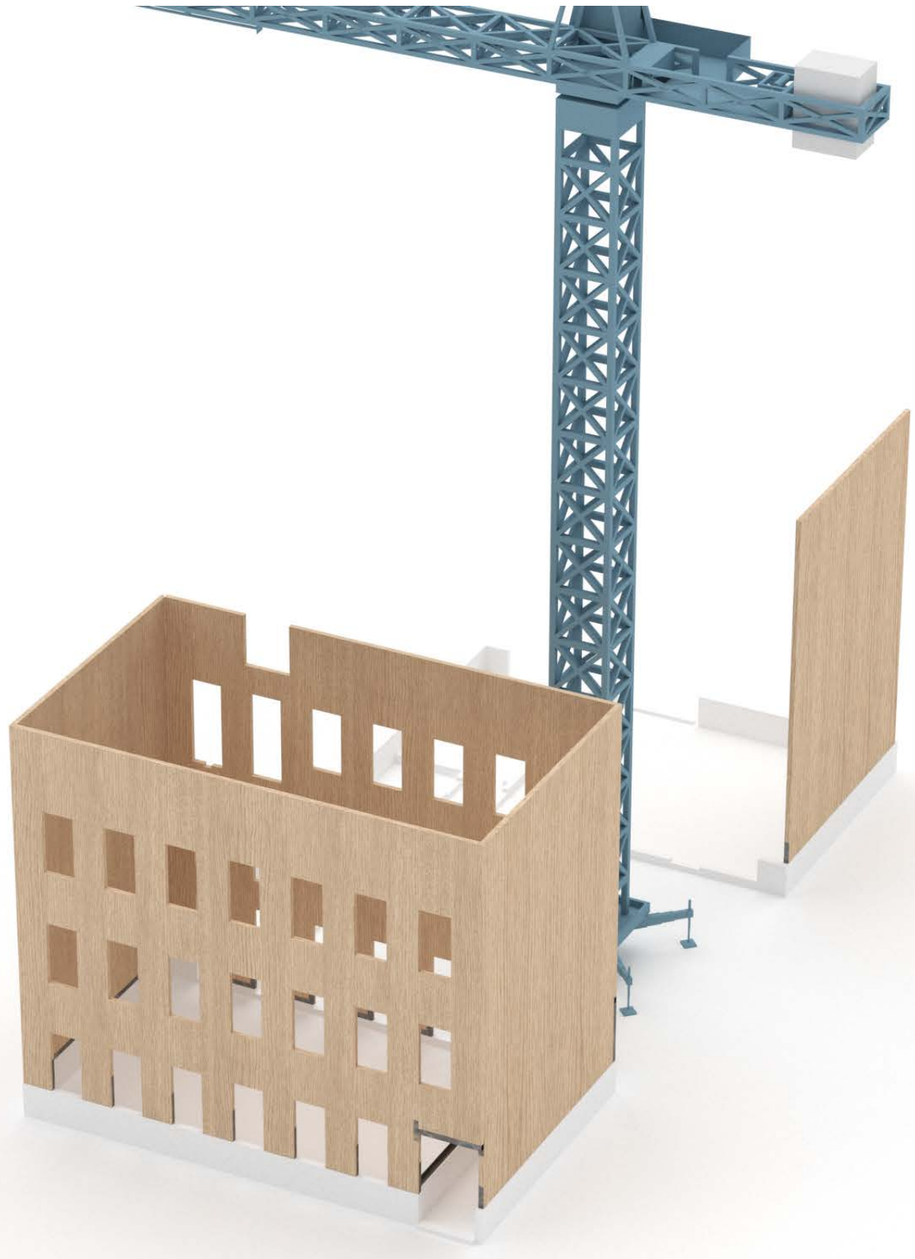

Hundegger
Portalbearbeitungszentrum
PBA
STOP

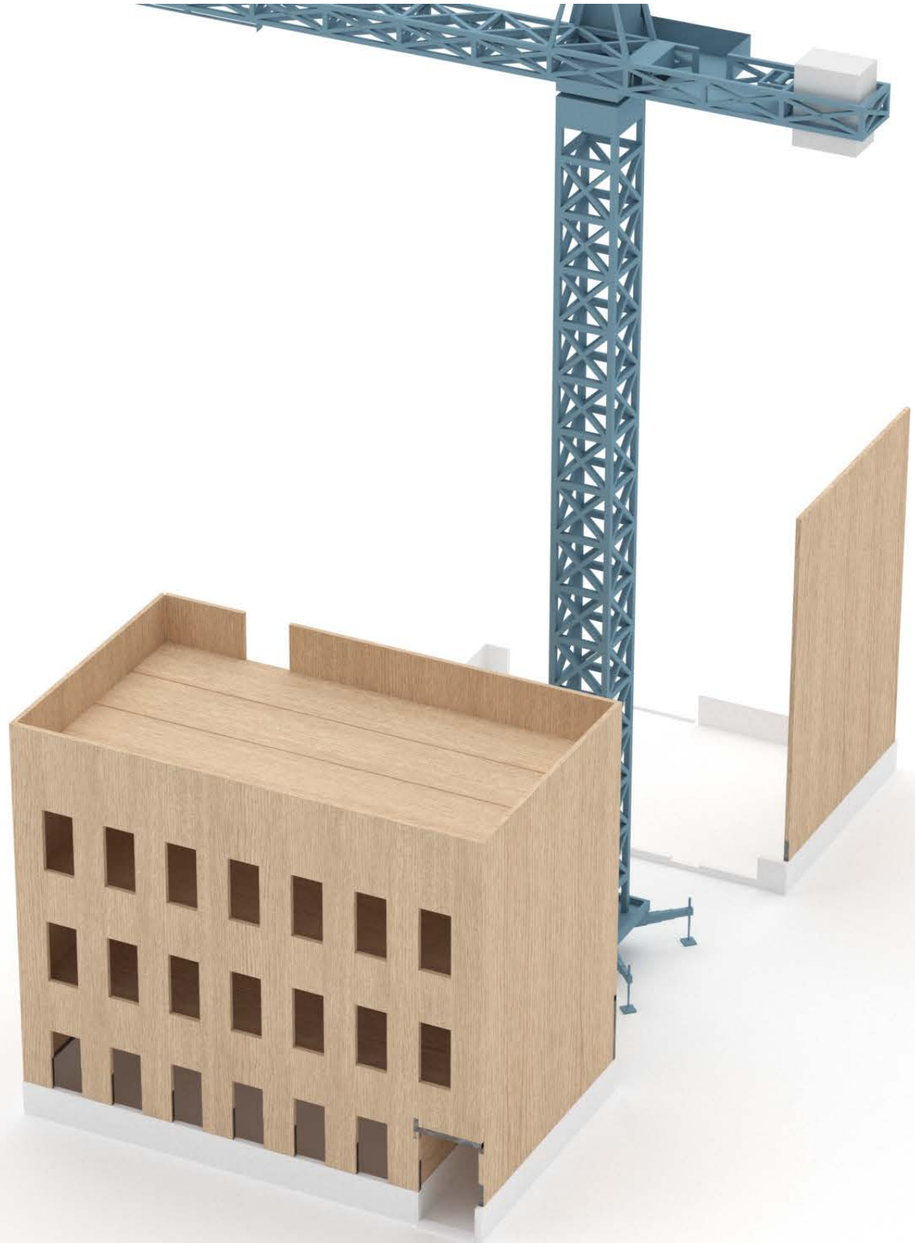

7
104
105.
74
103.
73
102.
101
72.
71.
41.

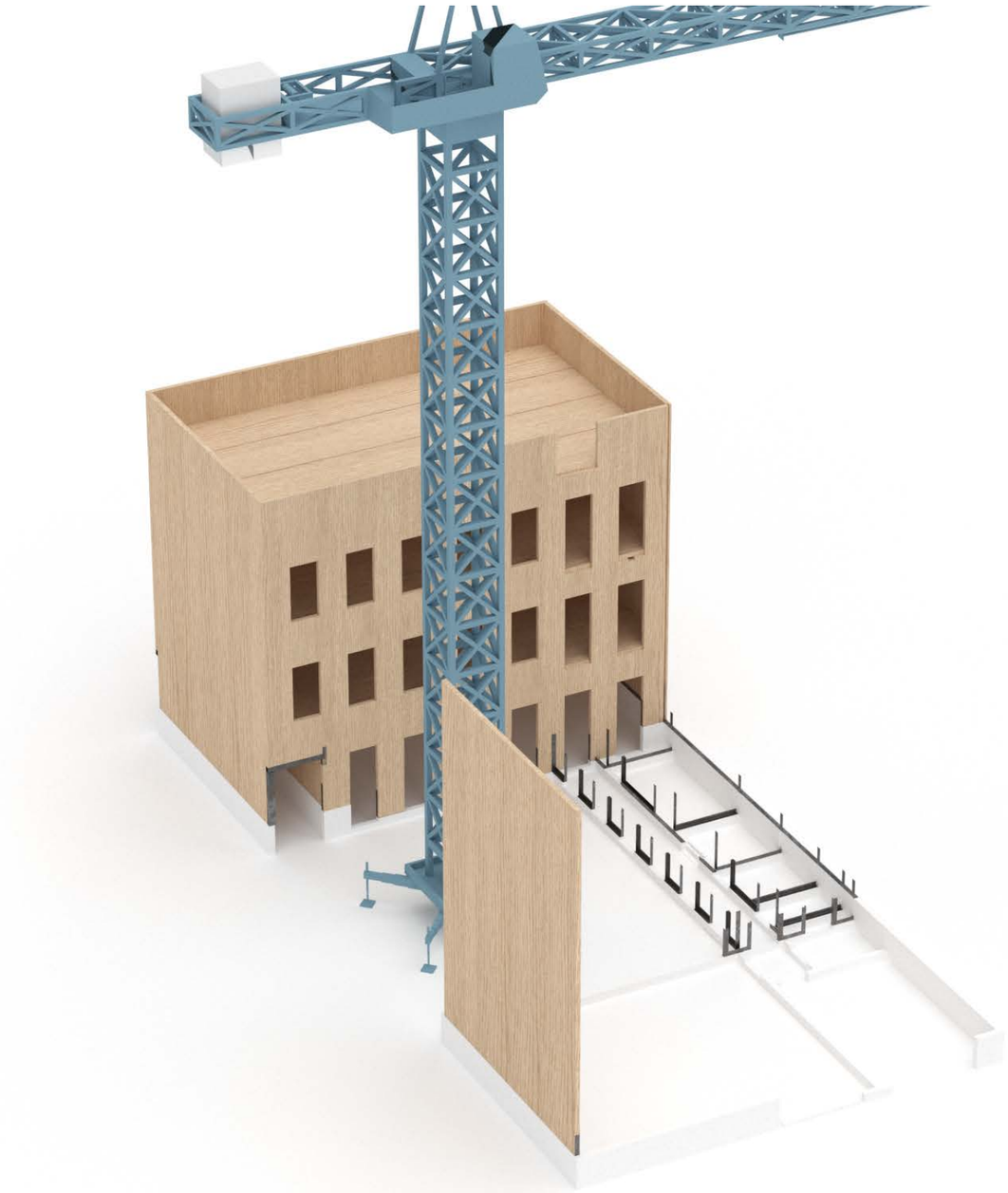

ABUS 15t (8t/8t)
MAERSK
KLH
D-TEC

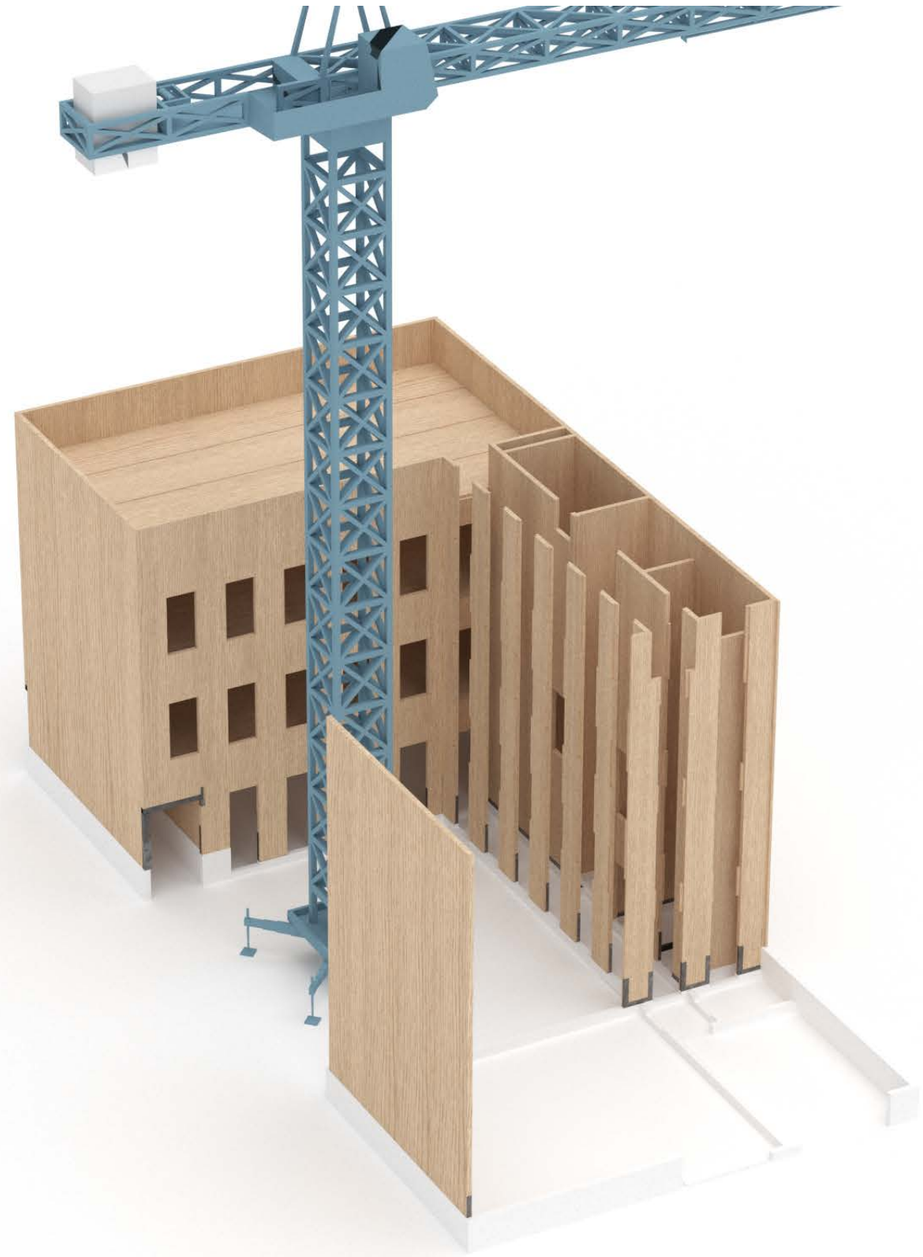
CONSTRUCTION SEQUENCING

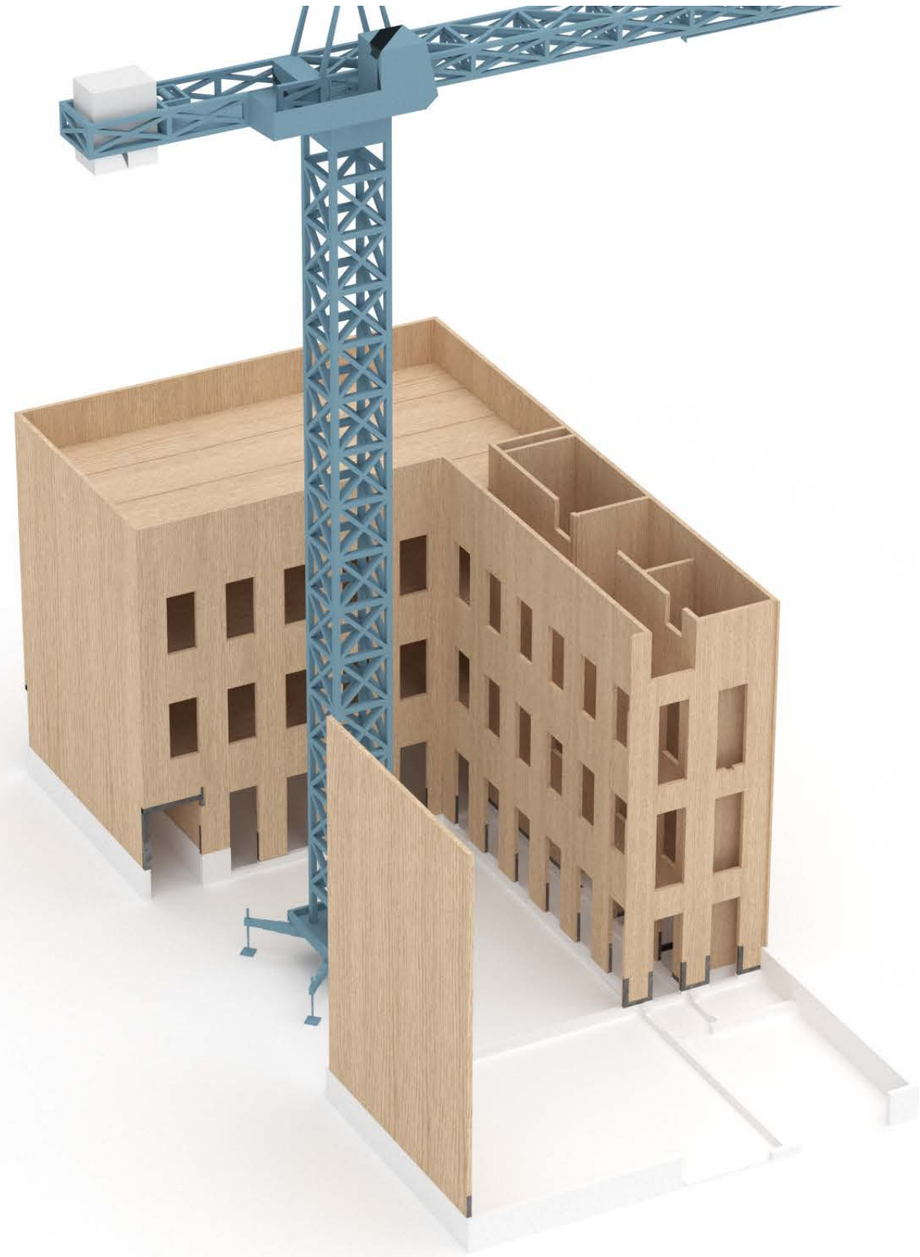


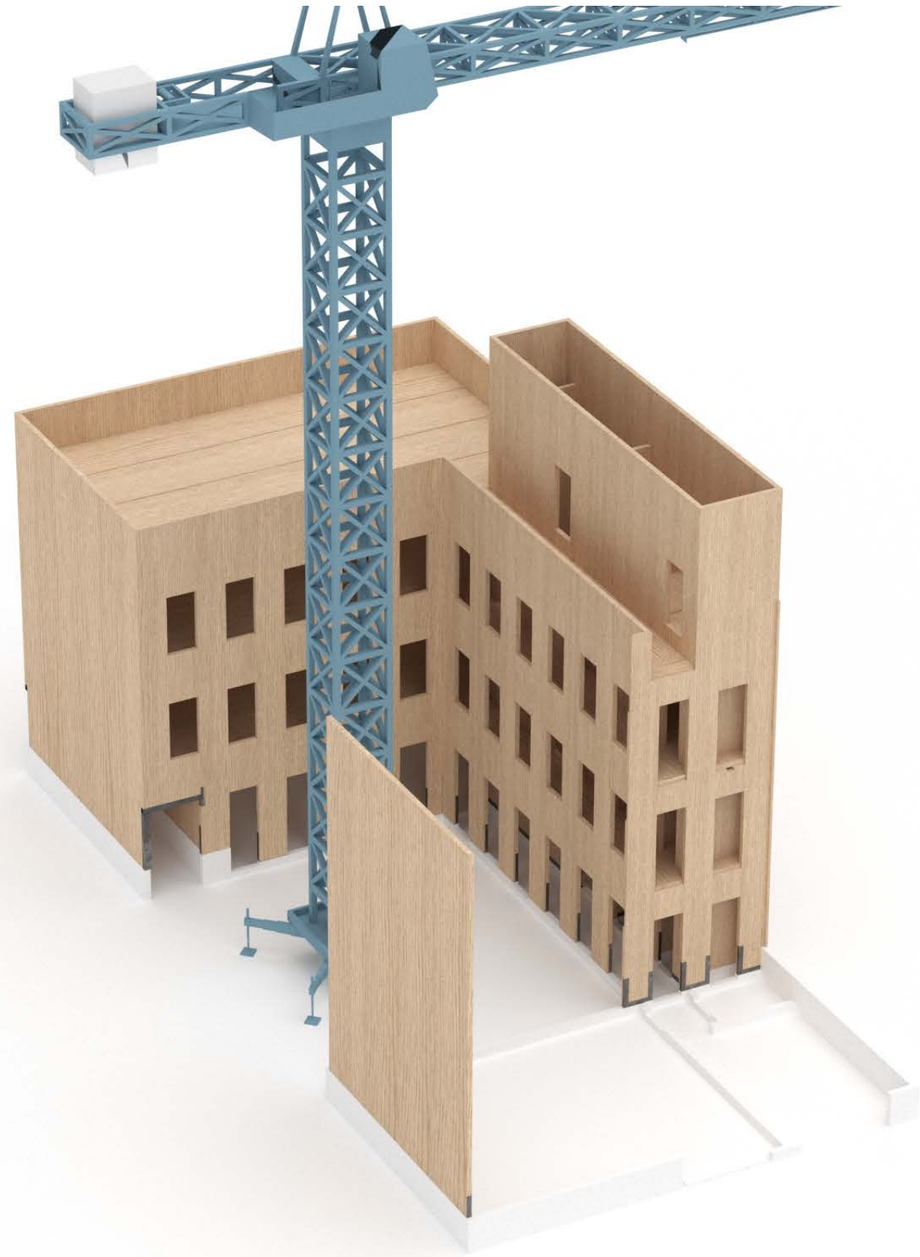


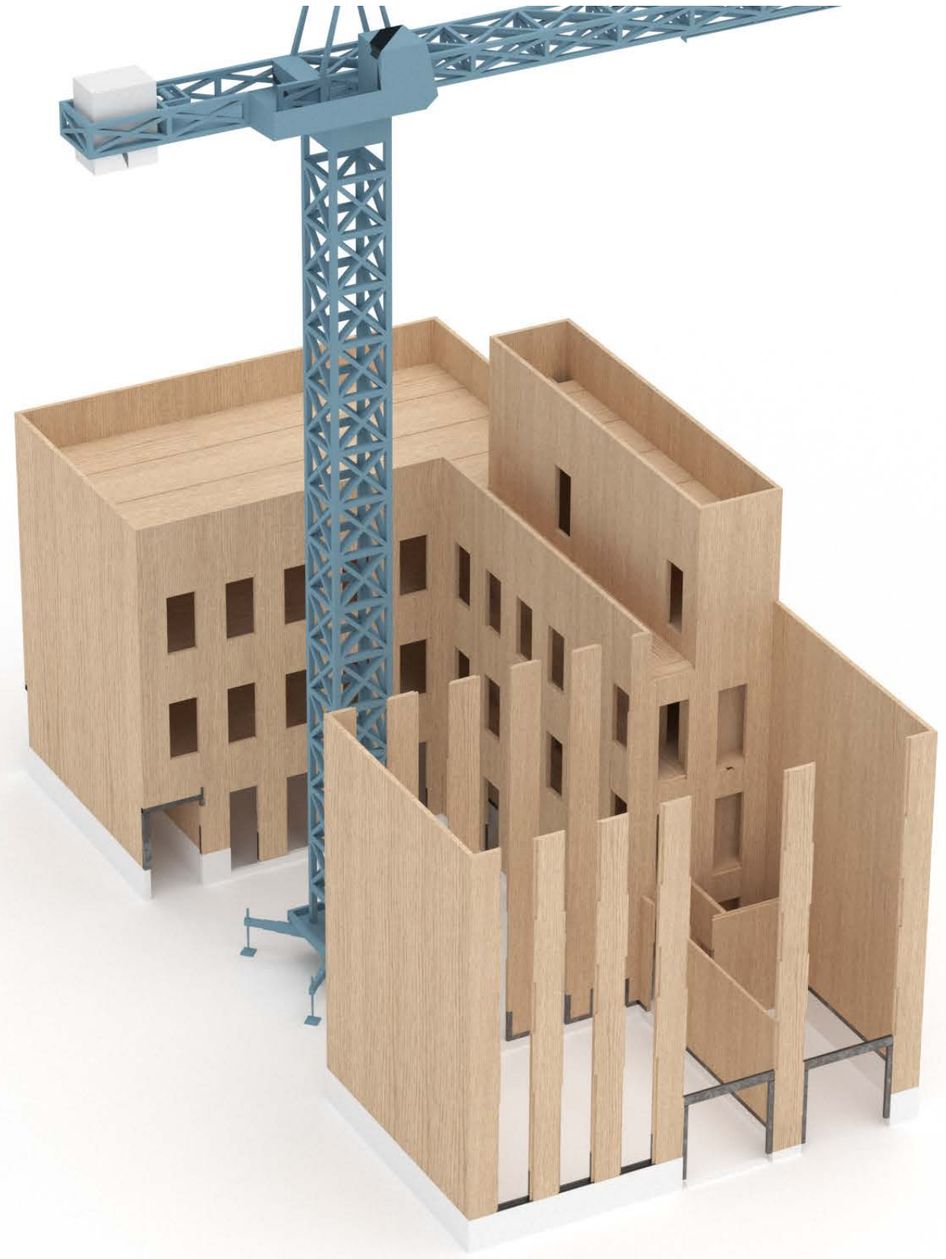













DANGER

LOVER

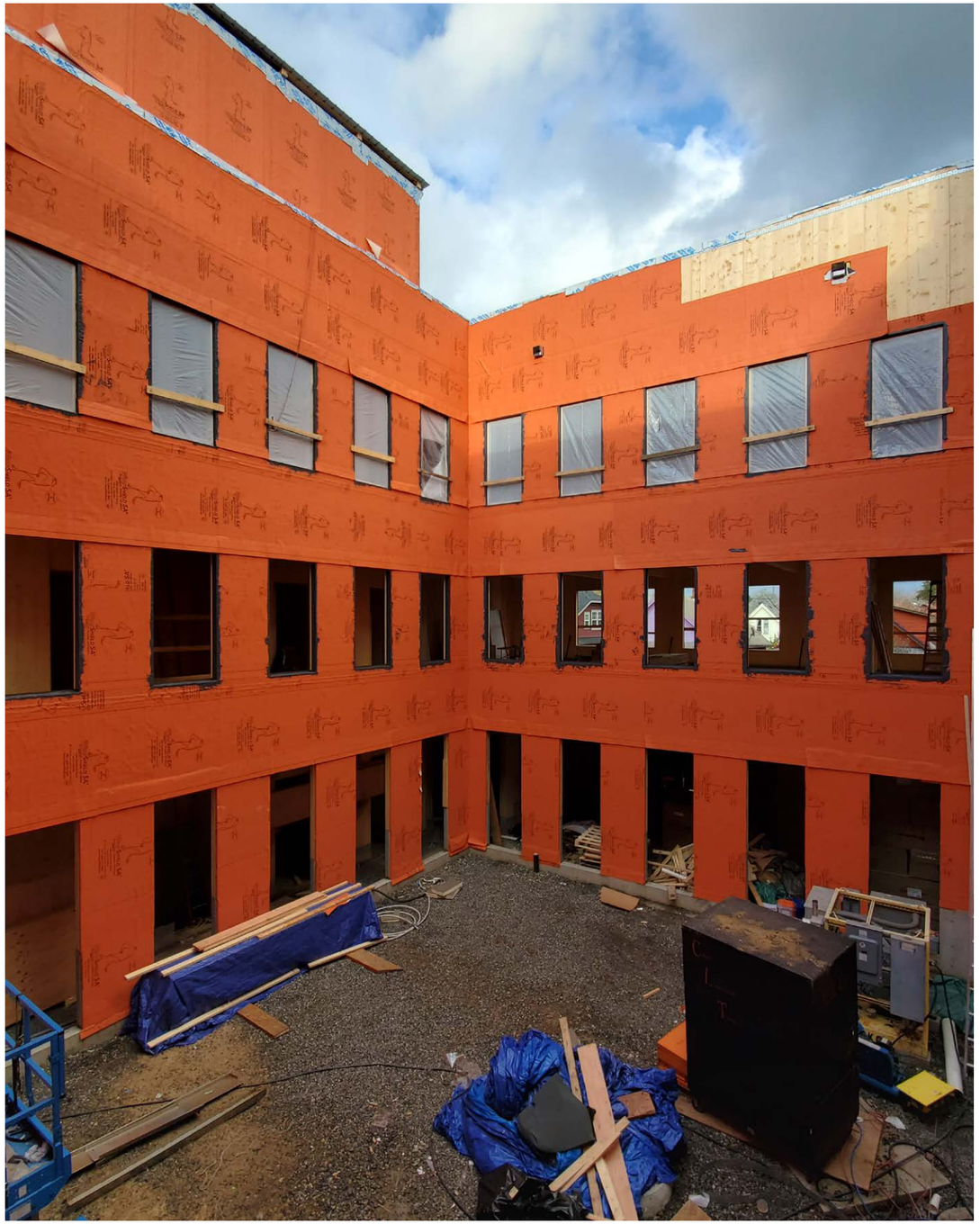

BARNHART
BARNHART
BARNHART
4220


COMANSA

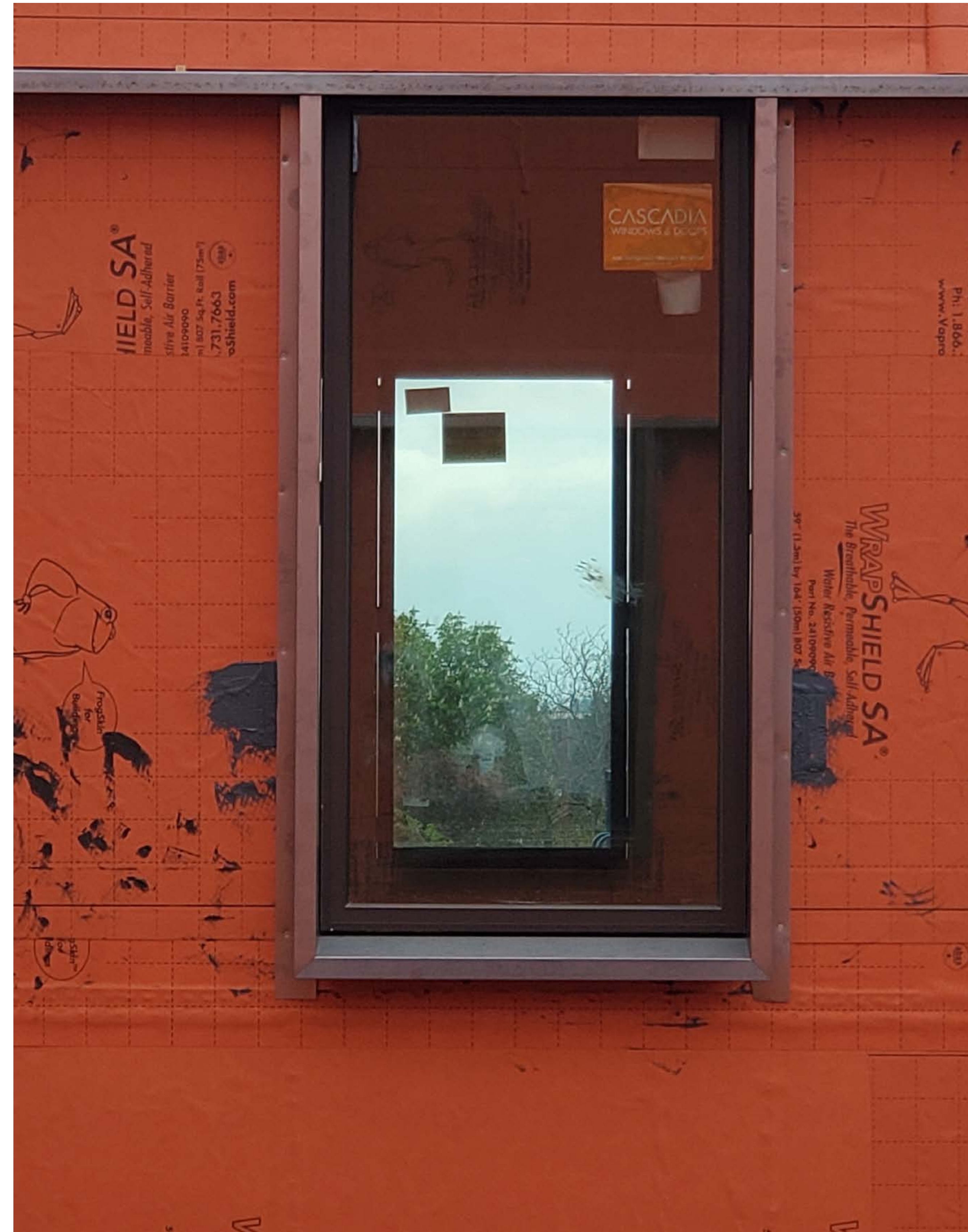

WAECHTER ARCHITECTURE
MID CONTINENT
COMANSA

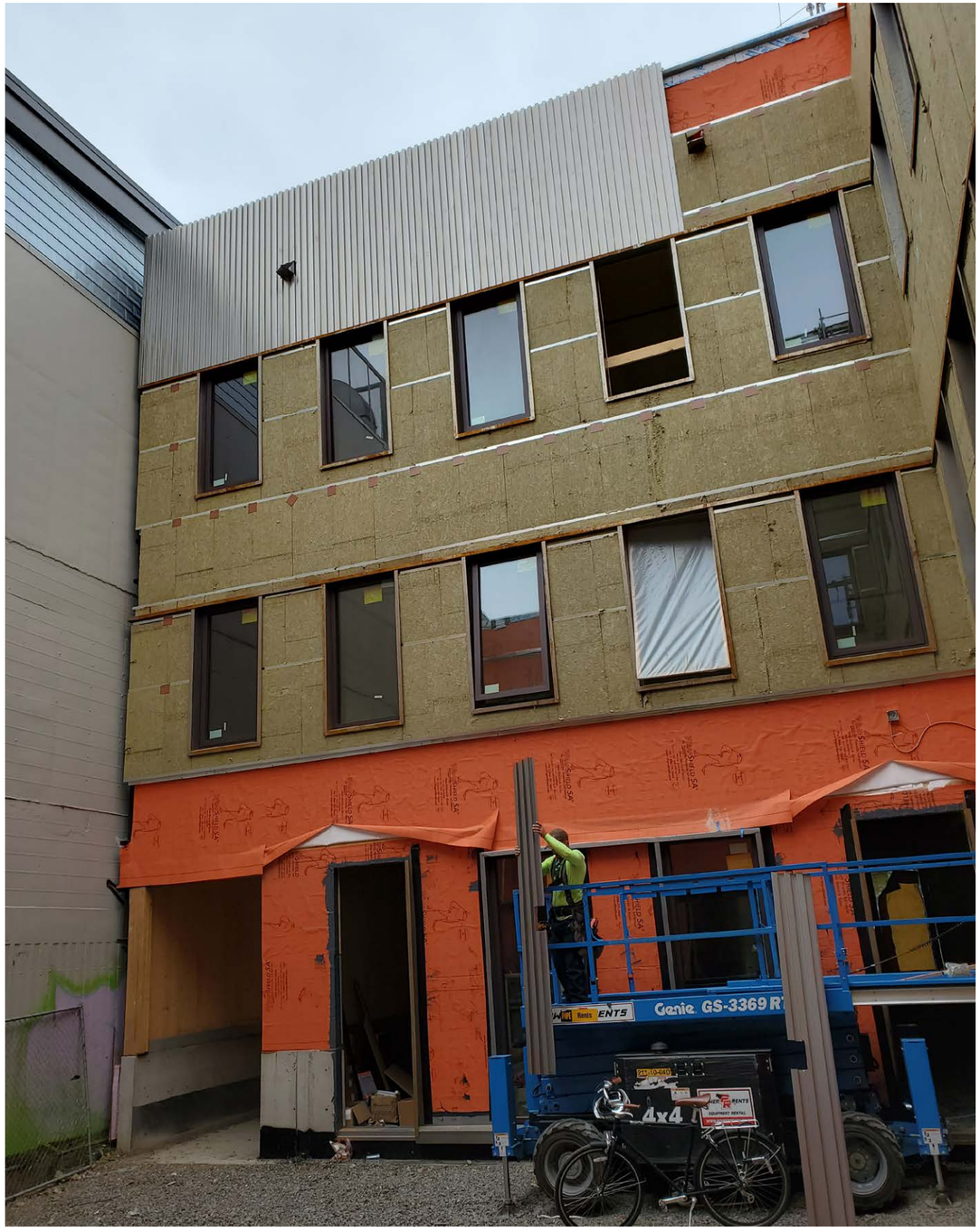

ROMANSKI

WATERPROOFING
& INSULATION




SHIELD SA®
WRAP SHIELD SA®


CASCADIA
WINDOWS & DOORS
WRAPSHIELD SA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4x4


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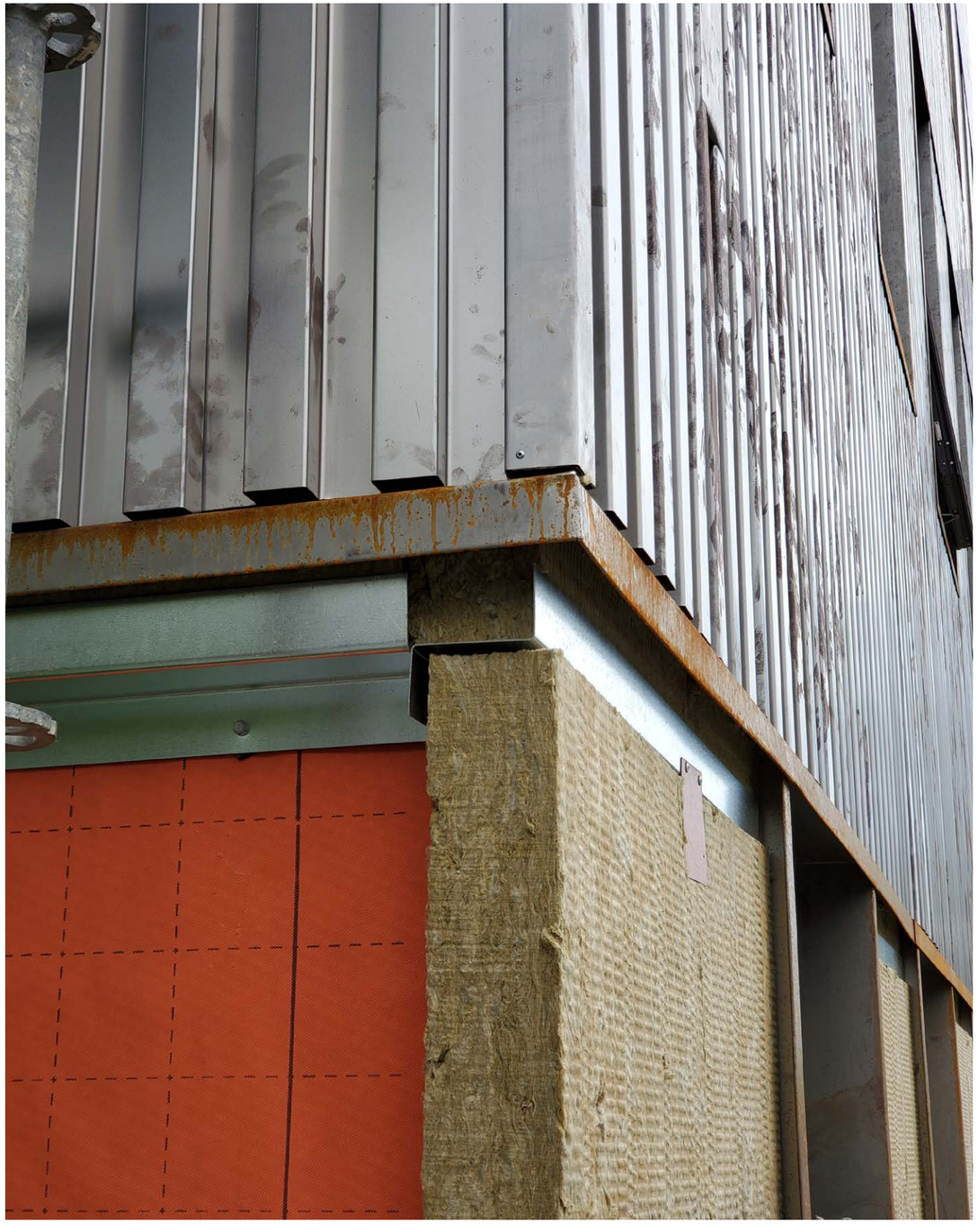
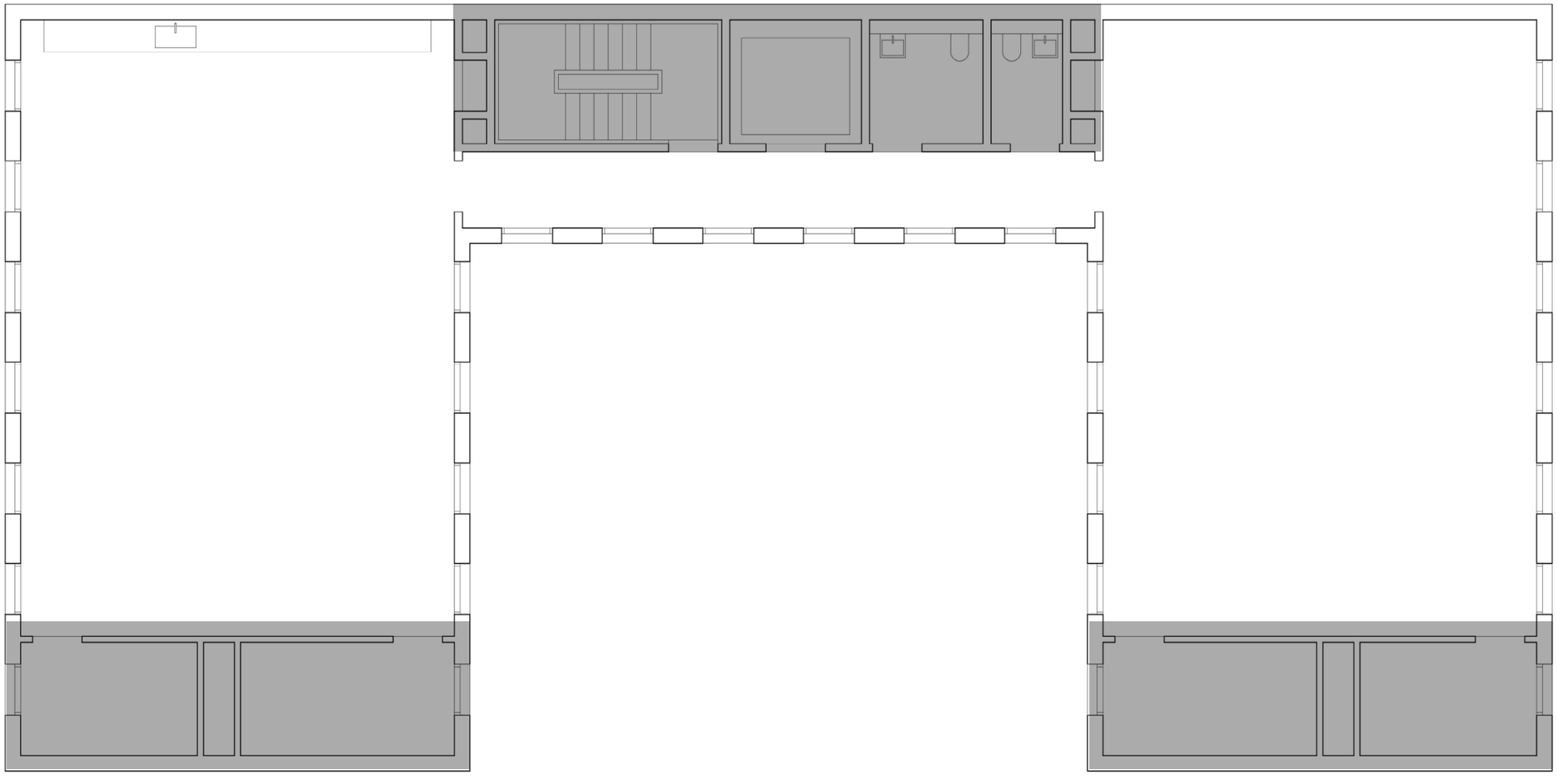
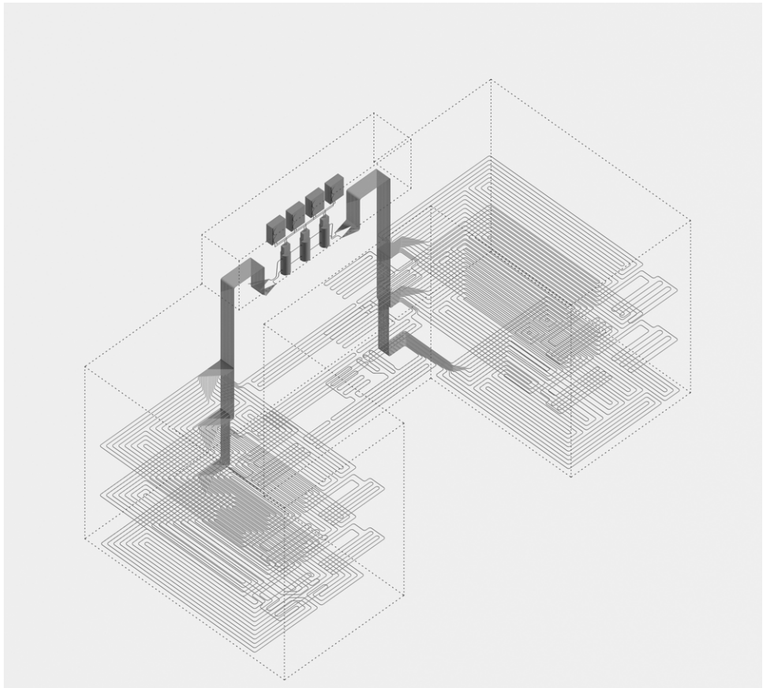
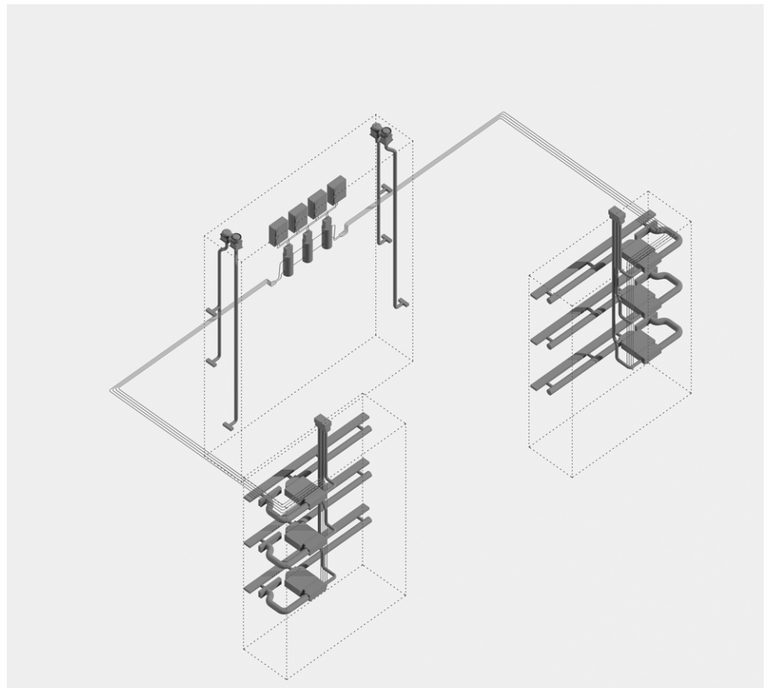


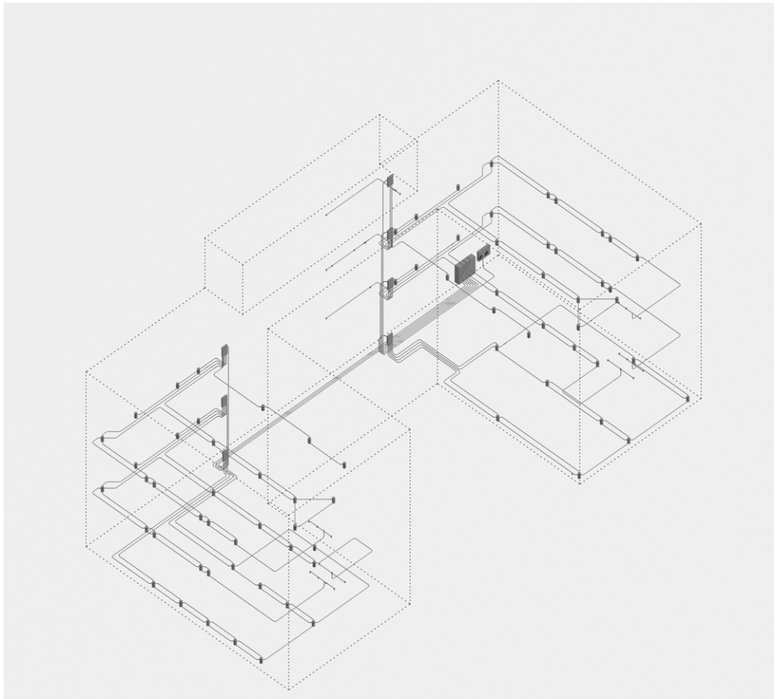

SIDEWALK CLOSED
SIDEWALK CLOSED

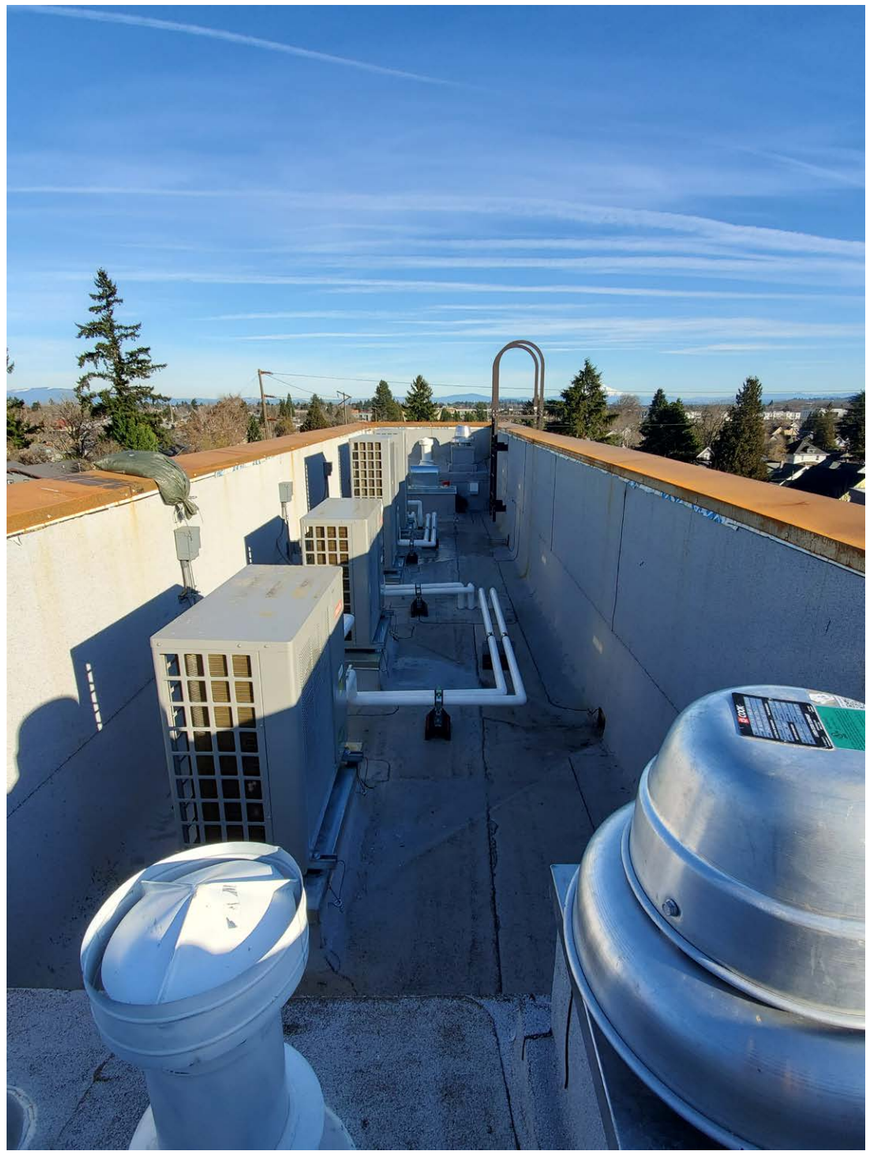
SYSTEMS INTEGRATION

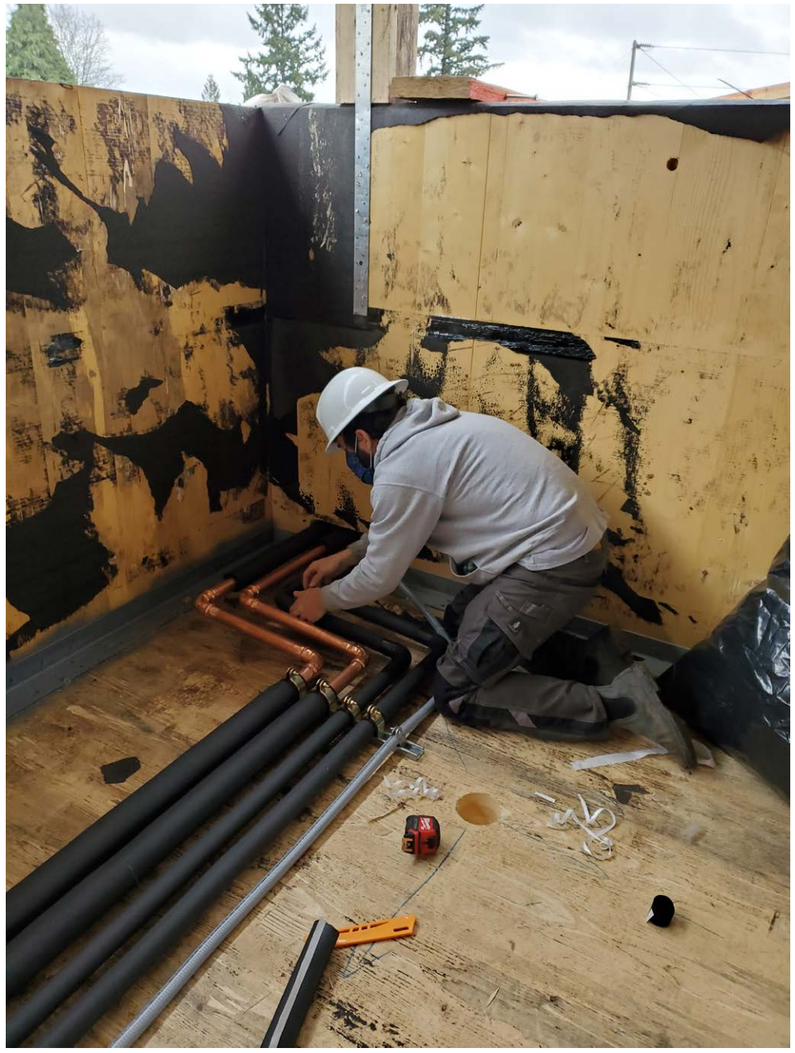


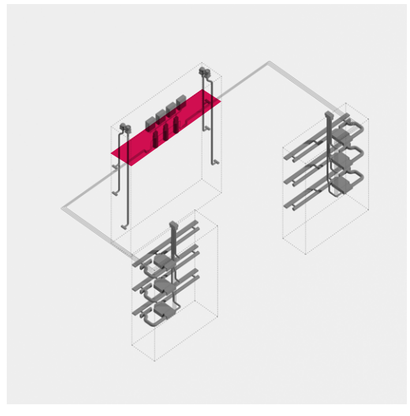


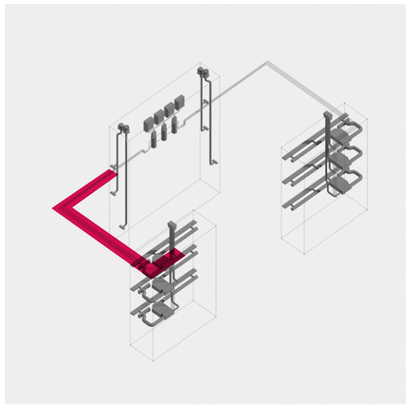


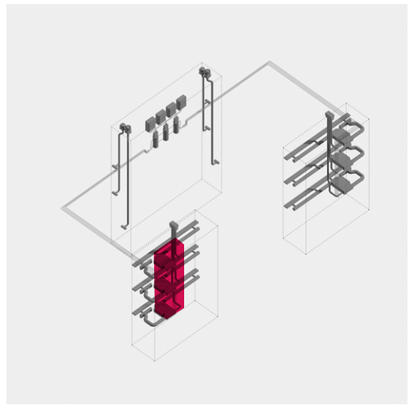


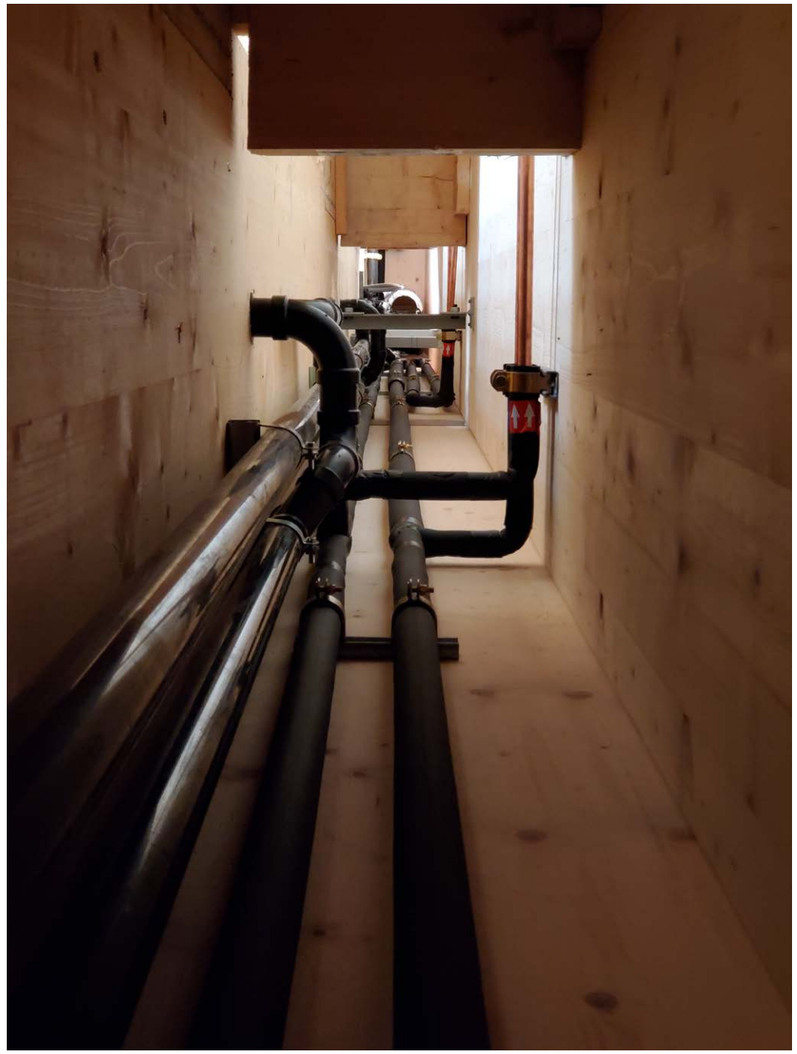


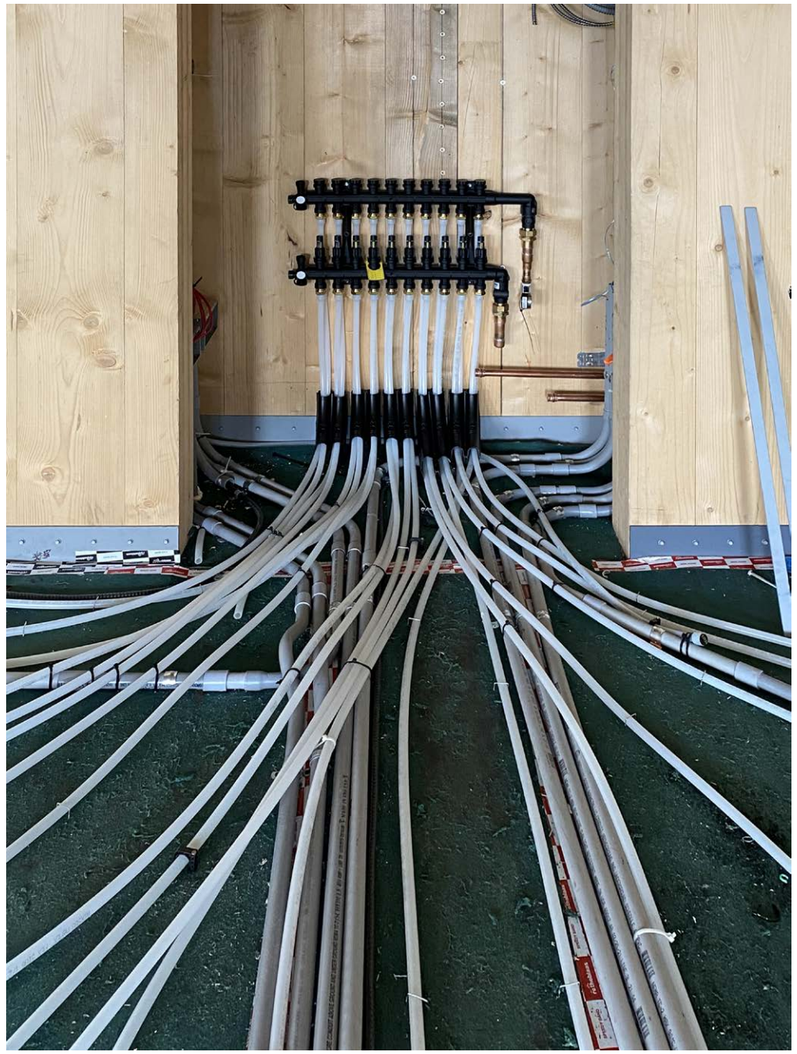




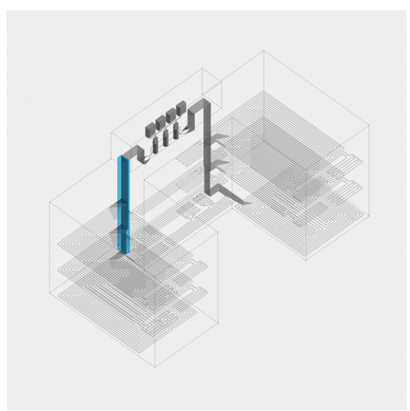


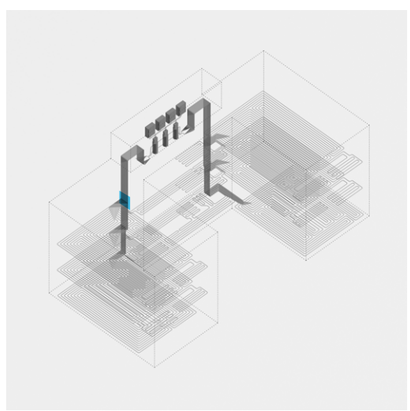


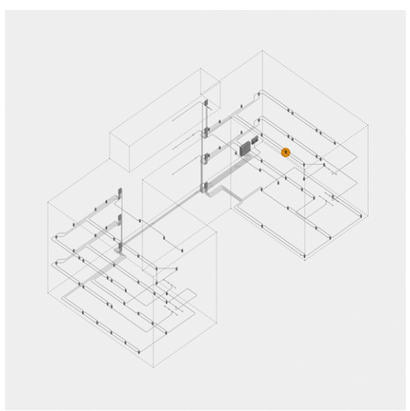





WELD-O
DUIT 41

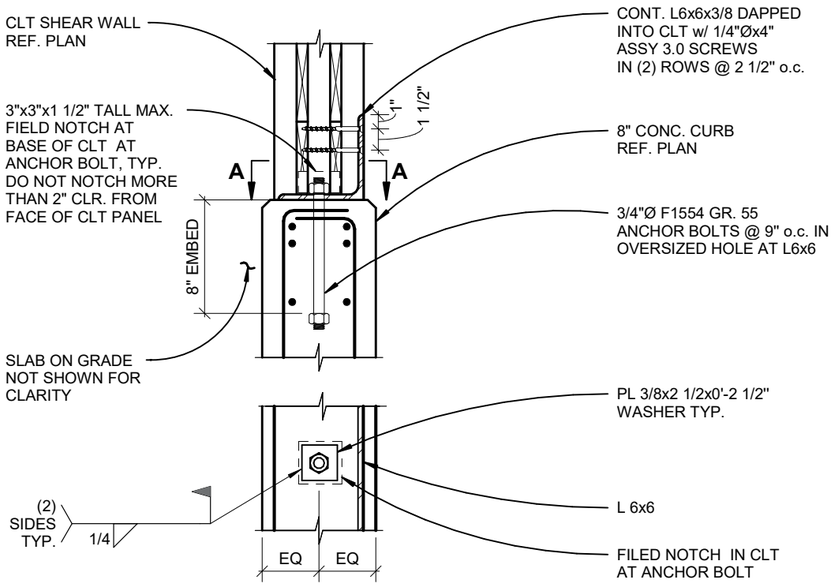






CONSTRUCTION DETAILS

TYPICAL CLT CONNECTION TO STEM WALLS



PLAN VIEW A-A

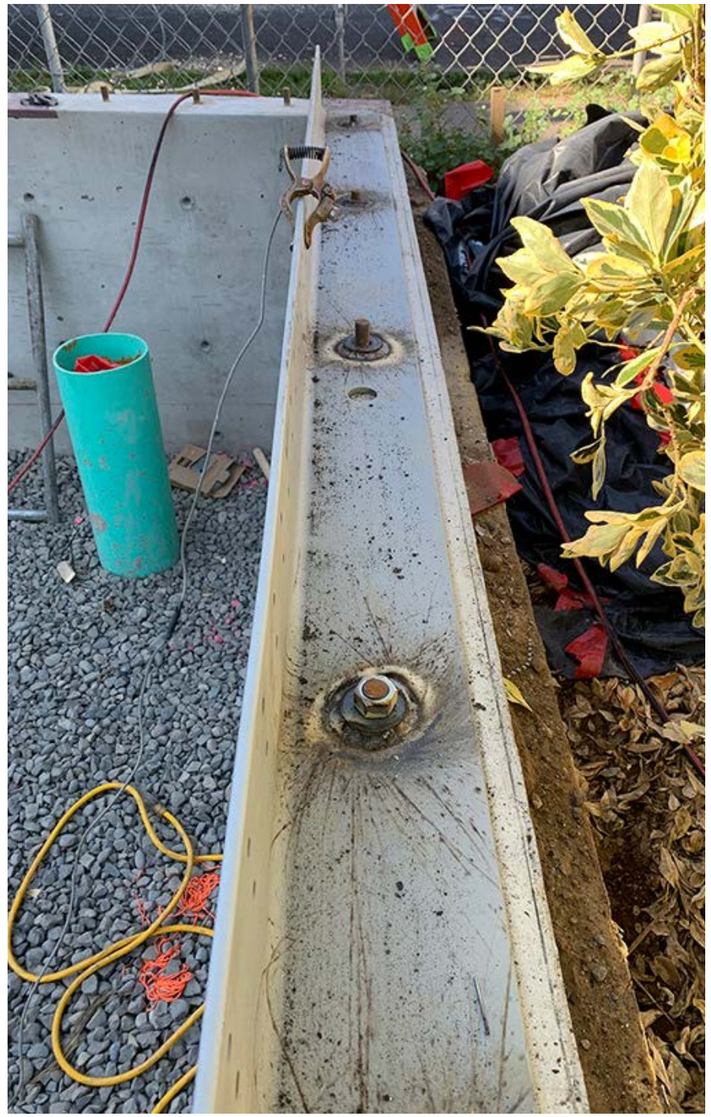
NOTES:

1. REF. ARCH. FOR L6x6 LOCATIONS AT INSIDE / OUTSIDE FACE.
2. REF. S5.3 FOR FOOTING AND CURB INFORMATION.

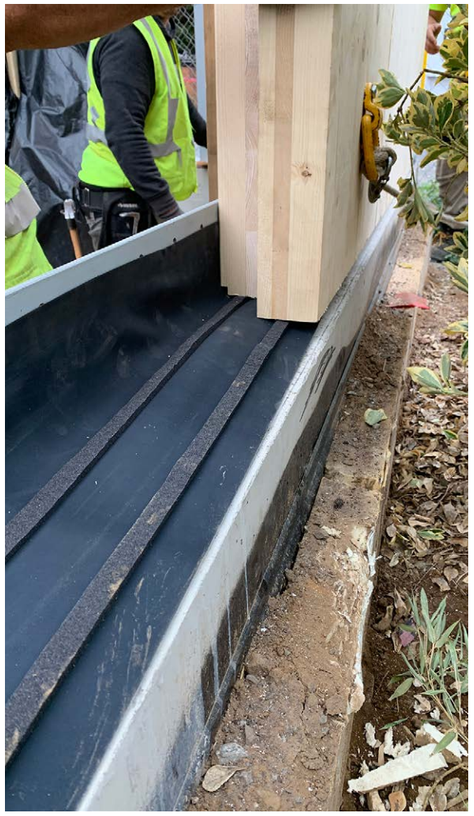
2 TYP. CLT SHEAR WALL TO CONCRETE CONNECTION

1 1/2" = 1'-0"

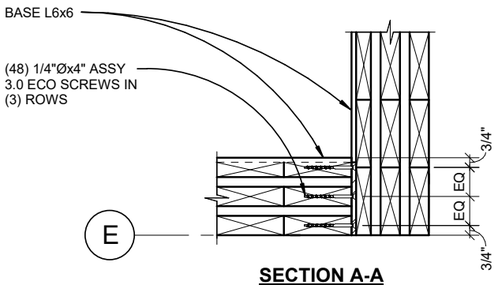
Courtesy KPFF Engineering



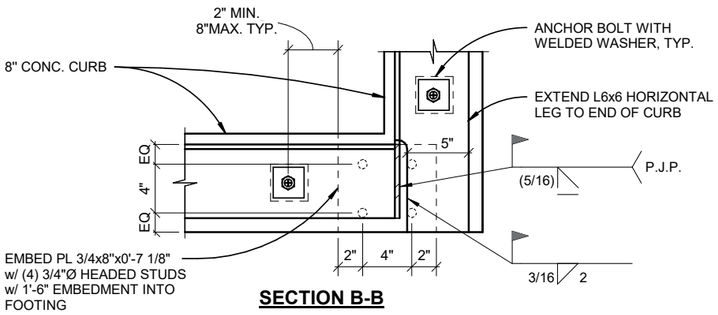
TYPICAL CLT CONNECTION TO STEM WALLS



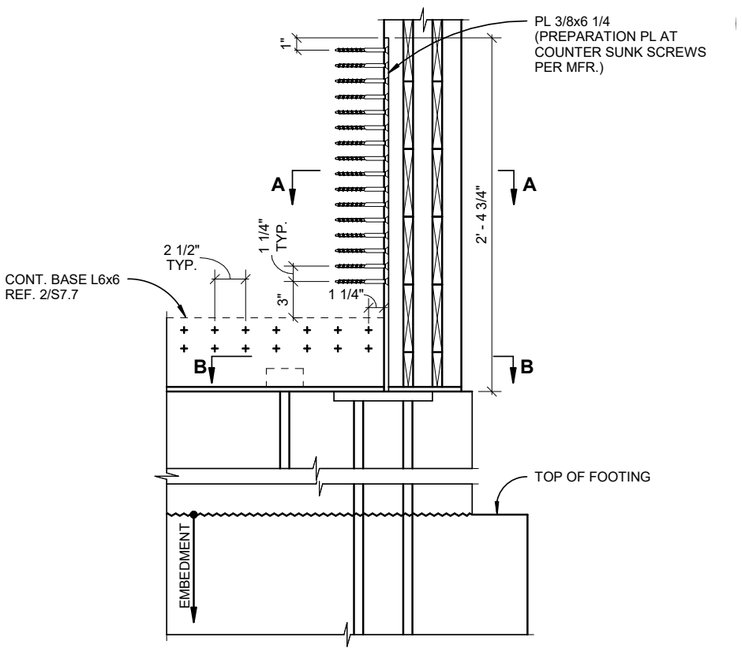
OUTSIDE CORNER HOLD DOWN



SECTION A-A



SECTION B-B



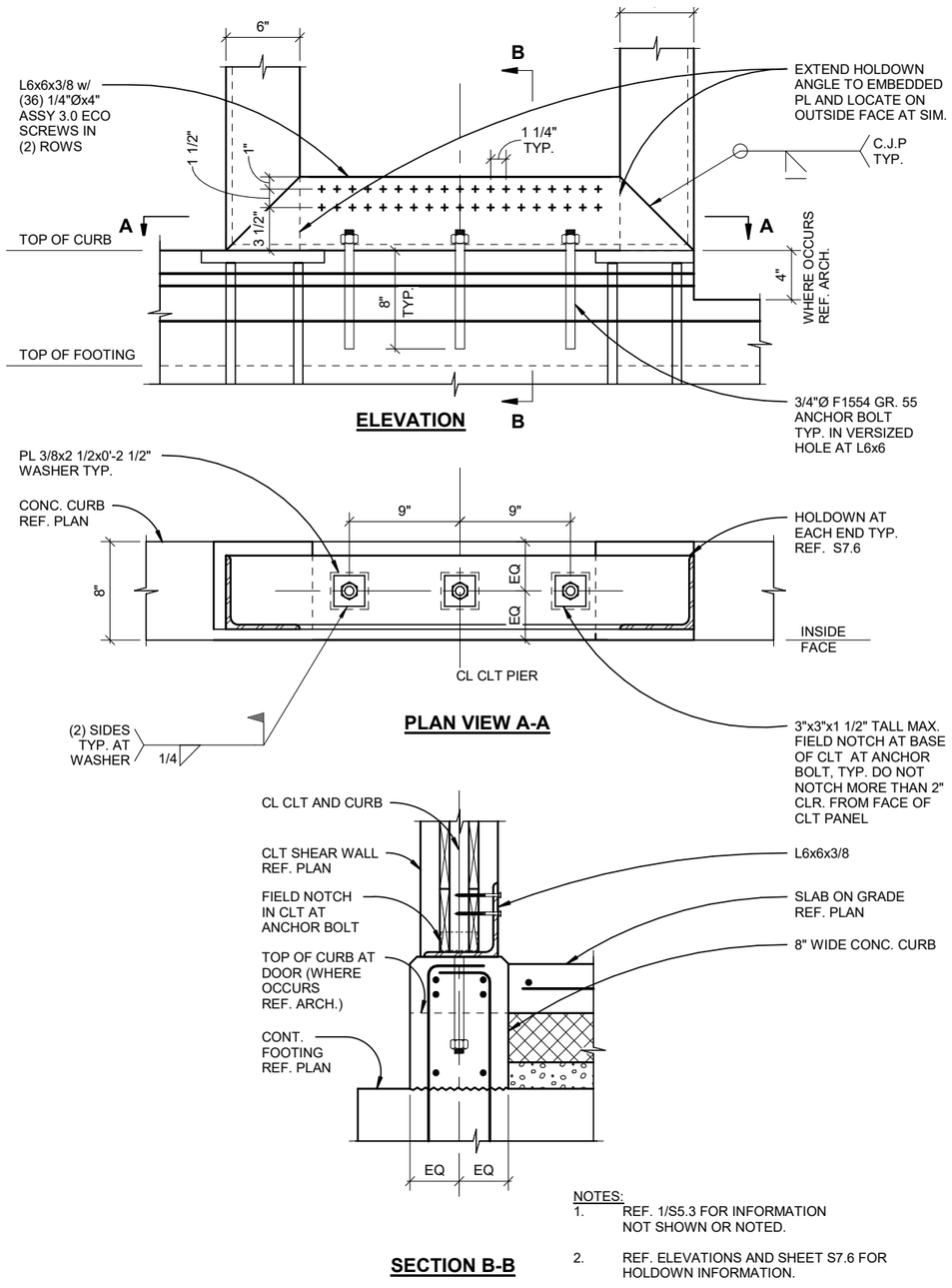
5 HOLDOWN AT GRID E

4

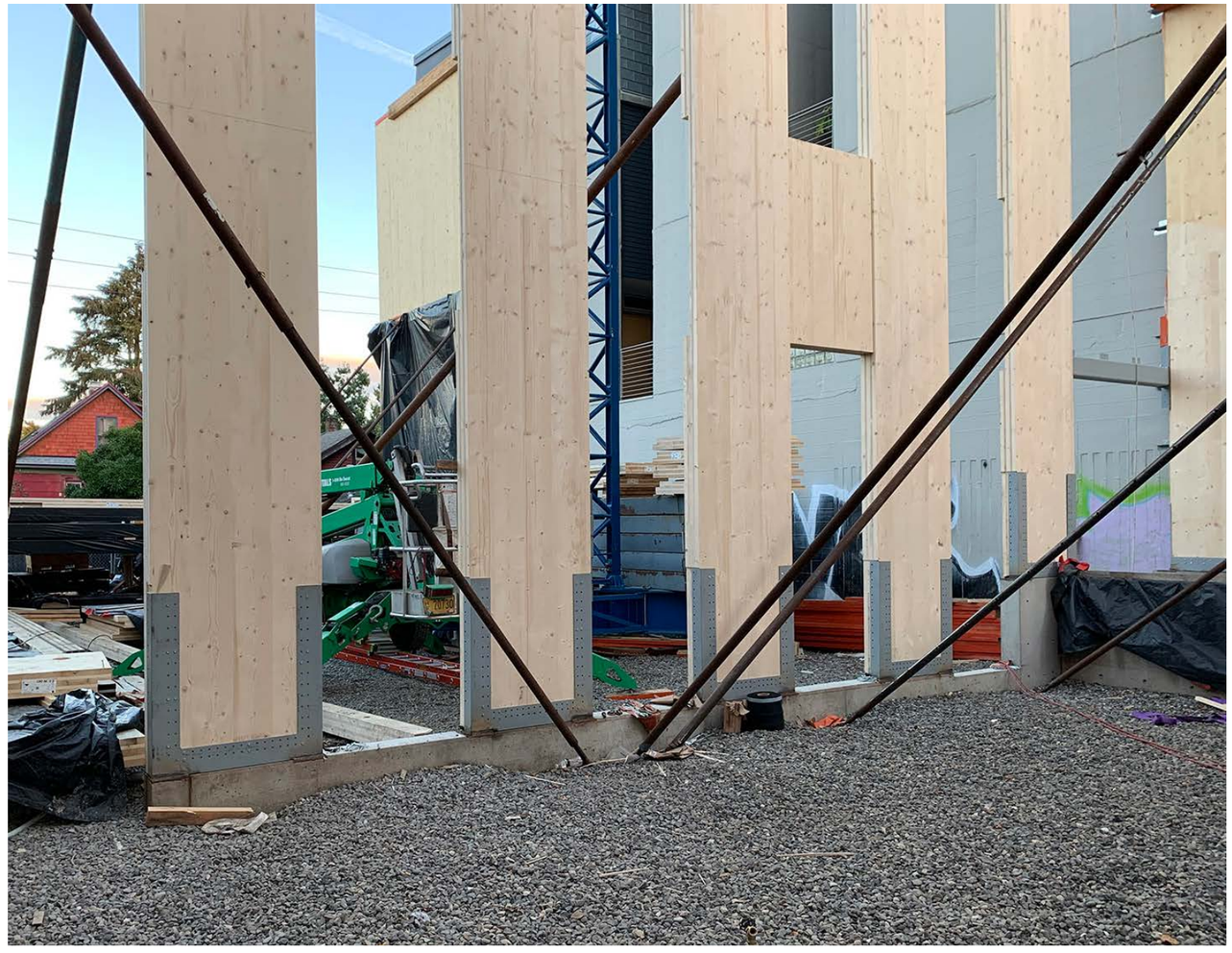
1 1/2" = 1'-0"

Courtesy KPFF Engineering

TYP CLT TO PIER



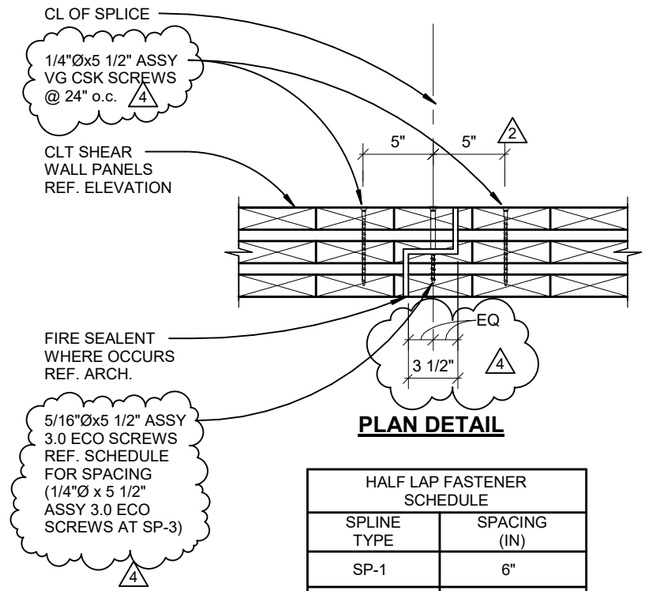
NOTES:
1. REF. 1/S5.3 FOR INFORMATION NOT SHOWN OR NOTED.
2. REF. ELEVATIONS AND SHEET S7.6 FOR HOLDOWN INFORMATION.



1 TYP. CLT PIER TO CONC. CURB/FDN.
1 1/2" = 1'-0"

Courtesy KPFF Engineering

CLT VERTICAL SPLICE

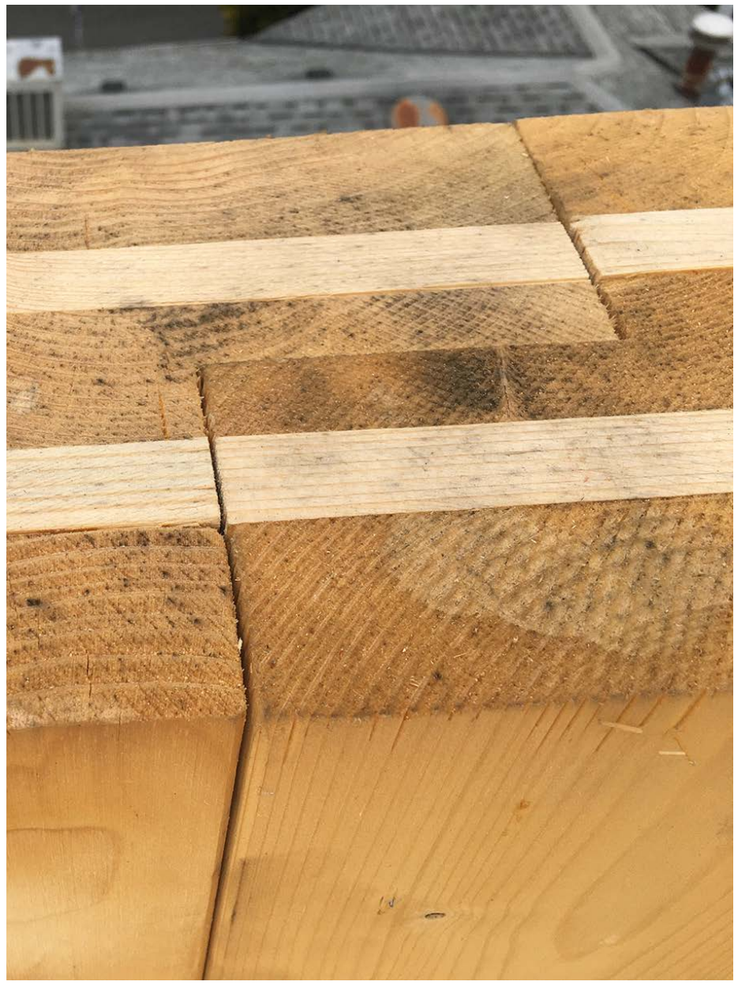


HALF LAP FASTENER SCHEDULE	
SPLINE TYPE	SPACING (IN)
SP-1	6"
SP-2	3"
SP-3 1	1 1/4"

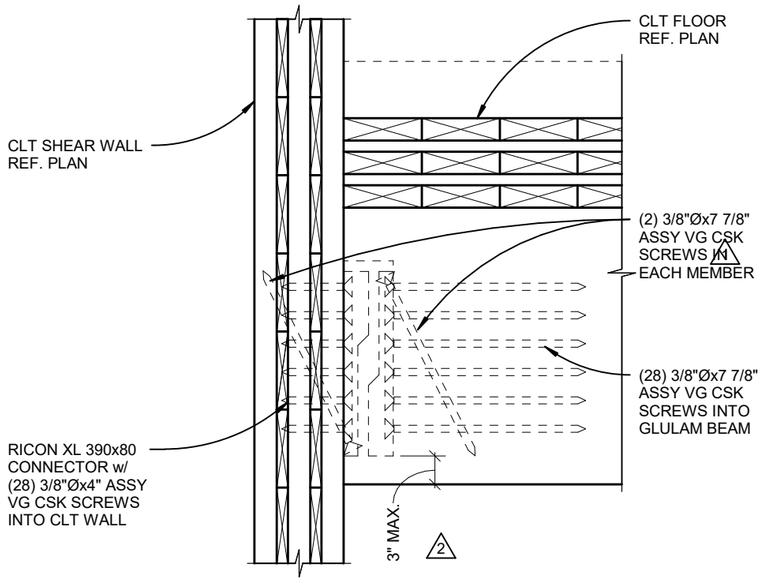
4

1 CLT SHEAR WALL
VERTICAL PANEL SPLICE DETAIL
1 1/2" = 1'-0"

Courtesy KPFF Engineering



TYP GLULAM BEAM TO CLT WALL CONNECTION



NOTES:

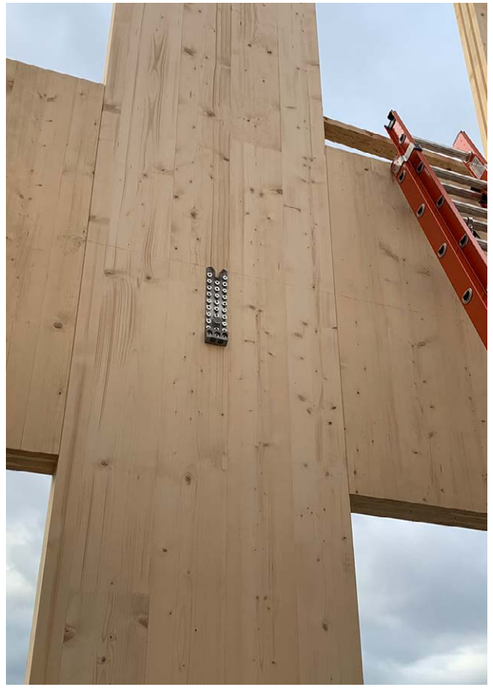
1. REF. 6/S7.1 FOR INFORMATION NOT SHOWN. 1

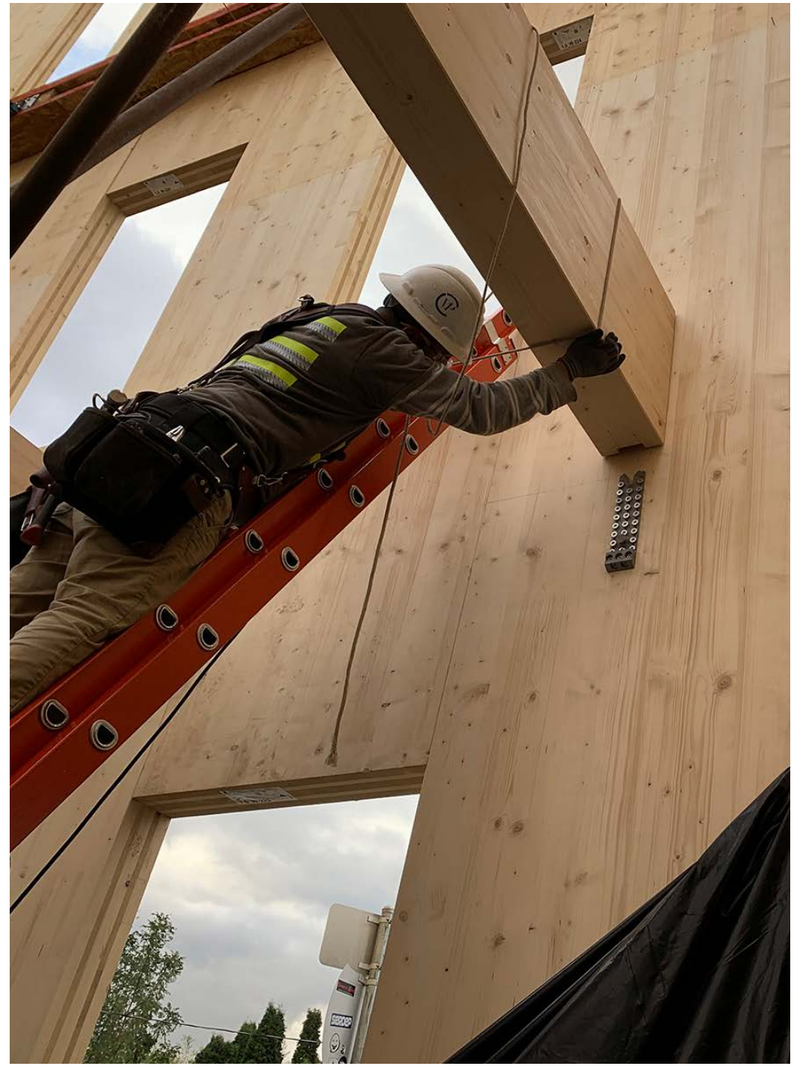
2. SIMPSON STRAPS NOT SHOWN FOR CLARITY. THE CONNECTOR SCREWS AND STRAP NAILS SHALL BE LOCATED PRIOR TO ERECTION TO AVOID CONFLICTS.

8 TYPICAL GLULAM BEAM TO CLT WALL CONNECTION

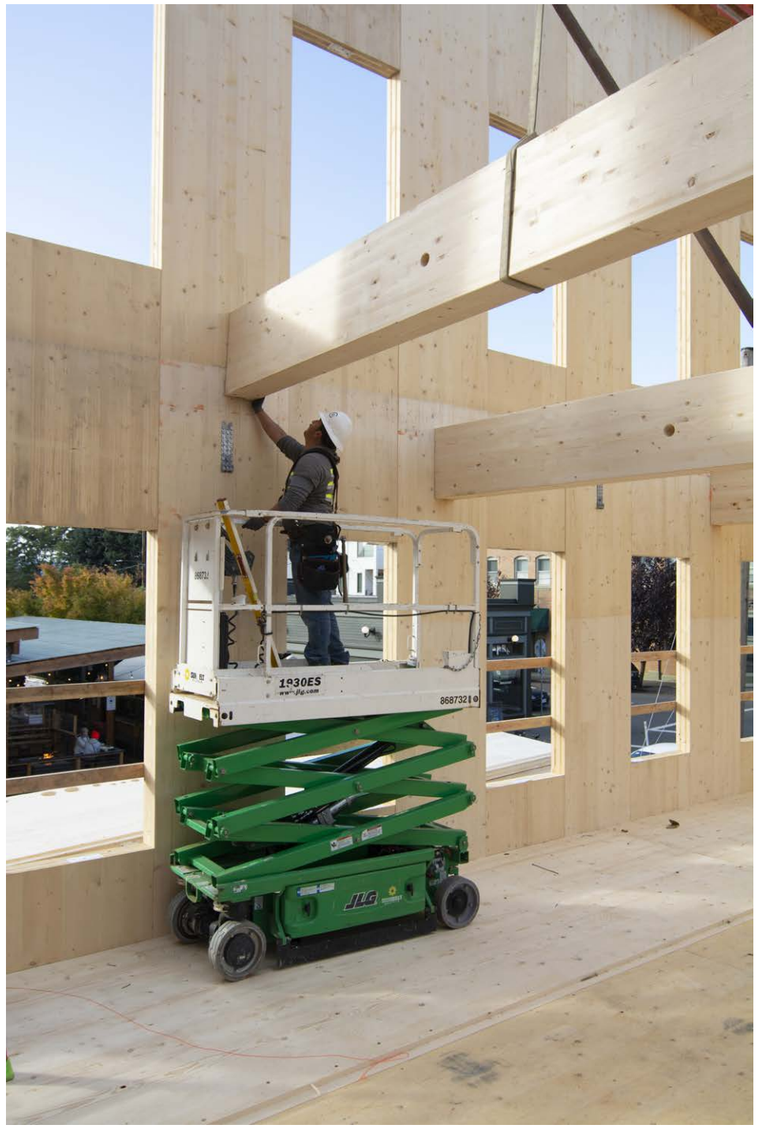
1 1/2" = 1'-0"

Courtesy KPFF Engineering

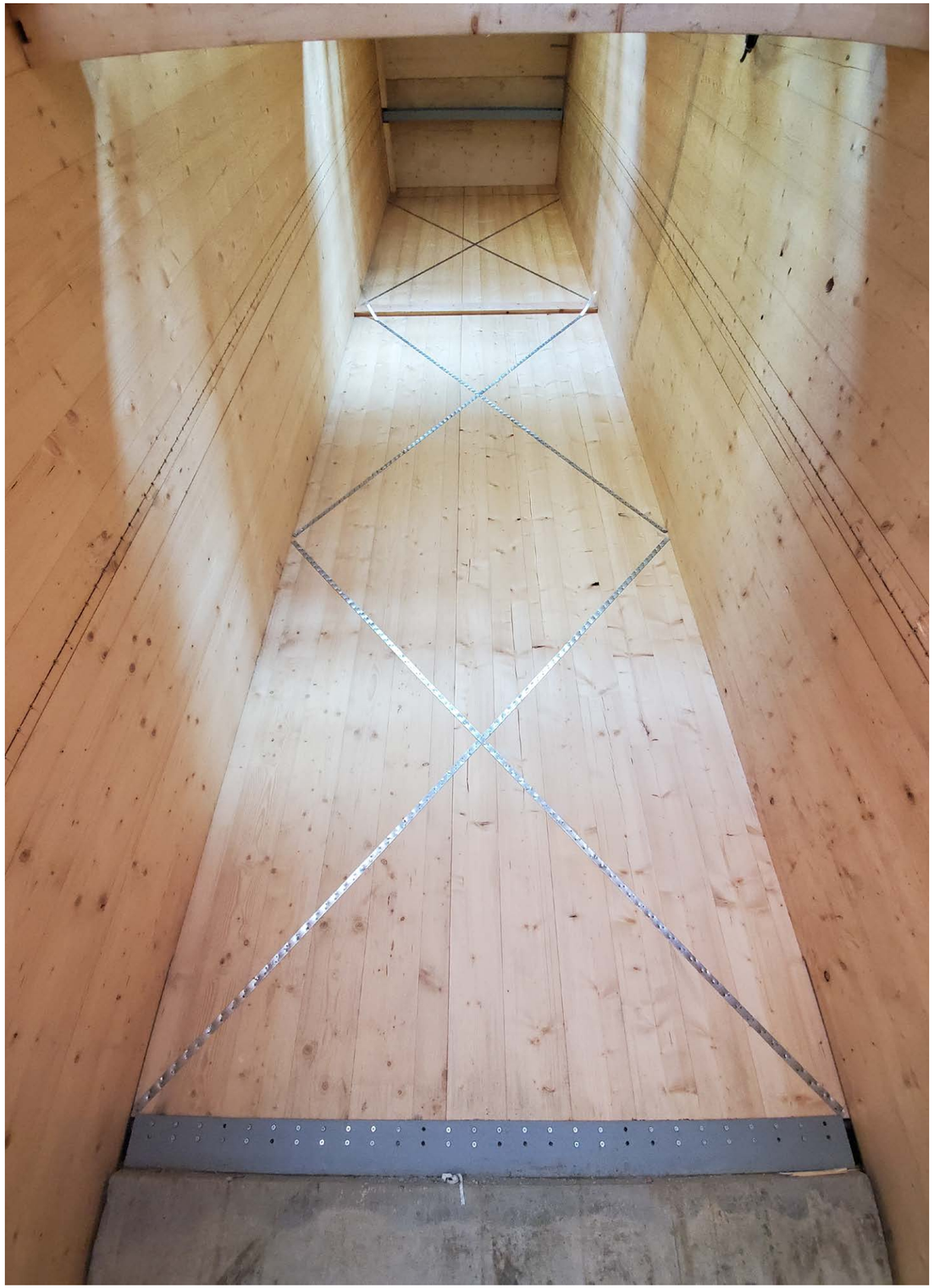




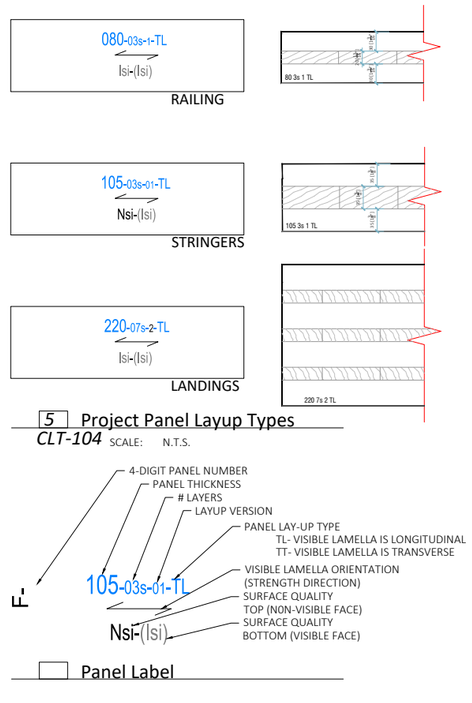
TYP GLULAM BEAM TO CLT WALL CONNECTION

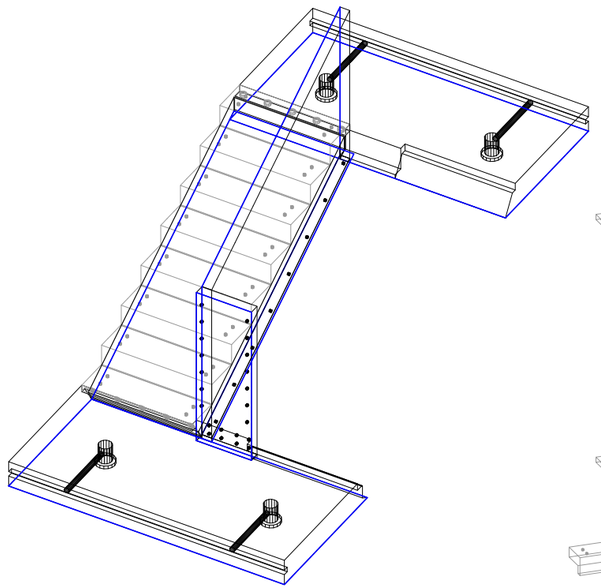



PARR

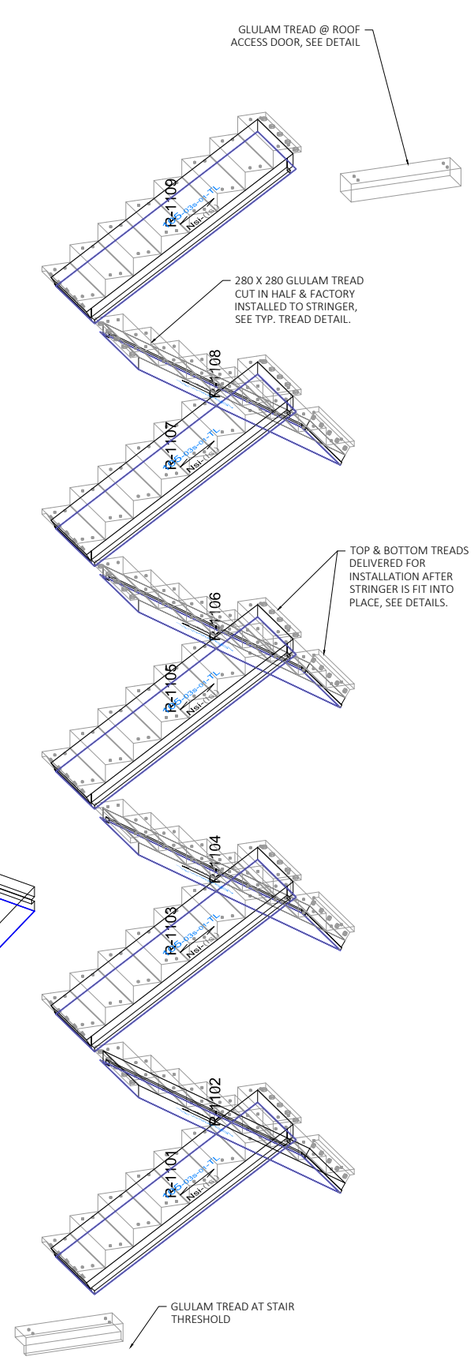


CLT / GLULAM STAIR

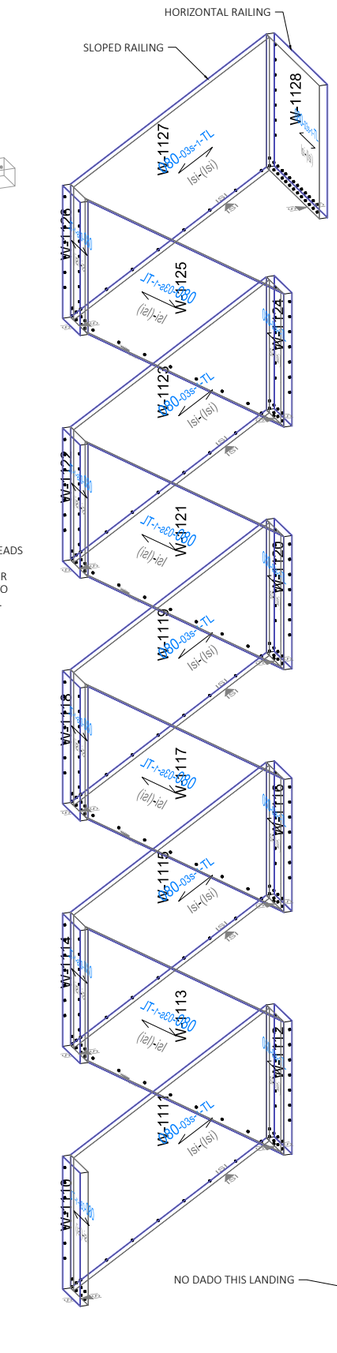




4 Enlarged Typical Assembly ISO
CLT-104 SCALE: N.T.S.

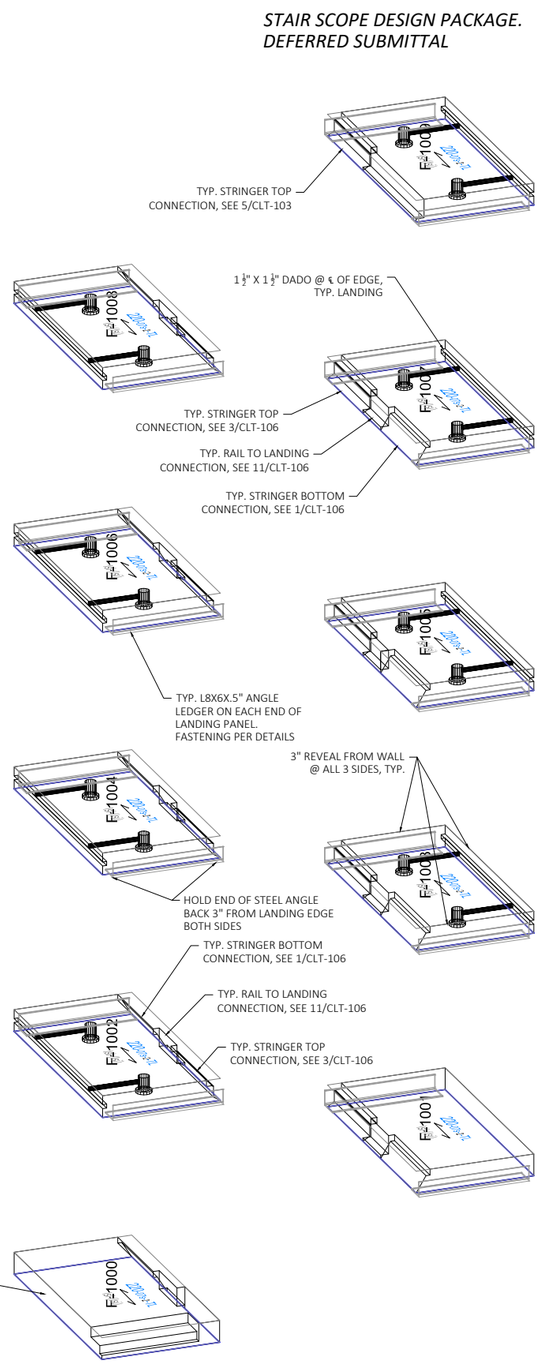


3 Glulam Treads & CLT Stringers
CLT-104 SCALE: $\frac{1}{2}$" = 1'-0"



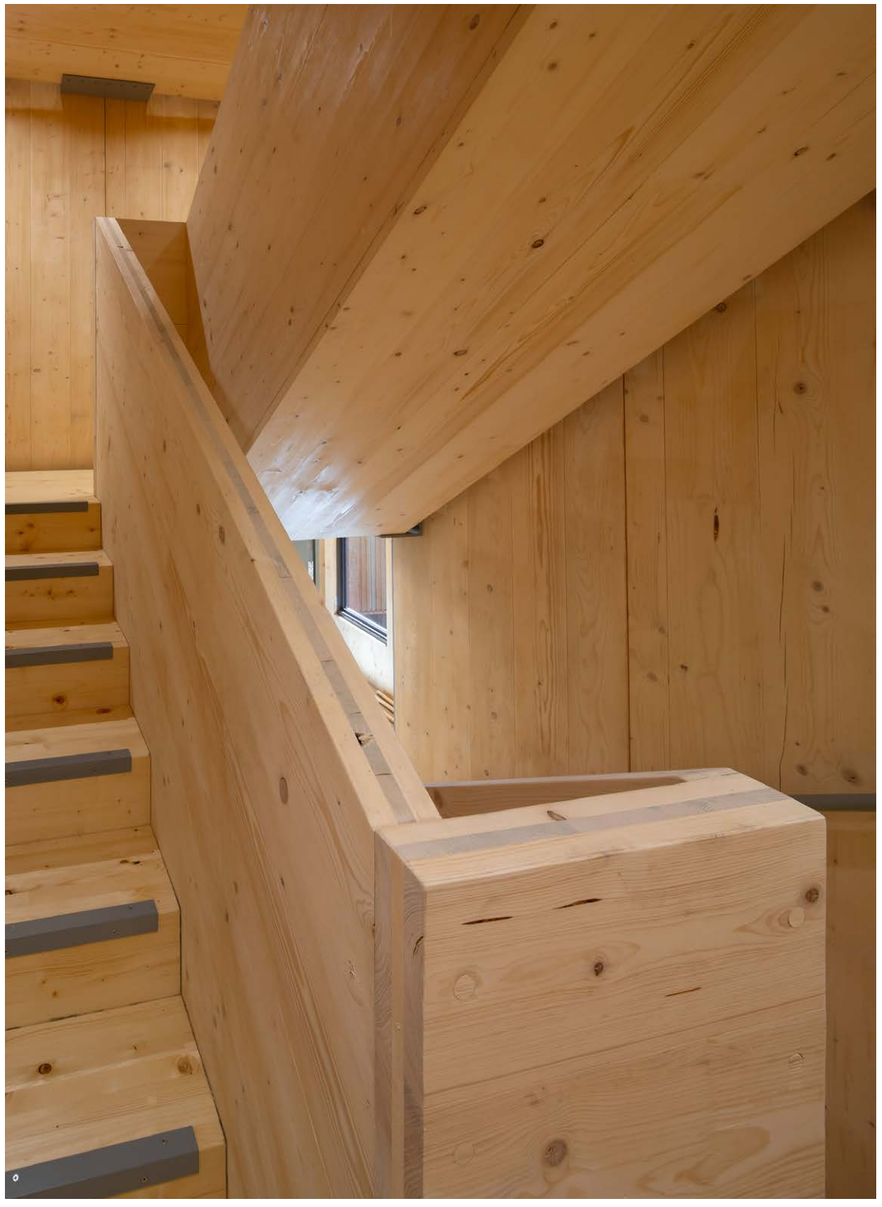
2 CLT Guardrails
CLT-104 SCALE: $\frac{1}{2}$" = 1'-0"

STAIR SCOPE DESIGN PACKAGE.
DEFERRED SUBMITTAL

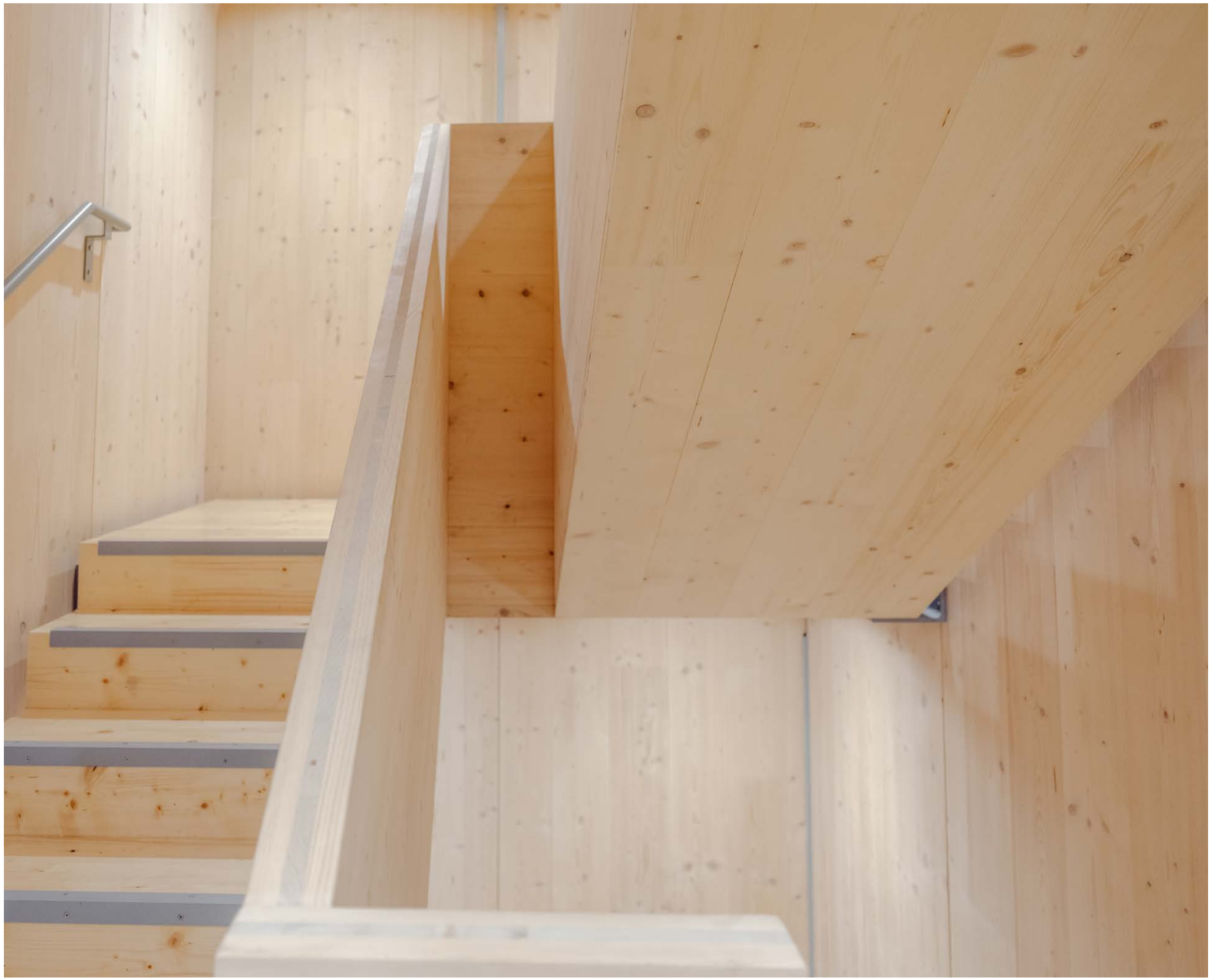


1 CLT Landings & Steel Ledgers
CLT-104 SCALE: $\frac{3}{4}$" = 1'-0"

CLT / GLULAM STAIR

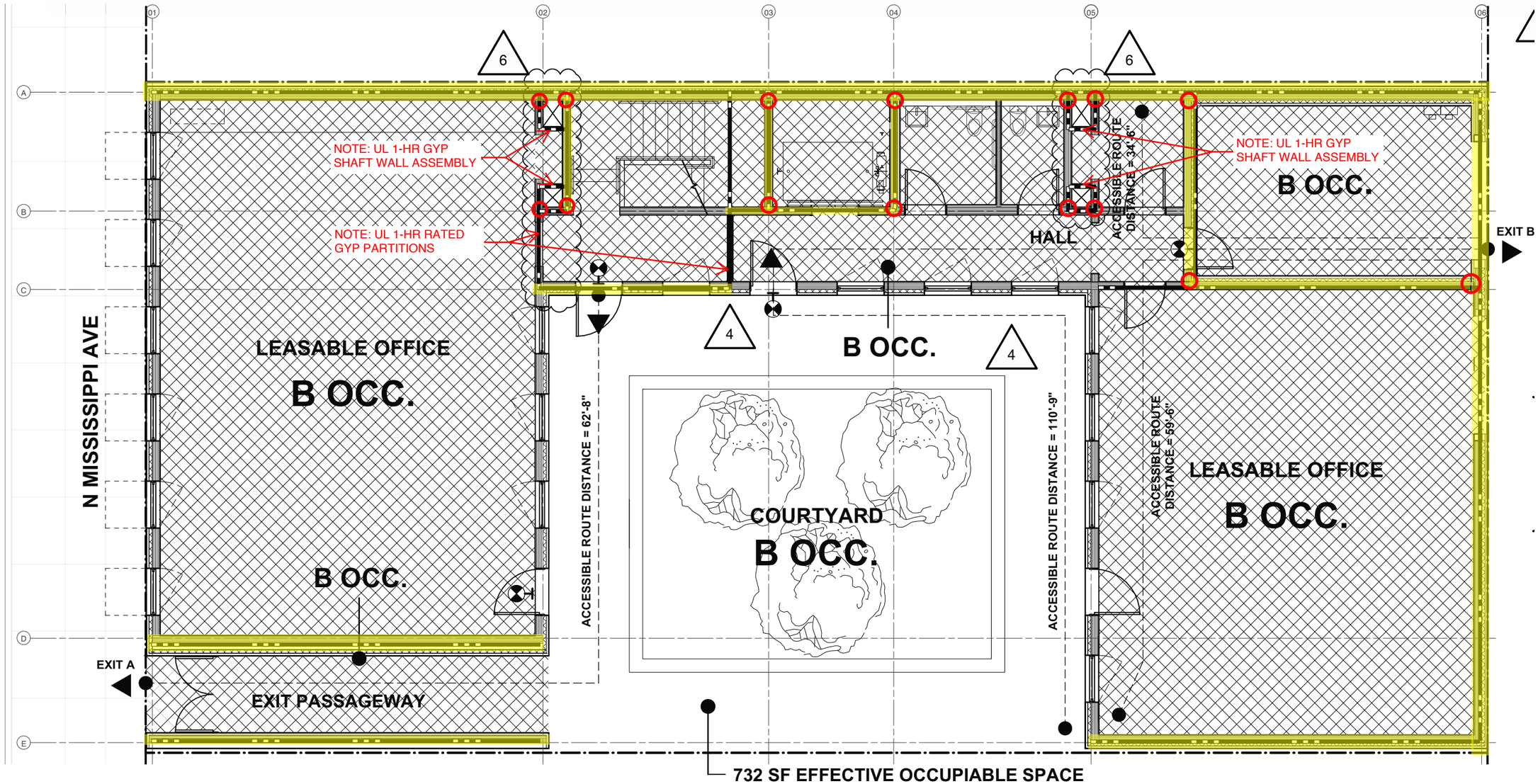


CLT / GLULAM STAIR



CODES AND FIRE RESISTANCE

CODE REVISIONS / FIRE RESISTANCE



FIRST FLOOR PLAN

HALF-LAP CONDITION
DETAIL 4/A8.2

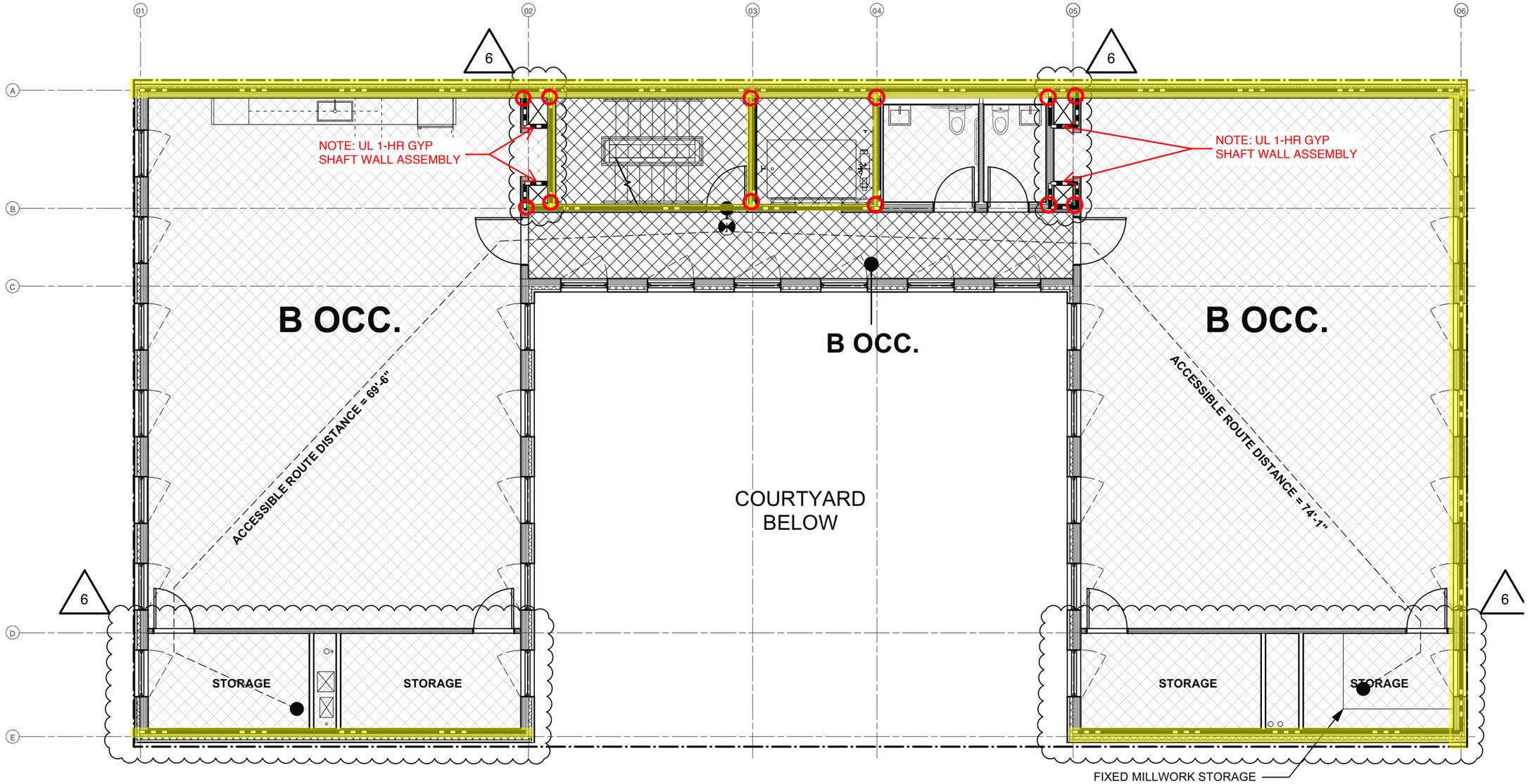
T-JOINT
DETAIL 5/A8.2

FIRE RATING AND OCCUPANCY SEPARATION

WALL FULL HEIGHT TO STRUCTURE,
1 HR FIRE BARRIER WITH 45 MIN OPENING PROTECTION

FIRE RATED EXTERIOR WALL
1 HR SEPERATION WITH 45 MIN OPENING PROTECTION WITH UNPROTECTED OPENINGS

CODE REVISIONS / FIRE RESISTANCE



SECOND FLOOR PLAN

HALF-LAP CONDITION
DETAIL 4/A8.2

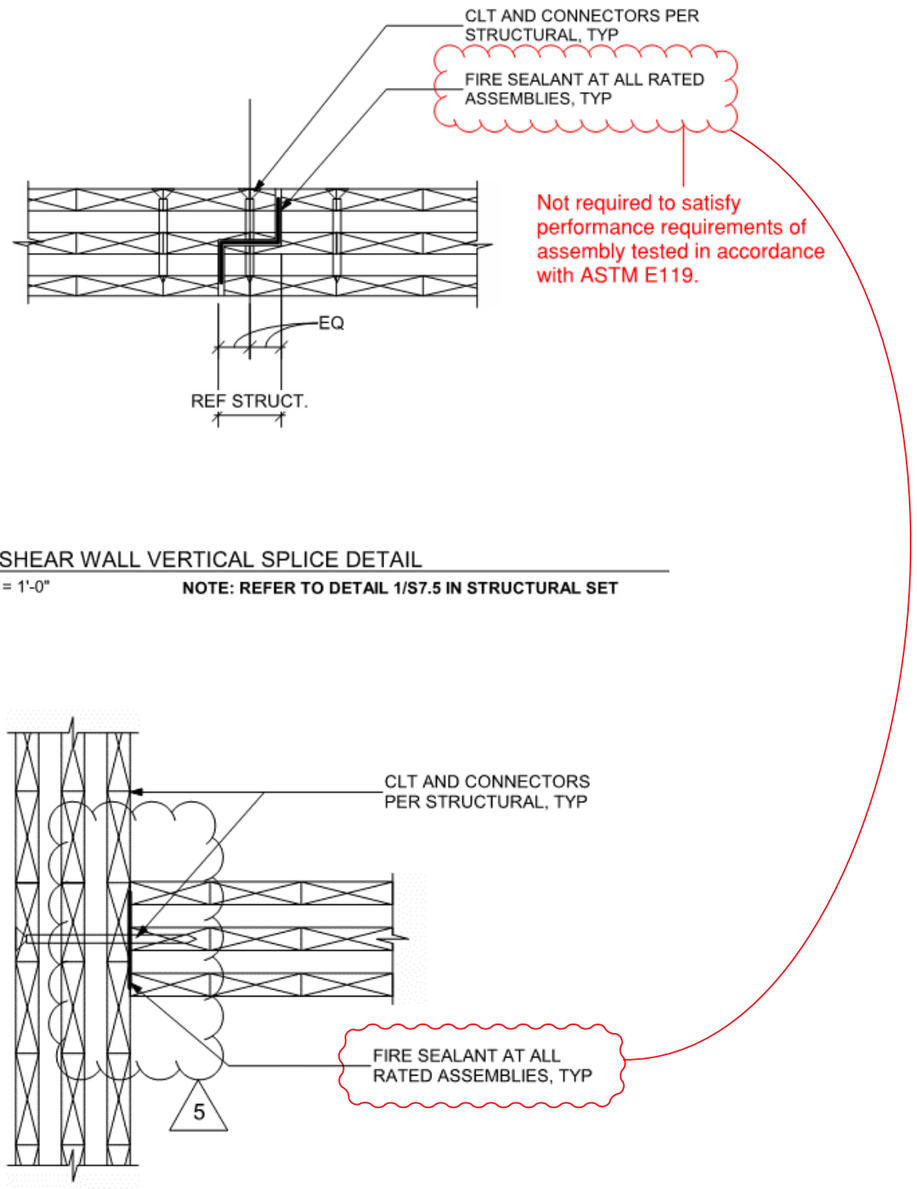
T-JOINT
DETAIL 5/A8.2

FIRE RATING AND OCCUPANCY SEPARATION

WALL FULL HEIGHT TO STRUCTURE,
1 HR FIRE BARRIER WITH 45 MIN OPENING PROTECTION

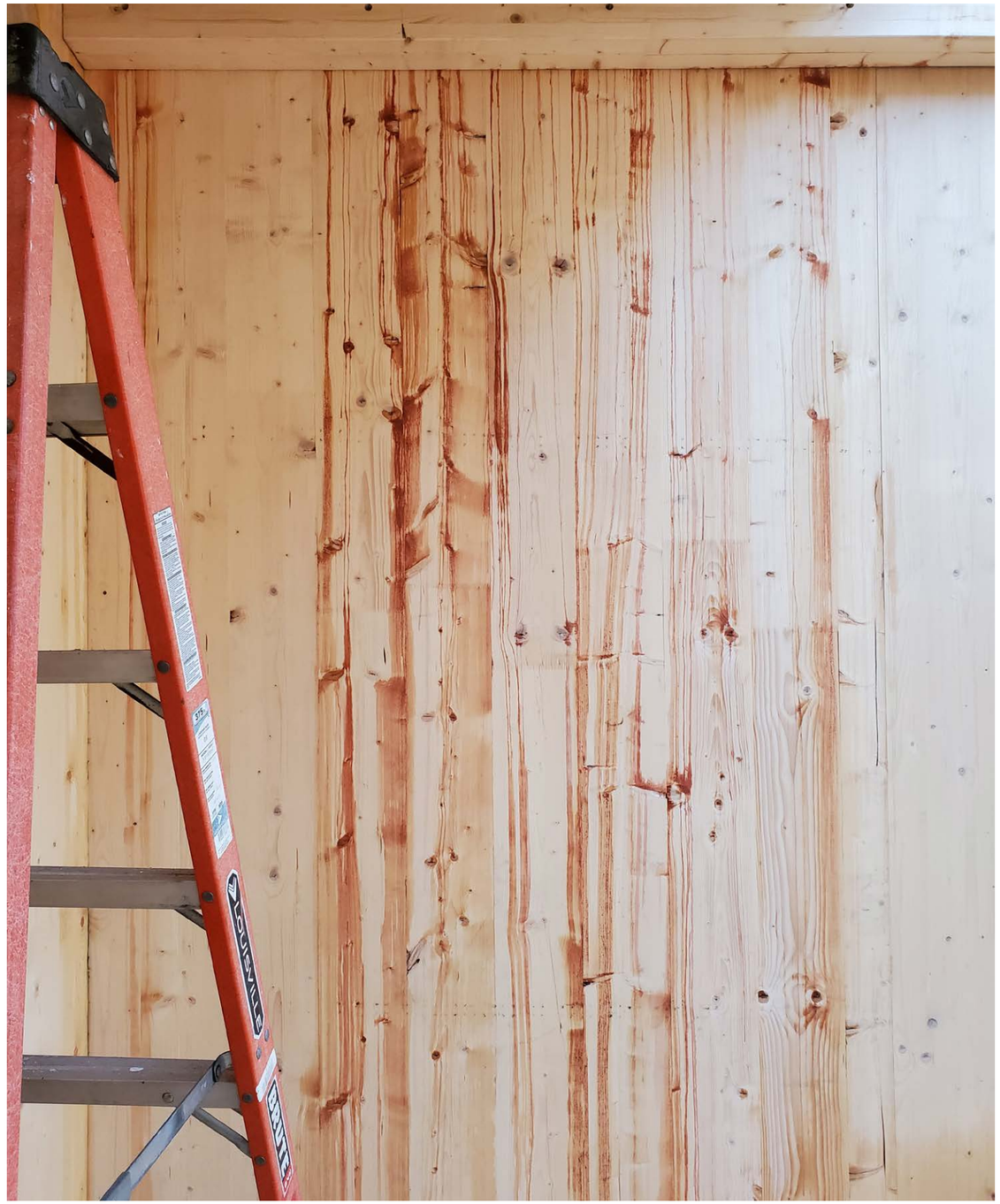
FIRE RATED EXTERIOR WALL
1 HR SEPERATION ~~WITH 45 MIN OPENING PROTECTION~~ WITH UNPROTECTED OPENINGS

CODE REVISIONS / FIRE RESISTANCE



4 CLT SHEAR WALL VERTICAL SPLICE DETAIL
1 1/2" = 1'-0"
NOTE: REFER TO DETAIL 1/S7.5 IN STRUCTURAL SET

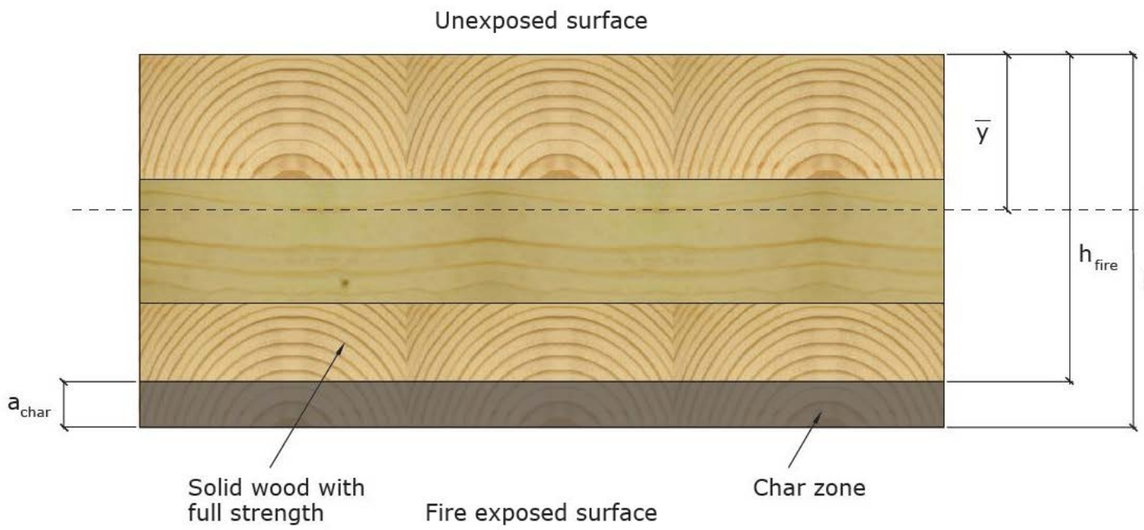
5 TYPICAL CLT SHEAR WALL T-JOINT
1 1/2" = 1'-0"
NOTE: REFER TO DETAIL 3/S7.5 IN STRUCTURAL SET

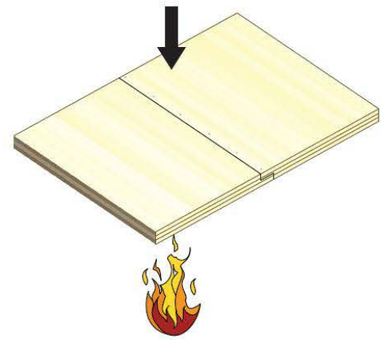


CODE REVISIONS / FIRE RESISTANCE

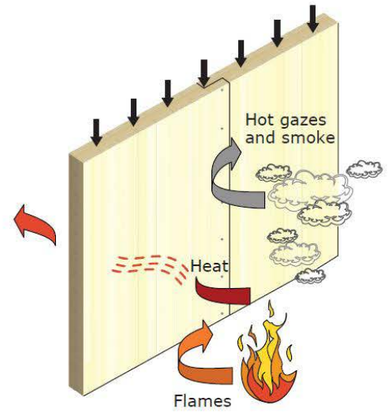
Table 4.1.1.4B Effective Char Depth (for CLT with β_n=1.5 inches/hour)

Required Fire Resistance (hr)	Lamination Thickness, h_{lam} (in.)								
	5/8	3/4	7/8	1	1-1/4	1-3/8	1-1/2	1-3/4	2
	Char Depth, a_{char} (in.)								
1-Hour	1.8	1.8	1.7	1.7	1.7	1.6	1.5	1.5	1.5
1½-Hour	2.8	2.7	2.6	2.5	2.4	2.4	2.4	2.3	2.2
2-Hour	3.7	3.6	3.4	3.4	3.2	3.2	3.0	3.0	3.0
	Effective Char Depth, a_{eff} (in.)								
1-Hour	2.2	2.2	2.1	2.0	2.0	1.9	1.8	1.8	1.8
1½-Hour	3.4	3.2	3.1	3.0	2.9	2.8	2.8	2.8	2.6
2-Hour	4.4	4.3	4.1	4.0	3.9	3.8	3.6	3.6	3.6

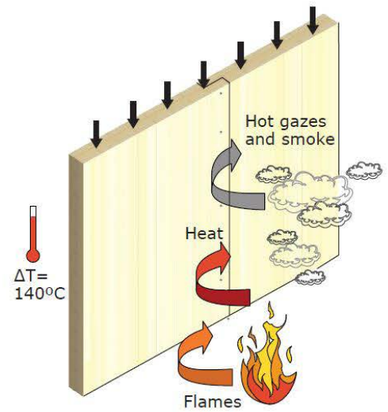




a) Structural resistance



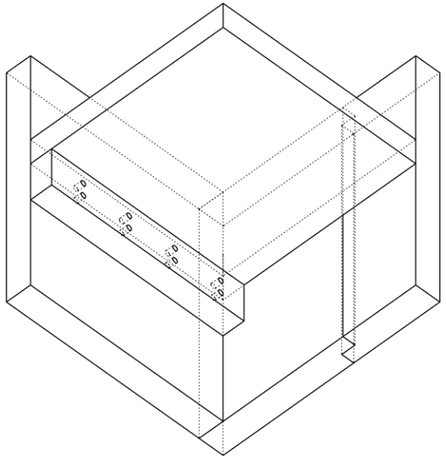
b) Integrity



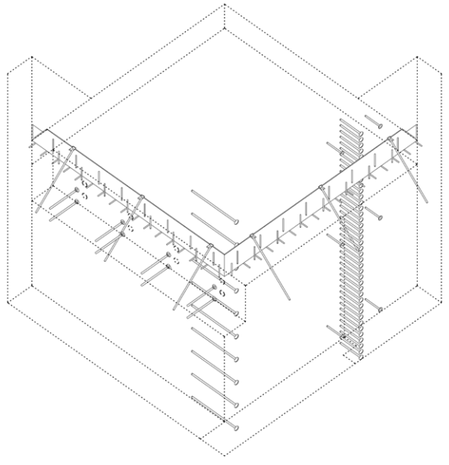
c) Insulation

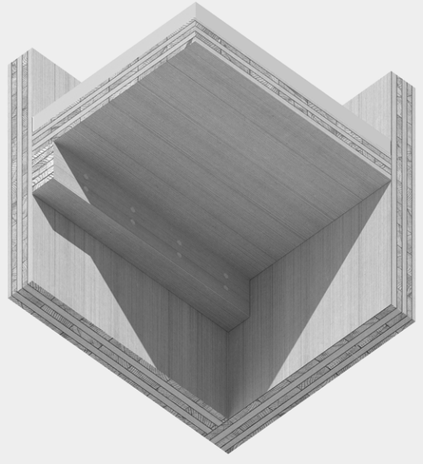
Figure 1
Fire resistance criteria per ASTM E119

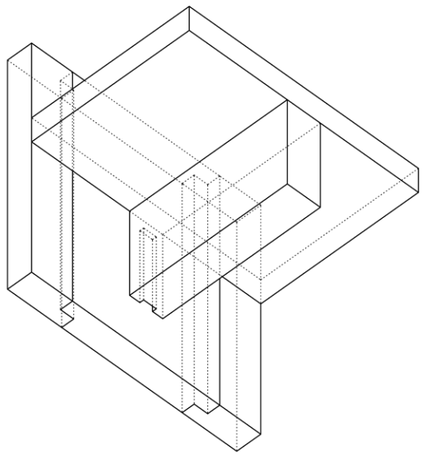
POST OCCUPANCY ANALYSIS / USDA WOOD INNOVATION GRANT



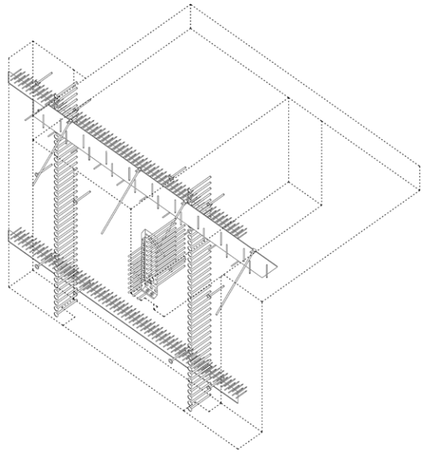
Ledger Connection

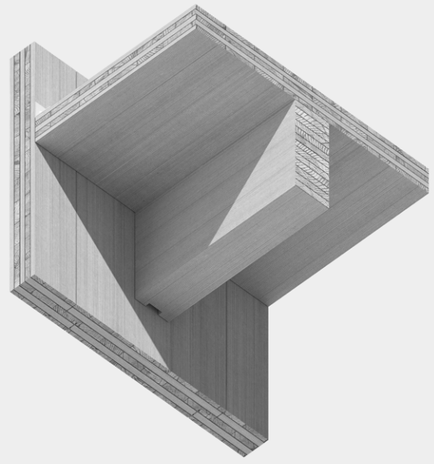




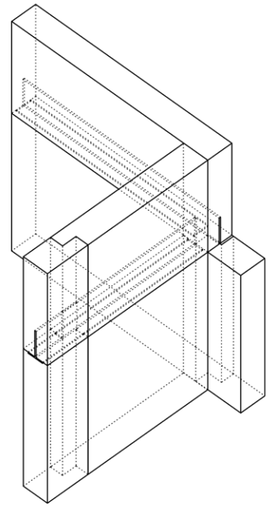


Ricon Beam Connection

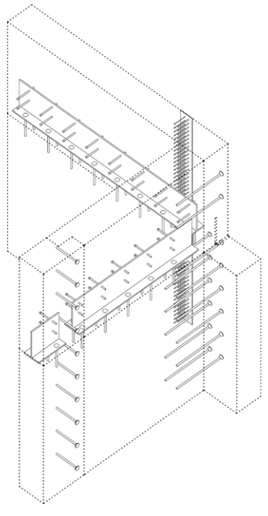


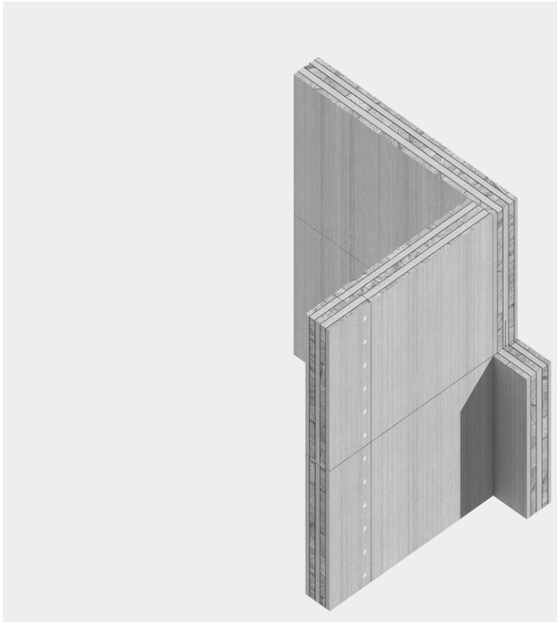


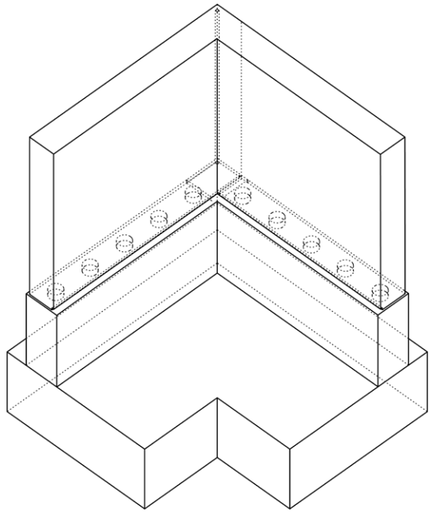
WOOD INNOVATION GRANT — DETAIL STUDIES



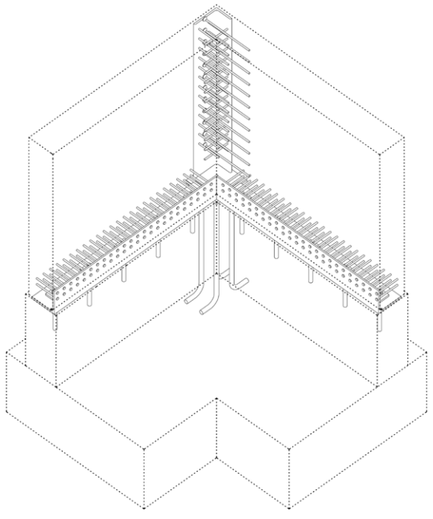
Bulkhead Extension

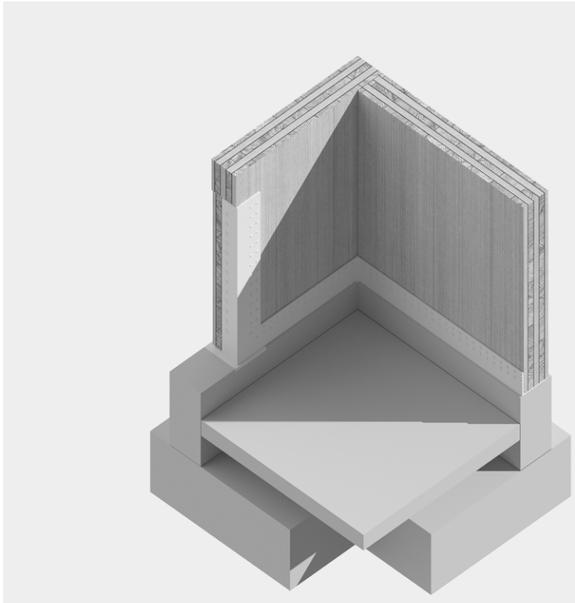




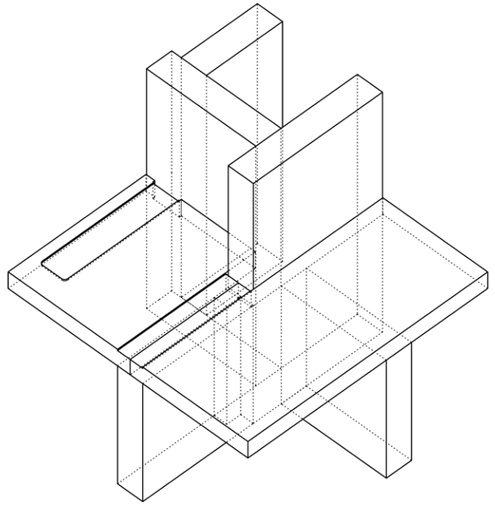


Stemwall Corner

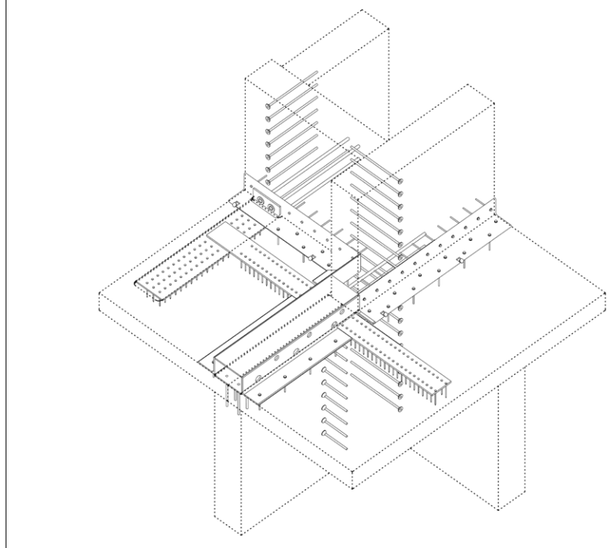


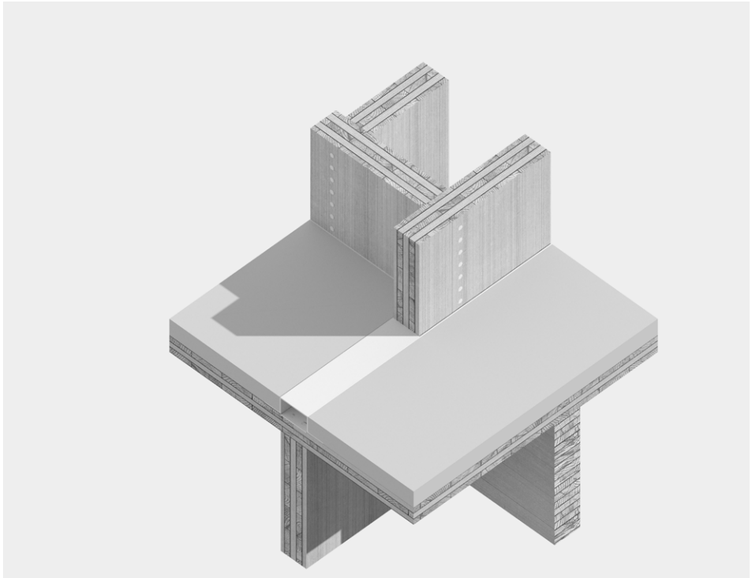


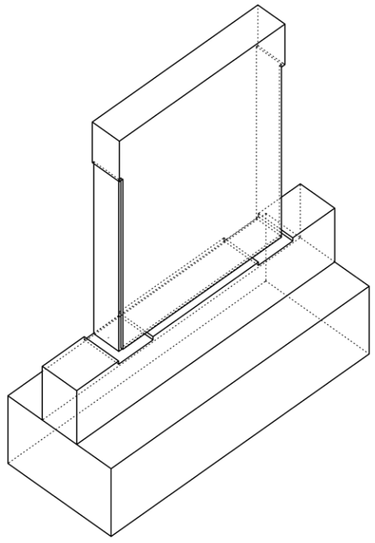
WOOD INNOVATION GRANT — DETAIL STUDIES



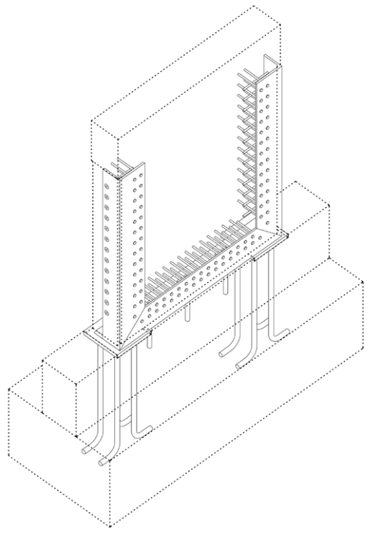
Drag Plate Connection

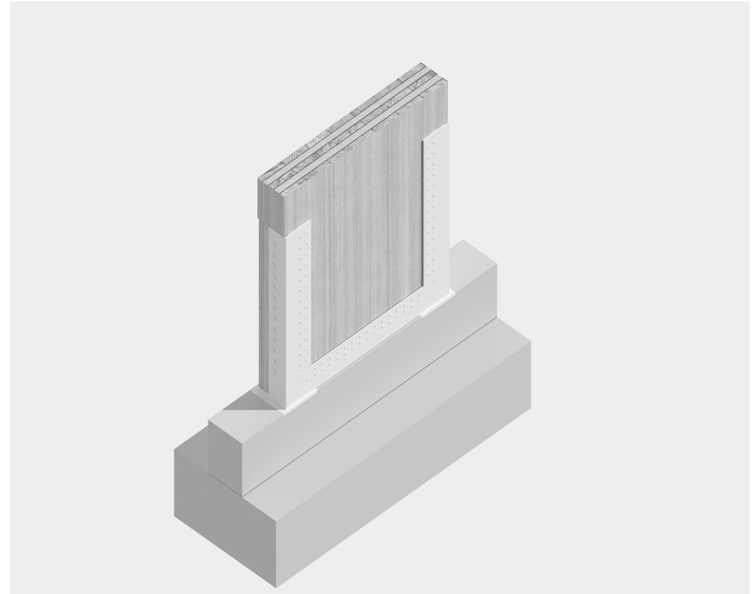






Stemwall U-Bracket



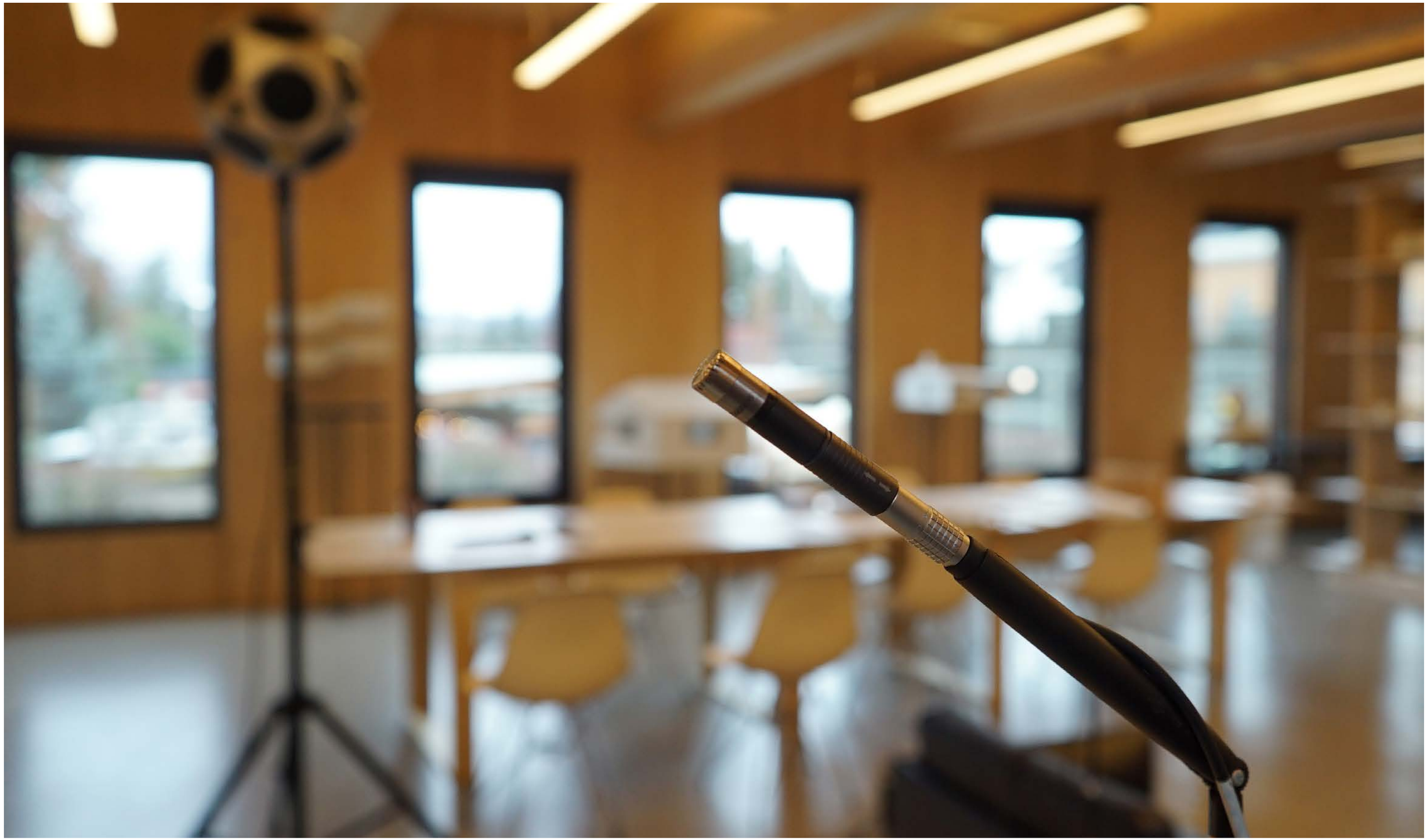


WOOD INNOVATION GRANT — DETAIL STUDIES

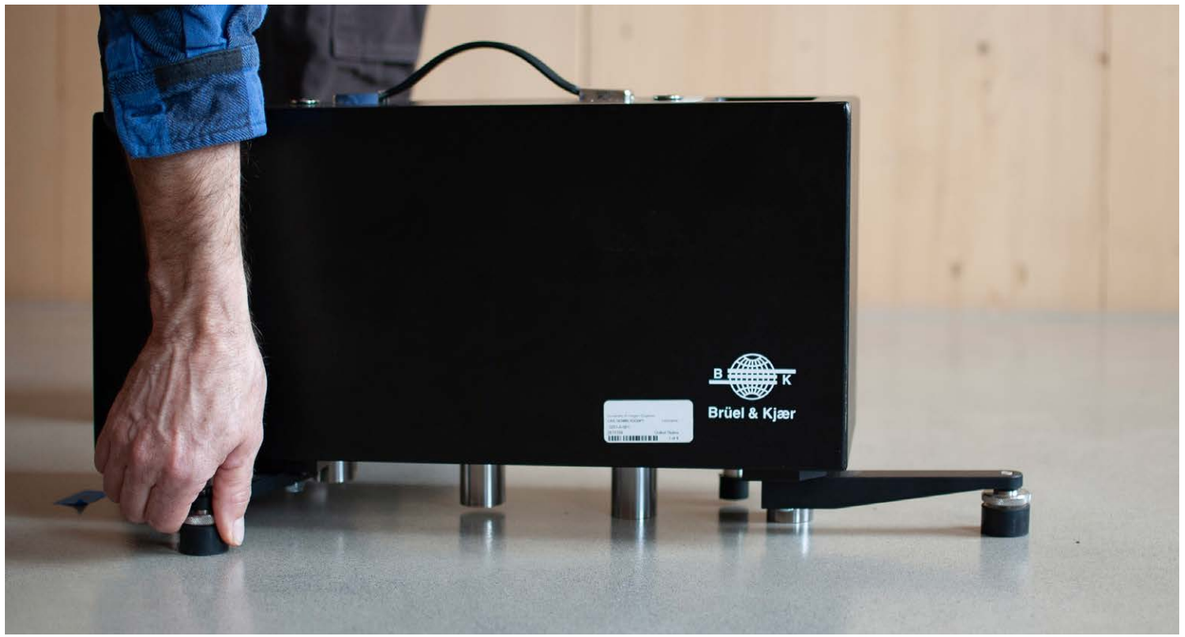
UNIVERSITY OF OREGON, INSTITUTE FOR HEALTH IN THE BUILT ENVIRONMENT

Mark Fretz, Director

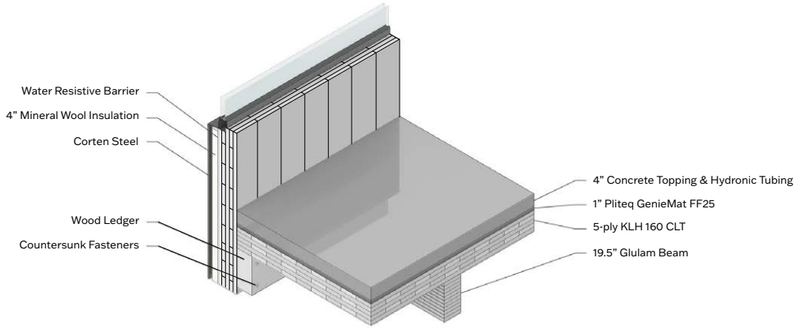
- Acoustic AirborneTesting
- Acoustic Impact Testing
- Thermal Imaging
- Infiltration (Blower Door)
- Air Quality (Temp. & RH)
- Air Quality (CO2 & VOC)

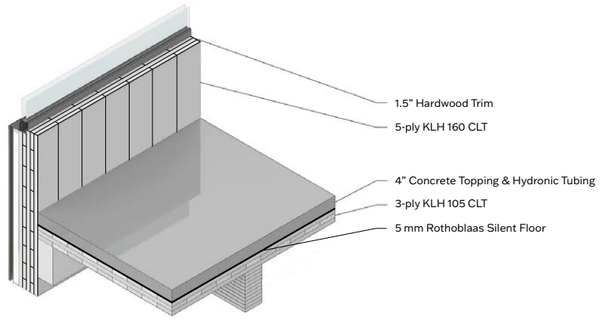


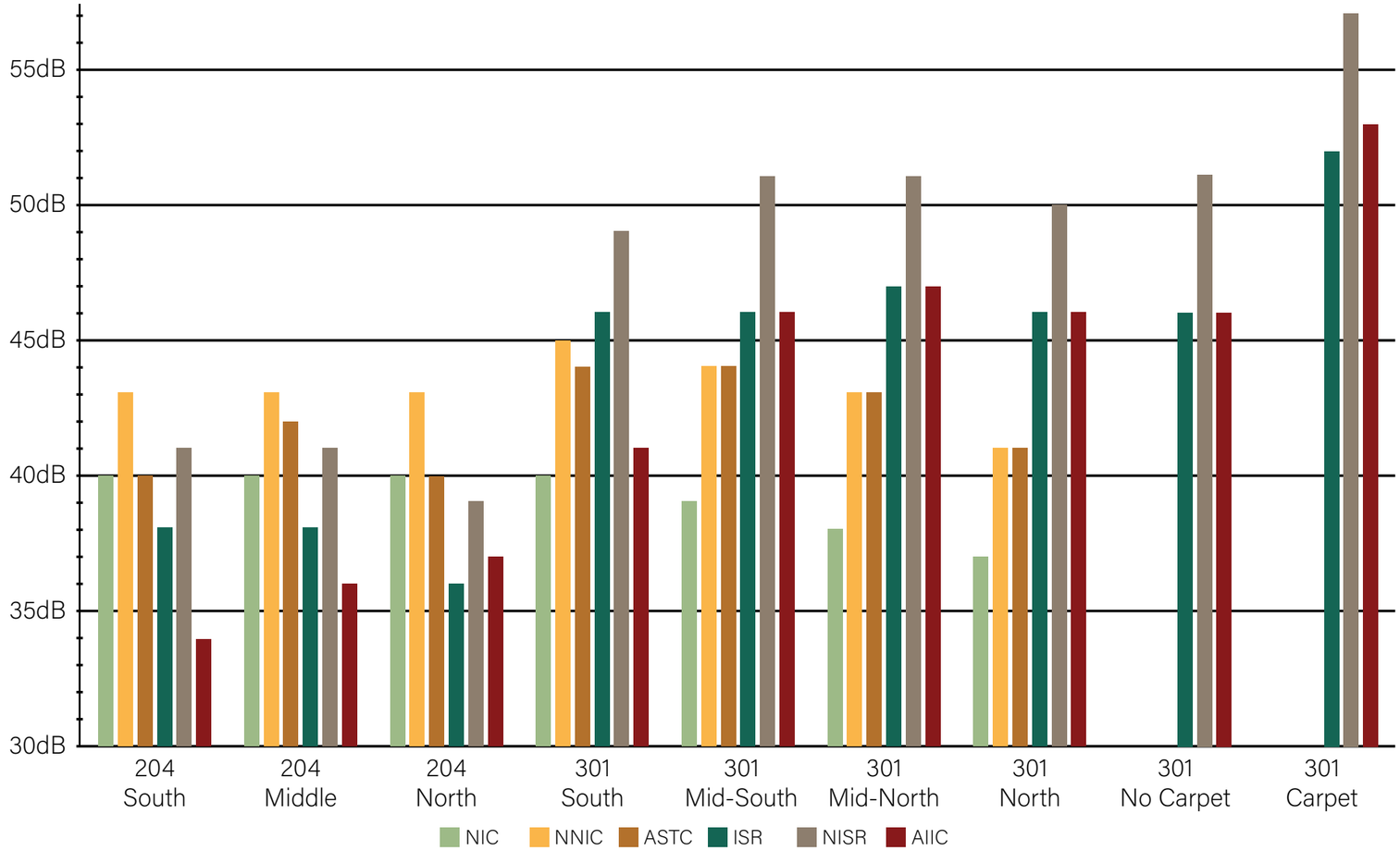
WOOD INNOVATION GRANT — ACOUSTIC TESTING

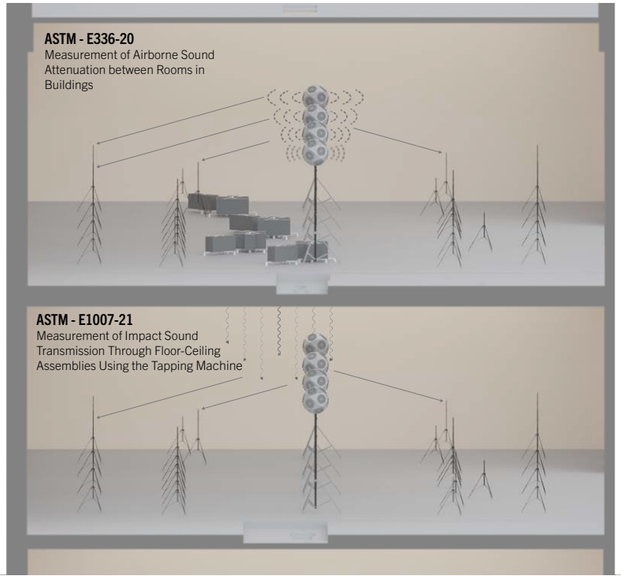


WOOD INNOVATION GRANT — ACOUSTIC TESTING









Results

Acoustics (Airborne and Impact Testing)

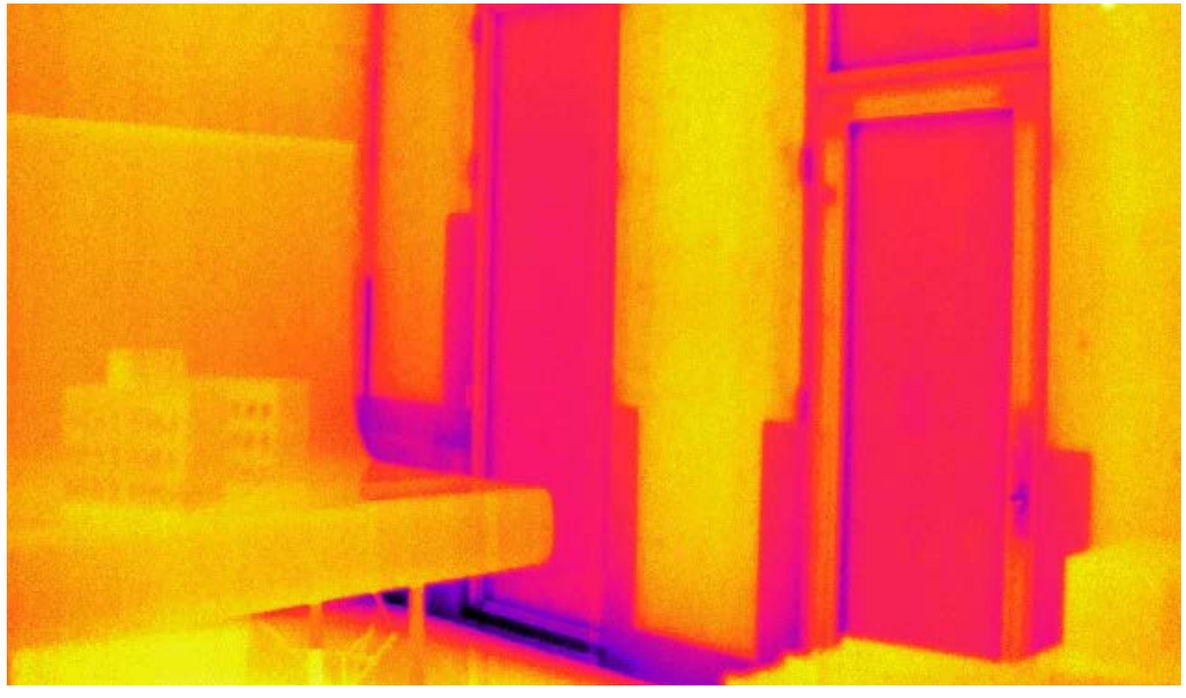
Note: Higher dB levels on the above table indicate greater resistance to sound transmission.

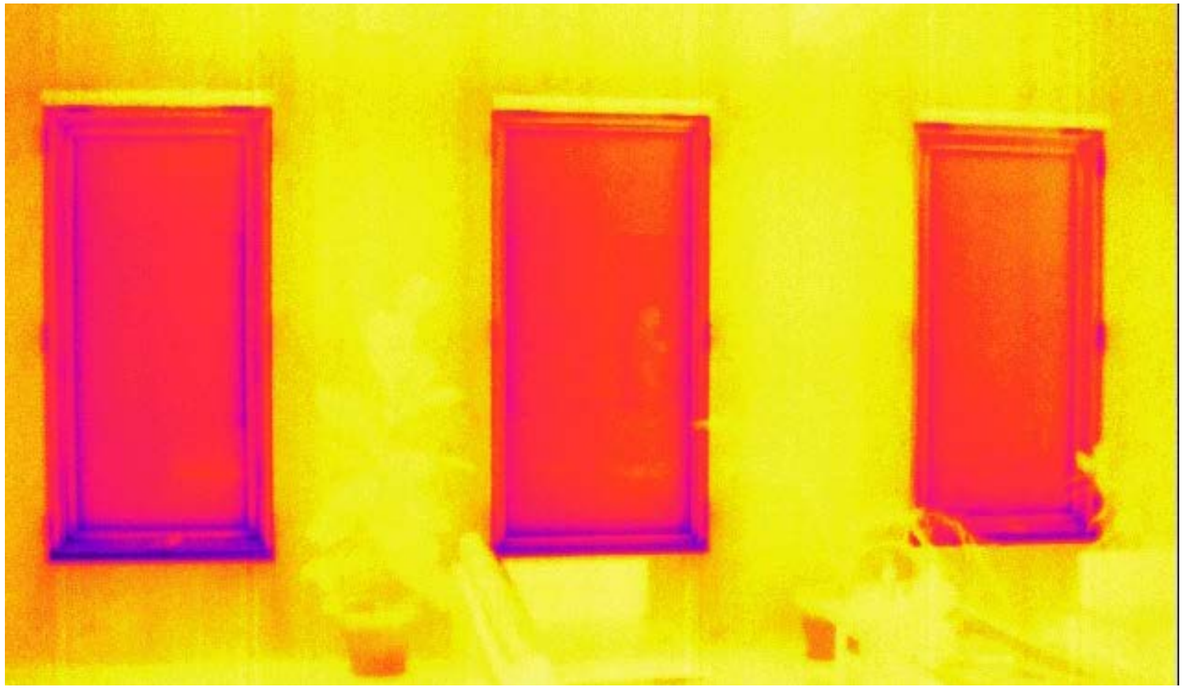
While less insulating than typical construction methods overall, the third floor residential spaces approach IBC multifamily standards as well as GSA standards for offices, with the best performing spaces reaching “High-Isolation Office” levels.

Key Takeaway: **the 5-ply CLT decking with 1” Piteq acoustic mat used for the 300 level is quieter and compliant with a wider range of performance standards.**

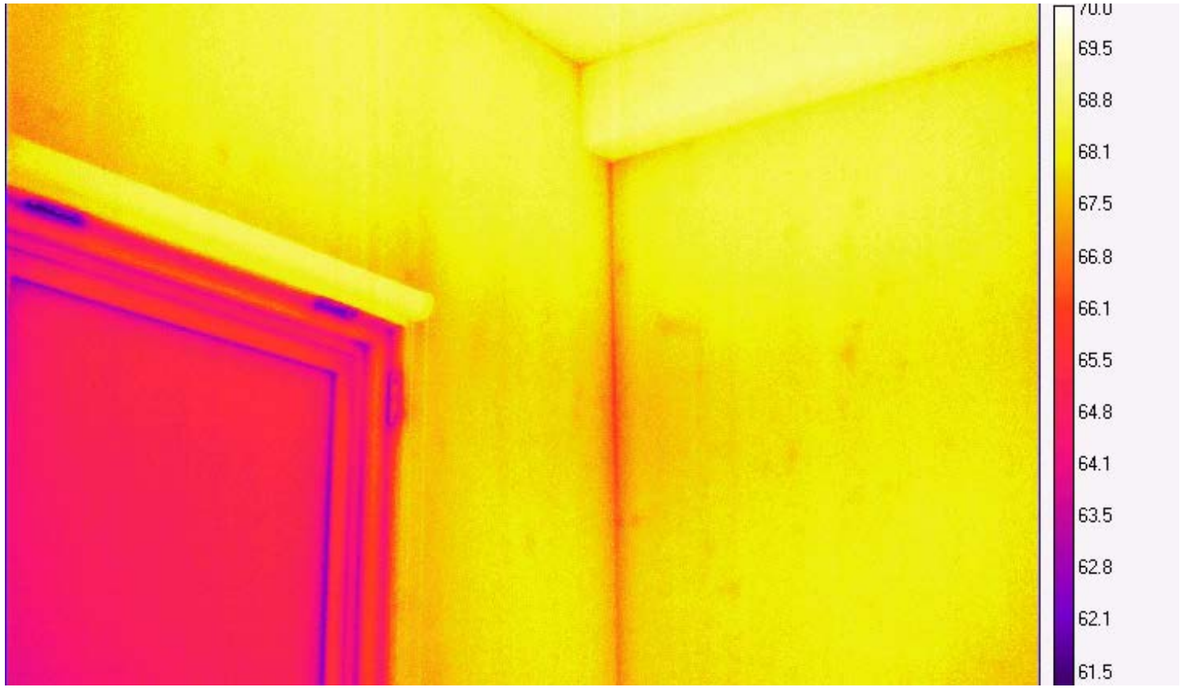
Our observation is that furnished and occupied spaces perform significantly better, and we’ve received favorable reports from our tenants for the audibility of speakers and instructors in our ground floor tenant spaces.

WOOD INNOVATION GRANT — THERMAL IMAGING

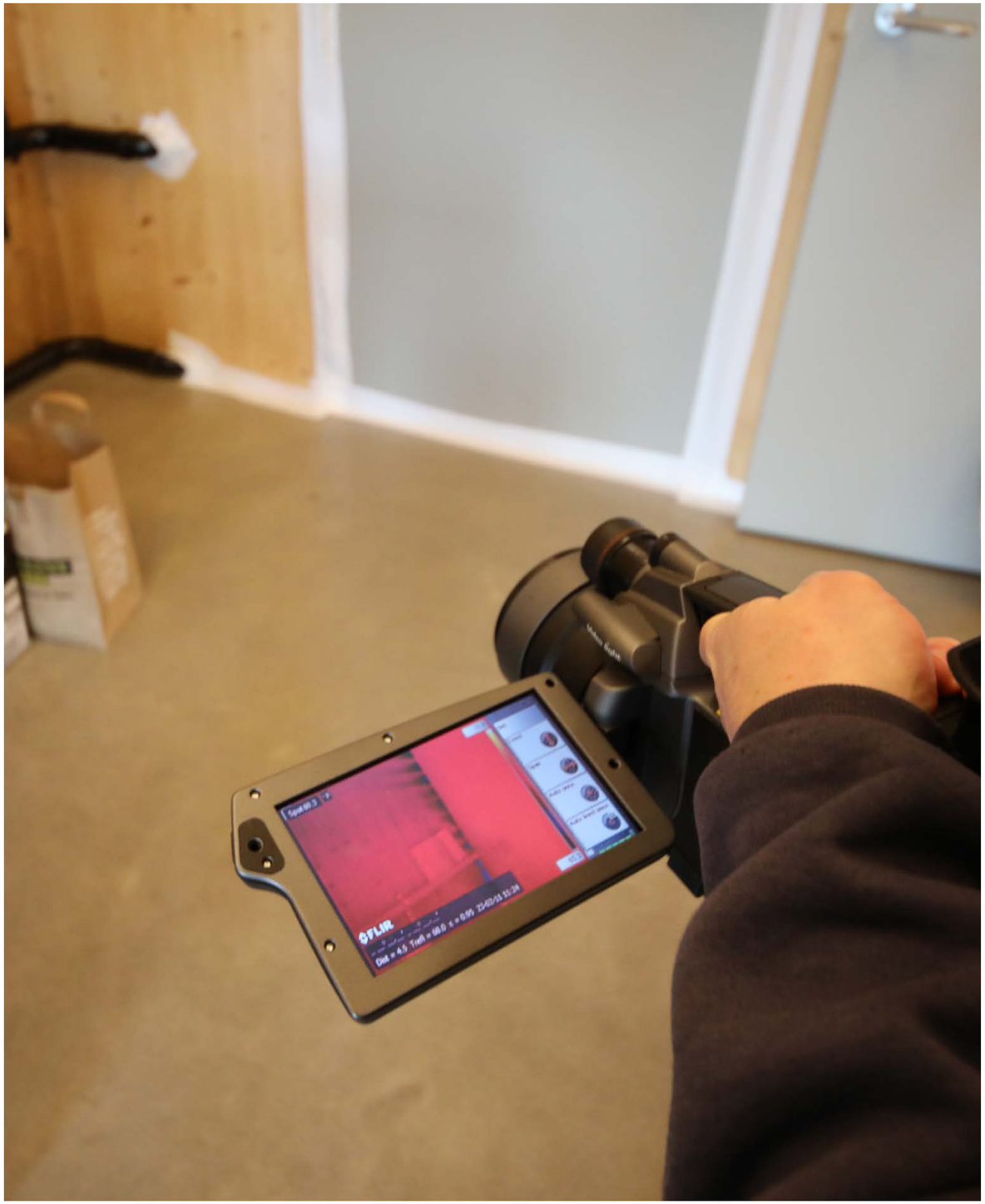




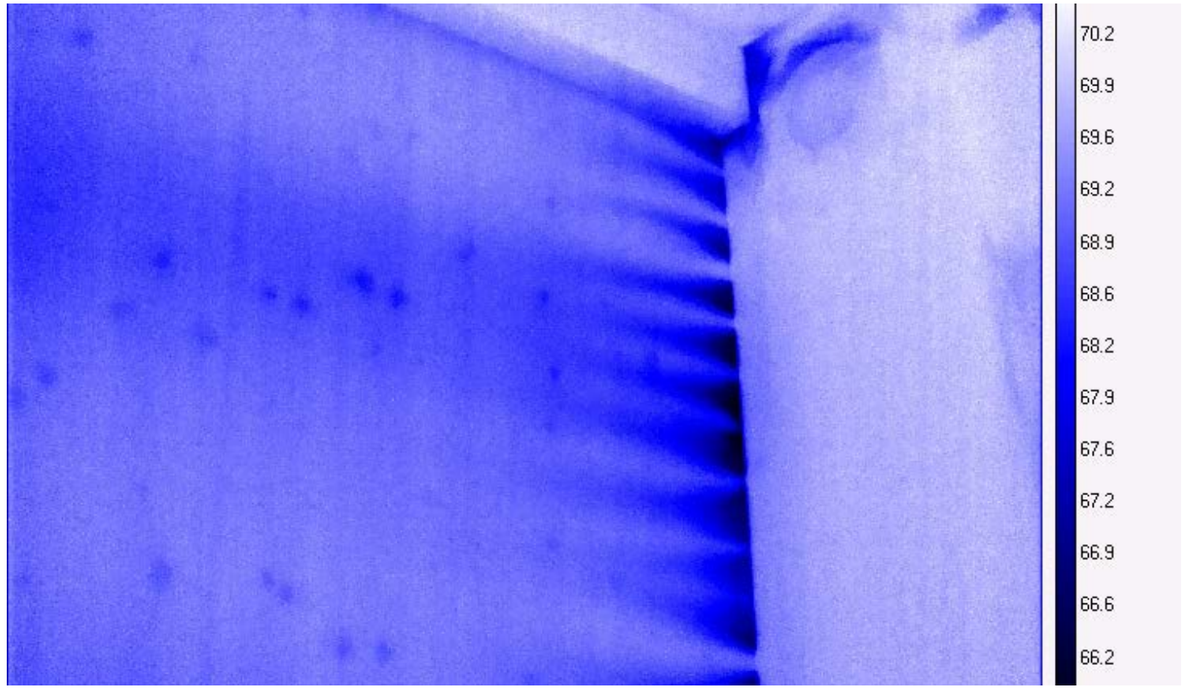
WOOD INNOVATION GRANT — THERMAL IMAGING

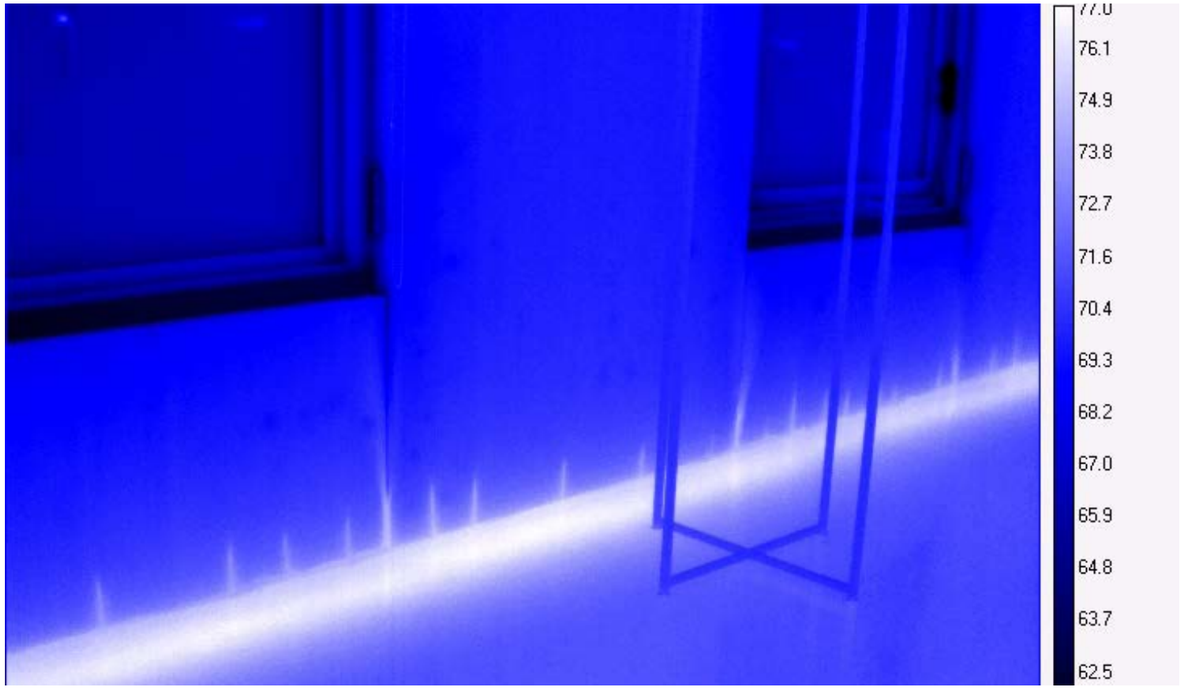


WOOD INNOVATION GRANT — THERMAL IMAGING

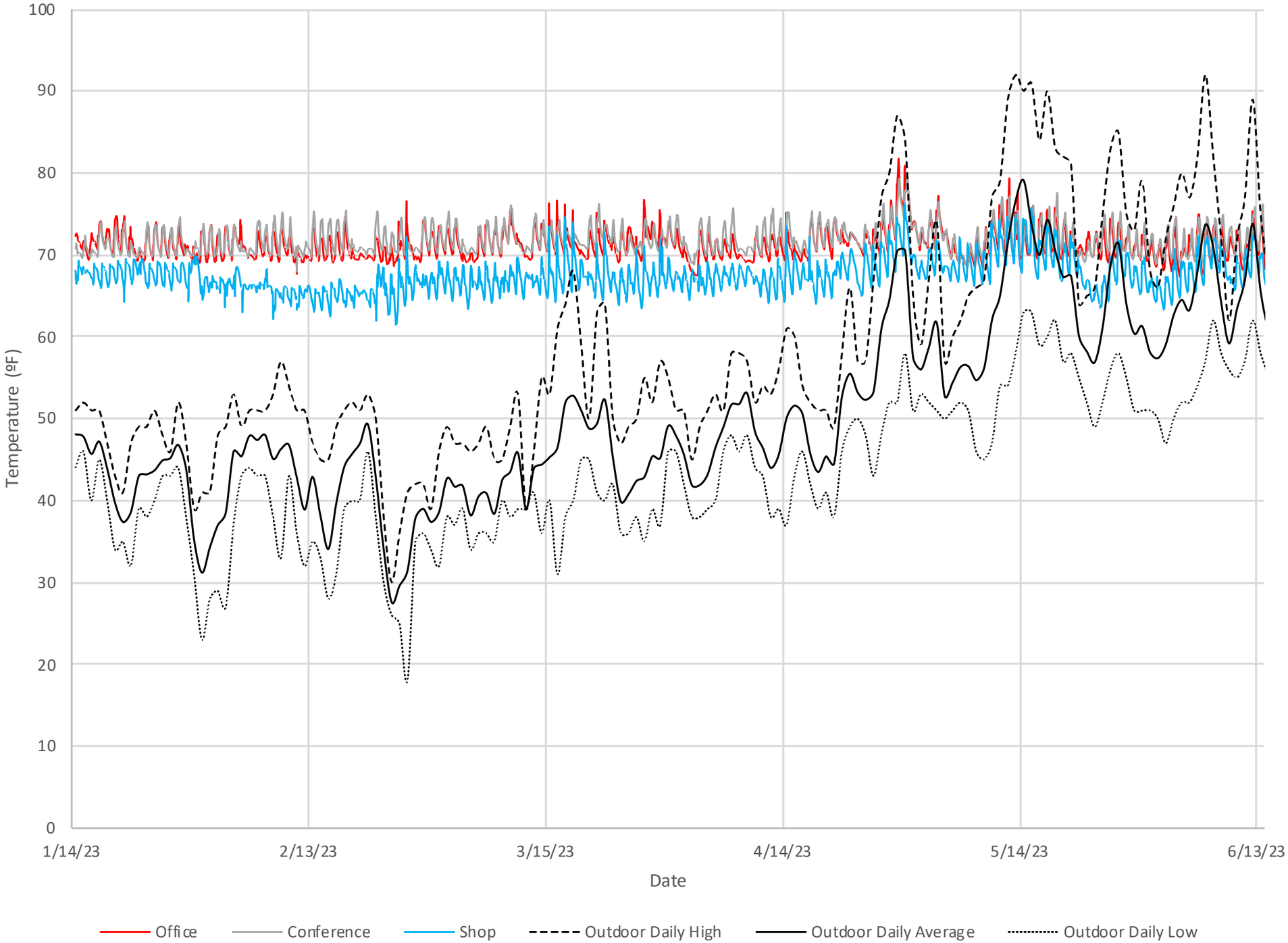


WOOD INNOVATION GRANT — INFILTRATION / BLOWER DOOR





WOOD INNOVATION GRANT — INFILTRATION / BLOWER DOOR



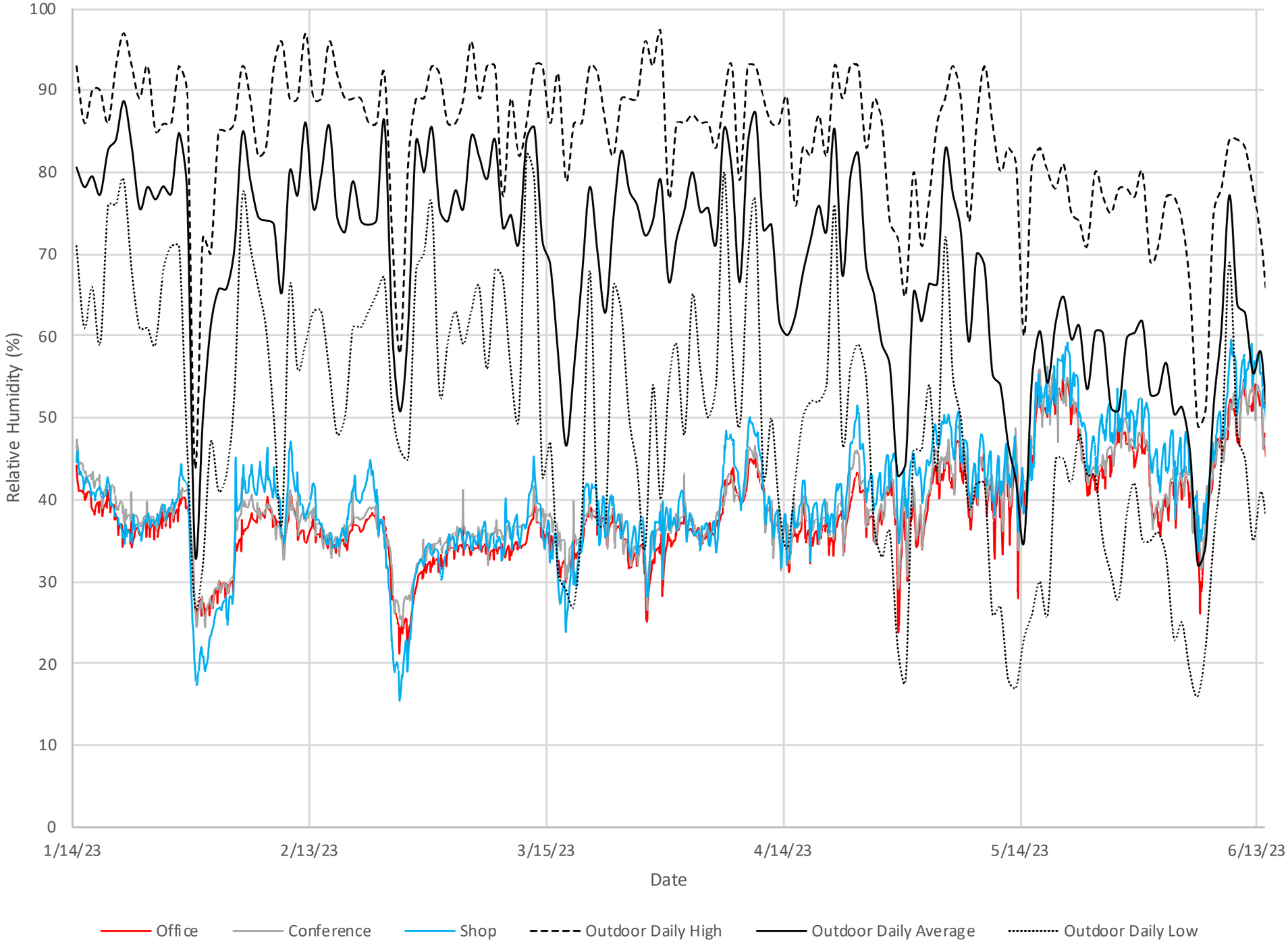
Results

Temperature

All spaces remained within a consistent comfort band, indicating proper functioning of the HVAC system.

During the shoulder season, indoor temperatures deviate, suggesting operation of windows with natural ventilation during these periods.

WOOD INNOVATION GRANT — AIR QUALITY (TEMPERATURE)



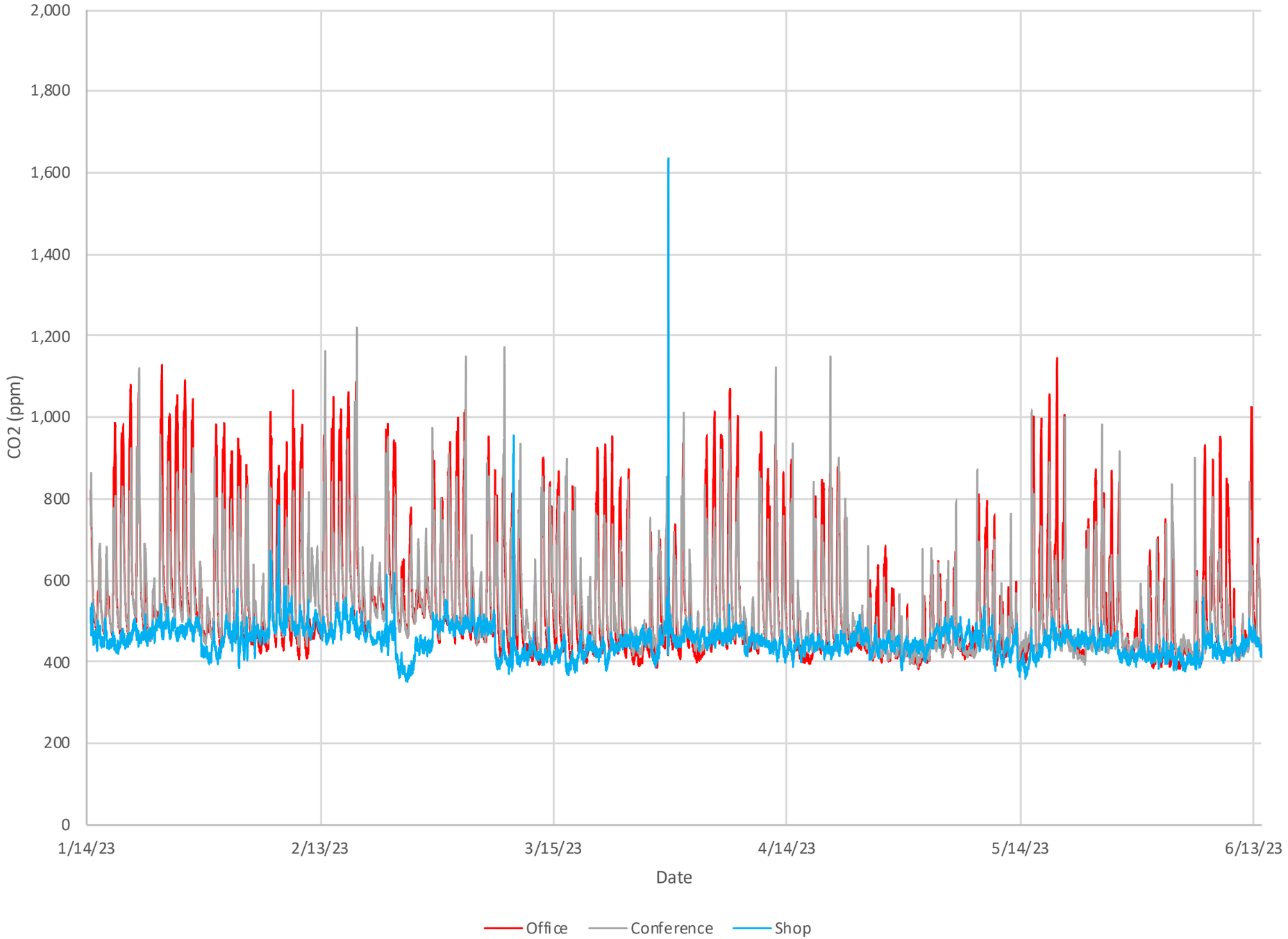
Results

Relative Humidity

The ideal range of indoor RH for human health is 40%-60%. During the winter, the indoor RH is frequently below 40%, suggesting **supplemental humidification would be beneficial during the heating season.**

During the shoulder season, indoor RH is within the ideal range and more closely tracks outdoor daily averages.

WOOD INNOVATION GRANT — AIR QUALITY (HUMIDITY)



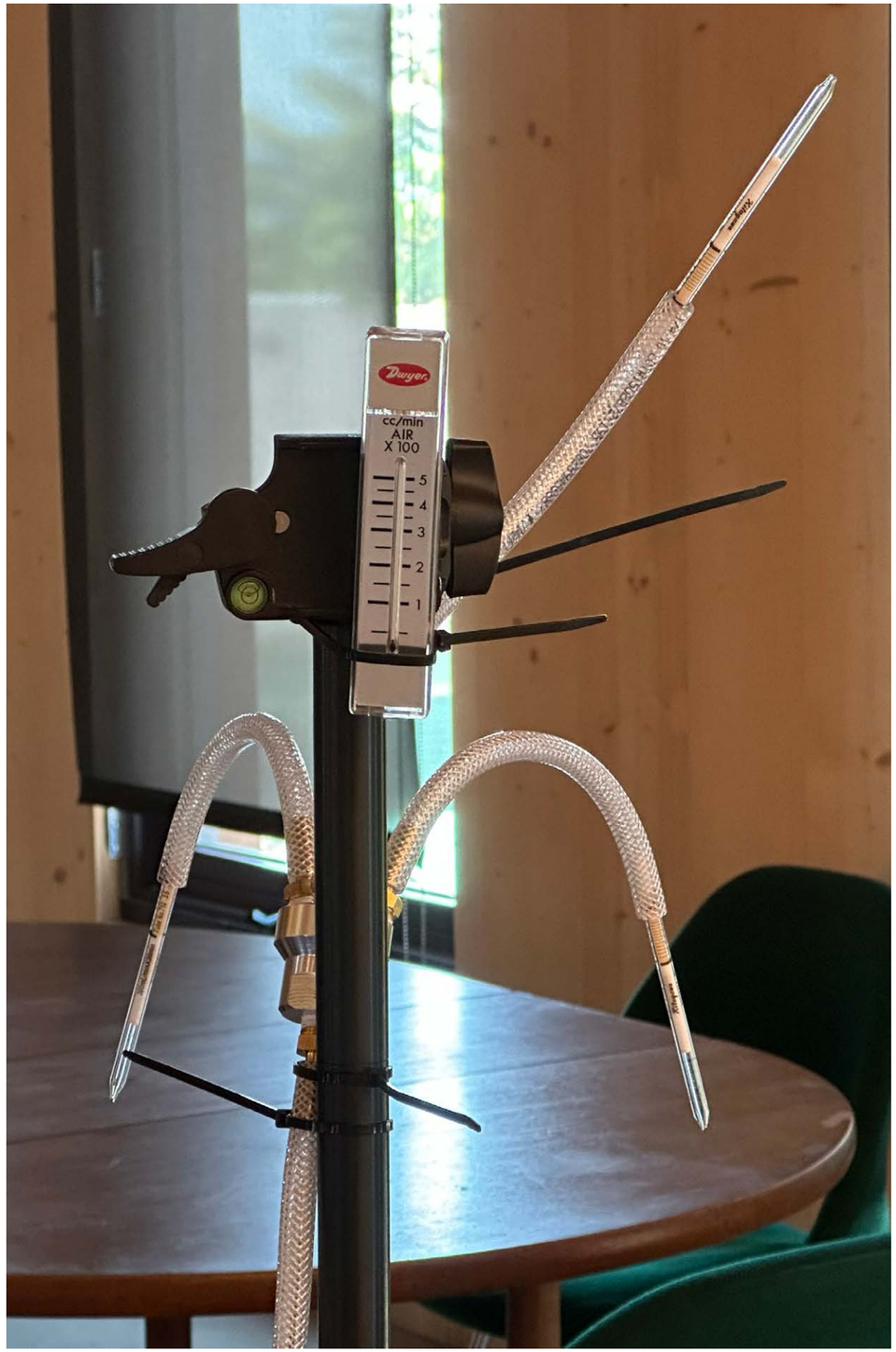
Results

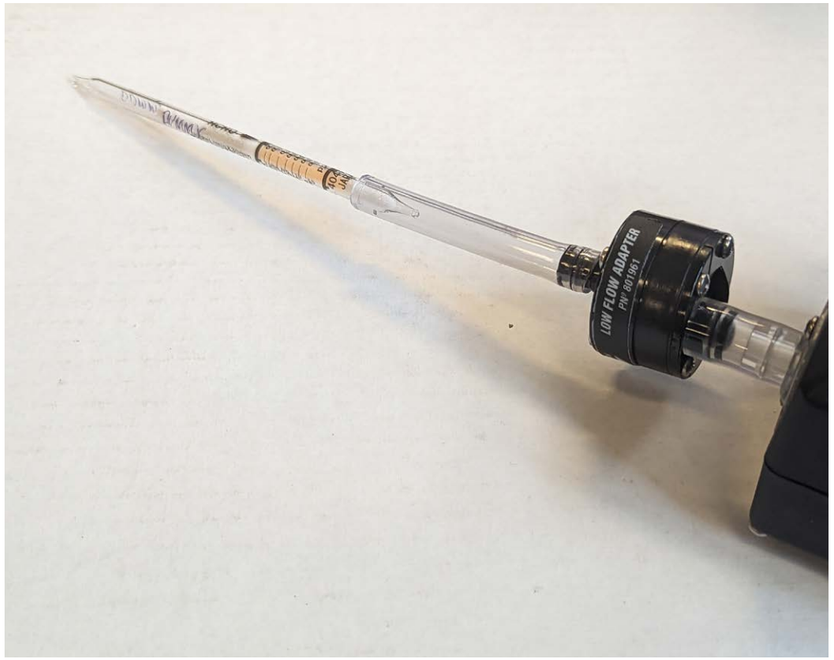
CO_2

The office/conference spaces have spikes in clusters of five with gaps in between suggesting a workweek occupancy. Levels are typically below 1000 ppm, **indicating adequate ventilation for indoor air quality.**

During the shoulder season, indoor CO2 levels approach outdoor levels, suggesting the use of natural ventilation.

WOOD INNOVATION GRANT — AIR QUALITY (CO2)





Results

Formaldehyde / VOC

Formaldehyde was not detected in the indoor air. It is one of the most measurable VOCs and is a good indicator of indoor air quality.

The spent collection tubes on have no color change, indicating no formaldehyde during the test period. While some wood products contain these compounds, the use of PUR (polyurethane resin) for all CLT and Glulam adhesive is likely responsible for the positive result.

Comparative Analysis

One of the objectives of Mississippi's design was to illustrate the ecological benefit and the economic and logistical feasibility of an "All-Wood" approach. We began with a hypothetical Type 5B building, of similar size, configuration, type and location—i.e. a 10,000sf, three-story, mixed-use building on an urban site in Portland.

We compared conventional stick frame construction, a concrete frame strategy, "Hybrid" construction using CLT frame and decking with standard infill, and two "All-Wood" models: the all-CLT approach used on Mississippi Workshop, and a model utilizing mass plywood panels (MPP).

- **All-Wood (CLT) - 124,126 kgCO2**
- **All-Wood (MPP) - 52,440 kgCO2**
- **Wood Framed + 88,133 kgCO2**
- **Hybrid CLT + 92,597 kgCO2**
- **Steel Framed + 284,088 kgCO2**
- **Concrete Frame + 496,970 kgCO2**

All-Wood
Cross Laminated
Timber Building

The All-Wood Cross Laminated Timber building is based entirely off of the Mississippi Project and can be considered an "as-built" analysis of it's materials.

CO2 Released through building materials: 130,133 (kgCO2)

CO2 Sequestered through wood material used: 42,000 (kgCO2)

Total Carbon Impact:

- 124,126 (kgCO2)

Standard
Wood Stud
Building

Using the same footprint and volume as the Mississippi Project, an alternate construction system assumes standard wood stud assemblies wrapped in gypsum.

CO2 Released through building materials: 130,133 (kgCO2)

CO2 Sequestered through wood material used: 42,000 (kgCO2)

Total Carbon Impact:

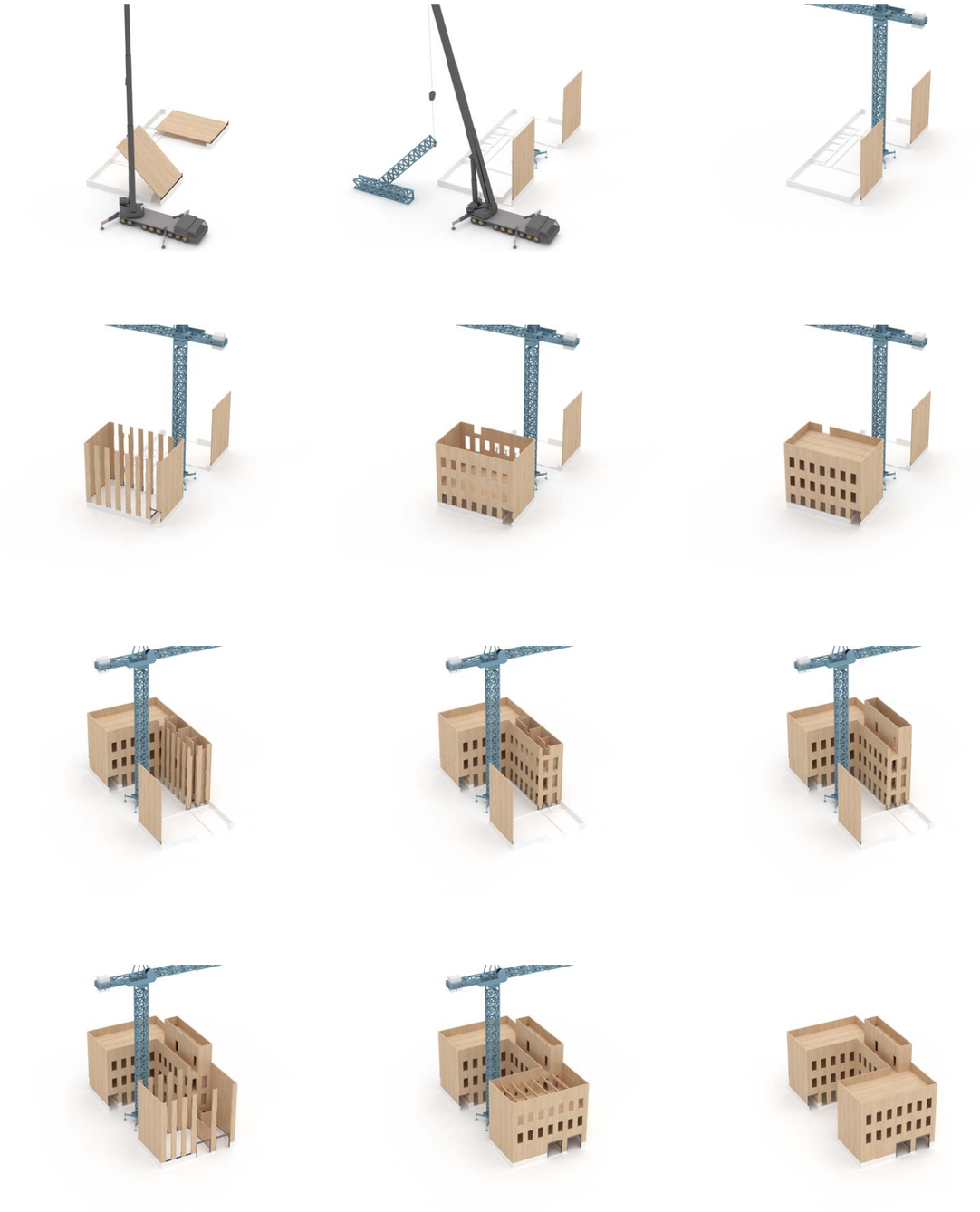
+ 88,133 (kgCO2)

Comparative Analysis

We worked in consultation with KLH, KPFF Structural Engineers and R&H Construction to account for variables in the sequencing and estimated duration for each construction method, again using a building of comparable size, configuration, type and location.

The durations were estimated as follows:

• **Hybrid CLT**	**40 weeks**	
• **Wood Framed**	**42 weeks**	**5% increase**
• **Steel Framed**	**42 weeks**	**5% increase**
• **All-Wood (CLT)**	**44 weeks**	**10% increase**
• **All-Wood (MPP)**	**44 weeks**	**10% increase**
• **Concrete Frame**	**48 weeks**	**20% increase**



Comparative Analysis

Completed in 2022, Mississippi cost approximately $3.75 million for 9,550sf (net), plus 1200sf of landscaped courtyard and passageway.

Despite the application of many new systems and materials, the building was delivered for **$392 per-square-foot.**

We're working with KLH, KPFF Structural Engineers and R&H Construction to estimate material quantities, labor costs, duration, and other key considerations to develop a ROM cost assessment of each construction method.

Given the limited palette of materials, finishes, and other efficiencies, we are seeing that All-Wood construction can be competitive, if not more cost effective, than other approaches.

	Building Design (Cubic Yard, UNO)					
MATERIAL	CLT BUILDING	MPP	HYBRID - MT	WOOD STUD	METAL STUD	CONCRETE
FOUNDATION						
CONCRETE - FOUNDATION	95.44	62.04	62.04	62.04	47.72	85.90
CONCRETE - STEM WALLS	152.03	152.03	152.03	152.03	152.03	X
WALLS						
CLT	358.83	X	26.35	X	X	X
MASS PLYWOOD	X	358.83	X	X	X	X
METAL SIDING (per LBS)	244.35	244.35	244.35	244.35	244.35	244.35
EXT. INSULATION - MINERAL WOOL (per Sqft)	15,714.00	15,714.00	15,714.00	15,714.00	15,714.00	15,714.00
INT. INSULATION - FIBERGLASS (per Sqft)	X	X	1,692.88	1,692.88	1,692.88	X
PLYWOOD (OSB)	X	X	37.40	37.40	37.40	X
GYPSUM BOARD TYPE X - 5/8" (per Sqft)	X	X	19,416.00	19,416.00	19,416.00	X
PAINT (per LBS)	X	X	55.47	55.47	55.47	X
DIMENSIONAL LUMBER	X	X	65.22	65.22	X	X
METAL STUD (per LBS)	X	X	X	X	21,255.46	X
STEEL (per LBS)	X	X	X	X	16,761.60	X
CONCRETE - WALLS	X	X	X	X	X	780.53
FLOOR / CEILING						
CLT	94.57	X	94.57	X	X	X
MASS PLYWOOD	X	94.57	X	X	X	X
CLT BEAMS	50.47	50.47	50.47	X	X	X
CONCRETE	119.59	119.59	119.59	119.59	358.78	717.56
WOOD I-JOIST (per ft)	X	X	X	2,784.00	X	X
LSL	X	X	X	7.00	X	X
METAL DECKING (per LBS)	X	X	X	X	18,952.42	18,952.42
PLYWOOD (OSB)	X	X	25.46	25.46	X	X
INSULATION (per Sqft)	X	X	3,744.47	3,744.47	3,744.47	X
PAINT (per LBS)	X	X	4.49	4.49	4.49	X
STEEL (per LBS)	0.14	0.14	0.14	0.14	43,485.30	X
GYPSUM CEILING BOARD - 5/8" (per Sqft)	X	X	1,571.18	1,571.18	1,571.18	X
ROOF						
ROOF ASPHALT (per ft)	2,858.46	2,858.46	2,858.46	2,858.46	2,858.46	2,858.46
ROOF INSULATION (per ft)	6,052.00	6,052.00	6,052.00	6,052.00	6,052.00	6,052.00
CONCRETE	5.64	5.64	5.64	5.64	16.93	X
MASS PLYWOOD	X	36.51	X	X	X	X
CLT	36.51	X	36.51	X	X	X

Initial quantity survey / material comparison (2023)

THANK YOU!