BUILDINGENERGY BOSTON

Scaling Mass Timber Construction in Dense Urban Environments: Three Not-So-Little Projects

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Curated by Kurt Roth

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Brent Buck Architects

GOA

Description

Using mass timber construction instead of concrete and steel can greatly reduce the embodied carbon of new construction, but faces specific challenges in dense urban environments in addition to limited contractor experience and cost risk. This session presents an affordable housing project in New Haven and multi-family and adaptive re-use projects in Brooklyn that highlight how effective design and project planning can mitigate these challenges to increase the construction of high-performance mass-timber buildings in urban cores.

Learning Objectives

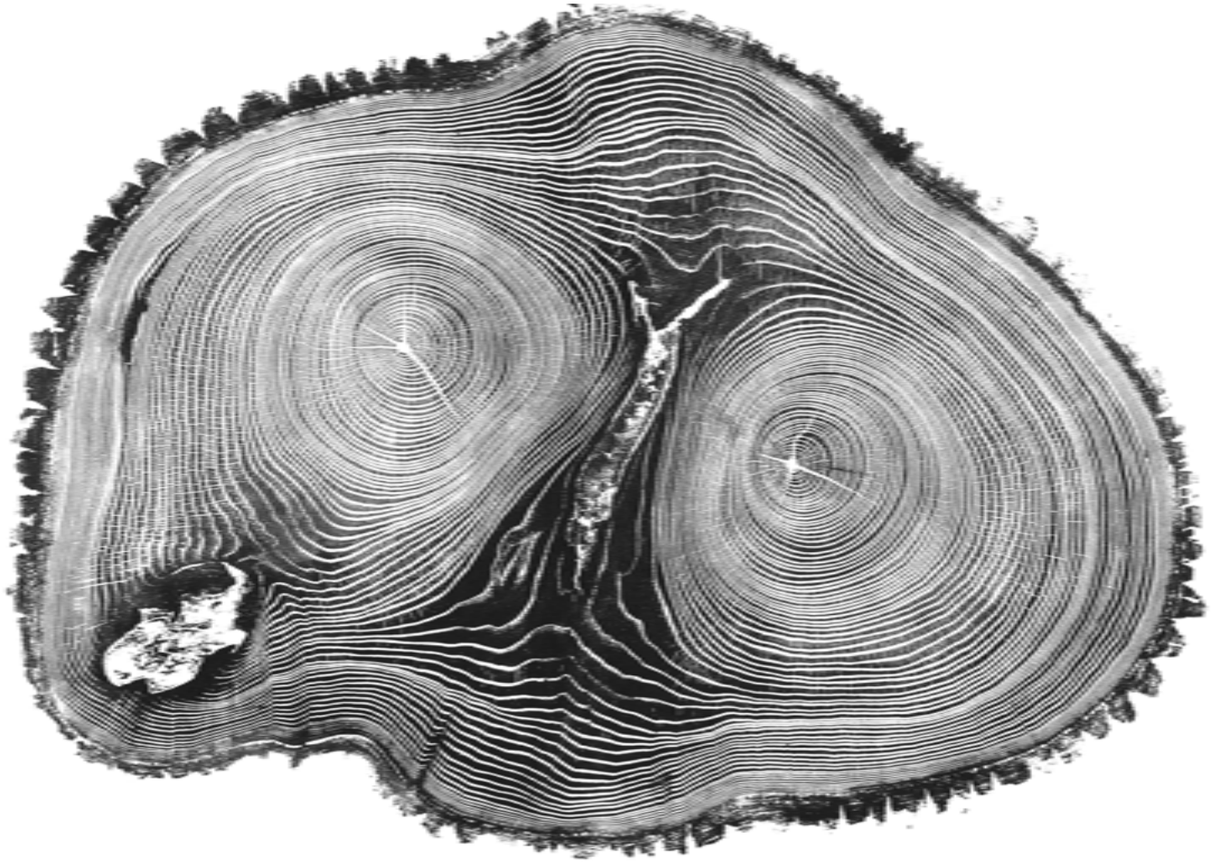
1. Summarize challenges encountered when building with mass timber in tight urban locations and solutions to help realize the benefit of faster construction timelines using prefabricated mass timber panels.

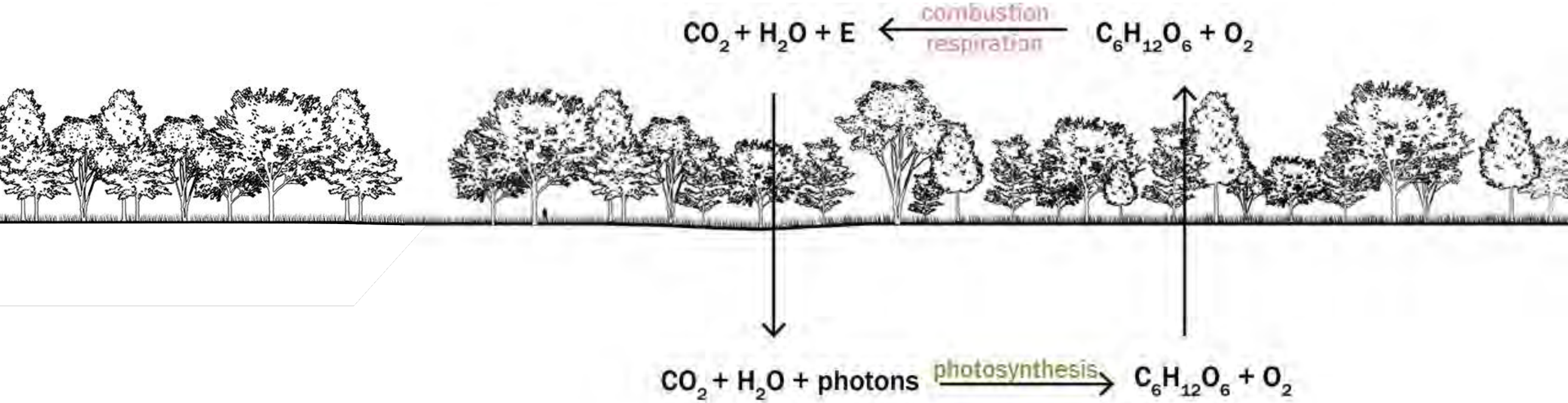
2. Discuss key design details to effectively integrate CLT/NLT into highly efficient envelopes that meet passive house principles without using foam insulation.

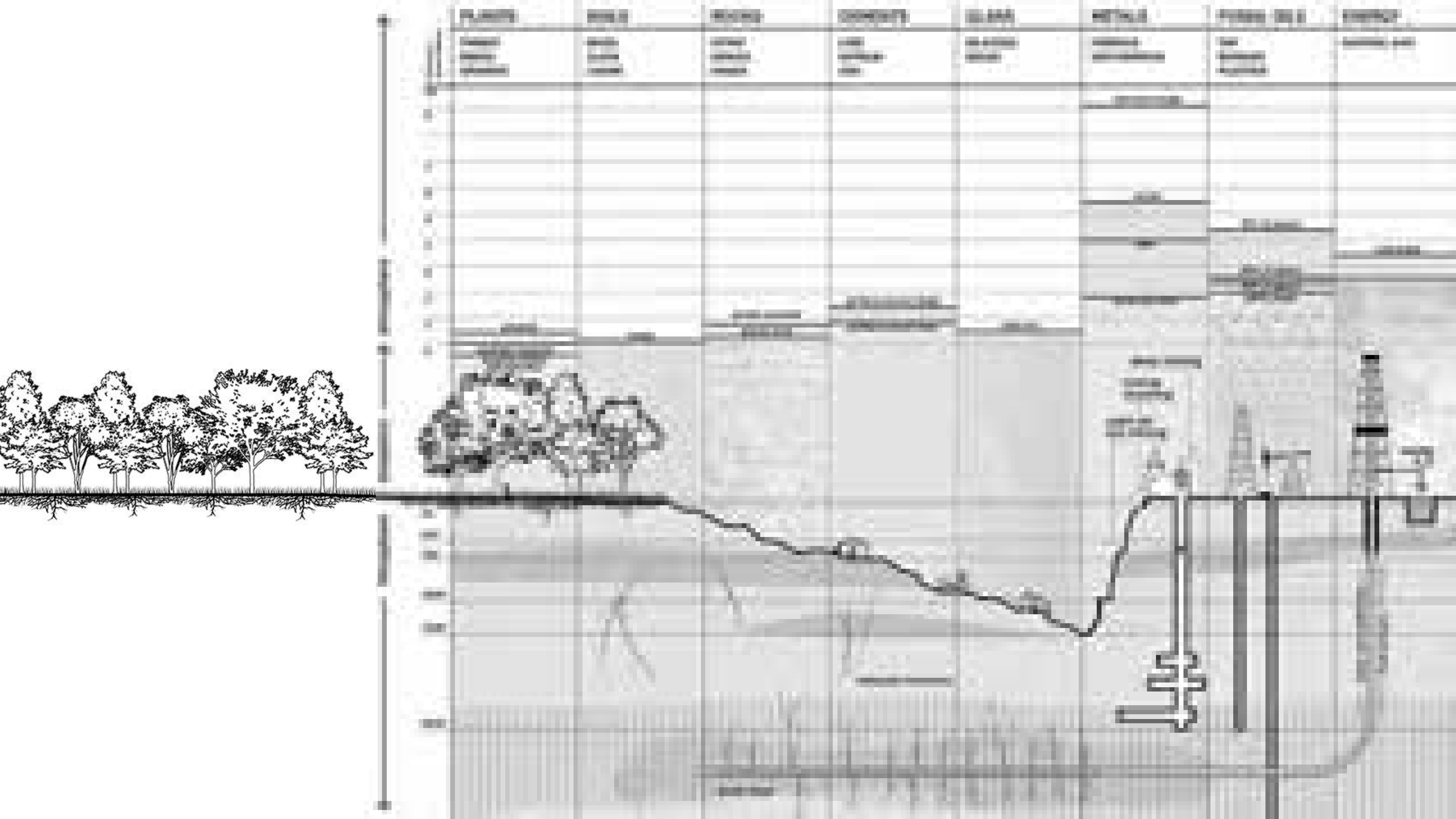
3. Describe the challenges that contractors with little or no experience with mass timber projects often face and ways to mitigate them.

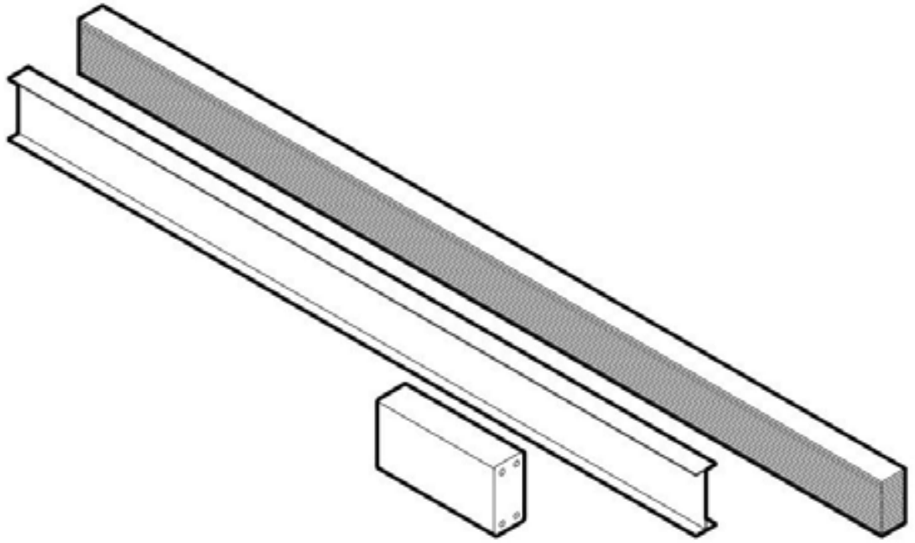
4. Identify measures to protect mass timber floor and walls from the elements during construction in the Northeast climate to maintain appealing panel finishes.

Introduction to Mass Timber



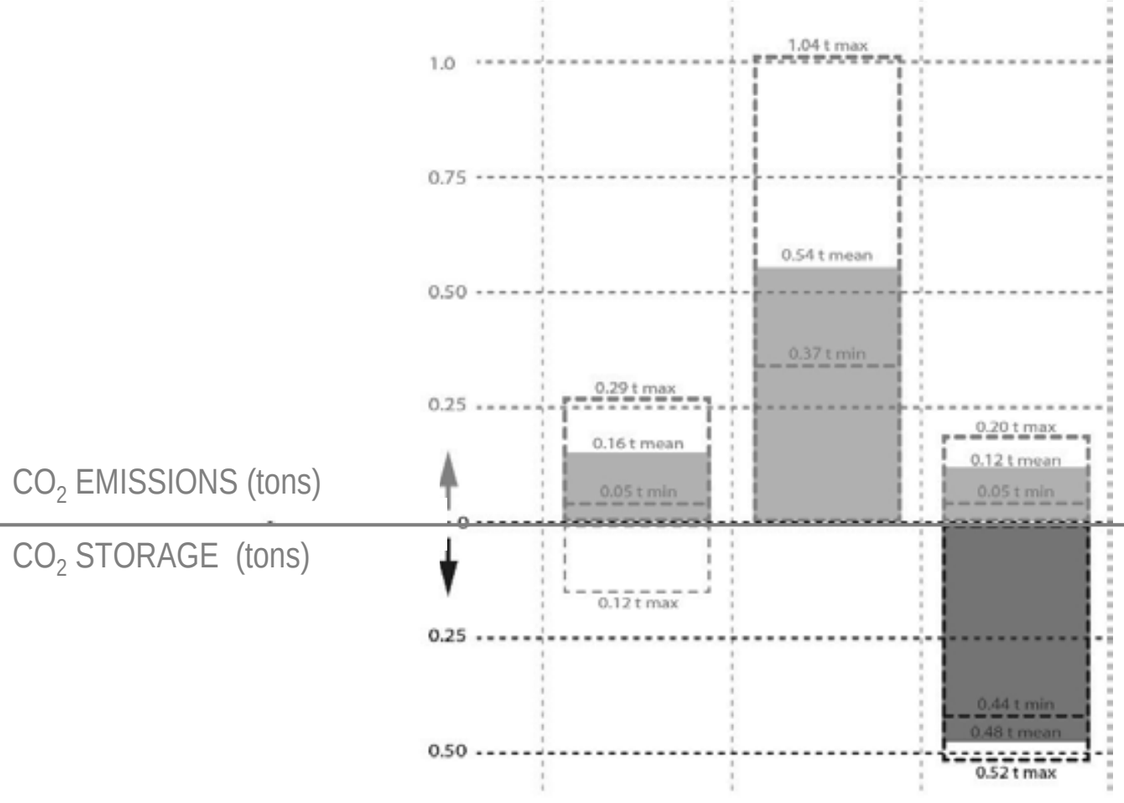

$CO_2 + H_2O + E$
combustion
respiration
$C_6H_{12}O_6 + O_2$
$CO_2 + H_2O + photons$
photosynthesis
$C_6H_{12}O_6 + O_2$





1 mT timber stores 1.2 mT CO_2

1 ton of material

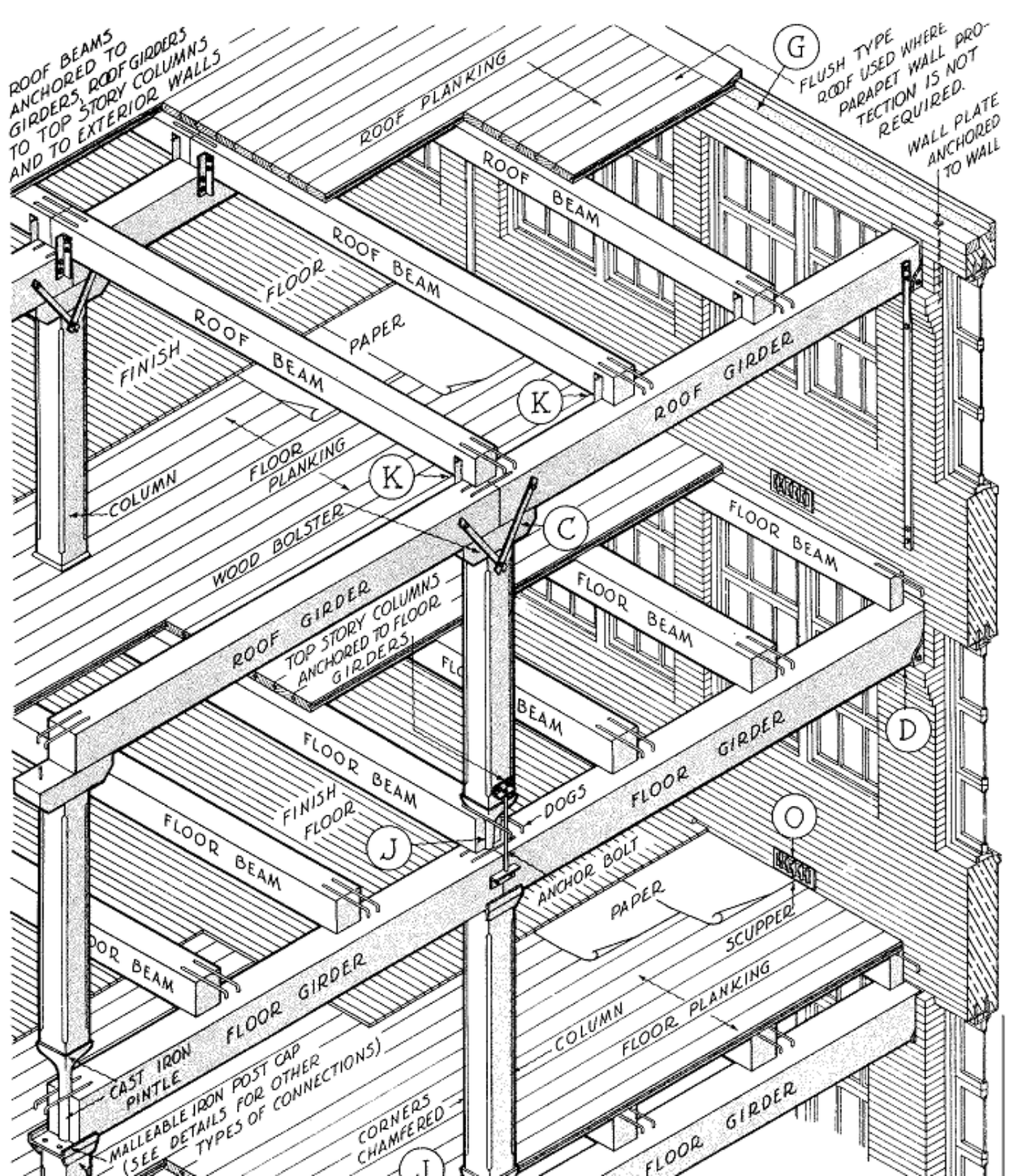


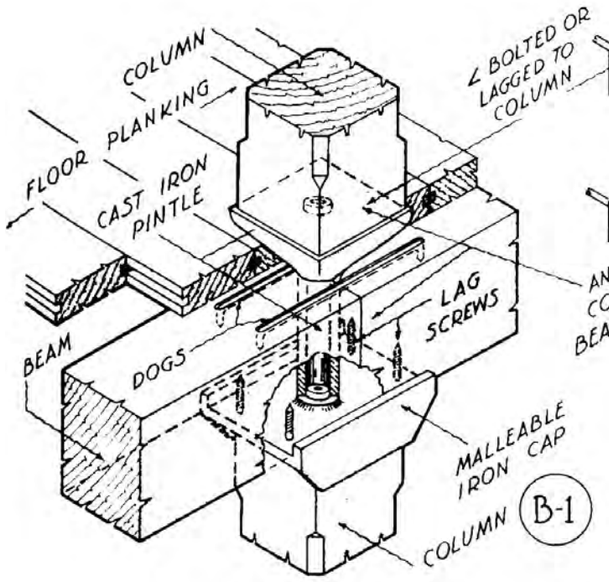
CO_2 EMISSIONS (tons)

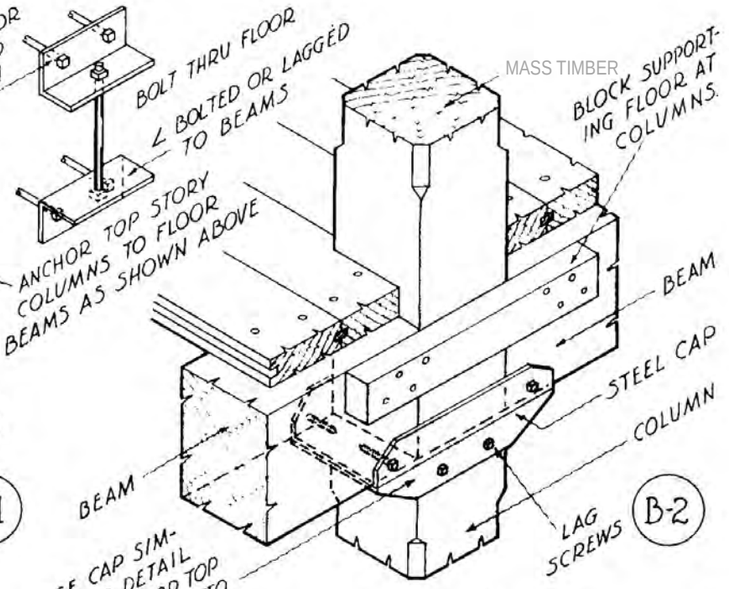
comparative emissions by weight

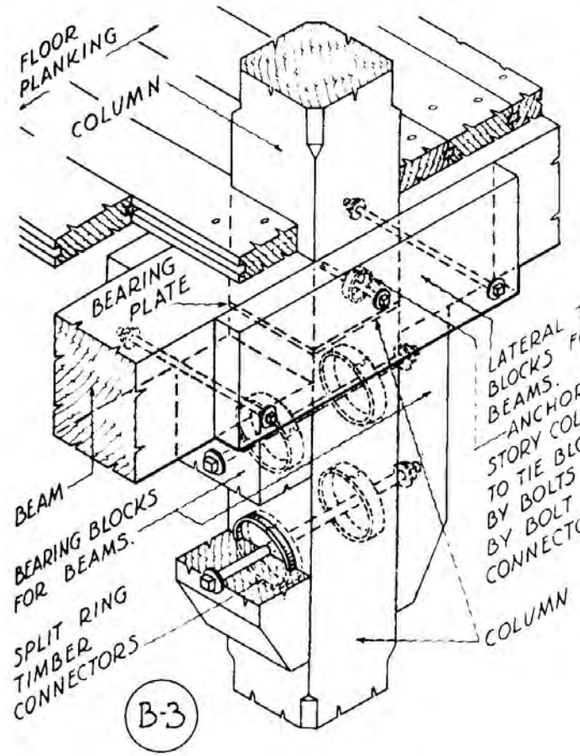
CO_2 STORAGE (tons)

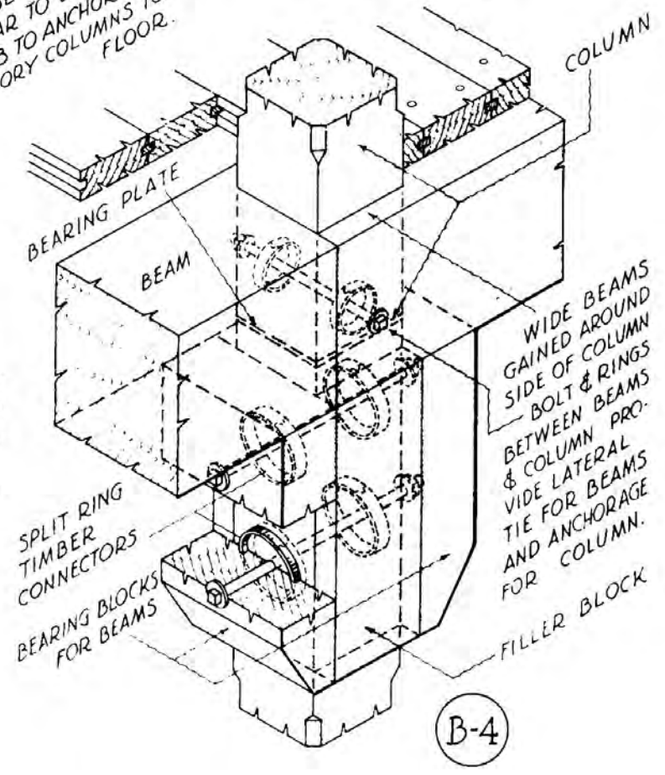
carbon storage by weight

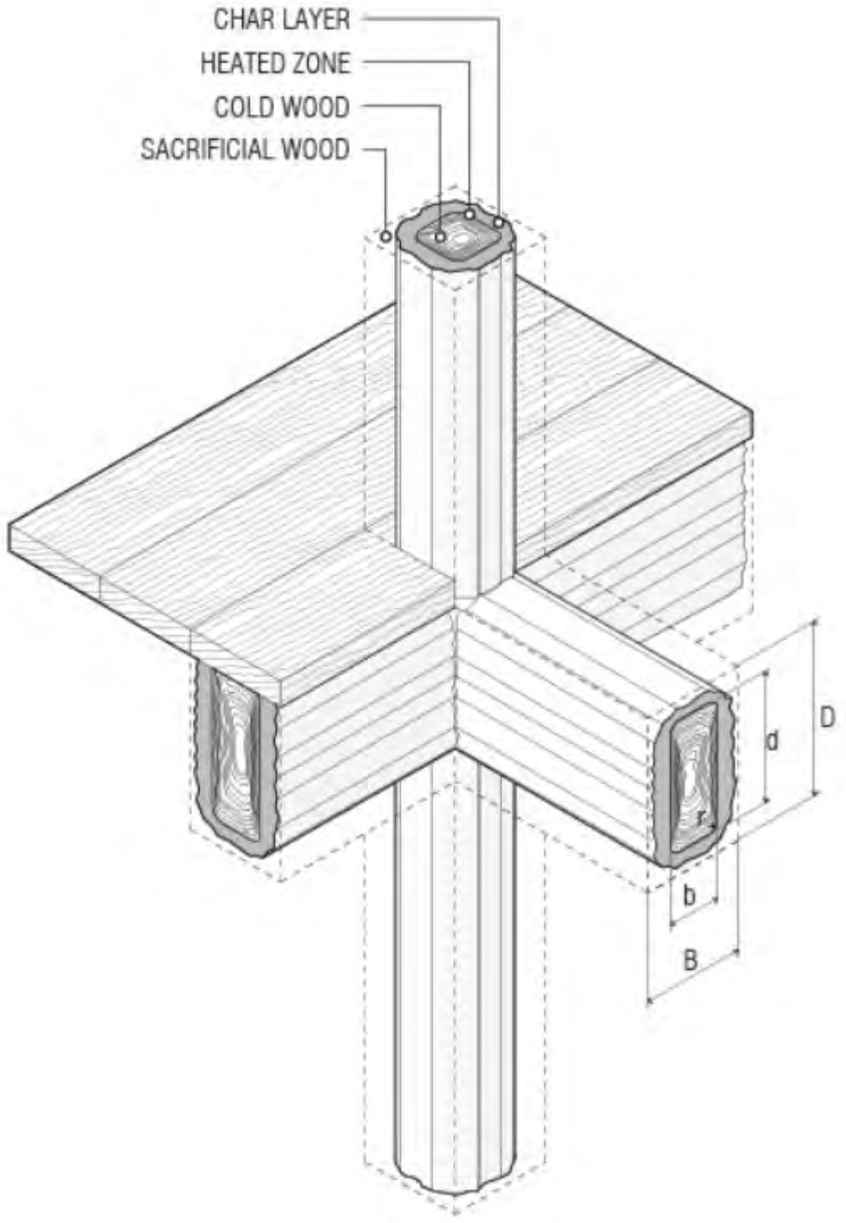

ROOF BEAMS ANCHORED TO GIRDERS, ROOF GIRDERS TO TOP STORY COLUMNS AND TO EXTERIOR WALLS
ROOF PLANKING
G
FLUSH TYPE ROOF USED WHERE PARAPET WALL PROTECTION IS NOT REQUIRED.
WALL PLATE ANCHORED TO WALL
ROOF BEAM
ROOF BEAM
FLOOR
PAPER
FINISH
ROOF BEAM
ROOF GIRDER
K
K
COLUMN
FLOOR PLANKING
WOOD BOLSTER
C
FLOOR BEAM
ROOF GIRDER
TOP STORY COLUMNS ANCHORED TO FLOOR GIRDERS
FLOOR BEAM
BEAM
FLOOR BEAM
FINISH FLOOR
DOGS
FLOOR GIRDER
D
J
ANCHOR BOLT
O
PAPER
SCUPPER
FLOOR BEAM
COLUMN
FLOOR PLANKING
CAST IRON PINTLE
FLOOR GIRDER
MALLEABLE IRON POST CAP (SEE DETAILS FOR OTHER TYPES OF CONNECTIONS)
CORNERS CHAMFERED
J

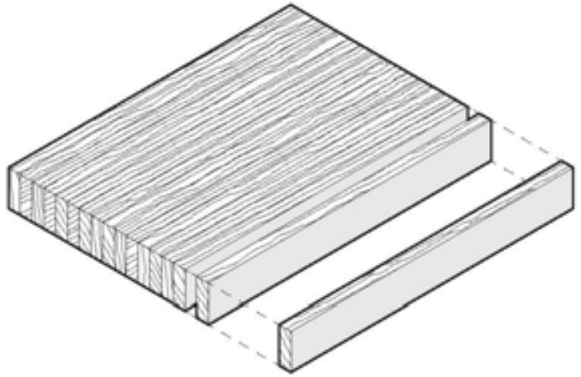

COLUMN
FLOOR PLANKING
CAST IRON PINTLE
BEAM
DOGS
∠ BOLTED OR LAGGED TO COLUMN
LAG SCREWS
MALLEABLE IRON CAP
COLUMN
B-1


BOLT THRU FLOOR
∠ BOLTED OR LAGGED TO BEAMS
ANCHOR TOP STORY COLUMNS TO FLOOR BEAMS AS SHOWN ABOVE
BLOCK SUPPORTING FLOOR AT COLUMNS.
BEAM
STEEL CAP
COLUMN
BEAM
LAG SCREWS
B-2
USE CAP SIMILAR TO DETAIL C-3 TO ANCHOR TOP STORY COLUMNS TO FLOOR.


FLOOR PLANKING
COLUMN
BEARING PLATE
LATERAL TIE BLOCKS FOR BEAMS.
ANCHOR TOP STORY COLUMNS TO TIE BLOCKS BY BOLTS OR BOLT AND CONNECTORS.
BEAM
BEARING BLOCKS FOR BEAMS.
SPLIT RING TIMBER CONNECTORS
COLUMN
B-3

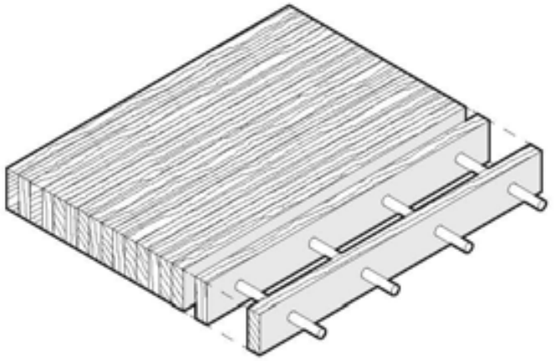

COLUMN
BEARING PLATE
BEAM
WIDE BEAMS GAINED AROUND SIDE OF COLUMN — BOLT & RINGS BETWEEN BEAMS & COLUMN PROVIDE LATERAL TIE FOR BEAMS AND ANCHORAGE FOR COLUMN.
SPLIT RING TIMBER CONNECTORS
BEARING BLOCKS FOR BEAMS
FILLER BLOCK
B-4


CHAR LAYER
HEATED ZONE
COLD WOOD
SACRIFICIAL WOOD
D
d
r
b
B



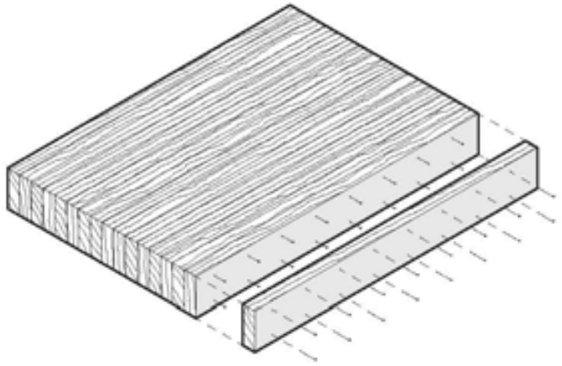
GLT
GLUE-LAMINATED TIMBER

Application:	Beams, Columns, Floors
Typical Species:	Southern Yellow Pine Douglas-Fir Larch Hem-Fir Spruce-Pine-Fir
Max Dimensions:	Limited only by clamp size and transportation



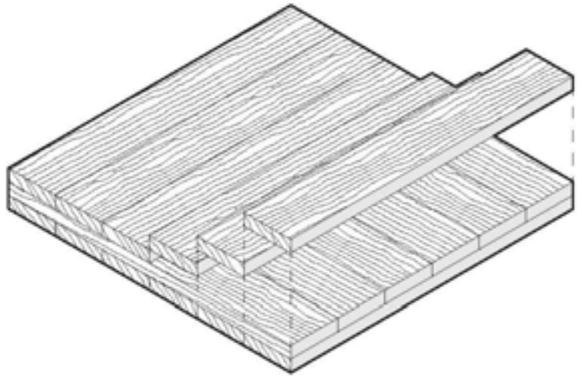
DLT
DOWEL-LAMINATED TIMBER

Application:	Floors. Roofs, Shafts
Typical Species:	Spruce-Pine-Fir Douglas-Fir Larch Alaska Yellow Cedar + many others
Max Dimensions:	12" x 12'-0" x 100'-0" Limited by shipping and Install constraints



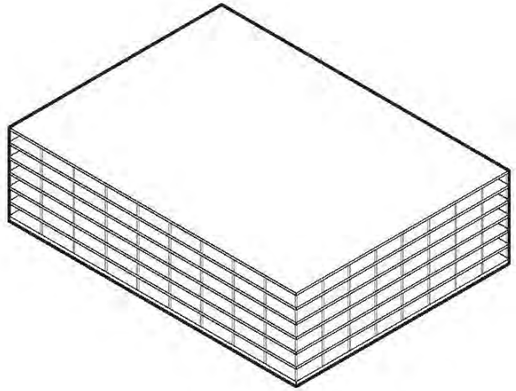
NLT
NAIL-LAMINATED TIMBER

Application:	Floors. Roofs, Shafts
Typical Species:	Spruce-Pine-Fir Douglas-Fir Larch Alaska Yellow Cedar + many others
Max Dimensions:	12" x 12'-0" x 100'-0" Limited by shipping and Install constraints



CLT
CROSS-LAMINATED TIMBER

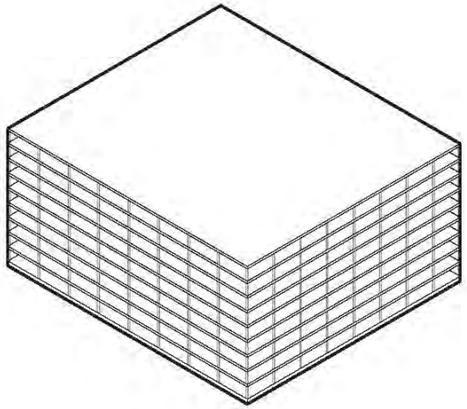
Application:	Floors. Roofs, Walls
Typical Species:	Spruce-Pine-Fir Douglas-Fir Southern Yellow Pine Black Spruce
Max Dimensions:	15" x 11'-0" x 64'-0" Limited by manufacturing equipment constraints



TYPE IV - HT

BUILDING AREA + HEIGHT	
MAXIMUM STORIES	6
MAXIMUM BUILDING HEIGHT	85'
MAXIMUM AREA PER FLOOR	144,000 SF

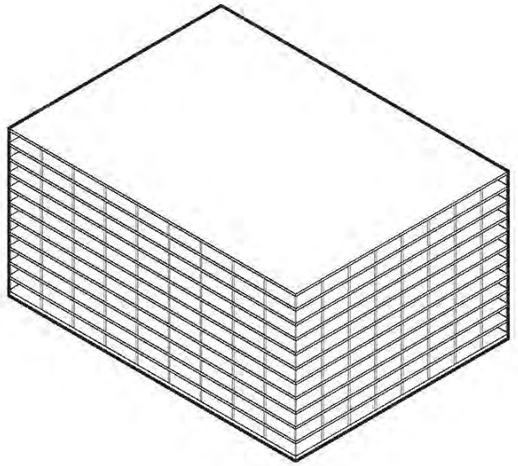
FIRE RESISTANCE RATINGS	
PRIMARY STRUCTURE	HEAVY TIMBER
BEARING WALLS (EXTERIOR)	2 HOURS
BEARING WALLS (INTERIOR)	1 / HEAVY TIMBER
FLOOR CONSTRUCTION	HEAVY TIMBER
ROOF CONSTRUCTION	HEAVY TIMBER



TYPE IV - C

BUILDING AREA + HEIGHT	
MAXIMUM STORIES	9
MAXIMUM BUILDING HEIGHT	85'
MAXIMUM AREA PER FLOOR	180,000 SF

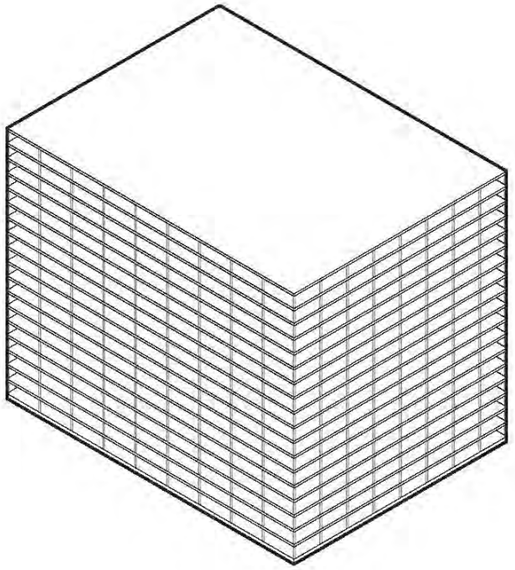
FIRE RESISTANCE RATINGS	
PRIMARY STRUCTURE	2 HOURS
BEARING WALLS (EXTERIOR)	2 HOURS
BEARING WALLS (INTERIOR)	2 HOURS
FLOOR CONSTRUCTION	2 HOURS
ROOF CONSTRUCTION	1 HOUR



TYPE IV - B

BUILDING AREA + HEIGHT	
MAXIMUM STORIES	12
MAXIMUM BUILDING HEIGHT	180'
MAXIMUM AREA PER FLOOR	288,000 SF

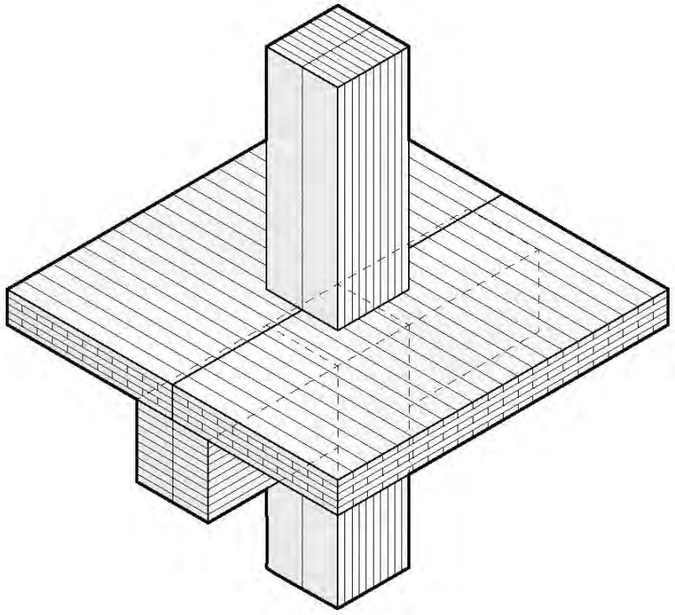
FIRE RESISTANCE RATINGS	
PRIMARY STRUCTURE	2 HOURS
BEARING WALLS (EXTERIOR)	2 HOURS
BEARING WALLS (INTERIOR)	2 HOURS
FLOOR CONSTRUCTION	2 HOURS
ROOF CONSTRUCTION	1 HOUR



TYPE IV - A

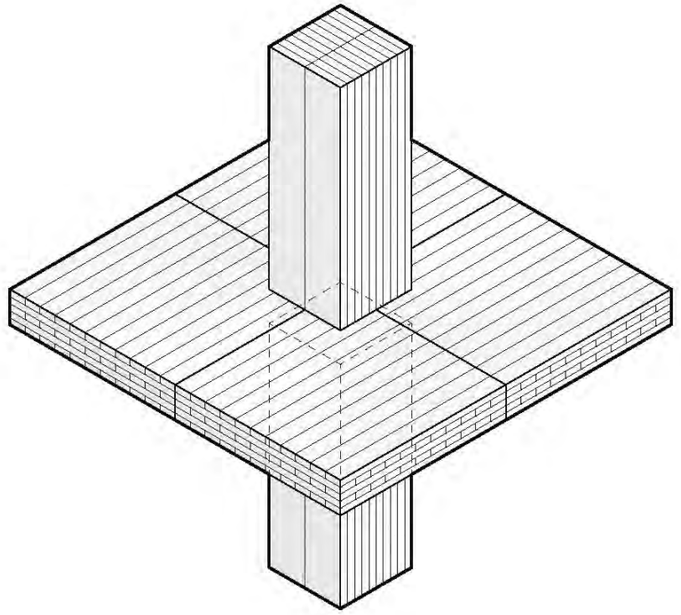
BUILDING AREA + HEIGHT	
MAXIMUM STORIES	18
MAXIMUM BUILDING HEIGHT	270'
MAXIMUM AREA PER FLOOR	432,000 SF

FIRE RESISTANCE RATINGS	
PRIMARY STRUCTURE	3 HOURS
BEARING WALLS (EXTERIOR)	3 HOURS
BEARING WALLS (INTERIOR)	3 HOURS
FLOOR CONSTRUCTION	2 HOURS
ROOF CONSTRUCTION	1 HOUR



POST + BEAM

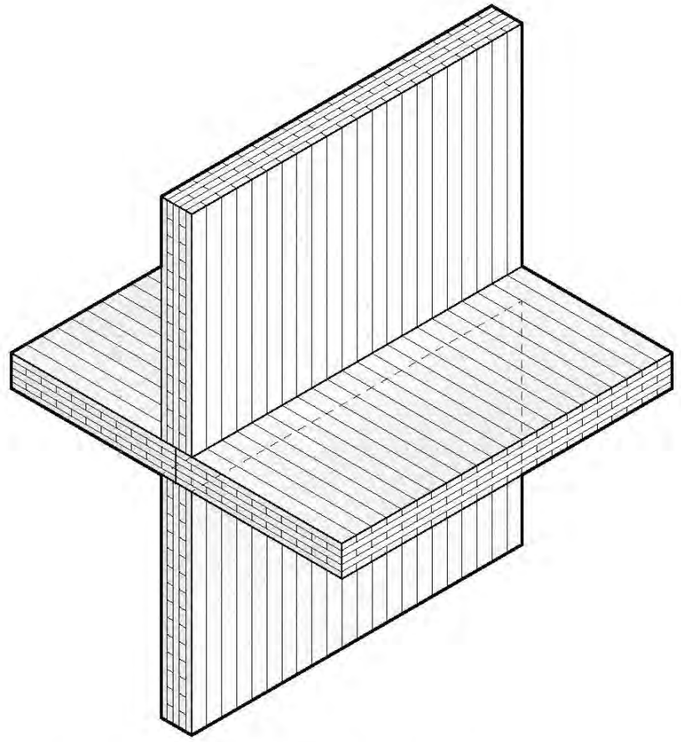
Column/Beam:	Glue-laminated timber
Floor Panel:	Cross-laminated timber Nail-laminated timber Dowel-laminated timber Glue-laminated timber
Roof Panel:	Cross-laminated timber Nail-laminated timber Dowel-laminated timber Glue-laminated timber



POINT-SUPPORTED

Column:	Glue-laminated timber
Floor Panel:	Cross-laminated timber
Roof Panel:	Cross-laminated timber

Column - to - panel connection requires specialized, concealed hardware that meets fire-rating requirements.



PANELIZED PLATFORM

Wall Panel:	Cross-laminated timber
Floor Panel:	Cross-laminated timber Nail-laminated timber Dowel-laminated timber Glue-laminated timber
Roof Panel:	Cross-laminated timber Nail-laminated timber Dowel-laminated timber Glue-laminated timber

WARREN ST

Client: 475 High Performance Building Supply

Lot Size: 1,875 SF

Zoning: R6B

Building Size: 3 stories / 3,647 SF

Code: 1938 NYC Building code

Energy: PHI and Phius 20

Mass Timber Supplier: City Line interior (NLT – build on site)

Construction Type: 1938 load bearing / non combustible masonry + nailed decking HT (current Type IV HT)

Exterior Facades: Existing masonry, CMU for extension

Concrete Use: Practically none, except for helical pile caps

Floor Assembly: Existing concrete slab + 2.5” of mineral wool

Blower Door Tests: 0.3ACH50 (prelim)

Exterior Glazing: steel 45 min lot line fire window + PHI certified wood window

Skylights: Triple pane with thermally broken frames

Sprinkled: yes, small system (<30 heads)

Occupancy: mixed use – existing 2 bedroom – 12 person office + warehouse

WARREN ST

- Located on Warren Street in Brooklyn’s Boerum Hill neighborhood, few block from downtown Brooklyn
- Originally constructed in 1886 as residential-over-retail.
- Ground floor space was built as a Wagon House, converted to store Ice Cream trucks in the 1950s – 1980s and to 5 accessory parking spaces in the 1990s.
- Purchased in 2023.

SITE LOCATION

5 accessory parking spots (for 1 apartment) in Downtown Brooklyn…..less then a block form Subway

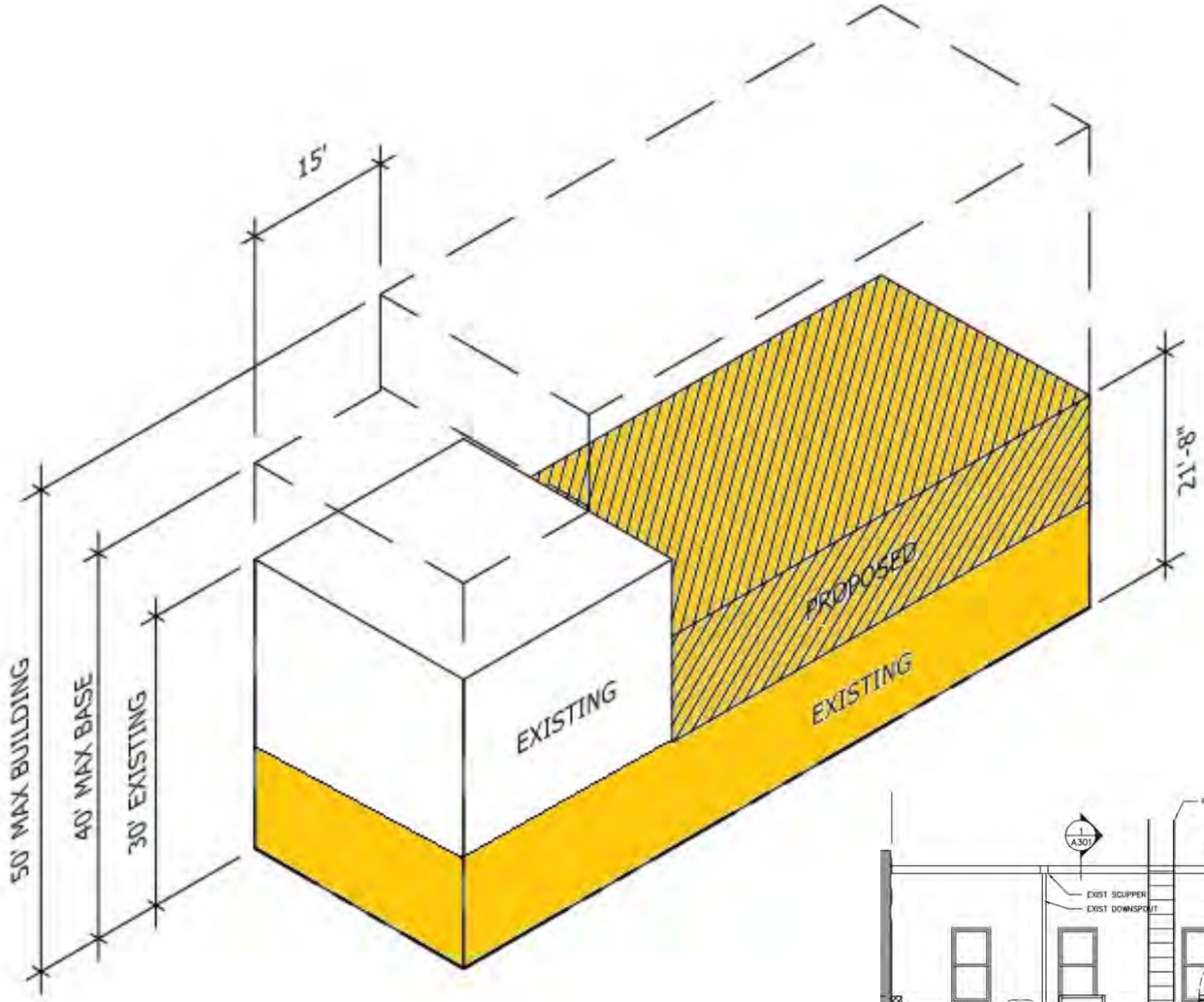
PROJECT BRIEF

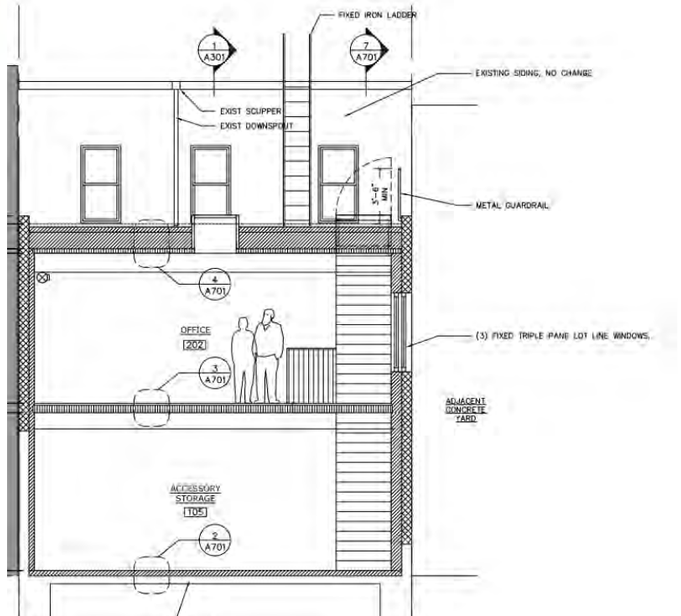
- Maximize building square foot per zoning:

- Lot Size: 25’ x 75’
- Maximum FAR: 2.00
- Current use 0.77
- Zone: R6B – C2-4 Overlay

- Maximize daylight

- Minimize carbon emissions

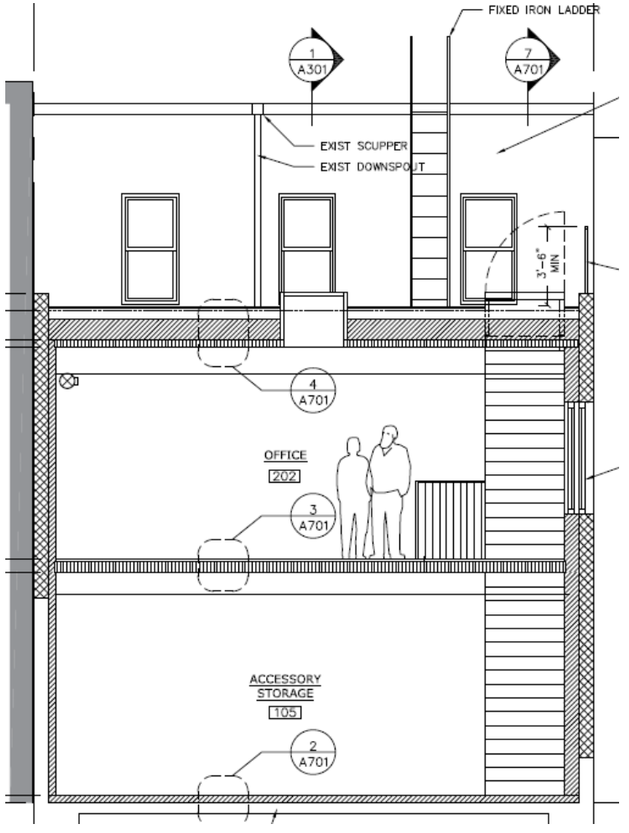




Ryan Enschede Architect

PROJECT BRIEF

- Reuse as much material as possible to save embodied carbon emissions
- Foam free Passive House



SITE COMPLICATIONS

- CLT priced out 2-3x more than NLT

- Existing masonry “uneven”
- CLT would have to be cut on site

- Logistics required 2 crane mobilizations for full day operation ($10k + each)

- Steel deck + concrete would be conventional – but much higher carbon – and require pumping of concrete to second floor + roof

SITE SOLUTION

- Nail-laminated timber (NLT)

- 2x6 – 640x – 12ft
- 2x4 520x – 12ft

Brought in through garage door

Material lift for Glue-laminated timber (GLT)

1600 lbs – 18” x 8.5” x 25’

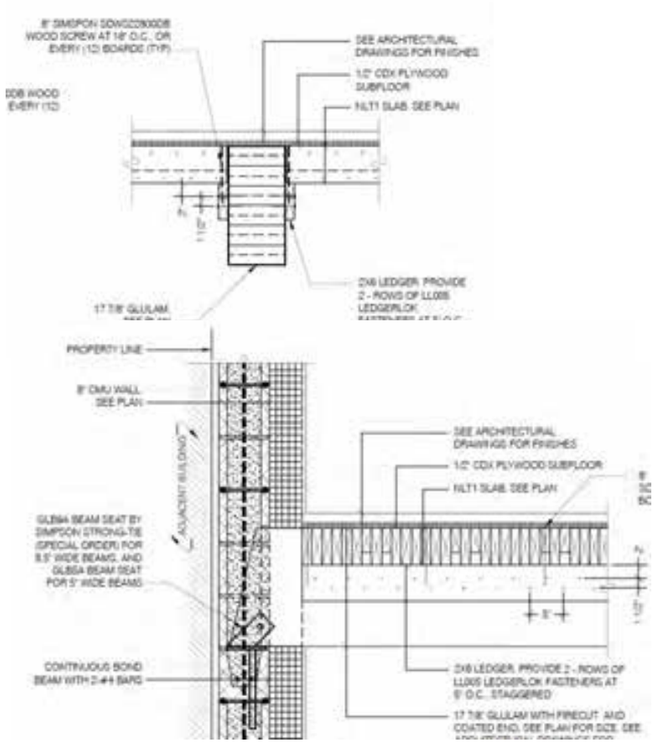
No cranes required!

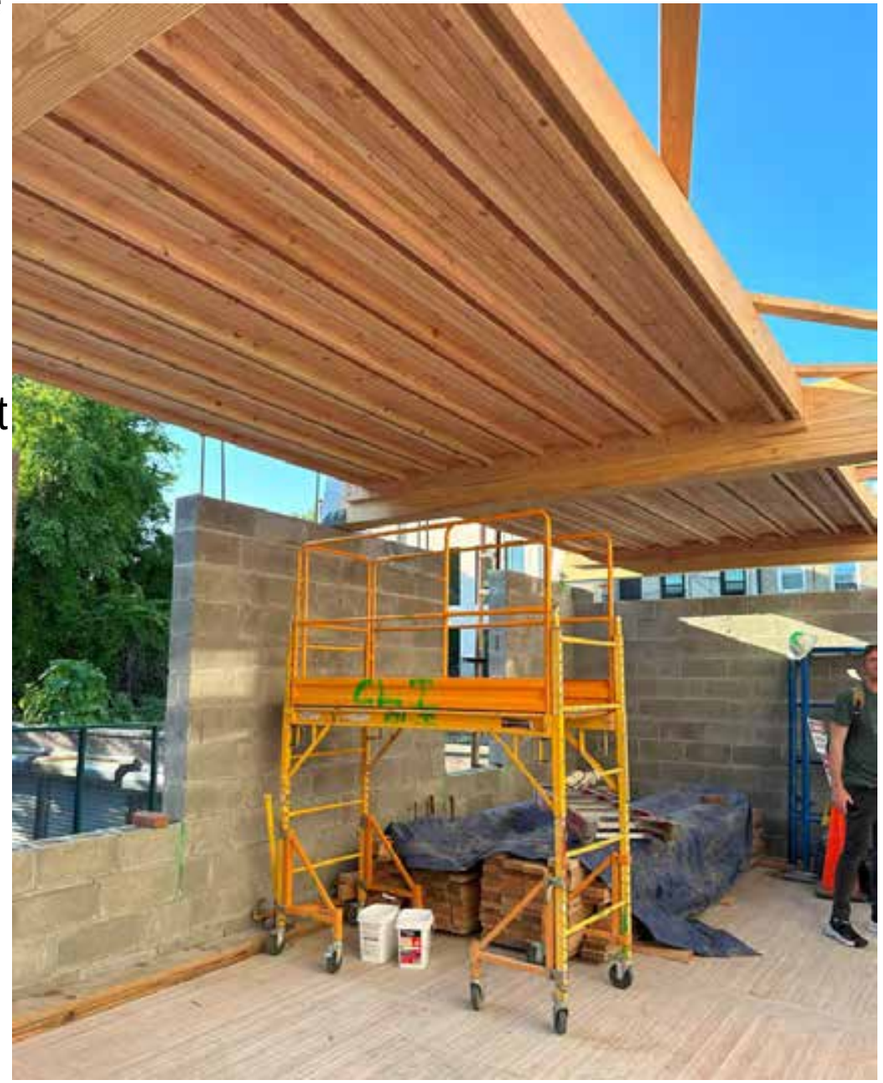
GC solutions
Glulams cut to length with a chain saw on site

NLT

- 2x6 ledgers with 5” self tapping large head screw
- 2x6 floor panels
- 2x4 roof panels
- 12ft spans/bays – easy to confirm to existing (site) conditions (walls not straight everywhere)

- GC used clamps to keep 2x’s straight

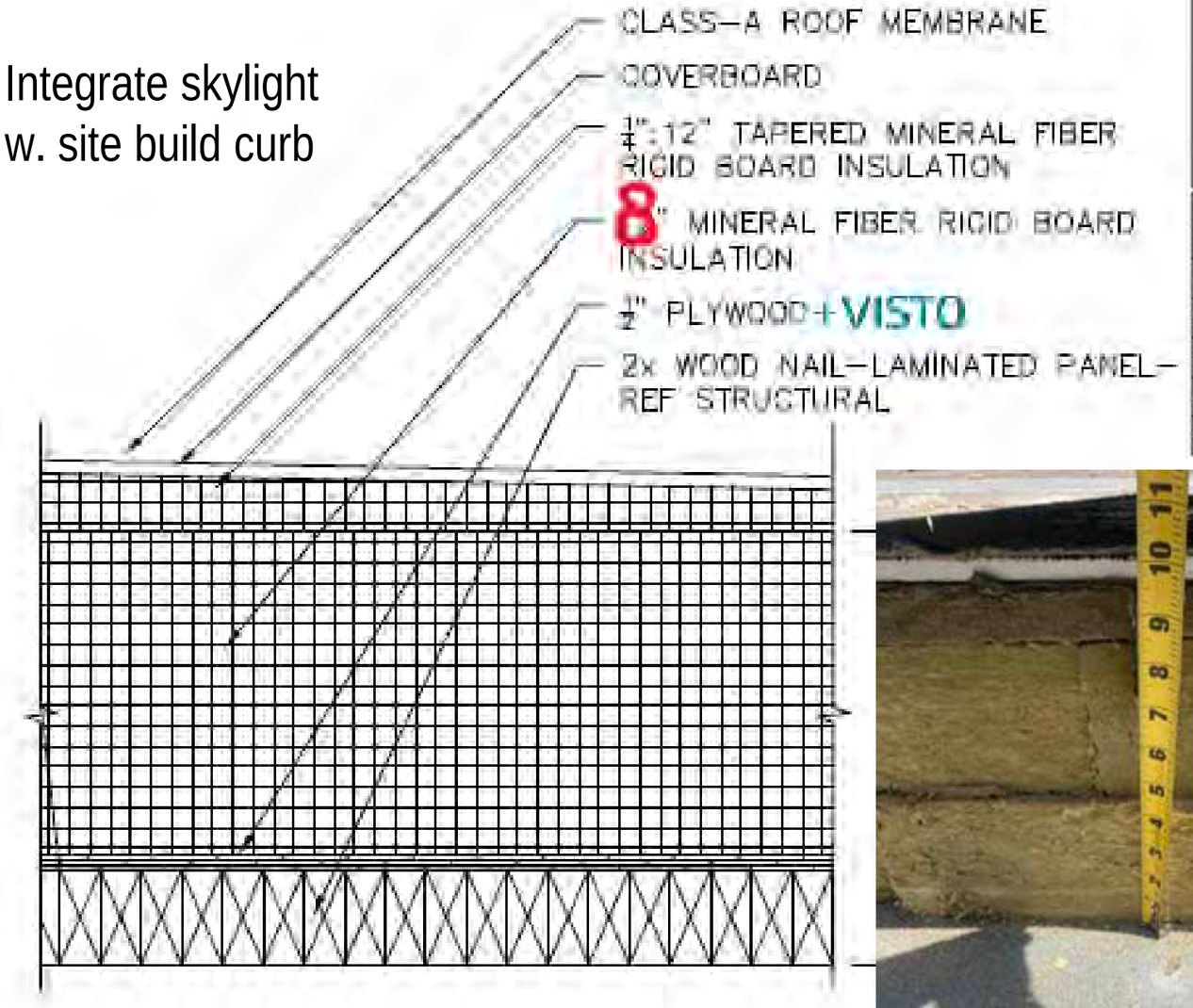




ROOF INSULATION – R43.3 – NO FOAM

Tapered mineral wool……

Integrate skylight
w. site build curb

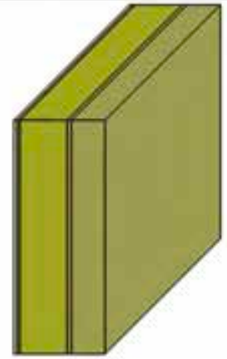


Homogenous layers

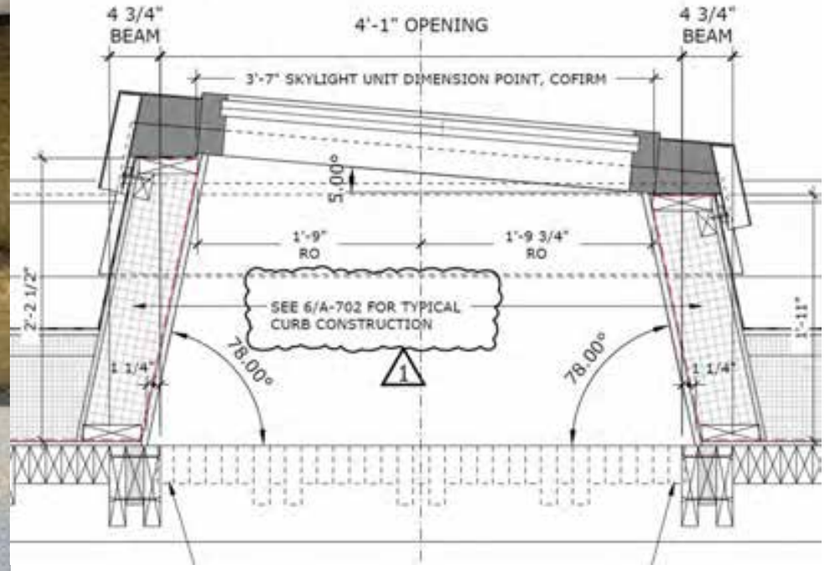
Thermal resistance: 43.402 hr ft² °F/Btu (without Rsi, Rse)

Heat transfer coefficient (U-value): 0.023 Btu/hr ft² °F

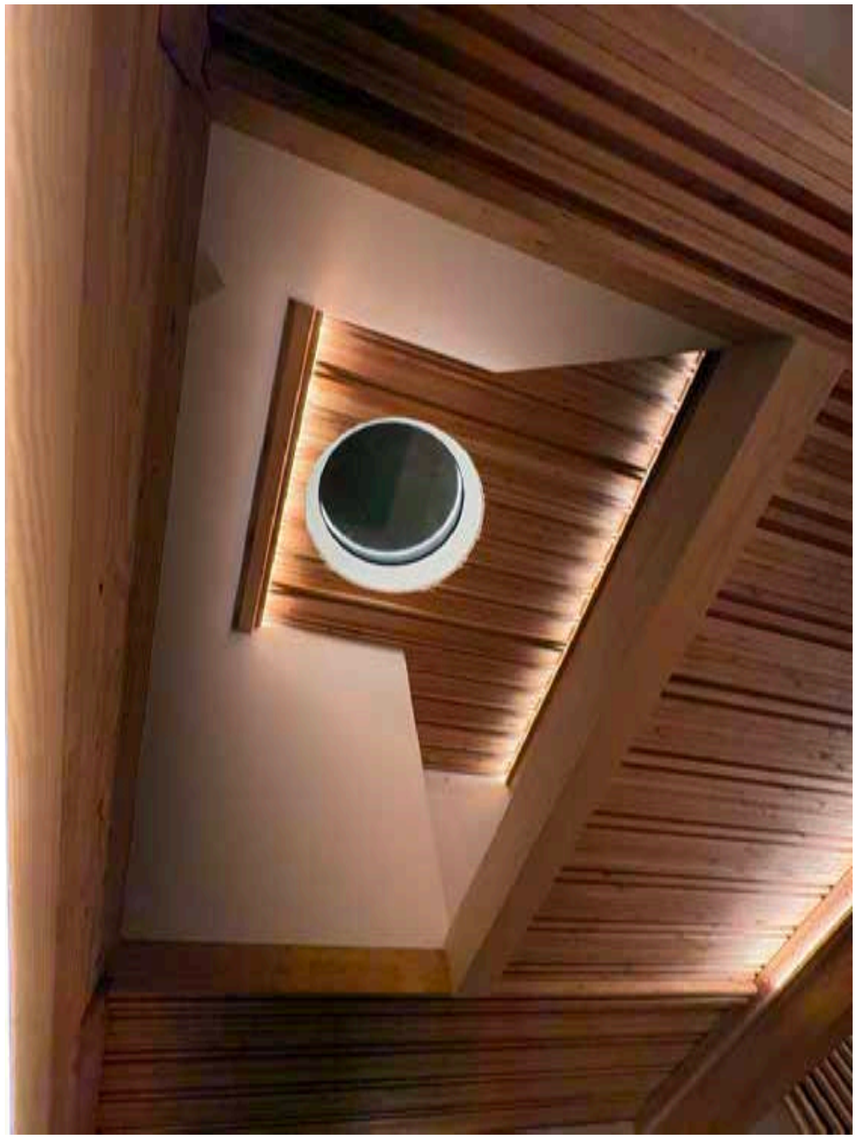
Thickness: 15.25 in



Nr.	Material/Layer (from outside to inside)	ρ [lb/ft³]	c [Btu/lb°F]	λ [Btu/hr ft °F]	Thickness [in]	Color
1	DensElement™ Barrier System	49.76	0.2	0.1143	0.5	
2	Roxul TopRock DD			0.0198	0.5	
3	Rockwool ComfortBoard 80 -Derated	4.06	0.2	0.0214	8	
4	Plywood (USA)	29.34	0.45	0.0485	0.75	
5	Eastern White Pine	28.72	0.45	0.0537	5.5	



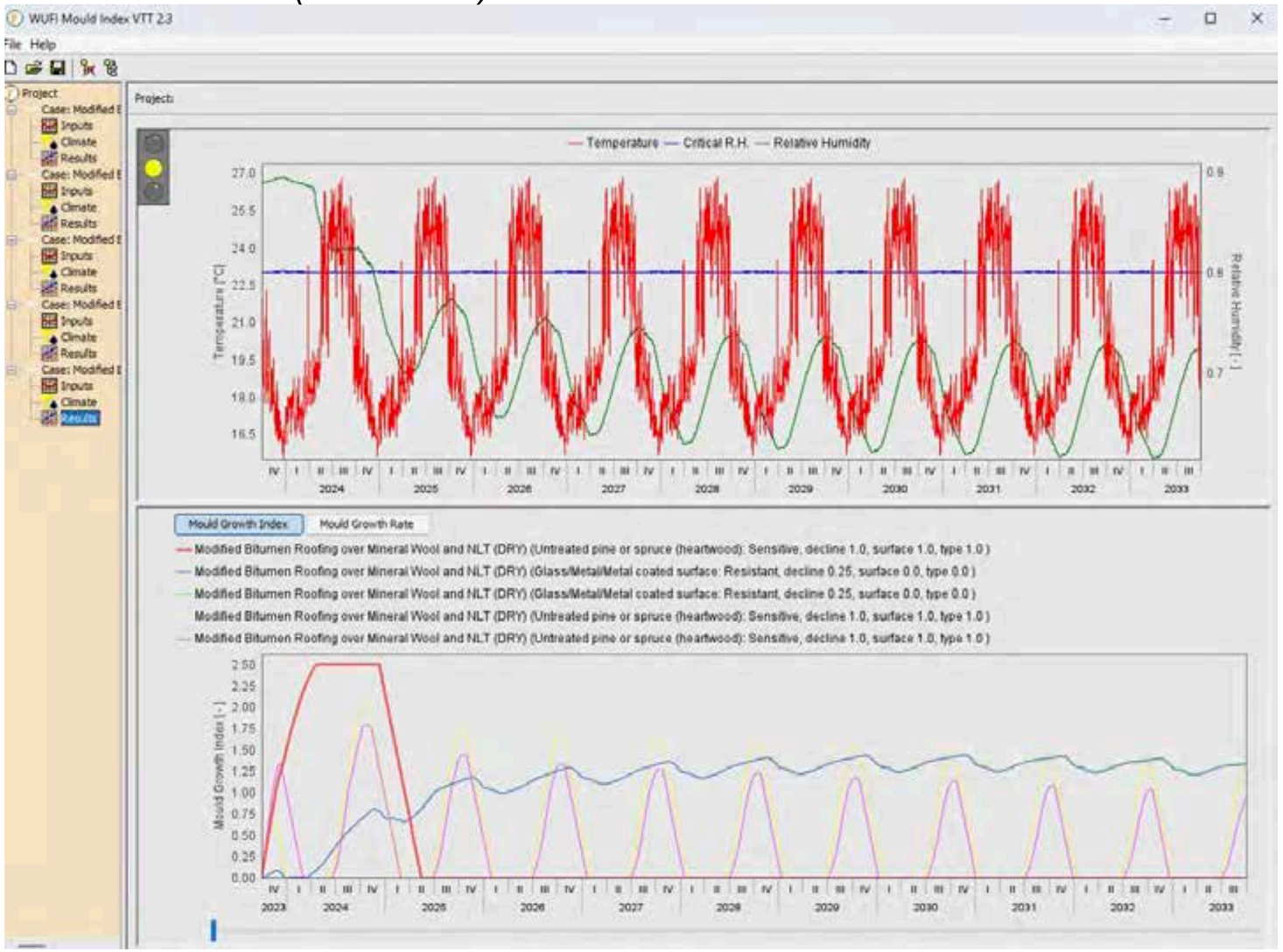
NLT PROTECTION – SELF DRYING ROOF

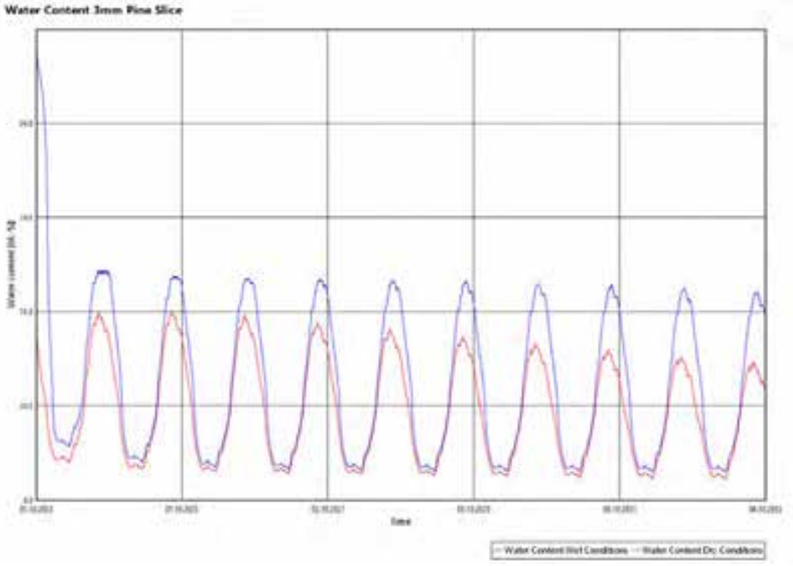


Doug Fir <19M% when delivered (as code requires) – it was 15M%
Protection with transparent membrane – semi vapor permeable – PROTECT
keep dry from rain and allows drying to 12M% in few months

NLT PROTECTION – SELF DRYING ROOF

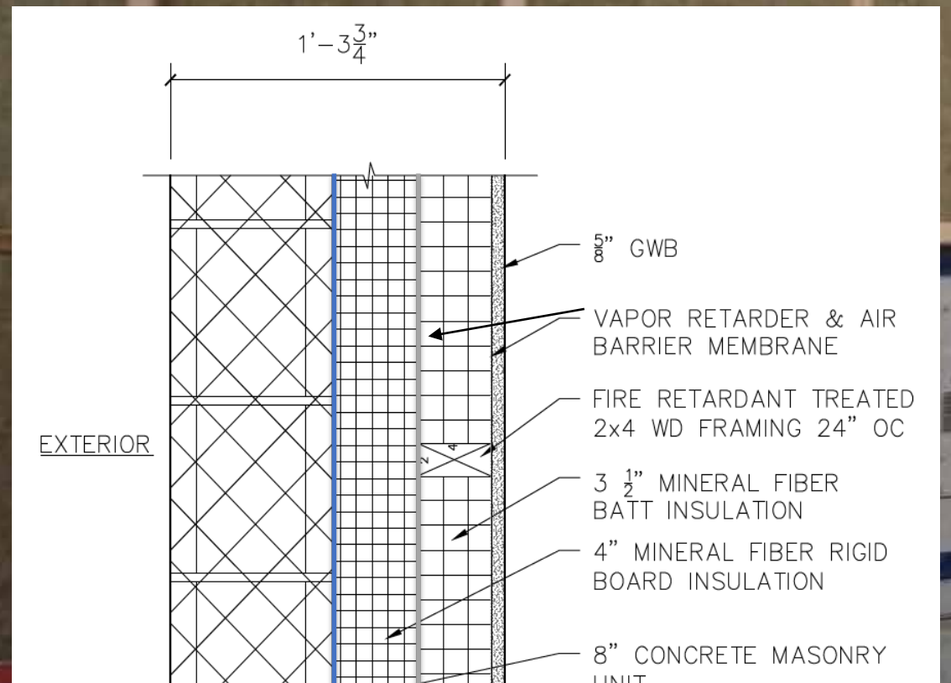
WUFI VALIDATION (FOR PHIUS)





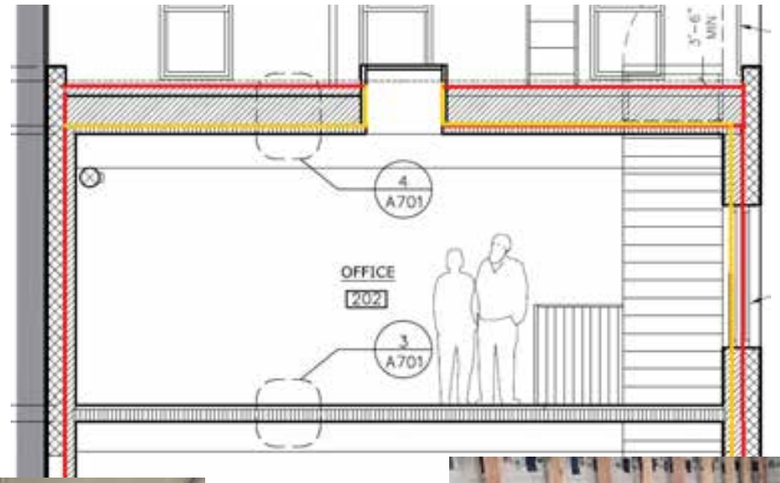
It dries every year – but essential to start with <19M% wood
PE to sign of on suitability as light is yellow (not green).

INSULATING masony on interior for Passive House



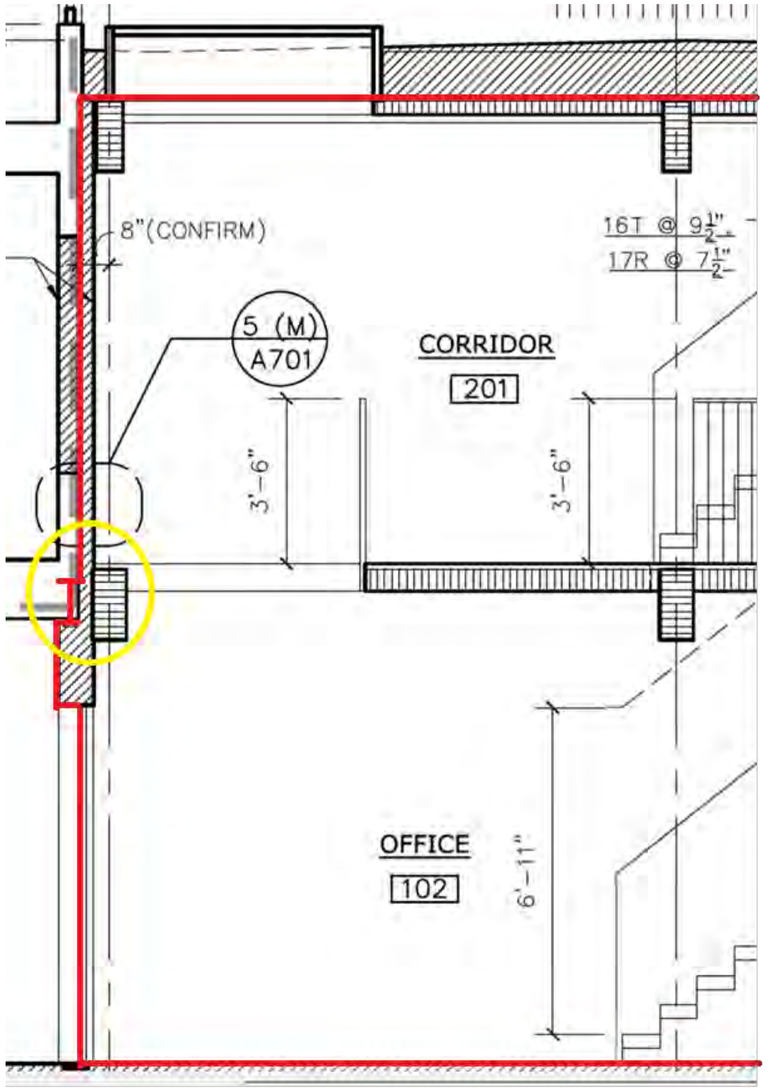
	Description of building assembly					Assembly no.		
	Masonry wall - interior insultation Warren st					02ud		
ntation of building assembly (or R_{si})		2-Wall					Interior insulation?	x
	Adjacent to (or R_{se})	1-Outdoor air					U-value supplement [W/(m²K)]	
	Area section 1	λ□[W/(mK)]	Area section	λ□[W/(mK)]	Area section	λ□[W/(mK)]	Thickness [mm]	Inches
	CMU	0.900'					194	7-5/8"
	Mineral wool board w Smart vapor retarder	0.034					102	4"
	Mineral wool batt	0.034	Wood Stud	0.14			89	3.5"
	GWB	0.170'					16	5/8"
	Percentage of sec. 1:	91%	ge of sec. 2:	9.40%	ge of sec. 3:			
	Heat transmission resistance coefficients					Total thickness [cm]:	40	15.75"
	Interior R_{si}:	0.13	m²K/W					
	Exterior R_{se}:	0.04	m²K/W			U-value [W/(m²K)]:	0.177	R-32
	credit: BLDGTYP							

WINDTIGHT – protect the masonry keep the insulation dry



Floor airbarrier – PE sheet over existing concrete + 2.5” Rockboard 110 (R9)
Wall – windtight with liquid applied (white) coating – taped to glulams only –
Roof – self adhered membrane (connected to liquid coating)

AIRTIGHTNESS



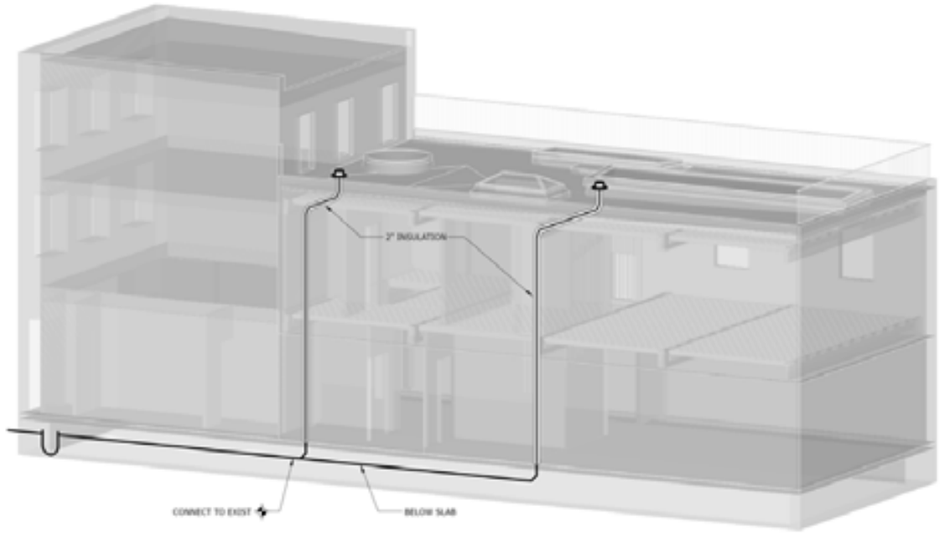
Complications in renovations – diligence, commitment and planning go hand in hand!
Old meets new – especially trick at connection to apartment/existing rear wall + new floor/roof

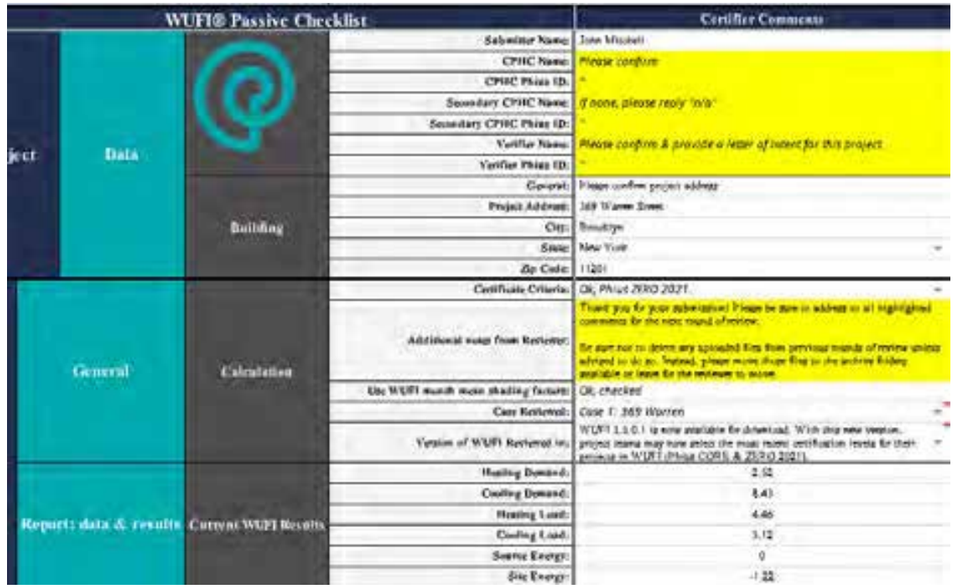
AIRTIGHTNESS – 0.3 ACH50 (prelim)

We know our sliding door that replaced the plywood will cause a small amount of leakage.

FOAM FREE PASSIVE HOUSE – PHI - PHPP

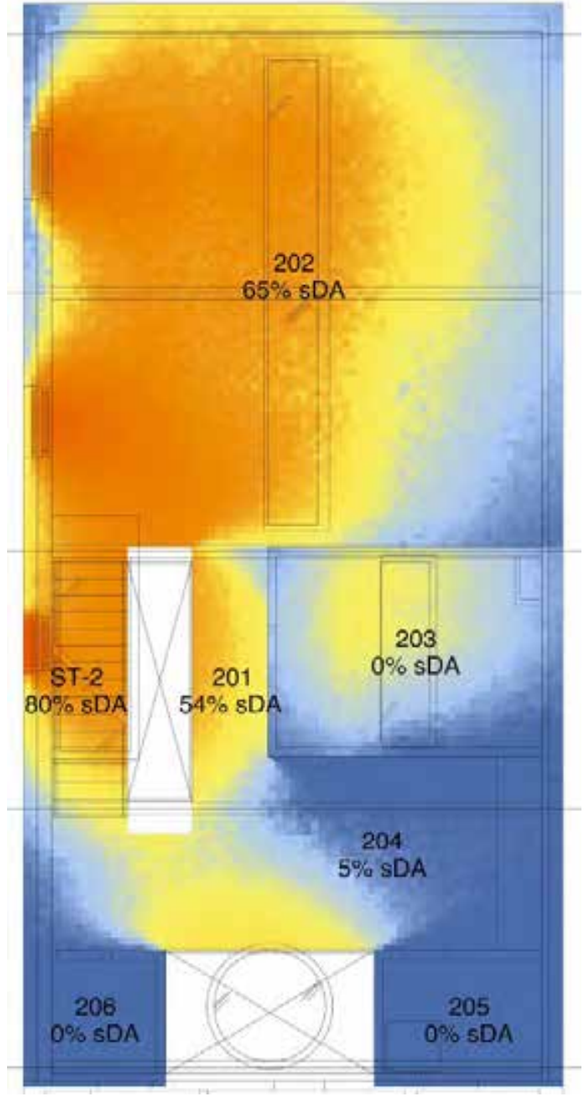
Specific building characteristics with reference to the treated floor area								
	Treated floor area	m²	183.6		Criteria	Alternative criteria		Fullfilled?[2]
Space heating	Heating demand	kWh/(m²a)	**12**	≤	15	-		**Yes**
	Heating load	W/m²	**10**	≤	-	10		
Space cooling	Cooling & dehum. demand	kWh/(m²a)	**14**	≤	16			**Yes**
	Frequency of overheating (> 25 °C)	%	**-**	≤	-			**-**
	Frequency of excessively high humidity (> 12 g/kg)	%	**0**	≤	10			**Yes**
Airtightness	Pressurisation test result n_{50}	1/h	**0.3**	≤	0.6			**Yes**

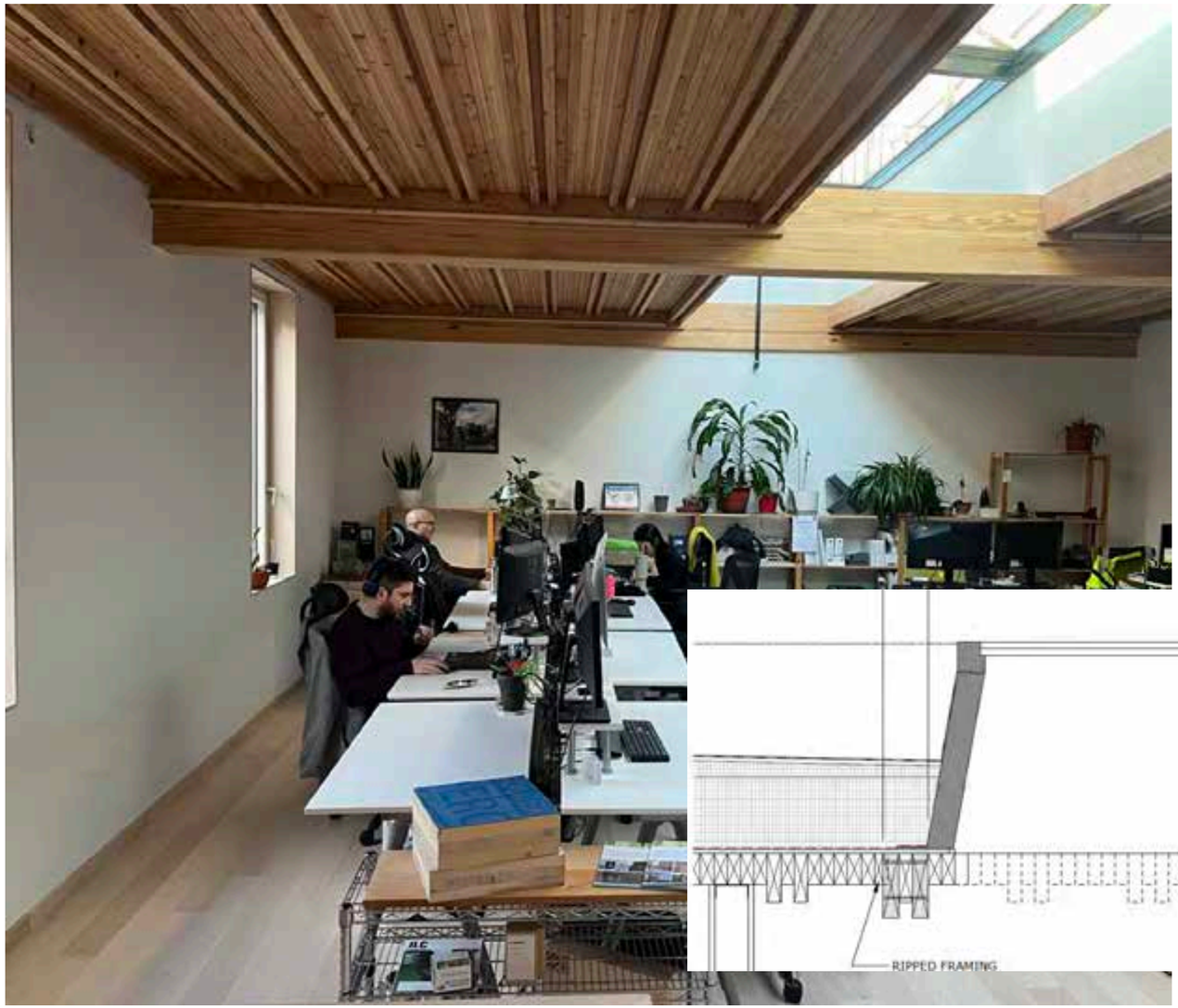




PHIUS Certification

DAYLIGHT AUTONOMY – THERMAL BRIDGE FREE SKYLIGHT INSTALLS



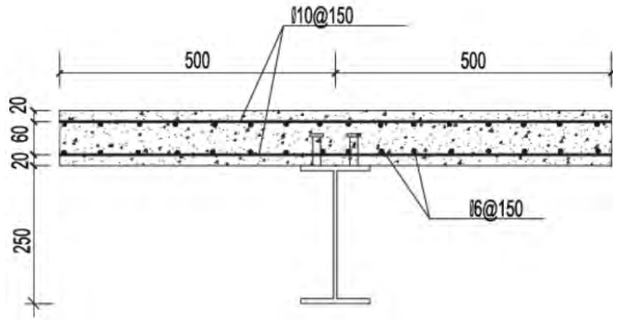


500 lux (Source: bldgtyp) 4:32PM – March 7th

Triple pane skylights with insulated curbs (only foam in the building) – Ug: 0.12 – SHGC 30%

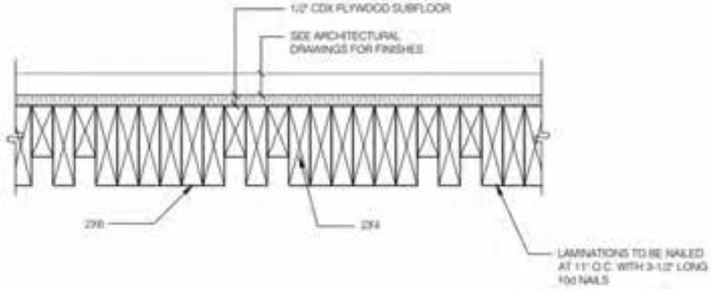
CARBON ACCOUNTING – CONCRETE VS NLT

BEAM / CLIMATE ACTION	REVIEW PROJECT MATERIALS		144,927	144,927
SECTION	CATEGORY	MATERIAL	NET EMISSIONS (kg CO_2e)	CARBON EMISSIONS (kg CO_2e)
Footings & Slabs	CONTINUOUS CONCRETE FOOTINGS	Concrete - 2501-3000 psi, Standard mix / NRMCA [Industry Avg | US & CA]	2,083	2,083
Footings & Slabs	CONCRETE COLUMN FOOTINGS, PADS & PIERS	Concrete - 2501-3000 psi, Standard mix / NRMCA [Industry Avg | US & CA]	7,190	7,190
Footings & Slabs	CONCRETE SLABS	Concrete - 2501-3000 psi, Standard mix / NRMCA [Industry Avg | US & CA]	10,741	10,741
Footings & Slabs	REBAR FOR CONTINUOUS FOOTINGS	Rebar / Concrete Reinforcing Steel Institute [Industry Avg | N.America] / #3	59	59
Footings & Slabs	REINFORCING MESH FOR SLAB	Welded wire mesh / Serfas / 6" x 6" x 6/6g / Norway	102	102
Footings & Slabs	SUB-SLAB INSULATION	XPS foam board / DuPont / Styrofoam / Reduced GWP / R 5.6/inch	7,762	7,762
Structural Elements	STRUCTURAL STEEL – WIDE FLANGE BEAMS	Structural Steel / Wide Flange / W360x57 (US W14x38) / AISC [Industry Avg | US]	4,985	4,985
Exterior Walls	LIGHT STEEL FRAME WALLS	Steel studs - Non-loadbearing / Scafco / 362VS125-18, 20EQ gauge	913	913
Exterior Walls	STRUCTURAL SHEATHING	Gypsum panels - glass mat / 5/8" Type X / Gypsum Association [Industry Avg | N.America]	629	629
Exterior Walls	CAVITY INSULATION	Spray polyurethane foam - Closed Cell (HFC gas) / R 6.6/inch / SPFA [Industry Avg | US & CA]	10,631	10,631
Exterior Walls	CONCRETE MASONRY UNIT (CMU) WALLS	CMU - Normal weight / 8" Normal weight blocks / 390 x 190 x 190 mm / CCMPA [Industry Avg | CA]	25,889	25,889
Exterior Walls	CONCRETE FILL FOR CMU WALL	Concrete - 2501-3000 psi, 20-29% Fly Ash / NRMCA [Industry Avg | US & CA]	48,427	48,427
Ceilings	CEILING FINISHES	Drywall 5/8" Type X / Gypsum Association [Industry Avg | US & CA]	608	608
Roof	WATERPROOFING MEMBRANE	SBS Modified Bitumen Roofing / ARMA / Includes: CertainTeed, Firestone, GAF, Henry, IKO, Johns Mansville, Malarkey, Siplast, Soprema /	931	931
Roof	CONTINUOUS ROOF INSULATION	XPS foam board / DuPont / Styrofoam / Reduced GWP / R 5.6/inch	23,975	23,975



20,014 kg CO2e Concrete
4,985 kg CO2e Steel

REVIEW PROJECT MATERIALS		60,099	60,099
MATERIAL		NET EMISSIONS (kg CO_2e)	CARBON EMISSIONS (kg CO_2e)
Concrete - 2501-3000 psi, Standard mix / NRMCA [Industry Avg | US & CA]		456	456
Rebar / Concrete Reinforcing Steel Institute [Industry Avg | N.America] / #3		15	15
Helical pier / Generic / 3" Nominal Pipe, 3.5 x 3/16" (89 x 5.5 mm), 10" Helix, Sched 40 Galvanized steel [Industry Avg]		1,128	1,128
Mineral wool board / Rockwool / Comfortboard 80 / R 4.2/inch		865	865
Glued Laminated Timber (Glulam) / AWC & CWC [Industry Avg | US & CA]		617	617
Wood / SPF / 2x4 Lumber / AWC & CWC [Industry Avg | US & CA]		163	163
Gypsum panels - glass mat / 5/8" Type X / Gypsum Association [Industry Avg | N.America]		629	629
Mineral wool batt / Rockwool / ComfortBatt R24 (5.5") / R 4.4/inch		642	642
Mineral wool board / Rockwool / Rockboard 60 / R 4.3/inch		1,118	1,118
CMU - Normal weight / 8" Normal weight blocks / 390 x 190 x 190 mm / CCMPA [Industry Avg | CA]		25,889	25,889
Concrete - 2501-3000 psi, 20-29% Fly Ash / NRMCA [Industry Avg | US & CA]		24,065	24,065
Dowel Laminated Timber / StructureCraft / DowelLam / 3-1/2"		239	239
SBS Modified Bitumen Roofing / ARMA / Includes: CertainTeed, Firestone, GAF, Henry, IKO, Johns Mansville, Malarkey, Siplast, Soprema /		931	931
Mineral wool board / Rockwool / Comfortboard 80 / R 4.2/inch		3,340	3,340



1,599 kg CO2e NLT
617 kg CO2e Glulam

No carbon storage included, only emissions

CASE STUDY – INSULATION MATTERS

BEAM / BUILDERS FOR CLIMATE ACTION	REVIEW PROJECT MATERIALS		144,927	144,927
SECTION	CATEGORY	MATERIAL	NET EMISSIONS (kg CO_2e)	CARBON EMISSIONS (kg CO_2e)
Footings & Slabs	CONTINUOUS CONCRETE FOOTINGS	Concrete - 2501-3000 psi, Standard mix / NRMCA [Industry Avg | US & CA]	2,083	2,083
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Roof	CONTINUOUS ROOF INSULATION	XPS foam board / DuPont / Styrofoam / Reduced GWP / R 5.6/inch	23,975	23,975

40,000 kg CO2e

REVIEW PROJECT MATERIALS		60,099	60,099
MATERIAL		NET EMISSIONS (kg CO_2e)	CARBON EMISSIONS (kg CO_2e)
Concrete - 2501-3000 psi, Standard mix / NRMCA [Industry Avg | US & CA]		456	456
Rebar / Concrete Reinforcing Steel Institute [Industry Avg | N.America] / #3		15	15
Helical pier / Generic / 3" Nominal Pipe, 3.5 x 3/16" (89 x 5.5 mm), 10" Helix, Sched 40 Galvanized steel [Industry Avg]		1,128	1,128
Mineral wool board / Rockwool / Comfortboard 80 / R 4.2/inch		865	865
Glued Laminated Timber (Glulam) / AWC & CWC [Industry Avg | US & CA]		617	617
Wood / SPF 2x4 Lumber / AWC & CWC [Industry Avg | US & CA]		163	163
Gypsum panels - glass mat / 5/8" Type X / Gypsum Association [Industry Avg | N.America]		629	629
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CMU - Normal weight / 8" Normal weight blocks / 390 x 190 x 190 mm / CCMPA [Industry Avg | CA]		25,889	25,889
Concrete - 2501-3000 psi, 20-29% Fly Ash / NRMCA [Industry Avg | US & CA]		24,065	24,065
Dowel Laminated Timber / StructureCraft / DowelLam / 3-1/2"		239	239
SBS Modified Bitumen Roofing / ARMA / Includes: CertainTeed, Firestone, GAF, Henry, IKO, Johns Mansville, Malarkey, Siplast, Soprema /		931	931
Mineral wool board / Rockwool / Comfortboard 80 / R 4.2/inch		3,340	3,340

5,865 kg CO2e

340+ DIXWELL

Client: Beulah Land Development Corporation, Spiritos Properties, HELP Development Corporation

Architect: SSA + GOA

Lot Size: 40,600 SF

Zoning: BA

Building Size: 4 stories / 86,805 SF

Code: 2018 Connecticut Building Code

Energy: 181 kW PV Array (30% Building Usage)

Mass Timber Supplier: Binderholz

Units: 69 (80% Affordable, 20% Market Rate)

Construction Type: Type V-A

Exterior Facades: CLT + Exterior Insulation + Fiber Cement Rainscreen

Concrete Use: Cast in place foundation + parking deck

Floor Assembly: Acoustic Mat + Gypcrete

Blower Door Target: 0.30 CFM50 / ft_2

Blower Door Tests: 0.21 CFM50 / ft_2 (average)

PHIUS: Pre-certified

Exterior Glazing: Alpen uPVC 3x Glazed

Sprinkled: Fully

Occupancy: April 2025

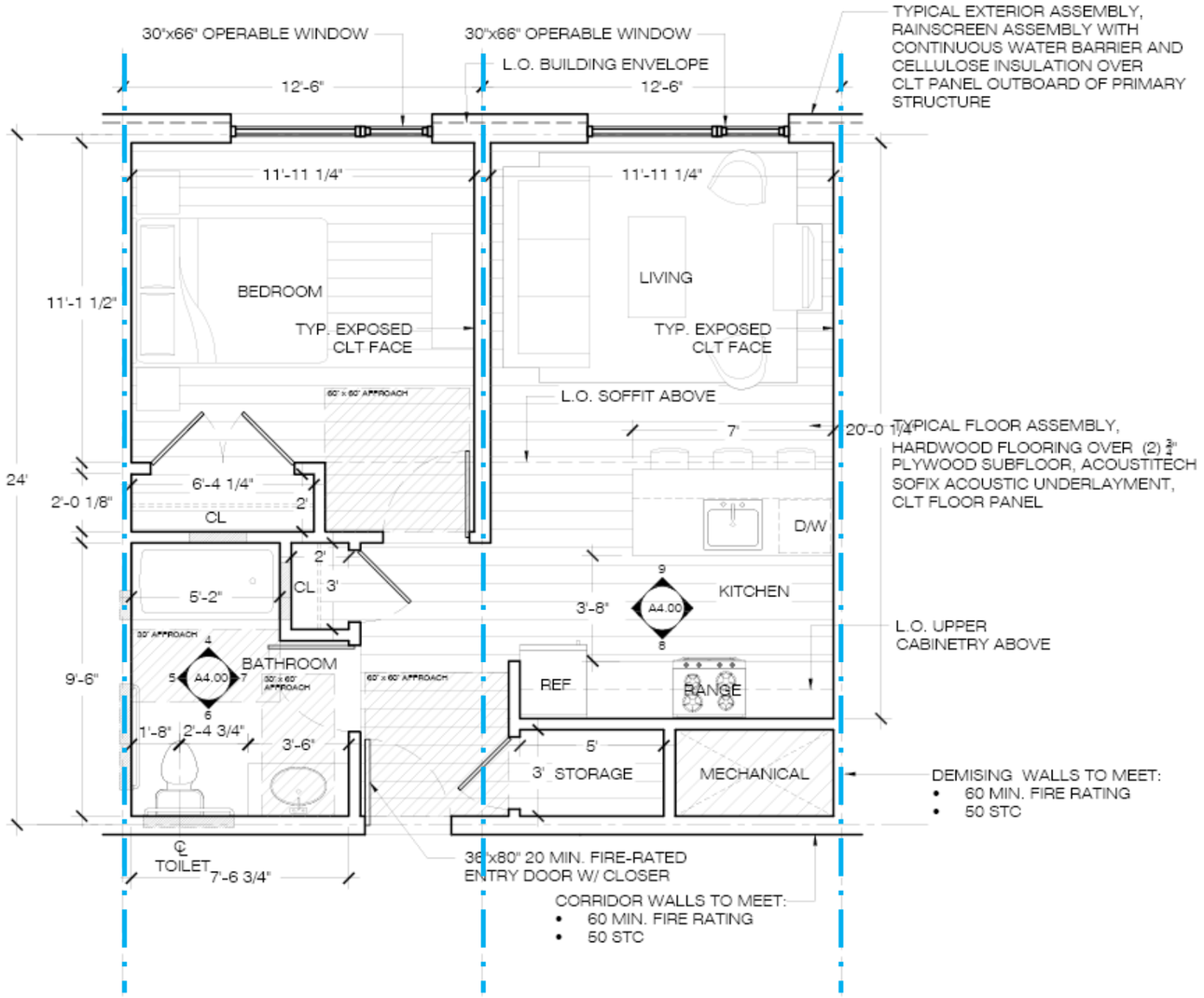
SITE CONTEXT

SITE CONTEXT

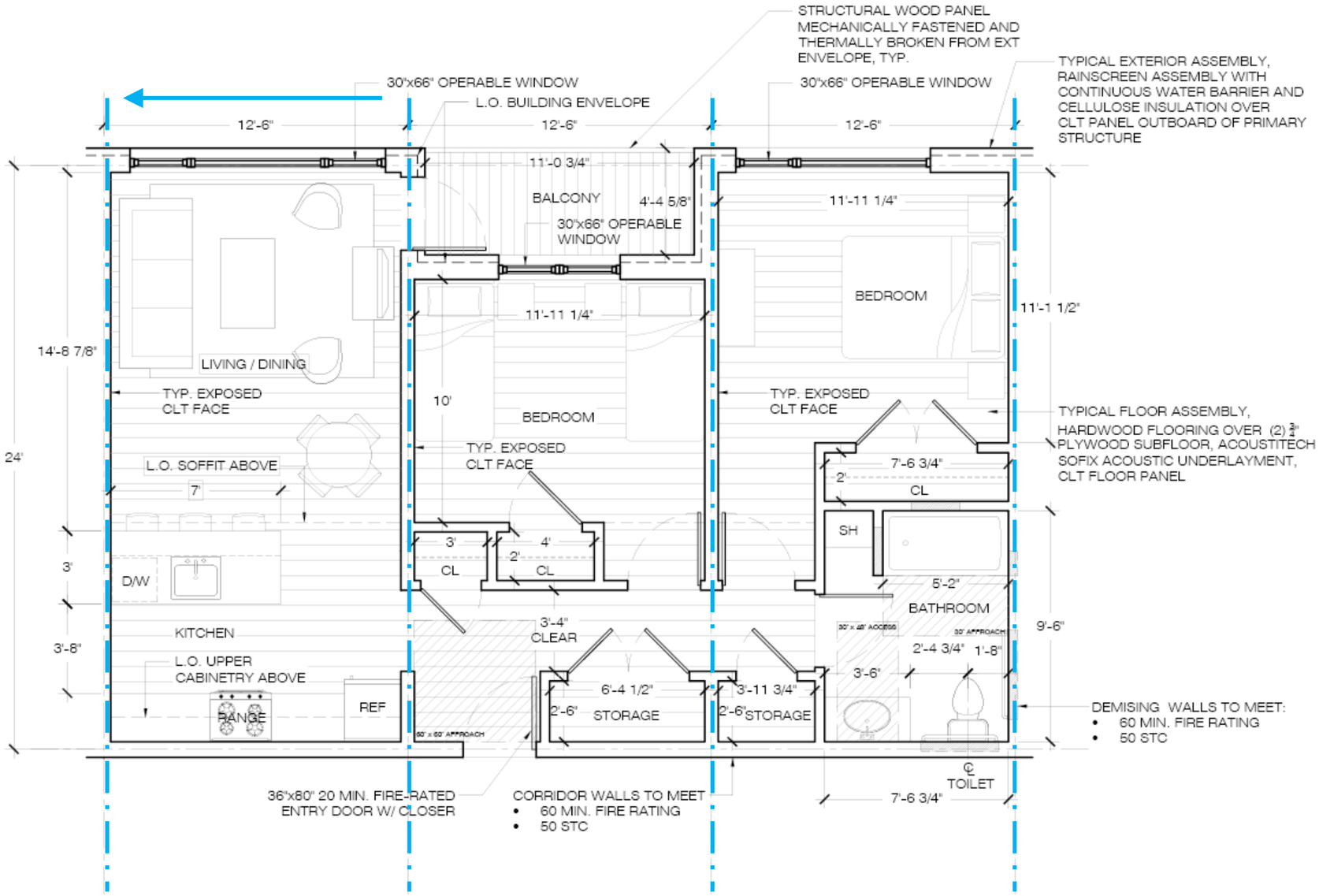
LEVEL 01

LEVEL 02-04

1 BR PLAN


30"x66" OPERABLE WINDOW
30"x66" OPERABLE WINDOW
L.O. BUILDING ENVELOPE
12'-6"
12'-6"
TYPICAL EXTERIOR ASSEMBLY, RAINSCREEN ASSEMBLY WITH CONTINUOUS WATER BARRIER AND CELLULOSE INSULATION OVER CLT PANEL OUTBOARD OF PRIMARY STRUCTURE
11'-11 1/4"
11'-11 1/4"
BEDROOM
LIVING
11'-1 1/2"
TYP. EXPOSED CLT FACE
TYP. EXPOSED CLT FACE
60" x 60" APPROACH
L.O. SOFFIT ABOVE
7'
20'-0 1/4"
TYPICAL FLOOR ASSEMBLY, HARDWOOD FLOORING OVER (2) 3/4" PLYWOOD SUBFLOOR, ACOUSTITECH SOFIX ACOUSTIC UNDERLAYMENT, CLT FLOOR PANEL
24'
6'-4 1/4"
2'
2'-0 1/8"
CL
D/W
2'
CL
3'
5'-2"
9
3'-8"
A4.00
8
KITCHEN
L.O. UPPER CABINETRY ABOVE
30" APPROACH
4
5
A4.00
7
6
BATHROOM
50" x 60" APPROACH
60" x 60" APPROACH
REF
RANGE
9'-6"
1'-8"
2'-4 3/4"
3'-6"
5'
3' STORAGE
MECHANICAL
DEMISING WALLS TO MEET:
• 60 MIN. FIRE RATING
• 50 STC
℄
TOILET
7'-6 3/4"
36"x80" 20 MIN. FIRE-RATED ENTRY DOOR W/ CLOSER
CORRIDOR WALLS TO MEET:
• 60 MIN. FIRE RATING
• 50 STC

2 BR PLAN


STRUCTURAL WOOD PANEL MECHANICALLY FASTENED AND THERMALLY BROKEN FROM EXT ENVELOPE, TYP.
TYPICAL EXTERIOR ASSEMBLY, RAINSCREEN ASSEMBLY WITH CONTINUOUS WATER BARRIER AND CELLULOSE INSULATION OVER CLT PANEL OUTBOARD OF PRIMARY STRUCTURE
30"x66" OPERABLE WINDOW
L.O. BUILDING ENVELOPE
30"x66" OPERABLE WINDOW
12'-6"
12'-6"
12'-6"
11'-0 3/4"
BALCONY
4'-4 5/8"
30"x66" OPERABLE WINDOW
11'-11 1/4"
BEDROOM
11'-1 1/2"
11'-11 1/4"
14'-8 7/8"
LIVING / DINING
TYP. EXPOSED CLT FACE
10'
BEDROOM
TYP. EXPOSED CLT FACE
TYP. EXPOSED CLT FACE
TYPICAL FLOOR ASSEMBLY, HARDWOOD FLOORING OVER (2) 3/4" PLYWOOD SUBFLOOR, ACOUSTITECH SOFIX ACOUSTIC UNDERLAYMENT, CLT FLOOR PANEL
24'
L.O. SOFFIT ABOVE
7'
7'-6 3/4"
2'
CL
SH
3'
4'
3'
2'
CL
CL
5'-2"
BATHROOM
D/W
3'
KITCHEN
3'-4" CLEAR
9'-6"
3'-8"
L.O. UPPER CABINETRY ABOVE
2'-4 3/4"
1'-8"
3'-6"
6'-4 1/2"
3'-11 3/4"
REF
RANGE
2'-6"
STORAGE
2'-6"
STORAGE
DEMISING WALLS TO MEET:
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℄
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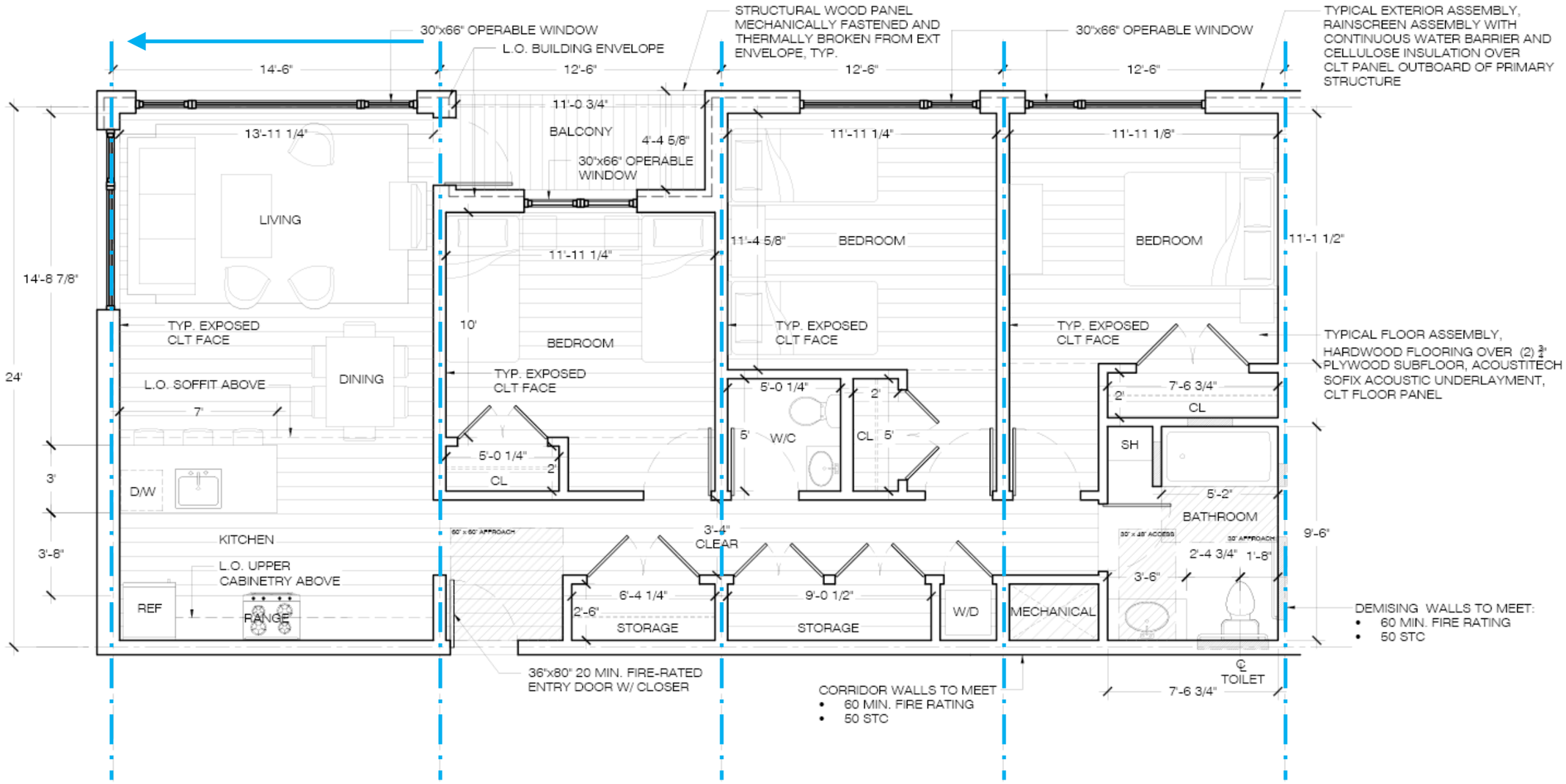
36"x80" 20 MIN. FIRE-RATED ENTRY DOOR W/ CLOSER
CORRIDOR WALLS TO MEET
• 60 MIN. FIRE RATING
• 50 STC

3 BR PLAN


30"x66" OPERABLE WINDOW
L.O. BUILDING ENVELOPE
STRUCTURAL WOOD PANEL MECHANICALLY FASTENED AND THERMALLY BROKEN FROM EXT ENVELOPE, TYP.
30"x66" OPERABLE WINDOW
TYPICAL EXTERIOR ASSEMBLY, RAINSCREEN ASSEMBLY WITH CONTINUOUS WATER BARRIER AND CELLULOSE INSULATION OVER CLT PANEL OUTBOARD OF PRIMARY STRUCTURE
14'-6"
12'-6"
12'-6"
12'-6"
11'-0 3/4"
BALCONY
4'-4 5/8"
30"x66" OPERABLE WINDOW
13'-11 1/4"
LIVING
11'-11 1/4"
11'-4 5/8"
BEDROOM
11'-11 1/8"
BEDROOM
11'-1 1/2"
14'-8 7/8"
11'-11 1/4"
TYP. EXPOSED CLT FACE
10'
BEDROOM
TYP. EXPOSED CLT FACE
TYP. EXPOSED CLT FACE
TYPICAL FLOOR ASSEMBLY, HARDWOOD FLOORING OVER (2) 3/4" PLYWOOD SUBFLOOR, ACOUSTITECH SOFIX ACOUSTIC UNDERLAYMENT, CLT FLOOR PANEL
24'
L.O. SOFFIT ABOVE
DINING
TYP. EXPOSED CLT FACE
5'-0 1/4"
2'
5'
W/C
CL
5'
7'-6 3/4"
2'
CL
7'
5'-0 1/4"
2'
CL
SH
3'
D/W
5'-2"
BATHROOM
KITCHEN
3'-4" CLEAR
9'-6"
3'-8"
L.O. UPPER CABINETRY ABOVE
2'-4 3/4"
1'-8"
3'-6"
6'-4 1/4"
9'-0 1/2"
2'-6"
REF
RANGE
STORAGE
STORAGE
W/D
MECHANICAL
DEMISING WALLS TO MEET:
• 60 MIN. FIRE RATING
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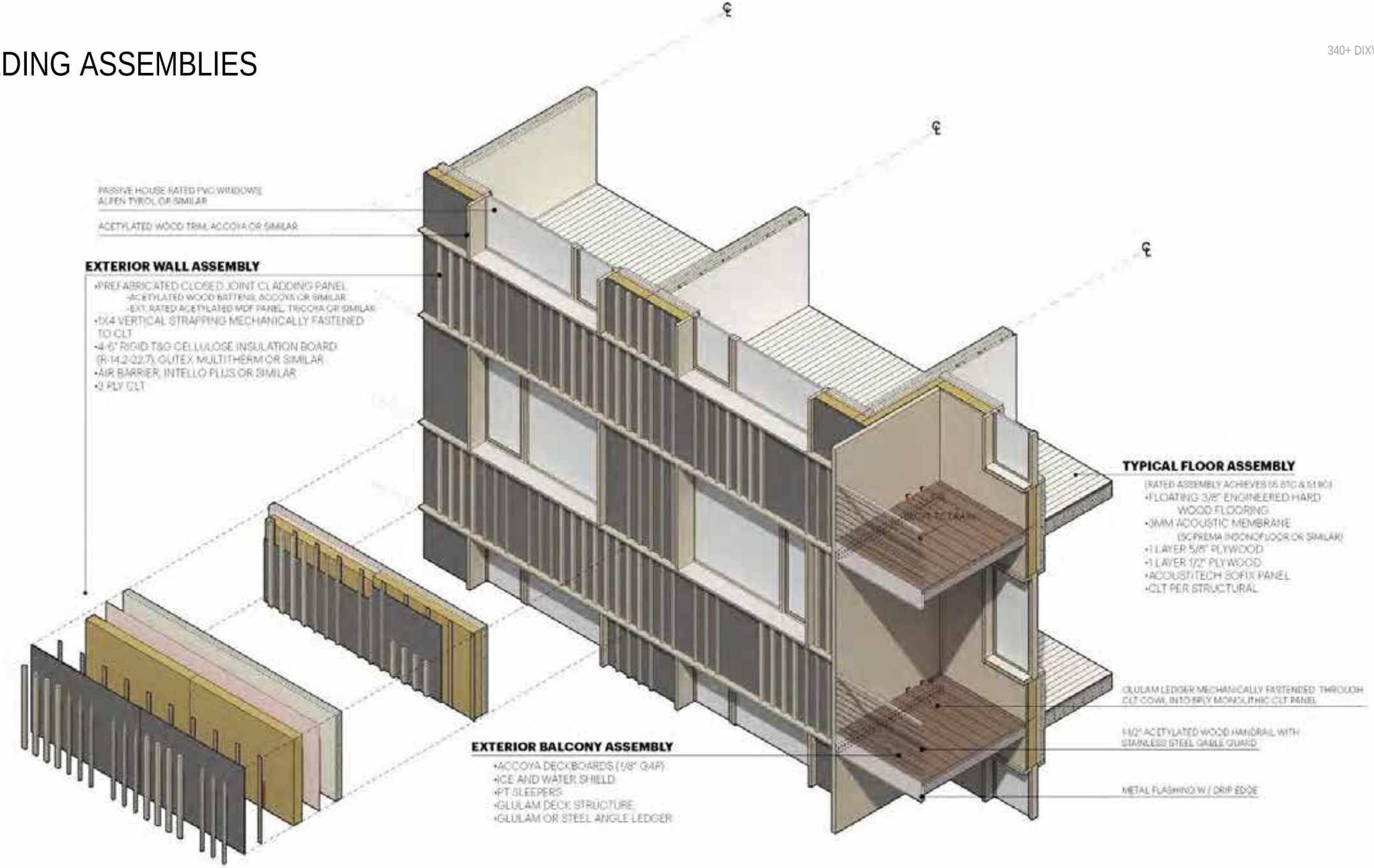
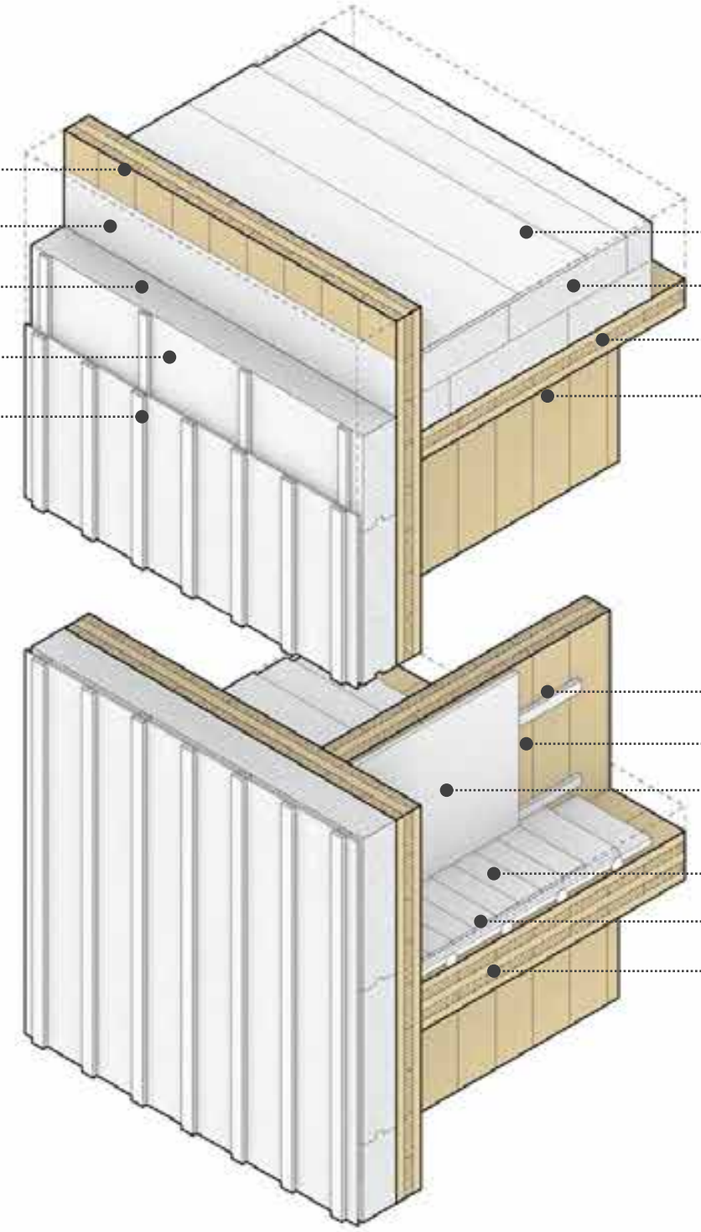
℄ TOILET
7'-6 3/4"
36"x80" 20 MIN. FIRE-RATED ENTRY DOOR W/ CLOSER
CORRIDOR WALLS TO MEET
• 60 MIN. FIRE RATING
• 50 STC

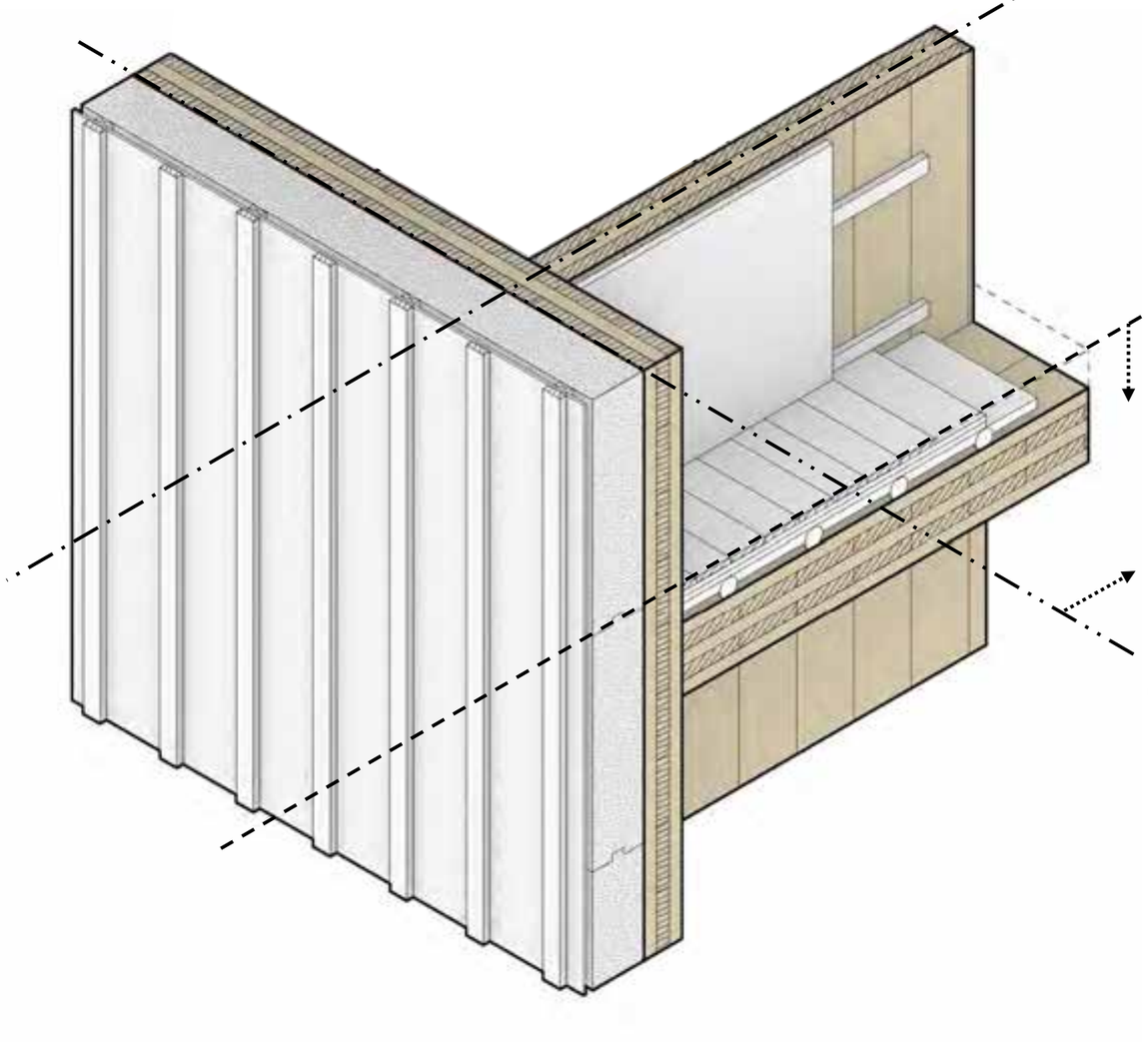
BUILDING ASSEMBLIES



BUILDING ASSEMBLIES



MASS TIMBER TOLERANCE

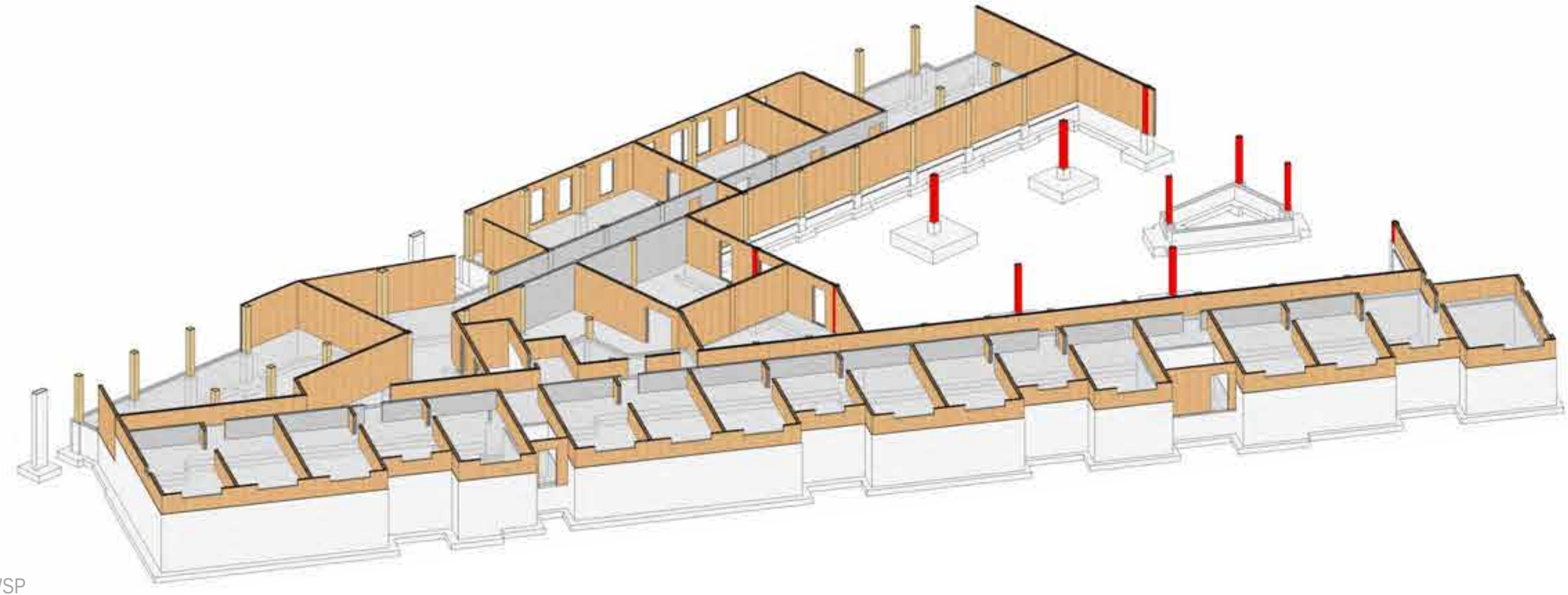


Centerline of CLT Wall
- *Bearing Capacity*
- *Shear / Lateral Capacity*
- *Fire Rating*
- *Acoustic Rating*

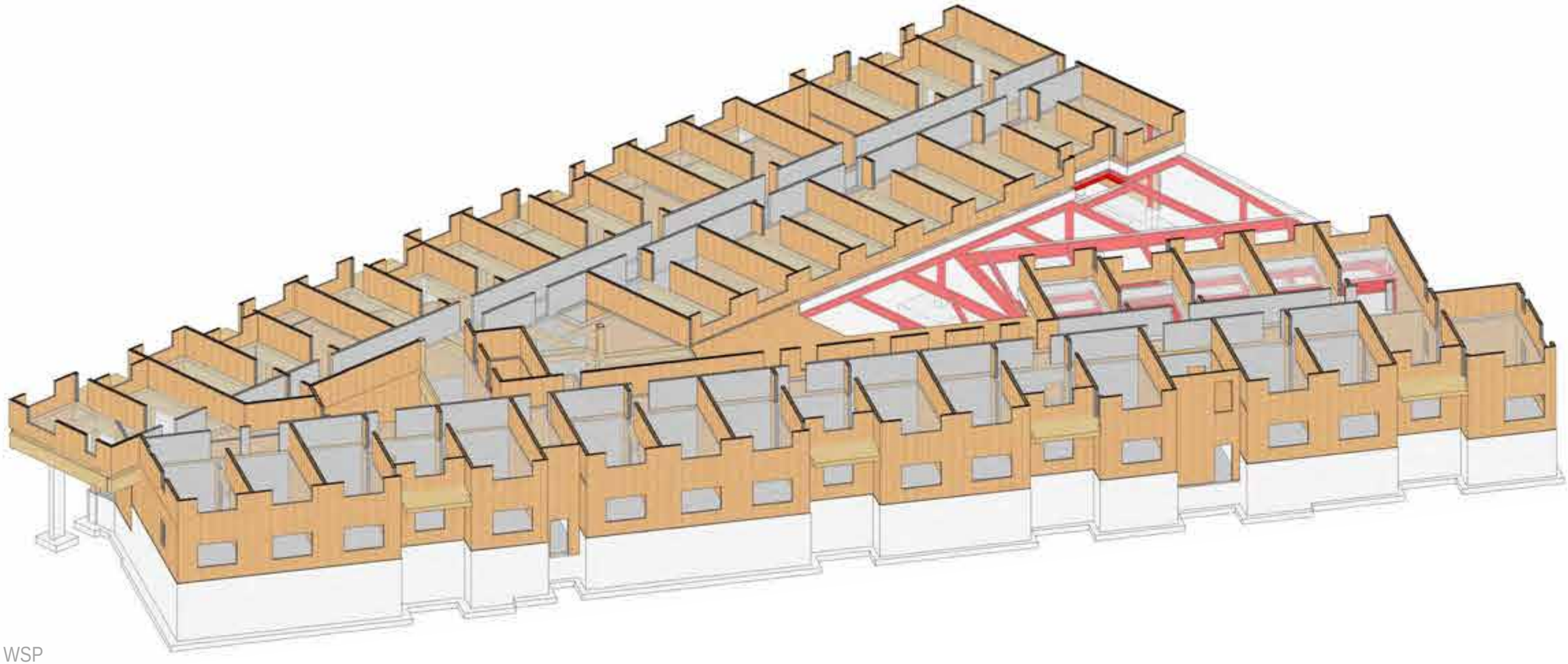
Finished Floor Elevation
- *Span Capacity*
- *Vibration / Deflection*
- *Fire Rating*
- *Acoustic Rating*

Outside face of CLT Wall
- Bearing Capacity
- Shear / Lateral Capacity
- Fire Rating
- Thermal Properties

STRUCTURAL SEQUENCE

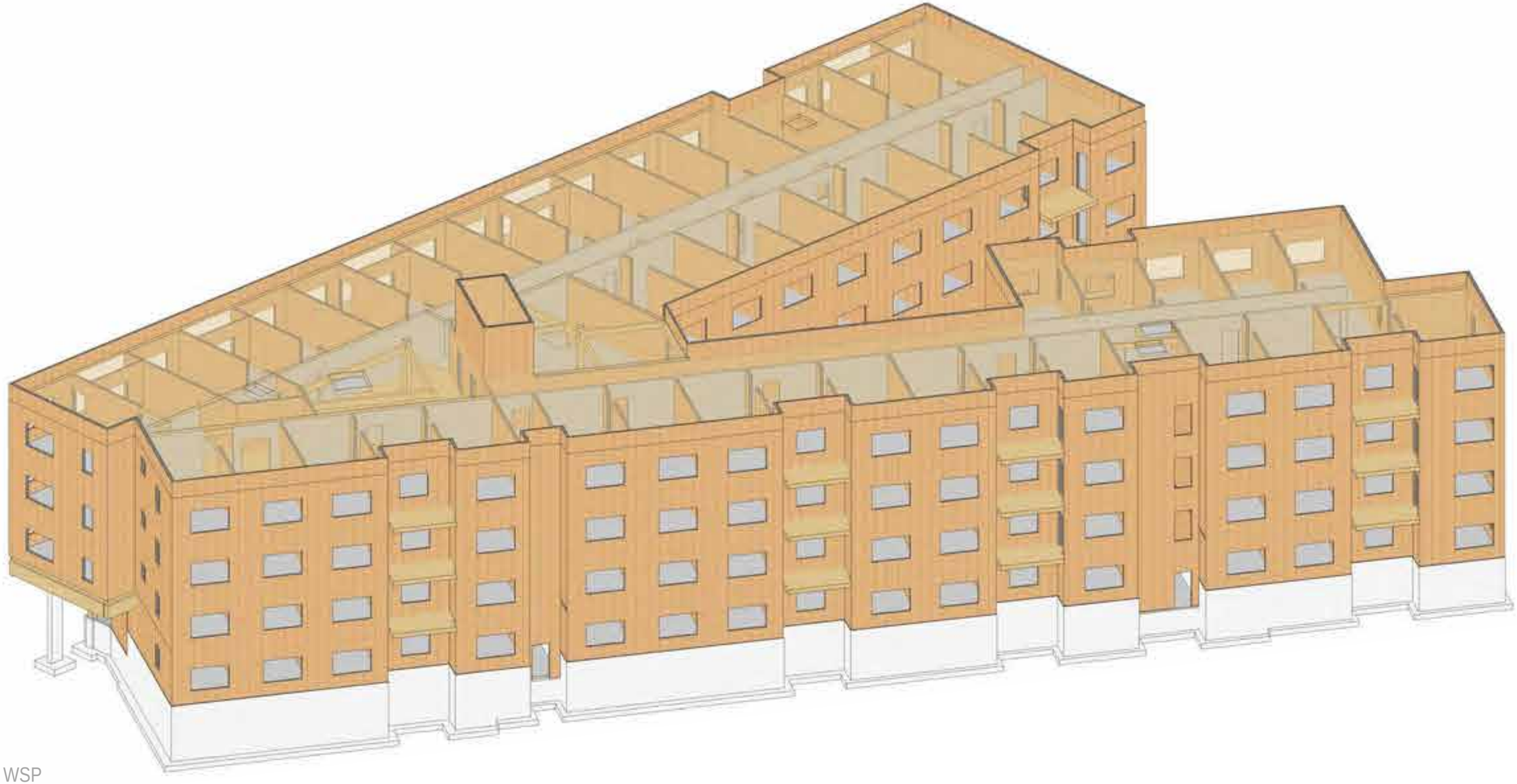


STRUCTURAL SEQUENCE



WSP

STRUCTURAL SEQUENCE



LESSONS LEARNED

STRUCTURAL DESIGN

Organize building geometries around repetitive spans and consistent structural centerlines

Design floor and roof panels for multiple spans to maximize sizing and performance advantages

Test floor panel span orientation for structural and construction efficiency

Study multiple structural morphology pathways, including panelized, post + beam, point supported, and hybrid construction

.


340+ DIXWELL

LESSONS LEARNED

SITE + SEQUENCE

Identify constraints and opportunities afforded by project site and location

Early coordination with mass timber supplier(s), if possible

Design delivery sequence and storage scenarios and identify impacts for on-site laydown space and heavy equipment access

Collaborate with GC/CM to schematize delivery and installation sequence for follow-on systems and trades

UNIT INTERIOR

UNIT INTERIOR

RESIDENTIAL CORRIDOR

MEP DISTRIBUTION

UNIT INTERIORS

LESSONS LEARNED
BUILDING SYSTEMS

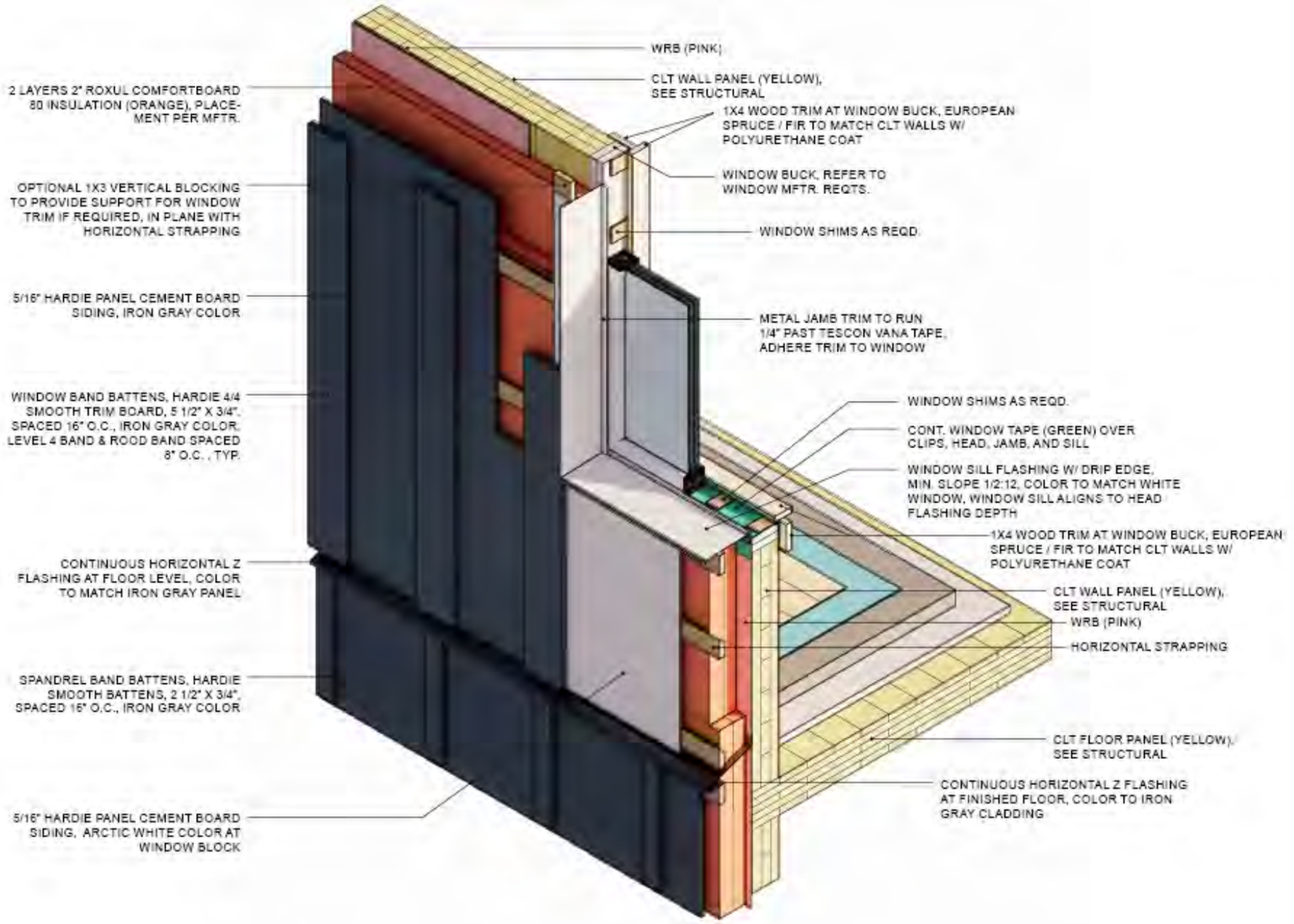
Identify interface between site-installed components and prefabricated mass timber components and introduce tolerances for installation

Develop construction details with an understanding of mass timber installation sequence, identifying opportunities for simplification and prefabrication

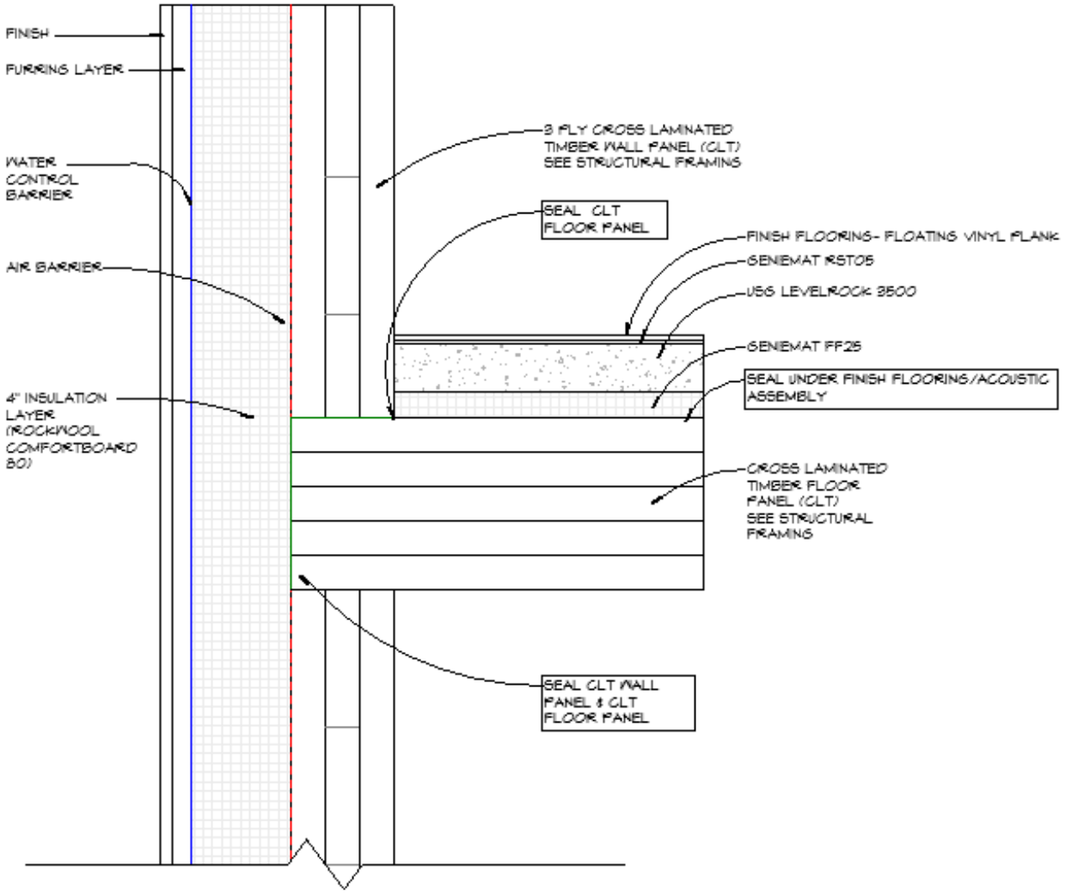
Identify challenges and opportunities for exposed timber surfaces

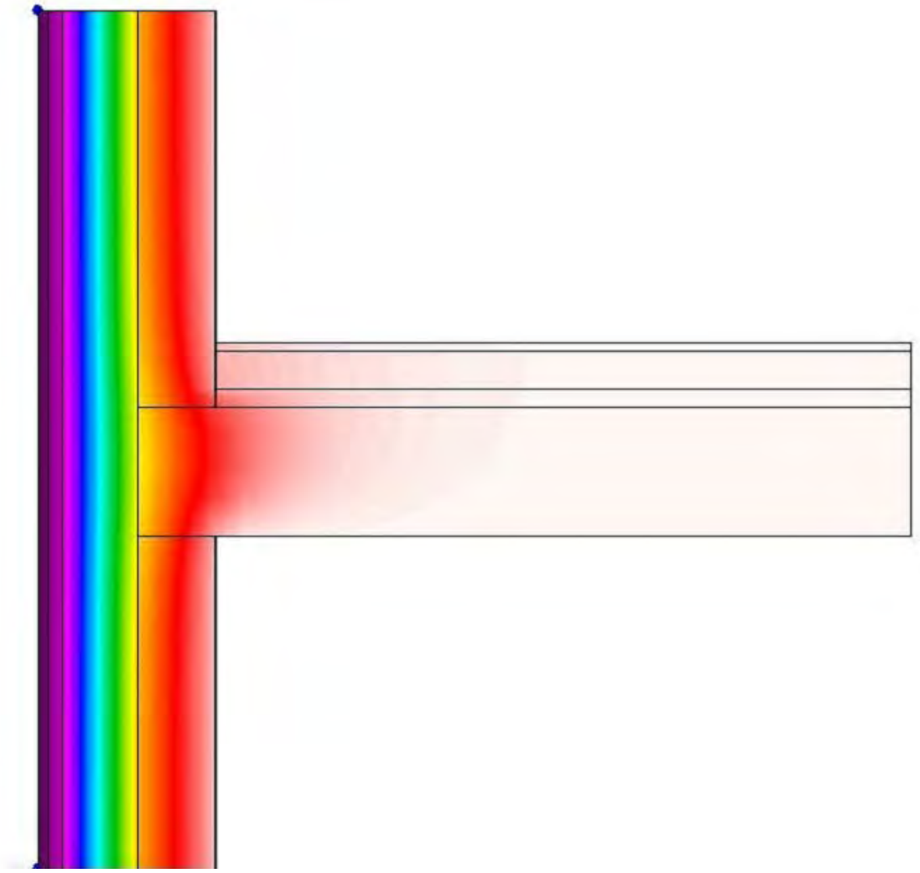
EXTERIOR

EXTERIOR ENVELOPE

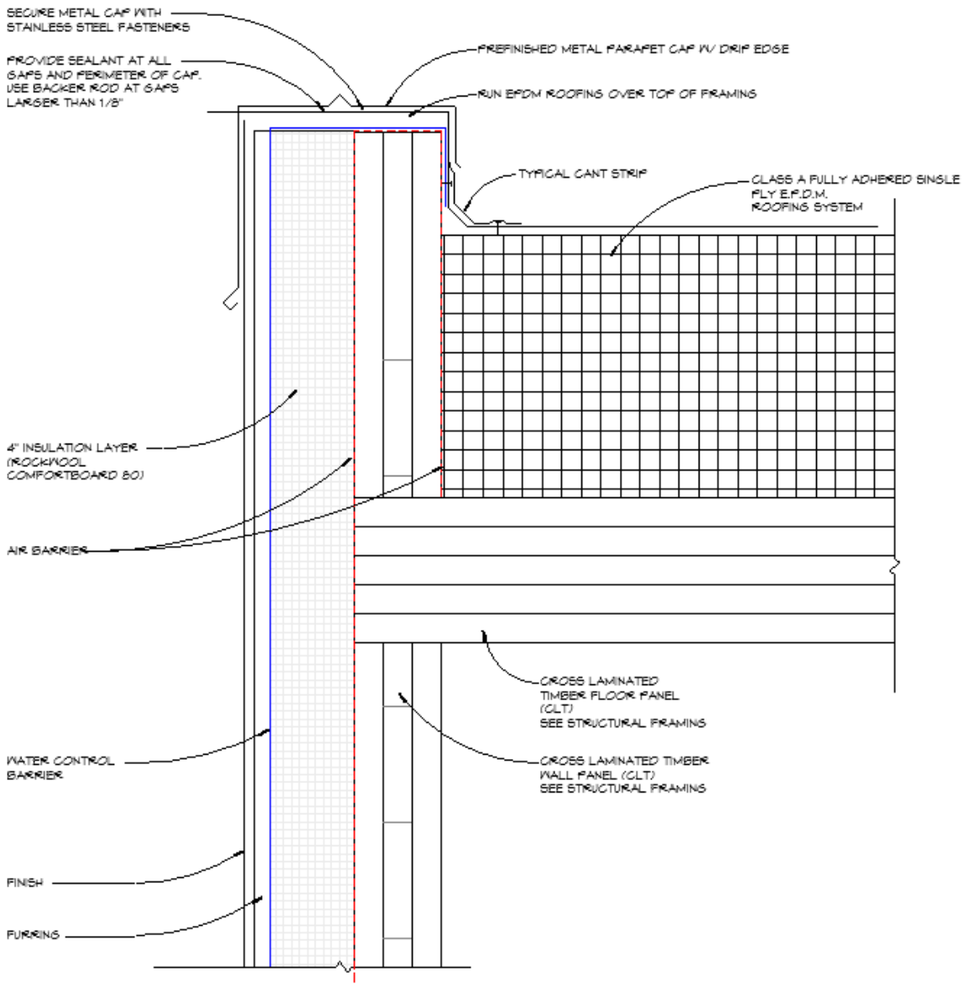


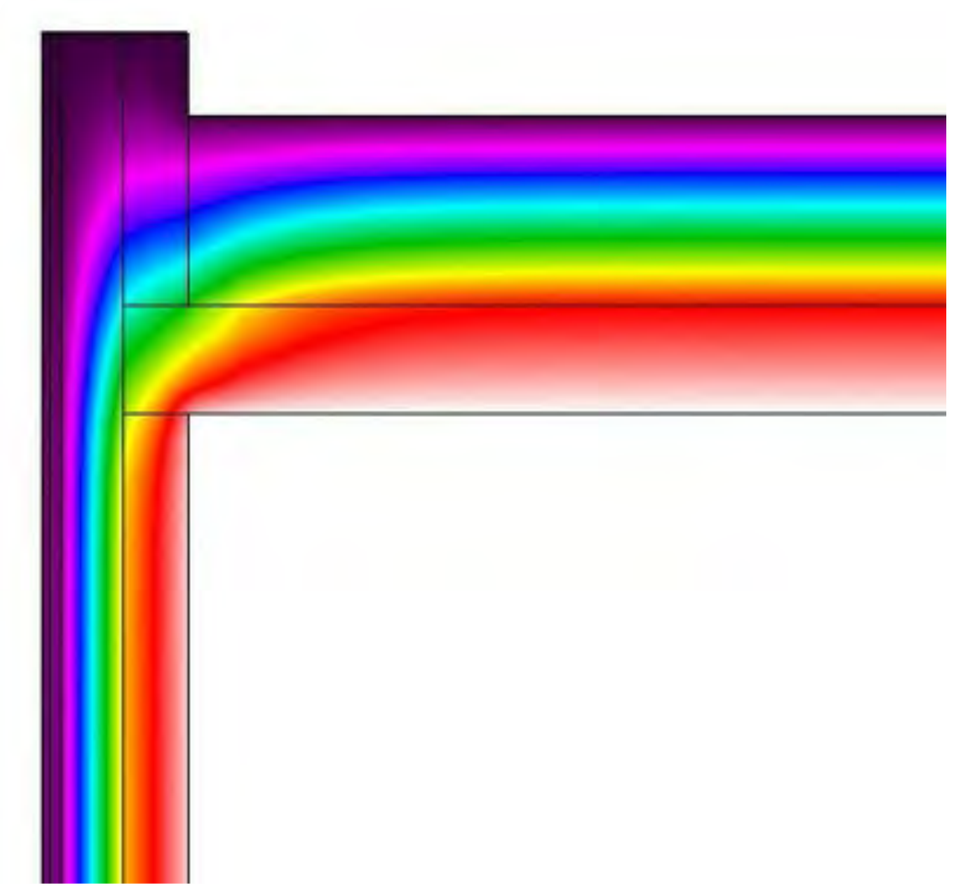
FLOOR ANALYSIS



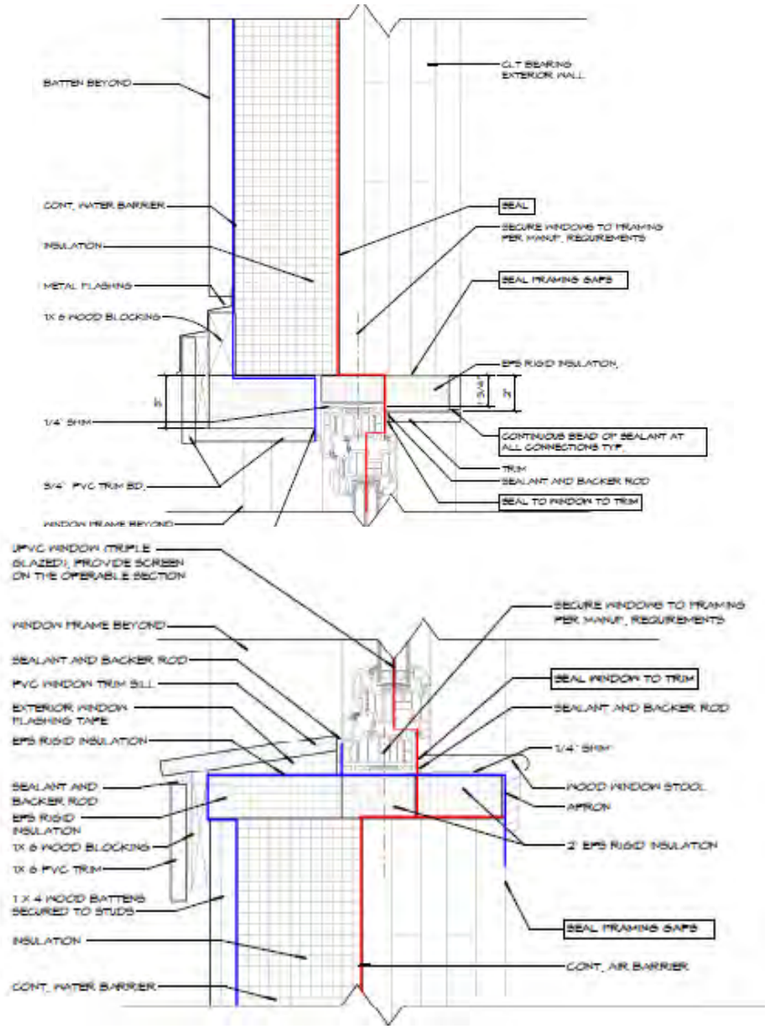


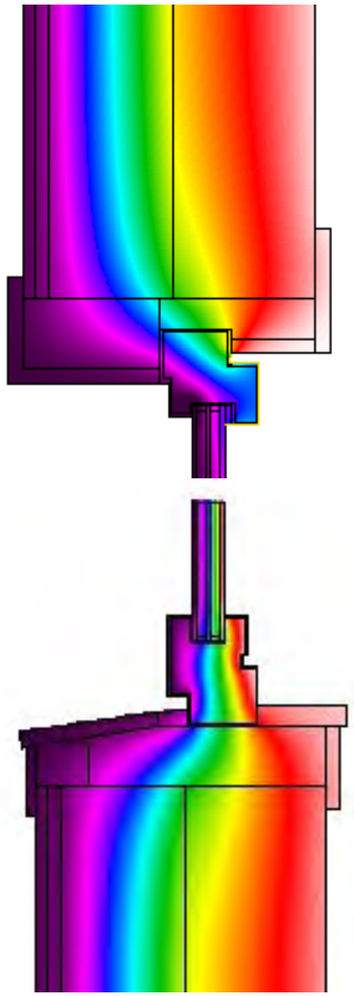
ROOF ANALYSIS





WINDOW ANALYSIS





LESSONS LEARNED

EXTERIOR ENVELOPE

Coordinate panelized wall construction dimensions and logistics with mass timber supplier(s)

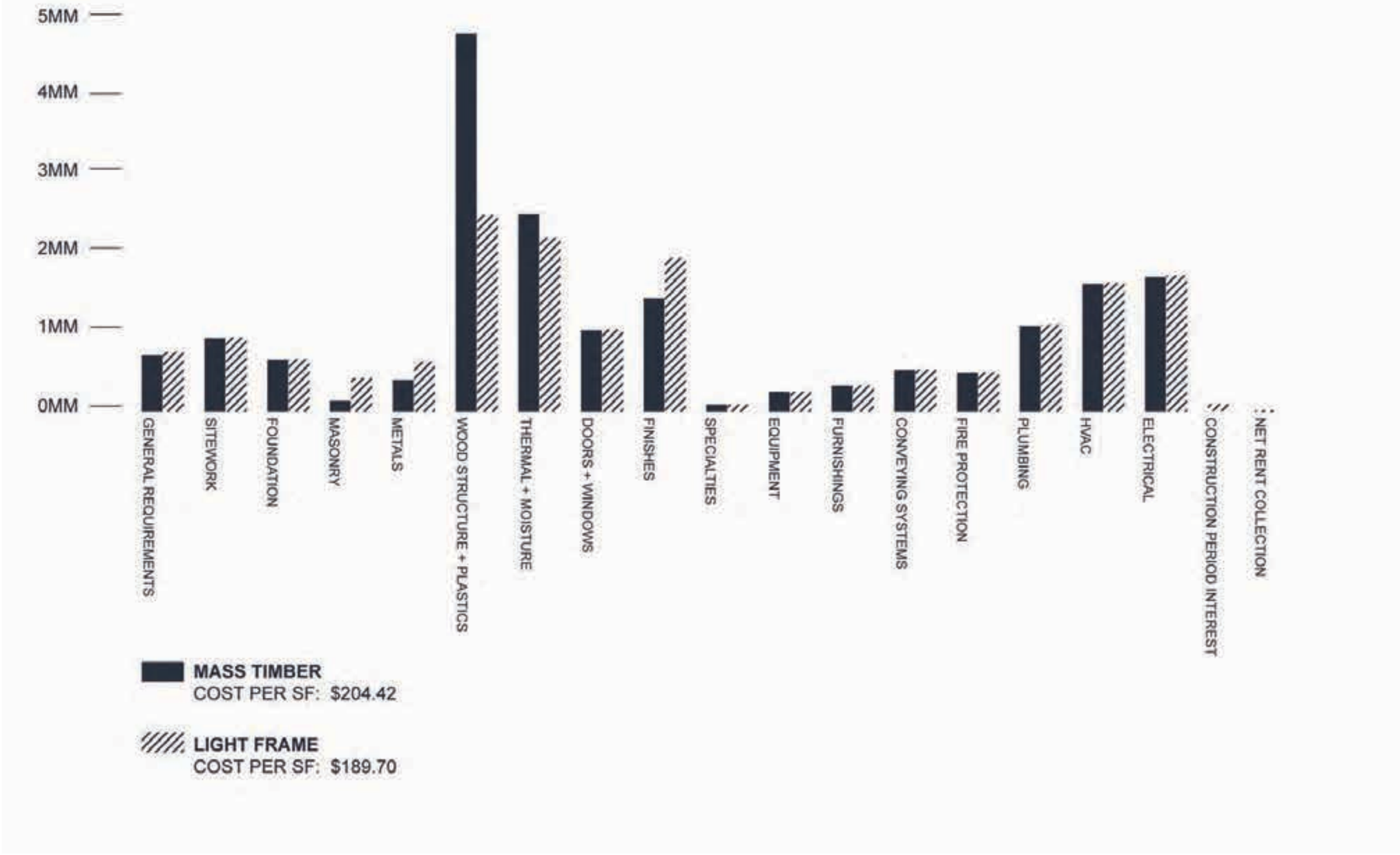
Identify opportunities to minimize panel joints

Develop thermal insulation and weather barrier solution appropriate to local climate, including temporary moisture protection during construction

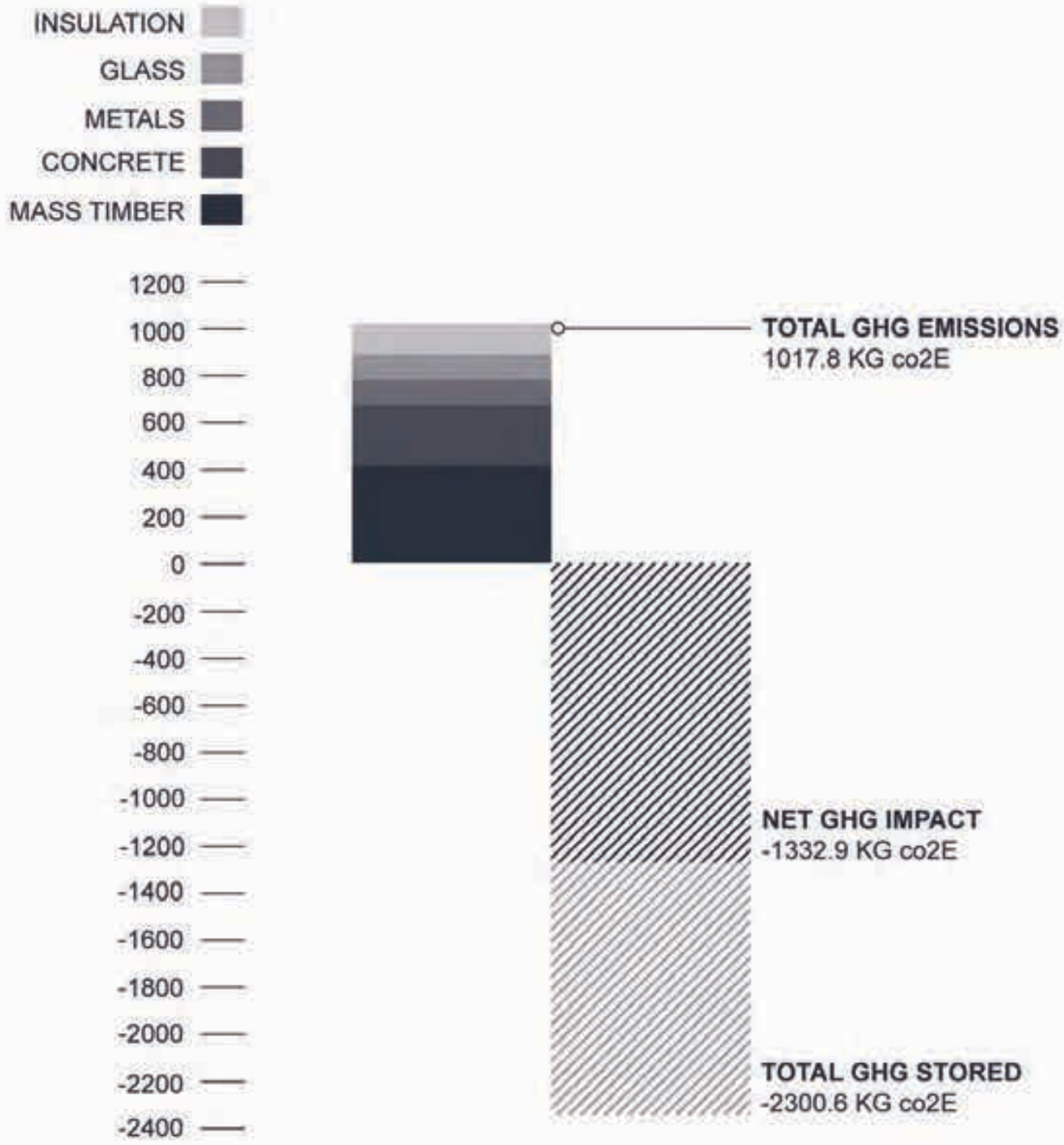
Coordinate MEP routing at building envelope to minimize penetrations

.

COST ANALYSIS



CARBON ANALYSIS



Lifecycle Carbon Assessment was performed in accordance with ISO 14044, ISO 21930, and ISO 21931

- *Lifecycle stages included: A1-A3*
- *Building elements included: Substructure, Superstructure, and Enclosure*
- *Materials included: Timber, Concrete, Metals, Glass, and Insulation*

Based on Project Construction Documents provided by design team:

- *Autodesk Revit® used for determining material quantities*
- *One Click LCA® used for Lifecycle Inventory Analysis*

Preliminary results – Final results to submitted for peer review and publication Q4 2024

This work was performed as part of the SUNY ESF Mass Timber Discovery Challenge

FRAME 122

Client: Frame Home

Lot Size: 100’ x 100’ lot

Zoning: R6B

Size: 20,000 SF above grade (30,000 SF total)

Code: 2022 NYC Building Code

Gas: No (all electric)

CLT Supplier: Element 5

Units: 15 Market Rate Rentals

Construction Type: Type IV (allows for CLT) Exterior

Facades: Non-Combustible Facades

Concrete Use: Cast in place Foundation + Elevator Cores (required to be non-combustible) Floor

Assembly: Acoustitech

Blower Door Tests: All Units

ERV: Per Unit

Exterior Glazing: Schüco 3x Glazed

Sprinkled: Fully

Occupancy: February 2025 (TCO - Novemeber 2024)

Waitlist: 100+

LESSONS LEARNED

CHALLENGES ENCOUNTERED

Permitting. This is new-ish in New York City. Foundation was designed to accommodate multiple structural systems. Demo permits were issued prior to the 2022 NYC Building Code being enacted.

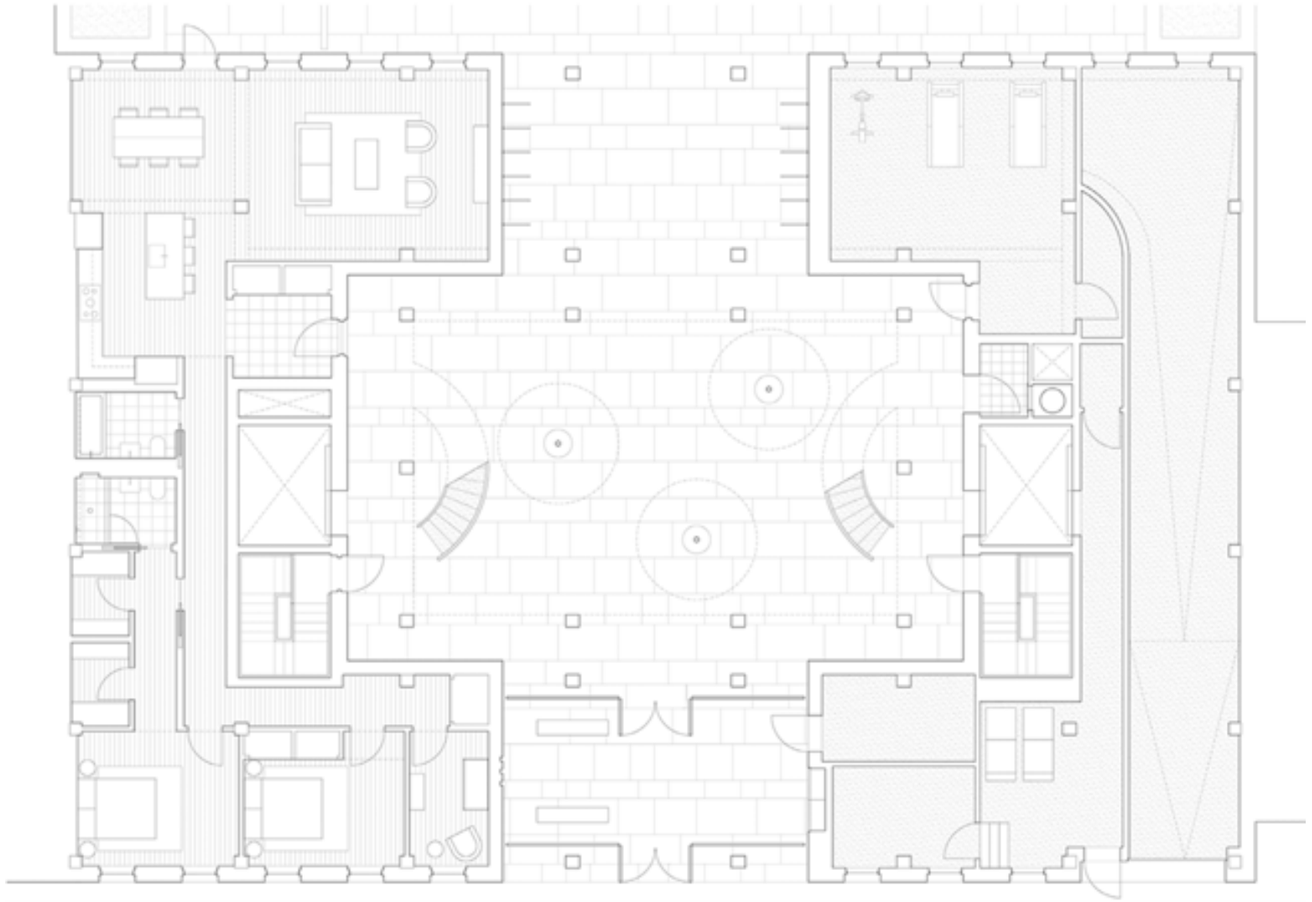
Scale of the Project. ~20,000 SF building seemed to be “small potatoes” for many bidders.

Crane Mobilization and Permitting. Crane permits due to local school were difficult to obtain. Design to allow the project (columns, beams) to be installed without a large crane.

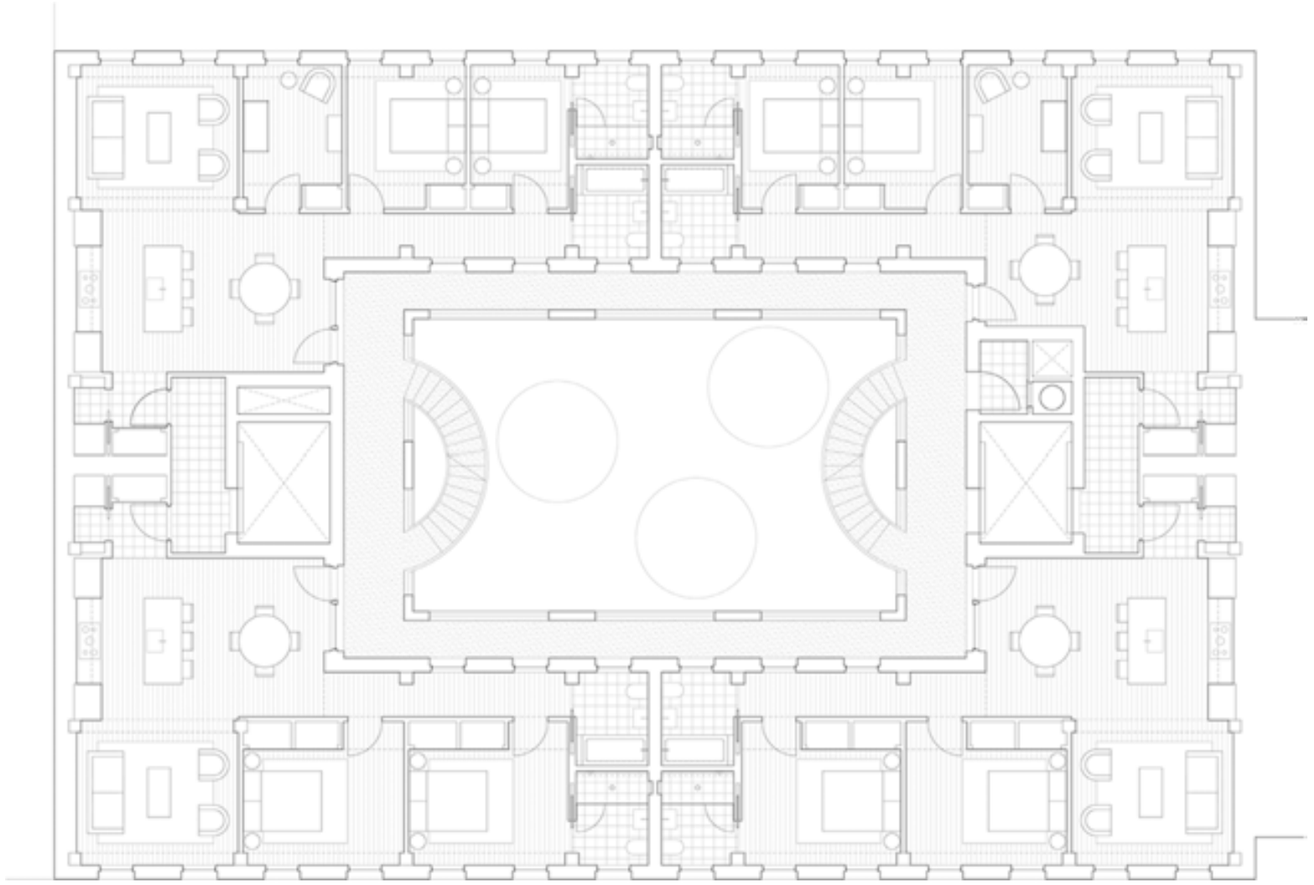
Mass Timber Protection. The structure is the finish. Buyout proper protections.

Cost. Mass timber added 3-4% to the project cost. Make timber essential, part of the brand of the building and why someone would rent there.

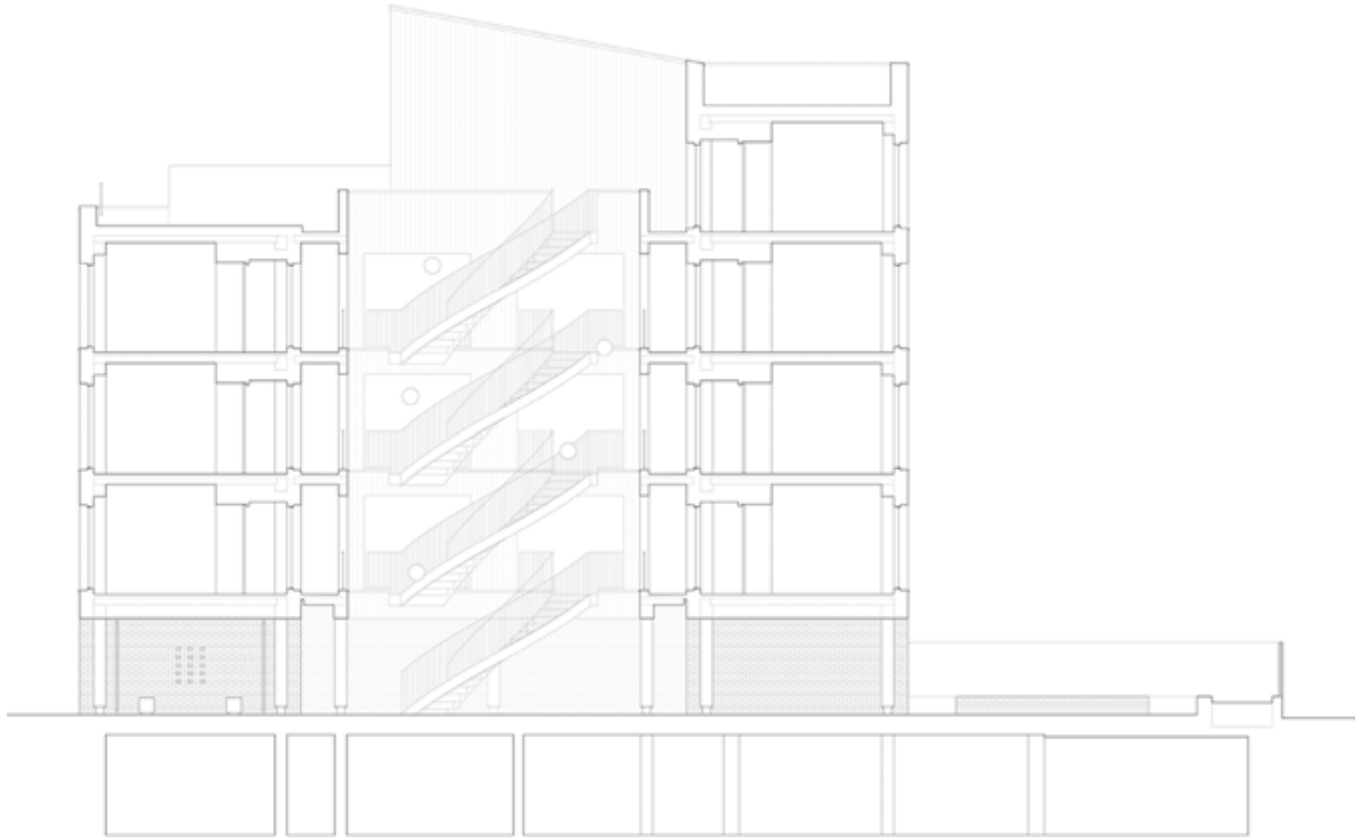
SITE PLAN



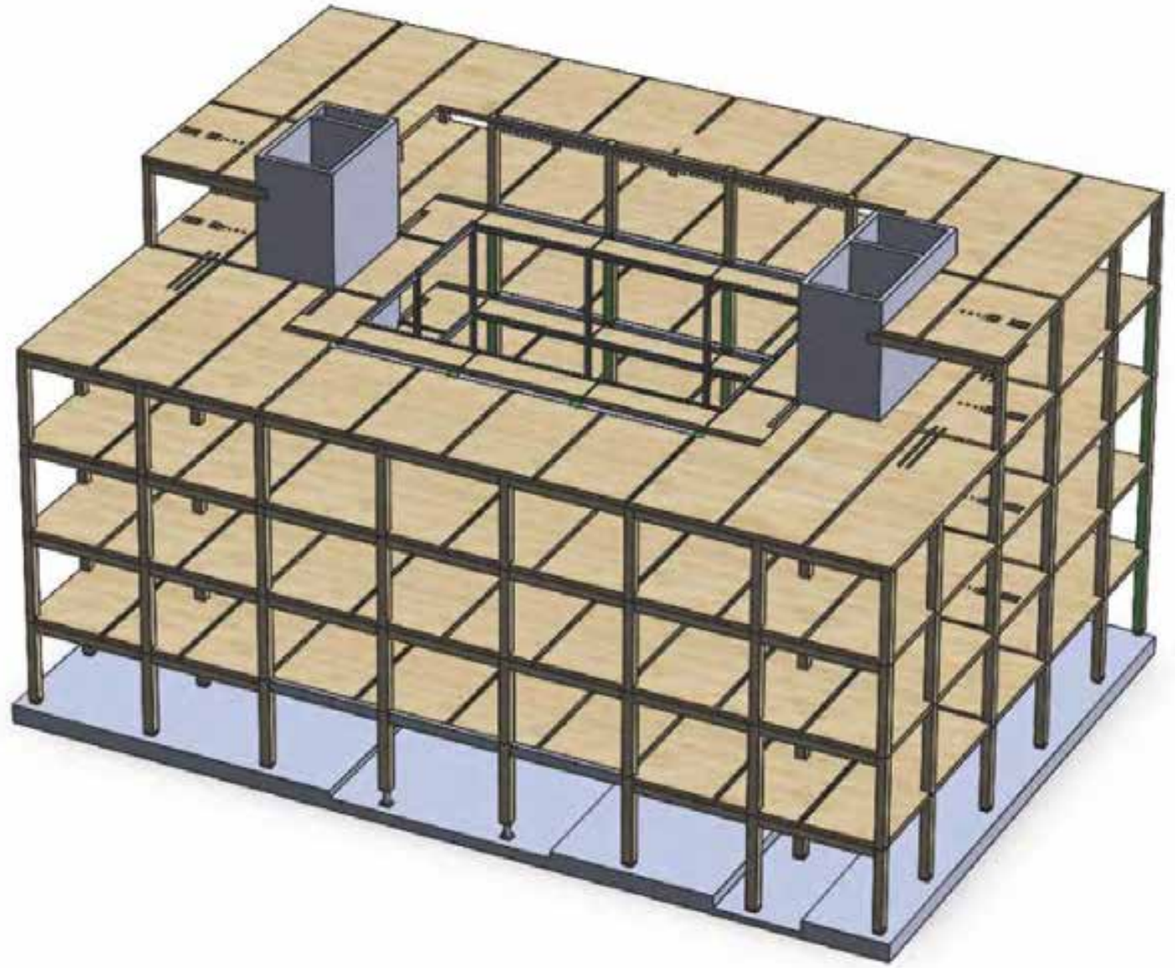
GROUND FLOOR PLAN



TYPICAL FLOOR PLAN



SECTION



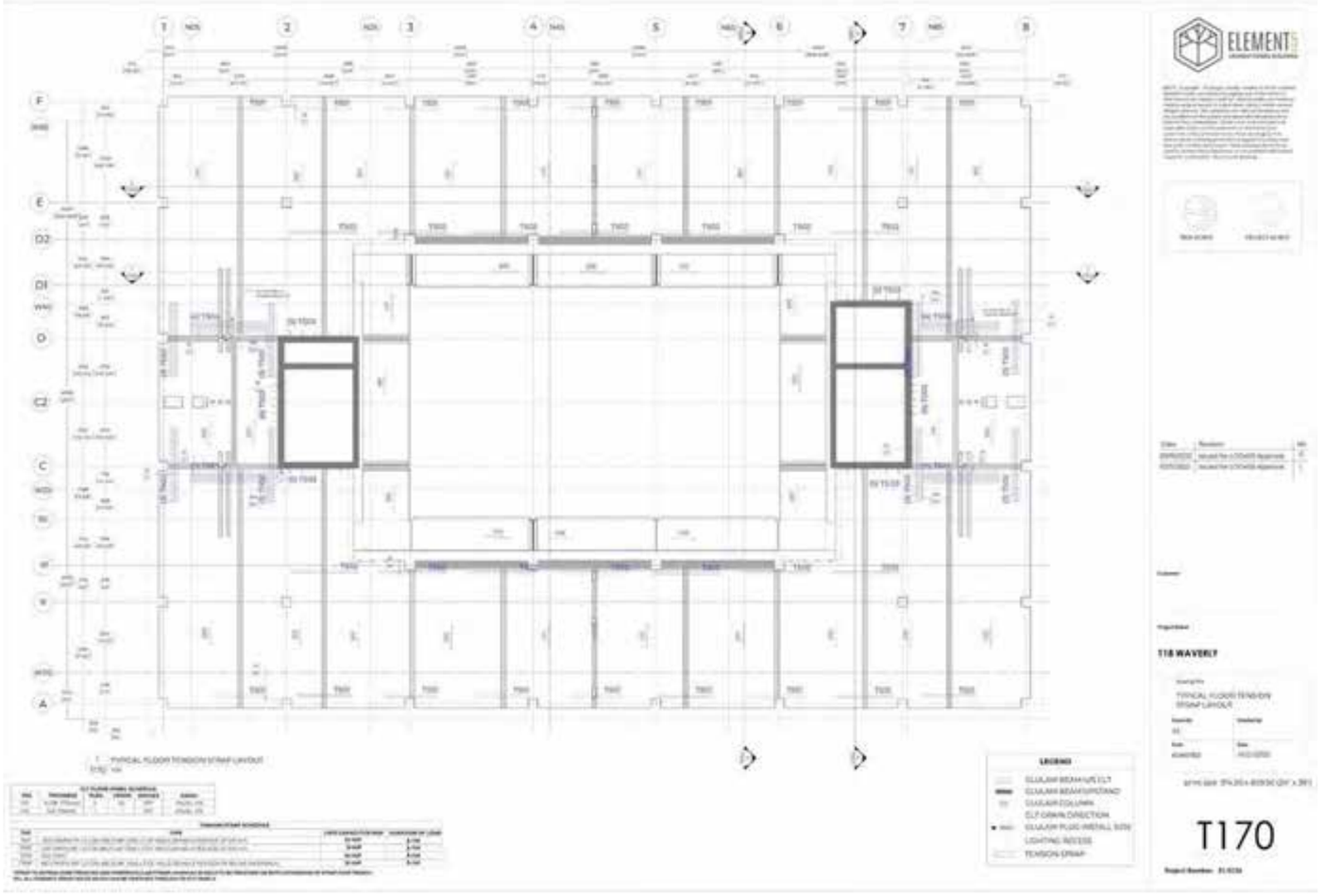
ELEMENT5

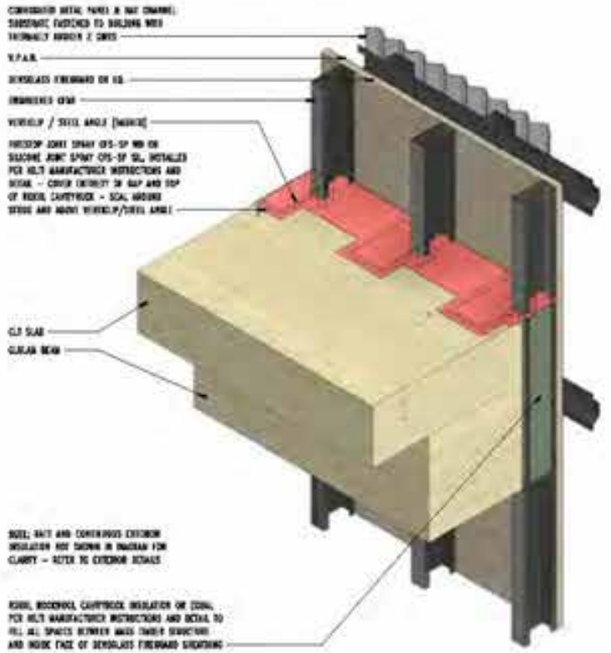
CM & Associates Construction Management LLC

118 Waverly Avenue
122 Waverly Ave. Brooklyn NY 11206

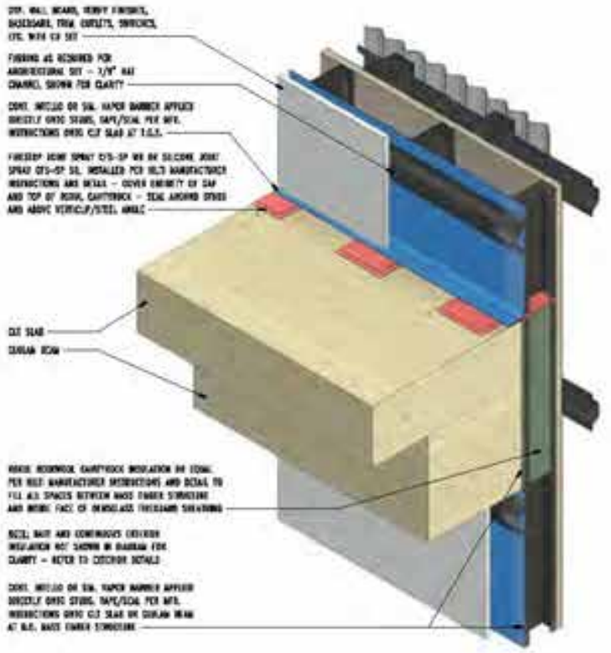
AXONOMETRIC VIEW

T100


ELEMENT5
118 WAVERLY
T170



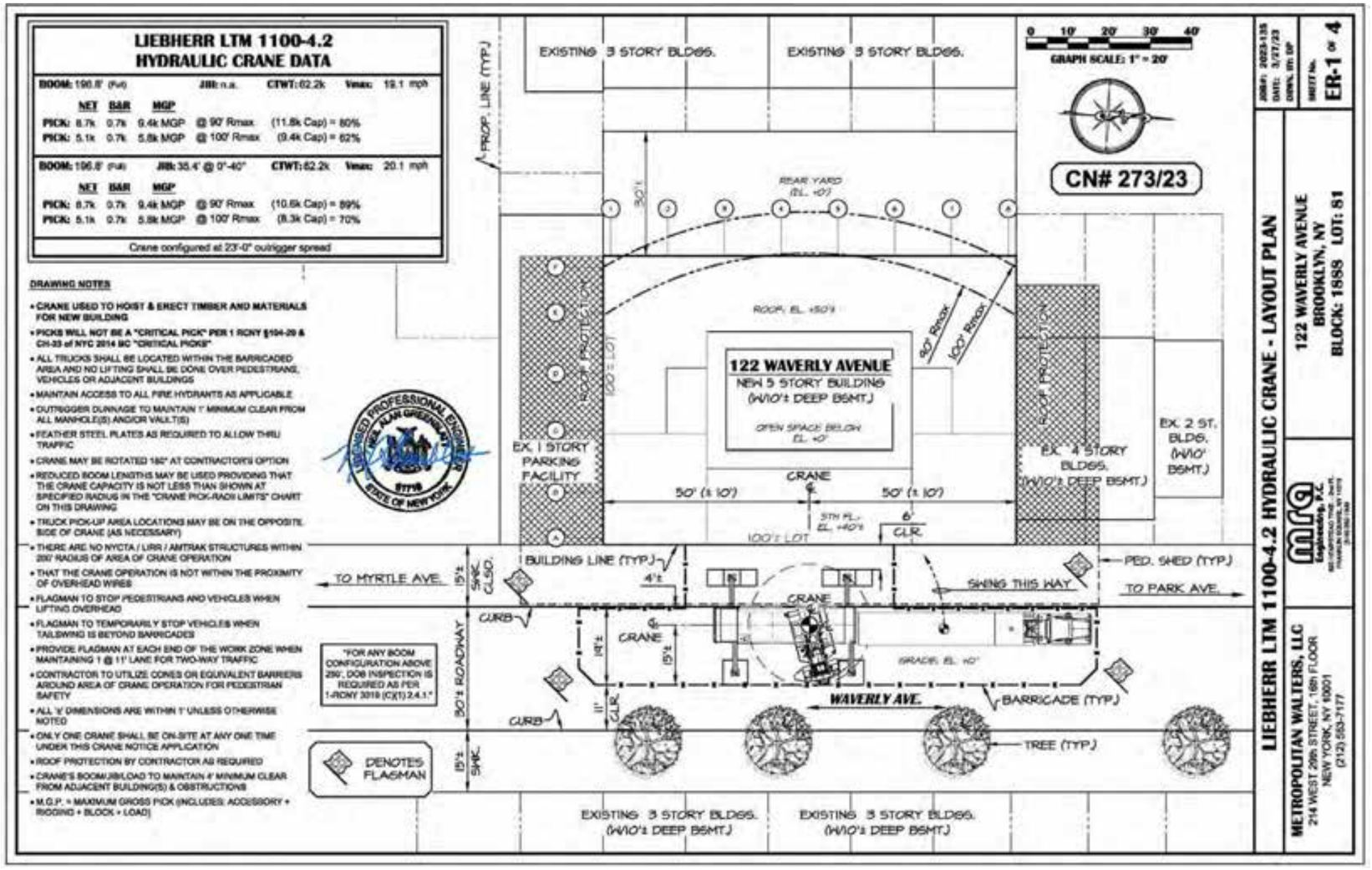
1 AXON - SLAB EDGE FIRESTOPPING DIAGRAM



2 AXON - SLAB EDGE FIRESTOPPING DIAGRAM - SHOWING AIR BARRIER & FINISH LAYER

SK064.00


ELEMENT


LIEBHERR LTM 1100-4.2
HYDRAULIC CRANE DATA
BOOM: 190.8' (Full) JIB: n.a. CTWT: 62.2k Vmax: 19.1 mph
NET B&R MGP
PICK: 8.7k 0.7k 9.4k MGP @ 90' Rmax (11.5k Cap) = 80%
PICK: 5.1k 0.7k 5.8k MGP @ 100' Rmax (9.4k Cap) = 62%
BOOM: 196.8' (Full) JIB: 35.4' @ 0°-40° CTWT: 62.2k Vmax: 20.1 mph
NET B&R MGP
PICK: 8.7k 0.7k 9.4k MGP @ 90' Rmax (10.6k Cap) = 89%
PICK: 5.1k 0.7k 5.8k MGP @ 100' Rmax (8.3k Cap) = 70%
Crane configured at 23'-0" outrigger spread
DRAWING NOTES
• CRANE USED TO HOIST & ERECT TIMBER AND MATERIALS FOR NEW BUILDING
• PICKS WILL NOT BE A "CRITICAL PICK" PER 1 RCNY §104-20 & CH-33 of NYC 2014 BC "CRITICAL PICKS"
• ALL TRUCKS SHALL BE LOCATED WITHIN THE BARRICADED AREA AND NO LIFTING SHALL BE DONE OVER PEDESTRIANS, VEHICLES OR ADJACENT BUILDINGS
• MAINTAIN ACCESS TO ALL FIRE HYDRANTS AS APPLICABLE
• OUTRIGGER DUNNAGE TO MAINTAIN 1' MINIMUM CLEAR FROM ALL MANHOLE(S) AND/OR VAULT(S)
• FEATHER STEEL PLATES AS REQUIRED TO ALLOW THRU TRAFFIC
• CRANE MAY BE ROTATED 180° AT CONTRACTOR'S OPTION
• REDUCED BOOM LENGTHS MAY BE USED PROVIDING THAT THE CRANE CAPACITY IS NOT LESS THAN SHOWN AT SPECIFIED RADIUS IN THE "CRANE PICK-RADII LIMITS" CHART ON THIS DRAWING
• TRUCK PICK-UP AREA LOCATIONS MAY BE ON THE OPPOSITE SIDE OF CRANE (AS NECESSARY)
• THERE ARE NO NYCTA / LIRR / AMTRAK STRUCTURES WITHIN 200' RADIUS OF AREA OF CRANE OPERATION
• THAT THE CRANE OPERATION IS NOT WITHIN THE PROXIMITY OF OVERHEAD WIRES
• FLAGMAN TO STOP PEDESTRIANS AND VEHICLES WHEN LIFTING OVERHEAD
• FLAGMAN TO TEMPORARILY STOP VEHICLES WHEN TAILSWING IS BEYOND BARRICADES
• PROVIDE FLAGMAN AT EACH END OF THE WORK ZONE WHEN MAINTAINING 1 @ 11' LANE FOR TWO-WAY TRAFFIC
• CONTRACTOR TO UTILIZE CONES OR EQUIVALENT BARRIERS AROUND AREA OF CRANE OPERATION FOR PEDESTRIAN SAFETY
• ALL 'x' DIMENSIONS ARE WITHIN 1' UNLESS OTHERWISE NOTED
• ONLY ONE CRANE SHALL BE ON-SITE AT ANY ONE TIME UNDER THIS CRANE NOTICE APPLICATION
• ROOF PROTECTION BY CONTRACTOR AS REQUIRED
• CRANE'S BOOM/JIB/LOAD TO MAINTAIN 4' MINIMUM CLEAR FROM ADJACENT BUILDING(S) & OBSTRUCTIONS
• M.G.P. = MAXIMUM GROSS PICK (INCLUDES: ACCESSORY + RIGGING + BLOCK + LOAD)
LICENSED PROFESSIONAL ENGINEER ALAN GREENBERG 077118 STATE OF NEW YORK
"FOR ANY BOOM CONFIGURATION ABOVE 250', DOB INSPECTION IS REQUIRED AS PER 1-RCNY 3018 (C)(1) 2.4.1."
DENOTES FLAGMAN
EXISTING 3 STORY BLDGS.
EXISTING 3 STORY BLDGS.
PROP. LINE (TYP.)
REAR YARD (EL. +0')
ROOF, EL. +50'±
122 WAVERLY AVENUE
NEW 5 STORY BUILDING (W/O 1 DEEP BSMT.)
OPEN SPACE BELOW EL. +0'
90' RMAX
100' RMAX
ROOF PROTECTION
EX. 1 STORY PARKING FACILITY
EX. 4 STORY BLDGS. (W/O 1 DEEP BSMT.)
EX. 2 ST. BLDG. (W/O BSMT.)
CRANE
50' (± 10')
50' (± 10')
6' CLR.
100'± LOT
BUILDING LINE (TYP.)
4'±
TO MYRTLE AVE.
TO PARK AVE.
PED. SHED (TYP.)
SWING THIS WAY
CURB
CRANE
14'±
15'±
GRADE, EL. +0'
WAVERLY AVE.
BARRICADE (TYP.)
11' CLR.
TREE (TYP.)
15'± SHLD. CLSD.
30'± ROADWAY
15'± SHLD.
EXISTING 3 STORY BLDGS. (W/O 1 DEEP BSMT.)
EXISTING 3 STORY BLDGS. (W/O 1 DEEP BSMT.)
0 10' 20' 30' 40'
GRAPH SCALE: 1" = 20'
CN# 273/23
LIEBHERR LTM 1100-4.2 HYDRAULIC CRANE - LAYOUT PLAN
122 WAVERLY AVENUE
BROOKLYN, NY
BLOCK: 1988 LOT: 51
JOB#: 2023-135
DATE: 3/27/23
DWN'L BY: DP
SHEET No.
ER-1 OF 4
METROPOLITAN WALTERS, LLC
214 WEST 29th STREET, 16th FLOOR
NEW YORK, NY 10001
(212) 563-7177
mfp Engineering, P.C.

LESSONS LEARNED

STRUCTURAL DESIGN

Rigor. Having repetitive measurements and structural elements allowed quicker reviews and increased coordination.

Number of Panels. Design floor and roof panels for to minimize CNC work and number of panels. Panel joints are not significantly visible.

Coordination. Thought beforehand allowed all MEP penetrations to be CNC'd in the factory. There were no conflicts on site. Coordination allowed the Mass Timber to be free of exposed services.

Tolerances. Concrete Cores. Mass timber tolerance far exceed the Cast-In-Place concrete tolerances. Allow for significant tolerance around site cast elements (cores)

New York Adjacent Manufacturing. Panels left the factory the night before installation. Damaged panel could be replaced the next day.


CMA
CM & Associates
Construction Management LLC
Skyline
Scaffolding
(718) 517.0481


FRAME122

LESSONS LEARNED

MEASURES TO PROTECT MASS TIMBER

Moisture Mitigation Plan. Hands on deck(s). It will rain. Staining caused by intumescent tape (to protect steel brackets) is hard to remove. Most water stains was relatively easy to remove.

Adhero Visto. Tape up column to floor panel connections.

Rigid Protection. Buyout protections for any exposed columns in high traffic areas.

Panel Sanding. Consider buying panel sanding at the finishing stages. (Painter)

CLT is Resilient. It can get wet within reason, it can be refinished onsite, within reason.

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Architectural Record
03 2025
$11.99
Spanning the Housing Spectrum
From Senior and Supportive to Single-Family

Thank you!
Questions?

Brent Buck Architects

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fkb@475.supply

GOA

Andrew Ruff
andrew@goaarchitecture.com