COLLECTIVE
CARPENTRY

Building System Design Guide
2025

Prefab construction.
Passive House standards.

Rane Wardwell & Jan Pratschke, Founders

BUILDING TECHNOLOGY EVOLVING

Thanks to advances in building science, computer-aided design, and manufacturing control, Collective Carpentry is pioneering a building technique that makes energy efficient, sustainable, healthy buildings attainable for a broad market.

WHO WE ARE

We are stewards of the natural world, determined to leave the planet a little better than we found it. Starting as a high-performance general contractor in 2006, we transitioned to off-site construction in 2014. Collective Carpentry now builds homes throughout the US and Canada from our British Columbia headquarters.

Our process cuts construction-related carbon emissions by prioritizing Passive House standards, using low embodied-carbon materials, understanding the latest building science, and reducing waste. We adopted these practices early and we've built an ambitious team that continues to grow.

DESIGN GUIDE

This guide is a resource for architects and engineers. Use it to:

- Optimize any residential design for high-performance and prefabricated panelization
- Integrate a prefabricated building enclosure with other building enclosure elements
- Inform design and engineering decisions to maximize performance and minimize construction time

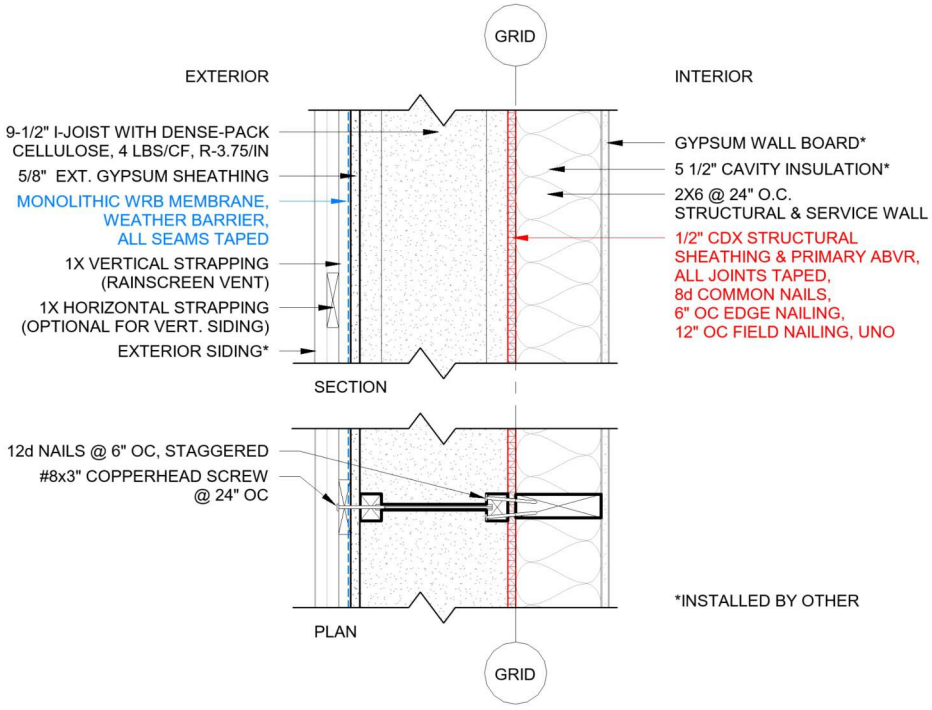
Since 2014, Collective Carpentry has refined the design and assembly of high-performance panelized systems. We hope that our experience, distilled in the guide, will help make your design a reality.

PLANNING Wall Panel Assembly Types

All of our panel assembly types use the best available materials in modern building science for superior weather protection, airtightness, vapor control, and fire resistance. Our wall panels have an interior 2x framed layer that is installed uninsulated to easily make structural connections and run services without jeopardizing the air barrier. The airtight layer is inboard of the primary insulation layer which is suitable for cold/mixed climates.

Passive House Wall (R55)

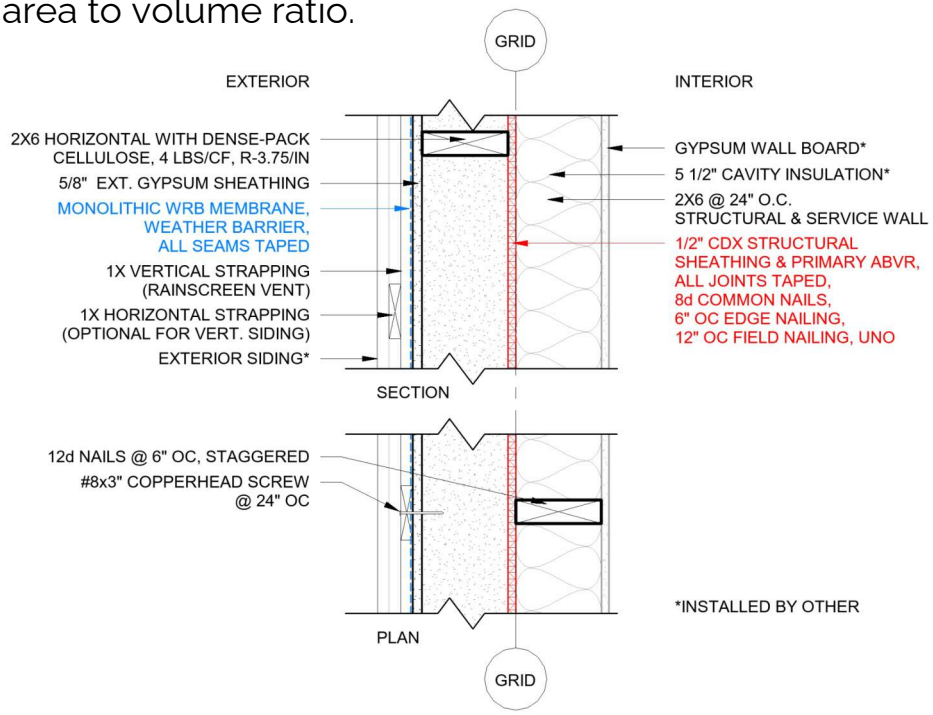
The Passive House wall uses a non-structural I-joist for the dense-pack cellulose cavity. The structural layer includes the 2x6 framing and the ½" plywood sheathing. This is our recommended wall type for most high-performance projects.



Passive House Wall (R55)					
Material	**Purpose**	**Thickness (in.)**	**Nominal R-Value**	**Installed by CC in shop**	**Installed by GC on site**
2x6 D. Fir #1	Structural Framing & Services Layer	5 1/2		☑	☐
Cavity Insulation	Cavity Insulation	5 1/2	20	☐	☑
1/2" CDX Exp. 1 Spruce Plywood	Structural Sheathing & Air Barrier	1/2		☑	☐
9-1/2" I-joists	Exo Framing	9 1/2		☑	☐
Dense-Pack Blown Cellulose Insulation (R-3.7/in)	Exo Insulation	9 1/2	35	☑	☐
Exterior Gypsum Sheathing	Exterior Sheathing, Fire Resistance	5/8		☑	☐
Exterior Reinforced, Waterproof, Vapor Permeable WRB Membrane	Weather Resistive Barrier			☑	☐
(2) 1x4 Vertical Strapping #3 Spruce	Rainscreen Strapping	1 1/2		☑	☐
Total Assembly Thickness		**17 5/8**			
Total Assembly Nominal R-Value			**55**		

High Performance Wall (R40)

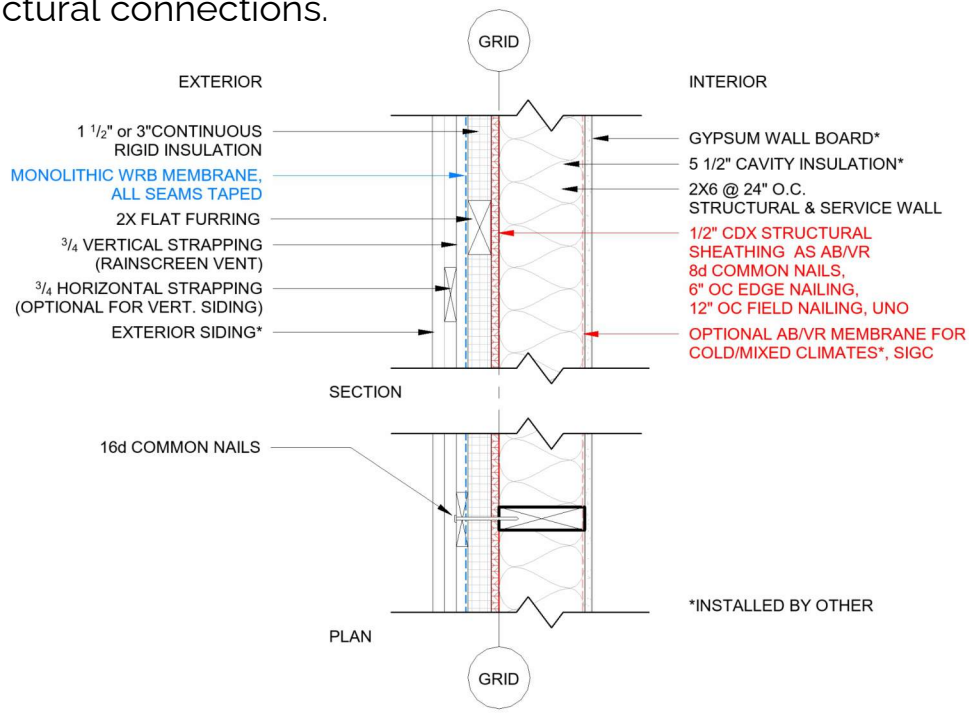
The High Performance wall has an interior 2x6 that is the structural layer. A horizontal 2x6 layer is the dense-pack cellulose cavity. This wall type lends itself to projects in milder climates, or large multifamily and institutional buildings with a low surface area to volume ratio.



High Performance Wall (R40)					
Material	**Purpose**	**Thickness (in.)**	**Nominal R-Value**	**Installed by CC in shop**	**Installed by GC on site**
2x6 D. Fir #1	Structural Framing & Services Layer	5 1/2		☑	☐
Cavity Insulation	Cavity Insulation	5 1/2	20	☐	☑
1/2" CDX Exp. 1 Spruce Plywood	Structural Sheathing & Air Barrier	1/2		☑	☐
2x6 #2 or better SPF (Horizontal)	Exo Framing	5 1/2		☑	☐
Dense-Pack Blown Cellulose Insulation (R-3.7/in)	Exo Insulation	5 1/2	20	☑	☐
Exterior Gypsum Sheathing	Exterior Sheathing, Fire Resistance	5/8		☑	☐
Exterior Reinforced, Waterproof, Vapor Permeable WRB Membrane	Weather Resistive Barrier			☑	☐
(2) 1x4 Vertical Strapping #3 Spruce	Rainscreen Strapping	1 1/2		☑	☐
Total Assembly Thickness		**13 5/8**			
Total Assembly Nominal R-Value			**40**		

Net Zero Wall (R25 or R30)

The Net Zero Wall is suitable for large buildings and/or tight setback constraints. The exterior continuous insulation thickness is variable to suit the appropriate climate zone. The structural wall cavity is left uninsulated for running services and making structural connections.



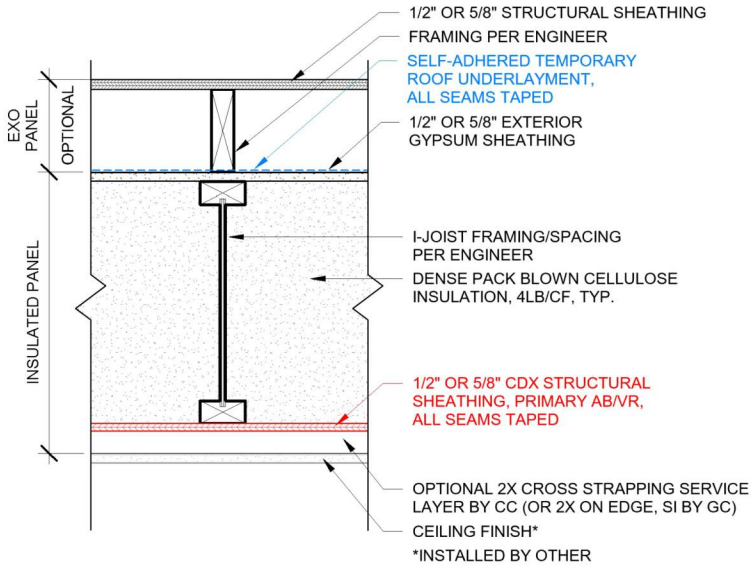
Net Zero Wall (R25 or R30)					
Material	**Purpose**	**Thickness (in.)**	**Nominal R-Value**	**Installed by CC in shop**	**Installed by GC on site**
2x6 D. Fir #1	Structural Framing	5 1/2		☑	☐
Cavity Insulation	Cavity Insulation	5 1/2	20	☐	☑
1/2" CDX Exp. 1 Spruce Plywood	Structural Sheathing	1/2		☑	☐
Rigid Insulation (Mineral Wool, Hemp, or Wood Fiber)	Continuous Exterior Insulation	1 1/2 - 3	5 - 10	☑	☐
Exterior Reinforced, Waterproof, Vapor Permeable WRB Membrane	Weather Resistive Barrier			☑	☐
(2) 1x4 Vertical Strapping #3 Spruce	Rainscreen Strapping	1 1/2		☑	☐
Total Assembly Thickness		**9 - 10 1/2**			
Total Assembly Nominal R-Value			**25 - 30**		

PLANNING Roof Panel Assembly Types

All of our panel assembly types use the best available materials in modern building science for superior weather protection, airtightness, vapor control, and fire resistance. Our roof panels have an interior flat 2x furring layer to easily run services without jeopardizing the air barrier. The airtight layer is inboard of the primary insulation layer which is suitable for cold/mixed climates.

Insulated Pitched Roof (2:12 Min.)

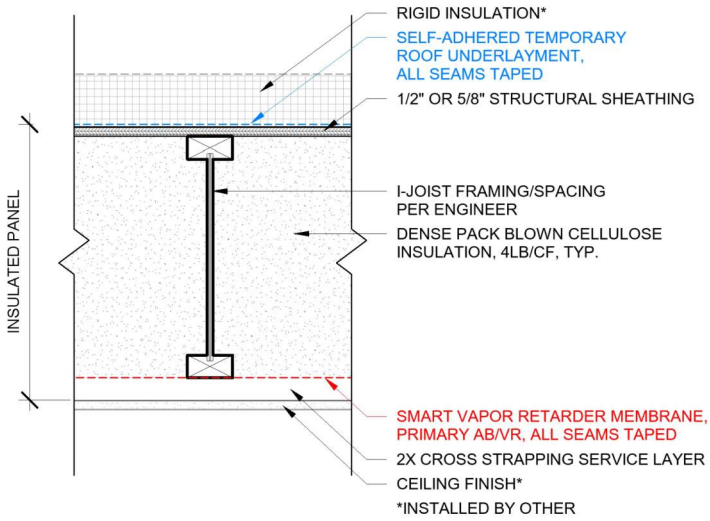
An 'Exo Panel' or 'Overframe Panel' is an optional addition to the insulated roof panel to provide roof venting and create overhang projections. This roof option has the structural sheathing to the interior. The structural sheathing also serves as the air barrier. Exterior gypsum sheathing is used for fire resistance and allows for outward drying.



Insulated Pitched Roof (2:12 Min.)					
Material	**Purpose**	**Thickness (in.)**	**Nominal R-Value**	**Installed by CC in shop**	**Installed by GC on site**
2x4 Flat	Interior Furring Service Layer	1 1/2		☑	☐
1/2" CDX Exp. 1 Spruce Plywood	Structural Sheathing & Air Barrier	1/2		☑	☐
16" I-joists	Structural Framing	9 1/2 - 16		☑	☐
Dense-Pack Blown Cellulose Insulation (R-3.7/in)	Cavity Insulation	9 1/2 - 16	35 - 60	☑	☐
5/8" Exterior Gypsum Board	Exterior Sheathing	5/8		☑	☐
Self-Adhering, Vapor Permeable Temporary Roof Underlayment	Roof Underlayment			☑	☐
Optional Exo Panel - 2x Overframing	Venting & Overhang Projections	3 1/2 - 7 1/4		☑	☐
Optional Exo Panel - 1/2" CDX Exp. 1 Spruce Plywood	Structural Sheathing	1/2		☑	☐
Total Assembly Thickness		**16 1/8 - 26 3/8**			
Total Assembly Nominal R-Value			**35 - 60**		

Insulated Flat Roof

This insulated roof panel is typically finished with tapered rigid foam installed by the GC on site at an appropriate thickness for the climate zone. The site-installed rigid insulation ensures that the roof sheathing stays warm enough during the winter to avoid moisture accumulation.



Insulated Flat Roof					
Material	**Purpose**	**Thickness (in.)**	**Nominal R-Value**	**Installed by CC in shop**	**Installed by GC on site**
2x4 Flat Strapping	Interior Furring Service Layer	1 1/2		☑	☐
Air Barrier & Smart Vapor Retarder Membrane	Air Barrier			☑	☐
16" I-joists	Structural Framing	9 1/2 - 16		☑	☐
Dense-Pack Blown Cellulose Insulation (R-3.7/in)	Cavity Insulation	9 1/2 - 16	35 - 60	☑	☐
5/8" CDX Exp. 1 Spruce Plywood	Structural Sheathing	5/8		☑	☐
Self-Adhering, Vapor Permeable Temporary Roof Underlayment	Roof Underlayment			☑	☐
Total Assembly Thickness		**11 5/8 - 18 1/8**			
Total Assembly Nominal R-Value			**35 - 60**		


INTELLO PLUS

PROCESS Starting a Prefab Project

1. Initial contact (SD or early DD)

Send us drawings with floor plans and elevations. Engage us early, before permit intake. We contract through the general contractor as a subcontractor. We are happy to recommend an engineer who is familiar with our systems.

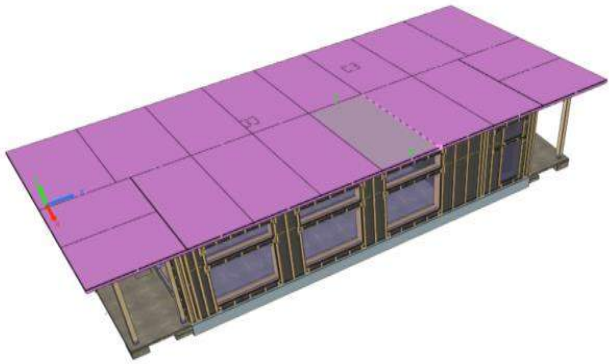
2. Preliminary drawings review

Collective Carpentry will review architectural drawings to clarify design questions and propose a scope of work.

3. File sharing for modeling and proposal

Send an IFC export of your 3D architectural model and we will prepare a prefab model for a preliminary scope and pricing proposal. This will serve as the basis for our contract.

4. Preliminary proposal review

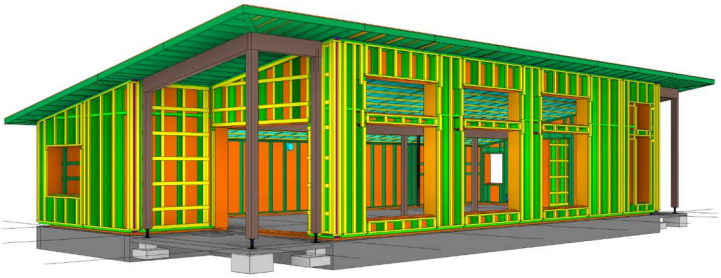


We will schedule a call to review the preliminary proposal with the GC and other stakeholders (architect and property owner). This will allow us to answer questions and determine if pricing is viable to proceed.

5. Sign contract

The GC should sign the proposal and pay the deposit. We will assign your project a tentative queue position for production and installation. Production slots are offered in the order that contracts are signed.

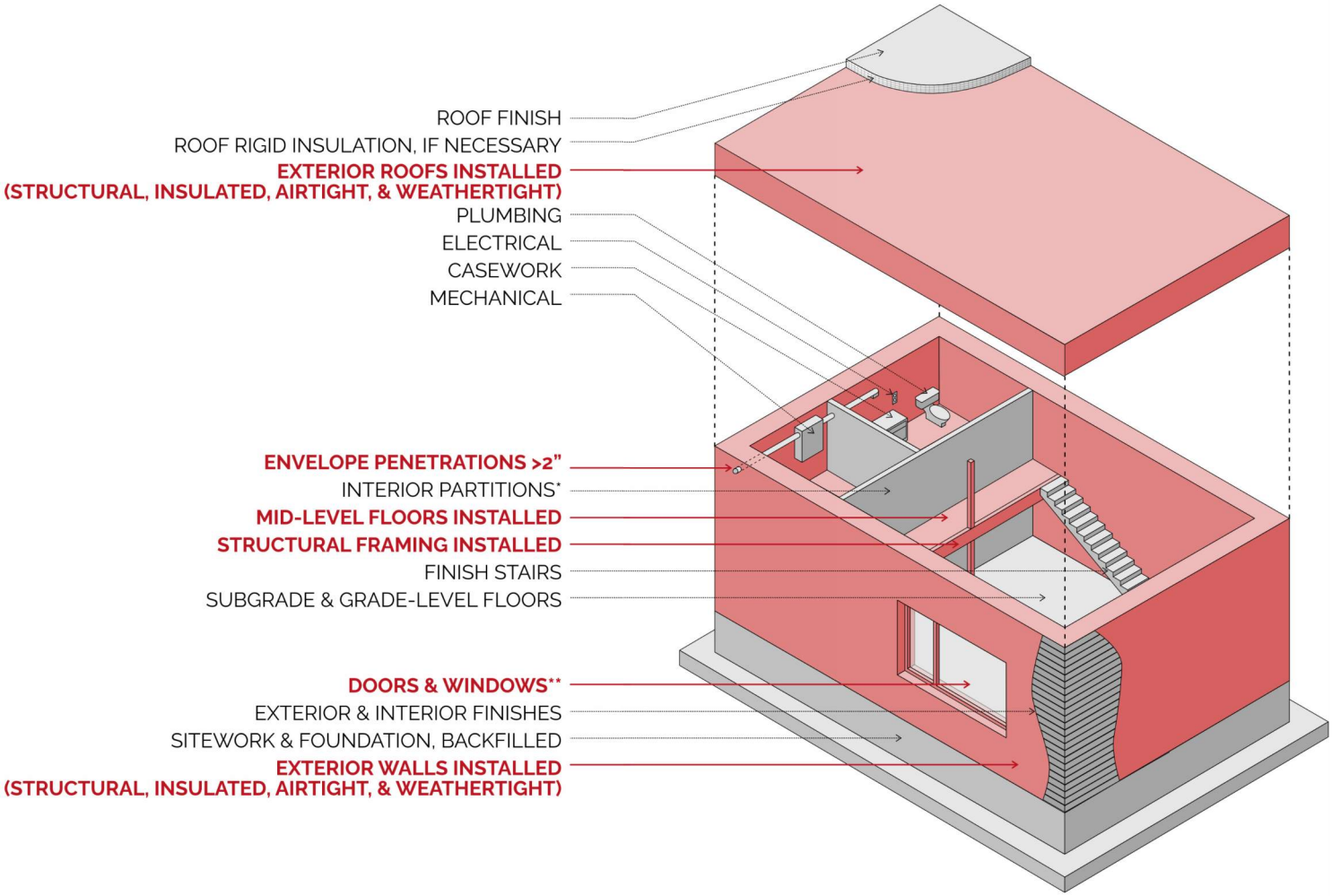
6. Prefab Design Kickoff



Your project will progress to our digital fabrication team. They will develop the prefab model and prepare review drawings for the GC, architect, and engineer to approve before moving into production.

SCOPE OF WORK Fabricate & Install

Projects that are prefabricated by Collective Carpentry require a local general contractor to complete the work beyond the prefabricated building envelope. **Collective Carpentry provides the structural, insulated, airtight, weathertight building envelope**. A local general contractor is responsible for preparing the site, building a foundation, and backfilling prior to panel install. After panel install, the GC is responsible for completing the build. Refer to the diagram below for a summary of the typical Collective Carpentry scope highlighted in **RED**.



*We will fabricate and install interior walls if they are load-bearing or shear walls.

**We may consider sourcing & installing windows & doors on a case-by-case basis.

High-Quality Materials

Panel Type	Product	Specification
Weather Resistive Barrier		
Passive House Wall High Performance Wall Net Zero Wall	Pro Clima Mento Plus	•4-Ply reinforced, monolithic, vapor permeable membrane •Living Building Challenge Compliant — Red List Free •Fire rating: Class A material per ASTM E84 test (0 FS, 85 SDI) •Durability: Covered by two PP protection fleeces and includes reinforcement grid •Water column: Resist over 8' of water column to ensure protection from the elements •Perm Rating: 38 perms (Sd-value 0.05 m) for enhanced outward drying potential •UV/weather resistance: Temporary roofing/weatherproofing of façade and roof for up to 4 months - certified by ZVDH (German roofing assoc) •Artificial aging: Pass long-term testing per DIN EN 1297 / DIN EN 1296
Roof Underlayment		
Insulated Flat Roof Insulated Pitched Roof	Pro Clima Adhero 3000	•Self-adhering, monolithic, vapor permeable membrane •Living Building Challenge Compliant — Red List Free •Air permeance: 0.00004 cfm/ft2 per ASTM E2178 •Vapor permeance ASTM E96: 8 perms wet cup, EN ISO 12572: 11 perms wet cup •Water column: resist 33' ft of water column •UV/weather Resistance: climate zone 4-8: four months for roofs, six months for walls •UV/weather resistance: climate zone 1-3: three months for roofs, four months for walls •Durability: PP cover fleece has optimized surface tension for superior tape bonding •Durability: Self-sealing around point penetrations (screws/nails)
Air Barrier & Vapor Retarder		
Insulated Flat Roof	Pro Clima Intello	• Humidity-variable, airtight vapor retarder for interior applications • Living Building Challenge Compliant — Red List Free • Air permeance: 0.00004 cfm/ft^2 per ASTM E2178 • Airtightness: meets Passive House air barrier requirements • Vapor permeance ASTM E96: 0.23 perms dry cup, ~13 perms wet cup — smart vapor behavior, EN ISO 12572: sd-value 0.25–25 m (humidity-variable) • Water column: resists >33 ft (10,000 mm) per EN 20811 • UV exposure: not intended for prolonged direct UV; approved for 12 months behind transparent interior cladding • Durability: reinforced for tear resistance, crease resilience, and long-term performance
Insulation		
Passive House Wall High Performance Wall Insulated Flat Roof Insulated Pitched Roof	Mountain Fiber Cellulose	• High-density, borate-treated cellulose insulation • Living Building Challenge Compliant — Red List Free • Fire resistance: Class A fire rating per ASTM E84 • Borate treated for fire, smoke, mold, and pest resistance • Low volatile organic compound (VOC) emissions • Thermal resistance: R-3.7 per inch nominal • Vapor permeability: highly vapor open; supports moisture buffering and drying potential • Environmental impact: 85% recycled newsprint with low embodied energy • Installed density: 3.5–4.5 lbs/ft^3 (dense-pack application)
Net Zero Wall	Rockwool Comfortboard 80	•Mineral wool rigid insulation •Made from natural & recycled materials •Class A Fire Rating •R-Value / inch @ 75 oF 4.2 hr.ft2.F/Btu •RSI value / 25.4 mm @ 24 oC 0.72 m2K/W •Vapor permeable •Mold & fungi resistant

DESIGN Opening Size & Placement

We can build anything, as custom as you like! If you're truly trying to optimize a design for prefab it is helpful to use the dimension **9'-6"** as a guide. This is the maximum width of a panel on a trailer on the highway. The diagrams below demonstrate how a rough opening can be framed in panelized construction with respect to this dimension.

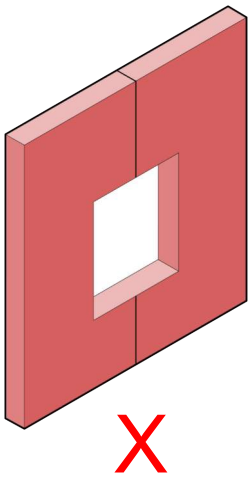


Figure 1

A rough opening cannot be split between two panels

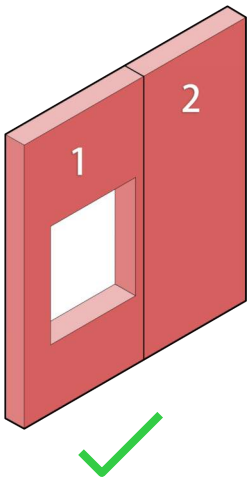


Figure 2

A rough opening can be contained within one panel.

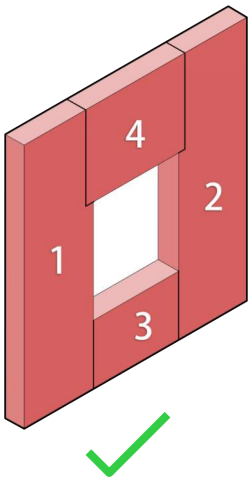
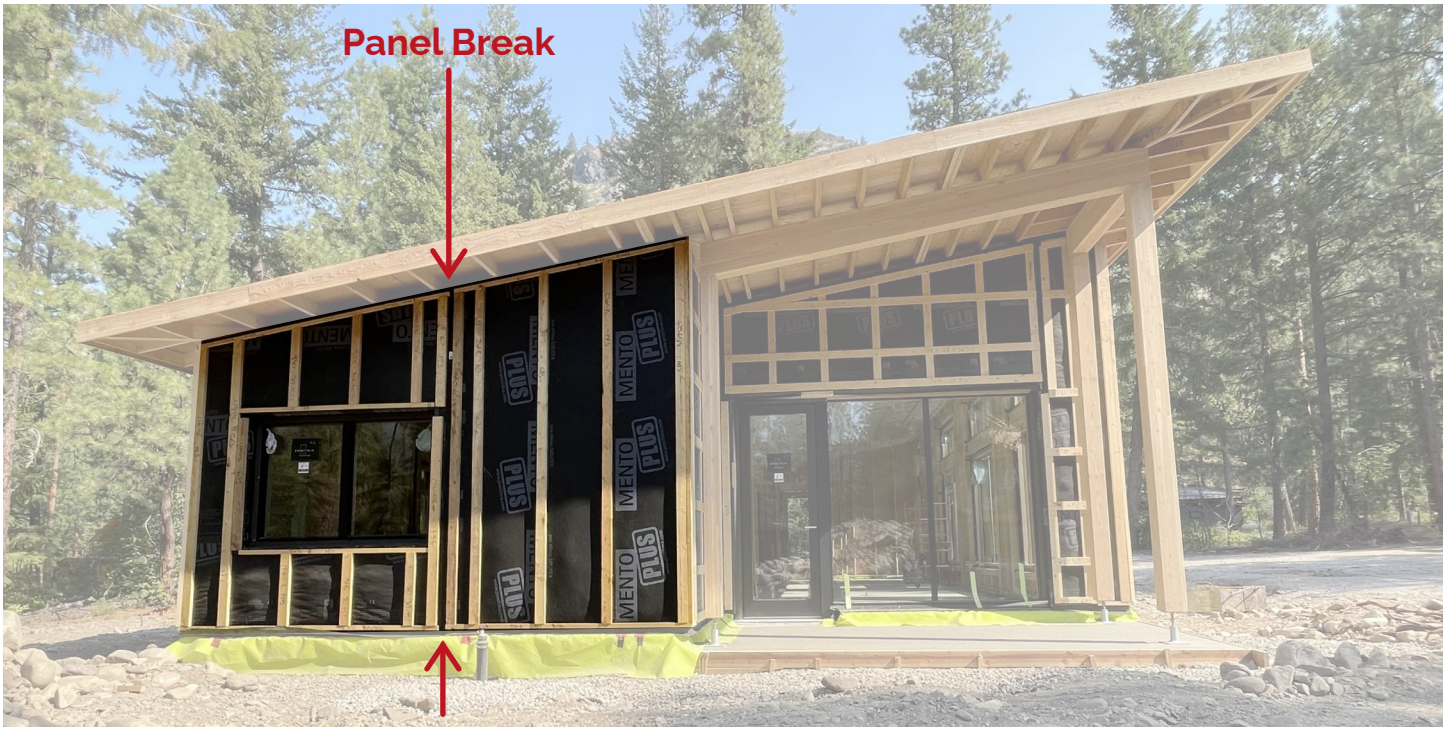


Figure 3

A rough opening can be framed by four panels: a sill, header, and two cripple panels. This is how large rough openings are framed.

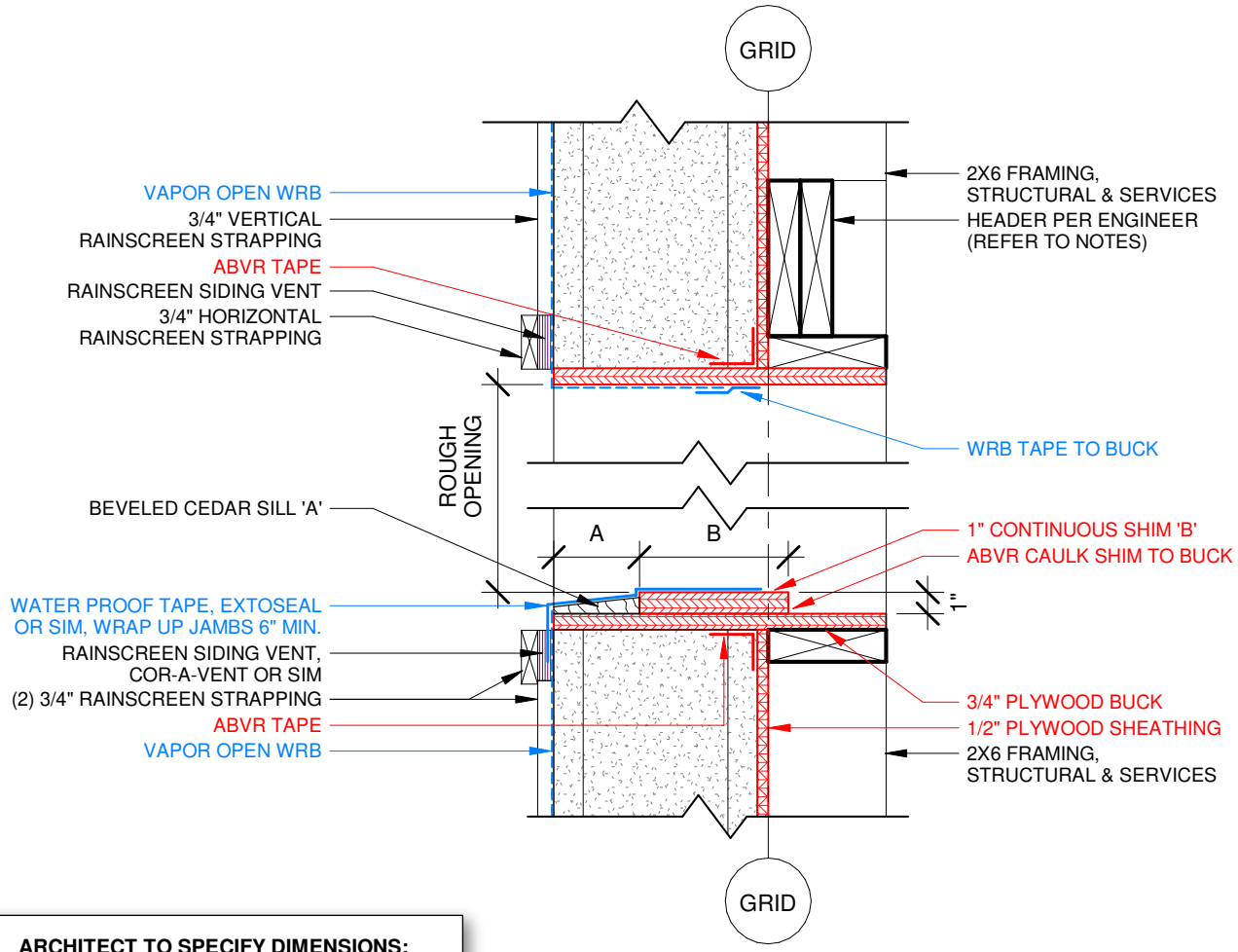



MS2
MS2
MS2
MS3

DESIGN Rough Openings

Collective Carpentry fabricates wall panels with rough openings prepared for window installation. The rough opening sill includes a beveled cedar sill and continuous plywood shim wrapped with a waterproof self-adhering membrane. The architect should specify the depth of these sill elements for the desired window installation detail. Windows can be installed by screwing directly through the frame, or using manufacturer-supplied clips. Windows cannot be installed with nail fins.

Wall Panel Rough Opening Detail
(Collective Carpentry scope)

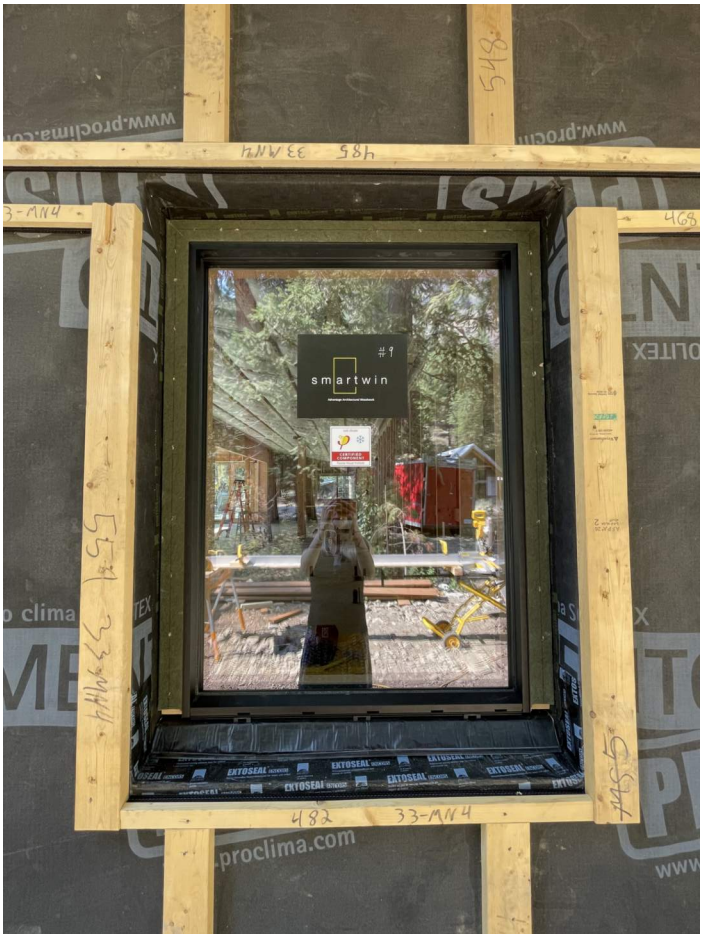


ARCHITECT TO SPECIFY DIMENSIONS:

A. DEPTH OF BEVELED CEDAR SILL. 3-1/2" TO 5-1/2"
B. DEPTH OF CONTINUOUS PLYWOOD SHIM (SHOULD INCLUDE DEPTH OF MFR. CLIPS IF APPLICABLE)

NOTES

1. HEADER TO BE DIMENSIONAL LUMBER OR LVL. GLULAM CANNOT BE LOCATED WITHIN PANELS.



Exterior

Interior

DESIGN Overframe Roof: Overhangs & Venting

Our panelized pitched roof system uses an overframe roof panel that is separate from the insulated roof panel to create overhang projections and provide roof venting. The overframe roof panel is typically dimensional lumber (per engineer) at the same spacing as the main roof joists, with a layer of sheathing above. This overframe roof panel is highlighted in the detail below, and shown in the install images to the right.

Wall to Roof Detail
Overframe Roof Panel Highlighted

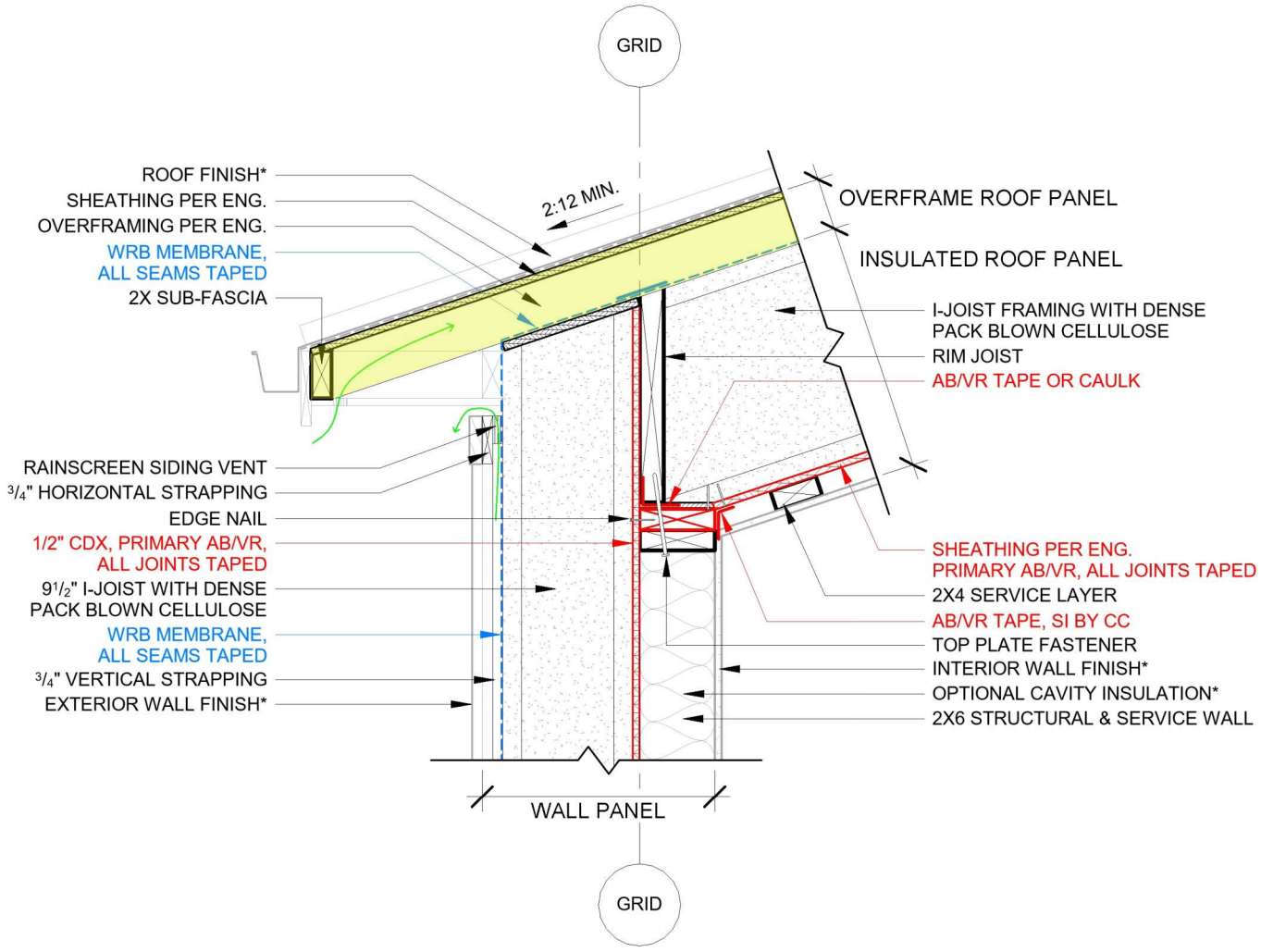


Figure 1
Insulated roof panels installed
(no overhangs)

Figure 2
Overframe roof panels being installed

Figure 3
Overframe roof panels installed above insulated roof panels creating overhang projections

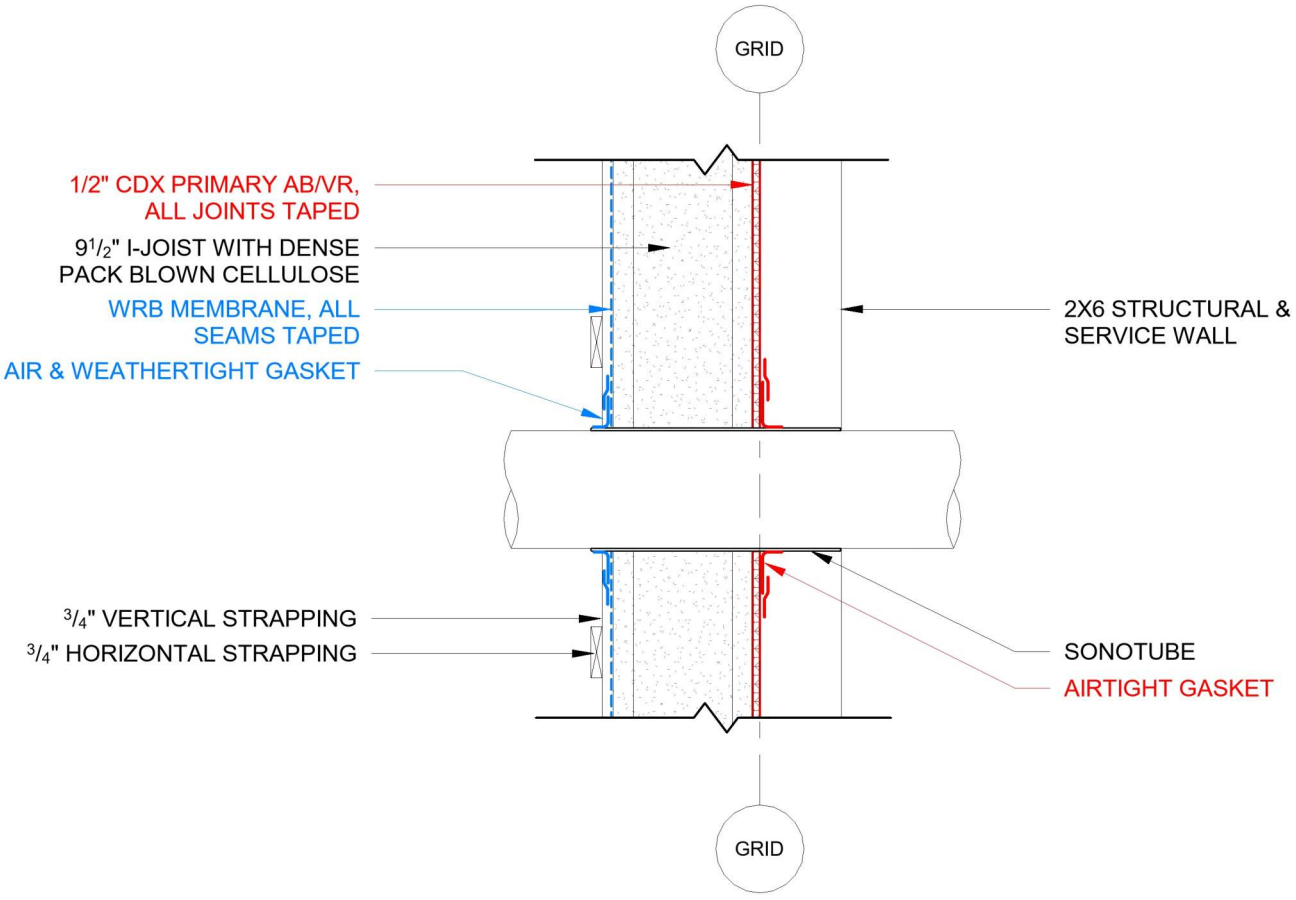
Credit:
Waymark Architecture &
Interactive Construction

DESIGN Envelope Penetrations

We fabricate wall and roof panels with penetrations over 2" provided. Typically this is done with a cardboard tube that is sealed with a gasket or tape to be airtight and weather-tight. The architectural drawings should provide specific dimensions for diameter and location of all envelope penetrations including HRV ducts, kitchen hood exhaust, plumbing vent stack, radon vent, etc.

The detail below shows a typical mechanical penetration through a wall panel. The images to the right show how these penetrations are coordinated and installed.

Wall Panel Mechanical Penetration Detail



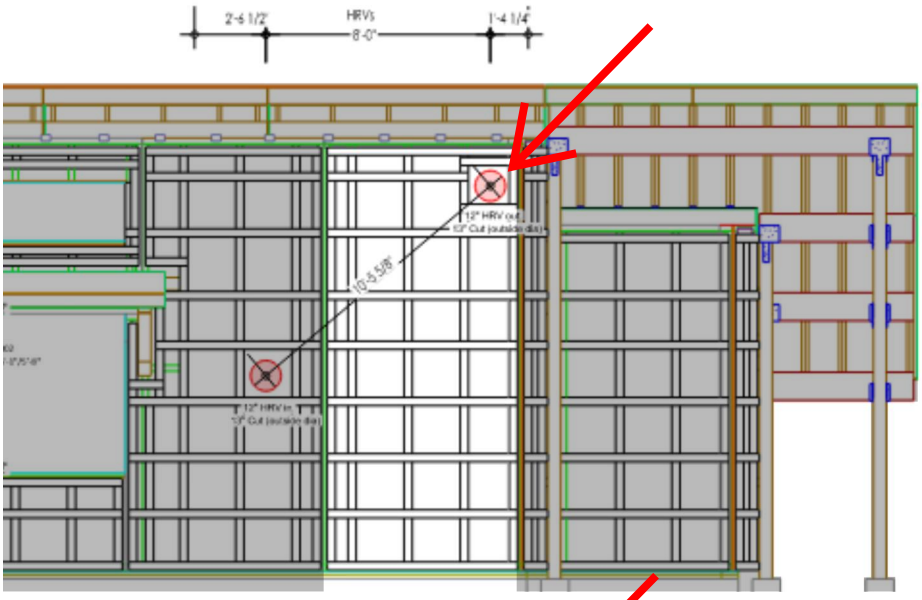


Figure 1

Envelope penetration coordinated during the prefab review phase

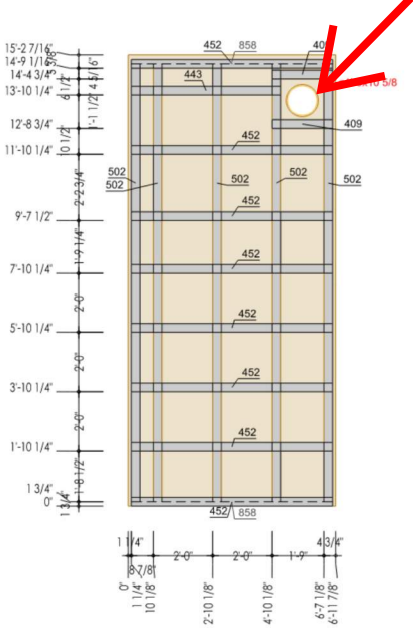


Figure 2

Envelope penetration represented on panel shop drawings

Figure 3

Envelope penetration fabricated, installed, and sealed

ENGINEERING Structural Framing

Dropped beams are preferred instead of flush beams for supporting insulated roof and insulated floor panels. This is because a flush beam requires access inside the panel to make structural connections during install, therefore the panel cannot be delivered fully insulated.

Glulam structure cannot be located within a panel. For example, a rough opening header should be LVL or dimensional lumber, not glulam.

Standard Sizes

Our current suppliers for glulam and LVL have standard sizes that are listed below. Our suppliers and their standard products are subject to change. Confirm that the following information is current with your Collective Carpentry contact.

Our current preferences are:

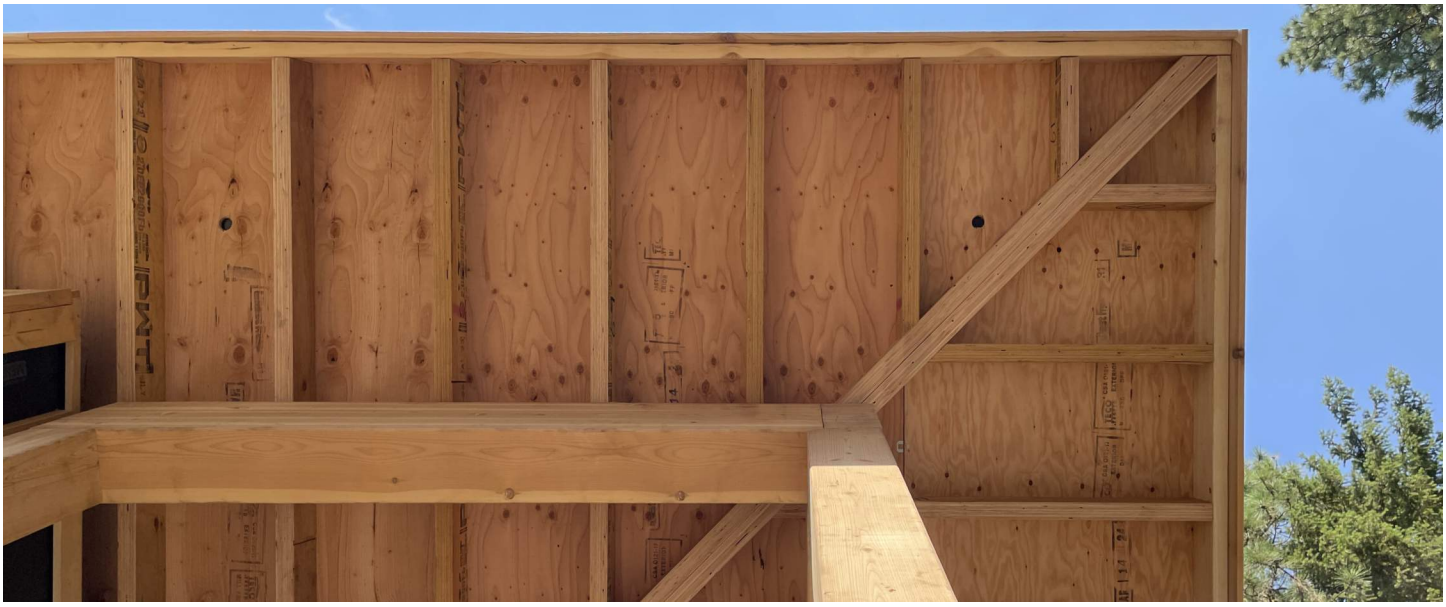
- **PWI** for structural engineered I-Joists
- **SPF #2** or **Dfir-Larch Select Structural** for dimensional lumber (determined by supply chain
- **Doug Fir** for glulam

Glulam Post & Beam Standard Sizes	
Widths	3-1/8”, 5-1/8”, 6-7/8”, 8-1/2”, 10-3/8”, 12-3/8”, 14-3/8”, 15-3/4”, 17-1/4”, 19-1/4”, 21-1/4”
Depths	(1-1/2” increments starting at 6”) 6”, 7-1/2”, 9”, 10-1/2”, 12”, 13-1/2”….. Up to 36”

LVL Standard Sizes	
1-3/4” X	3-1/2”, 5-1/2”, 7-1/4”, 9-1/2”, 11-7/8”, 14”, 16”, 18”

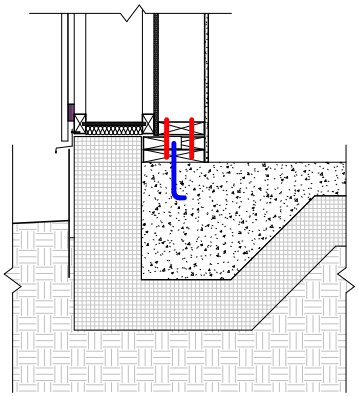
ENGINEERING Preferred Fasteners

Our preferred fastener suppliers are Rothoblaas and Simpson. The following matrix outlines our specific preferences for typical fastening. In general, we like the aesthetic of a concealed connection. Please inquire for other fastening recommendations.



Foundation

1



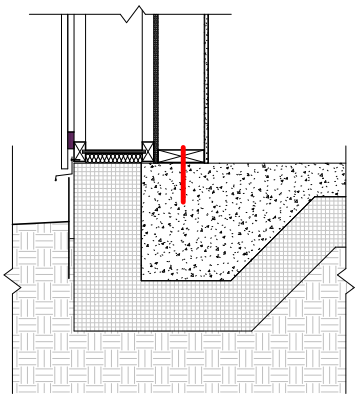
(Double Mud Sill)
Bottom Mud Sill
to
Foundation by GC

1. Anchor bolt with square washers by GC

(Double Mud Sill)
Wall Panel PT Bottom Plate
to
Mud Sill

1. (2) 16d common galv. nails, or
2. Rothoblaas HBS 6x120 Evo

2

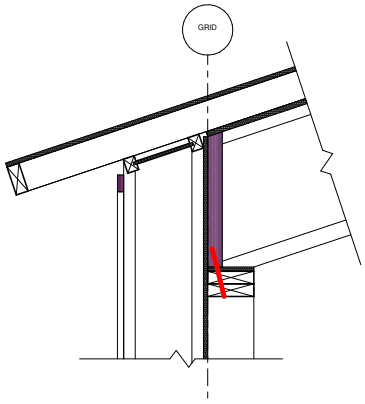


Wall Panel PT Bottom Plate
to
Foundation

1. Simpson Titen HD

Roof

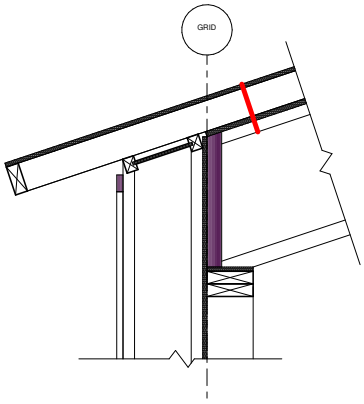
3



Wall Top Plate to Roof Joist or Rim Joist

1. Rothoblaas HBS 6x~160, CSK, PT

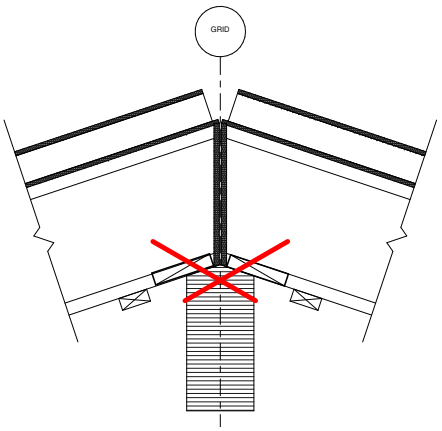
4



Overframe Roof Panel to Insulated Roof Panel

1. Rothoblaas TBS 8x160/200/240, flange head, PT

5

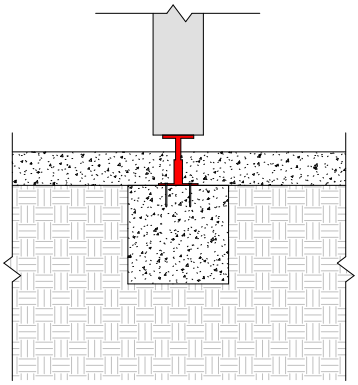


Ridge Beam to Roof Panel

1. Rothoblaas VGZ 7x~280, cyl. head, fully threaded, at every opposing rafter

Posts & Beams

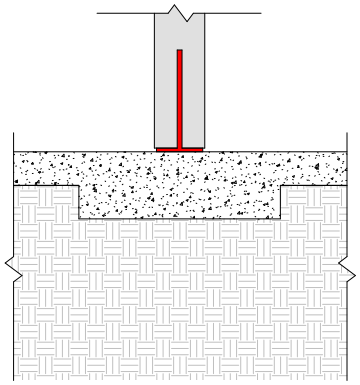
6



Exterior Post Base

1. Rothoblaas R10, R20, R40, or R60

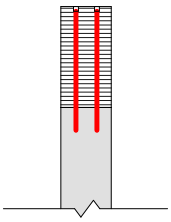
7



Interior Post Base

1. Rothoblaas F70, or
2. Simpson CPTZ

8



Beam to Post

1. (4) 10-12mm x 400-500mm fully threaded, CSK, cyl. head, structural screws, or
2. Simpson column cap, or sim. if required

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