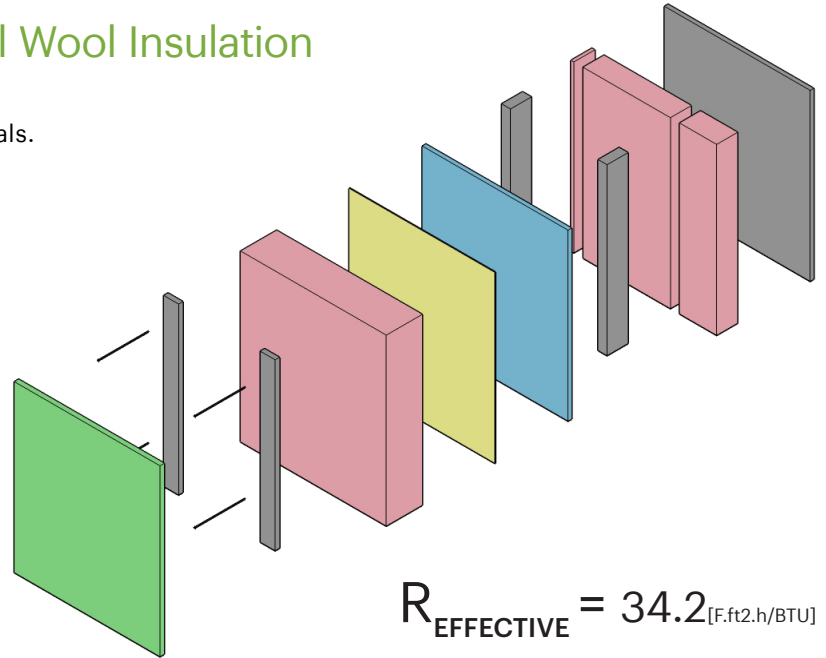


High Performance Wall Assemblies

In order to achieve the OAA +2030 targets for increased energy efficiency and reduced operational carbon in buildings, innovative sustainable design strategies should be implemented. This bulletin series provides an introduction to high performance wall assemblies and material selection from science-based, peer-reviewed solutions that can lower energy and carbon usage.

1. Sustainable Series 6 with Mineral Wool Insulation

The Sustainable Series 6 wall assembly uses well-known, traditional platform framing with readily available materials. Continuous exterior insulation provides higher thermal performance than traditional construction. Lightweight cladding can be supported with long screws, which minimize thermal bridging.



FOUR ENCLOSURE CONTROL LAYERS

- Weather Control Layer (WCL)
- Air Control Layer (ACL)
- Vapour Control Layer (VCL)
- Thermal Control Layer (TCL)

DURABILITY

- Highly vapour permeable to allow drying inward and outward avoiding mold
- Mineral wool insulation retains shape when wet and returns to full R-Value when dry
- Superior fire and pest resistance

SUSTAINABILITY

- Natural and recycled materials provide low embodied carbon
- Small additional amounts of materials are required to achieve high performance wall assembly
- Materials can be recycled at end of service life

CONSTRUCTABILITY

- Easy and flexible construction using traditional methods
- Mineral wool insulation is easier to handle than traditional fiberglass
- Long fasteners require additional planning to attach furring to studs

AFFORDABILITY

- No additional engineering required
- Mineral wool marginally more expensive than traditional fiberglass
- Lightweight cladding can reduce overall costs

ABOUT SBEC

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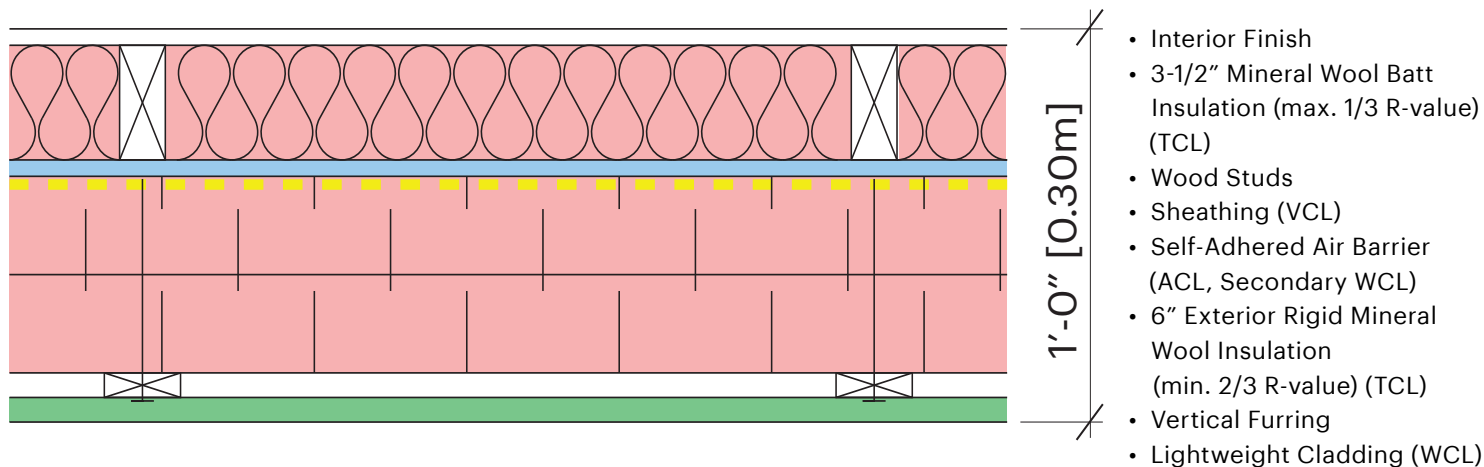
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High Performance Wall Assemblies

1. Sustainable Series 6 with Mineral Wool Insulation

$$R_{\text{NOMINAL}} = 38.0_{[\text{F.ft}^2.\text{h}/\text{BTU}]}$$

$$R_{\text{EFFECTIVE}} = 34.2_{[\text{F.ft}^2.\text{h}/\text{BTU}]}$$



Wall Assembly Considerations

Correct location of the four Enclosure Control Layers is important for high performance wall assemblies.

A vented rainscreen weather control layer (WCL) prevents bulk water from entering the wall assembly and provides a ventilated airspace to improve drying, reducing the potential for rot and mold.

Lightweight claddings are easy to support through a continuous thermal control layer (TCL) and do not require robust structural support systems that often significantly reduce the thermal effectiveness of the insulation.

A system of connected components are necessary to maintain a continuous air control layer (ACL), which can also serve as the secondary weather control layer (WCL).

Self-adhered and liquid applied air control layers (ACL) can often improve building airtightness due to their method of attachment, however an equal quality of airtightness can be achieved using sheet membranes with careful attention to detail during design and construction.

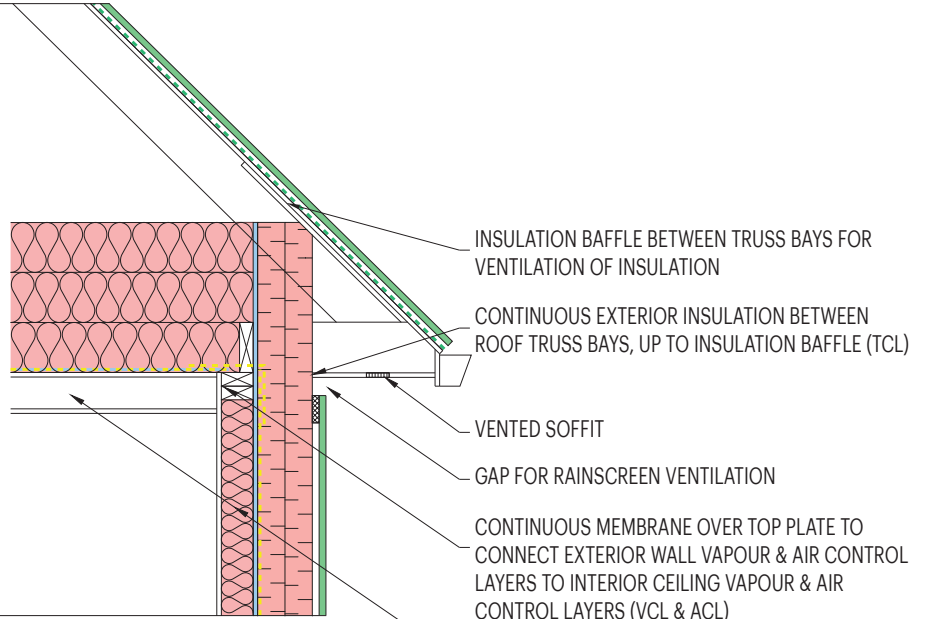
An independent vapour control layer (VCL) allows the assembly to dry in both directions preventing moisture accumulation in the wall.

For a protected vapour control layer (VCL) located within in the wall assembly, a minimum of 2/3 of the thermal control layer (TCL) R-value must be located on the cold side of the vapour control layer (VCL) and a maximum of 1/3 of the thermal control layer (TCL) R-value should be located on the warm side of the vapour control layer (VCL).

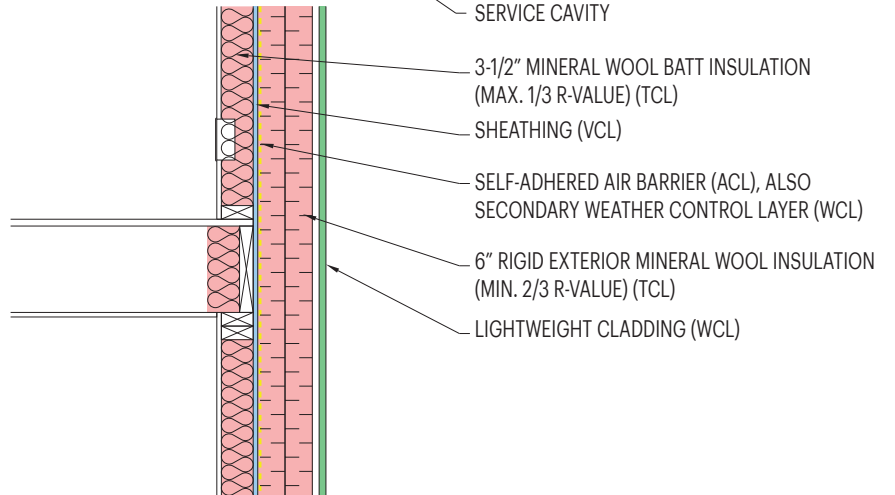
High Performance Wall Assemblies

1. Sustainable Series 6 with Mineral Wool Insulation

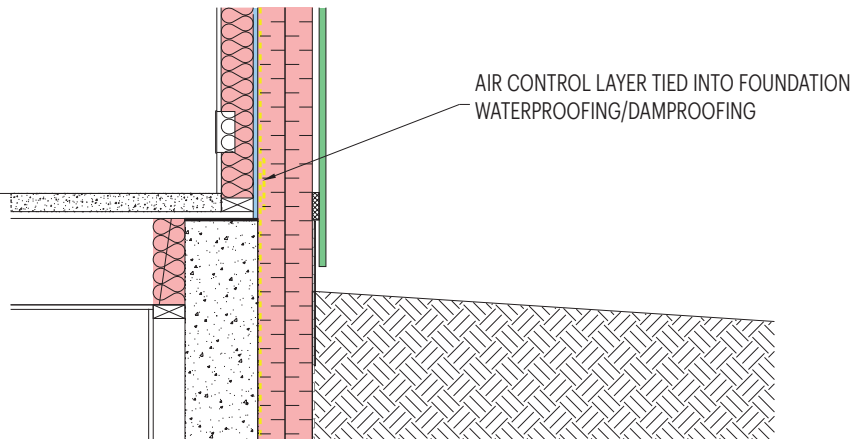
Construction Details



A1. ROOF TO WALL DETAIL



A2. FLOOR TO WALL DETAIL



A3. ABOVE GRADE WALL TO FOUNDATION WALL

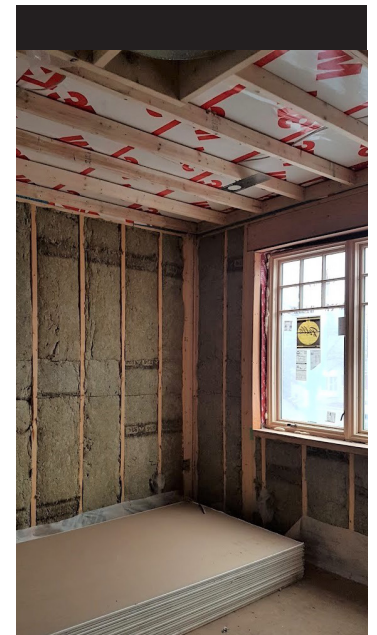
High Performance Wall Assemblies

1. Sustainable Series 6 with Mineral Wool Insulation

Case Study

ETOBICOKE RESIDENCE BY SUSTAINABLE ARCHITECTURE

This all-electric, single family home in Etobicoke, ON is constructed using the Sustainable Series 6 wall assembly. Special attention to sequencing and installation of the air barrier was required to ensure continuity at the attic ceiling, where the air control layer transitions from a self-adhered membrane on the wall to the smart vapour retarder on the ceiling. This design is expected to reduce the heating demand by 74% compared to a code minimum Ontario home.







High Performance Wall Assemblies

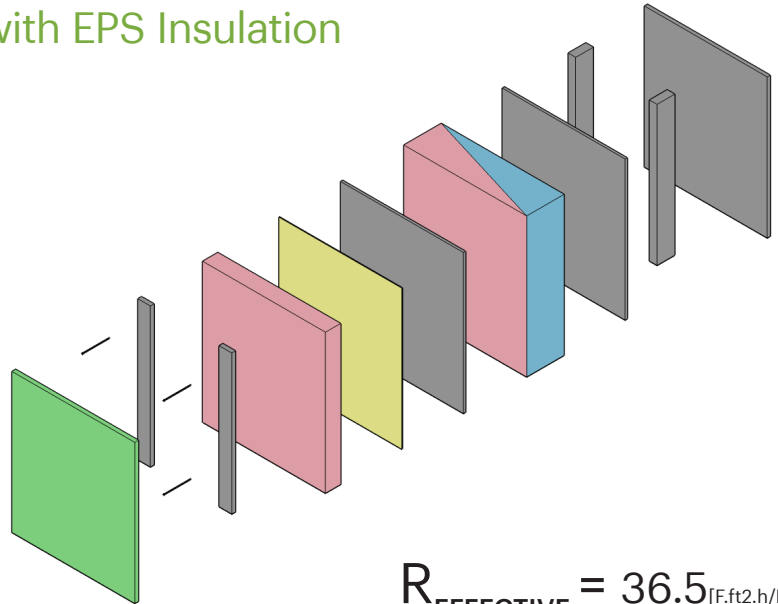
In order to achieve the OAA +2030 targets for increased energy efficiency and reduced operational carbon in buildings, innovative sustainable design strategies should be implemented. This bulletin series provides an introduction to high performance wall assemblies and material selection from science-based, peer-reviewed solutions that can lower energy and carbon usage.

2. Structural Insulated Panel (SIP) with EPS Insulation

Structural Insulated Panels are factory-made to fit any design, and are transported to site pre-assembled. They consist of an EPS foamcore sandwiched between two structural layers of OSB sheathing. They are traditionally used for residential and light commercial construction.

FOUR ENCLOSURE CONTROL LAYERS

-  Weather Control Layer (WCL)
-  Air Control Layer (ACL)
-  Vapour Control Layer (VCL)
-  Thermal Control Layer (TCL)



$$R_{\text{EFFECTIVE}} = 36.5_{[\text{F.ft}^2\text{h/BTU}]}$$

DURABILITY

- High airtightness rating and R-value
- Very strong structurally and resistant to movement
- Can support heavier claddings
- Lower life expectancy due to low drying potential

SUSTAINABILITY

- Embodied carbon is very high as EPS is made of non-renewable fossil fuels
- High global warming potential of blowing agents used in manufacturing foam
- Insulation must be sprayed with insecticide, having negative environmental implications
- Cannot be recycled at end of service life

CONSTRUCTABILITY

- Quick to assemble on site
- Detailing is similar to traditional construction methods but requires careful planning for openings
- Must pay special attention to sealing joints of panels
- SIP construction is not well-known to contractors

AFFORDABILITY

- Construction costs are higher than traditional stick frame methods, but less than other high-performance systems
- Savings are associated with reduced on-site labour, reduced waste, and increased construction efficiency

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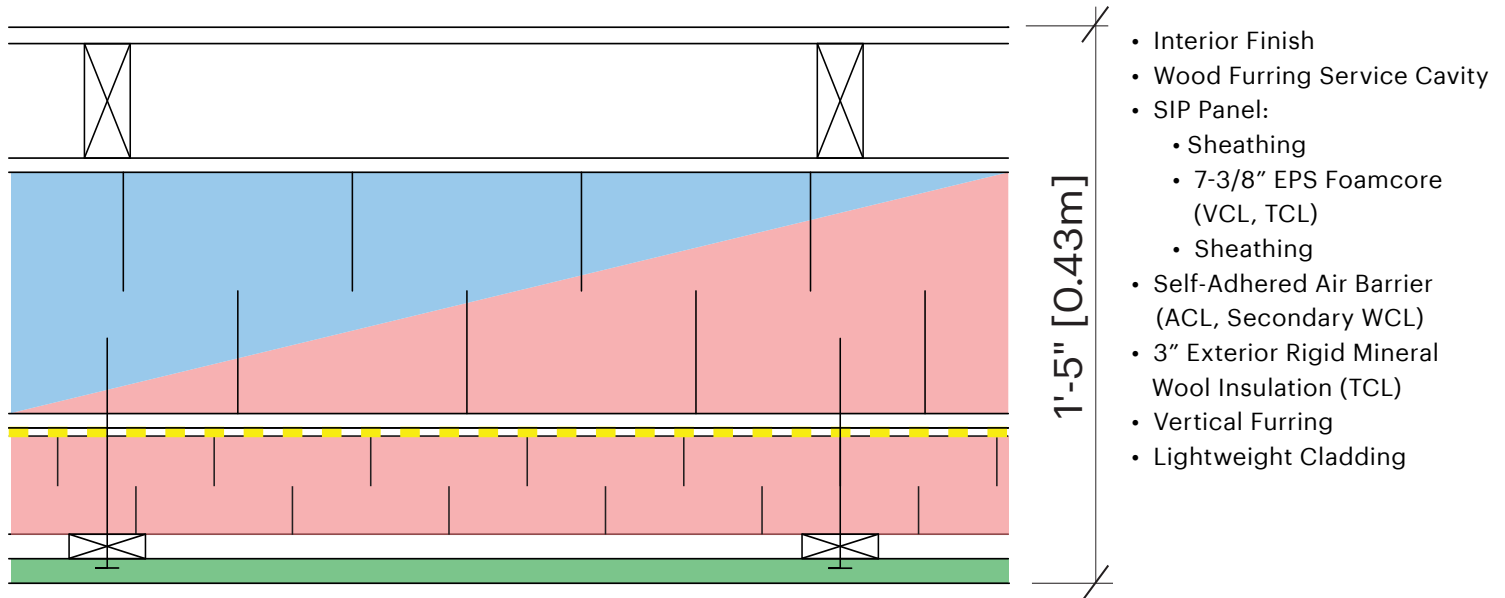
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High Performance Wall Assemblies

2. Structural Insulated Panel (SIP) with EPS Insulation

$$R_{\text{NOMINAL}} = 40.5_{[\text{F.ft}^2.\text{h}/\text{BTU}]}$$

$$R_{\text{EFFECTIVE}} = 36.5_{[\text{F.ft}^2.\text{h}/\text{BTU}]}$$



Wall Assembly Considerations

Correct location of the four Enclosure Control Layers is important for high performance wall assemblies.

A vented rainscreen weather control layer (WCL) prevents bulk water from entering the wall assembly and provides a ventilated airspace to improve drying, reducing the potential for rot and mold.

Lightweight claddings are easy to support through a continuous thermal control layer (TCL) and do not require robust structural support systems that often significantly reduce the thermal effectiveness of the insulation.

A system of connected components are necessary to maintain a continuous air control layer (ACL), which can also serve as the secondary weather control layer (WCL).

Self-adhered and liquid applied air control layers (ACL) can often improve building airtightness due to their method of attachment, however an equal quality of airtightness can be achieved using sheet membranes with careful attention to detail during design and construction.

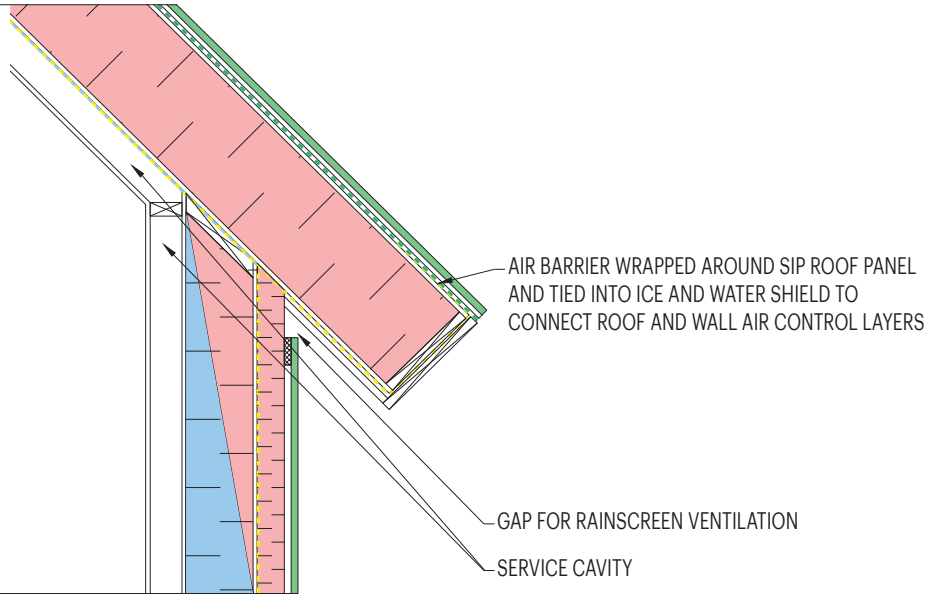
An independent vapour control layer (VCL) allows the assembly to dry in both directions preventing moisture accumulation in the wall.

For a protected vapour control layer (VCL) located within in the wall assembly, a minimum of 2/3 of the thermal control layer (TCL) R-value must be located on the cold side of the vapour control layer (VCL) and a maximum of 1/3 of the thermal control layer (TCL) R-value should be located on the warm side of the vapour control layer (VCL).

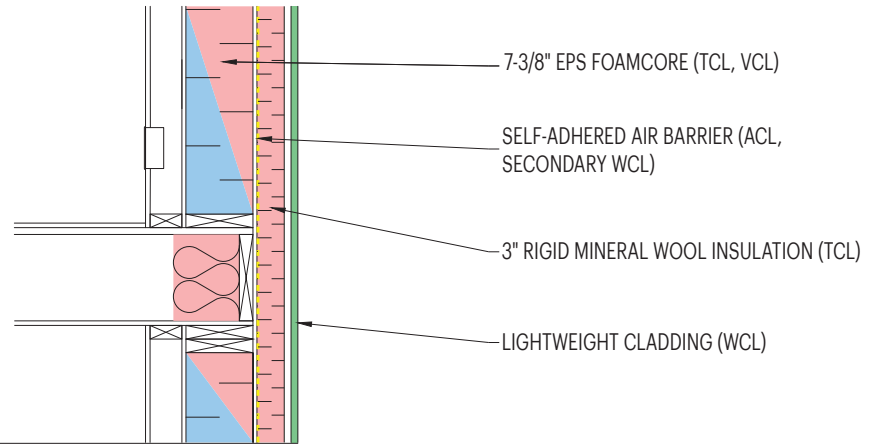
High Performance Wall Assemblies

2) Structural Insulated Panel (SIP) with EPS Insulation

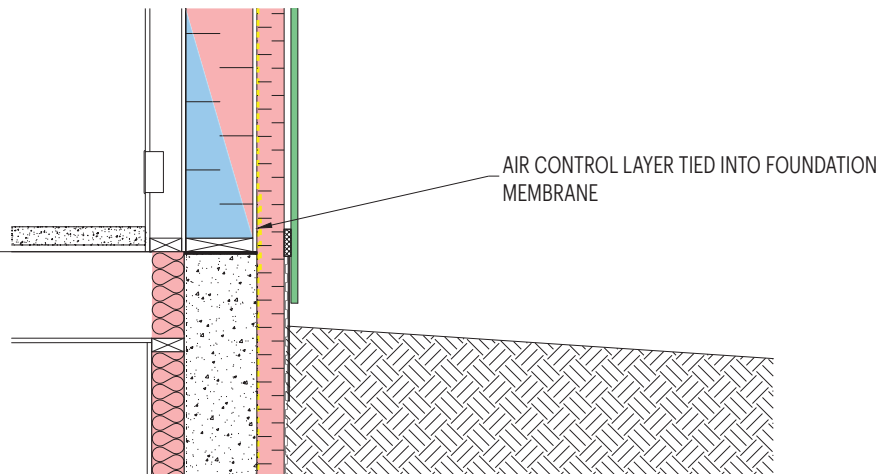
Construction Details



A1. ROOF TO WALL DETAIL



A2. FLOOR TO WALL DETAIL



A3. ABOVE GRADE WALL TO FOUNDATION WALL

High Performance Wall Assemblies

2. Structural Insulated Panel (SIP) with EPS Insulation

Case Study

TORONTO REBUILD BY SOLARES ARCHITECTURE

This single family home in Toronto, ON is a redesign of an existing bungalow by Solares Architecture. The exterior walls are constructed of SIPs, providing a high-performance wall system that occupies little space. Insulated concrete forms (ICF) are used below grade and triple glazed windows are installed that maintain a continuous high-performance envelope. The steel cladding is more durable than wood claddings. This design is three and a half times larger than the existing home, yet consumes 16% less energy.







High Performance Wall Assemblies

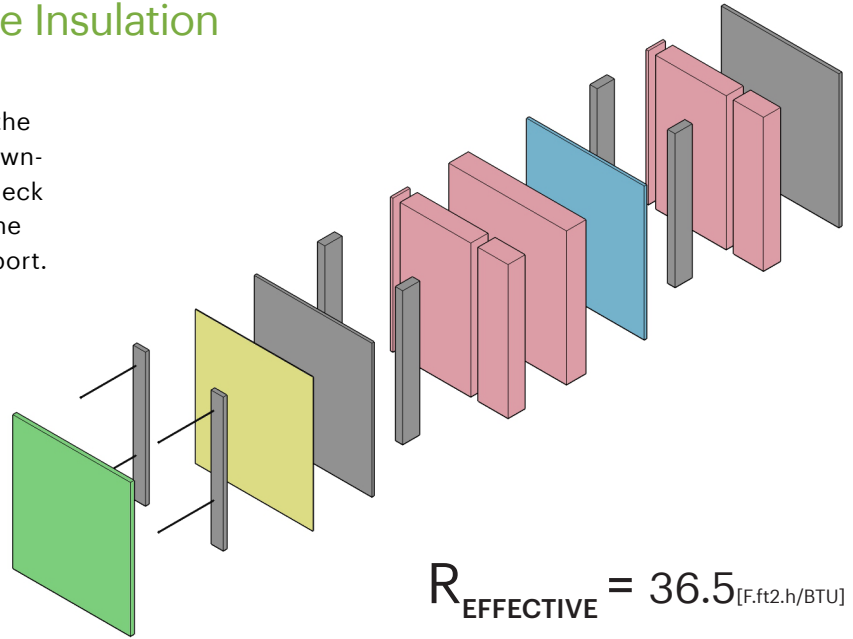
In order to achieve the OAA +2030 targets for increased energy efficiency and reduced operational carbon in buildings, innovative sustainable design strategies should be implemented. This bulletin series provides an introduction to high performance wall assemblies and material selection from science-based, peer-reviewed solutions that can lower energy and carbon usage.

3. Double Stud Wall with Cellulose Insulation

Double stud wall assemblies are constructed on site. The exterior load-bearing stud wall is separated from the interior finishing stud wall by a continuous layer of blown-in insulation. The interior stud wall is attached to the deck below and trusses and joists above. In tall buildings, the stud walls are attached together for strength and support.

FOUR ENCLOSURE CONTROL LAYERS

-  Weather Control Layer (WCL)
-  Air Control Layer (ACL)
-  Vapour Control Layer (VCL)
-  Thermal Control Layer (TCL)



$$R_{\text{EFFECTIVE}} = 36.5_{[\text{F.ft}^2\text{h/BTU}]}$$

DURABILITY

- Cellulose insulation is more durable than traditional fiberglass since it can absorb and release moisture
- A carefully employed vapour control strategy is needed to avoid condensation and allow drying in both directions
- Cellulose may sag over time reducing its R-value
- Double stud walls have significant thermal bridging at the rim joist

SUSTAINABILITY

- Embodied carbon of cellulose is low and consists of high amounts of recycled content
- Cellulose can be manufactured locally in many areas, reducing transport-related carbon emissions
- Materials can be reclaimed or recycled at end of service life

CONSTRUCTABILITY

- Quick and easy construction using traditional stick frame methods
- Custom frames are required for openings
- Flexible and easily adapted to desired wall thickness
- Construction time is longer due to additional stud wall
- Very thick walls make it not suitable for all projects

AFFORDABILITY

- Cellulose is less expensive than traditional fiberglass insulation, but costlier to install
- Double stud wall is costlier than traditional framing as it required more materials and time

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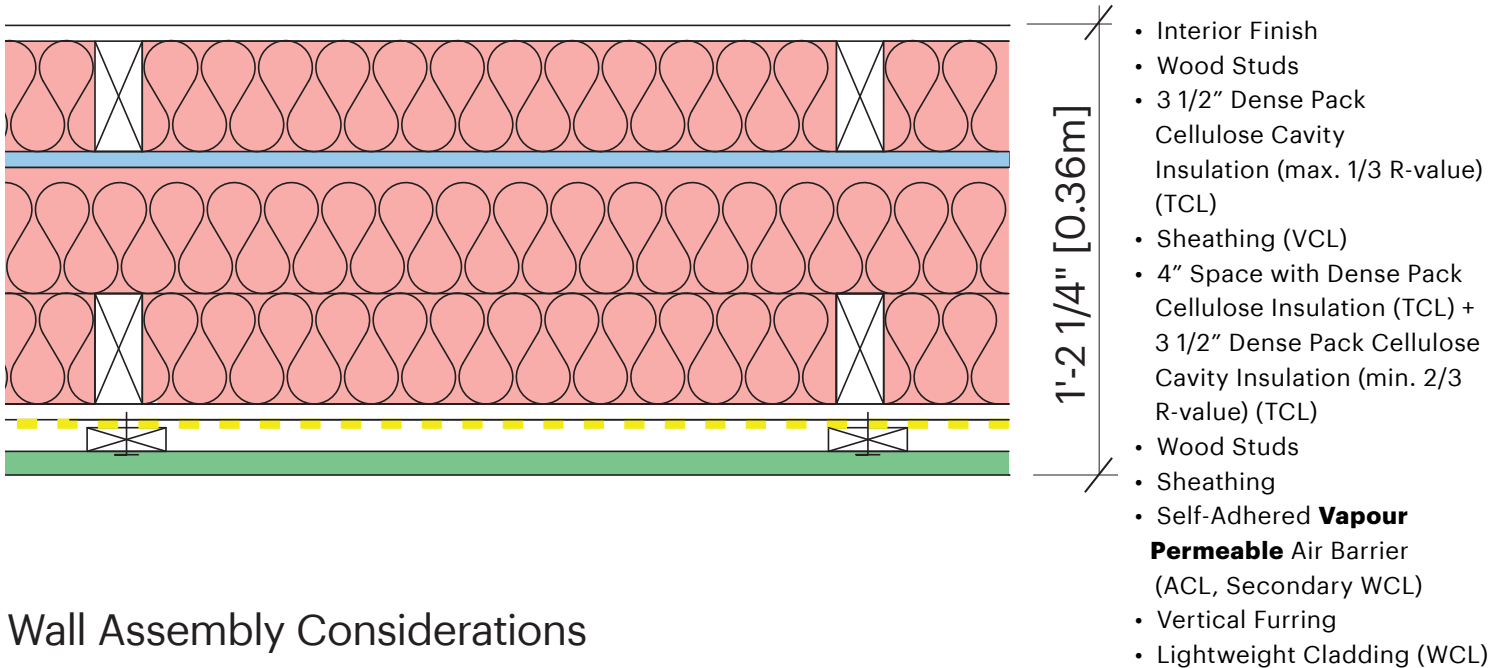
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High Performance Wall Assemblies

3. Double Stud Wall with Cellulose Insulation

$$R_{\text{NOMINAL}} = 44.0_{[\text{F.ft}^2\cdot\text{h}/\text{BTU}]}$$

$$R_{\text{EFFECTIVE}} = 36.5_{[\text{F.ft}^2\cdot\text{h}/\text{BTU}]}$$



Wall Assembly Considerations

Correct location of the four Enclosure Control Layers is important for high performance wall assemblies.

A vented rainscreen weather control layer (WCL) prevents bulk water from entering the wall assembly and provides a ventilated airspace to improve drying, reducing the potential for rot and mold.

Lightweight claddings are easy to support through a continuous thermal control layer (TCL) and do not require robust structural support systems that often significantly reduce the thermal effectiveness of the insulation.

A system of connected components are necessary to maintain a continuous air control layer (ACL), which can also serve as the secondary weather control layer (WCL).

Self-adhered and liquid applied air control layers (ACL) can often improve building airtightness due to their method of attachment, however an equal quality of airtightness can be achieved using sheet membranes with careful attention to detail during design and construction.

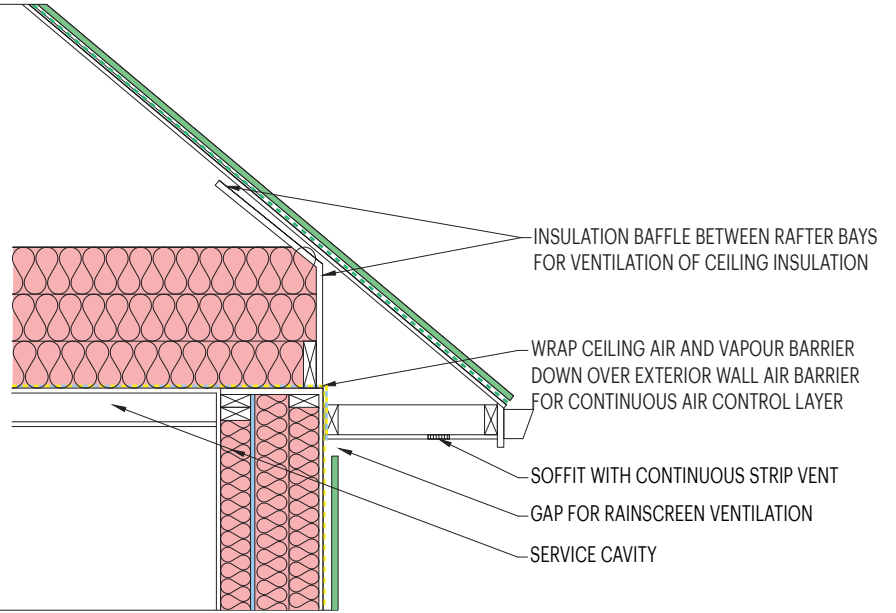
An independent vapour control layer (VCL) allows the assembly to dry in both directions preventing moisture accumulation in the wall.

For a protected vapour control layer (VCL) located within in the wall assembly, a minimum of 2/3 of the thermal control layer (TCL) R-value must be located on the cold side of the vapour control layer (VCL) and a maximum of 1/3 of the thermal control layer (TCL) R-value should be located on the warm side of the vapour control layer (VCL).

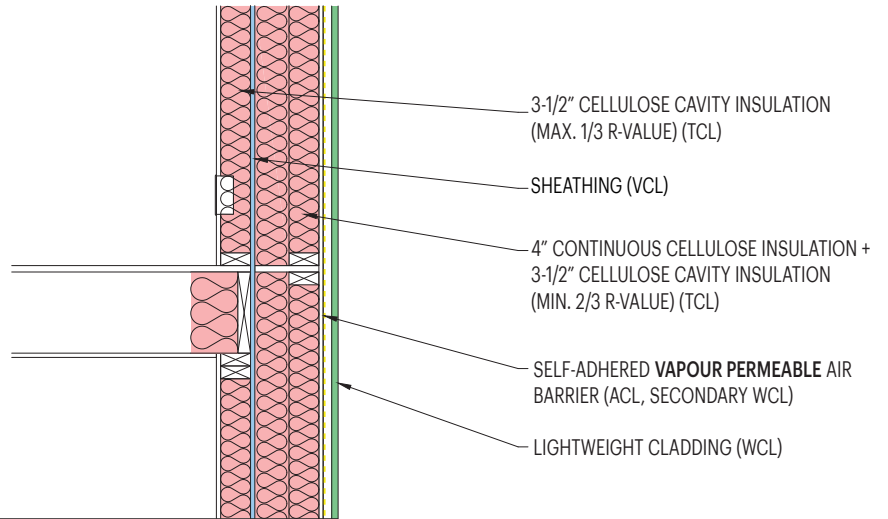
High Performance Wall Assemblies

3. Double Stud Wall with Cellulose Insulation

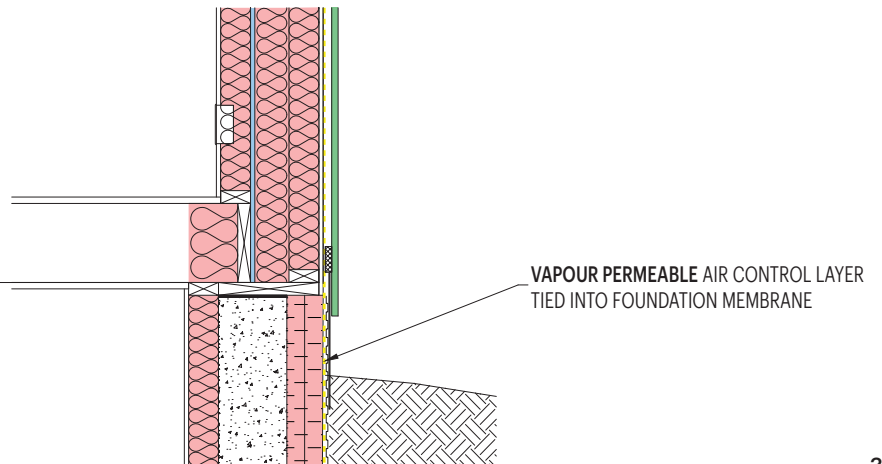
Construction Details



A1. ROOF TO WALL DETAIL



A2. FLOOR TO WALL DETAIL



A3. ABOVE GRADE WALL TO FOUNDATION WALL

High Performance Wall Assemblies

3. Double Stud Wall with Cellulose Insulation

Case Study

HIGH PERFORMANCE HOUSE BY COOLEARTH ARCHITECTURE

This family home in Parry Sound, ON is constructed with a double stud wall assembly. The original design called for dense-pack cellulose insulation, but was substituted for blown-in fiberglass insulation. Dense-pack cellulose is more environmentally friendly and redistributes moisture better than blown-in fiberglass, reducing moisture problems. Therefore, special attention to the moisture control strategy was required for this project. The studs are staggered to maximize the overall effective R-value (R-42) of the walls. Open web wood trusses were designed for the roof structure, which accommodates 16" of insulation (R-56) with minimal thermal bridging. The design incorporates Passive House principles to create a whole-house solution to high-performance building.



High Performance Wall Assemblies

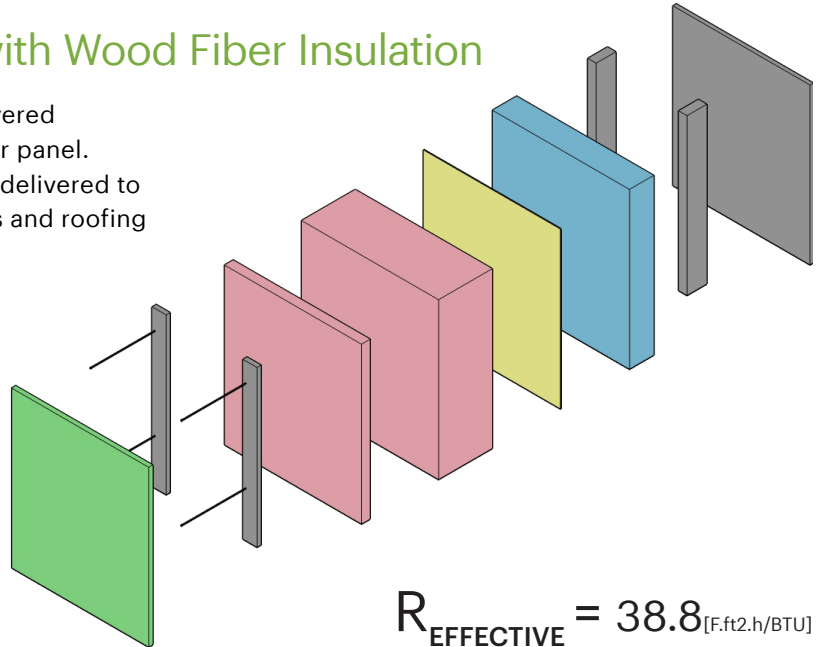
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4. Cross Laminated Timber (CLT) with Wood Fiber Insulation

Cross laminated timber refers to wood planks that are layered perpendicularly and glued together to form a solid timber panel. Large, custom CLT panels are factory-manufactured and delivered to site ready to install. CLT is suitable for use as floors, walls and roofing in low, mid- and high-rise buildings.

FOUR ENCLOSURE CONTROL LAYERS

- Weather Control Layer (WCL)
- Air Control Layer (ACL)
- Vapour Control Layer (VCL)
- Thermal Control Layer (TCL)



DURABILITY

- Increased strength and resistance to fire and earthquakes
- Wood fiber insulation boards smolder the flame in case of fire, preventing flame spread
- Breathable materials allow moisture to dry in both directions
- Precision of CLT manufacturing greatly improves airtightness
- Weather resistive wood fiber insulation may be unreliable as a secondary WCL

SUSTAINABILITY

- Insulation boards are made from waste wood products containing sequestered carbon and can be recycled at end of service life
- Natural additives to the wood fiber are non-toxic
- CLT panels have low embodied carbon, produce little waste during construction, and are recyclable at the end of service life

CONSTRUCTABILITY

- Pre-manufactured panels allow buildings to be erected more quickly than traditional methods
- Large spans without beams are achievable with CLT panels
- Heavy machinery is required to lift panels into place
- Long fasteners require additional planning to attach furring to CLT

AFFORDABILITY

- Structure and insulation can be more expensive than traditional methods
- Easily installed wood fiber boards cut installation time and costs
- Currently, wood fiber panels are not manufactured locally, increasing shipping costs, and embodied carbon

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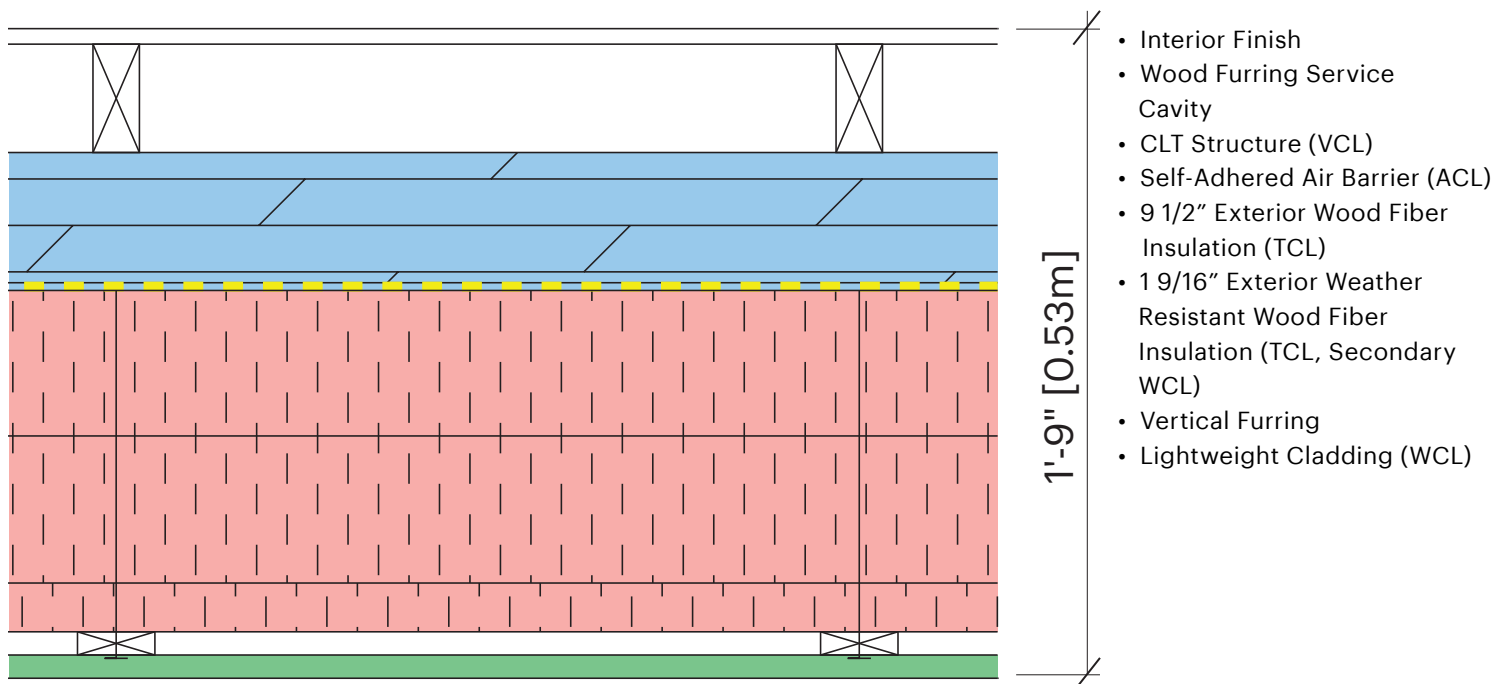
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High Performance Wall Assemblies

4. Cross Laminated Timber (CLT) with Wood Fiber Insulation

$$R_{\text{NOMINAL}} = 44.9_{[\text{F.ft}^2\cdot\text{h}/\text{BTU}]}$$

$$R_{\text{EFFECTIVE}} = 38.8_{[\text{F.ft}^2\cdot\text{h}/\text{BTU}]}$$



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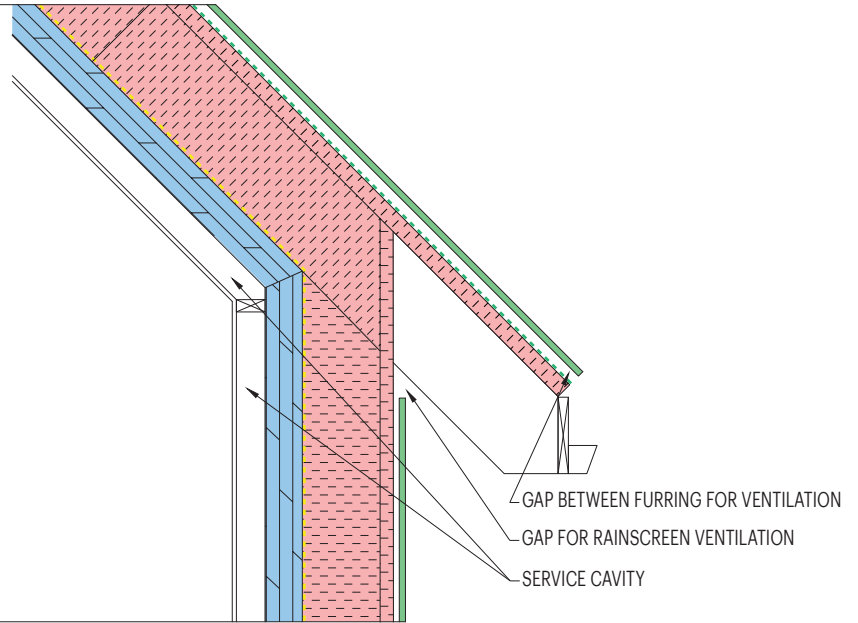
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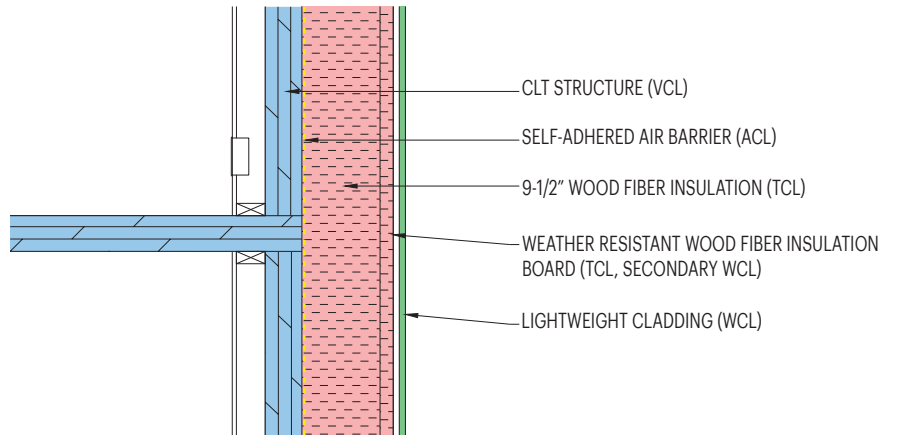
High Performance Wall Assemblies

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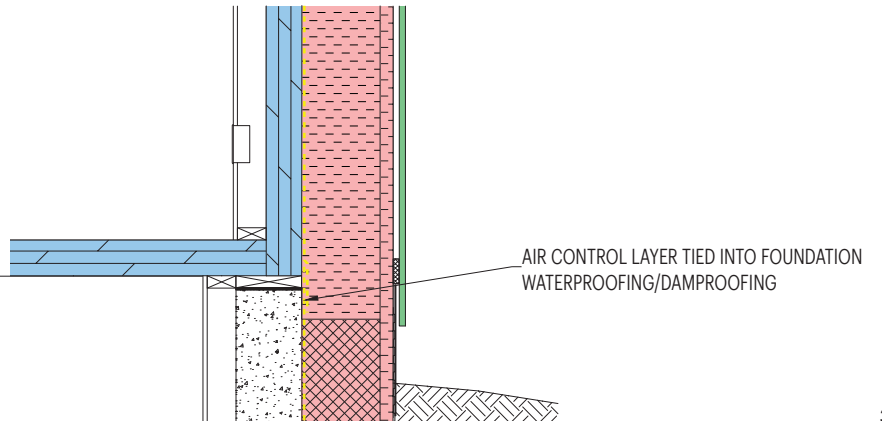
Construction Details



A1. ROOF TO WALL DETAIL



A2. FLOOR TO WALL DETAIL



A3. ABOVE GRADE WALL TO FOUNDATION WALL

High Performance Wall Assemblies

4. Cross Laminated Timber (CLT) with Wood Fiber Insulation

Case Study

WOLFE ISLAND PASSIVE HOUSE BY HUGHES DOWNEY ARCHITECTS

This single family home near Kingston, ON was designed to be affordable, replicable and sustainable. CLT panels were shipped from Austria and assembled on-site in two and a half days. Wood fiber insulation was shipped from Germany and installed with R-values of R-50 and R-60 in the walls and roof respectively. A blower door test measured an airtightness rating of 0.44 ACH50, which exceeds the airtightness requirements for Passive House certification. The design is targeting Passive House Certification and aims to be net-zero energy and heat and energy.

