

WALL ASSEMBLY COMPONENTS <sup>1</sup>		RSI	R
1	exterior air film	0.03	0.17
2	wood siding (bevelled) <sup>2</sup>	0.00	0.00
3	more than 3/4" (20mm +) air space <sup>3</sup>	0.00	0.00
4	asphalt impregnated paper <sup>4</sup>	0.00	0.00
5	1" (25.4mm) extruded polystyrene type 3/4	0.89	5.05
6	3/8" (9.5 mm) Plywood sheathing	0.08	0.47
7	2x6 framing filled with R22 batt @ 16" o.c.	2.55	14.48
8	smart vapour retarder <sup>5</sup>	0.00	0.00
9	1/2" (12.7mm) gypsum board	0.08	0.45
10	finish: 1 coat latex primer and latex paint	0.00	0.00
11	interior air film	0.12	0.68
<b>Effective RSI / R Value of Entire Assembly</b>		<b>3.75</b>	<b>21.30</b>
Centre of Cavity RSI / R Value		5.07	28.82
Installed Insulation RSI / R Value(nominal)		4.76	27.05
Effective RSI / R Value of Assembly with Advanced Framing (advanced framing as defined by NBC9.36.2.4.(1))		3.91	22.21

Note: <sup>1</sup>Values are for generic insulation products. Where a specific insulation product is used in the assembly, the thermal resistance value, or long term thermal resistance value, where applicable, of that product is permitted to be used as reported by the Canadian Construction Materials Centre (CCMC) in the evaluation of such a product. <sup>2</sup>The siding is exterior of the vented air space, therefore excluded from calculation. <sup>3</sup>The vented airspace created by furring for rain screen is not a closed air space therefore excluded as an air cavity. <sup>4</sup>Sheathing membrane material must comply with CAN/CGSB-51.32, "Sheathing Membrane Breather Type." <sup>5</sup>Smart vapour retarder properties are based on [CertainTeed's MemBrain™ Continuous Air Barrier and Smart Vapour Retarder](#) product.

LEGEND High Pass Pass Conditional Pass Conditional Fail Fail

Outboard to Inboard ratio exception - Please check permeance of the non-wood based sheathing. As per 2015 NBC 9.25.5.1 (4), if the non-wood based sheathing has a permeance greater than 30 ng/Pa·m<sup>2</sup> and has a thermal resistance greater than R4, it does not need to comply with the outboard to inboard ratio requirement of 9.25.5.2.

OUTBOARD TO INBOARD RATIO **0.22**

**SIMULATED DURABILITY ANALYSIS**

Note: See WUFI Assumptions. Non-wood based exterior sheathing material that has a water vapour permeance less than 60 ng/(Pa·s·m<sup>2</sup>) must comply to NBC 9.25.5.2.

LOCATION:	Vancouver	Edmonton	Toronto	Montreal	St. John's
DURABILITY RATING BASED ON SIMULATIONS AND FIELD EXPERIENCE					
OUTBOARD TO INBOARD RATIO COMPLIANCE (for listed locations only HDG < 6000)	0.2	0.3	0.2	0.2	0.2

**21.3**

R<sub>eff</sub>

## Summary

This is a relatively durable wall overall in all the climate zones listed, due to both the rain screen properties of the bevelled wood siding, and the benefits of the insulative sheathing, whether installed directly over a water resistive barrier such as asphalt impregnated paper, directly over the insulative sheathing, or installed over vertical furring outboard of the insulative sheathing as required in some jurisdictions (best practice). The bevelled wood siding is water shedding on all painted surfaces, thus minimizing solar-driven moisture issues, while maintaining good drying potential towards the outside due to the ventilation behind the siding for convective drying should any moisture find its way behind it. The asphalt impregnated 30 minute paper and the insulative sheathing act as secondary drainage planes behind the bevelled wood siding, and also reduce the risk of interstitial condensation by raising the temperature of the wall assembly inboard of it.

However, the low vapour permeability of the insulative sheathing reduces the outward drying potential of the assembly inboard of it, so extra care must be taken to minimize the leakage of warm, moist indoor air into the assembly by means of a continuous interior air barrier, and rain water leaks into the assembly must also be managed by proper detailing and use of flashings/sealants etc. Construction or built-in moisture must also be managed to reasonable levels. The variable permeance vapour retarder also allows drying towards the inside

### Notes:

- Any field cut edges must be caulked, painted or primed as per manufacturer guidelines to avoid moisture absorption
- Best practice is to install bevelled wood siding with the fastener heads driven snug against the siding (not flush), as the fastener head can then act as a spacer providing a small air gap where the two boards overlap shingle style, as this provides ventilation for convective drying and allows the assembly to better act as a rain screen

Due to the low permeance of the XPS layer, there is reduced drying potential to the outside.

## Energy & Thermal Performance

- Advanced framing as defined by NBC 9.36.2.4. (1) (e.g. insulated headers, 2 stud corners, ladder blocking, and in-line framing) can potentially reduce the framing factor by 10% to 20%)
- Maximum nominal R-value of cavity insulation is typically limited to R19,20,22,24 (fiberglass batt) to R30 with medium density spray-applied insulation
- Continuous exterior Insulation significantly minimizes the effect of thermal bridging and enhances overall effective R-value of the entire assembly
- Due to the limited permeance of exterior insulation materials, keeping the wall dry through detailed flashing and rigorous air barrier applications is important
- If wood siding is installed over a standard 16" on center stud built wall and furring strips can be lined up with the studs, then a minimum strapping thickness of 10mm (3/8 inch) is permissible. If the strapping is NOT applied directly over studs, then 25mm (full 1 inch thick) strapping MUST be used. See manufacturers installation guidelines in all cases.

## Exterior Moisture/Wetting

- Care must be taken at all penetrations and transitions (windows, etc.) by use of proper detailing as well as sealants and/or flashing to ensure water does not leak into the assembly.

- The lapped board/bevelled wood siding is rain shedding, and therefore acts as a rain screen when installed properly in accordance to manufacturer instructions. All field cut edges must be caulked, painted or primed. Flashing must be installed behind each siding butt joint.
- Unlike polyethylene, a variable permeance "smart" vapour retarder will help the assembly dry to the inside and help reduce risk of moisture accumulation.
- The lapped board/beveled wood siding must be installed over 3/4" or thicker vertical furring to provide ventilation behind the cladding.
- Built-in construction moisture must be managed to reasonable levels.
- The lapped board/bevelled wood siding is non-absorptive and rain shedding.

## Air Leakage Transported Moisture from Inside

- The effect of the insulative sheathing is a reduced risk of interstitial condensation on the wood sheathing or in the stud cavity from warm moisture-laden interior air leaking into the wall assembly, as the insulative sheathing raises the temperature inboard of it, causing the dew point in the heating season mostly to fall outboard of the inner surface of the insulative sheathing.
- For colder climates, the thickness of the insulative sheathing must be increased to maintain dew point condensation from falling outside of the inner surface of the stud cavity and insulative sheathing.
- Air leakage into the assembly must be managed by means of a continuous air barrier (preferably both interior and exterior). Proper detailing at any connection or penetrations (window openings, electrical boxes, plumbing penetrations etc.), will also help reduce heating and air conditioning costs.
- This wall assembly has good drying potential on the outboard side of the XPS towards the outside, but not from the inboard side of the XPS. This is due to the ventilation behind the siding in the furring space allowing for convective drying.

## Water Vapour Diffusion from Outside

- Solar driven moisture is not a significant issue with vinyl, fibre cement, metal, Maibec type coated wood siding (with all surfaces coated) or other similar non-absorptive and rain-shedding sidings, provided they are detailed properly, they have a ventilated (openings at the top and bottom of the assembly) air gap minimum 3/8" behind them, and that they are installed in accordance to manufacturer guidelines.
- The non-absorptive lapped board siding does not have significant solar driven moisture issues when installed properly in accordance to manufacturer instructions. All field cut edges must be caulked, painted or primed. Flashing must be installed behind each siding butt joint.

## Water Vapour Diffusion from Inside

- Vapour diffusion from the inside must be controlled by the installation of a vapour retarding membrane (such as polyethylene, a vapour retarder paint or variable permeance "smart" vapour retarder if the code allows) on the inside behind the gypsum board or painted onto the gypsum board according to code.

## Drying Potential

- If low vapour permeance insulative sheathing is used in an assembly, the outward drying potential of the wall is greatly reduced.
- Built-in moisture must be managed to reasonable levels.

## Ease of Construction

- This wall is easily constructed through traditional stick frame methods on-site
- Exterior wood sheathing provides both structural resistance to "racking" and a nailing substrate for cladding materials
- 19.2" stud spacing will typically require exterior sheathing and/or insulation panels to be installed horizontally, whereas 16" and 24" stud spacing can accommodate vertically installed panels (most panel goods have fastener spacing guidelines printed on the material based on vertical installation)
- Insulation, weather barrier and air barrier details and materials are readily available and understood within the Canadian industry
- Constructing walls with exterior insulation is rapidly becoming common practice in some Canadian Zones
- Handling, application and process integration of rigid insulation by Suppliers and Framers can initially affect cycle time - however, production cycle times quickly return to normal after the first few built units
- Materials such as studs, wood sheathing panels and/or insulation sheet goods are readily available in pre-cut lengths for 8' and 9' wall heights
- Exterior insulating sheathing can be an effective exterior air barrier when joints and seams are properly sealed with compatible air barrier qualified tapes, mastic, or caulking
- Prior to installation, furring strips shall be installed. It is very important to ensure adequate air circulation and drainage between the siding and sheathing so that walls can dry in all seasons and conditions. It is critical to follow manufacturer installation requirements and local prevailing building codes regarding drainage details and/or rain screen requirements.
- Wood siding cannot be applied DIRECTLY over/in contact with concrete forms (ICF) or continuous exterior insulated foam sheathings . See wood siding manufacturers installation requirements for fastening instructions when applying to ICF or insulated foam sheathing assemblies.
- The fastener spacing, size, and embedment into the backup wall attaching the insulation and cladding depends on the cladding weight, the stud spacing of the backup wall, the sheathing type and thickness, and the exterior insulation type and thickness.

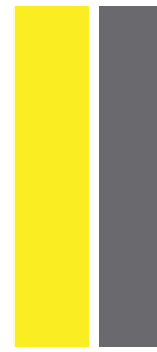
## Affordability: Cost Implications

- Cost of exterior rigid insulation material and labour vary widely from region to region
- Reduction in wood use framing stud members is possible (19.2" OR 24" o.c.) with no additional engineering required.
- Alternative bracing methods can be substituted for the wood sheathing panel (e.g. T-slot inlet bracing) - however, details for wall bracing, tall walls, and more than 3-storey construction may require additional engineering
- Wall thickness adjustment could require minor increase of foundation wall thickness (e.g. 8" to 10" foundation width) and increase costs
- Wall thickness adjustment could require minor jamb extensions or additional trim details on openings in the enclosure (i.e. for windows and doors)
- Advanced framing as defined by NBC 9.36.2.4. (1) (e.g. insulated headers, 2 stud corners, ladder blocking, and in-line framing) can potentially reduce overall lumber costs by upwards of 10 to 20% (i.e. for softwood and panel products)

## Esthetics: Architectural Design

- This wall assembly design can be used up to 3 storey construction under most prevailing building codes

- Exterior wood sheathing provides a nailing substrate for cladding materials including various siding applications (vertical or horizontal)
- Wall thickness adjustment could require minor increase of foundation wall thickness (e.g. 8" to 10" foundation width) and increase costs
- Wall thickness adjustment could require minor jamb extensions or additional trim details on openings in the enclosure (i.e. for windows and doors)
- Exterior wall dimension width may have minor effect on interior dimensions (i.e. stair widths on exterior walls and overall interior useable square footage)



**DISCLAIMER:** The Canadian Wood Council's Wall Thermal Design Calculator has been developed for information purposes only. Although all possible efforts have been made to ensure that the information on this tool is accurate, the CWC cannot under any circumstances guarantee the completeness, accuracy or exactness of the information. Reference should always be made to the appropriate Building Code and/or Standard. This tool should not be relied upon as a substitute for legal or design advice, and the user is responsible for how the tool is used or applied.

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