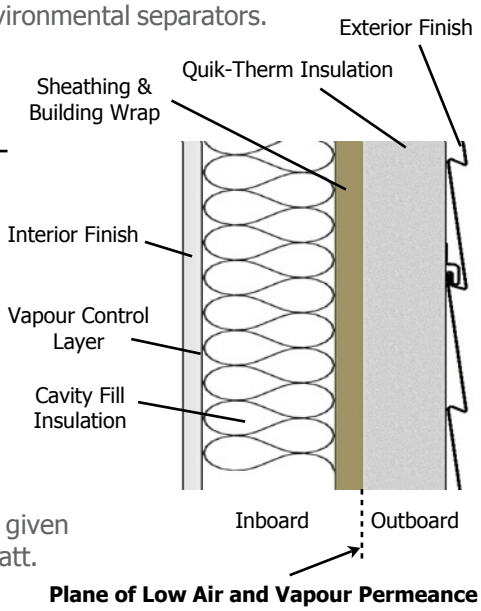
Inboard/Outboard Insulation Ratio

Article 9.25.5.2. Position of Low Permeance and Table 9.25.5.5 of the 2010 National Building Code of Canada (NBCC), defines the "Minimum Ratio of Total Thermal Resistance Outboard of Material's Inner Surface to the Total Thermal Resistance Inboard of Material's Inner Surface" for different climates defined by heating degree-days. The calculation, detailed in Appendix A-9.25.5.2., is based on nominal R-values for all building materials and air films. Table 9.25.5.2 assumes there is a vapour barrier on the warm side of the assembly.

Intent of the Code - 9.25.5.1.(1)

Intent 1. To limit the probability that, where separate products are used for the vapour barrier and insulation, the location of the vapour barriers in the assembly is at a plane in the building envelope where the temperature is sufficiently low to cause the condensation of water vapour from interior spaces on interior surfaces or within assemblies. This limits the probability of:

- condensation, or
- compromised thermal performance of components intended to provide resistance to heat transfer.
- an inadequate control of the temperature of interior spaces or relative humidity,
- the generation of pollutants from biological growth or from materials that become unstable on wetting, or
- deterioration, which could lead to compromised integrity of assemblies acting as environmental separators.
- negative effects on the air quality of indoor spaces, and
- the inadequate thermal comfort of persons.
- This is to limit the probability of harm to persons.



Calculating Inboard to Outboard Thermal Resistance

The calculation for In-board / Out-board insulation is based on the following principles:

- Heating degree days for regions across Canada,
- The inboard / outboard ratio is based on the nominal R-value for the total of all building components including - air films, gypsum, batt insulation, exterior sheathing, rigid board insulation, cladding, etc.

Minimum Outboard Insulation Requirement

The table below provides a calculation for the minimal nominal out-board R-value of a given typical wall assembly involving a 2" x 6" steel or wood stud wall with R 20 fiberglass batt.

Heating Degree Zones	Heating Degree Days	Min. RSI Ratio	Min. Outboard Insulation (RSI)	Min. Outboard Insulation (R-Value)	Recommended Quik-Therm Thickness Nominal R-Value (Type 2)
4, 5, 6	<4999	0.20	0.62	3.5	25 mm (1") *
7A	5000 to 5999	0.30	0.99	5.6	38 mm (1.5") *
7B	6000 to 6999	0.35	1.18	6.7	43 mm (1.75")
8	7000 to 7999	0.40	1.37	7.8	50 mm (2")
All Other Regions	8000 to 8999	0.50	1.74	9.9	63 mm (2.5")
	9000 to 9999	0.55	1.93	10.9	69 mm (2.75")
	10000 to 10999	0.60	2.11	12.0	75 mm (3")
	11000 to 11999	0.65	2.30	13.0	81 mm (3.25")
	>12000	0.75	2.67	15.2	94 mm (3.75")

* For Zones 4,5,6 and 7A, thicker insulation may be required depending on wall design and assembly components. Check local building codes.

** Quik-Therm Solar Dry and Connect Air Dry allow walls to breathe. There is no double vapour barrier. These systems are designed for hybrid wall assemblies that contain cavity batt insulation.

"Note that in an assembly using conventional foam exterior insulation panels, there will be a double vapour barrier, which limits the drying capacity of the assembly. The cavity provided by Quik-Therm Solar Dry (installed as per manufacturer's recommendations) provides a technical advantage. The vertical cavities, open at the base, provide a drying path to the outside." Mark Lawton - Morrison Hershfield

Building Science: Healthy, Energy Efficient & Sustainable Walls

quiktherm.com

Moisture management is the single most important factor in the design and construction of sustainable buildings and mold control. 90% of all building construction problems are related to water.

Rainscreen:

A minimum 10 mm air gap between continuous rigid insulation (ci) and exterior cladding. Walls drain and dry to the outside.

** "Building Science experts have proven rainscreen assemblies maximize the service life of buildings through superior moisture management (drainage and drying)." *James Hardie Siding*

Drainage/Drying Plane:

A small air gap between substrate materials (exterior drywall, OSB, etc.) and rigid ci. Walls "breathe" (disperse water vapour) to the outside.

** "In an assembly using conventional foam there will be a double vapour barrier, which limits the drying potential of the assembly. The cavity provided by Quik-Therm Solar Dry provides a technical advantage. The vertical cavities open at the base, providing a drying path to the outside." *Mark Lawton - Morrison Hershfield*

** "We have learned from our Vancouver work that we can get effective moisture redistribution and buffering and some outward drying by providing a small gap between the OSB sheathing and the impermeable or low permeable insulating sheathing." *By Joseph W. Lstiburek, Ph.D., P.Eng., Fellow ASHRAE*

Weather Resistant Barrier (WRB):

Thin layers which resist liquid water that has penetrated behind exterior cladding. WRB's improve the overall moisture efficiency and performance of a building's wall system. Water is channeled down and outward which reduces the likelihood of moisture problems, rot and degradation.

Conventional R-value Testing:

ASTM C518 is the most commonly referenced R-value test method. Testing is conducted at 75°F (23.9°C) with a temperature differential of 50°F (27.8°C). Insulations are typically tested with the cold side at 50°F (10°C) and the warm side at 100°F (37.8°C). This temperature range does not reflect how insulations perform in Canadian winter like conditions. It is anticipated the next code cycle will recommend insulation be tested at -18°C cold side / +21°C warm side.

Effective R-value:

"The use of effective R-values when evaluating the thermal resistance of an assembly is preferable to using the nominal R-value of the insulation alone. The benefits of this approach have been demonstrated in results obtained through laboratory tests such as ASTM C1363 and by data published in ASHRAE 90.1" - Mark Lawton - Morrison Hershfield

Long Term Thermal Resistance (LTTR):

The R-value of XPS and Polyiso decreases as gasses in the pores from the manufacturing process diffuse out and are replaced with air. The Canadian Construction Materials Center (CCMC) rates the per inch LTTR for XPS at 4.77. In cold climates like Canada, the estimated per inch LTTR for Polyiso is 5. ** Building Science Corporation - 2013

Carbon:

Sourcing of materials is an important component in building green. The distance a material has been shipped, composition of the material, and the manner in which it was created all come into consideration. Shipping materials long distances burns more fuel, making a larger carbon footprint, while materials found closer to home require less fuel for transport.