CCMC CANADIAN CODE COMPLIANCE EVALUATION

CCMC EVALUATION

CCMC 14280-R

CCMC Canadian code compliance evaluation

CCMC number:	14280-R
Status:	Active
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Evaluation holder:	**Huntsman Building Solutions (Canada) Inc.** 870, Curé-Boivin Boisbriand QC J7G 2A7 Canada Website: huntsmanbuildingsolutions.com/en-CA/ Telephone: 450-437-0123 Email: infoCanada@huntsmanbuilds.com
Product names:	• Airmetic® SOYA HFO - Radon Protection System • Heatlok® SOYA HFO - Radon Protection System • Polarfoam SOYA HFO - Radon Protection System
Code compliance:	NBC 2015
Evaluation requirements:	CCMC-TG-072623.01-15 "CCMC Technical Guide for Medium Density (MD) Spray Polyurethane Foam Insulation (SPUF) for Soil Gas (Radon) Control beneath Concrete Slabs-on-Ground"

In most jurisdictions this document is sufficient evidence for approval by Canadian authorities.
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Code compliance opinion

It is the opinion of the Canadian Construction Materials Centre that the evaluated products, when used as a soil gas (radon) barrier in accordance with the conditions and limitations stated in this evaluation, comply with the following code:

National Building Code of Canada 2015

Code provision	Solution type
9.13.4.2.(1) All wall, roof and floor assemblies sepa ...	Acceptable
9.25.3.6.(1) Materials used to provide a barrier to t ...	Alternative

The above opinion is based on the evaluation by the CCMC of technical evidence provided by the evaluation holder, and is bound by the stated conditions and limitations. For the benefit of the user, a summary of the technical information that forms the basis of this evaluation has been included.

Product information

Product names

- Airmetic® SOYA HFO - Radon Protection System
- Heatlok® SOYA HFO - Radon Protection System
- Polarfoam SOYA HFO - Radon Protection System

Product description

The product is an under-slab barrier designed to restrict naturally occurring radon gas from migrating through the ground and concrete slab. It is a closed-cell, spray-applied rigid polyurethane foam of medium density

,

evaluated under CCMC 14078-L, and consists of two components that must be labelled as follows:

- Isocyanate (Component A): A100 Isocyanate; and
- Resin (Component B): Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO resin.

The two components are mixed on site by Huntsman Building Solutions (Canada) Inc.-qualified installers (see the Qualified installers section below) with fixed-ratio positive displacement equipment. The colour of the installed final cured Heatlok® SOYA HFO and Airmetic® SOYA HFO products are green. The colour of the installed final cured Polarfoam SOYA HFO product is peach.

Qualified installers and site quality assurance program (SQAP)

Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO for radon control is a site-manufactured product, whereby Huntsman Building Solutions (Canada) Inc. requires that only specific qualified installers be authorized to install their proprietary spray polyurethane insulation in buildings. In accordance with the Huntsman Building Solutions (Canada) Inc. site quality assurance program (SQAP), the certification organization Caliber Quality Solutions Inc. (Caliber) has been commissioned to license the specified installers and issue them the requisite Caliber identification card. Note that the training and installer certification to install Heatlok® SOYA HFO, Airmetic SOYA HFO, Polarfoam SOYA HFO for radon control is in addition to the base Caliber/Huntsman Building Solutions (Canada) Inc. training for the spraying of polyurethane foam as a thermal insulation only in accordance with CAN/ULC-S705.2-05(R2016), “Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Application”). As part of their SQAP, Huntsman Building Solutions (Canada) Inc. also stipulates that site-audit inspections be conducted by site inspectors licensed by Caliber. Upon completion of the site audit, Caliber will report the product’s conformity results and any corrective action required, if necessary, to Huntsman Building Solutions (Canada) Inc. Building officials who would like site-audit inspections to be conducted on specific building sites can contact Caliber (see details in CCMC 14078-L).

All specified installers must present a Caliber identification card to the building official that indicates the installer is certified to install the spray foam for both intended functions; that is, as a thermal insulation (CAN/ULC-S705.2-05(R2016)) and as an air/radon barrier.

Thickness – spray foam and gravel drainage layer

Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO for radon control requires a minimum of 38-mm spray polyurethane to be installed. The spray polyurethane may be sprayed directly over the NBC-specified 100-mm gravel bed

or onto a geotextile. When applied directly over the gravel bed, the foam resin may penetrate up to 24 mm into the cavities between the surface gravel. For direct gravel applications, the gravel bed shall be increased to 124 mm to ensure a minimum 100-mm gravel bed as the gas-permeable layer to evacuate the radon gas.

Radon resistance

It should be noted that Sentence 9.13.4.2.(1) of Division B of the NBC 2015 requires an effective air barrier system be installed as a barrier to soil gas. Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO has qualified as an air barrier system required by the NBC 2015 for soil gas, as outlined in Table 2, air barrier system performance and, in Table 3, effective barrier performance to, specifically, radioactive radon. Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO, when installed at 38 mm, shows better resistance to radon than 6-mil polyethylene (that is, the NBC 2015 benchmark acceptable solution).

Manufacturing plant

This evaluation is valid only for products produced at the following plant:

Product names	Manufacturing plant
	Boisbriand, QC, CA
Airmetic® SOYA HFO - Radon Protection System	⊘
Heatlok® SOYA HFO - Radon Protection System	⊘
Polarfoam SOYA HFO - Radon Protection System	⊘

⊘ Indicates that the product from this manufacturing facility has been evaluated by the CCMC

Conditions and limitations

The CCMC's compliance opinion is bound by this product being used in accordance with the conditions and limitations set out below.

- The system must be applied on site by qualified installers who are Huntsman Building Solutions (Canada) Inc.-trained and Caliber-certified and who possess a Caliber identification card. (1) The SQAP and installation manual shall be available on site for review by the local authority having jurisdiction (AHJ).
- The thickness of the specified medium-density spray polyurethane foam shall be a minimum of 38 mm when installed over geotextile. When sprayed directly onto the gravel, the NBC-specified 100-mm gravel bed shall be increased to 124 mm for 3/4 in. gravel and to 118 mm for 1/2 in. and 1/4 in. gravel. Per Sentence 9.16.2.1.(1), Required Installation of Granular Material, of Division B of the NBC 2015, the specified gravel shall consist of coarse, clean granular material containing not more than 10% of material that will pass a 4 mm sieve.
- A minimum of 24 h shall pass before the installation of the 100-mm concrete floor slab.
- As with the 6-mil polyethylene sheet, care shall be taken to not damage the spray polyurethane surface during the installation of the concrete slab; in particular, damage from any reinforcement mesh.
- Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO has shown ability to seal around penetrations of 100-mm CPVC, copper, concrete and cast iron pipes and 38-mm ABS pipes, without need for sealant. Other materials may require additional sealant (that is, polyethylene pipes).

	Note
1	Periodic site-audit inspections of the installer are conducted by Caliber. Building officials may contact Caliber (telephone: 888-572-7435) and require an inspection for a specific job site if the building official deems it necessary.

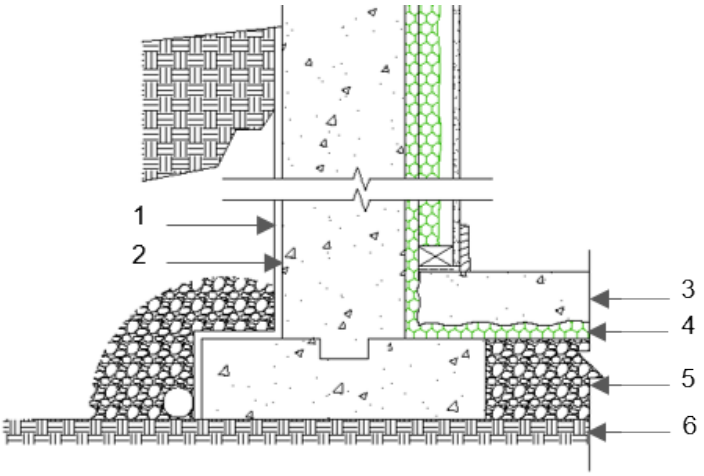

Figure 1. Application of Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO for radon control beneath concrete slab, with geotextile/100 mm gravel or without geotextile/118 to 124 mm gravel bed.

1. Exterior wall dampproofing
2. Concrete foundation wall
3. Concrete floor slab

4. Minimum 38-mm thick Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO (CCMC 14078-L)
5. 100 mm granular fill with geotextile, or 118 to 124 mm granular fill
6. Original soil

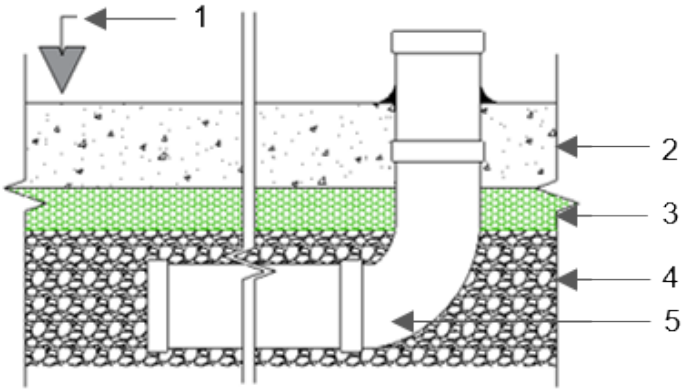

Figure 2. Application of Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO for radon control beneath concrete slab, with geotextile/100 mm gravel or without geotextile/118 to 124 mm gravel bed.

1. Centre of floor slab
2. Concrete floor slab
3. Minimum 38-mm thick Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polarfoam SOYA HFO (CCMC 14078-L)
4. 100 mm granular fill with geotextile, or 118 to 124 mm granular fill
5. Exhaust pipe

Technical information

This evaluation is based on demonstrated conformance with the following criteria:

Criteria number	Criteria name
CCMC-TG-072623.01-15	CCMC Technical Guide for Medium Density (MD) Spray Polyurethane Foam Insulation (SPUF) for Soil Gas (Radon) Control beneath Concrete Slabs-on-Ground

The Report Holder has submitted technical documentation for CCMC's evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

Performance requirements

The following were the key performance requirements for the evaluation:

1. **Material qualification:** Medium-density spray polyurethane foam (SPUF) complying with CAN/ULC-S705.1, and installation as per CAN/ULC-S705.2. Confirmed through possession of active CCMC Listing;
2. **Air barrier system:** The air barrier system for floors-on-ground qualification through testing. The NBC 2015 benchmark is 6-mil polyethylene as per Sentence 9.25.3.6.(1) of Division B of the NBC 2015 and;
3. **Soil gas barrier:** The barrier performance against soil gas, specifically radon, based on qualification testing, small-scale and large-scale. The NBC 2015 benchmark is 6-mil polyethylene as per Sentence 9.13.4.2.(1) of Division B of the NBC 2015, referring to Sentence 9.25.3.6.(1) and;
4. **Resistance to mechanical damage:** Repeat small-scale radon-barrier testing with indented SPUF by simulated concrete pour/workman load damage.

Table 1. Material qualification

SPUF product CAN/ULC-S705.1 compliance	Thermal insulation in field (CAN/ULC-S705.2) site quality assurance program (SQAP)	Radon barrier in field Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polar Foam SOYA HFO site quality assurance program (SQAP)
CCMC 14078-L (Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polar Foam SOYA HFO)	Huntsman Building Solutions (Canada) Inc.-trained and Caliber-certified installers	Huntsman Building Solutions (Canada) Inc.-trained and Caliber-certified installers

Table 2. Air barrier system performance

Material	Test procedure	Unit	Requirement	Result
SPUF product CCMC 14078-L sealing around pipe penetrations (1)	ASTM E 2178/E 2178M-13 (1)	$L/(s \cdot m^2)$	0.02 (2)	0.0041 – 0.0045 (3)
6-mil polyethylene	NBC 2015 Table A-9.25.5.1. (1)	$L/(s \cdot m^2)$	NBC-acceptable solution benchmark	negligible

Notes

1 The tested 1 m × 1 m specimens of 38-mm-thick SPUF contained a 100-mm diameter CPVC, copper, concrete and cast iron pipe to verify the SPUF sealing to elements that may penetrate Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polar Foam SOYA HFO in the field. The 6-mil polyethylene with a pipe penetration and tape/sealant was not tested.

2 The derivation of the criterion is based on the permitted air leakage of a fixed window per length of seal/joint (that is, 0.068 L/s/m. The circumference of the 100-mm pipe is 319 mm, resulting in a criterion of 0.319 m × 0.068 l/s/m = 0.0217 L/s.

3 Although this air leakage performance is not as low as the negligible performance for a 6-mil polyethylene sheet without a pipe penetration, this air leakage performance is still extremely low. This testing used air as the medium to compare SPUF to 6-mil polyethylene, the comparison in Table 3 Radon barrier performance for Huntsman Building Solutions (Canada) Inc. SPUF product CCMC 14078-L at 38-mm thickness below using radioactive radon (Rn) gas as the medium for comparison is the key performance indicator for evaluating/comparing the performance as a barrier to radon gas.

Table 3. Radon barrier performance for Huntsman Building Solutions (Canada) Inc. SPUF product CCMC 14078-L at 38-mm thickness

Property	Unit	Requirement (1)	Result
Small-scale tests			
Radon diffusion coefficient (D) (2)	m^2/s	$< 2.19 \times 10^{-11}$ m^2/s 6-mil polyethylene NBC benchmark	negligible (3)
Radon resistance (R_{radon}) (4)	s/m	≥ 6.96×10^6 s/m 6-mil polyethylene NBC benchmark	– (3)
Radon diffusion coefficient (D) after mechanical damage	m^2/s	$< 2.19 \times 10^{-11}$ m^2/s 6-mil polyethylene NBC benchmark	– (3) (5)
Radon resistance (R_{radon}) after mechanical damage	s/m	≥ 6.96×10^6 s/m 6-mil polyethylene NBC benchmark	– (3) (5)
Large-scale tests			
Radon infiltration (Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polar Foam SOYA HFO and floor assembly)	%	< 37.6 % (RnR/RnD) (6) 6-mil polyethylene NBC benchmark	3.0

Notes

1 The radon diffusion coefficient represents a material property that depends primarily on its chemical composition and is not affected by its thickness. A new product parameter known as radon resistance was defined in order to more accurately evaluate the effectiveness of material in reducing or preventing radon entry. Materials with higher radon resistance are considered less permeable to radon and therefore can prevent or reduce radon entry more effectively.

2	Testing was conducted using NRC Radon Diffusion Test Chamber (RDTC) (see Appendix A for schematic of test apparatus).
3	The radon diffusion coefficient for the SPUF products could not be obtained, and, as such, the radon resistance could not be calculated, since no significant amount of radon diffused through the SPUF samples during the radon diffusion tests. Therefore, the SPUF at 38-mm thickness is better than the 6-mil polyethylene benchmark as a barrier to radon in this small-scale test.
4	Testing was conducted using NRC Radon Infiltration Building Envelope Test Systems (RIBETS) (see Appendix A for schematic of test facility).
5	A comparison between the radon diffusion coefficients of material of different thicknesses may not represent the effectiveness of a material in reducing or preventing radon entry. The calculated radon resistance of the Heatlok® SOYA HFO, Airmetic® SOYA HFO, Polar Foam SOYA HFO SPUF sample after mechanical damage is the preferred property for assessing the performance.
6	The radon-measured levels ratio (Rn_R/Rn_D) is for comparison of the alternative solution to the benchmark acceptable solution. The numerator with subscript "R" represents the radon in the receiving chamber and the numerator with subscript "D" represents the radon in the dosing chamber. Therefore, the SPUF at 38-mm thickness is better than the 6-mil polyethylene benchmark as a barrier to radon in this large-scale test, which is representative of the installation in the field.

NRC Construction Research Centre Radon Testing Facilities

(1) Small-scale Tests Radon Diffusion Test Chamber (RDTC)

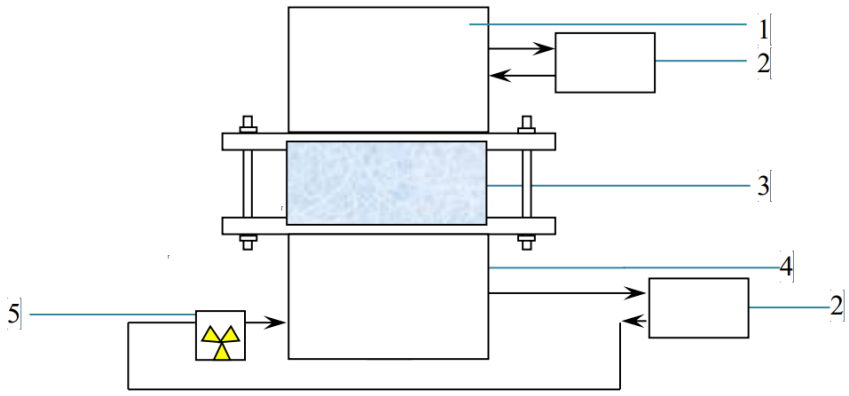

Figure 3. Schematic of RDTC

1. Receiving compartment
2. Radon monitor
3. Test sample
4. Dosing compartment
5. Radon source

(2) Large-scale Tests Radon Infiltration Building Envelope Test Systems (RIBETS)

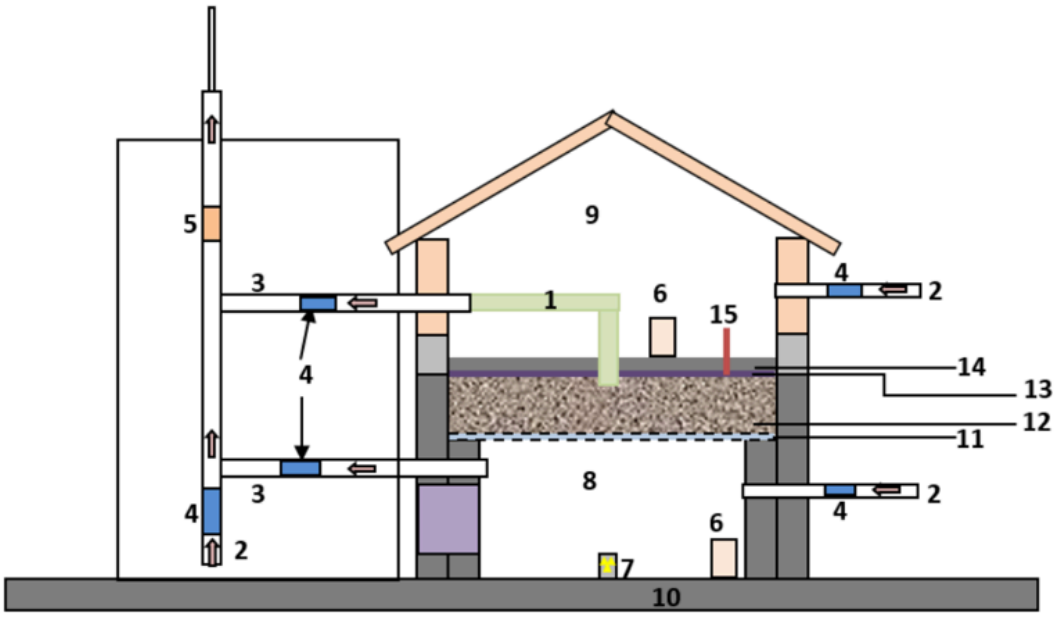

Figure 4. Conceptual design of the RIBETS

1. Sub-slab radon (Rn) exhaust stack (100 mm PVC pipe)
2. Make-up air stack
3. Exhaust stack
4. Control damper
5. In-line fan
6. Baseboard heater
7. Radon source
8. Dosing compartment
9. Receiving compartment
10. Concrete pad
11. Perforated stainless steel plate
12. Gravel (100 mm), specification as per NBC 2015 and NBC 2020
13. Air barrier (6-mil polyethylene or spray foam products)
14. Concrete slab (101.6 mm)
15. Copper tubing for pressure measurement

Administrative information

Disclaimer

This evaluation is issued by the Canadian Construction Materials Centre (CCMC), a part of the Construction Research Centre at the National Research Council of Canada (NRC). The evaluation must be read in the context of the entire CCMC Registry of Product Assessments and the legislated applicable building code in effect.

The CCMC was established in 1988 on behalf of the applicable regulator (i.e., the provinces and territories) to ensure—through assessment—conformity of alternative and acceptable solutions to regional building codes as determined by the local authority having jurisdiction (AHJ) as part of the issuance of a building permit.

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Canadian Construction Materials Centre
Construction Research Centre
National Research Council of Canada
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Language

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> Most Canadian authorities having jurisdiction (AHJs) consider CCMC product assessments acceptable as evidence for product approval.

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First Nations National Building Officers Association (FNNBOA)	(First Nations National Building Officers Association (FNNBOA))
Canadian Home Builders' Association (CHBA)	(Canadian Home Builders' Association (CHBA))
Alberta Building Officials Association (ABOA)	(Alberta Building Officials Associations (ABOA))
Saskatchewan Building Officials Association (SBOA)	(Saskatchewan Building Officials Association (SBOA))
Manitoba Building Officials Association (MBOA)	(Manitoba Building Officials Association (MBOA))
Ontario Building Officials Association (OBOA)	(Ontario Building Officials Association (OBOA))
New Brunswick Building Officials Association (NBBOA)	(New Brunswick Building Officials Association (NBBOA))
Nova Scotia Building Officials Association (NSBOA)	(Nova Scotia Building Officials Association (NSBOA))

> The CCMC provides code compliance assessments to Canadian code requirements, consulting nationwide with construction regulators to elicit regional variations in code requirements as well as provincial and local interpretations. Users are advised to review the technical information presented in CCMC assessments when making approval decisions. Learn more about how the CCMC provides a unique service for Canada.

For more information, contact the CCMC by phone at (613) 993-6189 or by email at ccmc@nrc-cnrc.gc.ca

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Code compliance as an acceptable solution

Code Compliance via Acceptable Solutions

> If a building design (e.g. material, component, assembly or system) can be shown to meet all provisions of the applicable **acceptable solutions** in Division B (e.g. it complies with the applicable provisions of a referenced standard), it is deemed to have satisfied the objectives and functional statements linked to those provisions and thus to have complied with that part of the Code.
>
> — **National Building Code of Canada, Sentence A-1.2.1.1.(1)(a)**

The CCMC has determined that compliance with this provision of the Code has been demonstrated as an **Acceptable Solution**. The evaluation report provides a summary of the basis of CCMC's compliance opinion.

CCMC's code compliance opinions

All CCMC evaluation reports are opinions of code compliance established in accordance with the National Building Code of Canada, Subsection 1.2.1. "Compliance with this Code," which requires compliance to be achieved by:

- complying with the applicable acceptable solutions in Division B, or
- using an alternative solution that will achieve at least the minimum level of performance required by Division B in the areas defined by the objective and functional statements attributed to the applicable acceptable solutions.

The CCMC assesses compliance with Canadian building, energy and safety codes, and is trusted by over 6,000 regulators across Canada.

Code compliance as an alternative solution

Code Compliance via Alternative Solutions

> Where a design differs from the acceptable solutions in Division B, then it should be treated as an "**alternative solution**." A proponent of an alternative solution must demonstrate that the alternative solution addresses the same issues as the applicable acceptable solutions in Division B and their attributed objectives and functional statements. However, because the objectives and functional statements are entirely qualitative, demonstrating compliance with them in isolation is not possible. Therefore, Clause 1.2.1.1.(1)(b) identifies the principle that Division B establishes the quantitative performance targets that alternative solutions must meet. In many cases, these targets are not defined very precisely by the acceptable solutions [...] Nevertheless, Clause 1.2.1.1.(1)(b) makes it clear that an effort must be made to demonstrate that an alternative solution will perform as well as a design that would satisfy the applicable acceptable solutions in Division B—not “well enough” but “as well as.”
>
> — **National Building Code of Canada, Sentence A-1.2.1.1.(1)(b)**

The CCMC has determined that compliance with this provision of the Code has been demonstrated as an **Alternative Solution**. The evaluation report provides a summary of the basis of CCMC's compliance opinion.

CCMC's code compliance opinions

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