

Building Policy Branch Discussion Paper

**Topic: National Building Code change:
rainscreen requirements for Part 9 buildings**

Purpose: For Discussion

Issue Summary: A change to the 2005 National Building Code will require cladding on Part 9 buildings in specified climates to either incorporate a capillary break (“rainscreen”) or comply with the provisions of Part 5. The Building Policy Branch is seeking to determine whether this change is an appropriate and feasible minimum standard for BC.

Background:

A change to Part 9 of the National Building Code will establish new requirements for building envelope construction in housing and small buildings. If adopted in BC, Part 9 buildings in coastal areas would have to either meet new standards requiring a capillary break (“rainscreen”), or comply with the provisions of Part 5.

The stated rationale for this change is that the code currently provides a general requirement to restrict ingress of precipitation into wall assemblies but does not define the extent of that restriction, nor does it apply to masonry or stucco.

The NBC change applies only to Part 9 buildings (the standards for Part 5 leave the determination of the need for rainscreen to the discretion of the building designer). Although industry has been consulted, limited input has been obtained from the sector most directly affected by the proposal, the home builders.

Policy Issue(s):

Before implementing this code change, the Building Policy Branch needs to obtain further insight into current practices for cladding on Part 9 buildings (primarily houses) and the performance of the building envelope on small buildings using current practices. The branch then needs to consider whether the code change represents an appropriate minimum standard for BC. The Branch would appreciate input from Building Envelope Council members.

A copy of the code change is attached.

Revised Section 9.27 for the 2005 NBC

Replace **Subsection 9.27** with the following:

As a consequence of this change, delete Subsection 9.23.17. and move its contents to the new Subsection 9.27.3. as shown below; renumber and relocate existing Appendix notes:

A-9.23.17.2.(1) to A-9.27.3.3., A-9.23.17.4.(2) to A-9.27.3.5.(2), A-9.23.17.5.(1) to A-9.27.3.6.(1), and
A-9.23.17.6. to A-9.27.3.7.

9.27 Cladding

9.27.1. Application

9.27.1.1. General

- 1) Where lumber, wood shingles, shakes, fibre-cement shingles, planks and sheets, plywood, OSB, waferboard, hardboard, vinyl, aluminum and steel, including trim and soffits, are installed as cladding on wood-frame walls exposed to precipitation, the cladding assembly shall comply with
 - a) Subsections 9.27.2. to 9.27.13., or
 - b) Part 5.
- 2) Where stucco is installed as cladding on wood-frame or masonry walls exposed to precipitation, the cladding assembly shall comply with
 - a) Subsections 9.27.2., 9.27.3. and 9.27.4., and Section 9.28, or
 - b) Part 5.
- 3) Where masonry serves as cladding on wood-frame or masonry walls exposed to precipitation, the cladding assembly shall comply with
 - a) Subsections 9.27.2. to 9.27.4., and Section 9.20., or
 - b) Part 5.
- 4) Where asphalt shingles are installed as cladding on wood-frame walls exposed to precipitation, the cladding assembly shall comply with
 - a) Subsections 9.27.2., 9.27.3. 9.27.4., and 9.26.7., or
 - b) Part 5.
- 5) Where cladding materials other than those described in Sentences (1) to (4) are installed, or where these are installed on substrates other than those identified in Sentences (1) to (4), the materials and installation shall comply with Part 5.

9.27.2. Required Protection from Precipitation

(See A-9.27.2. in Appendix A.)

9.27.2.1. Minimizing and Preventing Ingress and Damage

- 1) Except where exterior walls are protected from precipitation or where it can be shown that ingress will not adversely affect occupant health or safety, exterior walls shall be designed and constructed to
 - a) minimize ingress of precipitation into the assembly, and
 - b) prevent ingress into interior space.
(See Appendix A-9.27.2.1.)

- 2) Except where exterior walls are protected from specific mechanisms of deterioration, such as mechanical impact and ultraviolet radiation, exterior walls shall be designed and constructed to minimize the likelihood of required performance being reduced to an unacceptable level as a result of those mechanisms.

9.27.2.2. Minimum Protection from Precipitation Ingress

- 1) Except as provided in Sentence (2), a wall assembly is deemed to have a capillary break between the cladding and the back-up assembly where
 - a) there is a drained and vented air space not less than 10 mm in depth behind the cladding for the full height and width of the wall (see also Article 9.27.5.3.),
 - b) an open drainage material, not less than 10 mm thick and with not less than 80% open cross-sectional area, is installed between the cladding and the back-up for the full height and width of the wall, or
 - c) the cladding is loosely fastened to the back-up and there is a clear air space behind each cladding component that is
 - i) continuous for the full width of the component,
 - ii) not less than 10 mm in depth at the bottom of the component, and
 - iii) not less than 6 mm in depth over not less than 90 mm for every 230 mm of exposed height of the component (See A-9.27.2.2. in Appendix A), or
 - d) the wall is a masonry cavity wall or the cladding is masonry veneer constructed according to Section 9.20.
- 2) The drained and vented air space and drainage material described in Sentence (1) may be interrupted by
 - a) penetrations for windows, doors and services, and
 - b) flashing, and
 - c) furring provided the furring does not comprise more than 20% of the furred area.
- 3) Where a construction projects over the top of the drained and vented air space described in Clause (1)(a) or the drainage material described in Clause (1)(b), the air space or drainage material shall not be contiguous with concealed spaces in the projecting construction.
- 4) Exterior walls exposed to precipitation shall be protected against ingress of precipitation with an exterior cladding assembly consisting of a first plane of protection and a second plane of protection where the wall encloses spaces of residential occupancy or spaces that directly serve spaces of residential occupancy.
- 5) Except as provided in Sentence (6), exterior walls exposed to precipitation shall be protected against precipitation ingress with an exterior cladding assembly consisting of a first plane of protection and a second plane of protection incorporating a capillary break where

[This is the Sentence requiring a capillary break in BC's coastal climate.]

 - a) the number of degree-days is less than 3400 and the moisture index is greater than 0.90, or
 - b) the number of degree-days is 3400 or more, and the moisture index is greater than 1.00.

(See Sentence 2.2.1.1.(1) and Appendix C for information on moisture index.)
- 6) In exterior walls described in Sentence (5), the first and second plane of protection need not incorporate a capillary break where

- a) it can be shown that omitting the break will not adversely affect the performance of building assemblies, or
- b) the building is an accessory building, or
- c) the wall
 - i) is constructed with non-moisture sensitive materials, and intersecting or supported floors are constructed with non-moisture sensitive materials, or
 - ii) is constructed as a mass wall with sufficient thickness to minimize the transfer of moisture to the interior.

9.27.2.3. First and Second Planes of Protection

- 1) Where walls required to provide protection from precipitation are comprised of first and second planes of protection,
 - a) the first plane of protection shall
 - i) consist of cladding, with appropriate trim, accessory pieces and fasteners, and
 - ii) be designed and constructed to minimize the passage of rain and snow into the wall by minimizing holes and managing precipitation ingress due to kinetic energy of raindrops, surface tension, capillarity, gravity, and air pressure difference.
(See Subsections 9.27.4. to 9.27.13.),
 - b) the second plane of protection shall be designed and constructed to
 - i) intercept all rain and snow that gets past the first plane of protection, and
 - ii) effectively dissipate it to the exterior.
(See Subsection 9.27.3.), and
 - c) the protection provided by the first and second planes of protection shall be maintained at
 - i) wall penetrations created by the installation of components and services such as windows, doors, ventilation ducts, piping, wiring and electrical outlets, and
 - ii) the interface with other wall assemblies.

9.27.2.4. Protection of Cladding from Moisture

- 1) Not less than a 200 mm clearance shall be provided between finished ground and cladding, such as untreated wood, plywood, OSB, waferboard and hardboard, that is adversely affected by moisture.
- 2) Not less than a 50 mm clearance shall be provided between a roof surface and cladding that is adversely affected by moisture, such as untreated wood, plywood, OSB, waferboard and hardboard.

9.27.3. Second Plane of Protection

9.27.3.1. Elements of the Second Plane of Protection

(See A-9.27.3.1. in Appendix A.)

- 1) The second plane of protection shall consist of a drainage plane with appropriate inner boundary and flashing to dissipate rainwater to the exterior.
- 2) The inner boundary of the drainage plane shall comply with Articles 9.27.3.2. to 9.27.3.7.

3) The protection provided by the second plane of protection shall be maintained at wall penetrations created by the installation of components and services such as windows, doors, ventilation ducts, piping, wiring and electrical outlets, and at the interface with other wall assemblies.

4) Flashing material and installation shall comply with Articles 9.27.3.8. and 9.27.3.9.

9.27.3.2. Sheathing Membrane Material Standard

1) Sheathing membrane shall conform to the performance requirements of CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type."

9.27.3.3. Required Sheathing Membrane and Installation

1) Except as provided in Articles 9.27.3.4., 9.27.3.5. and 9.27.3.6., at least one layer of sheathing membrane shall be applied beneath cladding.

2) Sheathing membrane required in Sentence (1) shall be applied so that joints are lapped not less than 100 mm.

3) Where sheathing membrane required in Sentence (1) is applied horizontally, the upper sheets shall overlap the lower sheets.

9.27.3.4. Insulating Sheathing in Lieu of Sheathing Membrane

1) Where non-wood-based rigid exterior insulating sheathing, or exterior insulating sheathing with an integral sheathing membrane is installed, a separate sheathing membrane is not required.

2) Where insulating sheathing is installed as provided in Sentence (1),

a) sheathing panels subject to moisture deterioration shall be sealed at all joints, and

b) the joints of sheathing panels not subject to moisture deterioration shall be

i) sealed at all joints, or

ii) lapped or tongue and groove, and detailed to ensure drainage of water to the exterior.

(See A-9.27.3.4.(2) in Appendix A.)

9.27.3.5. Sheathing Membranes in Lieu of Sheathing

1) Except as provided in Article 9.23.3.7., where no sheathing is used, at least 2 layers of sheathing membrane shall be applied beneath the cladding. (See Article 9.23.16.1. and A-9.27.3.5.(1) in Appendix A.)

2) All joints in the sheathing membrane required in Sentence (1) shall occur over framing, and the membrane shall be fastened to the framing with roofing nails or staples spaced not more than 150 mm along the edges of the outer layer of sheathing membrane.

3) Wall sheathing is permitted to be used in lieu of one layer of sheathing membrane required in Sentence (1), and the thickness need not conform to Table 9.23.16.2.A.

9.27.3.6. Face Sealed Cladding

(See A-9.27.3.6. in Appendix A.)

1) Sheathing membrane is permitted to be omitted beneath cladding when the joints in the cladding are formed to effectively prevent the passage of wind and rain in conformance with Sentences (2) or (3), as applicable.

- 2) Cladding consisting of sheets of plywood, hardboard, OSB, waferboard or fibre cement is considered to meet the requirements in Sentence (1), provided the cladding is applied so that
 - a) all edges are directly supported by framing,
 - b) the vertical joints between adjacent sheets are sealed, and
 - i) covered with battens,
 - ii) shiplapped, or
 - iii) otherwise matched to provide weathertight joints, and
 - c) the horizontal joints between adjacent sheets are sealed, and
 - i) ship lapped, or
 - ii) otherwise matched to provide weathertight joints.
- 3) Metal siding consisting of sheets of metal is considered to meet the requirements of Sentence (1) where the joints between sheets are of the locked seam type.

9.27.3.7. Flashing Materials

- 1) Flashing shall consist of not less than
 - a) 1.73 mm thick sheet lead,
 - b) 0.33 mm thick galvanized steel,
 - c) 0.46 mm thick copper,
 - d) 0.46 mm thick zinc,
 - e) 0.48 mm thick aluminum, or
 - f) 1.02 mm thick vinyl.

9.27.3.8. Flashing Installation

- 1) Except as provided in Sentence (2), flashing shall be installed at
 - a) every horizontal junction between claddings elements,
 - b) every horizontal off-set in the cladding, and
 - c) every horizontal line where the cladding substrates change and
 - i) differ sufficiently for stresses to be concentrated along that line, or
 - ii) where the installation of the cladding on the lower substrate may compromise the drainage of moisture from behind the cladding above.
(See A-9.27.3.8.(1) in Appendix A.)
- 2) Flashing need not be installed as described in Sentence (1)
 - a) where the upper cladding elements overlap the lower cladding elements by not less than 25 mm,
 - b) where
 - i) the cladding above and below the joint is installed outboard of a drained and vented air space [see Clause 9.27.2.2.(1)(a)], and
 - ii) the horizontal detail is constructed to minimize ingress of precipitation into the airspace, or
 - c) at horizontal construction joints in stucco where
 - i) the joint is finished with an expansion-contraction strip, and
 - ii) the cladding is installed outboard of a drained and vented air space [see Clause 9.27.2.2.(1)(a)].

3) Except as provided in Sentence (6), flashing shall be installed over exterior wall openings where the vertical distance from the bottom of the eave to the top of the trim is more than one-quarter of the horizontal overhang of the eave. (See A-9.27.3.9.(3) in Appendix A.)

4) Flashing described in Sentences (1) and (3) shall

- a) extend not less than 50 mm upward inboard of the sheathing membrane or sheathing installed in lieu of the sheathing membrane (see Article 9.27.3.4.),
- b) have a slope of not less than 6% toward the exterior after accounting for expected shrinkage of the building frame,
- c) terminate at each end with an end-dam
 - i) with a height in millimetres not less than 25 mm or 1/10 the value of the 1-in-5 driving rain wind pressure in Pa, and
 - ii) at the height defined in Subclause (i), extending to the face of the adjacent cladding.
- d) lap not less than 10 mm vertically over the building element below, and
- e) terminate in a drip offset not less than 5 mm outward from the outer face of the building element below.

(See A-9.27.3.8.(4) in Appendix A.)

5) Except as provided in Sentence (6), where sills of windows and doors installed in exterior walls are not self-flashing, flashing shall be installed between the underside of the window or door and the wall construction below. (See Appendix A.)

6) Where a window or exterior door is provided with an integral exterior flange and is designed to be installed on the exterior of essentially flat lock-seam metal cladding without a head or sill flashing, the flange shall be

- a) bedded into a non-hardening sealant material, and
- b) screwed down over the sealant through to the wall framing to form a waterproof joint.

(See A-9.27.3.8.(8) in Appendix A.)

Summary of Significant Changes to Part 5 for the 2005 National Building Code (NBC), Environmental Separation

The following are some of the more significant proposed changes accepted by the Standing Committee on Environmental Separation after completion of the public review conducted in late 2002 and early 2003. They were approved by the Canadian Commission on Building and Fire Codes (CCBFC) in April 2004 for inclusion in the next edition of the NBC, scheduled for the later half of 2005. The next edition of the British Columbia Building Code should follow the NBC within approximately six months of the publication of the model NBC.

Part 5 NBC Changes for 2005

Structural Requirements for Environmental Separators and Assemblies Exposed to the Exterior

Recognizing that Part 4 does not identify all of the elements of environmental separators and assemblies exposed to the exterior to which structural design must apply, a series of changes are being introduced as an initial step to address this issue within Part 5. The changes recognize, for example, that air barrier systems and roofing are not the only elements that must be designed to resist air pressure loads. The changes also recognize that some building elements need not be “structurally designed.” An Appendix note is included to describe the kinds of building elements that are intended to fall into the latter category.

Referenced Standards for Materials, Components and Installation

New References

A proposed reference to CSA S478, “Guideline on Durability in Buildings,” in Article 5.1.4.2. was to provide guidance on current good practice to minimize the probability of premature failure. Agreement by the Standing Committee on Environmental Separation (SCES) that the standard should be referenced was a factor in the inclusion of this reference in the 1998 BC Building Code. However, the proposal was withdrawn due to concerns expressed by CCBFC members over the reference to a “durability” guideline in a code which does not have a durability objective. Continuation of the reference to the guideline in the BCBC is unresolved.

There will be guidance on good practice with regards to acceptable indoor conditions [Sentence 5.2.1.2.(1)] by adding a reference to Part 6 which refers to handbooks and standards of the American Society of Heating and Refrigeration Engineers; the standard includes, for example, ASHRAE 55, “Thermal Environmental Conditions for Human Occupancy,” on thermal comfort.

Eliminating Lengthy Lists of Referenced Standards

The provisions that reference material, component and installation standards do not identify all the possible materials or components that may be used to serve particular functions in environmental separators or assemblies exposed to the exterior. The inclusion of all possible references within these requirements would be cumbersome and many references would be repeated in the various Sections.

A general provision [Section 5.10.] will provide a table which will be a subset of the standards listed in Table 2.7.3.2. Consequently, the current lists of standards in Sections 5.3. to 5.6. and 5.8. will be deleted and the corresponding Appendix note will be combined and referenced from the new Article. This approach reverts in large part to that used prior to the 1995 NBC/1998 BCBC.

Exceptions to Basic Requirements

Questions have been raised as to when the exceptions apply to the basic requirements to heat, air and moisture transfer. Appendix notes are being added, or existing notes expanded, to provide this information with respect to air leakage, vapour diffusion, precipitation ingress and ingress of moisture from the ground.

“Minimize”

Because Part 5 is generally written in performance terms, many provisions require some action be taken to “minimize” the occurrence of particular phenomena. An explanation of the term, however, is only provided in the context of heat transfer and condensation. Appendix notes are added to explain the term as it appears in other contexts.

Performance Requirement for Control of Air Leakage and Vapour Diffusion

The current requirements for controlling air leakage and vapour diffusion begin with the specification of acceptable solutions; i.e., an air barrier system and a vapour barrier. Changes to Articles 5.4.1.1. and 5.5.1.1. will present the basic requirements in more performance-based terms and recognize the role of venting to achieve the intents of the requirements. These changes were instigated, in part, by a proposed change to Sentence 6.2.2.7.(1) that references Part 5 for requirements related to the venting of attics and roof spaces.

Heat Transfer and Ice Damming

Changes to the heat transfer control requirements acknowledge that providing means to dissipate heat can be as important as means to control heat transfer in some instances; e.g., in reducing the likelihood of ice damming. An Appendix note will be added to provide additional information and the new provision will be cross-referenced from Section 5.6., Precipitation.

Sound Transmission

In keeping with the general approach to organize requirements in the Code according to design and construction disciplines, the sound transmission requirements will be transferred from Part 3 to Part 5 [Section 5.9.]. This recognizes that those involved in the design of environmental separators, rather than fire safety specialists, are concerned with constructions to control sound transmission.

Recommended Maximum Air Barrier System Leakage Rates

Part 5 does not specify limits on air barrier system leakage rates but recommended levels are provided in the Appendix. The Appendix, however, does not explain clearly what these limits relate to, and incorrect assumptions are often made. A change to the Appendix note will state

explicitly that the specified leakage limits are intended to apply only to the opaque portions of the building envelope.

Changes to Other Parts of the Code

Administrative Requirements (Division C)

A new Subsection will require the provision of information on the design of environmental separators and elements exposed to the exterior, similar to subsections requiring such information on fire and structural safety, as well as HVAC design.

Part 3

As noted above, the existing sound transmission requirements will be transferred from Article 3.3.4.6. to Section 5.9.

Changes for Part 9 of the 2005 National Building Code related to the Building Envelope

The revisions relating to the building envelope in Part 9 of the 2005 NBC are mostly contained in Section 9.27, Cladding. These revisions have been approved by the Canadian Commission on Building and Fire Codes for inclusion in the NBC. At the time this document was prepared no decision had been made on inclusion of these provisions in the next edition of the British Columbia Building Code.

This paper also includes a partial list of Part 9 provisions being deleted from the NBC as a result of its conversion to an objective-based code.

Keeping the Rain Out (Section 9.27)

A submission from staff at the Canadian Construction Materials Centre proposed additional prescriptive requirements for cladding to provide more information on how to meet the existing performance requirement. The Province of Nova Scotia, at the urging of the Nova Scotia Home Builders' Association, submitted a proposal that the Code require a vented air space behind cladding. Information from British Columbia identified a number of problematic constructions that are not addressed prescriptively. Together, these prompted the development of an extensive set of proposed requirements relating to protection from precipitation ingress:

- A set of simple prescriptive requirements address junctions between walls and roofs or decks.
- Protection from precipitation is described in terms of two planes of protection – the first being the cladding, the second being the sheathing membrane and flashing with or without a drained and vented air space.
- All residential buildings will be required to be constructed with two planes of protection (no face-sealed cladding). In high moisture load regions, the two planes of protection will be separated by a capillary break. Normal vinyl or metal horizontal strip siding placed over sheathing paper would satisfy both of these requirements.
- The prescriptive requirements for flashing will identify additional locations where flashing is needed to divert water to the exterior and will specify minimum extensions, slope and end dams. The provision will require flashing under windows and doors where the sills are not self-flashing; i.e., they do not extend over the cladding below and do not have a drip on the underside of the sill.

In order to identify high moisture load regions, a new climatic indicator, moisture index, will be added to the table of climatic data in Appendix C. This is a single number that reflects both the amount of rainfall that the location receives and the duration of drying periods. It is based on research conducted as part of IRC's Moisture in Exterior Wall Systems (MEWS) project. As one might expect, coastal areas will tend to have high moisture indices and prairie areas will tend to have low moisture indices.

Other Proposed Changes

- Section 9.13. is reorganized to clarify the application of requirements for controlling ingress of soil gas, and to present in separate subsections the requirements for dampproofing, waterproofing and soil gas control.
- Article 9.25.1.2. has been expanded to indicate the limits of the application of Table 9.25.1.2. The indoor RH upon which the table is based is now indicated in the Article.
- Article 9.25.4.2. has also been expanded in consequence of the revision to 9.25.1.2. Vapor barriers will be designed in accordance with Part 5 where the indoor RH is above 35% or 60% where the “mild climate indicator” is above or below 6300 respectively. The mild climate indicator is calculated in accordance with 9.25.1.2.
- Loose-fill insulation will be permitted in basement walls. (A “special change” permitting loose-fill insulation on ceilings sloped up to 4.5 in 12 was already approved by the CCBFC and incorporated into the 1998 BCBC.)

Objectives-Related Changes

Now that the objectives of the NBC have been determined, following the public consultation of 2000-2001, a few requirements that cannot be linked to any of the declared objectives will be deleted from the Code. These include:

- The requirement that a door be provided for every water closet room will be eliminated.
- The requirements for door width in dwelling units will be simplified – 810 mm at an entrance, 610 mm for all others.
- The requirement for higher ceiling heights in certain rooms will be eliminated.
- The requirement that windows be provided in certain rooms in dwelling units, even if electric lighting is available, will be eliminated. However, most bedrooms will still be required to have windows for purposes of ventilation and emergency egress.
- The requirements that interior steel columns and beams be painted will be eliminated.

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