Submit a comment

Proposed Change 1998

Code Reference(s):	**NBC20 Div.A 2.2.1.1.(1) (first printing)** **NFC20 Div.A 2.2.1.1.(1) (first printing)**
Subject:	Other
Title:	Introduction of New OS Safety Sub-Objective for Firefighter Safety
Description:	This proposed change adds a new sub-objective OS6 Firefighter Safety that clarifies which existing requirements are intended to address firefighter safety by distinguishing firefighters from the "persons" in the definition of sub-objective OS1 Fire Safety.
Related Code Change Request(s):	CCR 1857

This change could potentially affect the following topic areas:

- [x] Division A
- [ ] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

The 2020 editions of the National Building Code of Canada (NBC) and National Fire Code of Canada (NFC) clarify, through an explanatory Note to the objectives, that in the definition of (sub-)objective OS1, Fire Safety, the term “person” refers to any individual in or adjacent to the building or facility, including emergency responders, including firefighters, when performing their duties. The explanatory Note also states that “certain technical requirements in the National Model Codes are intended to address the safety of emergency responders, including firefighters, when performing their duties.”

A code change request (CCR) was submitted by NRC in response to the federal mandate letter dated December 16, 2021 (https://www.pm.gc.ca/en/mandate-letters/2021/12/16/minister-innovation-science-and-industry-mandate-letter). The CCR provided an analysis on the intents and attributions (objectives and functional statements) of the existing Code requirements in the 2020 editions of the NBC and NFC to ascertain which requirements address the safety of emergency responders. The CCR analysis reveals that acceptable solutions with a documented intent to address the safety of emergency responders when performing their duties are only identifiable through the intent statements. There are 80 intent statements for requirements in the 2020 edition of the NBC, and 180 in the NFC, that refer to limiting the probability of harm to emergency responders.

The existing explanatory Note clarifies that "person" in sub-objective OS1 includes emergency responders, including firefighters, when performing their duties. The absence of an objective in the Codes for firefighter safety can lead to inconsistent Code development. When developing changes to the Code, the technical committees must consider the impact of the proposed changes relative to the attributed Code objectives. For example, proposed changes to a Sentence in the Code that has the OS1 sub-objective attributed to it would have an impact analysis that considers the impact of the proposed change on the safety of occupants, but consideration of the impact on firefighter safety has not been consistently included in these impact analyses even when the intent statements clearly show that firefighter safety is a consideration. By adding a specific objective for firefighter safety, future Code development would include impact analyses that consider the impact on all attributed objectives.

In addition, compliance with the Code is achieved by adhering to the acceptable solutions in Division B, or using alternative solutions that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the acceptable solution. An explanatory Note about Code compliance using an alternative solution highlights that, while intent statements clarify what undesirable results provisions are trying to prevent, the intent statements are not a legal component of the Code and are only advisory in nature. Correspondingly, intent statements are not included within the body of the Code, they are published separately as supplemental guidance.

The intent to address the safety of firefighters while performing their duties is not identifiable through the attribution of objectives and functional statements within the body of the Code because the term "person" used to describe the applicability of the OS1 Fire Safety sub-objective includes firefighters performing their duties and individuals (i.e., non-firefighters) and these two types of "persons" have different risk profiles. As a result, without reading the intent statements, a Code user would not understand the full breadth of the acceptable solution and the intended negative outcomes being mitigated. Specifically, not clearly identifying which provisions within the body of the Code address the safety of firefighters while performing their duties could result in that portion of the objective not being considered in the development or assessment of an alternative solution. Differing assessments of the attributions to be satisfied for alternative solutions could lead to different performance levels across jurisdictions or incomplete alternative solutions.

One example of a possible inconsistency in the consideration of firefighter safety could be through alternative solutions to NBC Sentence 3.4.4.1.(1), which requires a minimum fire-resistance rating for fire separations between exits and the rest of the building. The intent statements for Sentence (1) are as follows:

Intent 1:

To limit the probability that fire will spread into an exit, which could lead to delays in the evacuation or movement of persons to a safe place, which could lead to harm to persons.

Intent 2:

To limit the probability that fire will spread into an exit, which could lead to emergency responders being delayed in gaining access to floor areas, which could lead to delays or ineffectiveness in fire emergency response operations, which could lead to:

- delays in the evacuation or movement of persons to a safe place, which could lead to harm to persons including emergency responders, and
- the spread of fire to other parts of the building, which could lead to harm to persons.

The intent statements describe the need for a fire-resistance rating for the fire separation to allow enough time for occupants to evacuate the building, but the requirement for a fire-resistance rating also serves the purpose of allowing enough time for firefighters to safely perform their response operations. Alternative solutions for fire-resistance ratings for exits in some cases consider the time needed to safely perform firefighter operations, but in other cases alternative solutions only consider the evacuation of occupants. This inconsistency could be resolved by clarifying the objective of firefighter safety in the Codes.

Justification

In late 1990s, when the National Model Codes were transitioning to the objective-based structure, the Canadian Commission on Building and Fire Codes (CCBFC), Standing Committee on Fire Safety and Occupancy (SC-FSO), and Task Group (TG) on Implementation discussed potentially including firefighter safety as an objective or sub-objective.

An analysis was conducted of the requirements at that time, and the following was noted:

- "none of the requirements attributed to this objective [i.e., safety of emergency responders] is attributed uniquely to it,"
- "many of them are general fire safety provisions in Part 3 and Part 8 that … contribute to the safety of emergency responders as well as that of the general building occupants," and
- "perhaps in many of these cases, 'safety of emergency responders' could have been treated as an 'other benefit' rather than as a root objective of these code provisions."

When analyzing Part 9 provisions, it was also noted that "none of the requirements attributed to this objective [i.e., safety of emergency responders] is found in Part 9", the rationale being that "in Part 9 buildings, firefighters should not count on the unit of fire origin to be a safe place for them to operate."

The SC-FSO noted that "the reason it had never isolated [safety of emergency responders] as a lone objective was because of an earlier decision to always include property protection whenever [safety of emergency responders] was an objective. The role of emergency responders [would] be identified in either intent or additional benefit statements as appropriate." The TG on Implementation recommended that the facilitation role of emergency responders be "captured in the intent statement; falling under a prime objective of safety and/or property protection as applicable" rather than using a separate objective. The CCBFC concurred with the TG's recommendation.

Since the introduction of the objective-based Codes in 2005, Code development has inconsistently attributed firefighter safety in the NBC and NFC, and this inconsistency is driving the need for a unique objective for firefighter safety. In addition to clarifying the objectives for firefighter safety, there is additional work needed to correct any existing inconsistencies in the Codes. While this proposed change intends to clarify the objective, it does not propose any changes to the objective attributions that would correct any inconsistencies. This technical work will be captured in a separate proposed change once more informed by ongoing research.

One example of a potential inconsistency in the consideration of firefighter safety is the difference between NBC Sentence 3.2.5.5.(1) and NFC Sentence 3.3.3.3.(1). NBC Sentence 3.2.5.5.(1), location of access routes in the NBC, uses the rationale that access routes must be placed in a specific location to reduce the risk of emergency responders being harmed due to excessive radiation exposure. NFC Sentence 3.3.3.3.(1), rubber tires, uses the same rationale as the previous example that access routes must be placed in a specific location, but in this example the objective is to limit damage to the building only without the OS objective. In this example, occupant and emergency responder safety is not a consideration in the intent statement. One could logically question why these two examples do not share the same objectives and intents given that the hazard (exposure to radiant heat) is the same.

The explanatory Note to the OS1 Fire Safety sub-objective, published in the NBC 2020 and the NFC 2020, explained that the NBC and NFC explicitly consider the safety of emergency responders, including firefighters, while performing their duties. This proposed change builds on that clarification and takes a step further by creating a new OS6 sub-objective. Separating firefighters performing their duties from "other persons" (including building occupants, other emergency responders, and firefighters not performing fire-related search and rescue, suppression or fire protection activities) through the creation of a new sub-objective would facilitate easy and clear identification of the requirements intended to address the safety of other emergency responders within the existing OS1 Safety sub-objective and the safety of firefighters within the proposed OS6 Firefighter Safety sub-objective. The attribution of the proposed OS6 Firefighter Safety sub-objective is intended to apply to search and rescue, and suppression activities, as well as other fire protection activities mentioned in the Codes to ensure firefighter safety is clearly and consistently addressed during Code development and by alternative solutions.

Future Code development would also benefit from the proposed OS6 Firefighter Safety sub-objective as future provisions would have separate objectives to clearly distinguish between the safety of persons and the safety of firefighters. Future proposed changes will need to be assessed by the relevant committee to determine if they are intended to encompass, in addition to OS1 occupant safety, firefighter safety in relation to the specific risks identified in the proposed OS6 sub-objective.

The work to address firefighter safety in the Codes is being undertaken as follows:

- Approval of the new OS6 sub-objective during the 2025 Code cycle: this work is being addressed by this proposed change.
- A research project underway to analyze the existing requirements, attributions and intent statements of the NBC and NFC in order to inform technical discussions to validate the attribution of the proposed OS6 sub-objective.

EXISTING PROVISION

NBC20 Div.A 2.2.1.1.(1) (first printing)

2.2.1.1. Objectives

1) The objectives of this Code are as follows (see Note A-2.2.1.1.(1)):

OS Safety

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury.

OS1 Fire Safety

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to fire. The risks of injury due to fire addressed in this Code are those caused by—

OS1.1 - fire or explosion occurring

OS1.2 - fire or explosion impacting areas beyond its point of origin

OS1.3 - collapse of physical elements due to a fire or explosion

OS1.4 - fire safety systems failing to function as expected

OS1.5 - persons being delayed in or impeded from moving to a safe place during a fire emergency

OS2 Structural Safety

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to structural failure. The risks of injury due to structural failure addressed in this Code are those caused by—

OS2.1 - loads bearing on the *building* elements that exceed their *loadbearing* capacity

OS2.2 - loads bearing on the *building* that exceed the *loadbearing* properties of the supporting medium

OS2.3 - damage to or deterioration of *building* elements

OS2.4 - vibration or deflection of *building* elements

OS2.5 - instability of the *building* or part thereof

OS2.6 - collapse of the *excavation*

OS3 Safety in Use

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to hazards addressed in this Code are those caused by—

OS3.1 - tripping, slipping, falling, contact, drowning or collision

OS3.2 - contact with hot surfaces or substances

OS3.3 - contact with energized equipment

OS3.4 - exposure to hazardous substances

OS3.5 - exposure to high levels of sound from fire alarm systems

OS3.6 - persons becoming trapped in confined spaces

OS3.7 - persons being delayed in or impeded from moving to a safe place during an emergency (see Appendix A)

OS4 Resistance to Unwanted Entry

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of injury due to the *building's* low level of resistance to unwanted entry (see Sentence 2.1.1.2.(2) for application limitation). The risks of injury due to unwanted entry addressed in this Code are those caused by—

OS4.1 - intruders being able to force their way through locked doors or windows

OS4.2 - occupants being unable to identify potential intruders as such

OS5 Safety at Construction and Demolition Sites

An objective of this Code is to limit the probability that, as a result of the construction or demolition of the *building*, the public adjacent to a construction or demolition site will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to construction and demolition hazards addressed in this Code are those caused by—

OS5.1 - objects projected onto *public ways*

OS5.2 - vehicular accidents on *public ways*

OS5.3 - damage to or obstruction of *public ways*

OS5.4 - water accumulated in *excavations*

OS5.5 - entry into the site

OS5.6 - exposure to hazardous substances and activities

OS5.7 - loads bearing on a covered way that exceed its *loadbearing* capacity

OS5.8 - collapse of the *excavation*

OS5.9 - persons being delayed in or impeded from moving to a safe place during an emergency (see Appendix A)

OH Health

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person will be exposed to an unacceptable risk of illness.

OH1 Indoor Conditions

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness due to indoor conditions addressed in this Code are those caused by—

OH1.1 - inadequate indoor air quality

OH1.2 - inadequate thermal comfort

OH1.3 - contact with moisture

OH2 Sanitation

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to unsanitary conditions. The risks of illness due to unsanitary conditions addressed in this Code are those caused by—

OH2.1 - exposure to human or domestic waste

OH2.2 - consumption of contaminated water

OH2.3 - inadequate facilities for personal hygiene

OH2.4 - contact with contaminated surfaces

OH2.5 - contact with vermin and insects

OH3 Noise Protection

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to high levels of sound originating in adjacent spaces in the *building* (see Sentence 2.1.1.2.(3) for application limitation). The risks of illness due to high levels of sound addressed in this Code are those caused by—

OH3.1 - exposure to airborne sound transmitted through assemblies separating *dwelling units* from adjacent spaces in the *building*

OH4 Vibration and Deflection Limitation

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to high levels of vibration or deflection of *building* elements.

OH5 Hazardous Substances Containment

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, the public will be exposed to an unacceptable risk of illness due to the release of hazardous substances from the *building* (see Sentence 2.1.1.2.(4) for application limitation).

OA Accessibility

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person with a physical or sensory limitation will be unacceptably impeded from accessing or using the *building* or its facilities (see Sentence 2.1.1.2.(5) for application limitations).

OA1 Barrier-Free Path of Travel

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person with a physical or sensory limitation will be unacceptably impeded from accessing the *building* or circulating within it (see Sentence 2.1.1.2.(5) for application limitations).

OA2 Barrier-Free Facilities

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person with a physical or sensory limitation will be unacceptably impeded from using the *building's* facilities (see Sentence 2.1.1.2.(5) for application limitations).

OP Fire and Structural Protection of Buildings

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, the *building* or adjacent *buildings* will be exposed to an unacceptable risk of damage due to fire or structural insufficiency, or the *building* or part thereof will be exposed to an unacceptable risk of loss of use also due to structural insufficiency.

OP1 Fire Protection of the Building

An objective of this Code is to limit the probability that, as a result of its design or construction, the *building* will be exposed to an unacceptable risk of damage due to fire. The risks of damage due to fire addressed in this Code are those caused by—

OP1.1 - fire or explosion occurring

OP1.2 - fire or explosion impacting areas beyond its point of origin

OP1.3 - collapse of physical elements due to a fire or explosion

OP1.4 - fire safety systems failing to function as expected

OP2 Structural Sufficiency of the Building

An objective of this Code is to limit the probability that, as a result of its design or construction, the *building* or part thereof will be exposed to an unacceptable risk of damage or loss of use due to structural failure or lack of structural serviceability. The risks of damage and of loss of use due to structural failure or lack of structural serviceability addressed in this Code are those caused by—

OP2.1 - loads bearing on the *building* elements that exceed their *loadbearing* capacity

OP2.2 - loads bearing on the *building* that exceed the *loadbearing* properties of the supporting medium

OP2.3 - damage to or deterioration of *building* elements

OP2.4 - vibration or deflection of *building* elements

OP2.5 - instability of the *building* or part thereof

OP2.6 - instability or movement of the supporting medium

OP3 Protection of Adjacent Buildings from Fire

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, adjacent *buildings* will be exposed to an unacceptable risk of damage due to fire. The risks of damage to adjacent *buildings* due to fire addressed in this Code are those caused by—

OP3.1 - fire or explosion impacting areas beyond the *building* of origin

OP4 Protection of Adjacent Buildings from Structural Damage

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, adjacent *buildings* will be exposed to an unacceptable risk of structural damage. The risks of structural damage to adjacent *buildings* addressed in this Code are those caused by—

OP4.1 - settlement of the medium supporting adjacent *buildings*

OP4.2 - collapse of the *building* or portion thereof onto adjacent *buildings*

OP4.3 - impact of the *building* on adjacent *buildings*

OP4.4 - collapse of the *excavation*

OE Environment

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, the environment will be affected in an unacceptable manner.

OE1 Resources

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, resources will be used in a manner that will have an unacceptable effect on the environment. The risks of unacceptable effect on the environment due to use of resources addressed in this Code are those caused by –

OE1.1 - excessive use of energy

Note A-2.2.1.1.(1) Objectives.

Listing of objectives

Any gaps in the numbering sequence of the objectives are due to the fact that there is a master list of objectives covering the four principal National Code Documents—the National Building Code, the National Fire Code, the National Plumbing Code and the National Energy Code for Buildings—but not all objectives are pertinent to all Codes.

The building

Where the term “the building” is used in the wording of the objectives, it refers to the building for which compliance with the National Building Code is being assessed.

Emergency

The term “emergency”—in the context of safety in buildings—is often equated to the term “fire emergency;” however, the wording of objectives OS3.7 and OS5.9 makes it clear that the Code addresses any type of emergency that would require the rapid evacuation of the building, such as a bomb threat or the presence of intruders.

Fire Safety

In the definition of Objective OS1, Fire Safety, the term “person” refers to any individual in or adjacent to the building, including the occupants, the public, and emergency responders including firefighters when performing their duties.

Certain technical requirements in the National Model Codes are intended to address the safety of emergency responders, including firefighters, when performing their duties.

NFC20 Div.A 2.2.1.1.(1) (first printing)

2.2.1.1. Objectives

1) The objectives of this Code are as follows (see Note A-2.2.1.1.(1)):

OS Safety

An objective of this Code is to limit the probability that, as a result of specific circumstances related to the *building* or facility, a person in or adjacent to the *building* or facility will be exposed to an unacceptable risk of injury.

OS1 Fire Safety

An objective of this Code is to limit the probability that, as a result of

a. activities related to the construction, use or demolition of the *building* or facility,
b. the condition of specific elements of the *building* or facility,
c. the design or construction of specific elements of the facility related to certain hazards, or
d. inadequate built-in protection measures for the current or intended use of the *building*,

a person in or adjacent to the *building* or facility will be exposed to an unacceptable risk of injury due to fire. The risks of injury due to fire addressed in this Code are those caused by—

OS1.1 - fire or explosion occurring

OS1.2 - fire or explosion impacting areas beyond its point of origin

OS1.3 - collapse of physical elements due to a fire or explosion

OS1.4 - fire safety systems failing to function as expected

OS1.5 - persons being delayed in or impeded from moving to a safe place during a fire emergency

OS3 Safety in Use

An objective of this Code is to limit the probability that, as a result of

a. activities related to the construction, use or demolition of the *building* or facility,
b. the condition of specific elements of the *building* or facility,
c. the design or construction of specific elements of the

facility related to certain hazards, or

d. inadequate built-in protection measures for the current or intended use of the *building*,

a person in or adjacent to the *building* or facility will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to hazards addressed in this Code are those caused by—

OS3.1 - tripping, slipping, falling, contact, drowning or collision

OS3.2 - contact with hot surfaces or substances

OS3.3 - contact with energized equipment

OS3.4 - exposure to hazardous substances

OS3.7 - persons being delayed in or impeded from moving to a safe place during an emergency (see Note A-2.2.1.1.(1))

OH Health

An objective of this Code is to limit the probability that, as a result of specific circumstances related to the *building* or facility, a person will be exposed to an unacceptable risk of illness.

OH5 Hazardous Substances Containment

An objective of this Code is to limit the probability that, as a result of

a. activities related to the construction, use or demolition of the *building* or facility,
b. the condition of specific elements of the *building* or facility,
c. the design or construction of specific elements of the facility related to certain hazards, or
d. inadequate built-in protection measures for the current or intended use of the *building*,

the public will be exposed to an unacceptable risk of illness due to the release of hazardous substances from the *building* or facility.

OP Fire Protection of Buildings and Facilities

An objective of this Code is to limit the probability that, as a result of specific circumstances related to the *building* or facility, the *building* or facility will be exposed to an unacceptable risk of damage due to fire.

OP1 Fire Protection of the Building or Facility

An objective of this Code is to limit the probability that, as a result of

a. activities related to the construction, use or demolition of the *building* or facility,
b. the condition of specific elements of the *building* or

facility,

c. the design or construction of specific elements of the facility related to certain hazards, or
d. inadequate built-in protection measures for the current or intended use of the *building*,

the *building* or facility will be exposed to an unacceptable risk of damage due to fire. The risks of damage due to fire addressed in this Code are those caused by—

OP1.1 - fire or explosion occurring

OP1.2 - fire or explosion impacting areas beyond its point of origin

OP1.3 - collapse of physical elements due to a fire or explosion

OP1.4 - fire safety systems failing to function as expected

OP3 Protection of Adjacent Buildings or Facilities from Fire

An objective of this Code is to limit the probability that, as a result of

a. activities related to the construction, use or demolition of the *building* or facility,
b. the condition of specific elements of the *building* or facility,
c. the design or construction of specific elements of the facility related to certain hazards, or
d. inadequate built-in protection measures for the current or intended use of the *building*,

adjacent *buildings* or facilities will be exposed to an unacceptable risk of damage due to fire. The risks of damage to adjacent *buildings* and facilities due to fire addressed in this Code are those caused by—

OP3.1 - fire or explosion impacting areas beyond the *building* or facility of origin

Note A-2.2.1.1.(1) Objectives.

Listing of objectives

Any gaps in the numbering sequence of the objectives are due to the fact that there is a master list of objectives covering the four principal National Code Documents—the National Building Code, the National Energy Code for Buildings, the National Fire Code and the National Plumbing Code—but not all objectives are pertinent to all Codes.

The building or facility

Where the term “the building or facility” is used in the wording of the objectives, it refers to the building or facility for which compliance with the National Fire Code is being assessed.

Emergency

The term “emergency”—in the context of safety in buildings or facilities—is often equated to the term "fire emergency;" however, the wording of objective OS3.7 makes it clear that the Code addresses any type of emergency that would require the rapid evacuation of the building or facility, such as a bomb threat or the presence of intruders.

Fire Safety

In the definition of Objective OS1, Fire Safety, the term "person" refers to any individual in or adjacent to the building or facility, including the occupants, the public, and emergency responders including firefighters when performing their duties.

Certain technical requirements in the National Model Codes are intended to address the safety of emergency responders, including firefighters, when performing their duties.

PROPOSED CHANGE

NBC20 Div.A 2.2.1.1.(1) (first printing)

[2.2.1.1.] 2.2.1.1. Objectives

[1] 1) The objectives of this Code are as follows (see Note A-2.2.1.1.(1)):

OS Safety

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury.

OS6 Firefighter Safety

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, firefighters in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to fire while performing their duties. The risks of injury due to fire addressed in this Code are those caused by—

OS6.1 - fire or explosion occurring

OS6.2 - fire or explosion impacting areas beyond its point of origin

OS6.3 - collapse of physical elements due to a fire or explosion

OS6.4 - fire safety systems failing to function as expected

OS6.5 - firefighters being delayed in or impeded from moving to a safe place during a fire emergency

Note A-2.2.1.1.(1) Objectives.

Fire Safety

In the definition of Objective OS1, Fire Safety, the term "person" refers to any individual in or adjacent to the building, with the exception of firefighters when performing their duties. (See Objective OS6, Firefighter Safety.)

"Person" includ~~ing~~es the occupants, the public, and emergency responders other than ~~including~~firefighters ~~when performing their duties~~.

~~Certain t~~Technical requirements ~~in the National Model Codes are~~ intended to address the safety of ~~emergency responders, including~~ firefighters~~,~~ when performing their duties are attributed Objective OS6, Firefighter Safety.

NFC20 Div.A 2.2.1.1.(1) (first printing)

[2.2.1.1.] 2.2.1.1. Objectives

[1] 1) The objectives of this Code are as follows (see Note A-2.2.1.1.(1)):

OS Safety

An objective of this Code is to limit the probability that, as a result of specific circumstances related to the *building* or facility, a person in or adjacent to the *building* or facility will be exposed to an unacceptable risk of injury.

OS6 Firefighter Safety

An objective of this Code is to limit the probability that, as a result of

a. activities related to the construction, use or demolition of the *building* or facility
b. the condition of specific elements of the *building* or facility,
c. the design or construction of specific elements of the facility related to certain hazards, or
d. inadequate built-in protection measures for the current or intended use of the *building*, a firefighter in or adjacent to the *building* or facility will be exposed to an unacceptable risk of injury due to fire while performing their duties. The risk of injury due to fire addressed in this Code are those caused by—

OS6.1 - fire or explosion occurring

OS6.2 - fire or explosion impacting areas beyond its point of origin

OS6.3 - collapse of physical elements due to a fire or explosion

OS6.4 - fire safety systems failing to function as expected

OS6.5 - firefighters being delayed in or impeded from moving to a safe place during a fire emergency

Note A-2.2.1.1.(1) Objectives.

Fire Safety

In the definition of Objective OS1, Fire Safety, the term "person" refers to any individual in or adjacent to the building or facility, with the exception of firefighters when performing their duties. (See Objective OS6, Firefighter

Safety.) “Person” includes~~ing~~ the occupants, the public, and emergency responders other than~~including~~ firefighters ~~when performing their duties~~.

~~Certain t~~Technical requirements ~~in the National Model Codes are~~ intended to address the safety of ~~emergency responders, including~~ firefighters~~,~~ when performing their duties are attributed Objective OS6, Firefighter Safety.

Impact analysis

The addition of an OS6 Firefighter Safety sub-objective is not expected to entail any costs as it only clarifies what is already intended by the 2020 editions of the NBC and NFC. This proposed change has no impact on the existing acceptable solutions in Division B of the NBC and NFC. The proposed change does not introduce any new technical requirement related to firefighter safety in the Codes, nor does it attribute any existing requirement to the new OS6 sub-objective.

The benefit of separating OS6 Firefighter Safety from OS1 Fire Safety is that it would allow Code development efforts to more explicitly consider the attribution of firefighter safety in the development of acceptable solutions within the body of the Code.

Enforcement implications

Identifying the OS6 Firefighter Safety sub-objective would ensure consistent development and consideration of alternative solutions in the future by designers and authorities having jurisdiction by aligning the attributions with the intent statements.

This proposed change could be enforced by the infrastructure available to enforce the Codes without an increase in resources as this proposed change only reorganizes Code content. This proposed change does not introduce new technical content.

This proposed change to clarify firefighter safety in the NBC and NFC is intended to complement provincial and territorial Acts and regulations that are already in place to address the safety of firefighters.

Who is affected

Authorities having jurisdiction and designers will have a clear, common, basis for developing and reviewing proposed alternative solutions to satisfy fire safety requirements.

Firefighter organizations will be able to identify Code provisions intended to address firefighter safety while performing their duties allowing them to engage more effectively with the Code development system.

The separation of firefighter safety from other persons will help technical committees developing fire safety requirements explicitly consider which fire safety objective(s) should apply taking into account that different risk profiles may necessitate different solutions.

Submit a comment

Proposed Change 2061

Code Reference(s):	**NBC20 Div.B 1.1.3.1. (first printing)** **NBC20 Div.B 6.2.1. (first printing)** **NBC20 Div.B 9.33.2.1. (first printing)** **NBC20 Div.B 9.33.3. (first printing)** **NBC20 Div.B 9.33.5. (first printing)**
Subject:	Overheating
Title:	Overheating in New Dwelling Units
Description:	This proposed change adds a maximum indoor air temperature for new dwelling units.

This change could potentially affect the following topic areas:

- [x] Division A
- [x] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [x] Housing
- [x] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

As a result of global warming, overheating in buildings has become a greater health and safety concern. Overheating in dwelling units has become an area of health concern in all regions including those with temperate summers. The health and well-being of occupants who are directly exposed to high indoor air temperatures are affected.

These elevated indoor temperatures may strain the human physiological system and lead to serious health injury or death. Research has shown that overheating can lead to discomfort and sleep disturbances, and that older adults, children and people with certain health conditions may be more susceptible to the negative effects of overheating. Proactive measures to address overheating in new dwelling units should be introduced in the National Building Code of Canada (NBC).

Currently Sentence 9.33.3.1.(1) of Division B of the NBC requires residential buildings to be equipped with heating facilities to maintain a minimum indoor air temperature in winter. There is presently no corresponding requirement to limit the maximum indoor air temperature in summer. This may present an unacceptable risk of overheating and the associated health consequences in dwelling units.

Justification

Proposed Sentences 9.33.2.1.(2) and 9.33.3.1.(2) introduce a maximum indoor air temperature of 26°C in at least one living space in new dwelling units to be maintained by mechanical cooling or, where achievable, through passive cooling design measures.

After carrying out a heat-gain evaluation, mechanical cooling systems might be necessary to maintain a healthy living space and a reduced risk of overheating. Passive cooling measures would need to be explored at the design stage and might negate the need for mechanical cooling.

This proposed change:

- Aligns with the recently adopted change in B.C.
- Aims to establish an upper limit for indoor air temperature as the initial requirement to minimize the adverse effects of overheating on occupant health and safety in at least one living space in new dwelling units. The proposed temperature of 26°C aligns with other organizations' recommended maximum indoor air temperature, the B.C. Centre for Disease Control report to the Chief Coroner, and studies from the University of Ottawa and is supported by the World Health Organization.
- Does not resolve overheating issues in existing buildings nor resolve extreme heat events.
- References the listed July 2.5% outside design temperatures, as outlined in proposed Sentence 1.1.3.1.(4)-2025.
- Relies on 2.5% July dry temperatures for the calculation of the required capacity of cooling appliances, thereby recognizing regional considerations with respect to diverse climates and temperatures to ensure appropriate application across the country (proposed Sentence 9.33.3.1.(2)).
- Allows for design flexibility: CSA F280 is applicable when designing a single space within a dwelling unit; however, if the design encompasses the entire house, alternative standards can be considered (proposed Note A-9.33.3.1.(2)).
- Uses July 2.5% dry temperatures listed in Appendix C, which is not the projected assumption of future heat/thermal stresses. As such, some extreme weather events may exceed the capacity of cooling systems.
- Outlines the maximum indoor air temperature in at least one living space in dwelling units in proposed Sentence 9.33.3.1.(2), which is also referenced in proposed Sentence 6.2.1.2.(2), Indoor Design Temperatures.
- Recognizes that the room-by-room cooling calculations in CSA F280 are a tool for determining the sizing of the equipment and necessity of mechanical cooling for at least one living space in a dwelling unit using the 26°C temperature limit,

as outlined in revised Sentence 9.33.5.1.(1).
- Is based on climatic data and/or passive cooling measures; mechanical cooling systems may not be necessary (Sentence 9.33.2.1.).
- Acknowledges both vulnerability and practicality considerations.

PROPOSED CHANGE

NBC20 Div.B 1.1.3.1. (first printing)

[1.1.3.1.] 1.1.3.1. Climatic and Seismic Values

[1] 1) Except as provided in Sentences (2) and (4), the climatic and seismic values required for the design of *buildings* under this Code shall be in conformance with the values established by the *authority having jurisdiction*.

[2] 2) Where they have not been established by the *authority having jurisdiction*, the climatic values required for the design of *buildings* shall be in conformance with Sentences (3) and (4) and the values listed in Appendix C. (See Note A-1.1.3.1.(2).)

[3] 3) The outside winter design temperatures determined from Appendix C shall be those listed for the January 2.5% values. (See Note A-1.1.3.1.(3).)

[4] --) The outside summer design temperatures determined from Appendix C shall be those listed for the July 2.5% dry values.

[5] 4) Where they have not been established by the *authority having jurisdiction*, the seismic values required for the design of *buildings* under Part 4 and Part 9 shall be in conformance with Appendix C. (See Note A-1.1.3.1.(4).)

NBC20 Div.B 6.2.1. (first printing)

[6.2.1.] 6.2.1. General

[6.2.1.1.] 6.2.1.1. Good Engineering Practice

[6.2.1.2.] --- Indoor Design Temperatures

[1] --) Indoor design temperatures for mechanical heating and cooling facilities in *dwelling units* shall conform to Article 9.33.3.1.

[6.2.1.3.] 6.2.1.2. Outdoor Design Conditions

[6.2.1.4.] 6.2.1.3. Expansion, Contraction and System Pressure

[6.2.1.5.] 6.2.1.4. Structural Movement

[6.2.1.6.] 6.2.1.5. Installation Standards

[6.2.1.7.] 6.2.1.6. Installation – General

[6.2.1.8.] 6.2.1.7. Asbestos

NBC20 Div.B 9.33.2.1. (first printing)

[9.33.2.1.] 9.33.2.1. Required Heating and Cooling Systems

[1] 1) Residential *buildings* intended for use in the winter months on a continuing basis shall be equipped with heating facilities conforming to this Section.

[2] --) Except as provided in Article 9.33.5.1.-2025 or good engineering practice as described in Article 6.2.1.1., *dwelling units* intended for use during summer seasons on a continuing basis shall be equipped with cooling facilities conforming to this Section. (See Note A-9.33.2.1.(2).)

Note A-9.33.2.1.(2) Passive Cooling Measures.

Passive cooling measures, such as exterior shading, building orientation, insulation, low solar heat gain windows, and thermal mass, can reduce cooling loads and help to achieve the indoor air temperature specified in Sentence 9.33.3.1.(2).

NBC20 Div.B 9.33.3. (first printing)

[9.33.3.] 9.33.3. Design Temperatures

[9.33.3.1.] 9.33.3.1. Indoor Design Temperatures

[1] 1) At the outside winter design temperature, required heating facilities shall be capable of maintaining an indoor air temperature of not less than

[a] a) 22°C in all living spaces,

[b] b) 18°C in unfinished *basements*,

[c] c) 18°C in common *service rooms*, ancillary spaces and *exits* in houses with a *secondary suite*, and

[d] d) 15°C in heated crawl spaces.

[2] --) Except as provided in Sentence (3), at the outside summer design temperature, permanently installed cooling facilities shall be capable of maintaining an indoor air temperature of not more than 26°C in at least one living space in each *dwelling unit*.

[3] --) Optional comfort cooling facilities shall be designed using the indoor design temperature specified in CSA F280, "Determining the required capacity of residential space heating and cooling appliances", or applicable documents referenced in Article 9.33.4.1.

[9.33.3.2.] 9.33.3.2. Outdoor Design Temperatures

NBC20 Div.B 9.33.5. (first printing)

[9.33.5.] 9.33.5. Heating and Cooling ~~Air-conditioning~~ Appliances and Equipment

[9.33.5.1.] 9.33.5.1. Capacity of Heating and Cooling Appliances

[1] 1) The required capacity of heating and cooling *appliances* located in a *dwelling unit*, and serving only that *dwelling unit* or part of that *dwelling unit*~~,~~ shall be determined, using design temperatures conforming to Subsection 9.33.3., in accordance with ~~CSA F280, "Determining the required capacity of residential space heating and cooling appliances",except that the design temperatures shall conform to Subsection 9.33.3.~~

[a] --) CSA F280, "Determining the required capacity of residential space heating and cooling appliances", or

[b] --) good engineering practice as described in Article 6.2.1.1.

[9.33.5.2.] 9.33.5.2. Installation Standards

[1] 1) Except as provided in Articles 9.33.5.3. and 9.33.5.4., the installation of heating and cooling~~air-conditioning~~ *appliances* and equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to applicable provincial or territorial regulations or municipal bylaws or, in the absence of such regulations or bylaws, to

[a] a) CSA B51, "Boiler, pressure vessel, and pressure piping code",

[b] b) CSA B52, "Mechanical refrigeration code",

[c] c) CSA B139 Series, "Installation code for oil-burning equipment",

[d] d) CSA B149.1, "Natural gas and propane installation code",

[e] e) CSA C22.1, "Canadian Electrical Code, Part I", or

[f] f) CAN/CSA-C448 Series, "Design and installation of earth energy systems".

(See also Sentence 9.33.5.3.(1).)

[9.33.5.3.] 9.33.5.3. Design, Construction and Installation Standard for Solid-Fuel-Burning Appliances

[9.33.5.4.] 9.33.5.4. Fireplaces

Impact analysis

Refer to the supporting document for the complete impact analysis.

Executive summary

The proposed change described in PCF 2061 is recommending that the National Building Code of Canada mandate the addition of an acceptable upper indoor temperature that must be maintained in a single living space within each dwelling unit by the addition of mechanical cooling and/or by passive design measures. This report summarizes the impact analysis for implementing a maximum indoor air temperature for a single living space in a dwelling unit by the addition of mechanical cooling.

The benefits of reducing indoor air temperatures by installing single room ductless mini-split air conditioning (DMSAC) units in Part 9 dwelling units, and apartment type dwelling units, followed a pattern typical of preventive interventions, with the direct costs incurred up front and a delay before the full benefits are experienced. The direct benefits included the number of overheating related deaths prevented and any treatment costs avoided following the reduction in indoor air temperatures. The results of the analysis were presented in two parts:

i. Example case: single room DMSAC units in dwelling units, including apartment type dwelling units, built in 1 year.
ii. Full analysis: single room DMSAC units in dwelling units, including apartment type dwelling units, built over a 20-year period, the lifespan of the DMSAC units.

The methodology used to estimate the benefits provided by installing a DMSAC unit in a single living space in each dwelling unit, including apartment type dwelling units, was defined as follows:

- Two estimates (lower and upper) of current overheating related deaths associated with extreme heat events (estimated using a cutoff of 2.5th temperature percentile).
- Expected 100% effectiveness of the DMSAC in new dwelling units, assuming use by the occupants, in reducing illness and death associated with extreme heat events only.
- 20-year service life of the DMSAC

The annual cost for the 12-month period between July 1, 2021, and June 30, 2022, for installing a 9000 BTU/h single room DMSAC units in 221,492 dwellings of all types, including apartment type dwellings, is estimated to be $475 398 711. The estimated operational costs over the 1-year period is estimated to be $43 123 518. It is estimated that the lifespan of a DMSAC will be 20 years with minimal maintenance. The total cost of both the initial installation and operation costs at the end of the 20-year time period is estimated to be $1 337 869 100. The total treatment costs for illnesses related to overheating during extreme heat events over the 20-year time period is estimated to range between $2 430 920 and $14 853 880 for the lower and upper estimates, respectively. The cumulative number of overheating related deaths prevented over 20-year period during extreme heat events was estimated to be 2,520 and 17,290 for the lower and upper estimates, respectively, in the residents of all dwellings completed over 20 years following the installation of the DMSAC.

The impact analysis on installing a DMSAC unit in a single living space in each dwelling unit, including apartment type dwellings, demonstrates that the main benefit would be preventing 2 520 to 17 290 overheating associated deaths during extreme heat events in Canada over 20 years should the proposed change be adopted. Although the costs incurred for installing DMSAC units in all dwelling types, including apartment type dwellings, always exceeded the savings from preventing cases requiring overheating related illness treatment during extreme heat events, the cumulative cost per overheating death prevented decreased steeply after implementation and was lower than the Treasury Board of Canada Secretariat value of statistical life (VSL) after 1 year to 9 years for direct cost comparisons, and after 1 year to 19 years for direct and indirect cost comparisons.

Enforcement implications

This proposed change could be enforced by the infrastructure currently available to enforce the Codes.

Who is affected

- Homeowners and occupants would see an increase in the cost of their dwelling unit.
- Builders would need to incorporate the proposed change into the construction process for dwelling units.
- Architects, engineers, designers and contractors.
- Authorities having jurisdiction would need training to understand how to apply the new requirements.

Supporting Document(s)

Impact Analysis for PCF 2061: Overheating in New Dwelling Units (impact_analysis_for_pcf_2061_final.pdf)

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 1.1.3.1. (first printing)

[1.1.3.1.] -- ([4] --) no attributions

NBC20 Div.B 6.2.1. (first printing)

[6.2.1.1.] 6.2.1.1. ([1] 1) ([a] a) to ([e] e) [F31,F51-OP1.1]

[6.2.1.1.] 6.2.1.1. ([1] 1) ([a] a) to ([c] c),([e] e) to ([i] i) [F40,F50,F51,F52,F54,F63-OH1.1]

[6.2.1.1.] 6.2.1.1. ([1] 1) ([a] a) to ([c] c),([e] e) to ([h] h) [F50,F51,F52,F54,F63-OH1.2,OH1.3]

[6.2.1.1.] 6.2.1.1. ([1] 1) [F31,F50,F51,F52,F54,F63-OS3.2,OS3.4]

[6.2.1.1.] 6.2.1.1. ([1] 1) ([d] d) [F01-OS1.1]

[6.2.1.2.] -- ([1] --) no attributions

[6.2.1.3.] 6.2.1.2. ([1] 1) no attributions

[6.2.1.3.] 6.2.1.2. ([2] 2) [F40,F50-OH1.1]

[6.2.1.3.] 6.2.1.2. ([3] 3) [F40,F43,F44,F50-OH1.1]

[6.2.1.3.] 6.2.1.2. ([3] 3) [F44-OS3.4]

[6.2.1.4.] 6.2.1.3. ([1] 1) [F20-OS3.2]

[6.2.1.5.] 6.2.1.4. ([1] 1) [F23-OS3.1]

[6.2.1.5.] 6.2.1.4. ([1] 1) [F51,F63,F50-OH1.1,OH1.2,OH1.3]

[6.2.1.6.] 6.2.1.5. ([1] 1) [F43-OS1.1]

[6.2.1.6.] 6.2.1.5. ([1] 1) [F43-OS3.4]

[6.2.1.6.] 6.2.1.5. ([1] 1) [F43-OP1.1]

[6.2.1.7.] 6.2.1.6. ([1] 1) [F82-OS1.1]

[6.2.1.7.] 6.2.1.6. ([1] 1) [F82-OS3.4]

[6.2.1.7.] 6.2.1.6. ([1] 1) [F82-OP1.1]

[6.2.1.7.] 6.2.1.6. ([2] 2) [F31-OS3.1]

[6.2.1.7.] 6.2.1.6. ([3] 3) [F81-OS3.2,OS3.3,OS3.4]

[6.2.1.7.] 6.2.1.6. ([3] 3) [F81-OS1.1]

[6.2.1.8.] 6.2.1.7. ([1] 1) [F43-OH1.1]

NBC20 Div.B 9.33.2.1. (first printing)

[9.33.2.1.] **9.33.2.1. ([1] 1) [F51,F52-OH1.2] [F63-OH1.1]**

[9.33.2.1.] **9.33.2.1. ([1] 1) [F63-OS2.3]**

[9.33.2.1.] -- ([2] --) [F51-OH1.2]

NBC20 Div.B 9.33.3. (first printing)

[9.33.3.1.] **9.33.3.1. ([1] 1) [F51-OH1.2]**

[9.33.3.1.] -- ([2] --) [F51-OH1.2]

[9.33.3.1.] -- ([3] --) [F51-OH1.2]

[9.33.3.2.] **9.33.3.2. ([1] 1) no attributions**

NBC20 Div.B 9.33.5. (first printing)

[9.33.5.1.] **9.33.5.1. ([1] 1) [F63-OH1.1] [F51-OH1.2]**

[9.33.5.1.] **9.33.5.1. ([1] 1) [F63-OS2.3]**

[9.33.5.2.] **9.33.5.2. ([1] 1) [F01-OP1.1]** Applies to heating equipment.

[9.33.5.2.] **9.33.5.2. ([1] 1) [F41,F63,F50-OH1.1] [F51,F52-OH1.2]**

[9.33.5.2.] **9.33.5.2. ([1] 1) [F63-OS2.3]** Applies to heating equipment.

[9.33.5.2.] **9.33.5.2. ([1] 1) [F44-OS3.4]** Applies to heating equipment.

[9.33.5.2.] **9.33.5.2. ([1] 1) [F01-OS1.1]** Applies to heating equipment.

[9.33.5.3.] **9.33.5.3. ([1] 1) [F41,F43-OH1.1] [F51-OH1.2]**

[9.33.5.3.] **9.33.5.3. ([1] 1) [F51-OS2.3]**

[9.33.5.3.] **9.33.5.3. ([1] 1) [F43-OS3.4]**

[9.33.5.3.] **9.33.5.3. ([1] 1) [F01-OS1.1]**

[9.33.5.3.] **9.33.5.3. ([1] 1) [F01-OP1.1]**

[9.33.5.4.] **9.33.5.4. ([1] 1) no attributions**

Submit a comment

Proposed Change 1918

Code Reference(s):	**NBC20 Div.B 2.1.1.1. (first printing)**
Subject:	Large Farm Buildings (General)
Title:	Introduction of the OP3 Sub-Objective for Farm Buildings in the NBC
Description:	This proposed change facilitates the introduction of the spatial separation sub-objective (OP3) in Part 2 of Division B of the NBC by revising Note A-2.1.1.1.(1).
Related Proposed Change(s):	PCF 1777, PCF 1919, PCF 1935, PCF 1936

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [x] Large Buildings
- [x] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

In the 2015-2020 Code cycle, new technical requirements for large farm buildings were developed for publication in the 2020 editions of the National Building Code of Canada (NBC) and the National Fire Code of Canada (NFC). The new requirements were intended to address the Codes' life safety (OS) objectives, following the initial direction provided by the Canadian Commission on Building and Fire Codes (CCBFC).

In the course of this work, the CCBFC was consulted on whether spatial separation requirements should also be considered for farm buildings. In September 2019, the Executive Committee (EC) of the CCBFC, after consulting with the provinces and territories, requested that the Joint Task Group drafting the provisions "follow the normal Code development process when developing requirements for spatial separation."

Due to time limitations, spatial separation requirements for farm buildings were not included in the 2020 editions of the NBC and NFC, nor were OP objectives or intent statements. As such, there is a need to continue this work, which was deferred from the 2015-2020 Code cycle with the intention that these requirements and objectives would be included in the 2025 editions of these Codes.

For the 2020-2025 Code cycle, the Province of Ontario led the work to develop spatial separation requirements for large farm buildings in the NBC. Codes Canada expanded the application of the OP3 sub-objective to existing requirements in the NBC and introduced relevant intent statements where appropriate, as directed by the EC.

However, existing explanatory Note A-2.1.1.1.(1) of Division B of the NBC could create confusion for Code users if it is interpreted to mean that only the safety of persons is considered in the development of requirements for large farm buildings, and that no consideration is given to the OP3 sub-objective. This interpretation is in conflict with the direction provided by the EC in September 2019 and with the introduction of spatial separation requirements for large farm buildings in the NBC. The different possible interpretations may also cause disagreements between consultants, owners, builders and regulators, which could cause unnecessary delays in practice. As such, the explanatory Note suggesting this more limited intent of the farm building requirements in Part 2 of the NBC should be revised to clarify the application of objectives (and sub-objectives) to farm buildings.

Justification

Explanatory Note A-2.1.1.1.(1) could be interpreted to mean that only OS objectives are addressed in Part 2 of Division B of the NBC. Some Code users may conclude that the OP3 sub-objective is not considered at all, since the Note references the safety of persons in farm buildings exclusively.

To mitigate the risk of misinterpretation and avoid potential confusion, explanatory Note A-2.1.1.1.(1) should be revised. Because some provisions relate to life safety by requiring fire-resistance ratings or a minimum distance between two buildings, the corresponding Sentence 2.1.1.1.(1) of Division B would be left unchanged.

This proposed change would allow the OP3 sub-objective and related technical requirements to be considered for farm buildings without contradiction. It also aligns with the direction provided by the CCBFC in the previous Code cycle and would permit technical requirements related to property and exposure protection (such as spatial separation requirements) to be considered for farm buildings in Part 2.

EXISTING PROVISION

2.1.1.1. Scope

1) This Part is concerned with the fire, structural, heating, ventilating and air-conditioning performance of *farm buildings*, as well as processes and operations carried out therein that involve a risk of explosion, high flammability or related conditions that create a hazard to life safety. (See Note A-2.1.1.1.(1).)

Note A-2.1.1.1.(1) Safety of Persons.

The intent of Part 2 is to set forth measures to ensure the safety of persons in farm buildings.

PROPOSED CHANGE

[2.1.1.1.] 2.1.1.1. Scope

Note A-2.1.1.1.(1) Safety of Persons.

The intent of Part 2 is to set forth measures to ensure the safety of persons in farm buildings and the safety of persons in buildings adjacent to farm buildings by means of spatial separation.

Impact analysis

No new costs would be introduced by permitting the OP3 sub-objective to be considered for farm buildings. The proposed change would not introduce any new technical requirements but would rather allow the OP3 sub-objective to be considered for farm buildings in the NBC.

It should be noted that the future development of technical requirements related to the OP3 sub-objective may impact farm building use and construction costs. However, these requirements would be subject to separate evaluation and consideration at the time that they are developed, with impact analyses that are specific to the proposed technical requirements in question.

Enforcement implications

Allowing objectives other than life safety to be considered for large farm buildings does not on its own introduce any technical requirements that would need to be enforced by authorities having jurisdiction (AHJs), but AHJs should be aware of the change that permits the OP3 sub-objective to be considered.

This proposed change would reduce the risk of confusion for Code users and help facilitate the enforcement of the Code provisions.

Who is affected

Affected persons would include AHJs, architects, engineers, contractors and building owners, as they should be made aware that OS objectives are not the only objectives relevant to farm building requirements and that the OP3 sub-objective also applies to farm buildings.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[2.1.1.1.] 2.1.1.1. ([1] 1) no attributions

Submit a comment

Proposed Change 1777

Code Reference(s):	**NBC20 Div.B 2.2. (first printing)**
Subject:	Large Farm Buildings (General)
Title:	Spatial Separation and Exposure Protection
Description:	This proposed change introduces requirements for the spatial separation and exposure protection of large farm buildings.
Related Code Change Request(s):	CCR 1570
Related Proposed Change(s):	PCF 1918, PCF 1919, PCF 1935, PCF 1936

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [ ] Small Buildings
- [x] Fire Protection
- [ ] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [x] Division B
- [x] Design and Construction
- [ ] Housing
- [x] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

Farm buildings are unique occupancies having unique uses, hazards and expected performance. The NBC 2020 introduced Part 2 to acknowledge this fact by providing suitable minimum requirements for large farm buildings and agricultural occupancies.

NBC Part 2 provisions comprise a model set of minimum requirements for large farm buildings, with the objective being to limit the probability that, as a result of the design, construction or demolition of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury; and, more specifically, to limit the probability that a person will be exposed to an unacceptable risk of injury due to fire, structural failure or other hazards.

As originally directed by the Executive Committee of the Canadian Commission on Building and Fire Codes (EC), the overriding objective of the Part 2 requirements is the safety of persons in large farm buildings. Property protection objectives for farm buildings were not considered in the development of the technical requirements.

The requirements for farm buildings in Part 2 tend to include some relaxations of similar requirements for other occupancies. The rationale for this approach is based on the remote location of typical farm buildings and the specific characteristics of their occupants, namely:

- low human occupant load,
- typically familiar with the layout of the building,
- tend to be only in the building for short duration at limited times throughout a day, depending on specific farm building use,
- not typically members of the public, and
- not typically vulnerable.

Many farm buildings are constructed adjacent to property lines, public thoroughfares and non-farm buildings on the same property. The adjacent non-farm buildings have property protection objectives that must be satisfied. However, the lack of spatial separation requirements for Part 2 farm buildings does not provide the guidance necessary for designers to appropriately protect these adjacent properties and non-farm buildings from fires originating in farm buildings.

During the development of the technical requirements in the 2020 Code cycle, it was determined that spatial separation requirements should be developed for the large farm buildings covered by Part 2. These proposed requirements were not included in the NBC 2020. However, it was recommended that this issue be revisited during the 2025 Code cycle as the EC has confirmed through the property protection objective (i.e., OP3.1) that spatial separation requirements for large farm buildings may be considered.

Part 2 has few requirements for fire separations within large farm buildings. However, the occupant safety objectives (i.e., OS1.2 and OS1.5) relating to exposure protection between fire compartments and the protection of exits, which are typically grouped with spatial separation requirements, are important to capture in Part 2. These occupant safety requirements directly relate to the intent of Part 2.

Justification

While the intent of Part 2 is related to occupant safety, property protection objectives are required to be considered for adjacent buildings of other occupancy classifications and adjacent properties.

The spatial separation and exposure protection requirements are well developed in Subsection 3.2.3. For familiarity and clarity, this proposed change refers to these requirements.

Proposed Article 2.2.9.1. states the application of proposed Subsection 2.2.9. Sentence (1) establishes the spatial separation requirements for farm buildings to property lines, streets, lanes, public thoroughfares, farm buildings or non-farm buildings on the same property, and how this separation should be calculated. Sentence (2) requires that farm buildings be subjected to the applicable requirements for exposure protection in Subsection 3.2.3. Sentence (3) provides an exemption to the application of Sentence 3.2.3.1.(8) regarding fire department response time, as response time in rural areas will generally be more than 10 minutes. Existing rural firefighting services are well prepared to carry out their operations in rural areas for agricultural or other occupancies located in the countryside. Given the low density of development in rural areas, it would be unreasonable to impose the requirements of Sentence 3.2.3.1.(8).

Proposed Article 2.2.9.2. provides requirements related to limiting distance and area of unprotected openings for specific major occupancies by referring to Tables 3.2.3.1.-B and -C. Sentence 3) provides a relaxation of the spatial separation requirements between two exposing building faces of farm buildings with a G1 occupancy containing livestock and having below-floor storage areas for liquid manure, G2, G3 and G4 occupancies because these occupancies present a lower risk of fire spread and to the safety of persons in a fire. No relaxation is permitted for a Group G, Division 1 major occupancy, other than one containing livestock and having below-floor storage areas for liquid manure, because this specific occupancy, and the activities within the building, presents a higher fire or explosion risk that may lead to more severe damage to adjacent buildings. This approach is consistent with the intent of Part 2.

Proposed Article 2.2.9.3. provides requirements for the construction of the exposing building face for specific major occupancies by referring to Table 3.2.3.7.

When establishing the requirements in proposed Articles 2.2.9.2. and 2.2.9.3., differentiation was made between Group G, Division 1 major occupancy, other than one housing livestock having below-floor storage areas for liquid manure, and the other Group G major occupancies because the former presents a higher fire or explosion risk due to the anticipated activities within the building. As such, this occupancy needs to comply with relatively more stringent requirements.

PROPOSED CHANGE

[2.2.] 2.2. Fire Protection and Occupant Safety

[2.2.1.] 2.2.1. General

[2.2.1.1.] 2.2.1.1. Classification

[2.2.1.2.] 2.2.1.2. Prohibition of Occupancy Combinations

[2.2.1.3.] 2.2.1.3. Exceptions for Major Occupancies

[2.2.1.4.] 2.2.1.4. Separation of Occupancies

[2.2.1.5.] 2.2.1.5. Fire Separations and Closures

[2.2.1.6.] 2.2.1.6. Penetrations in Fire Separations and Fire-Rated Assemblies

[2.2.1.7.] 2.2.1.7. Firewalls

[2.2.1.8.] 2.2.1.8. Fire Blocks

[2.2.1.9.] 2.2.1.9. Additional Fire Separations

[2.2.1.10.] 2.2.1.10. Determination of Fire-Resistance Ratings

[2.2.1.11.] 2.2.1.11. Determination of Flame-Spread Ratings

[2.2.1.12.] 2.2.1.12. Flame-Spread Rating

[2.2.1.13.] 2.2.1.13. Foamed Plastics

[2.2.1.14.] 2.2.1.14. Fabrics and Films

[2.2.1.15.] 2.2.1.15. Electrical Wiring and Equipment

[2.2.1.16.] 2.2.1.16. Wires and Cables

[2.2.1.17.] 2.2.1.17. Occupant Load

[2.2.2.] 2.2.2. Building Size and Construction Relative to Major Occupancy

[2.2.2.1.] 2.2.2.1. Farm Buildings with Multiple Agricultural Major Occupancies

[2.2.2.2.] 2.2.2.2. Exceptions in Determining Building Height

[2.2.2.3.] 2.2.2.3. Group G, Division 1, up to 3 Storeys, Limited Area, Sprinklered

[2.2.6.6.] 2.2.6.6. Door Swing

[2.2.6.7.] 2.2.6.7. Doors and Door Hardware

[2.2.6.8.] 2.2.6.8. Ramps and Stairways

[2.2.6.9.] 2.2.6.9. Floor Openings

[2.2.6.10.] 2.2.6.10. Guards

[2.2.6.11.] 2.2.6.11. Signage

[2.2.6.12.] 2.2.6.12. Transparent Doors and Panels

[2.2.7.] 2.2.7. Exits

[2.2.7.1.] 2.2.7.1. Exit Facilities

[2.2.7.2.] 2.2.7.2. Types of Exits

[2.2.7.3.] 2.2.7.3. Minimum Number of Exits

[2.2.7.4.] 2.2.7.4. Distance between Exits

[2.2.7.5.] 2.2.7.5. Location of Exits

[2.2.7.6.] 2.2.7.6. Width and Height of Exits

[2.2.7.7.] 2.2.7.7. Direction of Exit Door Swing

[2.2.7.8.] 2.2.7.8. Exit Door Hardware

[2.2.7.9.] 2.2.7.9. Exit Stairs and Fire Escapes

[2.2.7.10.] 2.2.7.10. Exit Signs

[2.2.8.] 2.2.8. Hazardous Substances, Processes and Equipment

[2.2.8.1.] 2.2.8.1. General

[2.2.8.2.] 2.2.8.2. Exhaust Ventilation and Explosion Venting

[2.2.8.3.] 2.2.8.3. Below-Floor Storage Areas for Liquid Manure

[2.2.8.4.] 2.2.8.4. Welding and Cutting

[2.2.8.5.] 2.2.8.5. Liquid Manure Storage Tanks and Piping Systems

[2.2.8.6.] 2.2.8.6. Gas Traps or Valves

[2.2.8.7.] 2.2.8.7. Dangerous Goods Storage

[2.2.8.8.] 2.2.8.8. Pesticide Storage Areas

[2.2.9.] -- Spatial Separation and Exposure Protection

[2.2.9.1.] --- Application

[1] --) Except where stated otherwise, this Subsection applies to *farm buildings* located adjacent to

- [a] --) a property line,
- [b] --) the centre line of a *street*, lane or public thoroughfare, or
- [c] --) a *building* or part of a *building* on the same property.

[2] --) Except as provided in Sentence (3), the *farm buildings* referred to in Sentence (1) shall comply with Articles 2.2.9.2. and 2.2.9.3.

[3] --) Sentence 3.2.3.1.(8) does not apply to the *farm buildings* referred to in Sentence (1).

[2.2.9.2.] --- Limiting Distance and Area of Unprotected Openings

[1] --) A *building* or part of a *building* containing a Group G, Division 1 *major occupancy*, other than one housing livestock with a below-floor storage area for liquid manure, shall comply with Tables 3.2.3.1.-C and 3.2.3.1.-E.

[2] --) Except as provided in Sentence (3), a *building* or part of a *building* containing a Group G, Division 1 *major occupancy* housing livestock with a below-floor storage area for liquid manure or a Group G, Division 2, 3 or 4 *major occupancy* shall comply with Tables 3.2.3.1.-B and 3.2.3.1.-D.

[3] --) Where more than one *building* or part of a *building* containing a Group G, Division 1 *major occupancy* housing livestock with below-floor storage area for liquid manure or a Group G, Division 2, 3 or 4 *major occupancy* is located on the same property,

- [a] --) the *limiting distance* between their *exposing building faces* is permitted to be zero, and
- [b] --) the area of *unprotected openings* of their *exposing building faces* is permitted to be 100%.

[2.2.9.3.] --- Construction of Exposing Building Face

[1] --) The *fire-resistance rating*, construction and cladding for *exposing building faces* of *farm buildings*, or *fire compartments* within a *farm building*, containing a Group G, Division 1 *major occupancy*, other than one housing livestock with a below-floor storage area for liquid manure, shall comply with the requirements for a Group E or Group F, Division 1 or 2 *occupancy* in Table 3.2.3.7.

[2] --) The *fire-resistance rating*, construction and cladding for *exposing building faces* of *farm buildings*, or *fire compartments* within a *farm building*, containing a Group G, Division 1 *major occupancy* housing livestock with a below-floor storage area for liquid manure or a Group G, Division 2, 3 or 4 *major occupancy* shall comply with the requirements for a Group A, B, C or D or Group F, Division 3 *occupancy* in Table 3.2.3.7.

Impact analysis

Positive impacts of the provisions include the following:

- Clear, consistent methodology for designers to satisfy the property protection objectives of adjacent non-farm buildings and adjacent properties.
- Harmonization with Part 3 regarding occupant safety and logical protection of exit facilities and separate fire compartments within farm buildings to achieve the same level of protection.
- Clear, consistent methodology for authorities having jurisdiction to appropriately enforce spatial separation requirements.
- In many cases, there should be no discernable impact on farm building construction as similar requirements have existed since the 1995 edition of the National Farm Building Code of Canada (NFBC).

Potential negative impacts of the provisions may include the following:

- Large exposing building faces may cause increased construction costs for fire-rated exterior wall assemblies or increased land to meet the requirements for limiting distances. The actual incremental cost varies by building type and size of farm land.

The following are a few simple examples of common farm buildings used to illustrate the financial impact of this proposed change, assuming that the size of farm land is not large enough to provide the required limiting distance.

- According to a feasibility study conducted in Western Canada, a swine barn with concrete walls and manure tanks (Group G, Division 1 occupancy housing livestock with below-floor liquid manure storage tanks) promises the best longevity and reduced costs [1]. A cast-in-place concrete wall of at least 90 mm thick is able to meet the proposed requirement and provide a 1h fire-resistance rating without additional cost as a result of the proposed change. A cast-in-place concrete wall of at least 130 mm thick can provide a 2h fire-resistance rating as required for other Group G, Division 1 major occupancies according to Table D-2.1.1. of the NBC.
- Buildings containing Group G, Division 2 or 4 occupancies may also be constructed with concrete walls that already provide the required 1h fire-resistance rating if they are not less than 90 mm thick. Generally speaking, masonry walls are able to provide a similar level of fire performance to that required by Table D-2.1.1. of the NBC.
- Uninsulated wood-frame structures are commonly used for farm buildings. Table 1 shows a simple example that compares a non-compliant exterior wall assembly with one that has a 1h fire-resistance rating. There are various ways of achieving a 1h fire-resistance rating; the building owner may choose to use the same insulation and interior finish as wall assembly EW1a of Table 9.10.3.1.-A of the NBC. There could be a cost increase of 59.79% for the construction of the wood framing exterior wall (not the entire farm building) as a result of this proposed change.

Table 1. Comparison of Non-Compliant Exterior Wall Assembly with Assembly Having 1-Hour Fire-Resistance Rating(1)

Cost Analysis Example	38 mm × 140 mm stud wall (single bottom plate, double top plates), 2.438 m high, 60.96 m long on top of concrete wall expending 1.219 m above grade. Steel siding finish on the exterior.					
Baseline Wall Assembly	**Material**	**Labour**	**Base Total**	**Total O&P**	**Total w. 20% Contingency**	**Total Cost**
Steel siding, galvanized, corrugated or ribbed, on steel frame, 26 gauge, incl. fasteners	$ 4 112.00	$ 2 528.00	$ 6 640.00	$ 8,672.00	$ 10 406.40	$ 17 788.80 for 119.67 $/m^2
Furring, wood, on walls, on wood, 19 mm × 64 mm, pneumatic nailed	$ 450.00	$ 430.00	$ 880.00	$ 1,170.00	$ 1 404.00	
Sheathing, oriented strand board, 12.7 mm thick, on walls	$ 1 104.00	$ 816.00	$ 1 920.00	$ 2,544.00	$ 3 052.80	
Wall framing, studs, 38 mm × 140 mm, 2.438 m high wall	$ 332.00	$ 120.00	$ 452.00	$ 560.00	$ 672.00	
Wall framing, plates, untreated, 38 mm × 140 mm	$ 996.00	$ 480.00	$ 1 476.00	$ 1 878.00	$ 2 253.60	
1h Fire-Resistance Rating	**Material**	**Labour**	**Base Total**	**Total O&P**	**Total w. 20% Contingency**	**Total Cost**

Table 1. Comparison of Non-Compliant Exterior Wall Assembly with Assembly Having 1-Hour Fire-Resistance Rating(1) (Continued)

Cost Analysis Example	38 mm × 140 mm stud wall (single bottom plate, double top plates), 2.438 m high, 60.96 m long on top of concrete wall expending 1.219 m above grade. Steel siding finish on the exterior.					
Steel siding, galvanized, corrugated or ribbed, on steel frame, 26 gauge, incl. fasteners	$ 4 112.00	$ 2 528.00	$ 6 640.00	$ 8,672.00	$ 10 406.40	$ 28 425.60 for 191.23 $/m^2
Furring, wood, on walls, on wood, 19 mm × 64 mm, pneumatic nailed	$ 450.00	$ 430.00	$ 880.00	$ 1 170.00	$ 1 404.00	
Sheathing, oriented strand board, 12.7 mm thick, on walls	$ 1 104.00	$ 816.00	$ 1 920.00	$ 2 544.00	$ 3 052.80	
Blanket insulation, for walls or ceilings, mineral wool batts, 140 mm thick, R23	$ 6 240.00	$ 352.00	$ 6 592.00	$ 7 440.00	$ 8 928.00	
Wall framing, studs, 38 mm × 140 mm, 2.438 m high wall	$ 332.00	$ 120.00	$ 452.00	$ 560.00	$ 672.00	
Wall framing, plates, untreated, 38 mm × 140 mm	$ 996.00	$ 480.00	$ 1 476.00	$ 1 878.00	$ 2 253.60	

Table 1. Comparison of Non-Compliant Exterior Wall Assembly with Assembly Having 1-Hour Fire-Resistance Rating[(1)] (Continued)

Cost Analysis Example	38 mm × 140 mm stud wall (single bottom plate, double top plates), 2.438 m high, 60.96 m long on top of concrete wall expending 1.219 m above grade. Steel siding finish on the exterior.					
Gypsum wallboard, on walls, standard, 15.9 mm thick, finish excluded	$ 608.00	$ 480.00	$ 1 088.00	$ 1 424.00	$ 1 708.80	

Note to Table 1:

(1) This cost estimate was conducted using RSMeans 2023 data online from Gordian.

- New greenhouses (Group G, Division 3 occupancy) will likely experience increased land costs to ensure sufficient spatial separation with 100% unprotected openings as fire rating a greenhouse wall would be impractical. Note that the requirements in Subsection 3.1.2. of the NFBC 1995 are not applicable to greenhouses. Table 2 shows the value of farm land and buildings per 4 047 m^2 [2].

Geography	2020	2021	2022
Canada	$ 3 415	$ 3 739	$ 4 285
British Columbia	$ 6 540	$ 7 491	$ 8 485
Alberta	$ 3 009	$ 3 170	$ 3 380
Saskatchewan	$ 1 601	$ 1 656	$ 1 888
Manitoba	$ 2 281	$ 2 423	$ 2 739
Ontario	$ 11 889	$ 13 781	$ 17 143
Quebec	$ 6 897	$ 7 834	$ 8 824
New Brunswick	$ 2 880	$ 2 838	$ 3 100
Nova Scotia	$ 2 354	$ 2 542	$ 2 816
Prince Edward Island	$ 4 185	$ 4 356	$ 5 520
Newfoundland and Labrador	$ 5 421	$ 5 812	$ 6 298

- Requirements for exposure protection of exit facilities and separate fire compartments within a farm building may increase construction costs, as these requirements were not considered for large farm buildings in the past. However, these requirements would likely apply to a small number of new farm buildings or small parts of new farm buildings as Part 2 allows unlimited building area in most cases.

References

(1) Lemay, S., Laguë, C. and Chénard, L. (2002). Feasibility Study for Concrete Swine Buildings and Manure Storage Facilities in Western Canada. Available: https://www.prairieswine.com/wp-content/uploads/2020/10/Feasibility-Study-for-Concrete-Swine-Buildings-and-Manure-Storage-Facilities-in-Western-Canada.pdf

(2) Statistics Canada (2023). Value per acre of farm land and buildings at July 1. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210004701

Enforcement implications

As the spatial separation and exposure protection provisions are familiar to authorities having jurisdiction for all other occupancy classifications, it is anticipated that enforcement of this proposed change could be achieved using the established regulatory framework and resources.

Who is affected

People concerned with the design, construction and operation of farm buildings, such as engineers, architects, building owners and regulators, would be affected by this proposed change.

Supporting Document(s)

Cost Analysis for PCF 1777 (cost_analysis_for_pcf_1777.pdf)

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[2.2.1.1.] 2.2.1.1. ([1] 1) no attributions

[2.2.1.1.] 2.2.1.1. ([2] 2) no attributions

[2.2.1.2.] 2.2.1.2. ([1] 1) [F02-OS1.2]

[2.2.1.2.] 2.2.1.2. ([2] 2) [F02-OS1.2]

[2.2.1.3.] 2.2.1.3. ([1] 1) no attributions

[2.2.1.4.] 2.2.1.4. ([1] 1) [F03-OS1.2]

[2.2.1.4.] 2.2.1.4. ([2] 2) no attributions

[2.2.1.4.] 2.2.1.4. ([3] 3) [F03-OS1.2]

[2.2.1.5.] 2.2.1.5. ([1] 1) [F03-OS1.2]

[2.2.1.5.] 2.2.1.5. ([2] 2) no attributions

[2.2.1.6.] 2.2.1.6. ([1] 1) no attributions

[2.2.1.7.] 2.2.1.7. ([1] 1) [F03-OS1.2] [F12-OS1.5]

[2.2.1.7.] 2.2.1.7. ([2] 2) [F03-OS1.2] [F12-OS1.5]

[2.2.1.7.] 2.2.1.7. ([3] 3) no attributions

[2.2.1.8.] 2.2.1.8. ([1] 1) [F03-OS1.2]

[2.2.1.8.] 2.2.1.8. ([2] 2) [F03-OS1.2]

[2.2.1.8.] 2.2.1.8. ([3] 3) [F03-OS1.2]

[2.2.1.8.] 2.2.1.8. ([4] 4) [F03-OS1.2]

[2.2.1.8.] 2.2.1.8. ([5] 5) no attributions

[2.2.1.9.] 2.2.1.9. ([1] 1) [F03-OS1.2]

[2.2.1.9.] 2.2.1.9. ([2] 2) no attributions

[2.2.1.9.] 2.2.1.9. ([3] 3) ([a] a) [F02-OS1.2]

[2.2.1.9.] 2.2.1.9. ([3] 3) ([b] b) [F02,F03-OS1.2]

[2.2.1.9.] 2.2.1.9. ([4] 4) [F02,F03-OS1.2]

[2.2.1.9.] 2.2.1.9. ([5] 5) [F02,F03-OS1.2]

[2.2.1.9.] 2.2.1.9. ([6] 6) no attributions

[2.2.1.10.] 2.2.1.10. ([1] 1) [F03-OS1.2]

[2.2.1.10.] 2.2.1.10. ([1] 1) [F04-OS1.3]

[2.2.1.10.] 2.2.1.10. ([2] 2) [F03-OS1.2]

[2.2.1.10.] 2.2.1.10. ([2] 2) [F04-OS1.3]

[2.2.1.10.] 2.2.1.10. ([2] 2) no attributions

[2.2.1.11.] 2.2.1.11. ([1] 1) no attributions

[2.2.1.12.] 2.2.1.12. ([1] 1) [F02,F03-OS1.2]

[2.2.1.12.] 2.2.1.12. ([2] 2) no attributions

[2.2.1.12.] 2.2.1.12. ([3] 3) [F02,F03-OS1.2]

[2.2.1.13.] 2.2.1.13. ([1] 1) [F01-OS1.1] [F02-OS1.2]

[2.2.1.14.] 2.2.1.14. ([1] 1) [F02-OS1.2]

[2.2.1.15.] 2.2.1.15. ([1] 1) [F01-OS1.1] [F81-OS1.1]

[2.2.1.15.] 2.2.1.15. ([1] 1) [F81-OS1.4]

[2.2.1.15.] 2.2.1.15. ([1] 1) [F32-OS3.3]

[2.2.1.15.] 2.2.1.15. ([2] 2) [F01-OS1.1]

[2.2.1.15.] 2.2.1.15. ([2] 2) [F81-OS1.4]

[2.2.1.16.] 2.2.1.16. ([1] 1) no attributions

[2.2.1.17.] 2.2.1.17. ([1] 1) no attributions

[2.2.1.17.] 2.2.1.17. ([1] 1) [F10-OS1.5]

[2.2.2.1.] 2.2.2.1. ([1] 1) no attributions

[2.2.2.2.] 2.2.2.2. ([1] 1) no attributions

[2.2.2.2.] 2.2.2.2. ([2] 2) no attributions

[2.2.2.3.] 2.2.2.3. ([1] 1) no attributions

[2.2.2.4.] 2.2.2.4. ([1] 1) no attributions

[2.2.2.4.] 2.2.2.4. ([2] 2) no attributions

[2.2.2.5.] 2.2.2.5. ([1] 1) no attributions

[2.2.2.6.] 2.2.2.6. ([1] 1) no attributions

[2.2.2.7.] 2.2.2.7. ([1] 1) no attributions

[2.2.2.8.] 2.2.2.8. ([1] 1) no attributions

[2.2.3.1.] 2.2.3.1. ([1] 1) [F11-OS1.5] [F13-OS1.5,OS1.2]

[2.2.3.1.] 2.2.3.1. ([2] 2) no attributions

[2.2.3.2.] 2.2.3.2. ([1] 1) [F11-OS1.5]

[2.2.3.3.] 2.2.3.3. ([1] 1) ([a] a) [F03-OS1.2]

[2.2.3.3.] 2.2.3.3. ([1] 1) ([b] b) [F11-OS1.2]

[2.2.3.4.] 2.2.3.4. ([1] 1) ([a] a)

[2.2.3.4.] 2.2.3.4. ([1] 1) ([b] b),([c] c) [F11-OS1.5]

[2.2.3.4.] 2.2.3.4. ([2] 2) [F11-OS1.5]

[2.2.3.4.] 2.2.3.4. ([3] 3) [F11-OS1.5]

[2.2.3.5.] 2.2.3.5. ([1] 1) [F11-OS1.5] [F34,F81-OS1.5]

[2.2.3.6.] 2.2.3.6. ([1] 1) [F82-OS1.2,OS1.5]

[2.2.3.7.] 2.2.3.7. ([1] 1) ([a] a) [F11-OS1.5]

[2.2.3.7.] 2.2.3.7. ([1] 1) ([b] b) [F11-OS1.5]

[2.2.3.7.] 2.2.3.7. ([2] 2) [F02-OS1.2] [F11-OS1.5]

[2.2.4.1.] 2.2.4.1. ([1] 1) [F12-OS1.2,OS1.5]

[2.2.4.1.] 2.2.4.1. ([2] 2) [F12-OS1.2,OS1.5]

[2.2.4.2.] 2.2.4.2. ([1] 1) no attributions

[2.2.4.2.] 2.2.4.2. ([2] 2) no attributions

[2.2.4.2.] 2.2.4.2. ([3] 3) [F11-OS1.5] [F12-OS1.2,OS1.5]

[2.2.4.3.] 2.2.4.3. ([1] 1) [F02,F12,F81-OS1.2]

[2.2.5.1.] 2.2.5.1. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[2.2.5.1.] 2.2.5.1. ([1] 1) [F10-OS1.5]

[2.2.5.1.] 2.2.5.1. ([2] 2) [F30-OS3.1] [F10-OS3.7]

[2.2.5.1.] 2.2.5.1. ([2] 2) [F10-OS1.5]

[2.2.5.1.] 2.2.5.1. ([3] 3) [F30-OS3.1] [F10-OS3.7]

[2.2.5.1.] 2.2.5.1. ([3] 3) [F10-OS1.5]

[2.2.6.1.] 2.2.6.1. ([1] 1) no attributions

[2.2.6.1.] 2.2.6.1. ([2] 2) no attributions

[2.2.6.1.] 2.2.6.1. ([3] 3) no attributions

[2.2.6.1.] 2.2.6.1. ([4] 4) no attributions

[2.2.6.2.] 2.2.6.2. ([1] 1) [F10-OS1.5]

[2.2.6.2.] 2.2.6.2. ([2] 2) [F10-OS1.5]

[2.2.6.2.] 2.2.6.2. ([3] 3) [F10-OS1.5]

[2.2.6.3.] 2.2.6.3. ([1] 1) no attributions

[2.2.6.3.] 2.2.6.3. ([1] 1) [F10-OS1.5]

[2.2.6.4.] 2.2.6.4. ([1] 1) no attributions

[2.2.6.5.] 2.2.6.5. ([1] 1) no attributions

[2.2.6.5.] 2.2.6.5. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[2.2.6.5.] 2.2.6.5. ([1] 1) [F10-OS1.5]

[2.2.6.5.] 2.2.6.5. ([2] 2) [F43-OS3.7]

[2.2.6.6.] 2.2.6.6. ([1] 1) [F10-OS3.7]

[2.2.6.6.] 2.2.6.6. ([1] 1) [F10-OS1.5]

[2.2.6.6.] 2.2.6.6. ([2] 2) no attributions

[2.2.6.6.] 2.2.6.6. ([2] 2) [F10-OS3.7]

[2.2.6.7.] 2.2.6.7. ([1] 1) ([a] a),([b] b),([c] c) [F10,F12-OS3.7]

[2.2.6.7.] 2.2.6.7. ([1] 1) ([d] d) [F30-OS3.1]

[2.2.6.7.] 2.2.6.7. ([2] 2) no attributions

[2.2.6.7.] 2.2.6.7. ([2] 2) ([a] a) [F03-OS1.2]

[2.2.6.7.] 2.2.6.7. ([2] 2) ([b] b) [F44-OS3.4]

[2.2.6.7.] 2.2.6.7. ([3] 3) no attributions

[2.2.6.8.] 2.2.6.8. ([1] 1) ([a] a)

[2.2.6.8.] 2.2.6.8. ([1] 1) ([a] a) [F30-OS3.1]

[2.2.6.8.] 2.2.6.8. ([1] 1) ([b] b)

[2.2.6.8.] 2.2.6.8. ([2] 2) [F30-OS3.1]

[2.2.6.8.] 2.2.6.8. ([3] 3) no attributions

[2.2.6.9.] 2.2.6.9. ([1] 1) [F20-OS3.1]

[2.2.6.9.] 2.2.6.9. ([2] 2) [F30-OS3.1]

[2.2.6.9.] 2.2.6.9. ([2] 2) no attributions

[2.2.6.10.] 2.2.6.10. ([1] 1) [F30-OS3.1]

[2.2.6.10.] 2.2.6.10. ([2] 2) [F30-OS3.1]

[2.2.6.10.] 2.2.6.10. ([2] 2) no attributions

[2.2.6.10.] 2.2.6.10. ([3] 3) no attributions

[2.2.6.11.] 2.2.6.11. ([1] 1) no attributions

[2.2.6.12.] 2.2.6.12. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[2.2.6.12.] 2.2.6.12. ([2] 2) no attributions

[2.2.6.12.] 2.2.6.12. ([3] 3) [F30-OS3.1] [F10-OS3.7]

[2.2.7.1.] 2.2.7.1. ([1] 1) no attributions

[2.2.7.2.] 2.2.7.2. ([1] 1) no attributions

[2.2.7.3.] 2.2.7.3. ([1] 1) no attributions

[2.2.7.3.] 2.2.7.3. ([1] 1) [F10,F12-OS3.7]

[2.2.7.3.] 2.2.7.3. ([1] 1) [F10,F12-OS1.5]

[2.2.7.3.] 2.2.7.3. ([2] 2) no attributions

[2.2.7.3.] 2.2.7.3. ([3] 3) no attributions

[2.2.7.4.] 2.2.7.4. ([1] 1) no attributions

[2.2.7.4.] 2.2.7.4. ([1] 1) [F10-OS1.5]

[2.2.7.5.] 2.2.7.5. ([1] 1) no attributions

[2.2.7.5.] 2.2.7.5. ([1] 1) [F10-OS3.7]

[2.2.7.5.] 2.2.7.5. ([1] 1) [F10-OS1.5]

[2.2.7.5.] 2.2.7.5. ([2] 2) no attributions

[2.2.7.5.] 2.2.7.5. ([3] 3) no attributions

[2.2.7.6.] 2.2.7.6. ([1] 1) no attributions

[2.2.7.6.] 2.2.7.6. ([1] 1) [F10-OS3.7]

[2.2.7.6.] 2.2.7.6. ([2] 2) no attributions

[2.2.7.6.] 2.2.7.6. ([3] 3) no attributions

[2.2.7.6.] 2.2.7.6. ([3] 3) [F10,F30-OS3.7]

[2.2.7.6.] 2.2.7.6. ([3] 3) [F10-OS1.5]

[2.2.7.7.] 2.2.7.7. ([1] 1) [F10-OS3.7]

[2.2.7.7.] 2.2.7.7. ([1] 1) [F10-OS1.5]

[2.2.7.7.] 2.2.7.7. ([2] 2) no attributions

[2.2.7.8.] 2.2.7.8. ([1] 1) [F10-OS3.7]

[2.2.7.8.] 2.2.7.8. ([1] 1) [F10-OS1.5]

[2.2.7.9.] 2.2.7.9. ([1] 1) no attributions

[2.2.7.9.] 2.2.7.9. ([1] 1) [F10-OS3.7] [F30-OS3.1]

[2.2.7.9.] 2.2.7.9. ([2] 2) [F10-OS3.7]

[2.2.7.9.] 2.2.7.9. ([2] 2) [F10-OS1.5]

[2.2.7.9.] 2.2.7.9. ([3] 3) no attributions

[2.2.7.9.] 2.2.7.9. ([4] 4) no attributions

[2.2.7.9.] 2.2.7.9. ([5] 5) no attributions

[2.2.7.9.] 2.2.7.9. ([5] 5) [F10,F12-OS3.7] [F30-OS3.1]

[2.2.7.9.] 2.2.7.9. ([5] 5) [F10,F12-OS1.5]

[2.2.7.10.] 2.2.7.10. ([1] 1) no attributions

[2.2.8.1.] 2.2.8.1. ([1] 1) [F01,F02,F03-OS1.1,OS1.2]

[2.2.8.1.] 2.2.8.1. ([1] 1) [F43-OS3.4]

[2.2.8.1.] 2.2.8.1. ([1] 1) no attributions

[2.2.8.1.] 2.2.8.1. ([2] 2) no attributions

[2.2.8.1.] 2.2.8.1. ([3] 3) [F43-OS1.1]

[2.2.8.1.] 2.2.8.1. ([3] 3) [F43-OS3.4]

[2.2.8.1.] 2.2.8.1. ([4] 4) no attributions

[2.2.8.1.] 2.2.8.1. ([5] 5) no attributions

[2.2.8.2.] 2.2.8.2. ([1] 1) [F01-OS1.1]

[2.2.8.2.] 2.2.8.2. ([2] 2) no attributions

[2.2.8.2.] 2.2.8.2. ([3] 3) no attributions

[2.2.8.3.] 2.2.8.3. ([1] 1) no attributions

[2.2.8.3.] 2.2.8.3. ([2] 2) [F01-OS1.1]

[2.2.8.3.] 2.2.8.3. ([3] 3) ([a] a) [F11-OS1.1,OS1.4]

[2.2.8.3.] 2.2.8.3. ([3] 3) ([b] b),([c] c) [F11-OS1.1,OS1.4]

[2.2.8.3.] 2.2.8.3. ([3] 3) no attributions

[2.2.8.3.] 2.2.8.3. ([3] 3) ([d] d) [F01,F02-OS1.1]

[2.2.8.3.] 2.2.8.3. ([3] 3) ([e] e) [F01,F02-OS1.4]

[2.2.8.3.] 2.2.8.3. ([4] 4) [F01,F02-OS1.2] [F12-OS1.1]

[2.2.8.3.] 2.2.8.3. ([5] 5) [F03-OS1.2]

[2.2.8.4.] 2.2.8.4. ([1] 1) no attributions

[2.2.8.4.] 2.2.8.4. ([2] 2) no attributions

[2.2.8.5.] 2.2.8.5. ([1] 1) no attributions

[2.2.8.5.] 2.2.8.5. ([2] 2) no attributions

[2.2.8.5.] 2.2.8.5. ([3] 3) [F30,F34-OS3.1]

[2.2.8.5.] 2.2.8.5. ([4] 4) [F34-OS3.4]

[2.2.8.5.] 2.2.8.5. ([5] 5) [F34,F43-OS3.4]

[2.2.8.5.] 2.2.8.5. ([6] 6) [F34,F43-OS3.4]

[2.2.8.6.] 2.2.8.6. ([1] 1) [F01-OS1.1]

[2.2.8.6.] 2.2.8.6. ([1] 1) [F43-OS3.4]

[2.2.8.6.] 2.2.8.6. ([2] 2) [F01-OS1.1]

[2.2.8.6.] 2.2.8.6. ([2] 2) [F43-OS3.4]

[2.2.8.6.] 2.2.8.6. ([2] 2) no attributions

[2.2.8.7.] 2.2.8.7. ([1] 1) no attributions

[2.2.8.8.] 2.2.8.8. ([1] 1) no attributions

[2.2.8.8.] 2.2.8.8. ([2] 2) ([a] a)

[2.2.8.8.] 2.2.8.8. ([2] 2) ([a] a) [F01-OS1.1]

[2.2.8.8.] 2.2.8.8. ([2] 2) ([a] a) [F43-OS3.4]

[2.2.8.8.] 2.2.8.8. ([2] 2) ([b] b),([c] c) [F34-OS3.4]

[2.2.8.8.] 2.2.8.8. ([3] 3) [F43,F44-OS3.4]

[2.2.8.8.] 2.2.8.8. ([4] 4) [F43,F44,F46-OS3.4]

[2.2.8.8.] 2.2.8.8. ([4] 4) [F01,F02,F03-OS1.2]

[2.2.9.1.] -- ([1] --) no attributions

[2.2.9.1.] -- ([2] --) no attributions

[2.2.9.1.] -- ([3] --) no attributions

[2.2.9.2.] -- ([1] --) no attributions

[2.2.9.2.] -- ([1] --) [F03-OS1.2]

[2.2.9.2.] -- ([1] --) [F03-OP3.1]

[2.2.9.2.] -- ([2] --) no attributions

[2.2.9.2.] -- ([2] --) [F03-OS1.2]

[2.2.9.2.] -- ([2] --) [F03-OP3.1]

[2.2.9.2.] -- ([3] --) no attributions

[2.2.9.3.] -- ([1] --) no attributions

[2.2.9.3.] -- ([1] --) [F02,F03-OS1.2]

[2.2.9.3.] -- ([1] --) [F03-OP3.1]

[2.2.9.3.] -- ([2] --) no attributions

[2.2.9.3.] -- ([2] --) [F02,F03-OS1.2]

[2.2.9.3.] -- ([2] --) [F03-OP3.1]

Submit a comment

Proposed Change 1994

Code Reference(s):	**NBC20 Div.B 3.2.1.4.(1) (first printing)**
Subject:	Building Fire Safety
Title:	Exemptions List for Floor Assemblies over Basements
Description:	This proposed change adds Sentences 3.2.2.48.(3) and 3.2.2.51.(3) to the list of exceptions to the requirements for floor assemblies over basements in Sentence 3.2.1.4.(1).

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [x] Large Buildings
- [x] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

Sentence 3.2.1.4.(1) of Division B of the National Building Code of Canada (NBC) provides general requirements for floor assemblies immediately above basements. With the exception of certain assemblies for which specific requirements are provided elsewhere in the Code, such assemblies must

1. be constructed as a fire separation having a fire-resistance rating conforming the requirements of Articles 3.2.2.20. to 3.2.2.92., and
2. have a fire-resistance rating not less than 45 minutes.

To exempt certain assemblies from these general requirements, Sentence 3.2.1.4.(1) also points to seven Articles dealing with Group C major occupancies in which specific requirements for floor assemblies over basements are provided. In such cases, Code users do not need to comply with the requirements of Sentence 3.2.1.4.(1). Instead, the requirements of Sentence (3) of the relevant Article apply.

This proposed change notes that two additional Articles, 3.2.2.48. and 3.2.2.51., also address Group C major occupancies and provide requirements for floor assemblies above basements. However, these assemblies are not currently exempted from the application of Sentence 3.2.1.4.(1), which means they are subject to the requirements of both Sentence 3.2.1.4.(1) and the Article addressing their occupancy type.

Sentences 3.2.2.48.(3) and 3.2.2.51.(3) require floor assemblies over basements within a single dwelling unit to have a fire-resistance rating not less than one hour but do not require them to be constructed as fire separations. While the fire-resistance rating of not less than one hour is consistent with the fire-resistance rating required by Sentence 3.2.1.4.(1), there is a conflict as to whether the floor should be constructed as a fire separation. This inconsistency creates confusion for Code users and may lead to unnecessary expenditures if floors are constructed as fire separations without needing to be. It could also result in inconsistent interpretation of the requirements and challenges enforcing them in practice.

Justification

Sentence 3.2.1.4.(1) includes a list of exemptions from the requirement that a floor assembly immediately above a basement be constructed as a fire separation having a fire-resistance rating conforming to the requirements of Articles 3.2.2.20. to 3.2.2.92. but not less than 45 minutes.

The list of exemptions includes references to the Sentence (3) of seven of the nine Articles in Subsection 3.2.2. that establish requirements for Group C major occupancies:

- Article 3.2.2.47., Group C, Any Height, Any Area, Sprinklered
- Article 3.2.2.49., Group C, up to 6 Storeys, Sprinklered, Noncombustible Construction
- Article 3.2.2.50., Group C, up to 3 Storeys, Noncombustible Construction
- Article 3.2.2.52., Group C, up to 4 Storeys, Sprinklered
- Article 3.2.2.53., Group C, up to 3 Storeys, Increased Area
- Article 3.2.2.54., Group C, up to 3 Storeys
- Article 3.2.2.55., Group C, up to 3 Storeys, Sprinklered

The Articles listed above exempt certain floor assemblies over basements from the requirements of Sentence 3.2.1.4.(1), on the basis that they each possess the following Sentence (3) requirement:

> In a building that contains dwelling units that have more than one storey, subject to the requirements of Sentence 3.3.4.2.(3), the floor assemblies, including floors over basements, that are entirely contained within these dwelling units shall have a fire-resistance rating not less than 1 h* but need not be constructed as fire separations.

*Note: In Articles 3.2.2.54. and 3.2.2.55., the minimum fire-resistance rating is 45 minutes.

Two other Articles in Subsection 3.2.2. are also applicable to Group C major occupancies and include the same Sentence (3):

- Article 3.2.2.48., Group C, up to 12 Storeys, Sprinklered
- Article 3.2.2.51., Group C, up to 6 Storeys, Sprinklered

To avoid the conflict identified in the problem statement, this proposed change would add Sentences 3.2.2.48.(3) and 3.2.2.51.(3) to the list of provisions exempting certain floor assemblies over basements from the requirements of Sentence 3.2.1.4.(1). This addition would direct Code users to the appropriate Article for requirements for floor assemblies above basements, which was the intent when these two Articles were introduced.

PROPOSED CHANGE

[3.2.1.4.] 3.2.1.4. Floor Assembly over Basement

[1] 1) Except as permitted by Sentence 3.2.2.47.(3), 3.2.2.48.(3), 3.2.2.49.(3), 3.2.2.50.(3), 3.2.2.51.(3), 3.2.2.52.(3), 3.2.2.53.(3), 3.2.2.54.(3) or 3.2.2.55.(3), a floor assembly immediately above a *basement* shall be constructed as a *fire separation* having a *fire-resistance rating* conforming to the requirements of Articles 3.2.2.20. to 3.2.2.92. for a floor assembly, but not less than 45 min.

Impact analysis

The proposed change to Sentence 3.2.1.4.(1) would clarify the existing requirements for floor assemblies over basements by adding references to two exemptions. This clarification would not change the existing requirements in the Code.

To reflect the different requirements of Sentence 3.2.1.4.(1) and Sentences 3.2.2.48.(3) and 3.2.2.51.(3), the subject of the cost analysis is assumed to be a six-storey, Group C (residential) building of encapsulated mass timber construction (EMTC), equipped with a sprinkler system. Each dwelling unit within the building offers a floor area of 100 m^2, with floor perimeters measuring 40 m. The subfloor and structural systems are assumed to be the same in each.

Table 1 below provides a construction cost comparison of the fireproofing components of the two options for a floor assembly:

1. Having a fire-resistance rating (FRR) of 45 minutes and constructed as a fire separation (FS).
2. Having an FRR of one hour and not constructed as an FS.

These two options differ in their fire-resistance rating and construction as a fire separation, with the first conforming to the general requirements in Sentence 3.2.1.4.(1) and the second conforming to the more specific requirements in Sentences

3.2.2.48.(3) and 3.2.2.51.(3). The comparison focuses on the cost difference associated with the different fire-resistance ratings and the use of protective materials for the fire separation.

The NBC defines a fire separation as “a construction assembly that acts as a barrier against the spread of fire.” Note A-1.4.1.2.(1) in Division A additionally explains that “fire” refers to all products of combustion, including heat and smoke. While a fire separation may not always require a fire-resistance rating, its purpose is to serve as a barrier to the spread of fire, including heat and smoke, until an appropriate response is initiated. Furthermore, if the fire-resistance rating of a fire separation is permitted to be waived based on the presence of an automatic sprinkler system, it remains the intent of the Code that the fire separation be constructed such that it stays in place and functions as a barrier against the spread of smoke until the sprinklers are activated.

In the NBC, the term “firestop” refers to measures required to maintain the integrity of fire separations required in a building: “Firestop means a system consisting of a material, component and means of support used to fill gaps between fire separations or between fire separations and other assemblies, or used around items that wholly or partially penetrate a fire separation.”

Table 1. Cost Comparison of Fireproofing Components of the Two Types of Floor Assembly

Type of floor assembly	Floor assembly description	Cost (materials and labour)(1)(2)(3)	Total cost per 100 m^2
Minimum 45 min FRR and constructed as an FS, in accordance with Sentence 3.2.1.4.(1)	Two layers of 12.7 mm thick Type X gypsum board with firestop sealant	Gypsum board: \$3,206.50/100 $m^2 \times 2$ Firestop sealant: \$874/40 m	\$7,287
Minimum 1 h FRR, not constructed as an FS, in accordance with Sentences 3.2.2.48.(3) and 3.2.2.51.(3)	Two layers of 15.9 mm thick Type X gypsum board with acoustical sealant	Gypsum board: \$3,066.60/100 $m^2 \times 2$ Acoustical sealant: \$225/40 m	\$6,358
Cost difference per 100 m^2			\$929

Notes to Table 1

(1) Labour rate based on RSMeans data.
(2) Material costs based on RSMeans data and pricing from https://www.rona.ca/.
(3) Caulk requirements calculated using The Caulkulator® chart from http://www.phenoseal.com/Caulkulator.aspx.

Cost comparison conclusion

The total cost for the floor assembly conforming to the requirements of Sentence 3.2.1.4.(1) (i.e., having a fire-resistance rating of 45 minutes and constructed as a fire separation) is $7,287 for 100 m², while the total cost for the assembly conforming to the requirements of Sentences 3.2.2.48.(3) and 3.2.2.51.(3) (i.e., having a fire-resistance rating of one hour and not constructed as a fire separation) is $6,358 for 100 m², representing a cost difference of $929 per 100 m². Therefore, the proposed change could potentially save $929 per 100 m² and have a significant impact on project budgets, especially in larger construction projects.

Enforcement implications

The proposed change would enable consistent interpretation and enforcement of Code requirements, which would contribute to the harmonization of fire safety measures and more consistent levels of fire safety performance.

Who is affected

The proposed change would have an impact on Code users (including designers and regulators), as it would affect Code interpretation, building design and Code enforcement work.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.2.1.4.] 3.2.1.4. ([1] 1) no attributions

[3.2.1.4.] 3.2.1.4. ([1] 1) [F03-OS1.2] [F04-OS1.3]

[3.2.1.4.] 3.2.1.4. ([1] 1) [F03-OP1.2] [F04-OP1.3]

Submit a comment

Proposed Change 1939

Code Reference(s):	**NBC20 Div.B 3.2.3.7.(4) (first printing)** **NBC20 Div.B 3.2.5.12. (first printing)**
Subject:	Automatic Sprinkler System
Title:	Clarification of the Requirement for Sprinklers in Combustible Attic or Roof Spaces
Description:	This proposed change clarifies the requirement for sprinklers in combustible attic or roof spaces by removing "throughout" from Clause 3.2.3.7.(4)(b) and introducing a new Sentence 3.2.5.12.(8) and an accompanying Note.

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [x] Small Buildings
- [x] Large Buildings
- [x] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

In the National Building Code of Canada (NBC) 2020 and National Fire Code of Canada (NFC) 2020, there are approximately 200 instances of the phrase "sprinklered throughout" when referring to the installation of sprinkler systems in a building or part thereof.

Use of this phrase can lead to confusion regarding the sprinkler installation requirements in the NBC, particularly since the various referenced NFPA standards for sprinkler systems (NFPA 13, "Standard for the Installation of Sprinkler Systems"; NFPA 13R, "Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies"; and NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes") do not require sprinkler protection for certain areas or spaces within a sprinklered building or storey.

A review of all instances of "sprinklered throughout" in the NBC and NFC identified a single case in the NBC where the original intent was to mandate the installation of sprinklers throughout the space, regardless of the exemptions listed in the referenced standards for sprinkler systems.

This proposed change also introduces NBC Sentence 3.2.5.12.(8)-2025 and its explanatory Note. The NBC requires the installation of automatic sprinkler systems for the protection of combustible attic or roof spaces. Misinterpretation of the intent of the Code could lead to a fire not being suppressed or controlled, which could result in the spread of fire to other parts of the building, which could cause harm to persons and building damage.

This proposed change clarifies the intent of the Code by using consistent wording.

Justification

The phrase "sprinklered throughout" in the NBC creates the potential for confusion among Code users as to whether the combustible attic or roof spaces do not require sprinklers in accordance with the relevant standards for sprinkler systems: NFPA 13, "Standard for the Installation of Sprinkler Systems"; NFPA 13R, "Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies"; or NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes." All three of these installation and design standards permit various areas or spaces within a building, storey or floor area to be exempt from installation of sprinkler systems.

This proposed change removes the word "throughout" from the phrase "sprinklered throughout" in Clause 3.2.3.7.(4)(b); for consistency, the same editorial change would be made in other locations of the Code where "sprinklered throughout" appears.

Notwithstanding the exemptions listed in the referenced NFPA standards, the intent of the Code is to always require the protection of combustible attic or roof spaces in accordance with Clause 3.2.3.7.(4)(b) where noncombustible cladding is not provided and no other clause of Sentence 3.2.3.7.(4) applies.

This proposed change also clarifies the existing requirements by introducing a new Sentence and explanatory Note. The new notwithstanding provision in Sentence 3.2.5.12.(8)-2025 is consistent with the existing notwithstanding provisions for balconies and closets, and other spaces below a roof in Sentence 3.2.5.12.(7). In addition, the new explanatory Note clarifies the intent. A cross-reference to Sentence 3.2.5.12.(8)-2025 would also be added to Sentence 3.2.3.7.(4).

This proposed change ensures the intent of the Code is clear and avoids potential conflicts with the application of the provisions of the referenced standards for sprinkler systems.

PROPOSED CHANGE

[3.2.3.7.] 3.2.3.7. Construction of Exposing Building Face

[1] **4)** Except as provided in Articles 3.1.4.8. and 3.1.6.9., the requirement in Table 3.2.3.7. for *noncombustible* cladding for *buildings* or *fire compartments* where the maximum permitted area of *unprotected openings* is more than 25% but not more than 50% of the *exposing building face* is permitted to be waived where

- [a] a) the *limiting distance* is greater than 5 m,
- [b] b) the *building* or *fire compartment* and all *combustible attic* ~~and~~*or* *roof spaces* are *sprinklered* ~~throughout,~~(see Sentence 3.2.5.12.(8)-2025),
- [c] c) the cladding
  - [i] i) conforms to Subsections 9.27.6., 9.27.7., 9.27.8., 9.27.9. or 9.27.10.,
  - [ii] ii) is installed without furring members, or on furring not more than 25 mm thick, over gypsum sheathing at least 12.7 mm thick or over masonry, and
  - [iii] iii) after conditioning in conformance with ASTM D2898, "Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing", has a *flame-spread rating* not greater than 25 on the exterior face when tested in accordance with Sentence 3.1.12.1.(1),
- [d] d) the cladding
  - [i] i) conforms to Subsection 9.27.12.,
  - [ii] ii) is installed with or without furring members over gypsum sheathing at least 12.7 mm thick or over masonry,
  - [iii] iii) has a *flame-spread rating* not greater than 25 when tested in accordance with Sentence 3.1.12.1.(2), and
  - [iv] iv) does not exceed 2 mm in thickness, exclusive of fasteners, joints and local reinforcements (see Note A-3.2.3.7.(4)(d)(iv)), or
- [e] e) the exterior wall assembly complies with Article 3.1.5.5. or 3.1.5.6.

[3.2.5.12.] 3.2.5.12. Automatic Sprinkler Systems

[1] **1)** Except as permitted by Sentences (2) to (4) and (9), an automatic sprinkler system shall be designed, constructed, installed and tested in conformance with NFPA 13, "Standard for the Installation of Sprinkler Systems". (See Note A-3.2.5.12.(1).)

[2] **2)** Instead of the requirements of Sentence (1), NFPA 13R, "Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies", is permitted to be used for the design, construction and installation of an automatic sprinkler system installed

- [a] a) in a *building* of *residential occupancy* throughout that
  - [i] i) is not more than 4 *storeys* in *building height* and conforms to

Article 3.2.2.47., 3.2.2.49., 3.2.2.51., 3.2.2.52. or or 3.2.2.55., or

[ii] ii) is not more than 3 *storeys* in *building height* and conforms to Article 9.10.1.3., or

[b] b) in a *building* of *care occupancy* with not more than 10 occupants that is not more than 3 *storeys* in *building height* and conforms to one of Articles 3.2.2.42. to 3.2.2.46.

(See Note A-3.2.5.12.(2).)

[3] **3)** Instead of the requirements of Sentence (1), NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes", is permitted to be used for the design, construction and installation of an automatic sprinkler system installed

[a] a) in a *building* of *residential occupancy* throughout that contains not more than two *dwelling units*,

[b] b) in a *building* of *care occupancy*, provided

[i] i) it contains not more than two *suites* of *care occupancy*,

[ii] ii) it has not more than five residents throughout, and

[iii] iii) a 30-minute water supply demand can be met, and

[c] c) in a *building* of *residential occupancy* throughout that contains more than two *dwelling units*, provided

[i] i) except for a *secondary suite*, no *dwelling unit* is located above another *dwelling unit*,

[ii] ii) all *suites* are separated by a vertical *fire separation* having a *fire-resistance rating* of not less than 1 h that provides continuous protection from the top of the footing to the underside of the roof deck, with any space between the top of the wall and the roof deck tightly filled with mineral wool or *noncombustible* material,

[iii] iii) each *dwelling unit* has its own sprinkler water supply provided in accordance with NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes",

[iv] iv) a passive purge sprinkler system design is used as described in NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes", and

[v] v) where the sprinkler system is taken into consideration for the reduction of *limiting distance*, all rooms, including closets, bathrooms and attached garages, that adjoin an *exposing building face* are sprinklered, notwithstanding any exemption stated in NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes".

(See Note A-3.2.5.12.(2).)

[4] **4)** If a *building* contains fewer than 9 sprinklers, the water supply for these

sprinklers is permitted to be supplied from the domestic water system for the *building* provided the required flow for the sprinklers can be met by the domestic system.

[5] **5)** If a water supply serves both an automatic sprinkler system and a system serving other equipment, control valves shall be provided so that either system can be shut off independently.

[6] **6)** Notwithstanding the requirements of the standards referenced in Sentences (1) and (2) regarding the installation of automatic sprinkler systems, sprinklers shall not be omitted in any room or closet in the *storey* immediately below a roof assembly. (See Note A-3.2.5.12.(6).)

[7] **7)** Notwithstanding the requirements of the standards referenced in Sentences (1) and (2) regarding the installation of automatic sprinkler systems, in *buildings* conforming to Article 3.2.2.48., 3.2.2.51., 3.2.2.57. or 3.2.2.60., sprinklers shall be provided for balconies and decks exceeding 610 mm in depth measured perpendicular to the exterior wall. (See Note A-3.2.5.12.(7).)

[8] **--)** Notwithstanding the requirements of the standards referenced in Sentences (1) and (2) regarding the installation of automatic sprinkler systems, in *buildings* conforming to Clause 3.2.3.7.(4)(b), sprinklers shall be installed in *combustible attic or roof spaces*. (See Note A-3.2.5.12.(8)-2025.)

[9] **8)** Sprinklers in elevator machine rooms shall have a temperature rating not less than that required for an intermediate temperature classification and shall be protected against physical damage. (See Note A-3.2.5.12.(8).)

[10] **9)** Except as provided in Subsection 3.2.8., closely spaced sprinklers and associated draft stops need not be installed around floor openings in conformance with NFPA 13, "Standard for the Installation of Sprinkler Systems".

Note A-3.2.5.12.(8)-2025 Sprinkler Protection in Combustible Attic or Roof Spaces.

NFPA 13, “Standard for the Installation of Sprinkler Systems,” and NFPA 13R, “Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies,” describe many different cases where concealed spaces in combustible attic or roof spaces do not require sprinklers for compliance with those standards.

However, under Clause 3.2.3.7.(4)(b), where the building or fire compartment is not provided with noncombustible cladding, sprinklers must be installed throughout the attic or roof spaces, regardless of whether these spaces are exempted from the sprinkler requirements of the applicable referenced standard.

Impact analysis

This proposed change clarifies the intent of the Code by removing "throughout" from Clause 3.2.3.7.(4)(b) and using consistent wording in Sentence 3.2.5.12.(8) and its explanatory Note. No additional costs are expected where the intent of the Code is consistently and correctly applied.

Enforcement implications

This proposed change clarifies the intent of the requirements, which should aid in the understanding and enforcement of the Code.

Who is affected

Authorities having jurisdiction, designers and contractors.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.2.3.7.] 3.2.3.7. ([1] 4) [F03,F02-OP3.1]

[3.2.5.12.] 3.2.5.12. ([1] 1) [F02,F81,F82-OS1.2]

[3.2.5.12.] 3.2.5.12. ([1] 1) [F02,F81,F82-OP1.2]

[3.2.5.12.] 3.2.5.12. ([2] 2) [F02,F81-OS1.2]

[3.2.5.12.] 3.2.5.12. ([2] 2) [F02,F81-OP1.2]

[3.2.5.12.] 3.2.5.12. ([3] 3) [F02,F81-OS1.2]

[3.2.5.12.] 3.2.5.12. ([3] 3) [F02,F81-OP1.2]

[3.2.5.12.] 3.2.5.12. ([4] 4) [F02-OS1.2]

[3.2.5.12.] 3.2.5.12. ([4] 4) [F02-OP1.2]

[3.2.5.12.] 3.2.5.12. ([5] 5) [F81-OS1.2]

[3.2.5.12.] 3.2.5.12. ([5] 5) [F81-OP1.2]

[3.2.5.12.] 3.2.5.12. ([6] 6) no attributions

[3.2.5.12.] 3.2.5.12. ([6] 6) [F02-OS1.2]

[3.2.5.12.] 3.2.5.12. ([6] 6) [F02-OP1.2]

[3.2.5.12.] 3.2.5.12. ([7] 7) ~~[F03-OS1.2]~~

[3.2.5.12.] 3.2.5.12. ([7] 7) [F03-OP1.2]

[3.2.5.12.] 3.2.5.12. ([7] 7) [F03-OP3.1]

[3.2.5.12.] -- ([8] --) no attributions

[3.2.5.12.] -- ([8] --) [F03-OP1.2]

[3.2.5.12.] 3.2.5.12. ([9] 8) [F81-OS3.3,OS3.6]

[3.2.5.12.] 3.2.5.12. ([10] 9) no attributions

Submit a comment

Proposed Change 1938

Code Reference(s):	**NBC20 Div.B 3.2.3.16.(4) (first printing)** **NBC20 Div.B 3.2.5.11.(6) (first printing)** **NBC20 Div.B 3.3.1.17.(6) (first printing)** **NBC20 Div.B 3.4.2.6.(2) (first printing)**
Subject:	Automatic Sprinkler System
Title:	Removal of Redundant Sprinkler References
Description:	This proposed change removes redundant cross-references to Article 3.2.5.12. in Part 3 of Division B of the NBC.

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [x] Small Buildings
- [x] Large Buildings
- [x] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

Currently, several Sentences in Part 3 of Division B of the National Building Code of Canada (NBC) 2020 include cross-references to the requirements for automatic sprinklers in Article 3.2.5.12. in addition to references to the defined term "sprinklered." These cross-references are seen as being redundant and could be removed.

Article 3.2.5.12. includes provisions that mandate

- when the requirements of a referenced standard apply to a building or part of a building that is required to be sprinklered, and
- which of the following three referenced standards for sprinkler systems applies:
    - NFPA 13, "Standard for the Installation of Sprinkler Systems,"
    - NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes," or
    - NFPA 13R, "Standard for the Installation of Sprinkler Systems in Low-

Rise Residential Occupancies."

This proposed change aims to remove redundant references within the Code wording to clarify and thereby eliminate any potential confusion as to when sprinklers are required in the NBC.

Article 3.2.5.12. also presents specific rules and exceptions that apply beyond the installation and design requirements of the applicable referenced standards.

This proposed change removes redundant cross-references within the Code to eliminate any potential confusion as to when sprinklers are required by the NBC.

Justification

In combination with the defined term "sprinklered," use of the phrase "in accordance with Article 3.2.5.12.", "in conformance with Article 3.2.5.12.", or "in accordance with Sentence 3.2.5.12.(1)" is considered unnecessary. It is seen as repeating the same requirements established by use of the defined term.

Invoking the term as defined, "*Sprinklered* (as applying to a *building* or part thereof) means that the *building* or part thereof is equipped with system of automatic sprinklers," is considered sufficient for Code users to understand the application of the requirement for an automatic sprinkler system.

This proposed change would eliminate any potential confusion as to when sprinklers are required in the NBC by removing redundant cross-references within the Code.

PROPOSED CHANGE

[3.2.3.16.] 3.2.3.16. Protection of Soffits

[1] **4)** The protection required by Sentence (1) for projections is permitted to be omitted if

[a] a) the *fire compartments* behind the window and door openings are *sprinklered* ~~in accordance with Article 3.2.5.12.~~, and

[b] b) all rooms, including closets and bathrooms, having openings in the wall beneath the soffit are *sprinklered*, notwithstanding exceptions permitted in the standards referenced in Article 3.2.5.12. for the installation of automatic sprinkler systems.

[3.2.5.11.] 3.2.5.11. Hose Stations

[1] **6)** Where a *building* or part thereof is used as a *distillery* and the *building* is *sprinklered* ~~in conformance with Article 3.2.5.12.~~, small hose (38 mm) stations are permitted to be supplied from interior sprinkler piping.

[3.3.1.17.] 3.3.1.17. Capacity of Access to Exits

[1] **6)** In a *building* that is not *sprinklered* throughout ~~in accordance with~~

~~Sentence 3.2.5.12.(1)~~, an *access to exit* that is part of the principal entrance serving a dance hall or a licensed beverage establishment with an *occupant load* more than 250 shall provide at least one half of the required *exit* width.

[3.4.2.6.] 3.4.2.6. Principal Entrances

[1] 2) In a *building* that is not *sprinklered* throughout ~~in accordance with Sentence 3.2.5.12.(1)~~, the principal entrance serving a dance hall or a licensed beverage establishment with an *occupant load* more than 250 shall provide at least one half of the required *exit* width.

Impact analysis

This proposed change clarifies the intent of the Code by using consistent wording.

It also removes redundant cross-references to Article 3.2.5.12. to eliminate potential confusion resulting from inconsistent wording. No additional costs are expected.

Enforcement implications

This proposed change is intended to clarify the intent of the requirements, which should aid in the understanding and enforcement of the Code.

Who is affected

Authorities having jurisdiction, designers and contractors.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.2.3.16.] 3.2.3.16. ([1] 4) [F02-OS1.2]

[3.2.3.16.] 3.2.3.16. ([1] 4) [F02-OP1.2]

[3.2.3.16.] 3.2.3.16. ([1] 4) no attributions

[3.2.5.11.] 3.2.5.11. ([1] 6) [F02-OS1.2]

[3.2.5.11.] 3.2.5.11. ([1] 6) [F02-OP1.2]

[3.3.1.17.] 3.3.1.17. ([1] 6) [F10-OS3.7]

[3.4.2.6.] 3.4.2.6. ([1] 2) [F10-OS3.7]

Submit a comment

Proposed Change 1882

Code Reference(s):	**NBC20 Div.B 3.8. (first printing)**
Subject:	Accessibility, Visitability and Adaptability of Dwelling Units
Title:	Reinforcing Stud Walls in Washrooms for the Future Installation of Grab Bars: Showers and Bathtubs
Description:	This proposed change introduces requirements to reinforce stud walls around showers and bathtubs in dwelling units for the future installation of grab bars.
Related Proposed Change(s):	PCF 1884, PCF 1958, PCF 2030, PCF 2031

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [x] Housing
- [x] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [x] Occupant safety in use
- [x] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

General information

See the summary for subject Accessibility, Visitability and Adaptability of Dwelling Units.

Problem

Approximately 10% of Canadians have a disability related to balance and walking, including 9% of Canadians aged 35 years old to 64 years old, and 25% of Canadians over 65 years old [1]. The prevalence of disabilities related to mobility increases with age, being reported in most adults over 80 years old [2]. Thus, most Canadians will need balance and mobility assistance at some point in their lives. Strategies are needed to allow Canadians to easily and affordably retrofit their homes to accommodate their evolving health status and live at home for as long as possible.

Grab bars are the most common device used to improve the safety and accessibility of Canadians with disabilities related to mobility, used by 38% of this population [1]. Grab bars are typically installed near bathtubs and showers to prevent falls for persons with and without disabilities [3]. However, the National Building Code of Canada (NBC) 2020 makes it difficult to retrofit bathrooms with grab bars, which generally need to be mounted onto studs or other reinforcement behind outer wall materials to meet the NBC requirements for structural strength. This situation causes the following two problems for occupants who wish to install grab bars:

1. The range of locations where grab bars can be installed while meeting the NBC requirements for structural strength is limited because the NBC only requires studs to be spaced up to 400 mm to 600 mm apart in most interior bathrooms. This requirement makes it difficult to position grab bars in a way that allows a person with a disability related to balance or mobility to access and use the washroom facilities.
2. The narrow width of the studs (often less than 40 mm) allows little room for error in positioning the grab bar to ensure that all of the mounting screws penetrate the stud to meet the structural strength requirements. Slight misalignments in the wall studs may make it impossible to install grab bars properly. Loading improperly installed grab bars may cause the bar to detach from the wall and cause a fall or injury to users.

Justification

This proposed change introduces a requirement to install reinforcement to stud walls around the bathtub and shower in washrooms to support the potential installation of grab bars and similar fixtures by homeowners or other occupants. By reinforcing stud walls in washrooms, this proposed change addresses the following major barriers to grab bar installations:

- Increasing the range of locations where grab bars can be installed while still meeting NBC requirements for structural strength would allow an occupant to customize the location of grab bars to meet the occupant's individual needs for balance and mobility. This proposed change would limit the probability that users with a disability related to mobility would be unable to install a grab bar in a position that allows them to safely and easily use washroom facilities.
- Facilitating the proper installation of grab bars would make them more likely to meet the NBC requirements for structural strength. This proposed change would limit the probability of grab bars detaching from walls during use and resulting in falls or injuries to users.

The proposed change expands on existing requirements for reinforcement to washroom walls in Nova Scotia, Ontario, British Columbia and Alberta by prescribing the area around the wall where reinforcement is required, similar to the approach already adopted in Quebec.

A central element of this proposed change addresses the need for flexibility in the locations on the wall where grab bars can be installed and customized to individual needs, while minimizing the demands on the occupant installing grab bars in the future to be aware of the exact location of the wall that is reinforced. To that end, this proposed change expands on existing requirements for reinforcement to washroom walls in most provinces and territories (except for Quebec) by prescribing a larger area of wall coverage to support common applications of grab bars in private dwellings (which go beyond bar configurations to support wheelchair or bench transfers in public spaces). Also, this proposed change better addresses the vast range of washroom configurations in dwellings, where it is not always physically possible to install grab bars in the same locations recommended for public spaces because the washroom is too small. The proposed range includes:

1. A larger area of side wall coverage in showers to address the need for:
    - lower installations (690 mm to 850 mm) to support horizontal bars for children and initiating rising from a shower seat, as well as diagonal and vertical bars for continued balance while rising or standing [4],
    - mid-range installations (850 mm to 1 020 mm above the floor) to support horizontal or diagonal bars that can be optimized to user height for balance while standing in the shower [5][6], and
    - higher installations (1 020 mm to 1 630 mm above the floor) to support the upper end of vertical and diagonal bars for balance control in the shower [4] and for compatibility with the NBC 2020 requirements for accessible showers.
2. In addition to the proposed area for coverage in showers, bathtub coverage between 160 mm above the rim of the tub to 1 620 mm above the floor to permit the installation of horizontal and diagonal grab bars to support transferring between the base of the bathtub to a standing position [7][8], and for compatibility with the NBC grab bar requirements for accessible bathtubs (Subclause 3.8.3.18.(1)(f)(iv), stipulating a horizontal bar between 180 mm to 280 mm above the rim).
3. Coverage on the walls for entering and exiting bathtubs in locations compatible with common accessibility requirements for grab bars (e.g., CSA B651, “Accessible design for the built environment,” and NBC Article 3.8.3.18.), and demonstrated to reduce fall risk during bathtub exits [3].

The proposed change includes exemptions for:

- showers, bathtubs and bathtub/shower combinations that have prefabricated walls, on the basis that drilling through the walls of these products to install grab bars would generally void the product warranty, and that people who are replacing their prefabricated enclosures with tiled walls around their bathtub or shower would have the opportunity to install reinforcement and/or grab bars at that point, and

- bathtubs not abutting adjacent walls (e.g., sunken, drop-in and free-standing bathtubs), as mentioned in an explanatory Note, on the basis that stanchions are more common technologies for supporting bathtub transfers in these contexts, and these types of bathtubs tend to be located too far from the wall for the practical use of grab bars.

This proposed change should be considered in conjunction with the following other proposed changes:

- PCF 2031, which prescribes the minimum area for reinforcing walls around the toilet (i.e., water closet) for the present or future installation of grab bars, and
- PCF 2030, which stipulates a performance requirement for the structural strength of the reinforcement material and methods of attaching to the studs, alongside compliance options for different types of material.

References

(1) Statistics Canada. (2020). Canadians with a mobility disability. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2020085-eng.htm

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(3) Levine, I. C., Montgomery, R. E., and Novak, A. C. (2021). Grab bar use influences fall hazard during bathtub exit. *Human factors*. https://journals.sagepub.com/doi/abs/10.1177/00187208211059860

(4) King, E. C., & Novak, A. C. (2017). Effect of bathroom aids and age on balance control during bathing transfers. *The American Journal of Occupational Therapy*, 71(6), 1–9.

(5) Nirmalanathan, K. (2019). *Influence of Grab Bar Orientation on Balance Recovery Following a Perturbation During Bathtub Exits*. University of Toronto (Canada).

(6) Maki, B. E., Bartlett, S. A., & Fernie, G. R. (1984). Influence of stairway handrail height on the ability to generate stabilizing forces and moments. *Human Factors*, *26*(6), 705–714.

(7) Sveistrup, H., Lockett, D., Edwards, N., & Aminzadeh, F. (2006). Evaluation of bath grab bar placement for older adults. *Technology and Disability*, *18*(2), 45–55.

(8) Aminzadeh, F., Edwards, N., Lockett, D., & Nair, R. C. (2000). Utilization of bathroom safety devices, patterns of bathing and toileting, and bathroom falls in a sample of community living older adults. *Technology and Disability*, *13*(2), 95–103.

PROPOSED CHANGE

[3.8.] 3.8. Accessibility

(See Note A-3.8.)

[3.8.1.] 3.8.1. Scope

[3.8.1.1.] 3.8.1.1. Scope

[3.8.2.] 3.8.2. Application

[3.8.2.1.] 3.8.2.1. Exceptions

[3.8.2.2.] 3.8.2.2. Entrances

[3.8.2.3.] 3.8.2.3. Areas Requiring a Barrier-Free Path of Travel

[3.8.2.4.] 3.8.2.4. Access to Storeys Served by Escalators and Moving Walks

[3.8.2.5.] 3.8.2.5. Exterior Barrier-Free Paths of Travel to Building Entrances and Exterior Passenger-Loading Zones

[3.8.2.6.] 3.8.2.6. Controls

[3.8.2.7.] 3.8.2.7. Power Door Operators

[3.8.2.8.] 3.8.2.8. Plumbing Facilities

[3.8.2.9.] 3.8.2.9. Assistive Listening Systems

[3.8.2.10.] 3.8.2.10. Signs and Indicators

[3.8.2.11.] 3.8.2.11. Counters

[3.8.2.12.] 3.8.2.12. Telephones

[3.8.3.] 3.8.3. Design

[3.8.3.1.] 3.8.3.1. Design Standards

[3.8.3.2.] 3.8.3.2. Barrier-Free Path of Travel

[3.8.3.3.] 3.8.3.3. Exterior Walks

[3.8.3.4.] 3.8.3.4. Exterior Passenger-Loading Zones

[3.8.3.5.] 3.8.3.5. Ramps

[3.8.3.6.] 3.8.3.6. Doorways and Doors

[3.8.3.7.] 3.8.3.7. Passenger-Elevating Devices

[3.8.3.8.] 3.8.3.8. Controls

[3.8.3.9.] 3.8.3.9. Accessible Signs

[3.8.3.10.] 3.8.3.10. Drinking Fountains

[3.8.3.11.] 3.8.3.11. Water-Bottle Filling Stations

[3.8.3.12.] 3.8.3.12. Accessible Water-Closet Stalls

[3.8.3.13.] 3.8.3.13. Universal Washrooms

[3.8.3.14.] 3.8.3.14. Water Closets

[3.8.3.15.] 3.8.3.15. Water-Closet Stalls and Urinals for Persons with Limited Mobility

[3.8.3.16.] 3.8.3.16. Lavatories and Mirrors

[3.8.3.17.] 3.8.3.17. Showers

[3.8.3.18.] 3.8.3.18. Accessible Bathtubs

[3.8.3.19.] 3.8.3.19. Assistive Listening Systems

[3.8.3.20.] 3.8.3.20. Counters

[3.8.3.21.] 3.8.3.21. Telephones

[3.8.3.22.] 3.8.3.22. Spaces in Seating Area

[3.8.4.] -- Dwelling Units

[3.8.4.1.] --- Entrance Doorway Width

[3.8.4.2.] --- Walls around Water Closets

[3.8.4.3.] --- Walls around Showers and Bathtubs

(See Note 3.8.4.2. and 3.8.4.3.-2025 (PCF 2031).)

[1] --) Except as provided in Sentence (5), stud walls around showers shall be reinforced to support the present or future installation of grab bars in accordance with Sentence 9.31.2.3.(2)-2025 (PCF 2030).

[2] --) The reinforcement of stud walls around showers required by Sentence (1) shall cover a minimum area that:

- [a] --) on side walls, extends horizontally along the full length of the shower and vertically from 690 mm to 1 630 mm above the finished floor, and
- [b] --) on entrance walls, extends horizontally at least 400 mm, centred over the shower entrance, and vertically from 580 mm to 1 670 mm

above the finished floor.

(See Note A-3.8.4.3.(2) and (4).)

[3] --) Except as provided in Sentence (5), stud walls around bathtubs and bathtub/shower combinations shall be reinforced to support the present or future installation of grab bars in accordance with Sentence 9.31.2.3.(2)-2025 (PCF 2030).

[4] --) The reinforcement of stud walls around bathtubs and bathtub/shower combinations required by Sentence (3) shall cover a minimum area that

[a] --) on side walls, extends horizontally along the full length of the bathtub or bathtub/shower combination and vertically from 160 mm above the bathtub rim or tiling flange to 1630 mm above the finished floor, and

[b] --) on entrance walls, extends horizontally at least 400 mm, centred over the bathtub or bathtub/shower combination entrance, and vertically from 160 mm to 1 500 mm above the bathtub rim or tiling flange.

(See Note A-3.8.4.3.(2) and (4).)

[5] --) Where a shower, bathtub or bathtub/shower combination is provided with a prefabricated enclosure,

[a] --) Clauses 2(a) and 4(a) do not apply, and

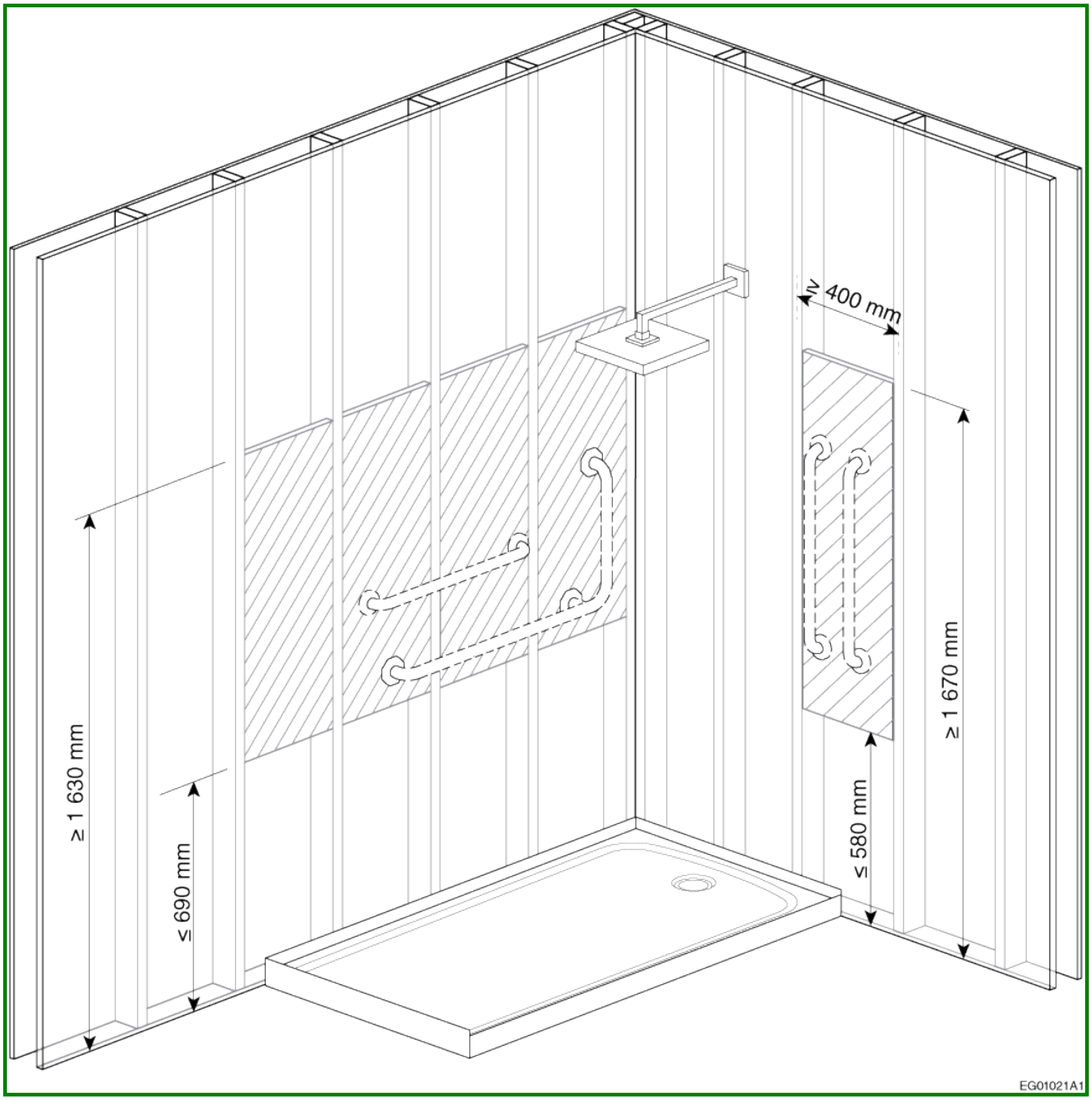
[b] --) Clauses 2(b) and 4(b) apply, except that the minimum reinforcement area shall extend horizontally from the entrance or rim to 400 mm beyond the entrance.

(See Note A-3.8.4.3.(5).)

Note A-3.8.4.3.(2) and (4) Reinforcement of Walls around Showers, Bathtubs and Bathtub/Shower Combinations.

Figures 3.8.4.3.(2) and (4)-A and -B illustrate examples of acceptable configurations for the reinforcement of stud walls around showers, bathtubs and bathtub/shower combinations, respectively. Possible grab bar configurations are also shown.

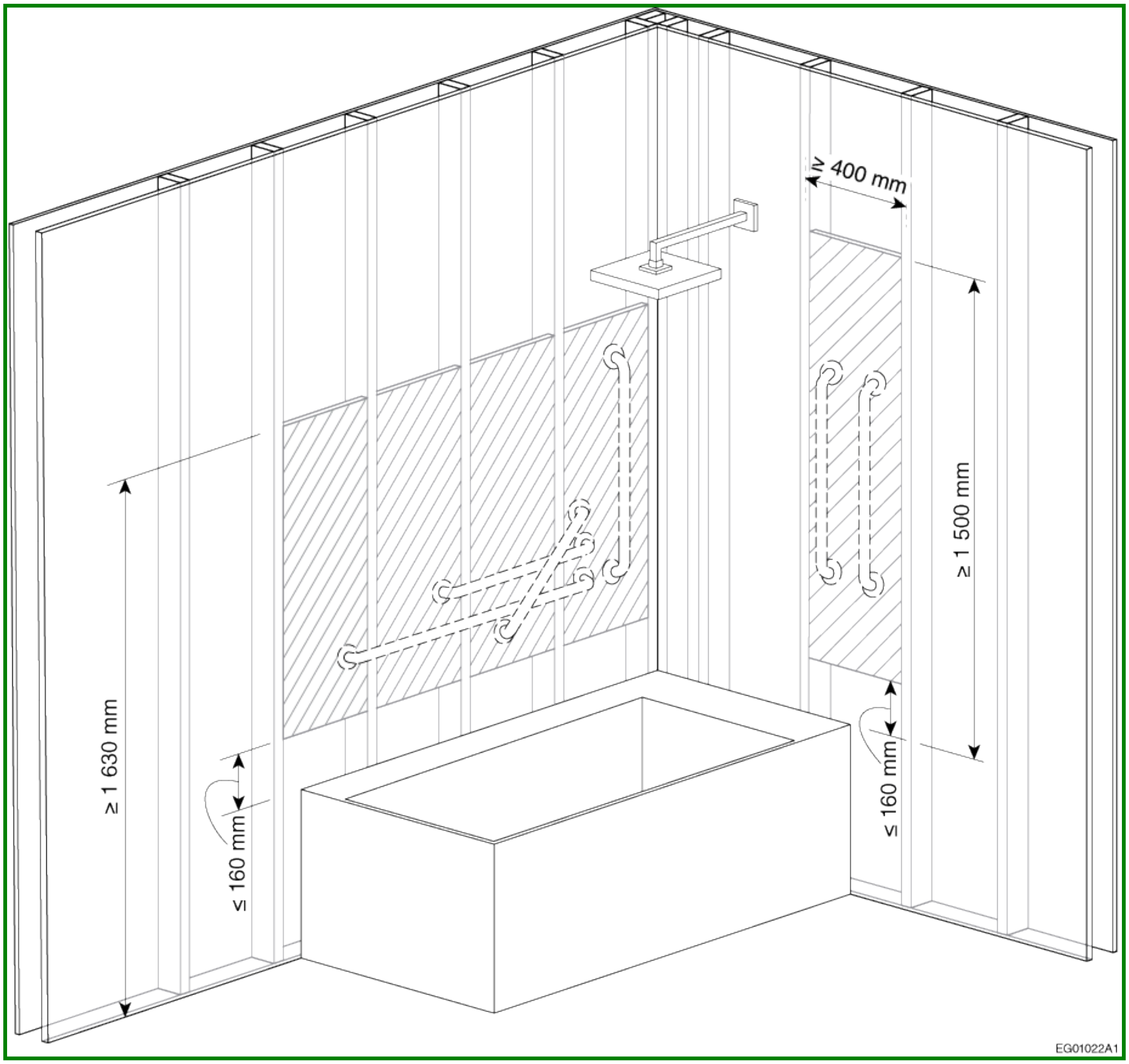
Figure [A-3.8.4.3.(2) and (4)-A]
Example of an acceptable configuration for the reinforcement of the side wall and entrance wall(1) of a shower



Note to Figure :

(1) It is assumed that additional framing (not shown) will be needed to support the reinforcement of the entrance wall; exact stud configurations will depend on factors like the size of the shower and the geometry of the washroom.

Figure [A-3.8.4.3.(2) and (4)-B]
Example of an acceptable configuration for the reinforcement of the side wall and entrance wall(1) of a bathtub or bathtub/shower combination



Note to Figure :

(1) It is assumed that additional framing (not shown) will be needed to support the reinforcement of the entrance wall; exact stud configurations will depend on factors like the size of the bathtub and the geometry of the washroom.

Note A-3.8.4.3.(3) Application of Sentence 3.8.4.3.(3) to Bathtubs and Bathtub/Shower Combinations Not Abutting Walls.

Bathtubs and bathtub/shower combinations that do not abut walls are exempted from compliance with Sentence 3.8.4.3.(3), as they may be located too far from nearby walls for the appropriate use of a wall-mounted grab bar and may require different movement strategies for entry and exit. Examples of exempted bathtubs include free-standing bathtubs, which are typically finished on all sides, drop-in bathtubs, which are typically embedded in a deck, and sunken bathtubs, which are partially or entirely embedded in the floor.

Note A-3.8.4.3.(5) Exceptions for Showers, Bathtubs and Bathtub/Shower Combinations Provided with Prefabricated Enclosures.

Showers, bathtubs and bathtub/shower combinations provided with prefabricated enclosures are partially exempted from Sentences 3.8.4.3.(2) and (4), as these enclosures are often not compatible with grab bars that are not fabricated as part of the enclosure. To permit grab bars to be installed near the entrance of these enclosures, the minimum reinforcement area is shifted so that it does not overlap with the prefabricated enclosure. Figures 3.8.4.3.(5)-A and -B illustrate examples of acceptable configurations for the reinforcement of stud walls around prefabricated enclosures. Possible configurations of grab bars with different lengths are also shown.

Figure [A-3.8.4.3.(5)-A]
Example of an acceptable configuration for the reinforcement of the entrance wall of a shower provided with a prefabricated enclosure

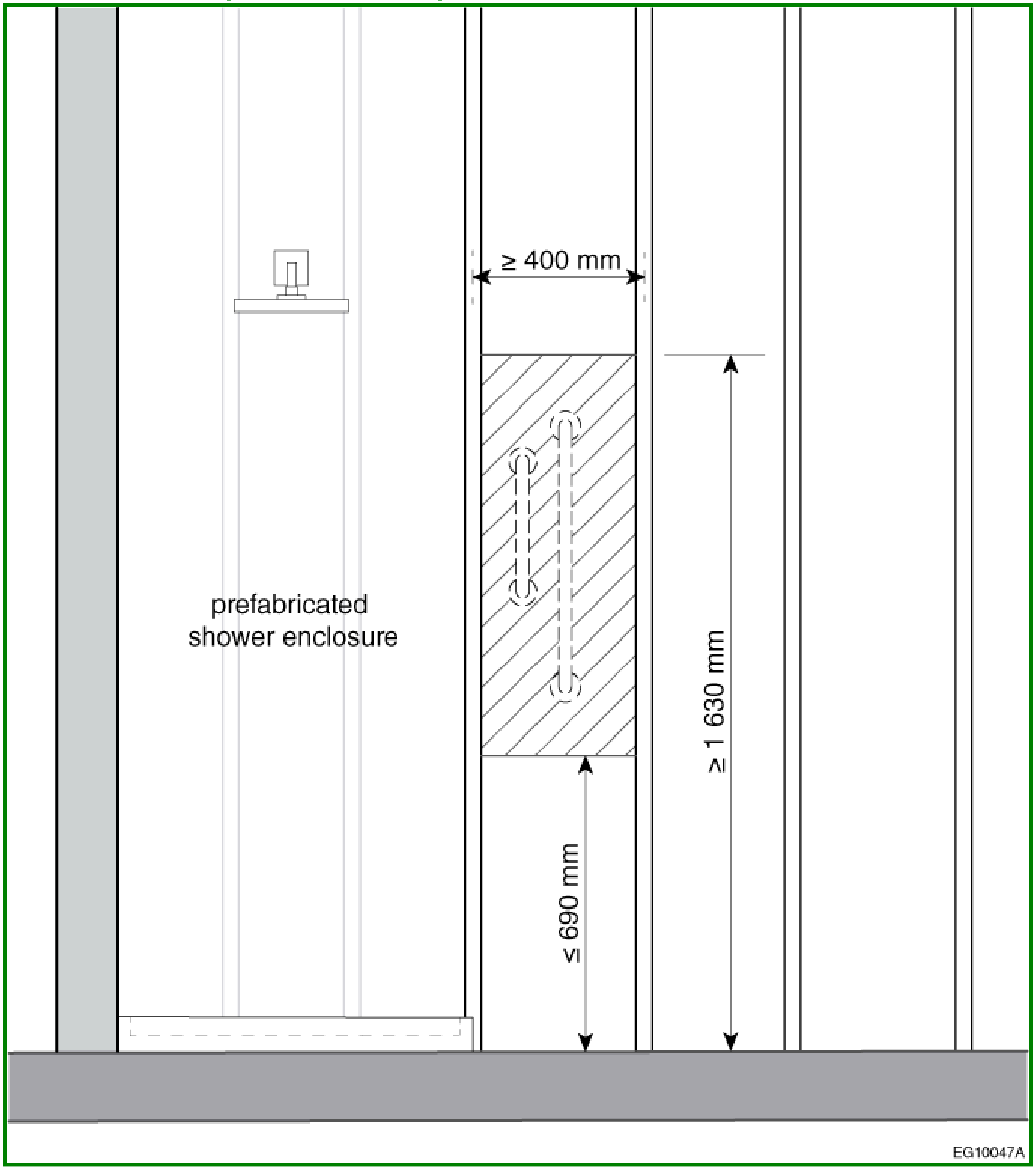
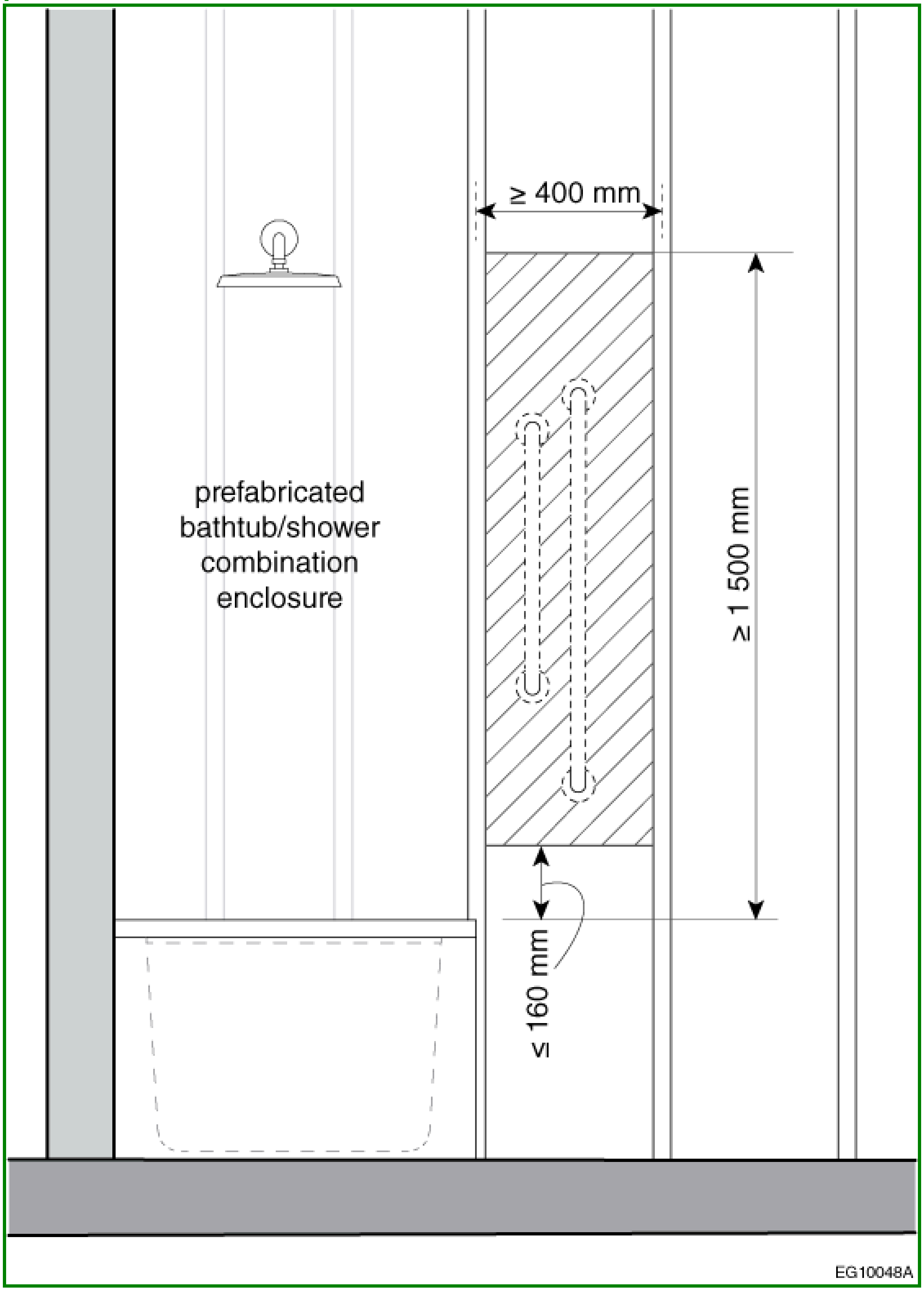


Figure [A-3.8.4.3.(5)-B]
Example of an acceptable configuration for the reinforcement of the entrance wall of a bathtub or bathtub/shower combination provided with a prefabricated enclosure



Impact analysis

Impact on Flexibility of Design

This proposed change is expected to improve design flexibility for homeowners by increasing the range of locations where grab bars can be installed around bathtubs and showers to meet individual accessibility and safety needs while still meeting the NBC requirements for structural strength.

Financial Impact

The financial impact of the proposed change depends on whether the jurisdiction already requires the reinforcement of washroom walls in some form, though in general the proposed change would increase the initial cost of construction. The cost estimates below are based on the prescriptive options described in PCF 2030. For designers who choose to use the performance-based option and demonstrate that their material, thickness and attachment combination would allow the installation of grab bars to meet the NBC requirements for structural strength, the costs would be different.

Table 1 presents a breakdown of the cost estimates. The key assumptions are as follows:

- The length of the side wall is 1 600 mm; costs differ based on the length of the wall.
- For the walls along the shower or bathtub entry or exit:
  - the required area is assumed to span between two studs, though a larger area of coverage (1 200 mm wide × 2 400 mm high / 4 ft. wide × 8 ft. high) is assumed for the sheathing option, and
  - an additional stud would be needed to provide framing on either side of the shower entrance or bathtub rim for the blocking option.
- For sheathing, the cost estimates assume that two 12.7 mm (0.5 in.) thick panels of plywood are fastened together with adhesive to achieve the required 25.4 mm (1 in.) thickness.
- For bathtubs, the height of the rim is 355 mm (15 in.) above the floor. This is a conservative estimate; for higher tubs, the required area for wall coverage would be less.

Table 1. Cost Estimates for the Reinforcement of Stud Walls around Bathtubs and Showers

Wall of Interest	Cost of Solid Lumber	Cost of Sheathing
Side wall - shower	~\$110–\$120 (assume a 4 × 4 grid of 2 × 10s)	~\$240–\$260 (assume 4 panels of 1 200 mm × 2 400 mm (4 ft. × 8 ft.) plywood @ 12.7 mm thick, fastened together to create 2 panels of 1 200 mm × 2 400 mm plywood @ 25.4 mm thick covering an area ≤ 2 400 mm × 2 400 mm; costs will be higher where the side wall is longer or higher)
Side wall - bathtub or bathtub/shower combination	~\$135–\$145 (assume a 4 × 4 grid of 2 × 12)	~\$240–\$260 (same assumption as above)
Entrance walls - shower	~\$35–\$45 per wall (assume a 4 x 1 grid of 2 × 12s + 1 additional stud on each side of the shower) ~\$70–\$90 total per shower, assuming that two walls are present for reinforcing	~\$120–\$130 per wall (assume 2 panels of 1 200 mm × 2 400 mm plywood @ 12.7 mm thick fastened together to cover an area of 1 200 mm × 2 400 mm) + additional material, labour, overhead and profit to make the entire wall flush with the reinforced area ~\$240–\$260 total per shower, assuming that two walls are present to be reinforced
Entrance walls - bathtub and bathtub/shower combination	~\$45–\$55 per wall (assume a 5 × 1 grid of 2 × 12s + 1 additional stud on each side of the shower) ~\$90–\$110 total per shower, assuming that two walls are present for reinforcing	~\$120–\$130 per wall (assume 2 panels of 1 200 mm x 2 400 mm plywood @ 12.7 mm thick fastened together to cover an area of 1 200 mm x 2 400 mm) + additional material, labour, overhead and profit to make the entire wall flush with the reinforced area ~\$240–\$260 total per shower, assuming that two walls are present for reinforcing

Where washroom walls beside showers or bathtubs are shorter, the cost will be lower to reflect that a smaller wall area is being reinforced. The material costs may also be lower in situations where spare material is available on construction sites. These cost estimates are based on RSMeans data for the Greater Ottawa Region from 2022 and account for materials, labour, overhead and profit.

- solid lumber (2 × 10) with pneumatic nails: \$18.27/linear m (\$5.57/linear ft.)
- solid lumber (2 × 12) with pneumatic nails: \$21.72/linear m (\$6.62/linear ft.)
- plywood (12.7 mm thick) with screws: \$20.77/m^2 (\$1.93/ft.^{2})
- extra stud for framing around the shower and bathtub entry (2 × 4 × 96):

~$5.00

The proposed change applies to new constructions. For dwelling units where grab bars are to be installed in the future, the proposed change is expected to result in cost savings relative to the current NBC requirements for the following two reasons:

1. To retrofit washroom walls with reinforcement that permit grab bar installation in any location, components of the existing wall would potentially need to be removed and replaced. Thus, the costs would include not only the cost of the reinforcement, but also the cost of replacing the other wall components (e.g., drywall, where applicable).
2. To retrofit a washroom with grab bars, many older adults rely on professional contractors to ensure that the bars are correctly mounted to the studs of the wall. This process can cost over $1 000, depending on the number of bars being installed. This discourages many older adults from installing grab bars when they would like to [9]. By reducing the complexity of grab bar installation, certain homeowners may be able to install these grab bars without requiring a professional contractor. For homeowners who hire a professional contractor, the presence of reinforcement will still reduce the complexity (and potentially the cost) of grab bar installation.

Impact on Spatial Requirements for Washrooms

The proposed change is not expected to impact the spatial requirements for washrooms where solid lumber is used as the material. In contexts where sheathing is installed between wall studs and drywall, the available space in the washroom will be reduced by 25.4 mm (1 in.) per wall face that is reinforced.

Impact on Accessibility

The proposed change does not impact immediate-term accessibility because it does not require individuals to install grab bars. However, over the life cycle of a dwelling unit, the proposed change would provide more flexibility for individuals who retrofit their washrooms with grab bars and similar fixtures in locations that improve the safety of mobility for a diverse range of user anthropometries and needs. At present, grab bars only meet the NBC requirements for structural strength when mounted to stud walls, which are typically spaced 400 mm apart and can be difficult to locate. The proposed change would allow grab bars or similar balance aids to be installed at a greater range of locations on washroom walls, while still providing adequate structural strength. This will make it easier to customize the grab bar location to user anthropometry and common movement tasks.

Nearly 25% of Canadians over 65 years old, and most people over 80 years old, report experiencing a disability related to mobility [1]. Furthermore, the Canadian population over the age of 85 is expected to triple in the next 30 years [10]. Together, these factors suggest that most Canadians will need to adapt their dwelling units at some point to meet their evolving needs and that the demand for adaptable housing will increase. The proposed change helps to address this demand by making it easier for individuals to install grab bars, which are the most common assistive device used by persons with disabilities related to mobility.

Impact on Safety

The proposed change does not affect immediate-term safety or health because it does not require grab bars or any other fall-prevention device to be installed. However, for persons who decide to install grab bars in washrooms, the proposed change makes it easier and less expensive to install grab bars in accordance with the NBC requirements for structural strength.

Impact on the Provinces and Territories

The impact of the proposed change on specific provinces and territories depends on the current application of accessibility requirements to different types of dwelling units. Nova Scotia and Ontario already require reinforcement of the washroom walls around the water closet in all dwellings to support the future installation of grab bars that comply with the NBC requirements for structural strength, while Quebec requires reinforcement of washroom walls in individual units in multi-unit residential buildings without an explicit requirement that addresses structural strength. While the proposed change prescribes the reinforcement of a larger wall area relative to provisions in Nova Scotia and Ontario, prescriptive requirements on the location of reinforcement and its design (PCF 2030) may reduce the costs of design that otherwise needs to demonstrate that the reinforcement meets the NBC performance-based requirements for structural strength supporting grab bars.

The impact of this proposed change would be the greatest in all other provinces and territories where requirements for the reinforcement of washroom walls are not yet in place, both in terms of initial cost of construction and increased flexibility in where grab bars can be safely installed in washrooms. Harmonizing requirements across the country may help to stimulate innovation in construction methods and materials to lower the cost of this proposed change.

References

(1) Statistics Canada. (2020). Canadians with a mobility disability. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2020085-eng.htm

(2) Musich, S., Wang, S. S., Ruiz, J., Hawkins, K., & Wicker, E. (2018). The impact of mobility limitations on health outcomes among older adults. *Geriatric nursing*, 39(2), 162-169.

(3) Levine, I. C., Montgomery, R. E., and Novak, A. C. (2021). Grab bar use influences fall hazard during bathtub exit. *Human factors*. https://journals.sagepub.com/doi/abs/10.1177/00187208211059860

(4) King, E. C., & Novak, A. C. (2017). Effect of bathroom aids and age on balance control during bathing transfers. *The American Journal of Occupational Therapy*, *71*(6), 1–9.

(5) Nirmalanathan, K. (2019). *Influence of Grab Bar Orientation on Balance Recovery Following a Perturbation During Bathtub Exits*. University of Toronto (Canada).

(6) Maki, B. E., Bartlett, S. A., & Fernie, G. R. (1984). Influence of stairway handrail height on the ability to generate stabilizing forces and moments. *Human Factors*, *26*(6), 705–714.

(7) Sveistrup, H., Lockett, D., Edwards, N., & Aminzadeh, F. (2006). Evaluation of bath grab bar placement for older adults. *Technology and Disability*, 18(2), 45–55.

(8) Aminzadeh, F., Edwards, N., Lockett, D., & Nair, R. C. (2000). Utilization of bathroom safety devices, patterns of bathing and toileting, and bathroom falls in a sample of community living older adults. *Technology and Disability*, *13*(2), 95–103.

(9) Wiseman, J. M., Stamper, D. S., Sheridan, E., Caterino, J. M., Quatman-Yates, C. C., & Quatman, C. E. (2021). Barriers to the initiation of home modifications for older adults for fall prevention. *Geriatric orthopaedic surgery & rehabilitation*, *12*.

(10) Statistics Canada. (2022). Population Projections for Canada (2021 to 2068), Provinces and Territories (2021 to 2043).

https://www150.statcan.gc.ca/n1/pub/91-520-x/91-520-x2022001-eng.htm.

Enforcement implications

This proposed change could be enforced to some extent by using existing methods in Nova Scotia, Ontario and Quebec, where changes related to the reinforcement of walls in washrooms have already been implemented in the provincial building codes. As the wall reinforcement is not visible after construction is complete, designers or builders would need to provide information about the location of reinforced walls with other detailed plans of the building. Details on the number and nature of fasteners used to attach the reinforcement to the stud wall would also be needed in contexts where the prescriptive options for compliance are used.

Authorities having jurisdiction would need to become familiar with the new requirements (including the expanded range where the reinforcement of washroom walls is required and the specifications for materials and thicknesses of the reinforcement) and techniques for evaluating compliance.

Who is affected

Homeowners and occupants would be able to install grab bars in a larger range of locations on washroom walls while still meeting the NBC requirements for structural strength.

Architects and designers would need to be aware of and potentially modify the design of dwelling units based on this proposed change.

Builders would need to incorporate this proposed change into the construction process for dwelling units.

Authorities having jurisdiction would need to become aware of this proposed change.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.8.1.1.] 3.8.1.1. ([1] 1) no attributions

[3.8.1.1.] 3.8.1.1. ([2] 2) no attributions

[3.8.2.1.] 3.8.2.1. ([1] 1) no attributions

[3.8.2.2.] 3.8.2.2. ([1] 1) [F73-OA1]

[3.8.2.2.] 3.8.2.2. ([2] 2) no attributions

[3.8.2.2.] 3.8.2.2. ([3] 3) no attributions

[3.8.2.2.] 3.8.2.2. ([4] 4) [F73-OA1]

[3.8.2.3.] 3.8.2.3. ([1] 1) [F73-OA1]

[3.8.2.3.] 3.8.2.3. ([2] 2) no attributions

[3.8.2.3.] 3.8.2.3. ([3] 3) [F74-OA2]

[3.8.2.3.] 3.8.2.3. ([4] 4) [F74-OA2]

[3.8.2.3.] 3.8.2.3. ([5] 5) [F74-OA2]

[3.8.2.3.] 3.8.2.3. ([5] 5) [F10-OS3.7] Applies to portion of Code text: "... each row of seats served by two aisles shall have one adaptable seat conforming to Subsection 3.8.3. located adjacent to one of the aisles."

[3.8.2.3.] 3.8.2.3. ([6] 6) [F74-OA2]

[3.8.2.4.] 3.8.2.4. ([1] 1) [F73-OA1]

[3.8.2.4.] 3.8.2.4. ([2] 2) [F73-OA1]

[3.8.2.5.] 3.8.2.5. ([1] 1) [F73-OA1]

[3.8.2.5.] 3.8.2.5. ([2] 2) [F73-OA1]

[3.8.2.5.] 3.8.2.5. ([3] 3) no attributions

[3.8.2.6.] 3.8.2.6. ([1] 1) no attributions

[3.8.2.7.] 3.8.2.7. ([1] 1) [F73-OA1]

[3.8.2.7.] 3.8.2.7. ([2] 2) no attributions

[3.8.2.7.] 3.8.2.7. ([3] 3) no attributions

[3.8.2.8.] 3.8.2.8. ([1] 1) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([1] 1) [F72-OH2.1] [F71-OH2.3]

[3.8.2.8.] 3.8.2.8. ([2] 2) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([2] 2) [F72-OH2.1] [F71-OH2.3]

[3.8.2.8.] 3.8.2.8. ([2] 2) no attributions

[3.8.2.8.] 3.8.2.8. ([3] 3) no attributions

[3.8.2.8.] 3.8.2.8. ([4] 4) [F72-OH2.1]

[3.8.2.8.] 3.8.2.8. ([4] 4) [F73-OA1]

[3.8.2.8.] 3.8.2.8. ([5] 5) no attributions

[3.8.2.8.] 3.8.2.8. ([6] 6) no attributions

[3.8.2.8.] 3.8.2.8. ([7] 7) no attributions

[3.8.2.8.] 3.8.2.8. ([8] 8) no attributions

[3.8.2.8.] 3.8.2.8. ([9] 9) no attributions

[3.8.2.8.] 3.8.2.8. ([10] 10) no attributions

[3.8.2.8.] 3.8.2.8. ([11] 11) no attributions

[3.8.2.8.] 3.8.2.8. ([12] 12) no attributions

[3.8.2.8.] 3.8.2.8. ([13] 13) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([13] 13) no attributions

[3.8.2.8.] 3.8.2.8. ([14] 14) no attributions

[3.8.2.8.] 3.8.2.8. ([15] 15) no attributions

[3.8.2.8.] 3.8.2.8. ([15] 15) [F74-OA2]

[3.8.2.9.] 3.8.2.9. ([1] 1) no attributions

[3.8.2.9.] 3.8.2.9. ([2] 2) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([1] 1) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([1] 1) no attributions

[3.8.2.10.] 3.8.2.10. ([2] 2) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([3] 3) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([3] 3) no attributions

[3.8.2.10.] 3.8.2.10. ([4] 4) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([4] 4) no attributions

[3.8.2.11.] 3.8.2.11. ([1] 1) [F74-OA2]

[3.8.2.11.] 3.8.2.11. ([1] 1) no attributions

[3.8.2.12.] 3.8.2.12. ([1] 1) [F74-OA2]

[3.8.2.12.] 3.8.2.12. ([1] 1) no attributions

[3.8.3.1.] 3.8.3.1. ([1] 1) no attributions

[3.8.3.2.] 3.8.3.2. ([1] 1) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([2] 2) no attributions

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([4] 4) no attributions

[3.8.3.2.] 3.8.3.2. ([5] 5) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([6] 6) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F30-OS3.1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([c] c)

[3.8.3.3.] 3.8.3.3. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([a] a) [F74-OA2]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([c] c) [F74-OA2]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([e] e),([f] f)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([a] a)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([2] 2) no attributions

[3.8.3.5.] 3.8.3.5. ([3] 3) no attributions

[3.8.3.5.] 3.8.3.5. ([4] 4) ([a] a) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([4] 4) ([b] b),([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([5] 5) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([1] 1) no attributions

[3.8.3.6.] 3.8.3.6. ([2] 2) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([6] 6) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([7] 7) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([8] 8) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([9] 9) no attributions

[3.8.3.6.] 3.8.3.6. ([10] 10) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([10] 10) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([10] 10) no attributions

[3.8.3.6.] 3.8.3.6. ([11] 11) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([13] 13) no attributions

[3.8.3.6.] 3.8.3.6. ([14] 14) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([15] 15) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([16] 16) no attributions

[3.8.3.6.] 3.8.3.6. ([17] 17) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([17] 17) [F10-OS3.7]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F73-OA1]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F74-OA2]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F74-OA2]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F10-OS3.7]

[3.8.3.9.] 3.8.3.9. ([1] 1) no attributions

[3.8.3.9.] 3.8.3.9. ([1] 1) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([1] 1) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F73-OA1]

[3.8.3.10.] 3.8.3.10. ([1] 1) [F74-OA2]

[3.8.3.10.] 3.8.3.10. ([2] 2) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([1] 1) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([2] 2) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F72-OH2.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([d] d)([i] i) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f),([g] g) [F30,F20-OS3.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f) and ([g] g)

[3.8.3.12.] 3.8.3.12. ([1] 1) ([h] h) [F30-OS3.1] Applies to portion of Code text: "… be equipped with a coat hook … projecting not more than 50 mm from the wall …"

[3.8.3.12.] 3.8.3.12. ([1] 1) no attributions

[3.8.3.13.] 3.8.3.13. ([1] 1) [F74-OA2]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([b] b) [F10-OS3.7]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([c] c)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([d] d)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([f] f)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([g] g) [F30-OS3.1] Applies to the requirement for a coat hook.

[3.8.3.13.] 3.8.3.13. ([1] 1) ([i] i) [F74-OA2] Applies to the requirement for a shelf.

[3.8.3.13.] 3.8.3.13. ([1] 1) [F72-OH2.1] [F71-OH2.3]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([b] b) [F74-OA2] Applies to portion of Code text: "… a door ... capable of being locked from the inside …"

[3.8.3.13.] 3.8.3.13. ([2] 2) [F72-OH2.1] [F71-OH2.3]

[3.8.3.14.] **3.8.3.14. ([1] 1) [F74-OA2]**

[3.8.3.14.] **3.8.3.14. ([1] 1) [F72-OH2.1]**

[3.8.3.15.] **3.8.3.15. ([1] 1) [F74-OA2]**

[3.8.3.15.] **3.8.3.15. ([1] 1) ([d] d) [F30-OS3.1]**

[3.8.3.15.] **3.8.3.15. ([1] 1) ([a] a)**

[3.8.3.15.] **3.8.3.15. ([2] 2) [F74-OA2]**

[3.8.3.15.] **3.8.3.15. ([2] 2) ([f] f) [F30-OS3.1]**

[3.8.3.15.] **3.8.3.15. ([2] 2) ([c] c)**

[3.8.3.16.] **3.8.3.16. ([1] 1) [F74-OA2]**

[3.8.3.16.] **3.8.3.16. ([1] 1) [F71-OH2.3]**

[3.8.3.16.] **3.8.3.16. ([1] 1) ([f] f) [F31-OS3.2]**

[3.8.3.16.] **3.8.3.16. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([1] 1) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([d] d),([e] e) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([f] f) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([h] h) [F31-OS3.2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F71-OH2.3]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([a] a) [F73-OA1]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F10-OS3.7]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([g] g) [F74-OA2]**

[3.8.3.18.] **3.8.3.18. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F11-OS3.7]**

[3.8.3.19.] **3.8.3.19. ([2] 2) [F74-OA2]**

[3.8.3.20.] **3.8.3.20. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F30-OS3.1]** Applies to portion of Code text: "…

level … level and have removable seats, …”

[3.8.3.22.] **3.8.3.22. ([1] 1) ([d] d) [F10-OS3.7]** Applies to portion of Code text: “… without infringing on egress from any row of seating or any aisle requirements …”

[3.8.3.22.] **3.8.3.22. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([2] 2) [F30-OS3.1]** Applies to portion of Code text: “… level, ...”

[3.8.3.22.] **3.8.3.22. ([3] 3) ([a] a) [F10-OS3.7]** Applies to portion of Code text: “… without infringing on egress from any row of seating or any aisle requirements …”

[3.8.3.22.] **3.8.3.22. ([3] 3) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([4] 4) [F10-OS3.7]**

[3.8.4.3.] -- ([1] --) no attributions

[3.8.4.3.] -- ([2] --) [F30-OS3.1] [F20-OS2.1]

[3.8.4.3.] -- ([3] --) no attributions

[3.8.4.3.] -- ([4] --) [F30-OS3.1] [F20-OS2.1]

[3.8.4.3.] -- ([5] --) no attributions

Submit a comment

Proposed Change 1884

Code Reference(s):	**NBC20 Div.B 3.8. (first printing)**
Subject:	Accessibility, Visitability and Adaptability of Dwelling Units
Title:	Paths of Travel Within a Visitable Dwelling Unit
Description:	This proposed change requires visitable dwelling units to have a path of travel to all amenities on the entrance floor.
Related Proposed Change(s):	PCF 1882, PCF 1958, PCF 2030, PCF 2031

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [x] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Construction and Demolition Sites
- [x] Division B
- [x] Design and Construction
- [x] Housing
- [x] Large Buildings
- [x] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [ ] Plumbing

General information

See the summary for subject Accessibility, Visitability and Adaptability of Dwelling Units.

Problem

Being able to access the main living spaces in a dwelling unit is essential for both residents and visiting friends and family. However, because of the existing shortcomings of the NBC requirements, these spaces may be inaccessible for persons who use mobility devices if

- the corridors and doorways are too narrow, or
- thresholds are too high and without adequate bevels (to prevent a person from tripping on or catching their mobility device).

Inaccessible living spaces can make it difficult for persons who use mobility aids to visit friends and family, participate in their community, and indeed live in their own home.

Justification

This proposed change introduces new requirements for dwelling units that are designated as visitable by federal, provincial, territorial regulations or municipal bylaws, such that the entrance level is designed to have the following:

- a path of travel with a clear width not less than 1 000 mm,
- doorways with a clear width not less than 850 mm when the door is in the open position, and
- thresholds no greater than 13 mm and beveled in accordance with NBC accessibility requirements.

By introducing minimum clear width requirements for access to all habitable rooms on the entrance level, the proposed change is expected to limit the probability that persons who use mobility aids would be unable to access facilities in the dwelling unit, irrespective of whether they live there or are visiting.

Providing access to habitable rooms on the entrance level is one of the main features of visitable dwelling units [1] and is essential for accessibility. Over 4% of community-dwelling Canadians over the age of 15 regularly use some type of walking aid (e.g., walker, rollator or cane) [2], and 1% regularly use a wheeled mobility aid (e.g., wheelchair or scooter) [3]. However, the prevalence of disabilities related to mobility and the associated use of assistive aids increases with age, with over 18% of community-dwelling Canadians over the age of 75 regularly using canes or walking sticks, 14% regularly using walkers or rollators, and 4% regularly using wheelchairs or scooters [2],[3]. As such, many Canadians will use assistive aids for mobility at some point in their lives and will require larger spaces for access to the washrooms and other essential building facilities while using these devices.

This proposed change should be considered in the context of PCF 1958, which proposes minimum technical requirements for a washroom in a visitable dwelling unit.

This proposed change only applies to dwelling units in multi-unit residential buildings that are required by the federal, provincial, territorial or municipal authority to be designed to be visitable. It does not apply to detached houses, semi-detached houses, houses with a secondary suite, duplexes, triplexes, town houses, row houses or boarding houses.

PROPOSED CHANGE

[3.8.] 3.8. Accessibility

(See Note A-3.8.)

[3.8.1.] 3.8.1. Scope

[3.8.1.1.] 3.8.1.1. Scope

[3.8.2.] 3.8.2. Application

[3.8.2.1.] 3.8.2.1. Exceptions

[3.8.2.2.] 3.8.2.2. Entrances

[3.8.2.3.] 3.8.2.3. Areas Requiring a Barrier-Free Path of Travel

[3.8.2.4.] 3.8.2.4. Access to Storeys Served by Escalators and Moving Walks

[3.8.2.5.] 3.8.2.5. Exterior Barrier-Free Paths of Travel to Building Entrances and Exterior Passenger-Loading Zones

[3.8.2.6.] 3.8.2.6. Controls

[3.8.2.7.] 3.8.2.7. Power Door Operators

[3.8.2.8.] 3.8.2.8. Plumbing Facilities

[3.8.2.9.] 3.8.2.9. Assistive Listening Systems

[3.8.2.10.] 3.8.2.10. Signs and Indicators

[3.8.2.11.] 3.8.2.11. Counters

[3.8.2.12.] 3.8.2.12. Telephones

[3.8.3.] 3.8.3. Design

[3.8.3.1.] 3.8.3.1. Design Standards

[3.8.3.2.] 3.8.3.2. Barrier-Free Path of Travel

[3.8.3.3.] 3.8.3.3. Exterior Walks

[3.8.3.4.] 3.8.3.4. Exterior Passenger-Loading Zones

[3.8.3.5.] 3.8.3.5. Ramps

[3.8.3.6.] 3.8.3.6. Doorways and Doors

[3.8.3.7.] 3.8.3.7. Passenger-Elevating Devices

[3.8.3.8.] 3.8.3.8. Controls

[3.8.3.9.] 3.8.3.9. Accessible Signs

[3.8.3.10.] 3.8.3.10. Drinking Fountains

[3.8.3.11.] 3.8.3.11. Water-Bottle Filling Stations

[3.8.3.12.] 3.8.3.12. Accessible Water-Closet Stalls

[3.8.3.13.] 3.8.3.13. Universal Washrooms

[3.8.3.14.] 3.8.3.14. Water Closets

[3.8.3.15.] 3.8.3.15. Water-Closet Stalls and Urinals for Persons with Limited Mobility

[3.8.3.16.] 3.8.3.16. Lavatories and Mirrors

[3.8.3.17.] 3.8.3.17. Showers

[3.8.3.18.] 3.8.3.18. Accessible Bathtubs

[3.8.3.19.] 3.8.3.19. Assistive Listening Systems

[3.8.3.20.] 3.8.3.20. Counters

[3.8.3.21.] 3.8.3.21. Telephones

[3.8.3.22.] 3.8.3.22. Spaces in Seating Area

[3.8.4.] -- Dwelling Units (PCFs 1881 to 1883, 1957 and 2031)

[3.8.5.] -- Visitable Dwelling Units

[3.8.5.1.] --- Path of Travel and Doors and Doorways

[1] --) The entrance level of a visitable *dwelling unit* shall be served by a path of travel that
- [a] --) conforms to Sentences 3.8.3.2.(1) to (4), and
- [b] --) extends into
  - [i] --) any dining rooms or spaces,
  - [ii] --) any living rooms or spaces, and
  - [iii] --) at least one washroom conforming to Article 3.8.5.2.-2025 (PCF 1958).

[2] --) All doors and doorways located in the path of travel described in Clause (1)(b) shall conform to Sentences 3.8.3.6.(2), (4) and (5). (See Note A-3.4.3.4.)

Impact analysis

Costs

Overview

Visitability requirements only apply to dwelling units where mandated by authorities having jurisdiction. In such case, where a federal, provincial or territorial or municipal authority introduces requirements for visitable dwelling units, PCF 1884 would also introduce the following three changes to the entrance level of a visitable dwelling unit, the expected impacts of which are also described below:

1. Increases the minimum width of a corridor in a dwelling unit from 860 mm to 1 000 mm (4% increase in total construction cost per visitable dwelling unit).
2. Requires each doorway to have a clear width of at least 850 mm ($15.31 increase per visitable dwelling unit, which is too small to present as a percentage increase in total construction cost).
3. Sets maximum door threshold height at 13 mm (not expected to present a measurable increase in total construction cost).

1. Calculation of Cost Impact for the Proposed Increase in Minimum Corridor Width

The layout of the dwelling unit could be adjusted to limit the consequences to the available space and thus prevent additional costs.

However, in cases where room sizes or plan elements cannot be changed, the overall dimensions of the dwelling unit may need to be adjusted to comply with the wider corridor and doorway widths required by this proposed change.

Assumptions:
- Unit Length: 8 m
- Unit Width: 6 m
- Orientation of Paths of Travel: 1 corridor width wise and another corridor length wise, so the dwelling unit would need to be increased in its length and its width.
- Change in Minimum Width of Path of Travel: 1 000 mm (PCF 1884) − 860 mm (NBC 2020) = 140 mm = 0.14 m

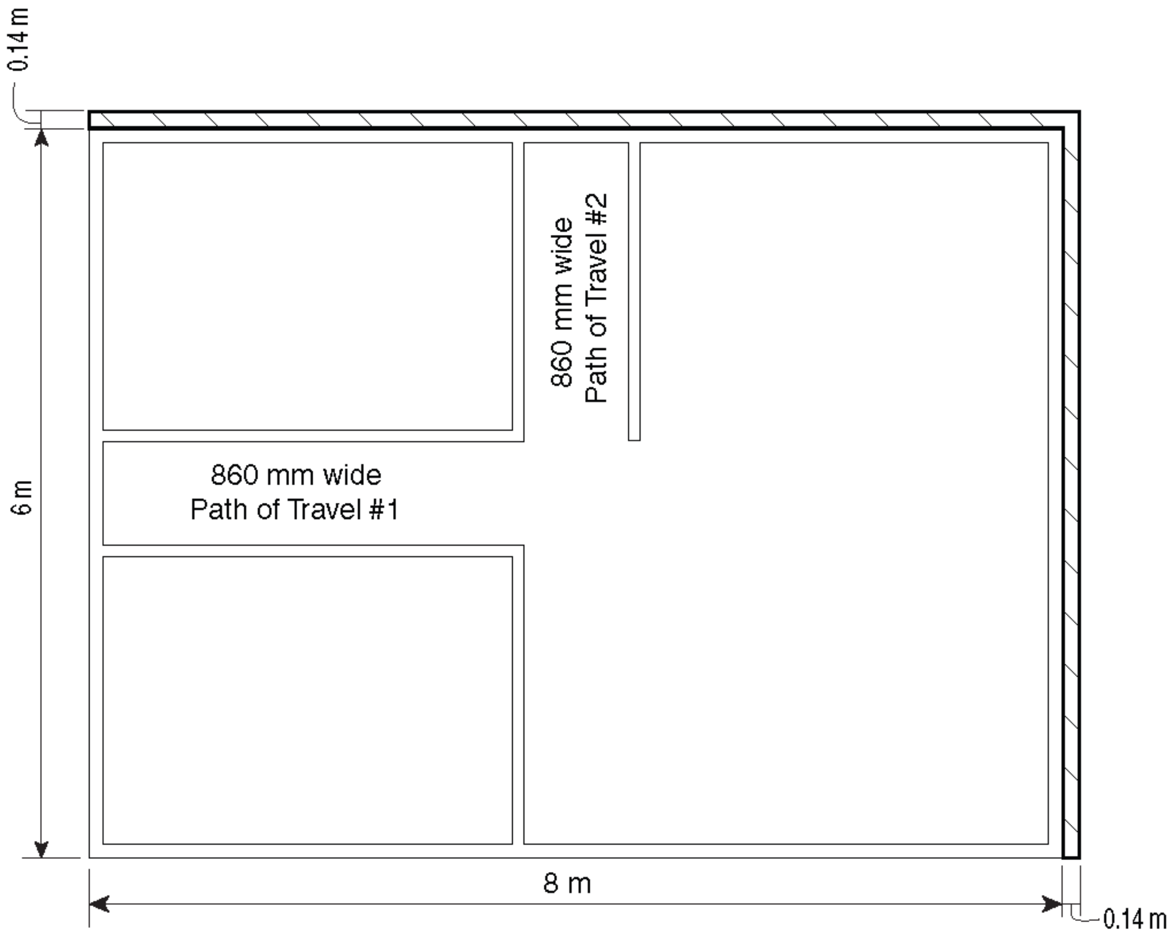


Figure 1. Example applying the proposed change in minimum width of path of travel in a dwelling unit

Table 1 shows the average cost to construct the example dwelling unit (condo) in Figure 1, based on the Altus Group 2023 Construction Cost data for multi-unit residential buildings (MURBs) in different Canadian regions.

Table 1. Average Construction Cost of a 48 m^2 Condo

	Cost by Location, $								
Condominiums/Apartments	**Vancouver**	**Calgary**	**Edmonton**	**Winnipeg**	**GTA(1)**	**Ottawa/Gatineau**	**Montréal**	**Halifax**	**St. John's**
12 or fewer storeys	178 250.43	149 833.70	149 833.70	169 208.74	169 208.74	162 750.40	134 333.66	112 375.27	114 958.61
13 to 39 storeys	188 583.79	155 000.38	155 000.38	153 708.71	169 208.74	170 500.41	136 917.00	117 541.95	N/A(2)
40 to 60 storeys	196 333.81	157 583.72	157 583.72	156 292.05	186 000.45	179 542.10	145 958.69	N/A(2)	N/A(2)
More than 60 storeys	213 125.52	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)
Wood-Frame Construction(3)									
6 or fewer storeys	153 708.71	118 833.62	118 833.62	117 541.95	145 958.69	112 375.27	102 041.91	86 541.88	91 708.56

Notes to Table 1:

(1) GTA = Greater Toronto Area

(2) N/A = not available

(3) Condo only.

Table 2 shows the worst-case scenario cost increase if a designer were to simply increase the length and width of a dwelling unit to be compliant with PCF 1884.

Table 2. Increase in Construction Cost to Expand an 8 m × 6 m Condo by 290 mm in Both Directions

	Cost by Location, $								
Condominiums/Apartments	**Vancouver**	**Calgary**	**Edmonton**	**Winnipeg**	**GTA(1)**	**Ottawa/Gatineau**	**Montréal**	**Halifax**	**St. John's**
12 or fewer storeys	7 278.56	6 118.21	6 118.21	6 909.36	6 909.36	6 645.64	5 485.29	4 588.66	4 694.14
13 to 39 storeys	7 700.50	6 329.18	6 329.18	6 276.44	6 909.36	6 962.10	5 590.78	4 799.63	N/A(2)
40 to 60 storeys	8 016.96	6 434.67	6 434.67	6 381.93	7 595.02	7 331.30	5 959.98	N/A(2)	N/A(2)

Condominiums/Apartments	Cost by Location, $								
	Vancouver	**Calgary**	**Edmonton**	**Winnipeg**	**GTA(1)**	**Ottawa/Gatineau**	**Montréal**	**Halifax**	**St. John's**
More than 60 storeys	8 702.63	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)	N/A(2)
Wood-Frame Construction(3)									
6 or fewer storeys	6 276.44	4 852.37	4 852.37	4 799.63	5 959.98	4 588.66	4 166.71	3 533.79	3 744.77

Notes to Table 2:

(1) GTA = Greater Toronto Area

(2) N/A = not available

(3) Condo only.

Calculation of Total Cost of Proposed Corridor Width in the Example Condo

The following calculation may be used:

% Cost Increase due to Increased Minimum Corridor Width = (Increase in Construction Cost listed in Table 2 / Average Construction Cost) × 100 = 4%

% Cost Increase due to Increased Minimum Corridor Width = 4%

* The cost increase described above is only applicable in the following cases:

- Where a designer ensures compliance by increasing the size of the dwelling unit instead of revising the layout of the home.
- For a dwelling unit having the dimensions used in the example. It should also be noted that smaller units could see a greater percentage increase in construction costs, while larger units could see a smaller percentage increase in construction costs.

2. Calculation of Cost Impact of the Proposed Clear Width for Doorways

Some of the cost of increasing the minimum door width is offset where a wider door reduces the amount of interior wall that needs to be constructed. The impact of increasing the minimum door width is calculated as follows:

Cost of increased door width − Cost reduction due to constructing less wall = Total cost of proposed clear width for doorways

This calculation makes the following assumptions:

- Most dwelling units in new-build MURBs have open-concept designs so they do not have doorways at the entrance of living rooms or kitchens; in this case, only washroom doorways would need to comply with the proposed clear width requirement.
- A dwelling unit in a MURB will only have one washroom that needs to be visitable.
- The NBC 2020 Part 9 minimum door width requirement for washrooms (610 mm) can be converted into a minimum clear width requirement that is calculated by subtracting 50 mm (i.e., 44 mm + 6 mm = interior door thickness + interior door jamb stop width) from the minimum door width. This means the NBC indirectly requires an approximate minimum clear width of 560 mm for doorways at washroom entrances.

Cost of Increased Door Width

Since PCF 1884 proposes a minimum clear width of 850 mm at entrances to washrooms, this would require a 900 mm door width (i.e., 850 mm + 50 mm = minimum clear width + assumed conversion adjustment). Table 3 identifies the cost difference between a 610 mm wide door and a 900 mm wide door.

Table 3. Comparison of Cost of Different Door Widths across Canada

Region	Cost, $			Description of Door
	NBC 2020 (610 mm)	**PCF 1884 (900 mm)**	**Difference**	
Home Depot (Canadian average)	92.34	111.00	18.66	Flush hollow core smooth interior door slab
Lowes (Canadian average)	157.99	179.00	21.01	2-panel hollow core smooth interior door
RSMeans	89.00	113.00	24.00	Hardboard hollow core
RSMeans	113.00	162.00	49.00	Birch hollow core

* The difference in cost between the RSMeans Birch Hollow Core doors (610 mm versus 900 mm) represents the largest cost difference, so **$49 is the assumed cost increase associated with the new minimum clear width requirement.**

Cost Reduction due to Constructing Less Wall

Since one of the assumptions made was that the NBC 2020 indirectly requires a minimum clear width of 560 mm at the entrance to washrooms, and PCF 1884 proposed to increase this to 850 mm, there is a 290 mm reduction in interior wall construction. Table 4 shows the RSMeans costing per metre for standard interior wall construction.

Table 4. Pricing a Basic Interior Wall

Components	Quantity	Unit Cost, $/m	Cost, $/m
12.7 mm gypsum wall board	2.44 m^2	14.31	34.92
38 mm × 89 mm @ 400 mm stud wall			
2 in. × 4 in. plates (2 top, 1 bottom)	3 m	5.71	17.13
38 mm × 89 mm stud walls	6.10 m	4.79	29.22
12.7 mm gypsum wall board	2.44 m^2	14.31	34.92
Total			116.18

* Reduction in required length of interior wall × Cost of interior wall per length

= 0.29 m × $116.18/m

= **$33.69, which is the assumed cost decrease associated with building less interior wall because of the wider door being installed.**

Total Cost of Proposed Clear Width for Doorways

= Cost of increased door width − Cost reduction due to constructing less wall

=$49.00 − $33.69

= **$15.31**

Benefits

The proposed change is expected to improve accessibility in dwelling units, both for the persons who reside there and for their visitors. Approximately 10% of Canadians have a disability related to mobility [4] and 4% of Canadians in the community regularly use some form of walking aid [2]. However, the prevalence of the use of disability and mobility aids increases with age, with over 18% of community-dwelling Canadians over the age of 75 regularly using canes or walking sticks, 14% regularly using walkers or rollators, and 4% regularly using wheelchairs or scooters [2],[3]. As such, many Canadians will use assistive aids for mobility at some point in their lives, highlighting the need for housing that is designed for access while using mobility aids.

Social isolation and loneliness are common in older adults and are severe risk factors for poor health and mortality. A recent literature review in Canada reported that the risk is comparable to smoking, alcohol consumption, obesity or frailty [5]. Strategies to promote social interaction and reduce isolation are urgently needed to enable people to live in the community for as long as possible. Promoting visits to the home, whether through a program or informally with friends and family, is one of the established strategies for reducing social isolation and loneliness [6]. Designing dwelling units so that residents and visitors can access normally occupied spaces on the main floor would help to support these social interactions that forestall loneliness and isolation as well as their associated health consequences.

References

(1) Canadian Centre on Disability Studies, via the Canadian Mortgage and Housing Corporation. (2017). Barriers and enablers to the uptake of VisitAble housing in Canada: Stakeholder perceptions. Retrieved March 8, 2023 from: https://eppdscrmssa01.blob.core.windows.net/cmhcprodcontainer/sf/project/archive/research_2/barriers_and_enablers_jul5_corrected.pdf

(2) Charette, C., Best, K.L., Smith, E. M., Miller, W.C., and Routhier, F. (2018). Walking aid use in Canada: prevalence and demographic characteristics among community-dwelling users. *Physical therapy*, 98(7), 571–577.

(3) Smith, E.M., Giesbrecht, E.M., Mortenson, W.B., and Miller, W.C. (2016). Prevalence of wheelchair and scooter use among community-dwelling Canadians. *Physical therapy*, 96(8), 1135–1142.

(4) Statistics Canada, "A profile of Canadians with a mobility disability and groups designated as visible minorities with a disability". (2020). Retrieved October 30, 2023 from https://www150.statcan.gc.ca/n1/daily-quotidien/201203/dq201203a-eng.htm)

(5) Freedman, A., and Nicolle, J. (2020). Social isolation and loneliness: The new geriatric giants: Approach for primary care. *Canadian Family Physician*, 66(3), 176-182.

(6) Dickens, A.P., Richards, S.H., Greaves, C.J., and Campbell, J.L. (2011). Interventions targeting social isolation in older people: a systematic review. *BMC public health*, *11*(1), 1-22.

Enforcement implications

This proposed change could be enforced with simple measuring tools (e.g., tape measure), similar to those used to enforce barrier-free paths of travel in public spaces.

Authorities having jurisdiction would need to be aware of this proposed change and its application to visitable dwelling units.

Who is affected

Builders, architects and engineers would need to consider wider doorways and hallways in their plan layouts.

Regulators would need to ensure that dwelling units designated as visitable comply with the new requirements.

Building occupants who use mobility aids would be able to navigate key spaces (e.g., kitchen or living room) within dwelling units, irrespective of whether they live there or are visiting friends and family.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.8.1.1.] **3.8.1.1. ([1] 1) no attributions**

[3.8.1.1.] **3.8.1.1. ([2] 2) no attributions**

[3.8.2.1.] **3.8.2.1. ([1] 1) no attributions**

[3.8.2.2.] **3.8.2.2. ([1] 1) [F73-OA1]**

[3.8.2.2.] **3.8.2.2. ([2] 2) no attributions**

[3.8.2.2.] **3.8.2.2. ([3] 3) no attributions**

[3.8.2.2.] **3.8.2.2. ([4] 4) [F73-OA1]**

[3.8.2.3.] **3.8.2.3. ([1] 1) [F73-OA1]**

[3.8.2.3.] **3.8.2.3. ([2] 2) no attributions**

[3.8.2.3.] **3.8.2.3. ([3] 3) [F74-OA2]**

[3.8.2.3.] **3.8.2.3. ([4] 4) [F74-OA2]**

[3.8.2.3.] **3.8.2.3. ([5] 5) [F74-OA2]**

[3.8.2.3.] **3.8.2.3. ([5] 5) [F10-OS3.7]** Applies to portion of Code text: "... each row of seats served by two aisles shall have one adaptable seat conforming to Subsection 3.8.3. located adjacent to one of the aisles."

[3.8.2.3.] **3.8.2.3. ([6] 6) [F74-OA2]**

[3.8.2.4.] **3.8.2.4. ([1] 1) [F73-OA1]**

[3.8.2.4.] **3.8.2.4. ([2] 2) [F73-OA1]**

[3.8.2.5.] **3.8.2.5. ([1] 1) [F73-OA1]**

[3.8.2.5.] **3.8.2.5. ([2] 2) [F73-OA1]**

[3.8.2.5.] **3.8.2.5. ([3] 3) no attributions**

[3.8.2.6.] **3.8.2.6. ([1] 1) no attributions**

[3.8.2.7.] **3.8.2.7. ([1] 1) [F73-OA1]**

[3.8.2.7.] **3.8.2.7. ([2] 2) no attributions**

[3.8.2.7.] **3.8.2.7. ([3] 3) no attributions**

[3.8.2.8.] **3.8.2.8. ([1] 1) [F74-OA2]**

[3.8.2.8.] **3.8.2.8. ([1] 1) [F72-OH2.1] [F71-OH2.3]**

[3.8.2.8.] **3.8.2.8. ([2] 2) [F74-OA2]**

[3.8.2.8.] **3.8.2.8. ([2] 2) [F72-OH2.1] [F71-OH2.3]**

[3.8.2.8.] **3.8.2.8. ([2] 2) no attributions**

[3.8.2.8.] **3.8.2.8. ([3] 3) no attributions**

[3.8.2.8.] **3.8.2.8. ([4] 4) [F72-OH2.1]**

[3.8.2.8.] **3.8.2.8. ([4] 4) [F73-OA1]**

[3.8.2.8.] **3.8.2.8. ([5] 5) no attributions**

[3.8.2.8.] **3.8.2.8. ([6] 6) no attributions**

[3.8.2.8.] **3.8.2.8. ([7] 7) no attributions**

[3.8.2.8.] **3.8.2.8. ([8] 8) no attributions**

[3.8.2.8.] **3.8.2.8. ([9] 9) no attributions**

[3.8.2.8.] **3.8.2.8. ([10] 10) no attributions**

[3.8.2.8.] **3.8.2.8. ([11] 11) no attributions**

[3.8.2.8.] **3.8.2.8. ([12] 12) no attributions**

[3.8.2.8.] **3.8.2.8. ([13] 13) [F74-OA2]**

[3.8.2.8.] **3.8.2.8. ([13] 13) no attributions**

[3.8.2.8.] **3.8.2.8. ([14] 14) no attributions**

[3.8.2.8.] **3.8.2.8. ([15] 15) no attributions**

[3.8.2.8.] **3.8.2.8. ([15] 15) [F74-OA2]**

[3.8.2.9.] **3.8.2.9. ([1] 1) no attributions**

[3.8.2.9.] **3.8.2.9. ([2] 2) [F74-OA2]**

[3.8.2.10.] **3.8.2.10. ([1] 1) [F74-OA2]**

[3.8.2.10.] **3.8.2.10. ([1] 1) no attributions**

[3.8.2.10.] **3.8.2.10. ([2] 2) [F74-OA2]**

[3.8.2.10.] **3.8.2.10. ([3] 3) [F74-OA2]**

[3.8.2.10.] **3.8.2.10. ([3] 3) no attributions**

[3.8.2.10.] **3.8.2.10. ([4] 4) [F74-OA2]**

[3.8.2.10.] **3.8.2.10. ([4] 4) no attributions**

[3.8.2.11.] **3.8.2.11. ([1] 1) [F74-OA2]**

[3.8.2.11.] **3.8.2.11. ([1] 1) no attributions**

[3.8.2.12.] **3.8.2.12. ([1] 1) [F74-OA2]**

[3.8.2.12.] **3.8.2.12. ([1] 1) no attributions**

[3.8.3.1.] **3.8.3.1. ([1] 1) no attributions**

[3.8.3.2.] **3.8.3.2. ([1] 1) [F73-OA1]**

[3.8.3.2.] **3.8.3.2. ([2] 2) no attributions**

[3.8.3.2.] **3.8.3.2. ([3] 3) ([a] a),([b] b) [F30-OS3.1]**

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([4] 4) no attributions

[3.8.3.2.] 3.8.3.2. ([5] 5) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([6] 6) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F30-OS3.1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([c] c)

[3.8.3.3.] 3.8.3.3. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([a] a) [F74-OA2]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([c] c) [F74-OA2]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([e] e),([f] f)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([a] a)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([2] 2) no attributions

[3.8.3.5.] 3.8.3.5. ([3] 3) no attributions

[3.8.3.5.] 3.8.3.5. ([4] 4) ([a] a) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([4] 4) ([b] b),([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([5] 5) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([1] 1) no attributions

[3.8.3.6.] 3.8.3.6. ([2] 2) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([6] 6) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([7] 7) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([8] 8) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([9] 9) no attributions

[3.8.3.6.] 3.8.3.6. ([10] 10) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([10] 10) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([10] 10) no attributions

[3.8.3.6.] 3.8.3.6. ([11] 11) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([13] 13) no attributions

[3.8.3.6.] 3.8.3.6. ([14] 14) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([15] 15) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([16] 16) no attributions

[3.8.3.6.] 3.8.3.6. ([17] 17) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([17] 17) [F10-OS3.7]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F73-OA1]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F74-OA2]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F74-OA2]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F10-OS3.7]

[3.8.3.9.] 3.8.3.9. ([1] 1) no attributions

[3.8.3.9.] 3.8.3.9. ([1] 1) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([1] 1) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F73-OA1]

[3.8.3.10.] 3.8.3.10. ([1] 1) [F74-OA2]

[3.8.3.10.] 3.8.3.10. ([2] 2) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([1] 1) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([2] 2) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F72-OH2.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([d] d)([i] i) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f),([g] g) [F30,F20-OS3.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f) and ([g] g)

[3.8.3.12.] 3.8.3.12. ([1] 1) ([h] h) [F30-OS3.1] Applies to portion of Code text: "… be equipped with a coat hook … projecting not more than 50 mm from the wall …"

[3.8.3.12.] 3.8.3.12. ([1] 1) no attributions

[3.8.3.13.] 3.8.3.13. ([1] 1) [F74-OA2]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([b] b) [F10-OS3.7]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([c] c)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([d] d)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([f] f)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([g] g) [F30-OS3.1] Applies to the requirement for a coat hook.

[3.8.3.13.] 3.8.3.13. ([1] 1) ([i] i) [F74-OA2] Applies to the requirement for a shelf.

[3.8.3.13.] 3.8.3.13. ([1] 1) [F72-OH2.1] [F71-OH2.3]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([b] b) [F74-OA2] Applies to portion of Code text: "… a door ... capable of being locked from the inside …"

[3.8.3.13.] 3.8.3.13. ([2] 2) [F72-OH2.1] [F71-OH2.3]

[3.8.3.14.] 3.8.3.14. ([1] 1) [F74-OA2]

[3.8.3.14.] 3.8.3.14. ([1] 1) [F72-OH2.1]

[3.8.3.15.] 3.8.3.15. ([1] 1) [F74-OA2]

[3.8.3.15.] 3.8.3.15. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.15.] 3.8.3.15. ([1] 1) ([a] a)

[3.8.3.15.] 3.8.3.15. ([2] 2) [F74-OA2]

[3.8.3.15.] 3.8.3.15. ([2] 2) ([f] f) [F30-OS3.1]

[3.8.3.15.] 3.8.3.15. ([2] 2) ([c] c)

[3.8.3.16.] 3.8.3.16. ([1] 1) [F74-OA2]

[3.8.3.16.] 3.8.3.16. ([1] 1) [F71-OH2.3]

[3.8.3.16.] 3.8.3.16. ([1] 1) ([f] f) [F31-OS3.2]

[3.8.3.16.] 3.8.3.16. ([2] 2) [F74-OA2]

[3.8.3.17.] 3.8.3.17. ([1] 1) [F74-OA2]

[3.8.3.17.] 3.8.3.17. ([1] 1) ([d] d),([e] e) [F30-OS3.1]

[3.8.3.17.] **3.8.3.17. ([1] 1) ([f] f) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([h] h) [F31-OS3.2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F71-OH2.3]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([a] a) [F73-OA1]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F10-OS3.7]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([g] g) [F74-OA2]**

[3.8.3.18.] **3.8.3.18. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F11-OS3.7]**

[3.8.3.19.] **3.8.3.19. ([2] 2) [F74-OA2]**

[3.8.3.20.] **3.8.3.20. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F30-OS3.1]** Applies to portion of Code text: "… level … level and have removable seats, …"

[3.8.3.22.] **3.8.3.22. ([1] 1) ([d] d) [F10-OS3.7]** Applies to portion of Code text: "… without infringing on egress from any row of seating or any aisle requirements …"

[3.8.3.22.] **3.8.3.22. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([2] 2) [F30-OS3.1]** Applies to portion of Code text: "… level, ..."

[3.8.3.22.] **3.8.3.22. ([3] 3) ([a] a) [F10-OS3.7]** Applies to portion of Code text: "… without infringing on egress from any row of seating or any aisle requirements …"

[3.8.3.22.] **3.8.3.22. ([3] 3) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([4] 4) [F10-OS3.7]**

[3.8.5.1.] -- ([1] --) [F73-OA1] [F74-OA2]

[3.8.5.1.] -- ([2] --) [F73-OA1]

Submit a comment

Proposed Change 1958

Code Reference(s):	**NBC20 Div.B 3.8. (first printing)**
Subject:	Accessibility, Visitability and Adaptability of Dwelling Units
Title:	Washrooms in Visitable Dwelling Units
Description:	This proposed change introduces design requirements for washrooms in visitable dwelling units.
Related Proposed Change(s):	PCF 1882, PCF 1884, PCF 2030, PCF 2031

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [x] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Construction and Demolition Sites
- [x] Division B
- [x] Design and Construction
- [x] Housing
- [x] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [x] Plumbing

General information

See the summary for subject Accessibility, Visitability and Adaptability of Dwelling Units.

Problem

Access to washroom facilities is essential for maintaining personal hygiene and dignity, both at home and when visiting the homes of others. The National Building Code of Canada (NBC) 2020 requires all dwelling units to have a washroom, but it does not specify the minimum requirements for clear floor space in washrooms to accommodate wheeled mobility aids. Consequently, washrooms in certain dwelling units may not provide enough clear floor space to allow a person to manoeuvre a wheeled mobility aid inside the washroom. Inadequate clear floor space can render a washroom inaccessible to persons who use wheeled mobility aids and thus make it difficult for these persons to visit friends and family and participate in their community.

Justification

This proposed change introduces minimum requirements for clear floor space in at least one washroom on the entrance level of visitable dwelling units to accommodate a wider range of wheeled mobility aids. This proposed change complements PCF 1884, which introduces requirements for providing paths of travel in normally occupied spaces on the entrance level. By providing enough clear floor space for persons using certain wheeled mobility aids to enter and leave the washroom, this proposed change would limit the probability that a person with a disability related to mobility would be unable to access this essential facility for personal hygiene.

There are two key components to this proposed change to the NBC that were largely derived from the following requirements for minimally accessible and adaptable washrooms in dwelling units in Quebec:

1. A lavatory with a centre line that is at least 460 mm from an adjacent side wall, to permit access to the lavatory; and
2. Round clear floor space having a minimum diameter of 1 500 mm, to allow a person using a wheelchair to enter the washroom, turn around and close the door.

The proposed visitable washroom would also need to comply with the proposed requirements for the reinforcement of washroom walls (for the present or future installation of grab bars), as described in PCF 2031 and PCF 1882, where applicable.

The provision of a washroom with adequate space for mobility aids on the main floor of the home is a critical feature of visitable dwellings units [1]. Older adults are less likely to visit other spaces when they are unsure about accessing a water closet [2], which highlights the importance of designing washrooms in visitable spaces to address the diverse mobility needs of Canadians. Over 4% of community-dwelling Canadians over the age of 15 regularly use some type of walking aid (e.g., walker, rollator or cane) [3], and 1% regularly use a wheeled mobility aid (e.g., wheelchair or scooter) [4]. However, the prevalence of disabilities related to mobility and the associated use of mobility aids increases with age, with over 18% of community-dwelling Canadians over the age of 75 regularly using canes or walking sticks, 14% regularly using walkers or rollators, and 4% regularly using wheelchairs or scooters [3, 4]. As such, many Canadians will use assistive aids for mobility at some point in their lives and will require larger spaces for access to washrooms and other essential building facilities while using these devices.

The importance of designing homes to support visiting is highlighted by the severe health consequences of social isolation and loneliness. A recent Canadian study revealed that social isolation and loneliness are comparable to smoking, obesity, alcohol consumption and frailty in terms of elevating the risk for poor health and mortality in older adults [5]. Promoting visits from others to the home is an established strategy for reducing isolation and loneliness [6] and the associated health consequences.

This proposed change should be considered within the context of:

- PCF 1884, which prescribes requirements for a path of travel from the entrance of the dwelling unit to all other normally occupied rooms on the entrance level;
- PCF 2031, which describes the proposed requirement for the reinforcement of washroom walls around water closets (for the present or

  future installation of grab bars), and with which the visitable dwelling unit would also need to comply; and
- PCF 1882, which describes the proposed requirement for the reinforcement of washroom walls around bathtubs and showers for the present or future installation of grab bars.
    - Although bathtubs and showers are not required in a visitable washroom, bathtubs and showers would need to be equipped with reinforcement when provided, notwithstanding the exemptions listed in PCF 1882.

This proposed change only applies to dwelling units in multi-unit residential buildings that are required by the federal, provincial, territorial or municipal authority to be designed to be visitable. It does not apply to detached houses, semi-detached houses, houses with a secondary suite, duplexes, triplexes, town houses, row houses or boarding houses.

PROPOSED CHANGE

[3.8.] 3.8. Accessibility

(See Note A-3.8.)

[3.8.5.] -- Visitable Dwelling Units

[3.8.5.1.] --- Path of Travel and Doors and Doorways (PCF 1884)

[3.8.5.2.] --- Washrooms

[1] --) At least one washroom on the entrance level of a visitable dwelling unit shall

[a] --) contain a water closet,

[b] --) contain a lavatory conforming to Clause 3.8.3.16.(1)(b), and

[c] --) be designed to permit a wheelchair to turn in a clear floor space not less than 1 500 mm in diameter (see Note A-3.8.5.2.(1)(c)).

Note A-3.8.5.2.(1)(c) Clear Floor Space in Visitable Washrooms.

Ideally, door swing should not encroach on the clear floor space described in Clause 3.8.5.2.(1)(c).

Impact analysis

This proposed change only applies to dwelling units in multi-unit residential buildings that are required by the province or territory to be designed in accordance with visitable dwelling unit requirements. Each province or territory may handle the application of visitability requirements differently, which can take the form of

- requiring a certain percentage of dwelling units in multi-unit residential buildings to comply (similar to how the barrier-free requirements are handled in Ontario, Nova Scotia and New Brunswick);
- requiring certain types or sizes of units to comply (e.g., focusing on larger units while exempting studio apartments under a certain size); or
- other policy approaches to meet the unique needs of the relevant province or territory.

Given the above:

- This proposed change does not affect houses.
- This proposed change does not affect dwelling units exempted from complying with the visitability requirements in the relevant federal, provincial, territorial or municipal authority.
- The impact of the proposed change depends entirely on the policy decisions of the relevant federal, provincial, territorial or municipal authority and will be larger in provinces and territories that choose to apply the visitability requirements to a larger percentage of dwelling units.

Impact on space and costs

To meet the minimum requirements for a washroom that conforms to this proposed change (i.e., spatial requirements for a lavatory and adequate clear floor space for a wheelchair to turn), approximately 3.4 m^2 of space will be needed (excluding the bathtub/shower). Space use across the unit may be more efficient if a shower, bathtub or bathtub/shower combination is integrated into the visitable washroom, which would occupy approximately 4.5 m^2 with a standard bathtub/shower combination. More efficient use of space can also be achieved by using smaller fixtures and altering the layout of the unit. Installing a curbless shower would also allow the shower area to count toward the clear floor space.

Given the spatial requirements above, the impact of this proposed change will differ based on the province or territory.

In the Ontario Building Code, washrooms are required to have "enough space" for the lavatory, the water closet and a shower stall or bath, which "could be as little as 3.0 m^2" [7]. Other provinces and territories do not appear to have minimum requirements for washroom sizes in multi-unit residential buildings that may be affected by this proposed change. As these dwelling units presumably also require enough space for washroom fixtures, Ontario's minimum space requirements for washrooms provide a reasonable benchmark for provinces and territories outside of Quebec. For layouts that only provide the minimum required space for washrooms (and assuming that they include a bathtub or bathtub/shower combination), this proposed change would represent a 1.5 m^2 increase to the minimum area of a washroom as a conservative estimate.

In Quebec, requirements similar to this proposed change are already partially in place for all dwelling units in multi-unit residential buildings, as part of the minimally accessible and adaptable dwelling unit requirements in the Quebec Construction Code. However, the Quebec Construction Code also permits alternatives to the proposed round clear floor space (1 500 mm in diameter) via rectangular clear floor spaces that are 1 200 mm × 1 400 mm surrounding the water closet and 750 mm × 1 200 mm in front of a lavatory. These alternative designs were not included in this proposed change because they may not permit several types of modern wheelchairs to turn inside the washroom and close the door. This proposed change would therefore (a) reduce flexibility in design for the visitable washroom in multi-unit residential buildings and (b) increase the minimum clear floor space required for units that would have used the rectangular alternatives rather than the round clear floor space.

Table 1 presents the average cost per square metre for the new construction of multi-unit residential buildings in certain metropolitan areas in Canada (all numbers represent the average costs in each metropolitan area and have been converted from the cost per square foot to the cost per square metre).

Table 1. Estimated Average Construction Costs for New Multi-Unit Residential Buildings by Metropolitan Area, \$/m^2

	Cost by Location, \$/m^2								
Condominiums/Apartments	**Vancouver**	**Calgary**	**Edmonton**	**Winnipeg**	**GTA(1)**	**Ottawa/Gatineau**	**Montréal**	**Halifax**	**St. John's**
12 or fewer storeys	3,713.55	3,121.54	3,121.54	3,121.54	3,525.18	3,390.63	2,798.62	2,341.15	2,394.97
13 to 39 storeys	3,928.83	3,229.17	3,229.17	3,202.26	3,525.18	3,552.09	2,852.44	2,448.79	N/A(2)
40 to 60 storeys	4,090.29	3,282.99	3,282.99	3,256.08	3,875.01	3,740.46	3,040.81	N/A	N/A
More than 60 storeys	4,440.11	N/A	N/A	N/A	4,278.66	4,224.84	N/A	N/A	N/A
Wood-Frame Construction(3)									
6 or fewer storeys	3,202.26	2,475.70	2,475.70	2,475.70	3,040.81	2,341.15	2,125.87	1,802.96	1,910.59

Source: Altus Group. (2023). “Canadian cost guide for construction.” go.altusgroup.com/canadian-cost-guide-2023
Notes to Table 1:

(1) GTA = Greater Toronto Area
(2) N/A = not available
(3) Condo only.

Table 2 presents the estimated cost increase per unit based on the costs in Table 1. Note the following:

- For metropolitan areas outside of Quebec, the cost estimates are based on the increase to the minimum washroom size (approximately 1.5 m^2), assuming current minima are 3 m^2 and would increase to 4.5 m^2, multiplied by the cost per square metre of new residential construction.
- Gatineau and Montréal are excluded from the cost analysis because this proposed change has already largely been implemented in Quebec. The greatest consequence of this proposed change to these centres is a loss of flexibility in design by removing the rectangular clear floor area alternatives.
- The cost increases represent an approximate worst-case scenario where the washroom is designed to meet the minimum spatial requirements. However, several residential washrooms are designed to include more space (exceeding the minimum requirements); in these cases, the impacts of this proposed change would be lower.
- Certain provinces and territories outside of Quebec have already implemented barrier-free requirements for a percentage of dwelling units that include larger washrooms, such as Ontario’s requirement that 15% of units in large apartment buildings have the same turning circle for a wheelchair as proposed in Clause 3.8.5.1.(1)(c)–2025.

Table 2: Estimated Cost Increase per Dwelling Unit with an Increased Washroom Size Relative to the Minimum Spatial Requirements for Washrooms by Metropolitan Area

	Cost by Location, $(1)							
Condominiums/Apartments	**Vancouver**	**Calgary**	**Edmonton**	**Winnipeg**	**GTA(2)**	**Ottawa**	**Halifax**	**St. John's**
12 or fewer storeys	5,570	4,682	4,682	4,682	5,288	5,086	3,512	3,592
13 to 39 storeys	5,893	4,844	4,844	4,803	5,288	5,328	3,673	N/A(3)
40 to 60 storeys	6,135	4,924	4,924	4,884	5,813	5,611	N/A	N/A
More than 60 storeys	6,660	N/A	N/A	N/A	6,418	6,337	N/A	N/A
Wood-Frame Construction(4)								
6 or fewer storeys	4,803	3,714	3,714	3,714	4,561	3,512	2,704	2,866

Notes to Table 2:

(1) All costs rounded to the nearest dollar.
(2) GTA = Greater Toronto Area
(3) N/A = not available
(4) Condo only.

It should be noted that an occupant of a visitable dwelling unit could choose to use the proposed larger space in the washroom for other purposes (assuming that the space is not always needed for accessibility purposes), such as for temporary storage.

Impact on visitability and accessibility

This proposed change is expected to permit access to a water closet in dwelling units designated as visitable for users of a large range of mobility aids. Irrespective of whether users of these mobility aids live in the dwelling unit or are visiting, being able to access a water closet is essential for personal hygiene, dignity and avoiding the consequences of incontinence. Alterations to expand the size of washrooms within multi-unit residential buildings are challenging (if not impossible, in many cases), highlighting the importance of providing adequate space in the washroom to use mobility aids when the unit is first built. Should the health circumstances of the owner change, such that the owner (or another frequent occupant) requires additional space or support in the washroom, the visitable washroom may minimize the need for renovations to address their needs.

This proposed change is also expected to benefit caregivers of persons with mobility disabilities who may need to provide assistance in the washroom. Inadequate space around the water closet makes it difficult (if not often impossible) for caregivers to use sound ergonomic practices when assisting others with toileting [8], and providing a larger washroom may help to reduce the risk of musculoskeletal injury in this cohort.

References

[1] Canadian Centre on Disability Studies, via the Canadian Mortgage and Housing Corporation. (2017). "Barriers and enablers to the uptake of VisitAble housing in Canada: Stakeholder perceptions." Retrieved March 8, 2023 from: https://eppdscrmssa01.blob.core.windows.net/cmhcprodcontainer/sf/project/archive/research_2/barriers_and_enablers_jul5_corrected.pdf

[2] Glover, L., Dyson, J., Cowdell, F., and Kinsey, D. (2020). Healthy ageing in a deprived northern UK city: A co-creation study. *Health & Social Care in the Community*, *28*(6), 2233–2242.

[3] Charette, C., Best, K. L., Smith, E. M., Miller, W. C., and Routhier, F. (2018). Walking aid use in Canada: Prevalence and demographic characteristics among community-dwelling users. *Physical Therapy*, *98*(7), 571–577.

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[5] Freedman, A., and Nicolle, J. (2020). Social isolation and loneliness: The new geriatric giants: Approach for primary care. *Canadian Family Physician*, *66*(3), 176–182.

[6] Dickens, A. P., Richards, S. H., Greaves, C. J., and Campbell, J. L. (2011). Interventions targeting social isolation in older people: A systematic review. *BMC Public Health*, *11*(1), 1–22.

[7] Government of Ontario. (2019). "Building code requirements." Retrieved November 15, 2023 from: https://www.ontario.ca/document/build-or-buy-tiny-home/building-code-requirements

[8] King, E. C., Boscart, V. M., Weiss, B. M., Dutta, T., Callaghan, J. P., and Fernie, G. R. (2019). Assisting frail seniors with toileting in a home bathroom: Approaches used by home care providers. *Journal of Applied Gerontology*, *38*(5), 717–749.

Enforcement implications

This proposed change could be enforced using visual inspection and a tape measure. Authorities having jurisdiction would need to be aware of this proposed change, as well as the scale of its local application (i.e., whether the particular dwelling unit needs to comply with visitability requirements).

Who is affected

Occupants of visitable units (whether they live in the unit or are visiting) would have improved access to a water closet, especially if they use a mobility aid.

Designers and builders would need to be aware of the requirement for a washroom on the entry level of a visitable dwelling unit.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.8.1.1.] **3.8.1.1. ([1] 1) no attributions**

[3.8.1.1.] **3.8.1.1. ([2] 2) no attributions**

[3.8.2.1.] **3.8.2.1. ([1] 1) no attributions**

[3.8.2.2.] **3.8.2.2. ([1] 1) [F73-OA1]**

[3.8.2.2.] **3.8.2.2. ([2] 2) no attributions**

[3.8.2.2.] **3.8.2.2. ([3] 3) no attributions**

[3.8.2.2.] **3.8.2.2. ([4] 4) [F73-OA1]**

[3.8.2.3.] **3.8.2.3. ([1] 1) [F73-OA1]**

[3.8.2.3.] **3.8.2.3. ([2] 2) no attributions**

[3.8.2.3.] **3.8.2.3. ([3] 3) [F74-OA2]**

[3.8.2.3.] **3.8.2.3. ([4] 4) [F74-OA2]**

[3.8.2.3.] **3.8.2.3. ([5] 5) [F74-OA2]**

[3.8.2.3.] **3.8.2.3. ([5] 5) [F10-OS3.7]** Applies to portion of Code text: "... each row of seats served by two aisles shall have one adaptable seat conforming to Subsection 3.8.3. located adjacent to one of the aisles."

[3.8.2.3.] **3.8.2.3. ([6] 6) [F74-OA2]**

[3.8.2.4.] **3.8.2.4. ([1] 1) [F73-OA1]**

[3.8.2.4.] **3.8.2.4. ([2] 2) [F73-OA1]**

[3.8.2.5.] **3.8.2.5. ([1] 1) [F73-OA1]**

[3.8.2.5.] **3.8.2.5. ([2] 2) [F73-OA1]**

[3.8.2.5.] **3.8.2.5. ([3] 3) no attributions**

[3.8.2.6.] **3.8.2.6. ([1] 1) no attributions**

[3.8.2.7.] **3.8.2.7. ([1] 1) [F73-OA1]**

[3.8.2.7.] **3.8.2.7. ([2] 2) no attributions**

[3.8.2.7.] **3.8.2.7. ([3] 3) no attributions**

[3.8.2.8.] **3.8.2.8. ([1] 1) [F74-OA2]**

[3.8.2.8.] **3.8.2.8. ([1] 1) [F72-OH2.1] [F71-OH2.3]**

[3.8.2.8.] **3.8.2.8. ([2] 2) [F74-OA2]**

[3.8.2.8.] **3.8.2.8. ([2] 2) [F72-OH2.1] [F71-OH2.3]**

[3.8.2.8.] **3.8.2.8. ([2] 2) no attributions**

[3.8.2.8.] **3.8.2.8. ([3] 3) no attributions**

[3.8.2.8.] **3.8.2.8. ([4] 4) [F72-OH2.1]**

[3.8.2.8.] **3.8.2.8. ([4] 4) [F73-OA1]**

[3.8.2.8.] **3.8.2.8. ([5] 5) no attributions**

[3.8.2.8.] **3.8.2.8. ([6] 6) no attributions**

[3.8.2.8.] **3.8.2.8. ([7] 7) no attributions**

[3.8.2.8.] **3.8.2.8. ([8] 8) no attributions**

[3.8.2.8.] **3.8.2.8. ([9] 9) no attributions**

[3.8.2.8.] **3.8.2.8. ([10] 10) no attributions**

[3.8.2.8.] 3.8.2.8. ([11] 11) no attributions

[3.8.2.8.] 3.8.2.8. ([12] 12) no attributions

[3.8.2.8.] 3.8.2.8. ([13] 13) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([13] 13) no attributions

[3.8.2.8.] 3.8.2.8. ([14] 14) no attributions

[3.8.2.8.] 3.8.2.8. ([15] 15) no attributions

[3.8.2.8.] 3.8.2.8. ([15] 15) [F74-OA2]

[3.8.2.9.] 3.8.2.9. ([1] 1) no attributions

[3.8.2.9.] 3.8.2.9. ([2] 2) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([1] 1) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([1] 1) no attributions

[3.8.2.10.] 3.8.2.10. ([2] 2) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([3] 3) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([3] 3) no attributions

[3.8.2.10.] 3.8.2.10. ([4] 4) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([4] 4) no attributions

[3.8.2.11.] 3.8.2.11. ([1] 1) [F74-OA2]

[3.8.2.11.] 3.8.2.11. ([1] 1) no attributions

[3.8.2.12.] 3.8.2.12. ([1] 1) [F74-OA2]

[3.8.2.12.] 3.8.2.12. ([1] 1) no attributions

[3.8.3.1.] 3.8.3.1. ([1] 1) no attributions

[3.8.3.2.] 3.8.3.2. ([1] 1) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([2] 2) no attributions

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([4] 4) no attributions

[3.8.3.2.] 3.8.3.2. ([5] 5) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([6] 6) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F30-OS3.1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([c] c)

[3.8.3.3.] 3.8.3.3. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([a] a) [F74-OA2]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([c] c) [F74-OA2]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([e] e),([f] f)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([a] a)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([2] 2) no attributions

[3.8.3.5.] 3.8.3.5. ([3] 3) no attributions

[3.8.3.5.] 3.8.3.5. ([4] 4) ([a] a) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([4] 4) ([b] b),([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([5] 5) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([1] 1) no attributions

[3.8.3.6.] 3.8.3.6. ([2] 2) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([6] 6) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([7] 7) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([8] 8) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([9] 9) no attributions

[3.8.3.6.] 3.8.3.6. ([10] 10) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([10] 10) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([10] 10) no attributions

[3.8.3.6.] 3.8.3.6. ([11] 11) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([13] 13) no attributions

[3.8.3.6.] 3.8.3.6. ([14] 14) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([15] 15) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([16] 16) no attributions

[3.8.3.6.] 3.8.3.6. ([17] 17) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([17] 17) [F10-OS3.7]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F73-OA1]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F74-OA2]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F74-OA2]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F10-OS3.7]

[3.8.3.9.] 3.8.3.9. ([1] 1) no attributions

[3.8.3.9.] 3.8.3.9. ([1] 1) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([1] 1) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F73-OA1]

[3.8.3.10.] 3.8.3.10. ([1] 1) [F74-OA2]

[3.8.3.10.] 3.8.3.10. ([2] 2) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([1] 1) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([2] 2) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F72-OH2.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([d] d)([i] i) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f),([g] g) [F30,F20-OS3.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f) and ([g] g)

[3.8.3.12.] 3.8.3.12. ([1] 1) ([h] h) [F30-OS3.1] Applies to portion of Code text: "… be equipped with a coat hook … projecting not more than 50 mm from the wall …"

[3.8.3.12.] 3.8.3.12. ([1] 1) no attributions

[3.8.3.13.] **3.8.3.13. ([1] 1) [F74-OA2]**

[3.8.3.13.] **3.8.3.13. ([1] 1) ([b] b) [F10-OS3.7]**

[3.8.3.13.] **3.8.3.13. ([1] 1) ([c] c)**

[3.8.3.13.] **3.8.3.13. ([1] 1) ([d] d)**

[3.8.3.13.] **3.8.3.13. ([1] 1) ([f] f)**

[3.8.3.13.] **3.8.3.13. ([1] 1) ([g] g) [F30-OS3.1]** Applies to the requirement for a coat hook.

[3.8.3.13.] **3.8.3.13. ([1] 1) ([i] i) [F74-OA2]** Applies to the requirement for a shelf.

[3.8.3.13.] **3.8.3.13. ([1] 1) [F72-OH2.1] [F71-OH2.3]**

[3.8.3.13.] **3.8.3.13. ([1] 1) ([b] b) [F74-OA2]** Applies to portion of Code text: "… a door ... capable of being locked from the inside …"

[3.8.3.13.] **3.8.3.13. ([2] 2) [F72-OH2.1] [F71-OH2.3]**

[3.8.3.14.] **3.8.3.14. ([1] 1) [F74-OA2]**

[3.8.3.14.] **3.8.3.14. ([1] 1) [F72-OH2.1]**

[3.8.3.15.] **3.8.3.15. ([1] 1) [F74-OA2]**

[3.8.3.15.] **3.8.3.15. ([1] 1) ([d] d) [F30-OS3.1]**

[3.8.3.15.] **3.8.3.15. ([1] 1) ([a] a)**

[3.8.3.15.] **3.8.3.15. ([2] 2) [F74-OA2]**

[3.8.3.15.] **3.8.3.15. ([2] 2) ([f] f) [F30-OS3.1]**

[3.8.3.15.] **3.8.3.15. ([2] 2) ([c] c)**

[3.8.3.16.] **3.8.3.16. ([1] 1) [F74-OA2]**

[3.8.3.16.] **3.8.3.16. ([1] 1) [F71-OH2.3]**

[3.8.3.16.] **3.8.3.16. ([1] 1) ([f] f) [F31-OS3.2]**

[3.8.3.16.] **3.8.3.16. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([1] 1) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([d] d),([e] e) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([f] f) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([h] h) [F31-OS3.2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F71-OH2.3]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([a] a) [F73-OA1]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F10-OS3.7]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([g] g) [F74-OA2]**

[3.8.3.18.] **3.8.3.18. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F11-OS3.7]**

[3.8.3.19.] **3.8.3.19. ([2] 2) [F74-OA2]**

[3.8.3.20.] **3.8.3.20. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F30-OS3.1]** Applies to portion of Code text: "… level … level and have removable seats, …"

[3.8.3.22.] **3.8.3.22. ([1] 1) ([d] d) [F10-OS3.7]** Applies to portion of Code text: "… without infringing on egress from any row of seating or any aisle requirements …"

[3.8.3.22.] **3.8.3.22. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([2] 2) [F30-OS3.1]** Applies to portion of Code text: "… level, ..."

[3.8.3.22.] **3.8.3.22. ([3] 3) ([a] a) [F10-OS3.7]** Applies to portion of Code text: "… without infringing on egress from any row of seating or any aisle requirements …"

[3.8.3.22.] **3.8.3.22. ([3] 3) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([4] 4) [F10-OS3.7]**

[3.8.5.2.] -- ([1] --) [F71-OA2] [F73-OA1] [F71-OH2.3]

[3.8.5.2.] -- ([1] --) [F74-OA2] [F72-OA2] [F72-OH2.3]

Submit a comment

Proposed Change 2031

Code Reference(s):	**NBC20 Div.B 3.8. (first printing)**
Subject:	Accessibility, Visitability and Adaptability of Dwelling Units
Title:	Reinforcing Stud Walls in Washrooms for the Future Installation of Grab Bars: Water Closets
Description:	This proposed change prescribes the reinforcement of walls around water closets in dwelling units for the future installation of grab bars.
Related Proposed Change(s):	PCF 1882, PCF 1884, PCF 1958, PCF 2030

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [x] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [x] Division B
- [x] Design and Construction
- [x] Housing
- [x] Large Buildings
- [x] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

General information

See the summary for subject Accessibility, Visitability and Adaptability of Dwelling Units.

Problem

Approximately 10% of Canadians have a disability related to balance and walking, including 9% of Canadians aged 35 years old to 64 years old, and 25% of Canadians over 65 years old [1]. The prevalence of disabilities related to mobility increases with age, being reported in most adults over 80 years old [2]. Thus, most Canadians will need balance and mobility assistance at some point in their lives. Strategies are needed to allow Canadians to easily and affordably retrofit their homes to accommodate their evolving health status and live at home for as long as possible.

Grab bars are the most common device used to improve the safety and accessibility of Canadians with disabilities related to mobility, used by 38% of this population [1]. Grab bars are typically installed near bathtubs and showers to prevent falls for persons with and without disabilities [3]. However, the National Building Code of Canada (NBC) 2020 makes it difficult to retrofit bathrooms with grab bars, which generally need to be mounted onto studs or other reinforcement behind outer wall materials to meet the NBC requirements for structural strength. This situation causes the following two problems for occupants who wish to install grab bars:

1. The range of locations where grab bars can be installed while meeting the NBC requirements for structural strength is limited because the NBC only requires studs to be spaced up to 400 mm to 600 mm apart in most interior bathrooms. This requirement makes it difficult to position grab bars in a way that allows a person with a disability related to balance or mobility to access and use the washroom facilities.
2. The narrow width of the studs (often less than 40 mm) allows little room for error in positioning the grab bar to ensure that all of the mounting screws penetrate the stud to meet the structural strength requirements. Slight misalignments in the wall studs may make it impossible to install grab bars properly. Loading improperly installed grab bars may cause the bar to detach from the wall and cause a fall or injury to users.

Justification

This proposed change introduces a requirement to install reinforcement to stud walls around the water closet in washrooms to support the potential installation of grab bars and similar fixtures. By reinforcing stud walls in washrooms, this proposed change addresses the following major barriers to grab bar installations:

- Increasing the range of locations where grab bars can be installed while still meeting NBC requirements for structural strength would allow an occupant to customize the location of grab bars to meet the occupant’s individual needs for balance and mobility. This proposed change would limit the probability that users with a disability related to mobility would be unable to install a grab bar in a position that allows them to safely and easily use washroom facilities.
- Facilitating the proper installation of grab bars would make them more likely to meet the NBC requirements for structural strength. This proposed change would limit the probability of grab bars detaching from walls during use and resulting in falls or injuries to users.

The proposed change expands on existing requirements for reinforcement to washroom walls in Nova Scotia, Ontario, British Columbia and Alberta by prescribing the area around the wall where reinforcement is required, similar to the approach already adopted in Quebec and is expected to simplify the application of this proposed change.

A central element of this proposed change addresses the need for flexibility in the locations on the wall where grab bars can be installed and customized to individual needs, while minimizing the demands on the occupant installing grab bars in the future to be aware of the exact location of the wall that is reinforced. To that end, this proposed change expands on existing requirements for reinforcement to washroom walls in most provinces and territories (except for Quebec) by prescribing a larger area of wall coverage to support common applications of grab bars in private dwellings (which go beyond bar configurations to support wheelchair or bench transfers in public spaces). Also, this proposed change better addresses the vast range of washroom configurations in dwellings, where it is not always physically possible to install grab bars in the same locations recommended for public spaces because the washroom is too small. The proposed range includes:

1. A larger area of side wall coverage by the water closet (i.e., toilet) to permit custom installations of diagonal and vertical grab bars, which were preferred by older adults with various disabilities related to mobility when using grab bars to transfer onto and off of the water closet (4).
2. Coverage behind the water closet to install grab bars in locations in accordance with common accessibility standards (e.g., CSA B651, "Accessible design for the built environment").

It should be noted that this proposed change focuses on prescribing an area for wall coverage around the water closet. It should be considered in conjunction with the following two proposed changes:

- PCF 1882, which prescribes the area for wall coverage around bathtubs and showers, and
- PCF 2030, which provides a performance requirement and compliance options for the reinforcement material and method of mounting to the studs, such that the material supports grab bars complying with the NBC requirements for structural strength of resisting 1.3 kN horizontally and vertically (Sentence 9.1.2.3.(1))

PROPOSED CHANGE

NBC20 Div.B 3.8. (first printing)

[3.8.] 3.8. Accessibility

(See Note A-3.8.)

[3.8.1.] 3.8.1. Scope

[3.8.1.1.] 3.8.1.1. Scope

[3.8.2.] 3.8.2. Application

[3.8.2.1.] 3.8.2.1. Exceptions

[3.8.2.2.] 3.8.2.2. Entrances

[3.8.2.3.] 3.8.2.3. Areas Requiring a Barrier-Free Path of Travel

[3.8.2.4.] 3.8.2.4. Access to Storeys Served by Escalators and Moving Walks

[3.8.2.5.] 3.8.2.5. Exterior Barrier-Free Paths of Travel to Building Entrances and Exterior Passenger-Loading Zones

[3.8.2.6.] 3.8.2.6. Controls

[3.8.2.7.] 3.8.2.7. Power Door Operators

[3.8.2.8.] 3.8.2.8. Plumbing Facilities

[3.8.2.9.] 3.8.2.9. Assistive Listening Systems

[3.8.2.10.] 3.8.2.10. Signs and Indicators

[3.8.2.11.] 3.8.2.11. Counters

[3.8.2.12.] 3.8.2.12. Telephones

[3.8.3.] 3.8.3. Design

[3.8.3.1.] 3.8.3.1. Design Standards

[3.8.3.2.] 3.8.3.2. Barrier-Free Path of Travel

[3.8.3.3.] 3.8.3.3. Exterior Walks

[3.8.3.4.] 3.8.3.4. Exterior Passenger-Loading Zones

[3.8.3.5.] 3.8.3.5. Ramps

[3.8.3.6.] 3.8.3.6. Doorways and Doors

[3.8.3.7.] 3.8.3.7. Passenger-Elevating Devices

[3.8.3.8.] 3.8.3.8. Controls

[3.8.3.9.] 3.8.3.9. Accessible Signs

[3.8.3.10.] 3.8.3.10. Drinking Fountains

[3.8.3.11.] 3.8.3.11. Water-Bottle Filling Stations

[3.8.3.12.] 3.8.3.12. Accessible Water-Closet Stalls

[3.8.3.13.] 3.8.3.13. Universal Washrooms

[3.8.3.14.] 3.8.3.14. Water Closets

[3.8.3.15.] 3.8.3.15. Water-Closet Stalls and Urinals for Persons with Limited Mobility

[3.8.3.16.] 3.8.3.16. Lavatories and Mirrors

[3.8.3.17.] 3.8.3.17. Showers

[3.8.3.18.] 3.8.3.18. Accessible Bathtubs

[3.8.3.19.] 3.8.3.19. Assistive Listening Systems

[3.8.3.20.] 3.8.3.20. Counters

[3.8.3.21.] 3.8.3.21. Telephones

[3.8.3.22.] 3.8.3.22. Spaces in Seating Area

[3.8.4.] -- Dwelling Units

[3.8.4.1.] --- Entrance Doorway Width

[3.8.4.2.] --- Walls around Water Closets

(See Note A-3.8.4.2. and 3.8.4.3.-2025 (PCF 1882).)

[1] --) Stud walls around water closets shall be reinforced to support the present or future installation of grab bars in accordance with Sentence 9.31.2.3.(2)-2025 (PCF 2030).

[2] --) Except as provided in Sentences (3) to (5), the reinforcement of stud walls around water closets required by Sentence (1) shall cover a minimum area that

[a] --) on the side walls, extends horizontally from the rear wall to 1 600 mm beyond the rear wall and vertically from 690 mm to 1 630 mm above the finished floor, and

[b] --) on the rear wall, on both sides of the water closet, extends horizontally from 200 mm to 600 mm beyond the centre line of the water closet and vertically from 690 mm and 960 mm above the

finished floor. (See Note A-3.8.4.2.(2)(b).)

(See Note A-3.8.4.2.(2).)

[3] --) Where the horizontal length of the side wall is greater than 400 mm but less than 1 600 mm, the reinforcement described in Clause (2)(a) need only extend to the end of the wall.

[4] --) Where the horizontal length of the side wall is 400 mm or less, the reinforcement described in Clause (2)(a) is not required.

[5] --) Where the side wall is located more than 600 mm from the centre line of the water closet, the reinforcement described in Clause (2)(a) is not required.

Note A-3.8.4.2. and 3.8.4.3. Reinforcing Walls in Washrooms.

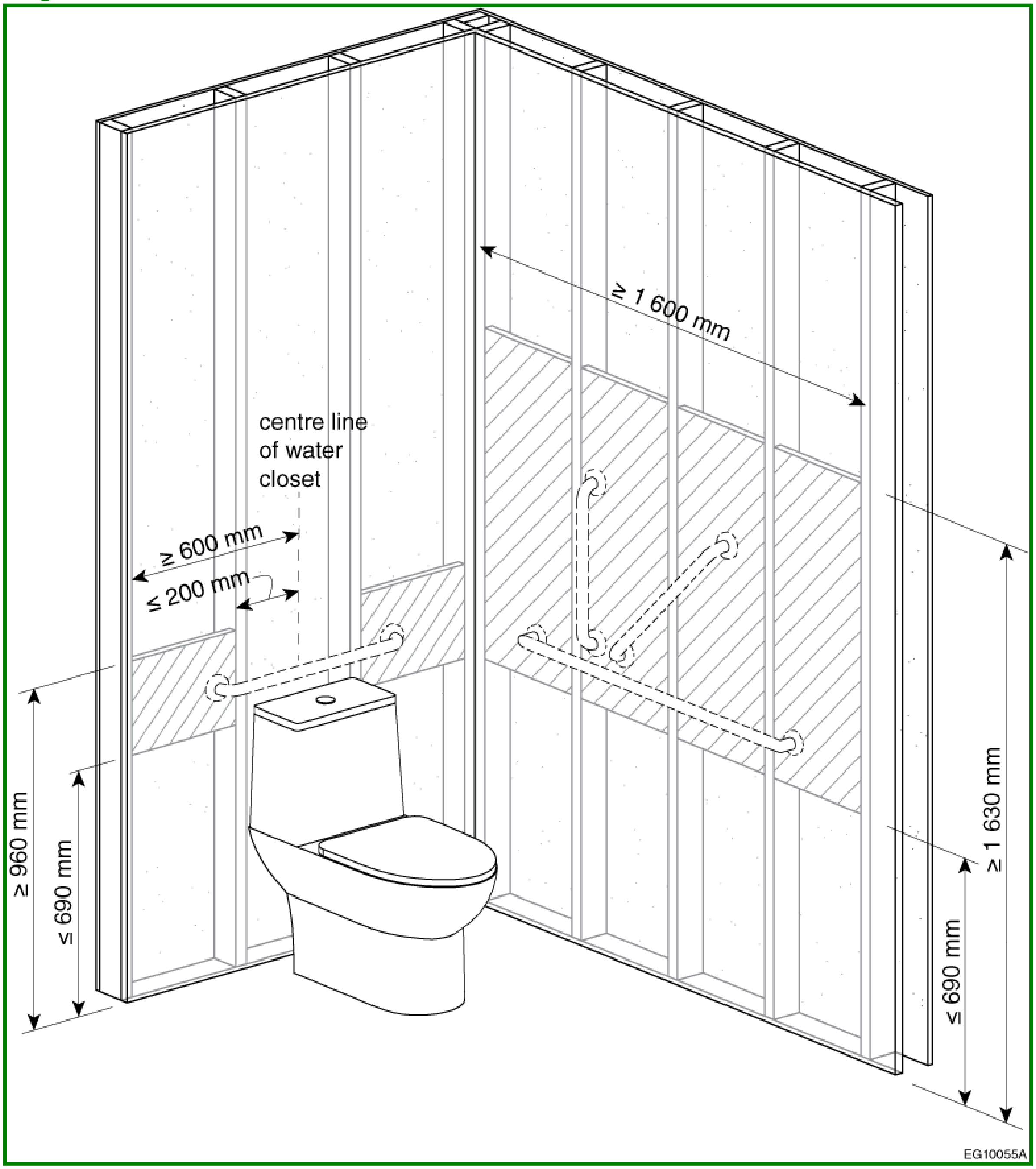
Reinforcing larger portions of washroom walls than required by Articles 3.8.4.2. and 3.8.4.3.-2025 (PCF 1882) will provide occupants with more flexibility to install grab bars to meet their evolving needs. However, reinforcement on its own does not address accessibility or safety without the installation of grab bars.

Note A-3.8.4.2.(2) Reinforcement of Walls around Water Closets.

Where two side walls are within 600 mm of the centre line of the water closet, both side walls are intended to be reinforced for the present or future installation of grab bars.

Figure A-3.8.4.2.(2) illustrates an example of an acceptable configuration for the reinforcement of stud walls around a water closet. Possible grab bar configurations are also shown.

Figure [A-3.8.4.2.(2)]
Example of an acceptable configuration for the reinforcement of stud walls around a water closet, where the horizontal length of the side wall is equal to or greater than 1 600 mm



Note A-3.8.4.2.(2)(b) Reinforcement of Wall Behind Water Closets.

The reinforcement described in Clause 3.8.4.2.(2)(b) is not designed to support fold-down grab bars.

Impact analysis

Impact on Flexibility of Design

This proposed change is expected to improve design flexibility for homeowners by increasing the range of locations where grab bars can be installed around the water closet to meet individual accessibility and safety needs while still meeting the NBC requirements for structural strength.

Financial Impact

The financial impact of the proposed change depends on whether the jurisdiction already requires the reinforcement of washroom walls in some form, though in general the proposed change would increase the initial cost of construction. The cost estimates below are based on the compliance options described in PCF 2030. For designers who choose to use the performance-based option and demonstrate that their material, thickness and attachment combination would allow the installation of grab bars to meet the NBC requirements for structural strength, the costs would be different.

Table 1 presents a breakdown of the cost estimates. The length of the side wall is assumed to be 1 600 mm; where the wall is shorter, costs will be lower. For the wall behind the water closet, reinforcement (i.e., blocking) is assumed to span between two studs, though a larger area of coverage (1 200 mm wide × 2 400 mm high) is assumed for the sheathing option. For sheathing, the cost estimates assume that two 12.7 mm thick panels of plywood are fastened together with adhesive to achieve the required 25.4 mm thickness.

Table 1. Breakdown of Cost Estimates

Wall of Interest	Cost of Solid Lumber	Cost of Sheathing
Side Wall	~$110–$120 (assume a 4 × 4 grid of 38 mm × 235 mm studs)	~$240–$260 (assume 4 panels of 1 200 mm × 2 400 mm plywood @ 12.7 mm thick, fastened together to create 2 panels of 1 200 mm × 2 400 mm plywood @ 25.4 mm thick covering an area less than or equal to 2 400 × 2 400 mm; costs will be higher where the side wall is longer or higher)
Rear Wall	~$15–$20 (assume 2 mm x 38 mm × 286 mm studs with a length of 400 mm)	~$120–$130 (assume 2 panels of 1 200 mm × 2 400 mm plywood @ 12.7 mm thick fastened together to cover an area of 1 200 mm × 2 400 mm) + additional material, labour, overhead and profit to make the entire wall flush with the reinforced area

Where washroom walls beside the water closet are shorter, the cost will be lower to reflect that a lower wall area is being reinforced. The material costs may also be lower in situations where spare material is available on construction sites. These cost estimates are based on RSMeans data for the Greater Ottawa Region for 2022 and account for materials, labour, overhead and profit.

- solid lumber (38 mm × 235 mm stud) with pneumatic nails: $18.27/linear m

- solid lumber (38 mm × 286 mm stud) with pneumatic nails: $21.72/linear m
- plywood (12.7 mm thick) with screws: $20.77/m^2

The proposed change applies to new constructions. For owners that install grab bars in the future, the proposed change is expected to result in cost savings relative to the cost of current NBC requirements for two major reasons:

1. To retrofit washroom walls with reinforcement to permit grab bar installation around the water closet, components of the existing wall would potentially need to be removed and replaced. Thus, the costs would include not only that of reinforcement, but also that of replacing the other components of the wall (e.g., drywall, where applicable).
2. To retrofit a washroom with grab bars, many older adults rely on professional contractors to ensure that the bars are correctly mounted to the studs of the wall. This process can cost over $1 000, depending on the number of bars being installed. This discourages many older adults from installing grab bars when they would like to [5]. By reducing the complexity of the installation of grab bars, some homeowners may be able to install them without requiring a professional contractor. Even for those who hire a professional contractor, the pre-installed reinforcement would reduce the complexity (and potentially the cost) of installing grab bars.

Impact on Spatial Requirements for Washrooms

The proposed change is not expected to impact the spatial requirements for washrooms where solid lumber is used as the material. In contexts where sheathing is installed between wall studs and drywall, the available space in the washroom will be reduced by 25.4 mm (1 in.) per wall face that is reinforced.

Impact on Accessibility

The proposed change does not impact immediate-term accessibility because it does not require individuals to install grab bars. However, over the life cycle of a dwelling unit, the proposed change would provide more flexibility for individuals who retrofit their washrooms with grab bars and similar fixtures in locations that improve the safety of mobility for a diverse range of user anthropometries and needs. At present, grab bars only meet the NBC requirements for structural strength when mounted to stud walls, which are typically spaced 400 mm apart and can be difficult to locate. The proposed change would allow grab bars or similar balance aids to be installed at a greater range of locations on washroom walls, while still providing adequate structural strength. This will make it easier to customize the grab bar location to user anthropometry and common movement tasks.

Nearly 25% of Canadians over 65 years old, and most people over 80 years old, report experiencing a disability related to mobility [1]. Furthermore, the Canadian population over the age of 85 is expected to triple in the next 30 years [6]. Together, these factors suggest that most Canadians will need to adapt their dwelling units at some point to meet their evolving needs and that the demand for adaptable housing will increase. The proposed change helps to address this demand by making it easier for individuals to install grab bars, which are the most common assistive device used by persons with disabilities related to mobility.

Impact on Safety

The proposed change does not affect immediate-term safety or health because it does not require grab bars or any other fall-prevention device to be installed. However, for persons who decide to install grab bars in washrooms, the proposed change makes it easier and less expensive to install grab bars in accordance with the NBC requirements for structural strength.

Impact on the Provinces and Territories

The impact of the proposed change on specific provinces and territories depends on the current application of accessibility requirements to different types of dwelling units. Nova Scotia and Ontario already require reinforcement of the washroom walls around the water closet in all dwellings to support the future installation of grab bars that comply with the NBC requirements for structural strength. As well, Quebec requires reinforcement of washroom walls in individual units in multi-unit residential buildings without an explicit requirement that addresses structural strength. While the proposed change prescribes the reinforcement of a larger wall area relative to provisions in Nova Scotia and Ontario, prescriptive requirements on the location of reinforcement and its design (PCF 2030) may reduce the costs of design that otherwise needs to demonstrate that the reinforcement meets the NBC performance-based requirements for structural strength supporting grab bars.

The impact of this proposed change would be the greatest in all other provinces and territories where requirements for the reinforcement of washroom walls are not yet in place, both in terms of initial cost of construction and increased flexibility in where grab bars can be safely installed in washrooms. Harmonizing requirements across the country may help to stimulate innovation in construction methods and materials to lower the cost of this proposed change.

References

(1) Statistics Canada. (2020). Canadians with a mobility disability. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2020085-eng.htm

(2) Musich, S., Wang, S. S., Ruiz, J., Hawkins, K., & Wicker, E. (2018). The impact of mobility limitations on health outcomes among older adults. *Geriatric nursing*, 39(2), 162–169.

(3) Levine, I. C., Montgomery, R. E., & Novak, A. C. (2021). Grab bar use influences fall hazard during bathtub exit. *Human factors*. https://journals.sagepub.com/doi/abs/10.1177/00187208211059860

(4) Kennedy, M. J., Arcelus, A., Guitard, P., Goubran, R. A., & Sveistrup, H. (2015). Toilet grab-bar preference and center of pressure deviation during toilet transfers in healthy seniors, seniors with hip replacements, and seniors having suffered a stroke. *Assistive Technology*, 27(2), 78-87.

(5) Wiseman, J. M., Stamper, D. S., Sheridan, E., Caterino, J. M., Quatman-Yates, C. C., & Quatman, C. E. (2021). Barriers to the initiation of home modifications for older adults for fall prevention. *Geriatric orthopaedic surgery & rehabilitation*, *12*, 21514593211002161.

(6) Statistics Canada. (2022). Population projections for Canada (2021 to 2068), Provinces and Territories (2021 to 2043). https://www150.statcan.gc.ca/n1/pub/91-520-x/91-520-x2022001-eng.htm

Enforcement implications

This proposed change could be enforced to some extent by using existing methods in Nova Scotia, Ontario and Quebec, where changes related to the reinforcement of walls in washrooms have already been implemented in the provincial building codes.

As homeowners would not be able to see the reinforcement after construction is complete, designers or builders would need to provide the locations of where the wall has been reinforced alongside other detailed plans of the house. Details on the number and nature of fasteners used to attach the reinforcement to the wall studs would also be needed in contexts where the prescriptive options for compliance (PCF 2030) are used.

Authorities having jurisdiction would need to become familiar with the new requirements (including the expanded range where the reinforcement of washroom walls is required and the specifications for materials and thicknesses of the reinforcement) and techniques for evaluating compliance.

Who is affected

Homeowners and occupants would be able to install grab bars in a larger range of locations on washroom walls while still meeting the NBC requirements for structural strength.

Architects and designers would need to be aware of and potentially modify the design of dwelling units based on this proposed change.

Builders would need to incorporate this proposed change into the construction process for dwelling units.

Authorities having jurisdiction would need to become aware of this proposed change.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 3.8. (first printing)

[3.8.1.1.] **3.8.1.1. ([1] 1) no attributions**

[3.8.1.1.] **3.8.1.1. ([2] 2) no attributions**

[3.8.2.1.] **3.8.2.1. ([1] 1) no attributions**

[3.8.2.2.] 3.8.2.2. ([1] 1) [F73-OA1]

[3.8.2.2.] 3.8.2.2. ([2] 2) no attributions

[3.8.2.2.] 3.8.2.2. ([3] 3) no attributions

[3.8.2.2.] 3.8.2.2. ([4] 4) [F73-OA1]

[3.8.2.3.] 3.8.2.3. ([1] 1) [F73-OA1]

[3.8.2.3.] 3.8.2.3. ([2] 2) no attributions

[3.8.2.3.] 3.8.2.3. ([3] 3) [F74-OA2]

[3.8.2.3.] 3.8.2.3. ([4] 4) [F74-OA2]

[3.8.2.3.] 3.8.2.3. ([5] 5) [F74-OA2]

[3.8.2.3.] 3.8.2.3. ([5] 5) [F10-OS3.7] Applies to portion of Code text: "... each row of seats served by two aisles shall have one adaptable seat conforming to Subsection 3.8.3. located adjacent to one of the aisles."

[3.8.2.3.] 3.8.2.3. ([6] 6) [F74-OA2]

[3.8.2.4.] 3.8.2.4. ([1] 1) [F73-OA1]

[3.8.2.4.] 3.8.2.4. ([2] 2) [F73-OA1]

[3.8.2.5.] 3.8.2.5. ([1] 1) [F73-OA1]

[3.8.2.5.] 3.8.2.5. ([2] 2) [F73-OA1]

[3.8.2.5.] 3.8.2.5. ([3] 3) no attributions

[3.8.2.6.] 3.8.2.6. ([1] 1) no attributions

[3.8.2.7.] 3.8.2.7. ([1] 1) [F73-OA1]

[3.8.2.7.] 3.8.2.7. ([2] 2) no attributions

[3.8.2.7.] 3.8.2.7. ([3] 3) no attributions

[3.8.2.8.] 3.8.2.8. ([1] 1) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([1] 1) [F72-OH2.1] [F71-OH2.3]

[3.8.2.8.] 3.8.2.8. ([2] 2) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([2] 2) [F72-OH2.1] [F71-OH2.3]

[3.8.2.8.] 3.8.2.8. ([2] 2) no attributions

[3.8.2.8.] 3.8.2.8. ([3] 3) no attributions

[3.8.2.8.] 3.8.2.8. ([4] 4) [F72-OH2.1]

[3.8.2.8.] 3.8.2.8. ([4] 4) [F73-OA1]

[3.8.2.8.] 3.8.2.8. ([5] 5) no attributions

[3.8.2.8.] 3.8.2.8. ([6] 6) no attributions

[3.8.2.8.] 3.8.2.8. ([7] 7) no attributions

[3.8.2.8.] 3.8.2.8. ([8] 8) no attributions

[3.8.2.8.] 3.8.2.8. ([9] 9) no attributions

[3.8.2.8.] 3.8.2.8. ([10] 10) no attributions

[3.8.2.8.] 3.8.2.8. ([11] 11) no attributions

[3.8.2.8.] 3.8.2.8. ([12] 12) no attributions

[3.8.2.8.] 3.8.2.8. ([13] 13) [F74-OA2]

[3.8.2.8.] 3.8.2.8. ([13] 13) no attributions

[3.8.2.8.] 3.8.2.8. ([14] 14) no attributions

[3.8.2.8.] 3.8.2.8. ([15] 15) no attributions

[3.8.2.8.] 3.8.2.8. ([15] 15) [F74-OA2]

[3.8.2.9.] 3.8.2.9. ([1] 1) no attributions

[3.8.2.9.] 3.8.2.9. ([2] 2) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([1] 1) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([1] 1) no attributions

[3.8.2.10.] 3.8.2.10. ([2] 2) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([3] 3) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([3] 3) no attributions

[3.8.2.10.] 3.8.2.10. ([4] 4) [F74-OA2]

[3.8.2.10.] 3.8.2.10. ([4] 4) no attributions

[3.8.2.11.] 3.8.2.11. ([1] 1) [F74-OA2]

[3.8.2.11.] 3.8.2.11. ([1] 1) no attributions

[3.8.2.12.] 3.8.2.12. ([1] 1) [F74-OA2]

[3.8.2.12.] 3.8.2.12. ([1] 1) no attributions

[3.8.3.1.] 3.8.3.1. ([1] 1) no attributions

[3.8.3.2.] 3.8.3.2. ([1] 1) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([2] 2) no attributions

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([a] a),([b] b) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([e] e),([f] f) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([3] 3) ([c] c),([d] d) [F30-OS3.1]

[3.8.3.2.] 3.8.3.2. ([4] 4) no attributions

[3.8.3.2.] 3.8.3.2. ([5] 5) [F73-OA1]

[3.8.3.2.] 3.8.3.2. ([6] 6) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([a] a) [F30-OS3.1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.3.] 3.8.3.3. ([1] 1) ([c] c)

[3.8.3.3.] 3.8.3.3. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([a] a) [F74-OA2]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([b] b) [F73-OA1]

[3.8.3.4.] 3.8.3.4. ([1] 1) ([c] c) [F74-OA2]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([d] d) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([e] e),([f] f)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([b] b),([e] e) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([1] 1) ([a] a)

[3.8.3.5.] 3.8.3.5. ([1] 1) ([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([2] 2) no attributions

[3.8.3.5.] 3.8.3.5. ([3] 3) no attributions

[3.8.3.5.] 3.8.3.5. ([4] 4) ([a] a) [F73-OA1]

[3.8.3.5.] 3.8.3.5. ([4] 4) ([b] b),([c] c) [F30-OS3.1]

[3.8.3.5.] 3.8.3.5. ([5] 5) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([1] 1) no attributions

[3.8.3.6.] 3.8.3.6. ([2] 2) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([3] 3) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([4] 4) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([5] 5) [F10-OS3.7]

[3.8.3.6.] 3.8.3.6. ([6] 6) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([7] 7) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([8] 8) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([9] 9) no attributions

[3.8.3.6.] 3.8.3.6. ([10] 10) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([10] 10) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([10] 10) no attributions

[3.8.3.6.] 3.8.3.6. ([11] 11) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F30-OS3.1]

[3.8.3.6.] 3.8.3.6. ([12] 12) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([13] 13) no attributions

[3.8.3.6.] 3.8.3.6. ([14] 14) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([15] 15) [F73-OA1]

[3.8.3.6.] 3.8.3.6. ([16] 16) no attributions

[3.8.3.6.] 3.8.3.6. ([17] 17) [F74-OA2]

[3.8.3.6.] 3.8.3.6. ([17] 17) [F10-OS3.7]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F73-OA1]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F74-OA2]

[3.8.3.7.] 3.8.3.7. ([1] 1) [F30-OS3.1] [F10-OS3.7]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F74-OA2]

[3.8.3.8.] 3.8.3.8. ([1] 1) [F10-OS3.7]

[3.8.3.9.] 3.8.3.9. ([1] 1) no attributions

[3.8.3.9.] 3.8.3.9. ([1] 1) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([1] 1) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F73-OA1]

[3.8.3.10.] 3.8.3.10. ([1] 1) [F74-OA2]

[3.8.3.10.] 3.8.3.10. ([2] 2) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([1] 1) [F74-OA2]

[3.8.3.11.] 3.8.3.11. ([2] 2) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) [F72-OH2.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([d] d)([i] i) [F74-OA2]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f),([g] g) [F30,F20-OS3.1]

[3.8.3.12.] 3.8.3.12. ([1] 1) ([f] f) and ([g] g)

[3.8.3.12.] 3.8.3.12. ([1] 1) ([h] h) [F30-OS3.1] Applies to portion of Code text: "… be equipped with a coat hook … projecting not more than 50 mm from the wall …"

[3.8.3.12.] 3.8.3.12. ([1] 1) no attributions

[3.8.3.13.] 3.8.3.13. ([1] 1) [F74-OA2]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([b] b) [F10-OS3.7]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([c] c)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([d] d)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([f] f)

[3.8.3.13.] 3.8.3.13. ([1] 1) ([g] g) [F30-OS3.1] Applies to the requirement for a coat hook.

[3.8.3.13.] 3.8.3.13. ([1] 1) ([i] i) [F74-OA2] Applies to the requirement for a shelf.

[3.8.3.13.] 3.8.3.13. ([1] 1) [F72-OH2.1] [F71-OH2.3]

[3.8.3.13.] 3.8.3.13. ([1] 1) ([b] b) [F74-OA2] Applies to portion of Code text: "… a door ... capable of being locked from the inside …"

[3.8.3.13.] 3.8.3.13. ([2] 2) [F72-OH2.1] [F71-OH2.3]

[3.8.3.14.] 3.8.3.14. ([1] 1) [F74-OA2]

[3.8.3.14.] 3.8.3.14. ([1] 1) [F72-OH2.1]

[3.8.3.15.] 3.8.3.15. ([1] 1) [F74-OA2]

[3.8.3.15.] 3.8.3.15. ([1] 1) ([d] d) [F30-OS3.1]

[3.8.3.15.] 3.8.3.15. ([1] 1) ([a] a)

[3.8.3.15.] **3.8.3.15. ([2] 2) [F74-OA2]**

[3.8.3.15.] **3.8.3.15. ([2] 2) ([f] f) [F30-OS3.1]**

[3.8.3.15.] **3.8.3.15. ([2] 2) ([c] c)**

[3.8.3.16.] **3.8.3.16. ([1] 1) [F74-OA2]**

[3.8.3.16.] **3.8.3.16. ([1] 1) [F71-OH2.3]**

[3.8.3.16.] **3.8.3.16. ([1] 1) ([f] f) [F31-OS3.2]**

[3.8.3.16.] **3.8.3.16. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([1] 1) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([d] d),([e] e) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([f] f) [F30-OS3.1]**

[3.8.3.17.] **3.8.3.17. ([1] 1) ([h] h) [F31-OS3.2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) [F71-OH2.3]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([a] a) [F73-OA1]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F10-OS3.7]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([b] b) [F74-OA2]**

[3.8.3.17.] **3.8.3.17. ([2] 2) ([g] g) [F74-OA2]**

[3.8.3.18.] **3.8.3.18. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F74-OA2]**

[3.8.3.19.] **3.8.3.19. ([1] 1) [F11-OS3.7]**

[3.8.3.19.] **3.8.3.19. ([2] 2) [F74-OA2]**

[3.8.3.20.] **3.8.3.20. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([1] 1) [F74-OA2]**

[3.8.3.21.] **3.8.3.21. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([1] 1) [F30-OS3.1]** Applies to portion of Code text: "… level … level and have removable seats, …"

[3.8.3.22.] **3.8.3.22. ([1] 1) ([d] d) [F10-OS3.7]** Applies to portion of Code text: "… without infringing on egress from any row of seating or any aisle requirements …"

[3.8.3.22.] **3.8.3.22. ([2] 2) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([2] 2) [F30-OS3.1]** Applies to portion of Code text: "…

level, ...”

[3.8.3.22.] **3.8.3.22. ([3] 3) ([a] a) [F10-OS3.7]** Applies to portion of Code text: “… without infringing on egress from any row of seating or any aisle requirements …”

[3.8.3.22.] **3.8.3.22. ([3] 3) [F74-OA2]**

[3.8.3.22.] **3.8.3.22. ([4] 4) [F10-OS3.7]**

[3.8.4.2.] -- ([1] --) no attributions

[3.8.4.2.] -- ([2] --) [F30-OS3.1] [F20-OS2.1]

[3.8.4.2.] -- ([3] --) no attributions

[3.8.4.2.] -- ([4] --) no attributions

[3.8.4.2.] -- ([5] --) no attributions

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Proposed Change 1766

Code Reference(s):	**NBC20 Div.B 3.8.3.9. (first printing)** **NBC20 Div.B 9.9.11. (first printing)**
Subject:	Accessibility — Inclusive signage
Title:	Accessible Safety Signage
Description:	This proposed change introduces requirements for visual and tactile information signs for accessibility and occupant safety.
Related Proposed Change(s):	PCF 1561, PCF 1569

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [x] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [x] Occupant safety in use
- [x] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

Much of the safety signage required by the National Building Code of Canada (NBC) is not inclusive because it cannot be read by persons with vision loss (i.e., is not tactile or Braille signage). Requirements for tactile signage were added to Part 3 of the NBC 2020. However, equivalent requirements for signage in Part 9 were not introduced. Without this proposed change, signage in Part 9 buildings might not provide information in a format that is accessible for people with vision loss and might also have a different format than signs in Part 3 buildings. These differences could cause confusion for people with vision loss as they navigate buildings in emergency situations, which could lead to delays in evacuation and could also lead to a person being unacceptably impeded from using the building’s facilities.

Part 9 refers to Part 3 for some signage requirements in small buildings by referencing Section 3.8. for accessibility requirements in small buildings and Article 3.4.6.16. for requirements for electromagnetic locks and signs at doors equipped with these locks.

Part 9 already points to Article 3.8.3.9. for requirements for accessible signs. However, Part 9 does not have the same requirements as Part 3 for visual and tactile information signage regarding exit stairs and floor numbering/lettering. These differences could lead to inconsistent signage because some signs in Part 9 small buildings are required to provide tactile information, while others are not.

Justification

This proposed change identifies safety signage that is intended for the general public in Part 9 buildings. The proposed change

- clarifies that this safety signage must be legible to all occupants, including those with low or no vision,
- states where these signs must be installed, and
- refers to a standard for the design of safety signage

These signs are required in order to limit the probability that a person with low or no vision would be unacceptably impeded from using the building's facilities or circulating within the building. These signs are also required for occupant safety purposes to limit the probability that a person could be delayed in moving to a safe place in an emergency.

PROPOSED CHANGE

[3.8.3.9.] **3.8.3.9. Accessible Signs**

[1] **1)** Visual information signs required by Subsections 3.4.5.,~~and~~ 3.4.6. and 9.9.11., and Article 3.8.2.10. shall comply with Clauses 4.5.2, 4.5.3 and 4.5.4 of CSA B651, "Accessible design for the built environment". (See Note A-3.8.3.9.(1) and (2).)

[2] **2)** Tactile information signs required by Subsections 3.4.5.,~~and~~ 3.4.6. and 9.9.11., and Article 3.8.2.10. shall

[a] a) have Braille and tactile characters in accordance with Clauses 4.5.6.2 and 4.5.6.3 of CSA B651, "Accessible design for the built environment",

[b] b) be installed on the wall closest to the latch side of the door or on the nearest wall on the right side of the door, where there is no wall at the latch side, and

[c] c) be centred 1 500 mm above the finished floor with the edge of the sign located not more than 300 mm from the door.

(See Note A-3.8.3.9.(1) and (2).)

[3] **3)** Signs required by Article 3.8.2.10. shall incorporate the International Symbol of Access or the International Symbol of Access for Hearing Loss and appropriate graphical or textual information that clearly indicates the

type of facilities available. (See Note A-3.8.3.9.(3).)

[9.9.11.] 9.9.11. Signs

[9.9.11.1.] 9.9.11.1. Application

[9.9.11.2.] 9.9.11.2. Visibility of Exits

[9.9.11.3.] 9.9.11.3. Exit Signs

[1] **1)** Every *exit* door shall have an *exit* sign providing visual information placed over it or adjacent to it if the *exit* serves

[a] a) a *building* that is 3 *storeys* in *building height*,

[b] b) a *building* having an *occupant load* of more than 150, or

[c] c) a room or *floor area* that has a fire escape as part of a required *means of egress*.

[2] **2)** Every *exit* sign providing visual information shall

[a] a) be visible on approach to the *exit*,

[b] b) consist of a green and white or lightly tinted graphical symbol meeting the colour specifications referred to in ISO 3864-1, "Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings", and

[c] c) conform to ISO 7010, "Graphical symbols – Safety colours and safety signs – Registered safety signs", for the following symbols (see Note A-3.4.5.1.(2)(c)):

[i] i) E001 emergency exit left,

[ii] ii) E002 emergency exit right,

[iii] iii) E005 90-degree directional arrow, and

[iv] iv) E006 45-degree directional arrow.

[3] **3)** Internally illuminated *exit* signs shall be continuously illuminated and

[a] a) where illumination of the sign is powered by an electrical circuit, be constructed in conformance with CSA C22.2 No. 141, "Emergency lighting equipment", or

[b] b) where illumination of the sign is not powered by an electrical circuit, be constructed in conformance with CAN/ULC-S572, "Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems".

[4] **4)** Externally illuminated *exit* signs shall be continuously illuminated and be constructed in conformance with CAN/ULC-S572, "Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems". (See Note A-3.4.5.1.(4).)

[5] **5)** The circuitry serving lighting for externally and internally illuminated *exit* signs shall

[a] a) serve no equipment other than emergency equipment, and

[b] b) be connected to an emergency power supply as described in

Sentences 9.9.12.3.(2), (3) and (7).

[6] **6)** Where no *exit* is visible from a *public corridor*, from a corridor used by the public, or from principal routes serving an open *floor area* having an *occupant load* of more than 150, an *exit* sign conforming to Clauses (2)(b) and (c) with an arrow or pointer indicating the direction of egress shall be provided.

[9.9.11.4.] --- Exit Signs with Tactile Information

[1] --) An *exit* sign displaying the word "EXIT" in tactile form that complies with Subsection 3.8.3. shall be mounted on the approach side of *exit* doors described in Sentence 9.9.11.3.(1), in the direction of travel to the *exit*.

[9.9.11.5.] 9.9.11.4. Signs for Stairs and Ramps at Exit Level

[1] **1)** In *buildings* that are 3 *storeys* in *building height*, any part of an *exit ramp* or stairway that continues up or down past the lowest *exit level* shall be clearly marked with both visual and tactile information in accordance with Subsection 3.8.3. to indicate that it does not lead to an *exit*, if the portion beyond the *exit level* may be mistaken as the direction of *exit* travel.

[9.9.11.6.] 9.9.11.5. Floor Numbering and Identification of Stair Shafts

[1] **1)** Arabic numerals indicating the assigned floor number in both visual and tactile forms in accordance with Subsection 3.8.3. shall be mounted permanently on the wall on the stair side and on the floor side at the latch side of doors to *exit* stair shafts.

[a] a) ~~mounted permanently on the stair side of the wall at the latch side of doors to *exit* stair shafts,~~

[b] b) ~~not less than 60 mm high, raised approximately 0.8 mm above the surface,~~

[c] c) ~~located 1 500 mm from the finished floor and not more than 300 mm from the door, and~~

[d] d) ~~contrasting in colour with the surface on which they are applied (see Note A-9.9.11.5.(1)(d)).~~

[2] --) Upper case letters indicating the designation assigned to each *exit* stair shaft in both visual and tactile forms in accordance with Subsection 3.8.3. shall be mounted permanently on the wall on the stair side and on the floor side at the latch side of doors to *exit* stair shafts.

Impact analysis

In locations where a sign with visual information is already required, it is expected that the increase in cost to make the same sign with tactile information is negligible (<1% increase). In locations where an additional sign with tactile information is required, the cost of the additional sign is estimated to be approximately $50 to $80 per sign for a 150 mm × 150 mm engraved panel interior sign with adhesive back and Braille lettering and tactile characters.

Part 9 already refers to Part 3 for visual and tactile signs for accessibility-related signage at doors and for signs at doors with electromagnetic locks. This proposed change updates the language for clarity (i.e., to make a distinction between visual and tactile information signs) and to reduce the probability that a person with vision loss will not be provided with the same information as a person without vision loss.

The societal benefits are related to limiting the probability that a person with vision loss would be unacceptably impeded from accessing a building, circulating within the building, or using its facilities. This benefit also extends to the safety of persons with vision loss, who must be able to identify exits, floor numbering, and stair shafts to move through a building during an emergency.

Enforcement implications

This proposed change can be enforced with the existing framework in place to enforce the Codes. This proposed change would not require additional resources; authorities having jurisdiction would have to verify that the required signage is in the right location and has the appropriate dimensions.

Who is affected

Building occupants with vision loss would be better able to circulate in a building with signage that can be read by everyone and would be able to exit a building as easily as a person without vision loss.

Architects, designers and builders would have to incorporate these new requirements into their designs.

Authorities having jurisdiction would have to ensure that the required signage is provided.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[3.8.3.9.] 3.8.3.9. ([1] 1) no attributions

[3.8.3.9.] 3.8.3.9. ([1] 1) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([1] 1) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([2] 2) [F73-OA1]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F74-OA2]

[3.8.3.9.] 3.8.3.9. ([3] 3) [F73-OA1]

[9.9.11.1.] 9.9.11.1. ([1] 1) no attributions

[9.9.11.2.] 9.9.11.2. ([1] 1) [F10-OS3.7]

[9.9.11.2.] 9.9.11.2. ([2] 2) [F10-OS3.7]

[9.9.11.3.] 9.9.11.3. ([1] 1) [F10-OS3.7]

[9.9.11.3.] 9.9.11.3. ([2] 2) [F10-OS3.7]

[9.9.11.3.] 9.9.11.3. ([3] 3) [F10,F81-OS3.7]

[9.9.11.3.] 9.9.11.3. ([4] 4) [F10,F81-OS3.7]

[9.9.11.3.] 9.9.11.3. ([5] 5) [F10-OS3.7]

[9.9.11.3.] 9.9.11.3. ([5] 5) no attributions

[9.9.11.3.] 9.9.11.3. ([6] 6) [F10-OS3.7]

[9.9.11.4.] -- ([1] --) [F10-OS3.7]

[9.9.11.4.] -- ([1] --) no attributions

[9.9.11.5.] 9.9.11.4. ([1] 1) [F10-OS3.7]

[9.9.11.6.] 9.9.11.5. ([1] 1) [F10-OS3.7]

[9.9.11.6.] 9.9.11.5. ([1] 1) [F73-OA1]

[9.9.11.6.] -- ([2] --) [F10,F12,F73-OS3.7]

[9.9.11.6.] -- ([2] --) [F12-OP1.2]

[9.9.11.6.] -- ([2] --) [F12-OS1.2]

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Proposed Change 1980

Code Reference(s):	**NBC20 Div.B 4.1.3.2. (first printing)** **NBC20 Div.B 4.1.6.2. (first printing)** **NBC20 Div.B 4.1.6.5. (first printing)** **NBC20 Div.B 4.1.6.7. (first printing)** **NBC20 Div.B 4.1.6.9. (first printing)** **NBC20 Div.B 4.1.6.10. (first printing)** **NBC20 Div.B 4.1.7.3. (first printing)** **NBC20 Div.B 4.1.8.2. (first printing)**
Subject:	Climatic Loads
Title:	Specified Wind and Snow Loads in Part 4
Description:	This proposed change revises provisions for wind and snow loading to account for potential loading changes resulting from climate change.
Related Code Change Request(s):	CCR 1639, CCR 1638, CCR 1626, CCR 1625, CCR 1624, CCR 1623, CCR 1622, CCR 1621, CCR 1620, CCR 1619, CCR 1618, CCR 1617
Related Proposed Change(s):	PCF 1979, PCF 2018, PCF 2048

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [x] Housing
- [x] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [x] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

Climate change effects not yet addressed in the NBC

In the 2020 and previous editions of NBC Part 4, it was assumed that climatic data statistics used in structural design are time-independent (or “stationary”). Although not specifically stated in the NBC, the service life of buildings has implicitly been taken as 50 years. Accordingly, the climatic design data in the NBC have been updated for each code cycle using past weather observations collected and analyzed by Environment and Climate Change Canada (ECCC), under the assumption that past statistics will continue to be applicable to the future. In the face of extensive evidence that the climate is changing across Canada, this practice raises real safety concerns for the design of the main structural systems and envelope of buildings to withstand climatic loads such as those due to snow and wind.

In addition, in the current edition of the NBC, wind data are based mainly on synoptic wind observations and do not account for the different existing climatic influences in Canada, where some regions are more prone to local convective thunderstorms. This phenomenon is expected to be exacerbated in the future with climate warming.

Uniform hazard approach in load calculations yields non-uniform probability of failure

An additional problem identified in reliability studies is that the current methodology for the structural design of buildings in the NBC uses what has been termed a “uniform hazard” approach. In this approach, reference design wind and snow loads at various locations across Canada are specified at an annual probability of exceedance of 1/50, corresponding to a 50-year return period in a stationary climate. The minimum safety criterion adopted in the NBC, expressed as a reliability index of 3.0, corresponds to a probability of failure (i.e., probability that the effects of loads are higher than the resistance of a structural member in a building) of 0.001 during the 50-year assumed service life of a building in the Normal Importance Category. To provide an acceptable probability of failure, the "specified design loads" or so-called "service loads" have been multiplied by load factors—1.5 for snow and 1.4 for wind—to obtain the "ultimate loads" applied in design calculations, where the load factor is function of the target reliability index and the variability of the load. These factors have been taken as constant across all regions of Canada. However, reliability studies [1] have shown that, due to the different behaviour of wind and snow events in Canada's various regions and the uncertainties in wind and snow loads identified by their coefficients of variation, this approach leads to a non-uniform probability of failure across the country. The probability of failure can differ by as much as a factor of 10, depending on where the project is located, and this variability could be further exacerbated by climate change.

Roof snow load adjustments needed for scouring effects and increase in roof insulation

There are some additional issues with the factors or coefficients that convert reference ground snow loads to snow loads on roofs of various configurations. These coefficients, which are intended to reflect the effects of scouring of snow off roofs by the wind and the accumulation of snow in drifts, have also been assumed to be essentially the same in all regions of Canada. Recent research [1] (also supported by past anecdotal evidence) has shown that the ability of wind to scour snow or form drifts depends on the combination of ambient temperatures and wind speeds during the winter months, and this combination varies significantly depending on geographic location. For example, in the milder winter climate of Vancouver, where snow tends not to persist for long before melting, the wind does not typically scour snow off roofs or form drifts to the same extent as at a location such as Winnipeg with its more prolonged intervals of cold temperatures combined with strong winds. Studies [1] have identified how the ground-to-roof conversion factors can more rationally account for regional climatic differences both in the present and in the future as the climate changes.

Snow loads on roofs are also affected by the combination of internal temperature inside the building, external temperature, and degree of roof insulation, a phenomenon left unaccounted for in the current edition of the NBC, while other codes and standards use a temperature factor to account for this effect. In a changing climate and with the trend towards better-insulated roofs for more energy-efficient buildings, the argument is made for introducing a thermal factor, C_T, in the assessment of snow loads on roofs in NBC Part 4.

Justification

Updating climatic data for climate change

Extensive research has been conducted by ECCC [2] into how the climate statistics are likely to change in various regions of Canada between now and 2100 under various greenhouse gas (GHG) emissions scenarios, namely representative concentration pathways RCP2.6, RCP4.5, RCP6 and RCP8.5.

This research provides a rational basis for future projections of climatic loads, such as those due to wind and snow, during the service life of buildings in different locations, and for inclusion of these expected future climatic load effects in the NBC. For the NBC 2025, the approach that is proposed to account for climate change effects in climatic data used for building design is based on RCP 8.5 (8.5 W/m^2), corresponding to a 2.5°C global warming scenario in a 50-year horizon. Refer to PCF 1979 for the updated climatic data.

RCP8.5 was selected by consensus among climate scientists and code experts, including regulators, across the country, considering that the differences between the different climate scenarios in the ECCC study were small and within the uncertainties inherent to the model predictions over the 50-year design life of a building.

In general terms, temperature and precipitation are expected to increase in all regions of the country between now and 2100, wind loads are expected to increase in most regions of the country, and ground snow loads are expected to decrease in all regions, except the Far North where some increases are expected [2].

For wind data, synoptic wind storms and design wind speeds for thunderstorms (convective wind storms) have been studied separately and the worst effects included in Table C-2 in accordance with the Minimax approach (see PCF1979). This is an important new aspect to consider since thunderstorms and synoptic storms may change differently in the future climate.

Adjusting loads to account for non-stationarity in a future changing climate

Results obtained using RCP8.5, corresponding to 2.5°C global warming, were adopted to establish future climatic loads for structural design. Comparisons were made on the basis of a building constructed in 2025 having a service life of 50 years, and the differences between the four RCP scenarios included in the ECCC study [2] remained within a narrow range. The decision to adopt RCP8.5 reflects a prudent approach, as there is uncertainty on the evolution of climate variables over the next 50 years. Recent studies [1] revealed the statistical significance of the non-stationarity of extreme wind speeds and ground snow loads based on the future projections provided by ECCC [2] for many regions across Canada.

Therefore, a non-stationary extreme-value analysis approach, known as the "Minimax Method," is proposed to design for the worst-case year of the building's service life, which ensures that the annual probability of failure remains acceptably low during its entire service life. For instance, for wind loads, future projections mostly show increases in reference pressure, making the last year of service life the worst case; for ground snow loads, future projections mostly show decreases, making the first year of service life the worst case.

Using ECCC's climate projections [2], regional climate change factors have been developed that can be applied to the wind and snow reference values in different regions across the country. These factors were used to determine the reference values tabulated in NBC Table C-2, Climatic Design Data for Selected Locations in Canada.

Introducing the uniform risk approach in ultimate limit state (ULS) design

To address the shortcomings related to the variability of the probability of failure across the country, a so-called "uniform risk" approach is proposed in which "ultimate loads" are specified directly for each location with load factors of 1.0, similar to the approach used for earthquake design in the NBC and other approaches adopted internationally. Notably, ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures," converted to uniform risk for wind loads in the 2010 edition [3] (and more recently for snow loads in the 2022 edition) and was preceded in this step by the Australian Building Code many years before [4].

Climate change factors were calculated as ratios of the future design-level values determined using the Minimax approach to the design-level values calculated in a stationary historical period using the conventional approach. For reference design wind pressures, most areas in Canada have a climate change factor of 1.05, while locations in Ontario, the Atlantic provinces, and west of 120°W in British Columbia have a climate change factor of 1.1. For ground snow loads, excepting the northern territories where a climate change factor of 1.05 applies, most regions have a climate change factor of 1.0, as the governing scenario is based on the present climate (see [5] and PCF1979).

In deriving climate change factors for the "uniform risk" approach, target annual probabilities of exceedance of 1/500 for wind and 1/1000 for snow were selected for Normal Importance Category buildings, and the worst-case reference value during the future service life was compared with the present value used in NBC 2020 (with an annual probability of exceedance of 1/50 for both wind and snow). With the proposed uniform risk approach, the reference wind pressures and ground snow loads are specified at much lower annual probabilities of exceedance, while eliminating the need for load factors (i.e., setting them to 1.0) for both wind and snow. The 1/500 and 1/1000 annual probabilities of exceedance were selected to maintain the average risk of failure across the country, without any consideration of climate change. As a result, the same target probability of failure of approximately 1/1000 is set, but with less variation from location to location.

Revising the roof snow load formula for scouring and heat loss effects

When considering snow accumulation on a roof, it is important to understand the relationship between the amount of snow on a roof and the amount of snow on the ground. In the NBC, this relationship is characterized through the combination of the basic roof snow load factor, C_b, and the wind exposure factor, C_w. An examination of the current NBC 2020 provisions reveals that the combination C_bC_w varies between 0.4 and 1.0, depending on the roof size and exposure to wind. However, the wind exposure factor currently does not account for variations in wind speed and temperature across the country, which can have a significant effect on the resulting roof snow distributions.

The effects of the winter wind speed and temperature were parametrically assessed for the representative range of stations used to observe the variations in ground snow load. The simulated ground snow loads were compared to the accumulations determined for a range of roof sizes. In general, buildings in cold regions, where snow builds up on a roof throughout the winter months with relatively high wind speeds, will experience significantly more scouring of snow off the roof compared to buildings in warmer regions with lower wind speeds. The wind exposure factor, C_w, currently used in the snow load formula in the NBC does not account for variations in the amount of snow that is scoured by the wind as a result of local climate conditions. Differences in the local winter temperatures and wind speeds result in variations in the scouring of snow off a roof surface. The current provisions acknowledge this in the form of reductions in snow load due to additional scouring for roofs that are exposed. However, they do not account for the potential for reduced scouring in warmer climates or in areas with low wind speeds. A change to the definition of C_w is proposed to account for these variations. In addition, a reduction in snow drift depth in sheltered areas, such as roof steps, occurs in regions with milder winters, and this variation can be accounted for with a revision to the snow accumulation factor, C_a.

Another aspect to consider is that the current edition of the NBC does not directly address the amount of melting due to heat loss through the roof; historic snow roof observations used in calibration have been collected for a variety of locations and roof geometries without differentiating for roof insulation levels. This shortcoming can become particularly problematic for new buildings designed to achieve the improved energy performance required in the NBC 2020 and the NECB 2020. The increase in the amount of insulation required in roofing results in reduced snow melting due to heat loss and, therefore, potentially increased snow depth. The proposed introduction of a new thermal factor, C_T, in the NBC snow load formula addresses this problem. The thermal factor was derived to include a reduction in roof snow loading due to heat loss; accordingly, where no heat loss is assumed, the factor is 1.0, as should be the case for most new buildings. If the internal temperature in the area directly underneath the roof surface or if the roof insulation properties are not known or highly uncertain, the thermal factor should be taken as 1.0. Whenever conditions for snow melting prevail, the C_T factor should not be less than 0.7.

Calibration studies and benefits of uniform risk approach

From the wind load perspective, regional variations in probability of failure can be significantly reduced by adopting ultimate return periods (1/500 annual probability of exceedance) for reference wind pressure, in accordance with the uniform risk approach. A load calibration procedure has been undertaken [1] that demonstrates that the variability range of the probability of failure and reliability index substantially decreases with the uniform risk approach. To illustrate the benefits of the new approach, the following two cases were considered:

- a uniform hazard case with a return period of 50 years and wind load factor of 1.4, which matches that currently used in the NBC 2020, and
- a uniform risk case with a return period of 500 years and a wind load factor of 1.0.

Buildings in the Low, Normal, High and Post-disaster Importance Categories were investigated. For the uniform hazard case, the range of reliability index, β, is 1.6 for coefficients of variation (COVs) ranging from 0.05 to 0.3. For the uniform risk case, the β range narrows significantly to 0.7 for the same range of COVs. Most sites have a COV in the range of 0.1 to 0.2; for these sites, the uniform hazard approach shows a β range of 0.7, whereas for the uniform risk approach, the β range narrows to 0.25.

New load combinations based on uniform risk

In moving to the uniform risk approach for wind and snow loads, new load calibrations have been carried out to update the various design load combinations needed for both the ultimate limit states (ULS) and the serviceability limit states (SLS). NBC Tables 4.1.3.2.-A and 4.1.3.2.-B for ULS have been updated, including the NBC 2020 load combination that relates to seismic loads. The roof snow load combination, E + 0.25S, has been reassessed and updated to E + 0.15S, where S is now based on the 1/1000 annual probability of exceedance rather than 1/50 for Normal Importance Category buildings. The 0.15 coefficient was selected to keep the total value equivalent to the current value prescribed in the NBC 2020 for most locations. NBC Table 4.1.3.4. for SLS required no changes, because revised importance factors for SLS in NBC Table 4.1.6.2. for snow and NBC Table 4.1.7.3. for wind essentially keep the snow and wind serviceability loads close to what they were before.

References

[1] RWDI Report No. 1702484 (2020). Development of Climate Change Provisions for Structural Design of Buildings and Implementation Plan in the National Building Code.

[2] Cannon, A.J., Jeong, D.I., Zhang, X., Zwiers, F.W. (2020). Climate-Resilient Buildings and Core Public Infrastructure: An Assessment of the Impact of Climate Change on Climatic Design Data in Canada. Government of Canada, Ottawa, ON. 106 p. (https://climate-scenarios.canada.ca/?page=buildings-report-overview).

[3] American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 7-22 (2022). Minimum Design Loads for Buildings and Other Structures.

[4] Australian/New Zealand Standard (AS/NZS) 1170.2:2002 (2002). Structural design actions, Part 2: Wind actions.

[5] Li, S.H., Irwin, P., Lounis, Z., Attar, A., Dale, J., Gibbons, M., Beaulieu, S. (2022). Effects of Nonstationarity of Extreme Wind Speeds and Ground Snow Loads in a Future Canadian Changing Climate. Natural Hazards Review, 23(4), 04022022.

PROPOSED CHANGE

[4.1.3.2.] 4.1.3.2. Strength and Stability

[1] **1)** A *building* and its structural components shall be designed to have sufficient strength and stability so that the factored resistance, φR, is greater than or equal to the effect of factored loads, which shall be determined in accordance with Sentence (2).

[2] **2)** Except as provided in Sentence (3), the effect of factored loads for a *building* or structural component shall be determined in accordance with the requirements of this Article and the following load combination cases, the applicable combination being that which results in the most critical effect:

[a] a) for load cases without crane loads, the load combinations listed in Table 4.1.3.2.-A, and

[b] b) for load cases with crane loads, the load combinations listed in Table 4.1.3.2.-B.

(See Note A-4.1.3.2.(2).)

[3] **3)** Other load combinations that must also be considered are the principal loads acting with the companion loads taken as zero.

[4] **4)** Where the effects due to lateral earth pressure, H, restraint effects from pre-stress, P, and imposed deformation, T, affect the structural safety, they shall be taken into account in the calculations, with load factors of 1.5, 1.0 and 1.25 assigned to H, P and T respectively. (See Note A-4.1.3.2.(4).)

[5] **5)** Except as provided in Sentence 4.1.8.16.(2), the counteracting factored *dead load*—0.9D in load combination cases 2, 3 and 4 and 1.0D in load combination case 5 in Table 4.1.3.2.-A, and 0.9D in load combination cases 1 to 5 and 1.0D in load combination case 6 in Table 4.1.3.2.-B—shall be used when the *dead load* acts to resist overturning, uplift, sliding, failure due to stress reversal, and to determine anchorage requirements and the factored resistance of members. (See Note A-4.1.3.2.(5).)

[6] **6)** The principal-load factor 1.5 for *live loads* L in Table 4.1.3.2.-A and L_{XC} in Table 4.1.3.2.-B may be reduced to 1.25 for liquids in tanks.

[7] **7)** The companion-load factor for *live loads* L in Table 4.1.3.2.-A and L_{XC} in Table 4.1.3.2.-B shall be increased by 0.5 for storage areas, and equipment areas and *service rooms* referred to in Table 4.1.5.3.

Table [4.1.3.2.-A] 4.1.3.2.-A
Load Combinations Without Crane Loads for Ultimate Limit States
Forming Part of Sentences [4.1.3.2.] 4.1.3.2.([2] 2) and ([5] 5) to ([10] 10), and 4.2.4.1.(3)

Case	Load Combination (1)	
	Principal Loads	Companion Loads
1	1.4D (2)	—
2	(1.25D (3) or 0.9D (4)) + 1.5L (5)	0.7~~1.0~~S (6) or 0.3~~0.4~~W
3	(1.25D (3) or 0.9D (4)) + 1.0~~1.5~~S	1.0L (6) (7) or 0.3~~0.4~~W
4	(1.25D (3) or 0.9D (4)) + 1.0~~1.4~~W	0.5L (7) or 0.35~~0.5~~S
5	1.0D (4) + 1.0E (8)	0.5L (6) (7) + 0.15~~0.25~~S (6)

Notes to Table [4.1.3.2.-A] 4.1.3.2.-A:

(1) See Sentences 4.1.3.2.(2) to (4).

(2) See Sentence 4.1.3.2.(9).

(3) See Sentence 4.1.3.2.(8).

(4) See Sentence 4.1.3.2.(5).

(5) See Sentence 4.1.3.2.(6).

(6) See Article 4.1.5.5.

(7) See Sentence 4.1.3.2.(7).

(8) See Sentence 4.1.3.2.(10).

Table [4.1.3.2.-B] 4.1.3.2.-B
Load Combinations With Crane Loads for Ultimate Limit States
Forming Part of Sentences [4.1.3.2.] 4.1.3.2.([2] 2), ([5] 5) to ([8] 8), and ([10] 10)

Case	Load Combination (1)	
	Principal Loads	Companion Loads
1	(1.25D (2) or 0.9D (3)) + (1.5C + 1.0L_{XC})	0.7~~1.0~~S (4) or 0.3~~0.4~~W
2	(1.25D (2) or 0.9D (3)) + (1.5L_{XC} (5) + 1.0C)	0.7~~1.0~~S (4) or 0.3~~0.4~~W
3	(1.25D (2) or 0.9D (3)) + 1.0~~1.5~~S	1.0C + 1.0L_{XC} (4) (6)
4	(1.25D (2) or 0.9D (3)) + 1.0~~1.4~~W	1.0C (7) + 0.5L_{XC} (4) (6)
5	(1.25D (2) or 0.9D (3)) + C_7	—
6	1.0D (3) + 1.0E (8)	1.0C_d + 0.5L_{XC} (4) (6) + 0.15~~0.25~~S (4)

Notes to Table [4.1.3.2.-B] 4.1.3.2.-B:

(1) See Sentences 4.1.3.2.(2) to (4).

(2) See Sentence 4.1.3.2.(8).

(3) See Sentence 4.1.3.2.(5).

(4) See Article 4.1.5.5.

(5) See Sentence 4.1.3.2.(6).

(6) See Sentence 4.1.3.2.(7).

(7) Side thrust due to cranes need not be combined with full wind load.

(8) See Sentence 4.1.3.2.(10).

[8] **8)** Except as provided in Sentence (9), the load factor 1.25 for *dead load*, D, for *soil*, superimposed earth, plants and trees given in Tables 4.1.3.2.-A and 4.1.3.2.-B shall be increased to 1.5, except that when the *soil* depth exceeds 1.2 m, the factor may be reduced to 1 + 0.6/h_s but not

less than 1.25, where h_s is the depth of *soil*, in m, supported by the structure.

[9] **9)** A principal-load factor of 1.5 shall be applied to the weight of saturated *soil* used in load combination case 1 of Table 4.1.3.2.-A.

[10] **10)** Earthquake load, E, in load combination cases 5 of Table 4.1.3.2.-A and 6 of Table 4.1.3.2.-B includes horizontal earth pressure due to earthquake determined in accordance with Sentence 4.1.8.16.(7).

[11] **11)** Provision shall be made to ensure adequate stability of the structure as a whole and adequate lateral, torsional and local stability of all structural parts.

[12] **12)** Sway effects produced by vertical loads acting on the structure in its displaced configuration shall be taken into account in the design of *buildings* and their structural members.

[4.1.6.2.] 4.1.6.2. Specified Snow Load

(See Note A-4.1.6.2.)

[1] **1)** The specified load, S, due to snow and associated rain accumulation on a roof or any other *building* surface subject to snow accumulation shall be calculated using the formula

$$\boxed{S = I_s\left[S_s\left(C_bC_wC_sC_a\right) + S_r\right]}$$

$$S = I_s\left[S_s\left(C_bC_wC_sC_aC_T\right) + S_r\right]$$

where

I_s = importance factor for snow load, as provided in Table 4.1.6.2.-A,
S_s = 1-in-1 000~~50-year~~ annual probability ground snow load, in kPa, determined in accordance with Subsection 1.1.3.,
C_b = basic roof snow load factor in Sentence (2),
C_w = wind exposure factor in Sentences (3) and (4),
C_s = slope factor in Sentences (5) to (7),
C_a = accumulation factor in Sentence (8), and
C_T = thermal factor in Sentences (10) and (11), and
S_r = 1-in-1 000~~50-year~~ annual probability associated rain load, in kPa, determined in accordance with Subsection 1.1.3., but not greater than $S_s(C_bC_wC_sC_aC_T)$~~$S_s(C_bC_wC_sC_a)$~~.

Table [4.1.6.2.-A] 4.1.6.2.-A
Importance Factor for Snow Load, I_S
Forming Part of Sentence [4.1.6.2.] 4.1.6.2.([1] 1)

Importance Category	Importance Factor, I_s	
	ULS	SLS
Low	0.8	0.6~~0.9~~
Normal	1	0.6~~0.9~~
High	1.15	0.6~~0.9~~
Post-disaster	1.25	0.6~~0.9~~

[2] **2)** The basic roof snow load factor, C_b, shall

[a] a) be determined as follows:

[i] i) C_b = 0.8 for $l_c \leq 70$, and

$$\boxed{C_b = 0.8 \text{ for } l_c \leq \left(\frac{70}{C_w^2}\right), \text{ and}}$$

[ii] ii)

$$C_b = 1 - (0.2)\exp\left(-\frac{l_c - 70}{100}\right) \text{ for } l_c > 70$$

$$\boxed{C_b = \frac{1}{C_w}\left[1 - \left(1 - 0.8C_w\right)\exp\left(-\frac{l_c C_w^2 - 70}{100}\right)\right] \text{ for } l_c > \left(\frac{70}{C_w^2}\right)}$$

where

l_c = characteristic length of the upper or lower roof, defined as $2w - w^2/l$, in m,

w = smaller plan dimension of the roof, in m, and

l = larger plan dimension of the roof, in m, or

[b] b) ~~conform to Table 4.1.6.2.-B, using linear interpolation for intermediate values of~~ $\boxed{l_c C_w^2}$~~, or~~

[c] c) be taken as equal to 1 for any roof structure with a mean height of less than $1 + S_s/\gamma$, in m, above *grade*, where γ is the specific weight of snow determined in accordance with Article 4.1.6.13.

(See Note A-4.1.6.2.(2).)

[3] **3)** Except as provided ~~for~~ in Sentence (4), the wind exposure factor, C_w, shall be ~~1.0.~~determined as follows:

$$C_w = 1.25 + \left[-0.00075\left(-T_{ws}\right)^{0.75}\left(V_{ws}^3\right)\right], \text{ but } C_w \geq 0.5$$

where

T_{ws} = winter average temperature, in °C, determined in accordance with Subsection 1.1.3., and

V_{ws} = winter average wind speed, in m/s, determined in accordance with Subsection 1.1.3.

[4] **4)** The wind exposure factor, C_w, shall be greater than or equal to 1.0 where~~For *buildings* in the Low and Normal Importance Categories as set out in Table 4.1.2.1., the wind exposure factor, C_w, given in Sentence (3) may be reduced to 0.75 for rural areas only, or to 0.5 for exposed areas north of the treeline, where~~

[a] a) ~~the *building* is exposed on all sides to wind over open terrain as defined in Clause 4.1.7.3.(5)(a), and is expected to remain so during its life,~~

[b] b) the area of roof under consideration is sheltered by~~exposed to the wind on all sides with no~~ significant obstructions on the roof, such as parapet walls, within a distance of at least 10 times the difference between the height of the obstruction and $C_b C_w S_s/\gamma$, in m, where γ is the specific weight of snow on roofs as specified in Article 4.1.6.13., ~~and~~

[c] c) the loading ~~does not~~ involves the accumulation of snow due to drifting from adjacent surfaces~~.~~, or

[d] --) the building is in the High or Post-disaster Importance Category as set out in Table 4.1.2.1.

[5] **5)** Except as provided for in Sentences (6) and (7), the slope factor, C_s, shall be

[a] a) 1.0 where the roof slope, α, is equal to or less than 30°,

[b] b) (70° − α)/40° where α is greater than 30° but not greater than 70°, and

[c] c) 0 where α exceeds 70°.

~~Table [4.1.6.2.-B] 4.1.6.2.-B~~

~~Basic Roof Snow Load Factor for~~ $\boxed{I_c > \left(70 / C_w^2\right)}$

~~Forming Part of Sentence [4.1.6.2.] 4.1.6.2.([2] 2)~~

~~Value of~~ $\boxed{I_c C_w^2}$	~~Value of C_w~~		
	~~1.0~~	~~0.75~~	~~0.5~~
	~~Value of C_b~~		
~~70~~	~~0.80~~	~~0.80~~	~~0.80~~
~~80~~	~~0.82~~	~~0.85~~	~~0.91~~
~~100~~	~~0.85~~	~~0.94~~	~~1.11~~
~~120~~	~~0.88~~	~~1.01~~	~~1.27~~
~~140~~	~~0.90~~	~~1.07~~	~~1.40~~
~~160~~	~~0.92~~	~~1.12~~	~~1.51~~
~~180~~	~~0.93~~	~~1.16~~	~~1.60~~
~~200~~	~~0.95~~	~~1.19~~	~~1.67~~
~~220~~	~~0.96~~	~~1.21~~	~~1.73~~
~~240~~	~~0.96~~	~~1.24~~	~~1.78~~
~~260~~	~~0.97~~	~~1.25~~	~~1.82~~
~~280~~	~~0.98~~	~~1.27~~	~~1.85~~
~~300~~	~~0.98~~	~~1.28~~	~~1.88~~
~~320~~	~~0.98~~	~~1.29~~	~~1.90~~
~~340~~	~~0.99~~	~~1.30~~	~~1.92~~
~~360~~	~~0.99~~	~~1.30~~	~~1.93~~
~~380~~	~~0.99~~	~~1.31~~	~~1.95~~
~~400~~	~~0.99~~	~~1.31~~	~~1.96~~
~~420~~	~~0.99~~	~~1.32~~	~~1.96~~
~~440~~	~~1.00~~	~~1.32~~	~~1.97~~
~~460~~	~~1.00~~	~~1.32~~	~~1.98~~
~~480~~	~~1.00~~	~~1.32~~	~~1.98~~
~~500~~	~~1.00~~	~~1.33~~	~~1.98~~
~~520~~	~~1.00~~	~~1.33~~	~~1.99~~
~~540~~	~~1.00~~	~~1.33~~	~~1.99~~
~~560~~	~~1.00~~	~~1.33~~	~~1.99~~
~~580~~	~~1.00~~	~~1.33~~	~~1.99~~
~~600~~	~~1.00~~	~~1.33~~	~~1.99~~
~~620~~	~~1.00~~	~~1.33~~	~~2.00~~

[6] **6)** The slope factor, C_s, for unobstructed slippery roofs where snow and ice can slide completely off

the roof shall be

[a] a) 1.0 where the roof slope, α, is equal to or less than 15°,

[b] b) (60° − α)/45° where α is greater than 15° but not greater than 60°, and

[c] c) 0 where α exceeds 60°.

[7] **7)** Unless otherwise stated in this Subsection, the slope factor, C_s, shall be 1.0 when used in conjunction with accumulation factors for increased snow loads.

[8] **8)** The accumulation factor, C_a, shall be 1.0, which corresponds to the uniform snow load case, except that where appropriate for the shape of the roof, it shall be assigned other values that account for

[a] a) increased non-uniform snow loads due to snow drifting onto a roof that is at a level lower than other parts of the same *building* or at a level lower than another *building* within 5 m of it horizontally, as prescribed in Articles 4.1.6.5., 4.1.6.6. and 4.1.6.8.,

[b] b) increased non-uniform snow loads on areas adjacent to roof projections, such as penthouses, large *chimneys* and equipment, as prescribed in Articles 4.1.6.7. and 4.1.6.8.,

[c] c) non-uniform snow loads on gable, arch or curved roofs and domes, as prescribed in Articles 4.1.6.9. and 4.1.6.10.,

[d] d) increased snow or ice loads due to snow sliding as prescribed in Article 4.1.6.11.,

[e] e) increased snow loads in roof valleys, as prescribed in Article 4.1.6.12., and

[f] f) increased snow or ice loads due to meltwater draining from adjacent *building* elements and roof projections.

[9] **9)** For shapes not addressed in Sentence (8), C_a corresponding to the non-uniform snow load case shall be established based on applicable field observations, special analyses including local climatic effects, appropriate model tests, or a combination of these methods.

[10] --) Except as provided in Sentence (11), the thermal factor, C_T, shall be taken as the greater of 0.7 and $C_T = -0.01\left(T_{\text{in}}U_{\text{roof}}\right)\sqrt{S_s} + 1.0$, but not greater than 1.0, where

T_{in}	= expected average indoor operating temperature of the *building*, in °C, and
U_{roof}	= overall thermal transmittance of the roof, in $W/(m^2 \times K)$.

[11] --) Where T_{in} or U_{roof} is not known, the thermal factor, C_T, shall be taken as 1.0.

[4.1.6.5.] 4.1.6.5. Multi-level Roofs

[1] **1)** The drifting load of snow on a roof adjacent to a higher roof shall be taken as trapezoidal, as shown in Figure 4.1.6.5.-A, and the accumulation factor, C_a, shall be determined as follows:

$$C_a = C_{a0} - \left(C_{a0} - 1\right)\left(\frac{x}{x_d}\right) \text{ for } 0 \le x \le x_d,$$

or

$$C_a = 1.0 \text{ for } x > x_d$$

where

C_{a0}	= peak value of C_a at x = 0 determined in accordance with Sentences (3) to (5) and as shown in Figure 4.1.6.5.-B,
x	= distance from roof step as shown in Figure 4.1.6.5.-A, and
x_d	= length of drift determined in accordance with Sentence (2) and as shown in Figure 4.1.6.5.-A.

[2] **2)** The length of the drift, x_d, shall be calculated as follows:

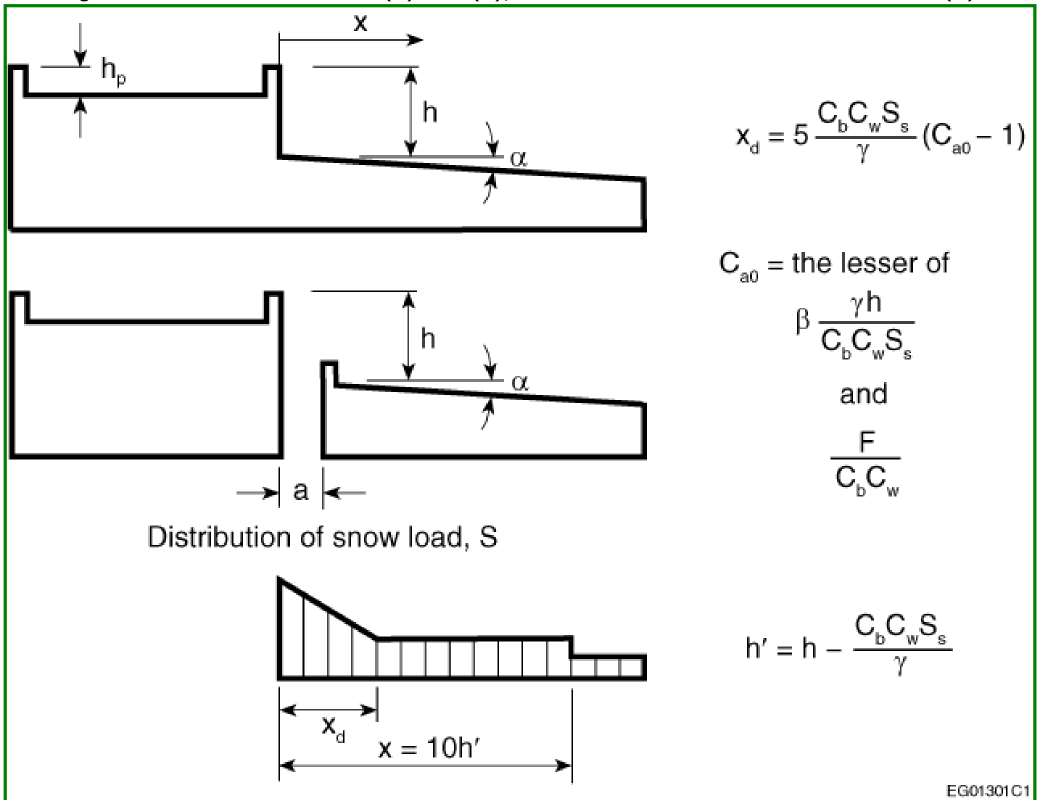
$$x_d = 5\frac{C_b C_w S_s}{\gamma}\left(C_{a0} - 1\right)$$

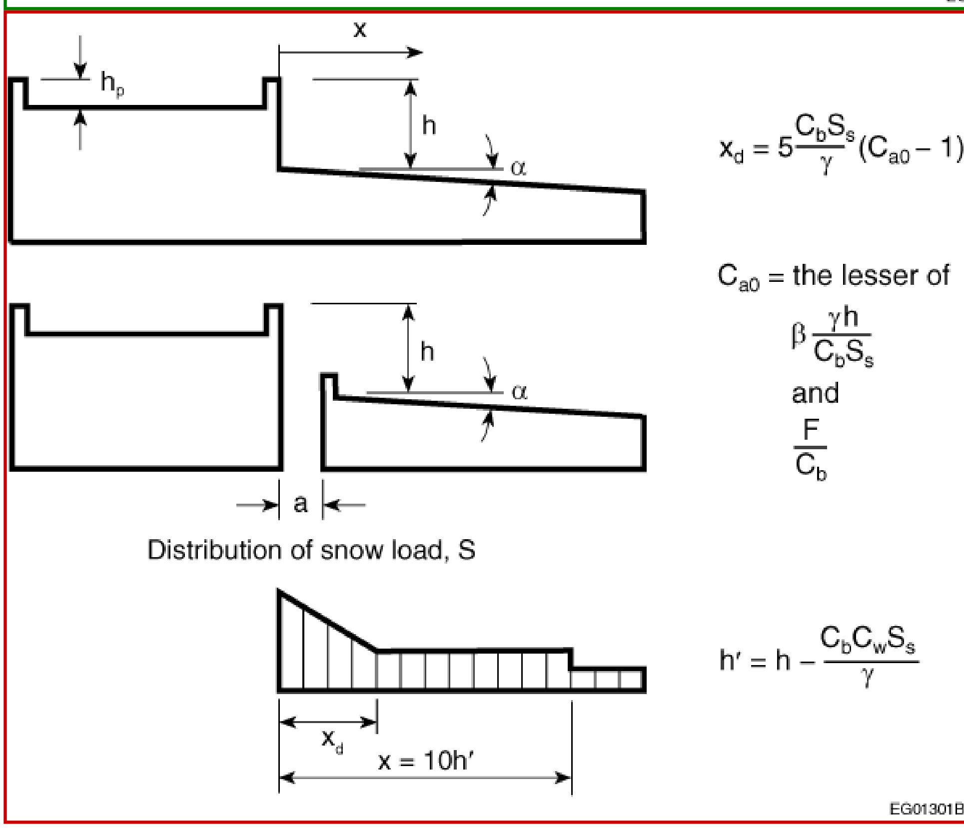
$$\boxed{x_d = 5\frac{C_b S_s}{\gamma}\left(C_{a0} - 1\right)}$$

where

γ = specific weight of snow as specified in Article 4.1.6.13.

Figure [4.1.6.5.-A] 4.1.6.5.-A
Snow load factors for lower level roofs
Forming Part of Sentences 4.1.6.5.(1) and (3), Table 4.1.6.5.-A and Sentence 4.1.6.6.(1)





Notes to Figure 4.1.6.5.-A:

(1) If a > 5 m or h ≤ $0.8S_s/\gamma$, drifting from the higher roof need not be considered.

(2) If h ≥ 5 m, the value of C_{a0} for Case I is permitted to be determined in accordance with Sentence 4.1.6.5.(4).

Table [4.1.6.5.-A] 4.1.6.5.-A
~~Wind Exposure,~~ Slope and Accumulation Factors in Figure 4.1.6.5.-A

Distance from Roof Step, x	Factors		
	~~C_w~~	C_s (1)	C_a
0	~~1.0~~	f(α)	C_{a0}
$0 < x \le x_d$	~~1.0~~	f(α)	$C_{a0} - (C_{a0} - 1)(x/x_d)$
$x_d < x \le 10h'$	~~1.0~~	f(α)	1.0
$x > 10h'$	~~1.0 for unexposed roof areas~~	f(α)	1.0
	~~0.75 for exposed roof areas~~		
	~~0.5 for exposed roof areas north of tree line~~		

Note to Table [4.1.6.5.-A] 4.1.6.5.-A:

(1) For lower roofs with parapets, C_s = 1.0; otherwise, C_s varies as a function of slope, α, as defined in Sentences 4.1.6.2.(5) and (6).

[3] 3) Except as provided in Sentence (4), the value of C_{a0} for each of Cases I, II and III shall be the lesser of

$$C_{a0} = \beta \frac{\gamma h}{C_b C_w S_s}$$

and

$$C_{a0} = \frac{F}{C_b C_w}$$

$$\boxed{C_{a0} = \beta \frac{\gamma h}{C_b S_s} \quad \text{and} \quad C_{a0} = \frac{F}{C_b}}$$

where

β = 1.0 for Case I, and 0.67 for Cases II and III,
h = difference in elevation between the lower roof surface and the top of the parapet on the upper roof as shown in Figure 4.1.6.5.-A, and

$$F = 0.43\,\beta\,F_{ws}\sqrt{\frac{\gamma\left(l_{cs} - 5h'_p\right)}{S_s}} + C_b C_w\text{, but } F \le 5 \text{ for } C_{ws} \ge 1.0$$

$$\boxed{F = 0.35\,\beta\sqrt{\frac{\gamma\left(l_{cs} - 5h'_p\right)}{S_s}} + C_b\text{, but } F \le 5 \text{ for } C_{ws} = 1.0}$$

where

F_{ws} = $0.019(-T_{ws})^{0.45}(V_{ws})^{1.6} + 0.45$, where T_{ws} and V_{ws} are as defined in Sentence 4.1.6.2.(3),
C_{ws} = value of C_w applicable to the source of drifting,

l_{cs} = characteristic length of the source area for drifting, defined as

$l_{cs} = 2w_s - \left(w_s^2 / l_s\right)$, where w_s and l_s are respectively the shorter and longer dimensions of the relevant source areas for snow drifting shown in Figure 4.1.6.5.-B for Cases I, II and III, and

$$h_p' = h_p - \left(\frac{0.8S_s}{\gamma}\right), \text{ but } 0 \le h_p' \le \left(\frac{l_{cs}}{5}\right)$$

where

h_p = height of the roof perimeter parapet of the source area, to be taken as zero unless all the roof edges of the source area have parapets.

[4] **4)** Where h ≥ 5 m, the value of C_{a0} for Case I is permitted to be taken as

$$C_{a0}\left(\frac{25-h}{20}\right)\left(\frac{F}{C_bC_w} - 1\right) + 1 \text{ for } 5\ m \le h \le 25\ m, \text{ and}$$

$$C_{a0} = 1 \text{ for } h > 25\ m$$

$$C_{a0} = \left(\frac{25-h}{20}\right)\left(\frac{F}{C_b} - 1\right) + 1 \text{ for } 5\ m \le h \le 25\ m, \text{ and}$$

$$C_{a0} = 1 \text{ for } h\ >\ 25\ m$$

[5] **5)** The value of C_{a0} shall be the highest of Cases I, II and III, considering the different roof source areas for drifting snow, as specified in Sentences (3) and (4) and Figure 4.1.6.5.-B.

Figure [4.1.6.5.-B] 4.1.6.5.-B
Snow load cases I, II and III for lower level roofs
Forming Part of Sentences 4.1.6.5.(1), (3) and (5), and Table 4.1.6.5.-B

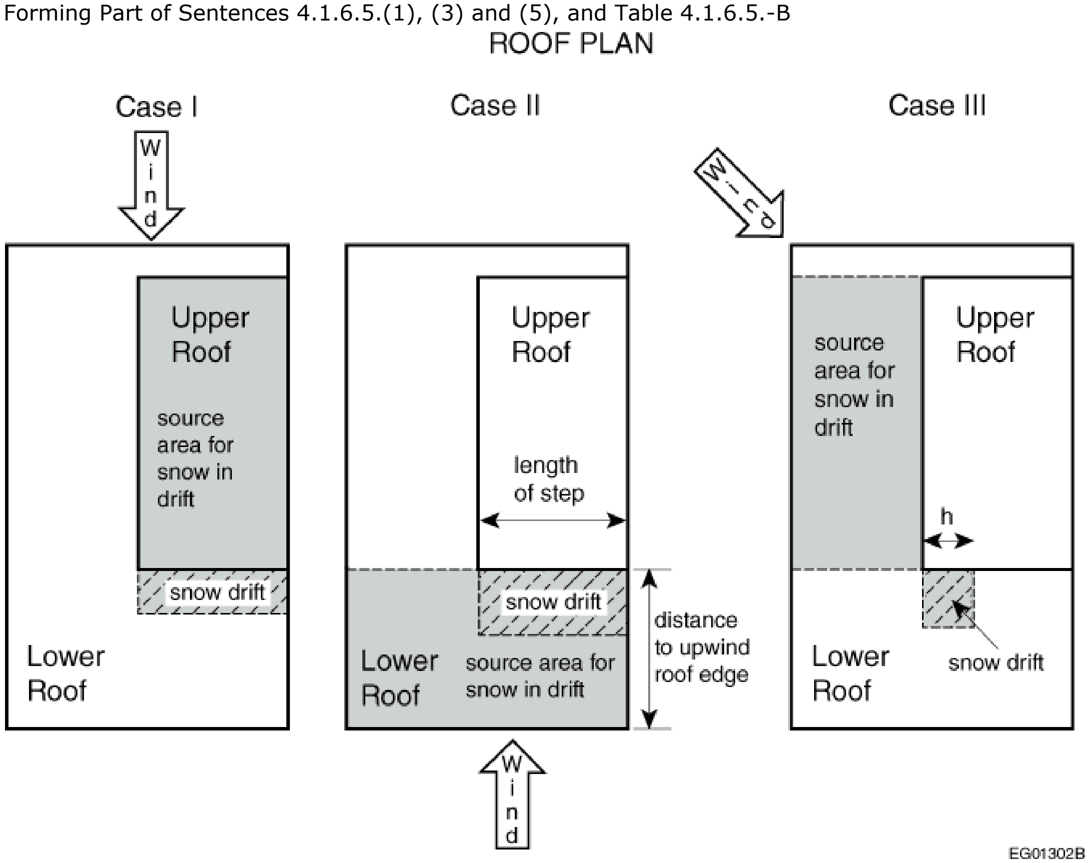


Table [4.1.6.5.-B] 4.1.6.5.-B
Parameters for Snow Load Cases in Figure 4.1.6.5.-B

Parameter	Case I	Case II	Case III
β	1.0	0.67	0.67
h_p	parapet height of upper-roof source area	parapet height of lower-roof source area	parapet height of lower-roof source area
$l_{cs} = 2w_s - \frac{w_s^2}{l_s}$	with w_s and l_s being the shorter and longer dimensions of the upper roof	with w_s and l_s being the shorter and longer dimensions of the source area on the lower roof for upwind-facing step	with w_s and l_s being the shorter and longer dimensions of the source area on the lower roof for downwind-facing step

---

[4.1.6.7.] 4.1.6.7. Areas Adjacent to Roof Projections

[1] **1)** Except as provided in Sentences (2) and (3), the accumulation factor, C_a, for areas adjacent to roof-mounted vertical projections shall be calculated in accordance with Sentence 4.1.6.5.(1) using the following values for the peak accumulation factor, C_{a0}, and the drift length, x_d:

[a] a) C_{a0} shall be taken as the lesser of

$$0.67\frac{\gamma h}{C_b C_w S_s} \text{ and } F_{ws}\left(\frac{\gamma l_0}{7.5 C_b C_w S_s}\right) + 1\text{, and}$$

$$\boxed{0.67\frac{\gamma h}{C_b S_s} \text{and} \frac{\gamma l_0}{7.5 C_b S_s} + 1\text{, and}}$$

[b] b) x_d shall be taken as the lesser of 3.35h and (2/3)l_0, where

F_{ws} = as defined in Sentence 4.1.6.5.(3),
h = height of the projection, and
l_0 = longest horizontal dimension of the projection.

(See Note A-4.1.6.7.(1).)

[2] **2)** C_a is permitted to be calculated in accordance with Article 4.1.6.5. for larger projections. (See Note A-4.1.6.7.(2).)

[3] **3)** Where the longest horizontal dimension of the roof projection, l_0, is less than 3 m, the drift surcharge adjacent to the projection need not be considered.

[4.1.6.9.] 4.1.6.9. Gable Roofs

(See Note A-4.1.6.9.)

[1] **1)** For all gable roofs, the full and partial load cases defined in Article 4.1.6.3. shall be considered.

[2] **2)** For gable roofs with a slope α > 15°, the unbalanced load case shall also be considered by setting the values of the accumulation factor, C_a, as follows:

[a] a) on the upwind side of the roof peak, C_a shall be taken as 0, and

[b] b) on the downwind side of the roof peak, C_a shall be taken as

[i] i) F_{ws}(0.25 + α/20)~~, where~~ for 15° ≤ α ≤ 20°, and

[ii] ii) 1.25F_{ws}~~, where~~ for 20° < α ≤ 90°~~.~~, where F_{ws} is as defined in Sentence 4.1.6.5.(3).

[3] **3)** For all gable roofs, the slope factor, C_s, shall be as prescribed in Sentences 4.1.6.2.(5) and (6).

[4] **4)** For all gable roofs, the wind exposure factor, C_w, shall be

[a] a) as prescribed in Sentences 4.1.6.2.(3) and (4) for the full and partial load cases, and

[b] b) 1.0 or the value prescribed in Sentence 4.1.6.2.(3)~~1.0~~, whichever is greater, for the unbalanced load case referred to in Sentence (2).

[4.1.6.10.] 4.1.6.10. Arch Roofs, Curved Roofs and Domes

[1] **1)** For all arch roofs, curved roofs and domes, the full and partial load cases defined in Article 4.1.6.3. shall be considered.

[2] **2)** For arch roofs, curved roofs and domes with a rise-to-span ratio h/b > 0.05 (see Figure 4.1.6.10.-A), the load cases provided in Sentences (3) to (7) shall also be considered.

[3] **3)** For arch roofs with a slope at the edge $\alpha_e \leq 30°$ (see Figure 4.1.6.10.-A and Table 4.1.6.10.), C_a shall be

[a] a) taken as 0 on the upwind side of the peak, and

[b] b) on the downwind side of the peak, taken as

$$C_a = F_{ws}\left(\frac{xh}{0.03C_bC_wb^2}\right) \text{ for } 0.05 < \frac{h}{b} \leq 0.12, \text{ and}$$

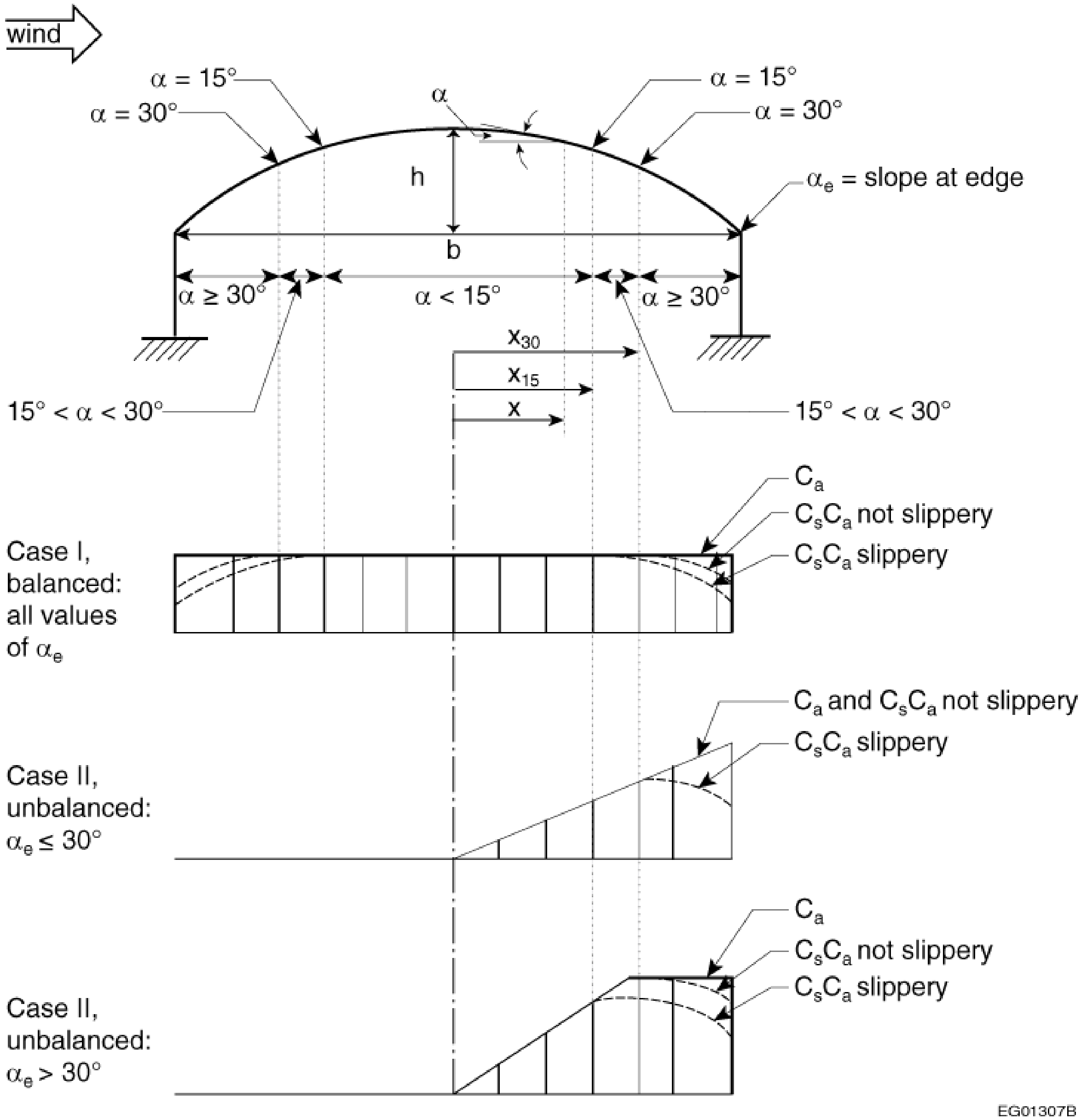
$$C_a = F_{ws}\left(\frac{4x}{C_bC_wb}\right) \text{ for } \frac{h}{b} > 0.12$$

$$\boxed{C_a = \frac{xh}{0.03C_bb^2} \text{ for } 0.05 < \frac{h}{b} \leq 0.12 \text{ and} \quad C_a = \frac{4x}{C_bb} \text{ for } \frac{h}{b} > 0.12}$$

where

F_{ws} = as defined in Sentence 4.1.6.5.(3),
x = horizontal distance from the roof peak,
h = height of arch, and
b = width of arch.

Figure [4.1.6.10.-A] 4.1.6.10.-A
Accumulation factors for arch roofs and curved roofs
Forming Part of Sentences 4.1.6.10.(2) to (4)



Note to Figure 4.1.6.10.-A:

(1) Refer to Table 4.1.6.10. for applicable values of C_w and Sentences 4.1.6.2.(5) and (6) for applicable values of C_s.

[4] **4)** For arch roofs with a slope at the edge $\alpha_e > 30°$ (see Figure 4.1.6.10.-A and Table 4.1.6.10.), C_a shall be

[a] a) taken as 0 on the upwind side of the peak, and

[b] b) on the downwind side of the peak,

[i] i) for the part of the roof between the peak and point where the slope $\alpha = 30°$, taken as

$$C_a = F_{ws}\left(\frac{xh}{0.06 C_b C_w x_{30} b}\right) \text{ for } 0.05 < \frac{h}{b} \le 0.12, \text{ and}$$

$$C_a = F_{ws}\left(\frac{2x}{C_b C_w x_{30}}\right) \text{ for } \frac{h}{b} > 0.12$$

$$\boxed{\begin{array}{c} C_a = \dfrac{\mathrm{xh}}{0.06C_b x_{30} b} \text{ for } 0.05 < \dfrac{h}{b} \le 0.12\text{, and} \\ C_a = \dfrac{2x}{C_b x_{30}} \text{ for } \dfrac{h}{b} > 0.12 \end{array}}$$

where

F_{ws} = as defined in Sentence 4.1.6.5.(3),
x, h, b = as specified in Sentence (2), and
x_{30} = value of x where the slope α = 30°, and

[ii] ii) for the part of the roof where the slope α > 30°, taken as

$$C_a = F_{ws}\left(\frac{h}{0.06C_bC_wb}\right) \text{ for } 0.05 < \frac{h}{b} \le 0.12\text{, and}$$

$$C_a = F_{ws}\left(\frac{2}{C_bC_w}\right) \text{ for } \frac{h}{b} > 0.12$$

$$\boxed{\begin{array}{c} C_a = \dfrac{h}{0.06C_b b} \text{ for } 0.05 < \dfrac{h}{b} \le 0.12\text{,and} \\ C_a = \dfrac{2}{C_b} \text{ for } \dfrac{h}{b} > 0.12 \end{array}}$$

[5] **5)** Except as provided in Sentence (6), C_a for curved roofs shall be determined in accordance with the requirements for arch roofs stated in Sentences (3) and (4).

Table [4.1.6.10.] 4.1.6.10.
Load Cases for Arch Roofs, Curved Roofs and Domes
Forming Part of Sentences [4.1.6.10.] 4.1.6.10.([3] 3), ([4] 4) and ([9] 9)

Load Case	**Range of Application**	**Factors**			
		All Arch or Curved Roofs and Domes	**Arch and Curved Roofs**		**Domes**
		C_w	**C_a Upwind Side**	**C_a Downwind Side**	**C_a Downwind Side**
Case I	All values of h/b	As stated in 4.1.6.2.(3) and (4)	1.0	1.0	1.0
Case II	Slope at edge ≤ 30° h/b > 0.05 all values of x	1.0	0.0	$C_a = F_{ws}\left(\frac{xh}{0.03C_bC_wb^2}\right)$ for $\frac{h}{b} \le 0.12$ $C_a = F_{ws}\left(\frac{4x}{C_bC_wb}\right)$ for $\frac{h}{b} > 0.12$ $\boxed{C_a = \frac{xh}{0.03C_bb^2} \text{ for } \frac{h}{b} \le 0.12}$ $\boxed{C_a = \frac{4x}{C_bb} \text{ for } \frac{h}{b} > 0.12}$	$C_a(x,y) = C_a(x,0)\left(1 - \frac{y}{r}\right)$

Load Case	**Range of Application**	**Factors**			
		All Arch or Curved Roofs and Domes	**Arch and Curved Roofs**		**Domes**
		C_w	**C_a Upwind Side**	**C_a Downwind Side**	**C_a Downwind Side**
	Slope at edge > 30° h/b > 0.05 $0 < x < x_{30}$	1.0	0.0	$C_a = F_{ws}\left(\frac{xh}{0.06C_bC_wx_{30}b}\right)$ for $\frac{h}{b} \le 0.12$ $C_a = F_{ws}\left(\frac{2x}{C_bC_wx_{30}}\right)$ for $\frac{h}{b} > 0.12$ $\boxed{C_a = \frac{xh}{0.06C_bx_{30}b} \text{ for } \frac{h}{b} \le 0.12}$ $\boxed{C_a = \frac{2x}{C_bx_{30}} \text{ for } \frac{h}{b} > 0.12}$	
	Slope at edge > 30° h/b > 0.05 $x \ge x_{30}$	1.0	0.0	$C_a = F_{ws}\left(\frac{h}{0.06C_bC_wb}\right)$ for $\frac{h}{b} \le 0.12$ $C_a = F_{ws}\left(\frac{2}{C_bC_w}\right)$ for $\frac{h}{b} > 0.12$ $\boxed{C_a = \frac{h}{0.06C_bb} \text{ for } \frac{h}{b} \le 0.12}$ $\boxed{C_a = \frac{2}{C_b} \text{ for } \frac{h}{b} > 0.12}$	

[6] **6)** Where the slope, α, of a curved roof at its peak is greater than 10°, C_a shall be determined in accordance with the requirements for gable roofs stated in Article 4.1.6.9. using a slope equal to the mean slope of the curved roof.

[7] **7)** For domes of circular plan form (see Figure 4.1.6.10.-B), C_a shall

[a] a) along the central axis parallel to the wind, vary in the same way as for an arch roof with the same rise-to-span ratio, h/b, and

[b] b) off this axis, vary according to

$$C_a(x,y) = C_a(x,0)\left(1 - \frac{y}{r}\right)$$

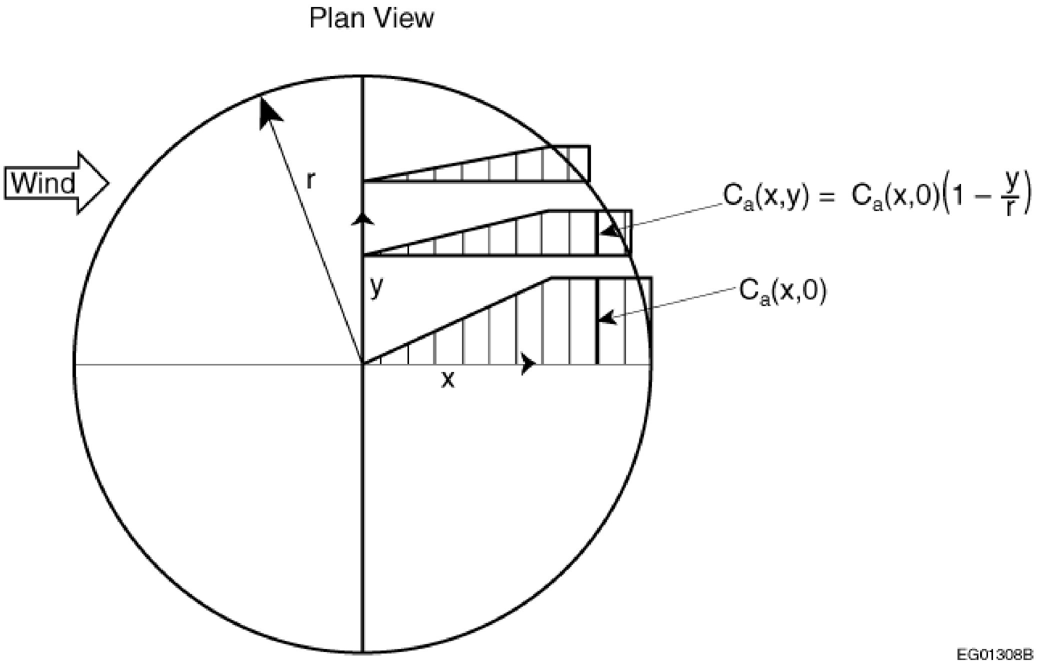
where

$C_a(x,y)$ = value of C_a at location (x,y),
$C_a(x,0)$ = value of C_a on the central axis parallel to the wind,
x = distance along the central axis parallel to the wind,
y = horizontal coordinate normal to the x direction, and
r = radius of dome.

[8] **8)** For all arch roofs, curved roofs and domes, the slope factor, C_s, shall be as prescribed in Sentences 4.1.6.2.(5) and (6).

[9] **9)** For all arch roofs, curved roofs and domes, the wind exposure factor, C_w, shall be as prescribed in Table 4.1.6.10.

Figure [4.1.6.10.-B] 4.1.6.10.-B
Unbalanced snow accumulation factor on a circular dome
Forming Part of Sentence 4.1.6.10.(7)



Notes to Figure 4.1.6.10.-B:

(1) Refer to Table 4.1.6.10. for applicable values of C_w and Sentences 4.1.6.2.(5) and (6) for applicable values of C_s.

(2) Refer to Sentences 4.1.6.10.(3) and (4) for the calculation of $C_a(x,0)$.

[4.1.7.3.] 4.1.7.3. Static Procedure

[1] **1)** The specified external pressure or suction due to wind on part or all of a surface of a *building* shall be calculated as follows:

$$p = I_W q C_e C_t C_g C_p$$

where

p	= specified external pressure acting statically and in a direction normal to the surface, considered positive when the pressure acts towards the surface and negative when it acts away from the surface,
I_W	= importance factor for wind load, as provided in Table 4.1.7.3.,
q	= reference velocity pressure, as provided in Sentence (4),
C_e	= exposure factor, as provided in Sentences (5) and (7),
C_t	= topographic factor, as provided in Article 4.1.7.4.,
C_g	= gust effect factor, as provided in Sentence (8), and
C_p	= external pressure coefficient, as provided in Articles 4.1.7.5. and 4.1.7.6.

Table [4.1.7.3.] 4.1.7.3.
Importance Factor for Wind Load, I_W
Forming Part of Sentences [4.1.7.3.] 4.1.7.3.([1] 1) and 4.1.7.8.(4)

Importance Category	Importance Factor, I_W	
	ULS	SLS
Low	0.8	~~0.75~~0.6
Normal	1	~~0.75~~0.6
High	1.15	~~0.75~~0.6
Post-disaster	1.25	~~0.75~~0.6

[2] **2)** The net wind load for the *building* as a whole shall be the algebraic difference of the loads on the windward and leeward surfaces, and in some cases, may be calculated as the sum of the products of the external pressures or suctions and the areas of the surfaces over which they are averaged as provided in Sentence (1).

[3] **3)** The net specified pressure due to wind on part or all of a surface of a *building* shall be the algebraic difference, such as to produce the most critical effect, of the external pressure or suction calculated in accordance with Sentence (1) and the specified internal pressure or suction due to wind calculated as follows:

$$p_i = I_W q C_{ei} C_t C_{gi} C_{pi}$$

where

p_i = specified internal pressure acting statically and in a direction normal to the surface, either as a pressure directed towards the surface or as a suction directed away from the surface,
I_W, q, C_t = as defined in Sentence (1),
C_{ei} = exposure factor for internal pressure, as provided in Sentence (7),
C_{gi} = internal gust effect factor, as provided in Sentence (10), and
C_{pi} = internal pressure coefficient, as provided in Article 4.1.7.7.

[4] **4)** The reference velocity pressure, q, shall be the appropriate value determined in conformance with Subsection 1.1.3., based on a probability of being exceeded in any one year of 1 in 50.

[5] **5)** The exposure factor, C_e, shall be based on the reference height, h, determined in accordance with Sentence (6), for the surface or part of the surface under consideration and shall be

[a] a) $(h/10)^{0.2}$ but not less than 0.9 for open terrain, where open terrain is level terrain with only scattered *buildings*, trees or other obstructions, open water or shorelines thereof,

[b] b) $0.7(h/12)^{0.3}$ but not less than 0.7 for rough terrain, where rough terrain is suburban, urban or wooded terrain extending upwind from the *building* uninterrupted for at least 1 km or 20 times the height of the *building*, whichever is greater, or

[c] c) an intermediate value between the two exposures defined in Clauses (a) and (b) in cases where the site is less than 1 km or 20 times the height of the *building* from a change in terrain conditions, whichever is greater, provided an appropriate interpolation method is used (see Note A-4.1.7.3.(5)(c)).

[6] **6)** The reference height, h, shall be determined as follows:

[a] a) for *buildings* whose height is less than or equal to 20 m and less than the smaller plan dimension, h shall be the mid-height of the roof above *grade*, but not less than 6 m,

[b] b) for other *buildings*, h shall be

[i] i) the actual height above *grade* of the point on the windward wall for which external pressures are being calculated,

[ii] ii) the mid-height of the roof for pressures on surfaces parallel to the wind direction, and

[iii] iii) the mid-height of the *building* for pressures on the leeward wall, and

[c] c) for any structural element exposed to wind, h shall be the mid-height of the element above the ground.

[7] **7)** The exposure factor for internal pressures, C_{ei}, shall be determined as follows:

[a] a) for *buildings* whose height is greater than 20 m and that have a dominant opening, C_{ei} shall be equal to the exposure factor for external pressures, C_e, calculated at the mid-height of the dominant opening, and

[b] b) for other *buildings*, C_{ei} shall be the same as the exposure factor for external pressures, C_e, calculated for a reference height, h, equal to the mid-height of the *building* or 6 m, whichever is greater.

[8] **8)** Except as provided in Sentences (9) and 4.1.7.6.(1), the gust effect factor, C_g, shall be one of the following values:

[a] a) 2.0 for the *building* as a whole and main structural members, or

[b] b) 2.5 for external pressures and suctions on secondary structural members, including cladding.

[9] **9)** For cases where C_g and C_p are combined into a single product, C_gC_p, the values of C_g and C_p need not be independently specified. (See Article 4.1.7.6.)

[10] **10)** The internal gust effect factor, C_{gi}, shall be 2.0, except it is permitted to be calculated using the following equation for large structures enclosing a single large unpartitioned volume that does not have numerous overhead doors or openings:

$$C_{gi} = 1 + \frac{1}{\sqrt{1 + \frac{V_0}{6950A}}}$$

where

V_0 = internal volume, in m^3, and
A = total area of all exterior openings of the volume, in m^2.

(See Note A-4.1.7.3.(10).)

[4.1.8.2.] 4.1.8.2. Notation

[1] **1)** In this Subsection

A_r = element or component force amplification factor to account for type of attachment, as defined in Sentence 4.1.8.18.(1),

A_x = height factor at level x to account for variation of response of an element or component with elevation within the *building*, as defined in Sentence 4.1.8.18.(1),

B_x = ratio at level x used to determine torsional sensitivity, as defined in Sentence 4.1.8.11.(10),

B = maximum value of B_x, as defined in Sentence 4.1.8.11.(10),

C_p = seismic coefficient for an element or component, as defined in Sentence 4.1.8.18.(1),

D_{nx} = plan dimension of the *building* at level x perpendicular to the direction of seismic loading being considered,

e_x = distance measured perpendicular to the direction of earthquake loading between centre of mass and centre of rigidity at the level being considered (see Note A-4.1.8.2.(1)),

F_a = acceleration-based site coefficient for application in standards referenced in Subsection 4.1.8., as defined in Sentence 4.1.8.4.(7),

F_s = site coefficient as defined in Sentence 4.1.8.1.(2) for application in Article 4.1.8.1.,

F_t = portion of V to be concentrated at the top of the structure, as defined in Sentence 4.1.8.11.(7),

F_v = velocity-based site coefficient for application in standards referenced in Subsection 4.1.8., as defined in Sentence 4.1.8.4.(7),

F_x	= lateral force applied to level x, as defined in Sentence 4.1.8.11.(7),
h_i, h_n, h_x	= height, in m, above the base (i = 0) to level i, n, or x respectively, where the base of the structure is the level at which horizontal earthquake motions are considered to be imparted to the structure,
h_s	= inter*storey* height ($h_i - h_{i-1}$),
I_E	= earthquake importance factor of the structure, as described in Sentence 4.1.8.5.(1),
J	= numerical reduction coefficient for base overturning moment, as defined in Sentence 4.1.8.11.(6),
J_x	= numerical reduction coefficient for overturning moment at level x, as defined in Sentence 4.1.8.11.(8),
Level i	= any level in the *building*, i = 1 for first level above the base,
Level n	= level that is uppermost in the main portion of the structure,
Level x	= level that is under design consideration,
M_v	= factor to account for higher mode effects on base shear, as defined in Sentence 4.1.8.11.(6),
M_x	= overturning moment at level x, as defined in Sentence 4.1.8.11.(8),
N	= total number of *storeys* above exterior *grade* to level n,
$\overline{N}_{60}$	= average standard penetration resistance, in blows per 0.3 m, in the top 30 m of *soil*, corrected to a rod energy efficiency of 60% of the theoretical maximum,
PGA(X)	= peak ground acceleration, expressed as a ratio to gravitational acceleration, for site designation X, as defined in Sentence 4.1.8.4.(1),
PGV(X)	= peak ground velocity, in m/s, for site designation X, as defined in Sentence 4.1.8.4.(1),
PI	= plasticity index for *soil*,
R_d	= ductility-related force modification factor reflecting the capability of a structure to dissipate energy through reversed cyclic inelastic behaviour, as defined in Article 4.1.8.9.,
R_o	= overstrength-related force modification factor accounting for the dependable portion of reserve strength in a structure designed according to these provisions, as defined in Article 4.1.8.9.,
R_p	= element or component response modification factor, as defined in Sentence 4.1.8.18.(1),
R_s	= combined overstrength and ductility-related modification factor, as defined in Sentence 4.1.8.1.(7), for application in Article 4.1.8.1.,
$S_a(T,X)$	= 5%-damped spectral acceleration, expressed as a ratio to gravitational acceleration, at period T for site designation X, as defined in Sentence 4.1.8.4.(1),
SC	= Seismic Category assigned to a *building* based on its Importance Category and the design spectral acceleration values at periods of 0.2 s and 1.0 s, as defined in Article 4.1.8.5.,
SFRS	= seismic force resisting system, that part of the structural system that has been considered in the design to provide the required resistance to the earthquake forces and effects defined in Subsection 4.1.8.,
S_p	= horizontal force factor for part or portion of a *building* and its anchorage, as given in Sentence 4.1.8.18.(1),
S(T)	= design spectral acceleration, expressed as a ratio to gravitational acceleration, at period T, as defined in Sentence 4.1.8.4.(6),
$\overline{s}_u$	= average undrained shear strength, in kPa, in the top 30 m of *soil*,
T	= period, in s,
T_a	= fundamental lateral period of vibration of the *building* or structure, in s, in the direction under consideration, as defined in Sentence 4.1.8.11.(3),
TDD	= total design displacement of any point in a seismically isolated structure, within or above the isolation system, obtained by calculating the mean + (I_E × the standard deviation) of the peak horizontal displacements from all sets of ground motion time histories analyzed,

but not less than $\sqrt{I_E}$ × the mean, where the peak horizontal displacement is based on the vector sum of the two orthogonal horizontal displacements considered for each time step,

T_s	= fundamental lateral period of vibration of the *building* or structure, in s, in the direction under consideration, as defined in Sentence 4.1.8.1.(7),
T_x	= floor torque at level x, as defined in Sentence 4.1.8.11.(11),
V	= specified lateral earthquake force at the base of the structure, as determined in Article 4.1.8.11.,
V_d	= specified lateral earthquake force at the base of the structure, as determined in Article 4.1.8.12.,
V_e	= lateral earthquake elastic force at the base of the structure, as determined in Article 4.1.8.12.,
V_{ed}	= adjusted lateral earthquake elastic force at the base of the structure, as determined in Article 4.1.8.12.,
V_p	= specified lateral earthquake force on an element or component, as determined in Article 4.1.8.18.,
V_s	= specified lateral earthquake force at the base of the structure, as determined in Sentence 4.1.8.1.(7), for application in Article 4.1.8.1.,
V_{s30}	= average shear wave velocity, in m/s, in the top 30 m of *soil* or *rock,*
W	= specified *dead load*, as defined in Article 4.1.4.1., except that the minimum *partition* weight as defined in Sentence 4.1.4.1.(3) need not exceed 0.5 kPa, plus 15%~~25%~~ of the specified snow load as defined in Subsection 4.1.6., plus 60% of the storage load for areas used for storage, except that *storage garages* need not be considered storage areas, and the full contents of any tanks (see Note A-4.1.8.2.(1)),
W_i, W_x	= portion of W that is located at or is assigned to level i or x respectively,
W_p	= weight of a part or portion of a structure, e.g., cladding, *partitions* and appendages,
X	= site designation, either X_V or X_S,
X_S	= site designation in terms of Site Class, where S is the Site Class determined in accordance with Sentence 4.1.8.4.(3),
X_V	= site designation in terms of V_{s30}, where V is the V_{s30} value calculated from in situ measurements of shear wave velocity,
X_{450}	= site designation X_V with V_{s30} = 450 m/s,
δ_{ave}	= average displacement of the structure at level x, as defined in Sentence 4.1.8.11.(10), and
δ_{max}	= maximum displacement of the structure at level x, as defined in Sentence 4.1.8.11.(10).

Impact analysis

To evaluate the expected cost impacts of the proposed change on both the structural design and the building envelope design, buildings located in 17 major cities selected to represent the variability in climate parameters across Canada were assessed, namely: British Columbia: Vancouver, Victoria; Alberta: Calgary, Edmonton; Saskatchewan: Regina; Manitoba: Winnipeg; Ontario: Ottawa, Toronto, Thunder bay; Quebec: Montréal, Québec City; New Brunswick: Fredericton; Nova Scotia: Halifax; Prince Edward Island: Charlottetown; Newfoundland and Labrador: St John's; Yukon: Whitehorse; Nunavut: Iqaluit.

Three building archetypes of 2-storey (with steel, concrete or wood primary structure), 10-storey (with steel, concrete or wood primary structure) and 20-storey (with steel or concrete primary structure) were considered for each location, each with a footprint of 800 m^2 (i.e., covered under Part 4 of the NBC; see Figure 1). These building archetypes were intended to represent typical building forms commonly seen for commercial or multi-unit residential buildings across Canada. The full impact analysis is included in [6].

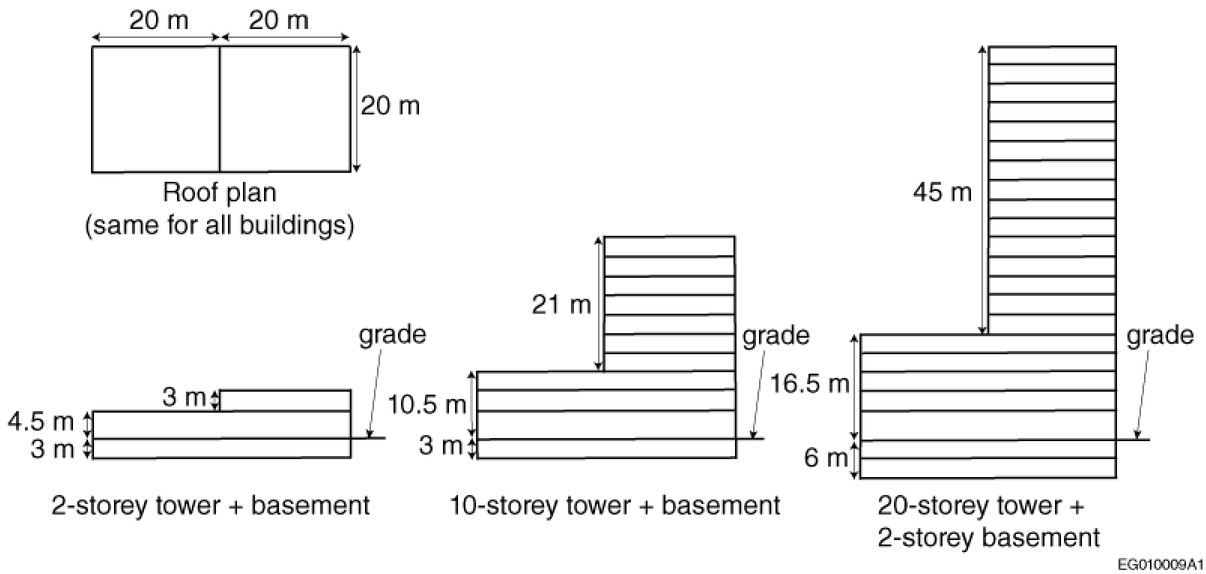


Figure 1. Building archetypes: 2-storey, 10-storey, and 20-storey towers with podium sections.

1. Impact on the structural design

The study included the cost of each structure as a new build under both the existing NBC 2020 provisions and the proposed change.

Three construction materials were considered in this impact assessment: concrete, steel and cross-laminated timber (CLT). The costs of the construction materials per unit were determined based on RMS Online Construction Base for each of the 17 locations, except for Iqaluit where the data was not available and, as such, was determined based on the data for the nearest Canadian city.

The proposed change, including the impact of climate change on building design and material selection, affects structural design wind loads differently for different city locations. The change in the overturning moments are mostly within 10%, except for the locations of Thunder Bay and Vancouver. Although the interstorey drift was found to increase for some locations, the magnitude of the increase was negligible relative to the building design capacity.

For concrete building archetypes, the results of the assessments show that the cost change due to the proposed change, with consideration of the impact of climate change on building design and material selection, was within 0.1% for all locations and building heights examined in this study.

For steel building archetypes, the results of the assessments show that the change in cost due to the proposed change, with consideration of the impact of climate change on building design and material selection, was within 2% for all locations and building heights examined in this study.

For CLT building archetypes, the results of the assessments show that the change in cost due to the proposed change, with consideration of the impact of climate change on building design and material selection, was within 0.5% for all locations and building heights examined in this study.

In general, the proposed change is expected to have negligible to very small economic impact on the cost of a new structure, primarily due to the following:

- In regions where seismic forces govern, changes to the wind or snow load do not result in a significant impact on structural costs.
- Moving to the uniform risk approach for the NBC 2025 results in a decrease to wind and snow loads at the 1/500 or 1/1000 annual probability of exceedance in several cases.
- For the building archetypes assessed, there was little impact on the lateral systems, implying that additional structural reinforcement would not be warranted.

With respect to structural design and material selection for new concrete, structural steel and CLT buildings, the greatest cost impact was a 1.5% increase for a 2-storey steel building located in St. John’s. When the proposed change was considered in the assessment, for the majority of cases, no changes were evident or a decrease to the cost was found. Overall, the costs for reinforcement were negligible relative to the total costs of the buildings. In some regions, seismic loads were found to govern the cost of the building, regardless of the changes to the wind and snow loads.

2. Impact on the building envelope

The impact assessment pertaining to building envelope design was conducted for the 17locations across Canada, as previously identified. Wind loads on wall, roof and fenestration assemblies, and snow loads on roofs were determined for the three building archetypes considered in this study. These configurations included both steel and wood stud wall cladding, as well as different roof assemblies and fenestration systems. The configurations were selected based on conventional design choices for the respective building archetypes.

Economic impacts of the proposed change were determined for wall assemblies, roof assemblies and fenestration systems and are presented in Supplementary Report B in [6]. A summary of the findings is provided below.

2.1 Wall assemblies

It was noted that in cases of increased load demands due to the proposed change, the magnitude of the increase was typically found to be within the range that a designer could accommodate within the existing structural design capacity or through solutions such as minor detailing, connections or spans and that would not affect costs.

For projects where the existing capacity or minor design changes were insufficient, it was determined that decreasing the spacing of secondary supporting structures could provide a solution (e.g., changing the spacing of secondary supporting structures from 16 in. to 12 in.). In cases where a reduced spacing for secondary supporting structures would be required to satisfy the proposed change, it was shown that costs would increase by up to 6.8% for buildings located in the five climate zones investigated. The potential maximum cost increases are summarized in Table 1 below. There was little difference between the maximum and average cost increases for the locations considered (within 0.2% for all cases); as such, only the maximum values are presented in the Table.

Table 1: Maximum Percentage Cost Increase by Wall Assembly Type Based on Decreasing Support Spacing from 16 in. to 12 in.

Wall Assembly(1)	Maximum Cost Increase
W1 - Exterior insulated steel stud wall, fiber cement cladding	6.8%
W2 - Exterior insulated steel stud wall, metal panel cladding	3.2%
W3 - Exterior insulated steel stud wall, brick cladding	0.5%
W4 - Interior insulated wood-framed wall, wood siding	2.0%
W5 - Interior insulated wood-framed wall, brick cladding	0.5%
W6 - Split insulated wood-framed wall, wood siding	1.7%
W7 - Split insulated wood-framed wall, brick cladding	0.5%

Note to Table 1:
(1) Wall types W1, W2 and W3 are applicable to all three building archetypes, while the remaining wall types (W4 to W7) are only applicable to the 2- and 10-storey buildings.

2.2 Roof assemblies

Findings show that for positive pressures that impart a compressive force on roofing materials, the compressive strength of the roofing materials far exceeds any observed increases in positive roof load; therefore, no significant increases in costs are expected.

For negative pressures, the impacts are dependent on the roof assembly construction type, namely, mechanically secured or ballasted. For mechanically secured roofs, the estimated potential maximum cost increase was determined to be 5%. In providing this estimate, it was noted that additional fasteners would only be required in localized areas across the roof. This is taken to mean that, if only 50% of the roof required additional fasteners, the cost impact would be half of 5% (i.e., 2.5%) or less.

For ballasted roofs, the estimated potential maximum cost increase was determined to be 3%, based on increased aggregate costs.

It is important to note that these cost increases are maximum cost increases and do not apply to every building archetype or to every roof zone within a given building archetype and roof construction configuration. Similarly to wall pressures, roof uplift pressure differences from the NBC 2020 to the proposed NBC 2025 provisions range from −2% to +13%, with an average difference of +4% across the 17 cities investigated. Therefore, a pressure difference to cost increase relationship can be determined on a city-by-city basis, based on the maximum change in wind pressure (+13%) and the maximum cost differences (3% and 5%). Where factored wind pressures decreased, the cost increases were set to 0%.

Table 2: Maximum Percentage Cost Increase by City Based on Roof Assembly Construction

City	Increase in Factored Wind Pressure	Maximum Increase in Cost, Mechanically Secured Roofs	Maximum Increase in Cost, Ballasted Roofs
Calgary	−2%	0%	0%
Charlottetown	7%	3%	2%
Edmonton	−2%	0%	0%
Fredericton	5%	2%	1%
Halifax	7%	3%	2%
Iqaluit	2%	1%	0%
Montréal	2%	1%	0%
Ottawa	7%	3%	2%
Québec City	2%	1%	0%
Regina	−1%	0%	0%
St John’s	7%	3%	2%
Thunder Bay	13%	5%	3%
Toronto	7%	3%	2%
Vancouver	10%	4%	2%
Victoria	3%	1%	1%
Whitehorse	7%	3%	2%
Winnipeg	0%	0%	0%

From Table 2, the average maximum cost increase is 1.8% for mechanically secured roofs and 1.1% for ballasted roofs, which assumes a 0% increase in cost in locations where factored pressures decrease.

2.3 Fenestration

While there could be cost implications associated with the proposed change, it may also be possible for designers to avoid these cost implications through value engineering solutions. The situation is similar to that for wall and roof assemblies.

The cost implications of increasing the frame depth for three fenestration systems were considered. The biggest cost increase was seen for aluminum curtain wall systems for which the frame depth increased from 7.5 in. to 10.5 in.; this corresponds to a maximum cost increase of 13.33%.

Table 3: Maximum Percentage Cost Increase by Fenestration Assembly Type Based on Indicated Frame Depth Increase

Fenestration Assembly	Maximum Cost Increase
F1 - Aluminum curtain wall, double glazed, 6 in. to 7.5 in. frame	3.45%
F1 - Aluminum curtain wall, double glazed, 7.5 in. to 10.5 in. frame	13.33%
F1 - Aluminum curtain wall, triple glazed, 6.75 in. to 8.25 in. frame	3.03%

Table 3: Maximum Percentage Cost Increase by Fenestration Assembly Type Based on Indicated Frame Depth Increase (Continued)

Fenestration Assembly	Maximum Cost Increase
F1 - Aluminum curtain wall, triple glazed, 8.25 in. to 11.25 in. frame	11.76%
F2 - Aluminum punched window, double glazed, 4 in. to 5 in. frame	3.57%
F2 - Aluminum punched window, double glazed, 5 in. to 6 in. frame	3.45%
F2 - Aluminum punched window, triple glazed, 4 in. to 5 in. frame	3.13%
F2 - Aluminum punched window, triple glazed, 5 in. to 6 in. frame	3.03%

As above, wall types W1, W2 and W3 are applicable to all three building archetypes, while the remaining wall types (W4 to W7) are only applicable to the 2- and 10-storey buildings.

The percentage of window assemblies that would require changes to their frame depth to accommodate increased loads was not quantified in this study. Mullion stress was found to decrease in 4 out of the 17 locations considered; it can, therefore, be concluded that the proposed change would not result in any cost increases. A further 6 of the 17 locations showed nominal mullion stress increases (5% or less). Similarly to what was observed for the other assemblies, the largest increase in mullion stress, 11%, was found for Thunder Bay.

With respect to vinyl punched windows, which were only considered for the 2-storey building archetype, exceeding the load case requirements in the NBC 2020 and the proposed change indicates that there are no cost implications for this specific type of fenestration system.

In summary, the effects of the slight changes in the specified wind loads and snow loads (in the North only), are not expected to significantly increase the total cost of a new building. While changes in some locations may seem significant, the approach being proposed is reasonably simple and is not disruptive to the current practice.

The main benefit of the proposed change is a lower risk of failure during the building service life as compared to past practice.

In most cases, it is expected that common construction methods, material spacings, and design considerations would prove to be resilient enough that no significant additional measures or costs are needed to satisfy the engineering design resulting from the shift to the proposed uniform risk approach and climate change factors.

References

[6] RWDI Report No. 1702484 (2023). Code Amendments for Climate Change and Economic Impact Assessment.

Enforcement implications

There are no foreseeable enforcement implications.

Who is affected

Designers, architects, building regulators and building owners.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[4.1.3.2.] 4.1.3.2. ([1] 1) [F20-OP2.1] [F22-OP2.4]

[4.1.3.2.] 4.1.3.2. ([1] 1) [F20-OS2.1]

[4.1.3.2.] **4.1.3.2. ([2] 2) [F20-OS2.1] [F22-OS2.4,OS2.5]** Applies to the stabilizing resistance of the *dead load*.

[4.1.3.2.] **4.1.3.2. ([2] 2) [F20-OP2.1] [F22-OP2.4,OP2.5]**

[4.1.3.2.] **4.1.3.2. ([3] 3) [F20-OS2.1] [F22-OS2.4,OS2.5]** Applies to the stabilizing resistance of the *dead load*.

[4.1.3.2.] **4.1.3.2. ([3] 3) [F20-OP2.1] [F22-OP2.4,OP2.5]**

[4.1.3.2.] **4.1.3.2. ([4] 4) [F20-OS2.1]**

[4.1.3.2.] **4.1.3.2. ([4] 4) [F20-OP2.1] [F22-OP2.4]**

[4.1.3.2.] **4.1.3.2. ([5] 5) [F20-OS2.1] [F22-OS2.4,OS2.5]**

[4.1.3.2.] **4.1.3.2. ([5] 5) [F20-OP2.1] [F22-OP2.4,OP2.5]**

[4.1.3.2.] **4.1.3.2. ([6] 6) no attributions**

[4.1.3.2.] **4.1.3.2. ([7] 7) no attributions**

[4.1.3.2.] **4.1.3.2. ([8] 8) [F20-OS2.1]**

[4.1.3.2.] **4.1.3.2. ([8] 8) [F20-OP2.1] [F22-OP2.4]**

[4.1.3.2.] **4.1.3.2. ([9] 9) [F20-OS2.1]**

[4.1.3.2.] **4.1.3.2. ([9] 9) [F20-OP2.1] [F22-OP2.4]**

[4.1.3.2.] **4.1.3.2. ([10] 10) no attributions**

[4.1.3.2.] **4.1.3.2. ([11] 11) [F20-OS2.1] [F22-OS2.4,OS2.5]**

[4.1.3.2.] **4.1.3.2. ([12] 12) [F20-OS2.1]**

[4.1.3.2.] **4.1.3.2. ([12] 12) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([1] 1) [F20-OS2.1]**

[4.1.6.2.] **4.1.6.2. ([1] 1) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([2] 2) [F20-OS2.1]**

[4.1.6.2.] **4.1.6.2. ([2] 2) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([3] 3) [F20-OS2.1]**

[4.1.6.2.] **4.1.6.2. ([3] 3) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([4] 4) no attributions**

[4.1.6.2.] **4.1.6.2. ([5] 5) [F20-OS2.1]**

[4.1.6.2.] **4.1.6.2. ([5] 5) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([6] 6) [F20-OS2.1]**

[4.1.6.2.] **4.1.6.2. ([6] 6) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([7] 7) [F20-OS2.1]**

[4.1.6.2.] **4.1.6.2. ([7] 7) [F20-OP2.1] [F22-OP2.4]**

[4.1.6.2.] **4.1.6.2. ([8] 8) [F20-OS2.1]** Applies to portion of Code text: “The accumulation factor, C_a, shall be 1.0, …”

[4.1.6.2.] **4.1.6.2. ([8] 8) [F20-OP2.1] [F22-OP2.4]** Applies to portion of Code text: “The accumulation factor, C_a, shall be 1.0, …”

[4.1.6.2.] **4.1.6.2. ([8] 8) ([a] a) to ([f] f) [F20-OS2.1]** Applies to roof shapes and configurations that call for a higher accumulation factor.

[4.1.6.2.] **4.1.6.2. ([8] 8) ([a] a) to ([f] f) [F20-OP2.1] [F22-OP2.4]** Applies to roof shapes and configurations that call for a higher accumulation factor.

[4.1.6.2.] 4.1.6.2. ([9] 9) [F20-OS2.1]

[4.1.6.2.] 4.1.6.2. ([9] 9) [F20-OP2.1] [F22-OP2.4]

[4.1.6.2.] -- ([10] --) [F20-OS2.1]

[4.1.6.2.] -- ([10] --) [F20-OP2.1] [F22-OP2.4]

[4.1.6.5.] 4.1.6.5. ([1] 1) [F20-OS2.1]

[4.1.6.5.] 4.1.6.5. ([1] 1) [F20-OP2.1] [F22-OP2.4]

[4.1.6.5.] 4.1.6.5. ([2] 2) [F20-OS2.1]

[4.1.6.5.] 4.1.6.5. ([2] 2) [F20-OP2.1] [F22-OP2.4]

[4.1.6.5.] 4.1.6.5. ([3] 3) [F20-OS2.1]

[4.1.6.5.] 4.1.6.5. ([3] 3) [F20-OP2.1] [F22-OP2.4]

[4.1.6.5.] 4.1.6.5. ([4] 4) [F20-OS2.1]

[4.1.6.5.] 4.1.6.5. ([4] 4) [F20-OP2.1] [F22-OP2.4]

[4.1.6.5.] 4.1.6.5. ([5] 5) [F20-OS2.1]

[4.1.6.5.] 4.1.6.5. ([5] 5) [F20-OP2.1] [F22-OP2.4]

[4.1.6.7.] 4.1.6.7. ([1] 1) [F20-OS2.1]

[4.1.6.7.] 4.1.6.7. ([1] 1) [F20-OP2.1] [F22-OP2.4]

[4.1.6.7.] 4.1.6.7. ([2] 2) no attributions

[4.1.6.7.] 4.1.6.7. ([3] 3) no attributions

[4.1.6.9.] 4.1.6.9. ([1] 1) [F20-OS2.1]

[4.1.6.9.] 4.1.6.9. ([1] 1) [F20-OP2.1] [F22-OP2.4]

[4.1.6.9.] 4.1.6.9. ([2] 2) [F20-OS2.1]

[4.1.6.9.] 4.1.6.9. ([2] 2) [F20-OP2.1] [F22-OP2.4]

[4.1.6.9.] 4.1.6.9. ([3] 3) no attributions

[4.1.6.9.] 4.1.6.9. ([4] 4) [F20-OS2.1]

[4.1.6.9.] 4.1.6.9. ([4] 4) [F20-OP2.1] [F22-OP2.4]

[4.1.6.9.] 4.1.6.9. ([4] 4) no attributions

[4.1.6.10.] 4.1.6.10. ([1] 1) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([1] 1) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([2] 2) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([2] 2) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([3] 3) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([3] 3) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([4] 4) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([4] 4) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([5] 5) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([5] 5) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([6] 6) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([6] 6) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([7] 7) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([7] 7) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([8] 8) no attributions

[4.1.6.10.] 4.1.6.10. ([9] 9) [F20-OS2.1]

[4.1.6.10.] 4.1.6.10. ([9] 9) [F20-OP2.1] [F22-OP2.4]

[4.1.6.10.] 4.1.6.10. ([9] 9) no attributions

[4.1.7.3.] 4.1.7.3. ([1] 1) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([1] 1) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([1] 1) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([2] 2) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([2] 2) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([2] 2) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([3] 3) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([3] 3) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([3] 3) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([4] 4) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([4] 4) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([4] 4) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([5] 5) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([5] 5) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([5] 5) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([6] 6) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([6] 6) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([6] 6) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([7] 7) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([7] 7) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([7] 7) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([8] 8) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([8] 8) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([8] 8) [F22-OH4]

[4.1.7.3.] 4.1.7.3. ([9] 9) no attributions

[4.1.7.3.] 4.1.7.3. ([10] 10) [F20-OS2.1]

[4.1.7.3.] 4.1.7.3. ([10] 10) [F20-OP2.1] [F22-OP2.4]

[4.1.7.3.] 4.1.7.3. ([10] 10) [F22-OH4]

[4.1.8.2.] 4.1.8.2. ([1] 1) no attributions

Submit a comment

Proposed Change 1900

Code Reference(s):	**NBC20 Div.B 4.1.8.15.(8) (first printing)**
Subject:	Earthquake Design — Other
Title:	Clarification of the Use of the Importance Factor in the Determination of Design Forces
Description:	This proposed change clarifies the use of the earthquake importance factor in the calculation of design forces according to Sentence 4.1.8.15.(8).

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [x] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

In Sentence 4.1.8.15.(8) of Division B of the NBC, it is not explicitly clear whether the earthquake importance factor must be applied in the calculation of the design forces associated with the lateral capacity of the seismic force resisting system (SFRS). Omission of the importance factor in the calculation of the elastic force level (with R_dR_o = 1.0) or the upper limit on the design forces (with R_dR_o = 1.3) for High Importance Category buildings and post-disaster buildings will result in unconservative designs, leading to buildings that are very likely to perform below the expected performance level. This could increase the risk to life safety and risk of injury for building occupants beyond the risk levels that are currently acceptable in the NBC for a design-level earthquake event.

Justification

The capacity-protected non-yielding components of an SFRS are designed to remain essentially elastic. In order to ensure that this is the case, the appropriate importance factors must be applied in determining the elastic force level in non-yielding components in High Importance Category buildings and post-disaster buildings.

If the importance factors are not used, such components are likely to be under-designed and may become the weakest link in the structure. This could result in brittle failure of such components, leading to premature collapse of the structure.

PROPOSED CHANGE

[4.1.8.15.] 4.1.8.15. Design Provisions

[1] **8)** The design forces associated with the lateral capacity of the SFRS need not exceed the forces determined in accordance with Sentence 4.1.8.7.(1) with R_dR_o taken as 1.0, unless otherwise provided by the applicable referenced design standards for elements, in which case the design forces associated with the lateral capacity of the SFRS need not exceed the forces determined in accordance with Sentence 4.1.8.7.(1) with R_dR_o taken as less than or equal to 1.3. (See Note A-4.1.8.15.(8).)

Note A-4.1.8.15.(8) Design Forces in Elements.

The earthquake importance factor, I_E, of 1.3 for High Importance Category buildings or 1.5 for post-disaster buildings must be applied when designing for the elastic force level using R_dR_o = 1.0 or for the upper limit on the design forces using R_dR_o = 1.3. Similarly, an I_E of 0.8 may be applied for Low Importance Category buildings. Additional i~~I~~nformation on the design forces in elements can be found in the Commentary entitled Design for Seismic Effects in the "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)".

Impact analysis

The proposed change is a clarification and does not add any new requirements. The impact would be neutral in terms of cost and positive in terms of facilitating the correct application of the Code.

Enforcement implications

The proposed change is a clarification. It would help enforcement staff to properly understand Sentence 4.1.8.15.(8) and its application. No difficulties are expected to result from the proposed change.

Who is affected

Owners, designers, contractors and enforcement professionals dealing with the construction of High Importance Category buildings and post-disaster buildings.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[4.1.8.15.] 4.1.8.15. ([1] 8) no attributions

Submit a comment

Proposed Change 2048

Code Reference(s):	**NBC20 Div.B 9.4.2. (first printing)** **NBC20 Div.B 9.6.1.3. (first printing)** **NBC20 Div.B 9.23.3.4.(3) (first printing)** **NBC20 Div.B 9.23.3.5. (first printing)** **NBC20 Div.B 9.23.6.1. (first printing)** **NBC20 Div.B 9.23.13.1. (first printing)** **NBC20 Div.B 9.23.13.2. (first printing)** **NBC20 Div.B 9.23.13.3. (first printing)** **NBC20 Div.B 9.23.16.1. (first printing)** **NBC20 Div.B 9.23.16.5. (first printing)** **NBC20 Div.B 9.27.5.4.(2) (first printing)**
Subject:	Structural Design (Part 9)
Title:	Specified Wind and Snow Loads in Part 9
Description:	This proposed change aligns Part 9 with the proposed changes in Part 4 to wind and snow loading to account for potential loading changes resulting from climate change.
Related Proposed Change(s):	PCF 1979, PCF 1980, PCF 2018

This change could potentially affect the following topic areas:

☐ Division A	☑ Division B
☐ Division C	☑ Design and Construction
☐ Building operations	☑ Housing
☑ Small Buildings	☐ Large Buildings
☐ Fire Protection	☐ Occupant safety in use
☐ Accessibility	☑ Structural Requirements
☐ Building Envelope	☐ Energy Efficiency
☐ Heating, Ventilating and Air Conditioning	☐ Plumbing
	☐ Construction and Demolition Sites

Problem

Climate change effects not yet addressed in the NBC

In the 2020 and previous editions of the National Building Code of Canada (NBC), it was assumed that climatic data statistics used in structural design did not change over time (or were stationary). Accordingly, the climatic design data in the NBC have been updated for each Code cycle using past weather observations collected and analyzed by Environment and Climate Change Canada (ECCC) under the assumption that past statistics will continue to be applicable to the future. In the face of extensive evidence that the climate is changing across Canada, this practice raises real safety concerns regarding the design of the main structural systems and envelope of buildings to withstand climatic loads such as those due to snow and wind.

In addition, in the current edition of the NBC, wind data are based mainly on synoptic wind observations and do not account for the different existing climatic influences in Canada, where some regions are more prone to local convective thunderstorms. This phenomenon is expected to be exacerbated in the future with climate warming.

PCF 1979 proposes to update the climatic data in Table C-2, Climatic Design Data for Selected Locations in Canada.

Further to PCF 1979, this proposed change develops an approach for the design of Part 9 buildings using the new climatic data, which reflects expected changes to the climate in future.

Uniform hazard approach in load calculations yields non-uniform probability of failure

An additional problem identified is that the current methodology for the structural design of buildings in the NBC uses what has been termed a “uniform hazard” approach. In this approach, reference design wind and snow loads at various locations across Canada are specified at an annual probability of exceedance of 1/50, corresponding to a 50-year return period in a stationary climate. The minimum safety criterion adopted in the NBC corresponds to a probability of failure (i.e., probability that the effects of loads are higher than the resistance of a structural member in a building) of 0.001 during the 50-year assumed service life of a building in the Normal Importance Category. To provide an acceptable probability of failure, the “specified design loads” or so-called “service loads” taken at the 50-year return period have been multiplied by load factors (i.e., 1.5 for snow and 1.4 for wind) to obtain the “ultimate loads” applied in design calculations. These load factors are influenced by the target safety criteria and the variability of the load, and historically have been taken as constant across all regions of Canada. However, reliability studies [1] have shown that this approach leads to a non-uniform probability of failure across the country, due to the different behaviour of wind and snow events in Canada’s various regions and the localized variation in these loads. The probability of failure can differ by as much as a factor of 10, depending on where the project is located, and this variability could be further exacerbated by climate change.

Justification

Adjusting loads to account for non-stationarity in a future changing climate

Results obtained using RCP8.5, corresponding to 2.5°C global warming, were adopted to establish future climatic loads for structural design. Comparisons were made based on a building constructed in 2025 having a service life of 50 years, and the differences between the four RCP scenarios included in the ECCC study [2] remained within a narrow range. The decision to adopt the most extreme RCP8.5 scenario reflects a prudent approach, as there is uncertainty in the 50-year estimate. Recent studies [1] revealed the statistical significance of the non-stationarity of extreme wind speeds and ground snow loads based on the future projections provided by ECCC [2] for many regions across Canada.

Therefore, a non-stationary extreme-value analysis approach, known as the “Minimax Method,” is proposed to design for the worst-case year of the building’s service life. This approach ensures that the annual probability of failure remains acceptably low during the entire service life. For instance, future projections for wind loads mostly predict increases in reference pressure, making the last year of service life the worst case; conversely, for ground snow loads, future projections mostly show decreases, making the first year of service life the worst case.

Using ECCC’s climate projections [2], regional climate change factors have been developed that can be applied to the wind and snow reference values in different regions across the country. These factors were used to determine the reference values tabulated in NBC Table C-2, Climatic Design Data for Selected Locations in Canada.

Introducing the uniform risk approach in ultimate limit state (ULS) design

To address the variability of the probability of failure across the country, a so-called “uniform risk” approach is proposed in which “ultimate loads” are specified directly for each location with load factors of 1.0. This approach is similar to the approach used for earthquake design in the NBC and other approaches adopted internationally. Notably, ASCE/SEI 7, “Minimum Design Loads for Buildings and Other Structures,” has used uniform risk for wind loads since the 2010 edition [3] (and more recently for snow loads since the 2022 edition), and the Australian Building Code [4] many years before.

Climate change factors were calculated by comparing the future design levels, determined using the Minmax approach, with design levels based on the conventional stationary approach. For reference design wind pressures, most areas in Canada have a climate change factor of 1.05, while locations in Ontario, the Atlantic provinces, and west of 120°W in British Columbia have a climate change factor of 1.1. For ground snow loads, the northern territories have a climate change factor of 1.05, while most regions have a climate change factor of 1.0 (see [5] and PCF 1979).

In deriving climate change factors for the "uniform risk" approach, target annual probabilities of exceedance of 1/500 for wind and 1/1 000 for snow were selected. With the proposed uniform risk approach, the targeted probabilities are applied with a load factor of 1.0, as opposed to the present method of using a 1/50 target and increasing it by a load factor across the country. The 1/500 and 1/1 000 annual probabilities of exceedance were selected to maintain the average risk of failure across the country. As a result, the same target probability of failure of approximately 1/1 000 is set, but with more precise estimates from location to location.

Calibration studies and benefits of the uniform risk approach

From the wind load perspective, regional variations in probability of failure may be significantly reduced by adopting the uniform risk approach. Analysis [1] demonstrates that the differences in the probability of failure and safety criteria between locations substantially decreases by adopting ultimate return periods (1/500 annual probability of exceedance) for reference wind pressure with a load factor of 1.0. To illustrate the benefits of the new approach, the following two cases were considered:

- a uniform hazard case, with a return period of 50 years and wind load factor of 1.4, which matches that currently used in the NBC 2020, and
- a uniform risk case, with a return period of 500 years and a wind load factor of 1.0.

Building cases that consider Low, Normal, High and Post-disaster Importance Categories were investigated. For the uniform hazard case, the range in reliability index, β, is 1.6 when comparing between high- and low-variability data. For the uniform risk case, the range of reliability index narrows significantly to 0.7 for the same data. For a range of variability applicable to most locations in Canada, the uniform hazard approach shows a range in β of 0.7, while the uniform risk approach shows a range that narrows to 0.25.

New load combinations based on uniform risk

In moving to the uniform risk approach for wind and snow loads, new load calibrations have been carried out to update the various design load combinations needed for both the ultimate limit state (ULS) and the serviceability limit state (SLS). The roof snow load combination 1.0E + 0.25S has been reassessed and updated to 1.0E + 0.15S, where S is now based on the 1/1 000 probability of exceedance rather than 1/50 for Normal Importance Category buildings. The 0.15 coefficient was selected to keep the total value equivalent to the current value prescribed in the NBC 2020 for most locations. Load factors for SLS required no changes because revised importance factors for SLS in NBC Table 4.1.6.2. for snow and NBC Table 4.1.7.3. for wind essentially keep the snow and wind serviceability loads close to what they were before.

References

(1) RWDI Report No. 1702484, 2020, Development of Climate Change Provisions for Structural Design of Buildings and Implementation Plan in the National Building Code.

(2) Cannon, A.J., Jeong, D.I., Zhang, X., and F. W. Zwiers. (2020). Climate-Resilient Buildings and Core Public Infrastructure: An Assessment of the Impact of Climate Change on Climatic Design Data in Canada. Government of Canada, Ottawa, ON. 106 p. (https://climate-scenarios.canada.ca/?page=buildings-report-overview).

(3) ASCE 7-22, Minimum Design Loads for Buildings and Other Structures.

(4) Australian/New Zealand Standard (AS/NZS) 1170.2:2002, Structural design actions. Part 2: Wind actions.

(5) Li S.H., Irwin P., Lounis Z., Attar A., Dale J., Gibbons M., Beaulieu, S. (2022). Effects of Nonstationarity of Extreme Wind Speeds and Ground Snow Loads in a Future Canadian Changing Climate. *Nat Hazard Rev.* 23(4):04022022.

PROPOSED CHANGE

NBC20 Div.B 9.4.2. (first printing)

[9.4.2.] 9.4.2. Specified Loads

[9.4.2.1.] 9.4.2.1. Application

[9.4.2.2.] 9.4.2.2. Specified Snow Loads

(See Note A-9.4.2.1. and 9.4.2.2.)

[1] 1) Except as provided in Sentences (2) to (4), specified snow loads shall be not less than those calculated using the following formula:

$$\boxed{S = C_b S_s + S_r}$$

$$S = \frac{C_b S_{s,1/1000}}{1.5} + \frac{S_{r,1/1000}}{1.5}$$

where

S	= specified snow load,
C_b	= basic snow load roof factor, which is 0.45 where the entire width of the roof does not exceed 4.3 m and 0.55 for all other roofs,
$S_{s,1/1\,000}$	= 1-in-~~50~~1 000 annual probability~~-year~~ ground snow load in kPa, determined according to Subsection 1.1.3., and
$S_{r,1/1\,000}$	= associated 1-in-~~50~~1 000 annual probability~~-year~~ rain load in kPa, determined according to Subsection 1.1.3.

[2] 2) In no case shall the specified snow load be less than 1 kPa.

[3] --) Where the specified snow load, S, as calculated in Sentence (1) is used to design structural members and their connections in accordance with Part 4 and Subclause 9.4.1.1.(1)(c)(i), it shall be multiplied by a factor of 1.5.

[4] 3) Bow string, arch or semi-circular roof trusses having an unsupported span greater than 6 m shall be designed in conformance with the snow load requirements in Subsection 4.1.6.

[5] 4) Where the height of a roof step at the intersection of an upper level roof and a lower level roof is greater than 2 m, and the upper level roof has a slope less than 1 in 6 and an area greater than 600 m^2, the specified snow load on the lower level roof shall be

[a] a) for distances from the roof step that are less than or equal to the drift length, x_d, calculated in accordance with Sentence (5), not less than 1.5 times the specified snow load, S, calculated using the formula in Sentence (1) with C_b equal to 0.55, and

[b] b) for distances from the roof step that are greater than the drift length, x_d, calculated in accordance with Sentence (5), as specified in Sentence (1).

[6] 5) For the purposes of Sentence (4), the drift length, x_d, in m, shall be calculated as follows:

$$x_d = 5\left(h - \frac{0.55S_s}{\gamma}\right)$$

where

h	= height of the roof step, in m, and
γ	= specific weight of snow as specified in Clause 9.4.2.1.(1)(f).

[9.4.2.3.] --- Reference Hourly Wind Pressure

[1] --) The reference hourly wind pressure (RHWP) referred to in this Part shall be calculated as follows:

$$\text{RHWP} = \frac{q_{1/500}}{1.4}$$

where

$q_{1/500}$	=1-in-500 annual probability wind pressure, in kPa, determined in accordance with Subsection 1.1.3.

[2] --) Where the RHWP, as calculated in Sentence (1), is used to design structural members and their connections in accordance with Part 4 and Subclause 9.4.1.1.(1)(c)(i), it shall be multiplied by a factor of 1.4.

[9.4.2.4.] 9.4.2.3. Platforms Subject to Snow and Occupancy Loads

[9.4.2.5.] 9.4.2.4. Attics and Roof Spaces

NBC20 Div.B 9.6.1.3. (first printing)

[9.6.1.3.] 9.6.1.3. Structural Sufficiency of Glass

[1] 1) Except as provided in Sentence (2), glass shall be designed in conformance with
- [a] a) CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings",or
- [b] b) ASTM E1300, "Standard Practice for Determining Load Resistance of Glass in Buildings". (See also Article 4.3.6.1.)

[2] 2) Where the *building* has an essentially uniform distribution of paths for air leakage, including operable openings, but no large openings that would permit wind gusts to rapidly enter the *building* and the *building* is not in an exceptionally exposed location such as a hilltop, the maximum area of individual panes of glass for windows shall conform to
- [a] a) Tables 9.6.1.3.-A to 9.6.1.3.-C, where the *building* has a height from *grade* to the uppermost roof of 12 m or less, and is located in a built-up area, no less than 120 m away from the boundary between this area and open terrain, or
- [b] b) Tables 9.6.1.3.-D to 9.6.1.3.-F.

(See Note A-9.6.1.3.(2).)

Table [9.6.1.3.-A] 9.6.1.3.-A
Maximum Glass Area for Windows in Areas for which the ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) is less than 0.55 kPa (1)
Forming Part of Clause 9.6.1.3.(2)(a)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.58	0.96	1.47	2.04	2.84	4.74	6.65	9.74
Factory-sealed insulated glass (IG) units (2)	1.02	1.71	2.68	3.74	5.24	7.93	9.92	13.92
Heat-strengthened or tempered	1.24	1.93	2.60	3.18	3.99	5.55	6.99	9.74
Wired	0.27	0.45	0.68	0.93	1.31	2.15	3.07	5.03

Notes to Table [9.6.1.3.-A] 9.6.1.3.-A:

(1) ~~The maximum hourly wind pressure with one chance in fiftyof being exceeded in any one year, as provided in Appendix C~~See Sentence 9.4.2.3.(1)-2025 for the calculation of RHWP.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

Table [9.6.1.3.-B] 9.6.1.3.-B
Maximum Glass Area for Windows in Areas for which the ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) is less than 0.75 kPa (1)
Forming Part of Clause 9.6.1.3.(2)(a)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.42	0.68	1.02	1.42	2.04	3.34	4.70	7.65
Factory-sealed insulated glass (IG) units (2)	0.72	1.19	1.85	2.56	3.64	6.01	8.35	11.83
Heat-strengthened	0.88	1.46	2.21	2.71	3.39	4.73	5.92	8.29
Tempered	1.18	1.64	2.21	2.71	3.39	4.73	5.92	8.29
Wired	0.20	0.32	0.50	0.68	0.94	1.55	2.19	3.60

Notes to Table [9.6.1.3.-B] 9.6.1.3.-B:

(1) ~~The maximum hourly wind pressure with one chance in fiftyof being exceeded in any one year, as provided in Appendix C~~See Sentence 9.4.2.3.(1)-2025 for the calculation of RHWP.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

Table [9.6.1.3.-C] 9.6.1.3.-C
Maximum Glass Area for Windows in Areas for which the ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) is less than 1.00 kPa (1)
Forming Part of Clause 9.6.1.3.(2)(a)

Type of Glass	Maximum Glass Area, m²							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.30	0.50	0.77	1.05	1.45	2.40	3.40	5.62
Factory-sealed insulated glass (IG) units (2)	0.52	0.86	1.31	1.86	2.57	4.30	6.10	9.89
Heat-strengthened	0.65	1.04	1.63	2.26	2.92	4.07	5.10	7.14
Tempered	1.01	1.42	1.90	2.33	2.92	4.07	5.10	7.14
Wired	0.16	0.26	0.38	0.52	0.71	1.15	1.63	2.69

Notes to Table [9.6.1.3.-C] 9.6.1.3.-C:

(1) ~~The maximum hourly wind pressure with one chance in fiftyof being exceeded in any one year, as provided in Appendix C~~See Sentence 9.4.2.3.(1)-2025 for the calculation of RHWP.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

Table [9.6.1.3.-D] 9.6.1.3.-D
Maximum Glass Area for Windows in Areas for which the ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) is less than 0.55 kPa – OPEN TERRAIN (1)
Forming Part of Clause 9.6.1.3.(2)(b)

Type of Glass	Maximum Glass Area, m²							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.46	0.75	1.16	1.60	2.25	3.76	5.32	8.70
Factory-sealed insulated glass (IG) units (2)	0.80	1.34	2.11	2.93	4.10	6.90	9.66	12.53
Heat-strengthened	0.98	1.74	2.33	2.86	3.59	5.00	6.26	8.78
Tempered	1.25	1.74	2.33	2.86	3.59	5.00	6.26	8.78
Wired	0.22	0.36	0.55	0.76	1.05	1.75	2.47	4.09

Notes to Table [9.6.1.3.-D] 9.6.1.3.-D:

(1) ~~The maximum hourly wind pressure with one chance in fiftyof being exceeded in any one year, as provided in Appendix C~~See Sentence 9.4.2.3.(1)-2025 for the calculation of RHWP.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

Table [9.6.1.3.-E] 9.6.1.3.-E
Maximum Glass Area for Windows in Areas for which the ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) is less than 0.75 kPa – OPEN TERRAIN (1)
Forming Part of Clause 9.6.1.3.(2)(b)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.33	0.54	0.83	1.14	1.61	2.67	3.75	6.14
Factory-sealed insulated glass (IG) units (2)	0.57	0.94	1.47	2.04	2.85	4.75	6.72	10.97
Heat-strengthened	0.70	1.15	1.79	2.44	3.06	4.36	5.34	7.47
Tempered	1.06	1.48	1.99	2.44	3.06	4.36	5.34	7.47
Wired	0.16	0.26	0.40	0.55	0.76	1.24	1.77	2.93

Notes to Table [9.6.1.3.-E] 9.6.1.3.-E:

(1) ~~The maximum hourly wind pressure with one chance in fiftyof being exceeded in any one year, as provided in Appendix C~~See Sentence 9.4.2.3.(1)-2025 for the calculation of RHWP.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

Table [9.6.1.3.-F] 9.6.1.3.-F
Maximum Glass Area for Windows in Areas for which the ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) is less than 1.00 kPa – OPEN TERRAIN (1)
Forming Part of Clause 9.6.1.3.(2)(b)

Type of Glass	Maximum Glass Area, m^2							
	Glass Thickness, mm							
	2.5	3	4	5	6	8	10	12
Annealed	0.25	0.40	0.62	0.84	1.17	1.94	2.75	4.50
Factory-sealed insulated glass (IG) units (2)	0.42	0.68	1.04	1.46	2.05	3.41	4.87	7.92
Heat-strengthened	0.51	0.84	1.30	1.79	2.52	3.69	4.60	6.44
Tempered	0.92	1.28	1.72	2.10	2.63	3.69	4.60	6.44
Wired	0.12	0.20	0.30	0.41	0.57	0.94	1.31	2.18

Notes to Table [9.6.1.3.-F] 9.6.1.3.-F:

(1) ~~The maximum hourly wind pressure with one chance in fiftyof being exceeded in any one year, as provided in Appendix C~~See Sentence 9.4.2.3.(1)-2025 for the calculation of RHWP.

(2) Maximum glass area values apply to IG units of two identical lites (annealed, heat-strengthened or tempered) spaced at 12.7 mm.

[3] **3)** The maximum area of individual panes of glass for doors shall conform to Table 9.6.1.3.-G.

Table [9.6.1.3.-G] 9.6.1.3.-G
Glass Area for Doors
Forming Part of Sentence [9.6.1.3.] 9.6.1.3.([3] 3)

Glass Thickness, mm	Maximum Glass Area, m^2 (1)						
	Type of Glass						
	Annealed	Annealed, Multiple-Glazed, Factory-Sealed Units	Laminated	Wired	Heat-Strengthened	Fully Tempered	Fully Tempered, Multiple-Glazed, Factory-Sealed
3	0.50	0.70	(2)	(2)	1.00	1.00	2.00
4	1.00	1.50	(2)	(2)	1.50	4.00	4.00
5	1.50	1.50	(2)	(2)	1.50	No limit	No limit
6	1.50	1.50	1.20	1.00	1.50	No limit	No limit

Notes to Table [9.6.1.3.-G] 9.6.1.3.-G:

(1) See Note A-Table 9.6.1.3.-G.

(2) Not generally available.

NBC20 Div.B 9.23.3.4.(3) (first printing)

[9.23.3.4.] 9.23.3.4. Nailing of Framing

[1] **3)** Where the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 0.8 kPa, roof rafters, joists or trusses shall be tied to the wall framing with connectors that will resist a factored uplift load of 3 kN.

NBC20 Div.B 9.23.3.5. (first printing)

[9.23.3.5.] 9.23.3.5. Fasteners for Sheathing or Subflooring

[1] **1)** Except as provided in Sentences (2) to (4), fastening of sheathing and subflooring shall conform to Table 9.23.3.5.-A where the reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is less than 0.8 kPa and the seismic spectral acceleration, $S_a(0.2)$, is equal to or less than 0.70.

Table [9.23.3.5.-A] 9.23.3.5.-A
Fasteners for Subflooring and for Sheathing where the ~~1-in-50~~ Reference Hourly Wind Pressure (RHWP) < 0.8 kPa and $S_a(0.2) \leq 0.70$
Forming Part of Sentence [9.23.3.5.] 9.23.3.5.([1] 1)

Element	Minimum Length of Fasteners, mm				Minimum Number or Maximum Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails or Screws	Roofing Nails	Staples	
Board lumber 184 mm or less wide	51	45	n/a	51	2 per support
Board lumber more than 184 mm wide	51	45	n/a	51	3 per support
Fibreboard sheathing up to 13 mm thick	n/a	n/a	44	28	150 mm o.c. along edges and 300 mm o.c. along intermediate supports
Gypsum sheathing up to 13 mm thick	n/a	n/a	44	n/a	
Plywood, OSB or waferboard up to 10 mm thick	51	45	n/a	38	
Plywood, OSB or waferboard over 10 mm and up to 20 mm thick	51	45	n/a	51	
Plywood, OSB or waferboard over 20 mm and up to 25 mm thick	57	51	n/a	n/a	

[2] 2) Fastening of roof sheathing and sheathing in required *braced wall panels* shall conform to Table 9.23.3.5.-B, where

[a] a) the ~~1-in-50~~ ~~hourly wind pressure (~~RHWP~~)~~, as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 0.8 kPa and less than 1.2 kPa and the seismic spectral acceleration, $S_a(0.2)$, is not more than 0.90, or

[b] b) the seismic spectral acceleration, $S_a(0.2)$, is greater than 0.70 and not more than 0.90.

Table [9.23.3.5.-B] 9.23.3.5.-B
Fasteners for Sheathing where 0.8 kPa ≤ ~~1-in-50~~ Reference Hourly Wind Pressure (RHWP) < 1.2 kPa and $S_a(0.2) \leq 0.90$ or where $0.70 < S_a(0.2) \leq 0.90$
Forming Part of Sentence [9.23.3.5.] 9.23.3.5.([2] 2)

Element	Minimum Length of Fasteners, mm			Minimum Number or Maximum Spacing of Fasteners
	Common, Spiral or Ring Thread Nails	Screws	14-gauge Staples	
Board lumber 184 mm or less wide	63	51	63	2 per support
Board lumber more than 184 mm wide	63	51	63	3 per support
Plywood, OSB or waferboard up to 20 mm thick (1)	63	51	63	150 mm o.c. along edges and 300 mm o.c. along intermediate supports; and for roof sheathing where 0.8 kPa ≤ RHWP < 1.2 kPa ~~is equal to or greater than 0.8 kPa and less than 1.2 kPa~~, 50 mm o.c. within 1 m of the edges of the roof
Plywood, OSB or waferboard over 20 mm and up to 25 mm thick	63	57	n/a	

Note to Table [9.23.3.5.-B] 9.23.3.5.-B:

(1) See Note A-Table 9.23.3.5.-B.

[3] **3)** Fastening of roof sheathing and sheathing in required *braced wall panels* shall conform to Table 9.23.3.5.-C, where

[a] a) the ~~1-in-50~~ ~~hourly wind pressure (~~RHWP~~)~~, as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 0.8 kPa and less than 1.2 kPa and the spectral acceleration, $S_a(0.2)$, is not more than 1.8, or

[b] b) the seismic spectral acceleration, $S_a(0.2)$, is greater than 0.90 and not more than

1.8.

Table [9.23.3.5.-C] 9.23.3.5.-C
Fasteners for Sheathing where 0.8 kPa ≤ ~~1-in-50~~Reference Hourly Wind Pressure (RHWP) < 1.2 kPa and $S_a(0.2)$ ≤ 1.8 or where 0.90 < $S_a(0.2)$ ≤ 1.8
Forming Part of Sentence [9.23.3.5.] 9.23.3.5.([3] 3)

Element	Minimum Length of Fasteners, mm		Minimum Number or Maximum Spacing of Fasteners
	Common, Spiral or Ring Thread Nails	Screws	
Plywood, OSB or waferboard up to 20 mm thick (1)	63	51	75 mm o.c. along edges and 300 mm o.c. along intermediate supports; and for roof sheathing where ~~1-in-50~~0.8 kPa ≤ RHWP < 1.2 kPa~~is equal to or greater than 0.8 kPa and less than 1.2 kPa~~, 50 mm o.c. within 1 m of the edges of the roof
Plywood, OSB or waferboard over 20 mm and up to 25 mm thick	63	57	

Note to Table [9.23.3.5.-C] 9.23.3.5.-C:

(1) See Note A-Table 9.23.3.5.-B.

[4] **4)** Fastening of sheathing shall conform to Part 4,
- [a] a) where the ~~1-in-50~~ ~~hourly wind pressure~~ RHWP, as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 1.2 kPa, or
- [b] b) for required *braced wall panels*, where the seismic spectral acceleration, $S_a(0.2)$, is greater than 1.8.

[5] **5)** Staples shall not be less than 1.6 mm in diameter or thickness, with not less than a 9.5 mm crown driven with the crown parallel to framing.

[6] **6)** Roofing nails for the attachment of fibreboard or gypsum sheathing shall not be less than 3.2 mm in diameter with a minimum head diameter of 11.1 mm.

[7] **7)** Flooring screws shall not be less than 3.2 mm in diameter.

[8] **8)** The edges of sheathing in a *braced wall panel* shall be supported and fastened to wood blocking where
- [a] a) the seismic spectral acceleration, $S_a(0.2)$, is greater than 1.2, or
- [b] b) the *braced wall panel* supports more than a roof of lightweight construction.

NBC20 Div.B 9.23.6.1. (first printing)

[9.23.6.1.] 9.23.6.1. Anchorage of Building Frames

[1] **1)** Except as required by Sentence 9.23.6.3.(1), *building* frames shall be anchored to the *foundation* unless a structural analysis that considers wind and earthquake loads and lateral earth pressures shows that anchorage is not required.

[2] **2)** Except as provided in Sentences (3) to (6), anchorage shall be provided by

[a] a) embedding the ends of the first floor joists in concrete, or

[b] b) fastening the sill plate to the *foundation* with not less than 12.7 mm diam anchor bolts spaced not more than 2.4 m o.c.

[3] 3) For *buildings* with 2 or more floors supported by frame walls that are in areas where the seismic spectral acceleration, $S_a(0.2)$, is not greater than 0.70 or the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 0.80 kPa but not greater than 1.20 kPa, anchorage shall be provided by fastening the sill plate to the *foundation* with not less than two anchor bolts per *braced wall panel*, where all anchor bolts used are

[a] a) not less than 15.9 mm in diameter, located within 0.5 m of the end of the *foundation*, and spaced not more than 2.4 m o.c, or

[b] b) not less than 12.7 mm in diameter, located within 0.5 m of the end of the *foundation*, and spaced not more than 1.7 m o.c.

[4] 4) For *buildings* supported by frame walls that are in areas where the seismic spectral acceleration, $S_a(0.2)$, is greater than 0.70 but not greater than 1.8 and the ~~1-in-50 hourly wind pressure (~~RHWP~~)~~, as calculated in Sentence 9.4.2.3.(1)-2025, is not greater than 1.20 kPa, anchorage shall be provided by fastening the sill plate to the *foundation* with not less than two anchor bolts per *braced wall panel* located within 0.5 m of the end of the *foundation* and spaced in accordance with Table 9.23.6.1.

Table [9.23.6.1.] 9.23.6.1.
Anchor Bolt Spacing where the ~~1-in-50~~ Reference Hourly Wind Pressure (RHWP) ≤ 1.20 kPa and 0.70 < $S_a(0.2)$ ≤ 1.8
Forming Part of Sentence [9.23.6.1.] 9.23.6.1.([4] 4)

Anchor Bolt Diameter, mm	$S_a(0.2)$	Maximum Spacing of Anchor Bolts Along *Braced Wall Band*, m				
		Light Construction			Heavy Construction [(1)]	
		Number of Floors Supported [(2)]				
		1	2	3	1	2
12.7	0.70 < $S_a(0.2)$ ≤ 0.80	2.4	2.3	1.8	2.4	2.0
	0.80 < $S_a(0.2)$ ≤ 0.90	2.4	2.3	1.8	2.4	2.0
	0.90 < $S_a(0.2)$ ≤ 1.0	2.4	2.2	1.5	2.4	1.8
	1.0 < $S_a(0.2)$ ≤ 1.1	2.4	2.1	1.4	2.4	1.6
	1.1 < $S_a(0.2)$ ≤ 1.2	2.4	2.0	1.3	2.4	1.5
	1.2 < $S_a(0.2)$ ≤ 1.3	2.4	1.9	1.3	2.4	1.5
	1.3 < $S_a(0.2)$ ≤ 1.35	2.4	1.8	1.2	2.3	1.4

Anchor Bolt Diameter, mm	$S_a(0.2)$	Maximum Spacing of Anchor Bolts Along *Braced Wall Band*, m				
		Light Construction			Heavy Construction (1)	
		Number of Floors Supported (2)				
		1	2	3	1	2
	$1.35 < S_a(0.2) \le 1.8$	2.4	1.8	1.1	2.3	1.4
15.9Table9.23.6.1	$0.70 < S_a(0.2) \le 0.80$	2.4	2.4	2.2	2.4	2.4
	$0.80 < S_a(0.2) \le 0.90$	2.4	2.4	2.2	2.4	2.4
	$0.90 < S_a(0.2) \le 1.0$	2.4	2.4	2.1	2.4	2.3
	$1.0 < S_a(0.2) \le 1.1$	2.4	2.4	1.9	2.4	2.3
	$1.1 < S_a(0.2) \le 1.2$	2.4	2.4	1.9	2.4	2.2
	$1.2 < S_a(0.2) \le 1.3$	2.4	2.4	1.8	2.4	2.1
	$1.3 < S_a(0.2) \le 1.35$	2.4	2.3	1.7	2.4	2.0
	$1.35 < S_a(0.2) \le 1.8$	2.4	2.2	1.6	2.4	1.9

Notes to Table [9.23.6.1.] 9.23.6.1.:

(1) See Note A-9.23.13.2.(1)(a)(i).

(2) All constructions include support of a roof load in addition to the indicated number of floors.

[5] **5)** Anchor bolts referred to in Sentences (2) to (4) shall be
- [a] a) fastened to the sill plate with nuts and washers,
- [b] b) embedded not less than 100 mm in the *foundation*, and
- [c] c) so designed that they may be tightened without withdrawing them from the *foundation*.

[6] **6)** Where the seismic spectral acceleration, $S_a(0.2)$, is greater than 1.8 or the ~~1-in-50 hourly wind pressure~~ RWHP, as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 1.2 kPa, anchorage shall be designed according to Part 4.

NBC20 Div.B 9.23.13.1. (first printing)

[9.23.13.1.] 9.23.13.1. Requirements for Low to Moderate Wind and Seismic Forces (See Note A-9.23.13.1.)

[1] **1)** This Article applies in locations where the seismic spectral acceleration, $S_a(0.2)$, is not more than 0.70 and the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is less than 0.80 kPa.

[2] **2)** Bracing to resist lateral loads shall be designed and constructed as follows:
- [a] a) exterior walls shall be
  - [i] i) clad with panel-type cladding in accordance with Section 9.27.,
  - [ii] ii) sheathed with plywood, OSB, waferboard, fibreboard, gypsum board or diagonal lumber sheathing complying with Subsection 9.23.17. and fastened in accordance with Table 9.23.3.5.-A, or
  - [iii] iii) finished on the interior with a panel-type material in accordance with the requirements of Section 9.29., or
- [b] b) in accordance with
  - [i] i) Articles 9.23.13.4. to 9.23.13.7.,
  - [ii] ii) Part 4, or
  - [iii] iii) good engineering practice such as that provided in CWC 2014, "Engineering Guide for Wood Frame Construction".

Note A-9.23.13.1.

Bracing to Resist Lateral Loads in Low Load Locations

Of the 679 locations identified in Appendix C, 614 are locations where the seismic spectral acceleration, $S_a(0.2)$, is less than or equal to 0.70 and the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is less than 0.80 kPa. For buildings in these locations, Sentence 9.23.13.1.(2) requires only that exterior walls be braced using the acceptable materials and fastening specified. There are no spacing or dimension requirements for braced wall panels in these buildings.

NBC20 Div.B 9.23.13.2. (first printing)

[9.23.13.2.] 9.23.13.2. Requirements for High Wind and Seismic Forces

[1] **1)** Except as provided in Article 9.23.13.1., this Article applies in locations where
- [a] a) the seismic spectral acceleration, $S_a(0.2)$, is greater than 0.70 but not more than 1.8 and
  - [i] i) the lowest exterior frame wall supports not more than 1 floor in *buildings* of heavy construction (see Note A-9.23.13.2.(1)(a)(i)), or
  - [ii] ii) the lowest exterior frame wall supports not more than 2 floors in other types of construction, and
- [b] b) the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is less than 1.20 kPa.

[2] **2)** Bracing to resist lateral loads shall be designed and constructed in accordance with
- [a] a) Articles 9.23.13.4. to 9.23.13.7.,
- [b] b) Part 4, or
- [c] c) good engineering practice such as that provided in CWC 2014, "Engineering Guide for Wood Frame Construction".

NBC20 Div.B 9.23.13.3. (first printing)

[9.23.13.3.] 9.23.13.3. Requirements for Extreme Wind and Seismic Forces

[1] **1)** Except as provided in Articles 9.23.13.1. and 9.23.13.2., this Article applies in locations where
- [a] a) the seismic spectral acceleration, $S_a(0.2)$, is
  - [i] i) greater than 1.8,
  - [ii] ii) greater than 0.70 and the lowest exterior frame wall supports more than 2 floors in *buildings* of light construction, or
  - [iii] iii) greater than 0.70 and the lowest exterior frame wall supports more than 1 floor in *buildings* of heavy construction, or
- [b] b) the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence

9.4.2.3.(1)-2025, is equal to or greater than 1.20 kPa.

[2] **2)** Bracing to resist lateral loads shall be designed and constructed in accordance with

[a] a) Part 4, or

[b] b) good engineering practice such as that provided in CWC 2014, "Engineering Guide for Wood Frame Construction".

NBC20 Div.B 9.23.16.1. (first printing)

[9.23.16.1.] 9.23.16.1. Required Roof Sheathing

[1] **1)** Except where the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is less than 0.8 kPa and the seismic spectral acceleration, $S_a(0.2)$, is less than or equal to 0.70, continuous lumber or panel-type roof sheathing shall be installed to support the roofing.

NBC20 Div.B 9.23.16.5. (first printing)

[9.23.16.5.] 9.23.16.5. Lumber Roof Sheathing

[1] **1)** Lumber roof sheathing shall not be more than 286 mm wide and shall be applied so that all ends are supported with end joints staggered.

[2] **2)** Lumber roof sheathing shall be installed diagonally, where

[a] a) the seismic spectral acceleration, $S_a(0.2)$, is greater than 0.70 but not greater than 1.2, or

[b] b) the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 0.80 kPa but less than 1.20 kPa.

[3] **3)** Lumber roof sheathing shall be designed according to Part 4, where

[a] a) the seismic spectral acceleration, $S_a(0.2)$, is greater than 1.2, or

[b] b) the ~~1-in-50~~ ~~hourly wind pressure~~RHWP, as calculated in Sentence 9.4.2.3.(1)-2025, is equal to or greater than 1.20 kPa.

NBC20 Div.B 9.27.5.4.(2) (first printing)

[9.27.5.4.] 9.27.5.4. Size and Spacing of Fasteners

[1] **2)** Screw size and spacing for the attachment of cladding, trim and furring members to the web fastening strips of flat wall insulating concrete form (ICF) units shall conform to Table 9.27.5.4.-B where the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is less than or equal to 0.60 kPa. (See Note A-9.27.5.4.(2).)

Note A-9.27.5.4.(2) Attachment of Cladding to Flat Wall ICF Units where the ~~1-in-50~~Reference Hourly Wind Pressure~~HWP~~ Exceeds 0.60 kPa.

For locations where the ~~1-in-50~~reference hourly wind pressure (RHWP), as calculated in Sentence 9.4.2.3.(1)-2025, is greater than 0.60 kPa, the results of testing fasteners to ASTM D1761, "Standard Test Methods for Mechanical Fasteners in Wood and Wood-Based Materials", must be obtained from a testing facility or from the insulating concrete form manufacturer to confirm their ultimate strengths for both direct withdrawal and lateral shear. In accordance with limit states design as described in Subsection 4.1.3., the factored resistances of the fastener must be equal to or greater than the factored loads on the fastener at the spacing proposed by the designer. In order to align with the limit states design procedures used to develop Table 9.27.5.4.-B, the factored resistances must be calculated by applying a reduction factor of $\Phi = 0.35$ to the fastener's ultimate strengths, and the factored loads must lie within the area under the line of linear interaction in a diagram that plots the factored lateral shear resistance of the fastener against its factored direct withdrawal resistance.

Impact analysis

Refer to the supporting document titled "Cost impact of climatic load changes on Part 9: Adopting Part 4 proposed new return periods in PCF 2048" for the full cost analysis. A summary is reproduced here.

Cost impact on Part 9 buildings of updated hourly wind pressure with longer return periods

As a result of the new 1-in-500 annual probability hourly wind pressure data and the introduction of a "reference hourly wind pressure" in this proposed change to replace 1-in-50 annual probability hourly wind pressure, the value decreased for six locations, remained the same for eight locations, and increased for the remaining 666 locations out of the 680 locations in Table C-2 included in PCF 1979.

For the structural sufficiency of glass (NBC Sentence 9.6.1.3.(2)), a 128.5 m^2, two-storey detached house was used as the building archetype, which contained five differently sized windows with areas of glass between 0.57 m^2 and 1.43 m^2. In 620 of the 680 locations in Table C-2, the 1-in-50 annual probability hourly wind pressure remained below the maximum limits provided in NBC Tables 9.6.1.3.-A, 9.6.1.3.-B and 9.6.1.3.-C before and after the change, resulting in no impact. In three of the 60 locations with potential impact — Cowley, AB; Cape Race, NL; and Resolution Island, NU — the reference hourly wind pressure before and after the proposed change exceeded the maximum value of 1.0 kPa provided in the prescriptive table in the NBC, which would require consultation with the window manufacturer for glass thickness. For the remaining 57 locations, windows increased in cost between $126.98 and $353.51.

For the nailing of framing — roof trusses, rafters and joists to wall framing (NBC Sentence 9.23.3.4.(3)), a 120 m^2 bungalow was used as the building archetype. Due to the proposed change, two new locations — Channel-Port aux Basques and St. John's, NL — had reference hourly wind pressure that was equal to or exceeded 0.8 kPa, where roof trusses, rafters or joists would be required to be tied to wall framing with connectors that can resist 3 kN of roof uplift. In these locations, the number of required galvanized-steel connectors was calculated to be approximately 72, resulting in a cost increase of $437.04.

For fasteners for sheathing (NBC Article 9.23.3.5.), a 128.5 m^2, two-storey detached house was used as the building archetype. In 671 of the 680 locations in Table C-2, the 1-in-50 annual probability hourly wind pressure and reference hourly wind pressure remained below 0.8 kPa, resulting in no impact. Seven of the nine remaining locations had a 1-in-50 annual probability hourly wind pressure and reference hourly wind pressure greater than 0.8 kPa, resulting in no impact. The same remaining two locations noted above exceeded 0.8 kPa as a result of the proposed change, having the following impact:

- For roof sheathing, the two locations would require larger size fasteners and fasteners spaced at 50 mm within 1 m of the roof edge. The cost increase using common wire nails is estimated to be $468.68 for each location.
- For wall sheathing, the two locations would require braced wall panels with wood-based wall sheathing, resulting in a cost increase of $1,125.30 for each location.

For the anchorage of building frames (NBC Sentence 9.23.6.1.(3)), the same two locations noted above had a 1-in-50 annual probability hourly wind pressure that exceeded 0.8 kPa, resulting in an increase in the number of anchor bolts by 15 for a total cost increase of $94.20.

For required roof sheathing (NBC Sentence 9.23.16.1.(1)), a 128.5 m^2 two-storey detached bungalow was used. Similar to the above results, the same two locations would be impacted by the proposed change and be required to meet NBC Subsection 9.23.16. The cost increase from sheathing deemed too thin for truss spacing in NBC Sentence 9.23.16.7.(2) to compliant plywood sheathing is approximately $168.82.

For lumber roof sheathing (NBC Article 9.23.16.5.), the roof area of a 128.5 m^2, two-storey detached house was used as the building archetype. Similar to the above results, the same two locations would be impacted by the proposed change and be required to install lumber roof sheathing diagonally instead of horizontally in accordance with NBC Sentence 9.23.16.5. This results in a cost increase of approximately $311.67 for each location.

For the attachment of cladding to flat ICF wall units (NBC Sentence 9.27.5.4.(2), a 128.5 m^2, two-storey detached house was used. In 619 of the 680 locations in Table C-2, the 1-in-50 annual probability hourly wind pressure and reference wind pressure was equal to or less than 0.6 kPa before and after the change, resulting in no impact. In 34 of the remaining 61 locations, the 1-in-50 annual probability hourly wind pressure and reference hourly wind pressure were greater than 0.6 kPa before and after the change, so the impact is assumed to be minimal and would account for additional fasteners. The greatest impact is assumed to occur at locations where the 1-in-50 annual probability hourly wind pressure is equal to or less than 0.60 kPa and the reference hourly wind pressure is more than 0.6 kPa after the change, which occurred in the remaining 27 locations. This resulted in approximate cost increases of $2,009.15 in these locations, representing the different material costs of fasteners into concrete, additional labour, and reduced daily output to attach the furring through the flat wall ICF units into the solid concrete backup wall.

Cost impact on Part 9 buildings of updated snow loads with longer return periods

As a result of the new 1-in-1 000 annual probability snow load data and modification to the calculation of specified snow loads in this proposed change, out of the 680 locations in Table C-2 of PCF 1979, the specified snow load remained the same in 41 locations (neutral), increased in 154 locations (adverse), and decreased in the remaining 485 locations (beneficial).

For platforms subject to snow and occupancy loads (NBC Sentence 9.4.2.3.(1)), a 3.5 m × 4 m archetype exterior platform was assessed. Before and after the change, 483 out of the 680 locations had specified snow loads less than 1.9 kPa, resulting in no impact. Of the 197 remaining locations, 115 locations had specified snow loads that remained between the same range before and after the change, resulting in no impact. Using the archetype, NBC Span Tables, and costs from RSMeans, 16 of the 82 remaining locations experienced a cost increase ranging from $47.77 to $291.81, and 37 locations experienced a cost decrease ranging from $47.77 to $126.43. In 24 locations, the same joist and built-up beam size was sufficient before and after the change, resulting in no impact.

For the performance of windows, doors and skylights (NBC Sentence 9.7.3.1.(2)), the magnitude of the cost impact could not be determined without industry knowledge about the structural design of skylights, including the capacity of the skylight frames and glazing, for the 154 locations where snow loads increase.

For columns (NBC Subclause 9.17.1.1.(1)(b)(ii)), a 2.44 m × 4 m exterior platform raised 3 m from the ground by three columns was assessed. In 657 of the 680 locations, the sum of the specified snow load and the occupancy load remained below 4.8 kPa before and after the change, resulting in no impact. In 19 of the 23 remaining locations, the same column size was applicable before and after the change, resulting in no impact. In three of the remaining locations, there was a cost decrease of $290.86. One location experienced a cost increase of $290.86.

For ridge support (NBC Sentence 9.23.14.8.(5) and Table 9.23.14.8.), a 120 m^2 bungalow was used as the building archetype. In 481 of the 680 locations, the specified snow load remained within the same range, resulting in no impact. Of the 199 remaining locations, 58 were not impacted because the same number of nails were sufficient before and after the change. In the remaining 141 locations, 112 experienced a decrease in the required number of nails (maximum three nails less), and 29 experienced an increase in the number of nails (maximum three nails more) resulting in additional material costs of $5.54.

For ICF lintels (NBC Sentence 9.20.17.4.(3) and Tables 9.20.17.4.-A, 9.20.17.4.-B and 9.20.17.4.-C), a 120 m^2 bungalow was used assuming 150 mm thick ICF walls. ICF lintel sizes before and after the change where the ground snow load exceeded 3.33 kPa were analyzed. In six locations, the ground snow load before and after the change remained below or equal to 1.5 kPa, resulting in no impact. In

105 locations the ICF lintel size was sufficient to support the snow load before and after the change, resulting in no impact. In 62 locations, the ground snow load exceeded both the values in the NBC Span Tables and those provided by an ICF manufacturer, which would likely require a structural engineer to design using Part 4 and additional material and labour costs. For the remaining 507 locations, there was an increased cost for ICF lintels of between $6.71 and $88.46.

For spans for joists, rafters and beams (NBC Sentence 9.23.4.2.(1)), a 120 m^2 bungalow was used. In 589 of the 680 locations, the specified snow load before and after the change remained in the same range, resulting in no impact. The impact on the remaining 91 locations was the following:

- For roof joists (NBC Tables 9.23.4.2.-D and 9.23.4.2.-E), 37 of the 91 locations did not experience an impact because the same roof joist size was sufficient before and after the change. The cost impact was not determined for five locations where the specified snow load exceeded 4.0 kPa and the NBC Span Tables could not be used to determine the size of roof joists required either before or after the change. Of the remaining locations, 10 experienced a cost increase of approximately $1,850.00, while 39 locations experienced a cost decrease of the same amount.
- For roof rafters (NBC Tables 9.23.4.2.-F and 9.23.4.2.-G), 26 of the 91 locations did not experience an impact because the size of the roof rafters was sufficient before and after the change. The cost impact was not determined for five locations where the specified snow load exceeded 4.0 kPa and the NBC Span Tables could not be used to determine the size of roof rafters required either before or after the change. Of the remaining locations, 16 experienced a cost increase of between $255.30 and $1,342.89, while 44 locations experienced a cost decrease of between $255.30 and $1,342.89.
- For built-up ridge beams and lintels supporting the roof (NBC Table 9.23.4.2.-L), 12 of the 91 locations did not experience an impact because the size of the built-up ridge beam was sufficient before and after the change. The cost impact was not determined for nine locations where the specified snow load exceeded 3.0 kPa and the NBC Span Tables could not be used to determine the size of roof rafters required either before or after the change. Of the remaining locations, 17 experienced a cost increase of between $140.24 and $262.66, while 53 locations experienced a cost decrease of the same amount.
- For lintels for various wood species (NBC Tables 9.23.12.3.-A, 9.23.12.3.-B, 9.23.12.3.-C and 9.23.12.3.-D), the cost impact was not determined for nine locations where the specified snow load exceeded 3.0 kPa and the NBC Span Tables could not be used to determine the size of the lintel required either before or after the change. Of the remaining locations, 18 experienced a cost increase of between $32.13 and $84.47, while 64 locations experienced a cost decrease of the same amount.

Enforcement implications

There are no foreseeable enforcement implications.

Who is affected

Designers, architects, building regulators and building owners.

Supporting Document(s)

Cost impact of climatic load changes on Part 9: Adopting Part 4 proposed new return periods in PCF 2048 (cost_impact_of_pcf_2048.pdf)

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 9.4.2. (first printing)

[9.4.2.1.] **9.4.2.1. ([1] 1) no attributions**

[9.4.2.2.] **9.4.2.2. ([1] 1) [F20-OS2.1,OS2.3] [F22-OS2.3]**

[9.4.2.2.] **9.4.2.2. ([1] 1) [F20-OP2.1,OP2.3] [F22-OP2.3]**

[9.4.2.2.] **9.4.2.2. ([1] 1) [F22-OH1.1,OH1.2,OH1.3]**

[9.4.2.2.] **9.4.2.2. ([2] 2) [F20-OS2.1]**

[9.4.2.2.] **9.4.2.2. ([2] 2) [F20-OP2.1]**

[9.4.2.2.] -- ([3] --) [F20-OS2.1,OS2.3] [F22-OS2.3]

[9.4.2.2.] -- ([3] --) [F20-OP2.1,OP2.3] [F22-OP2.3]

[9.4.2.2.] -- ([3] --) [F22-OH1.1,OH1.2,OH1.3]

[9.4.2.2.] **9.4.2.2. ([4] 3) no attributions**

[9.4.2.2.] **9.4.2.2. ([5] 4) [F20-OS2.1,OS2.3] [F22-OS2.3]**

[9.4.2.2.] **9.4.2.2. ([5] 4) [F20-OP2.1,OP2.3] [F22-OP2.3]**

[9.4.2.2.] **9.4.2.2. ([5] 4) [F22-OH1.1,OH1.2,OH1.3]**

[9.4.2.2.] **9.4.2.2. ([6] 5) no attributions**

[9.4.2.3.] -- ([2] --) [F20-OS2.1,OS2.3] [F22-OS2.3]

[9.4.2.3.] -- ([2] --) [F20-OP2.1,OP2.3] [F22-OP2.3]

[9.4.2.3.] -- ([2] --) [F22-OH1.1,OH1.2,OH1.3]

[9.4.2.4.] **9.4.2.3. ([1] 1) [F20-OS2.1]**

[9.4.2.4.] **9.4.2.3. ([1] 1) [F20-OP2.1]**

[9.4.2.5.] **9.4.2.4. ([1] 1) [F20-OS2.1]**

[9.4.2.5.] **9.4.2.4. ([1] 1) [F20-OP2.1]**

NBC20 Div.B 9.6.1.3. (first printing)

[9.6.1.3.] **9.6.1.3. ([1] 1) [F20-OS2.1]**

[9.6.1.3.] **9.6.1.3. ([2] 2) [F20-OS2.1]**

[9.6.1.3.] **9.6.1.3. ([3] 3) [F30-OS3.1] [F10-OS3.7]**

NBC20 Div.B 9.23.3.4.(3) (first printing)

[9.23.3.4.] **9.23.3.4. ([1] 3) [F20-OS2.1] [F20,F22-OS2.3] [F20,F22-OS2.5]**

[9.23.3.4.] **9.23.3.4. ([1] 3) [F20-OP2.1,OP2.5] [F20,F22-OP2.3] [F22-OP2.4,OP2.5]**

[9.23.3.4.] **9.23.3.4. ([1] 3) [F20,F22-OH1.1,OH1.2,OH1.3]**

[9.23.3.4.] **9.23.3.4. ([1] 3) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

NBC20 Div.B 9.23.3.5. (first printing)

[9.23.3.5.] **9.23.3.5. ([1] 1) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([1] 1) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.3.5.] **9.23.3.5. ([1] 1) [F22-OS3.1]** Applies to floors and elements that support floors. **[F22-OS3.7]** Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.

[9.23.3.5.] **9.23.3.5. ([1] 1) [F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([1] 1) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([1] 1) [F20,F22-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([2] 2) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([2] 2) [F22-OS3.1]** Applies to floors and elements that support floors.**[F22-OS3.7]** Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.

[9.23.3.5.] **9.23.3.5. ([2] 2) [F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([2] 2) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([2] 2) [F20,F22-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([3] 3) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([3] 3) no attributions**

[9.23.3.5.] **9.23.3.5. ([3] 3) [F22-OS3.1]** Applies to floors and elements that support floors.**[F22-OS3.7]** Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.

[9.23.3.5.] **9.23.3.5. ([3] 3) [F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([3] 3) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([3] 3) [F20,F22-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([4] 4) no attributions**

[9.23.3.5.] **9.23.3.5. ([5] 5) [F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([5] 5) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([5] 5) [F20,F22-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([5] 5) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([5] 5) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.3.5.] **9.23.3.5. ([5] 5) [F22-OS3.1]** Applies to floors and elements that support floors. **[F22-OS3.7]** Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.

[9.23.3.5.] **9.23.3.5. ([6] 6) [F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([6] 6) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([6] 6) [F20,F22-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([6] 6) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([6] 6) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.3.5.] **9.23.3.5. ([6] 6) [F22-OS3.1]** Applies to floors and elements that support floors. **[F22-OS3.7]** Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.

[9.23.3.5.] **9.23.3.5. ([7] 7) [F20,F22-OS2.1]**

[9.23.3.5.] **9.23.3.5. ([7] 7) [F20-OP2.1] [F22-OP2.4]**

[9.23.3.5.] **9.23.3.5. ([7] 7) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([7] 7) [F22-OS3.1]** Applies to floors and elements that support floors.

[9.23.3.5.] **9.23.3.5. ([7] 7) [F20-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.3.5.] **9.23.3.5. ([8] 8) [F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([8] 8) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.3.5.] **9.23.3.5. ([8] 8) [F20,F22-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

NBC20 Div.B 9.23.6.1. (first printing)

[9.23.6.1.] **9.23.6.1. ([1] 1) [F20-OS2.1,OS2.5] [F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([1] 1) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([1] 1) [F20-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([1] 1) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([1] 1) [F20-OS3.1]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([2] 2) [F20-OS2.1,OS2.5] [F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([2] 2) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([2] 2) [F20-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([2] 2) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([2] 2) [F20-OS3.1]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([3] 3) [F20-OS2.1,OS2.5] [F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([3] 3) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([3] 3) [F20-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([3] 3) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([3] 3) [F20-OS3.1]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([4] 4) [F20-OS2.1,OS2.5] [F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([4] 4) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([4] 4) [F20-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([4] 4) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([4] 4) [F20-OS3.1]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([5] 5) [F20-OS2.1,OS2.5] [F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([5] 5) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([5] 5) [F20-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([5] 5) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([5] 5) [F20,F22-OS3.1]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([6] 6) [F20-OS2.1,OS2.5] [F22-OS2.5] [F20,F22-OS2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([6] 6) [F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([6] 6) [F20-OH1.1,OH1.2,OH1.3]** Applies to elements that support or are part of an environmental separator.

[9.23.6.1.] **9.23.6.1. ([6] 6) [F22-OH4]** Applies to floors and elements that support floors.

[9.23.6.1.] **9.23.6.1. ([6] 6) [F20-OS3.1]** Applies to floors and elements that support floors.

NBC20 Div.B 9.23.13.1. (first printing)

[9.23.13.1.] **9.23.13.1. ([1] 1) no attributions**

[9.23.13.1.] **9.23.13.1. ([2] 2) [F20-OS2.1,OS2.3,OS2.5] [F22-OS2.3,OS2.4,OS2.5]**

[9.23.13.1.] **9.23.13.1. ([2] 2) [F20-OP2.1,OP2.3,OP2.5] [F22-OP2.3,OP2.4,OP2.5]**

[9.23.13.1.] **9.23.13.1. ([2] 2) [F20,F22-OH1.1,OH1.2,OH1.3]**

[9.23.13.1.] **9.23.13.1. ([2] 2) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.13.1.] **9.23.13.1. ([2] 2) [F22-OS3.1]** Applies to walls that support floors.
[F22-OS3.7] Applies to walls that contain doors or windows required for emergency egress.

[9.23.13.1.] **9.23.13.1. ([2] 2) [F20,F22-OH4]** Applies to walls that support floors.

NBC20 Div.B 9.23.13.2. (first printing)

[9.23.13.2.] **9.23.13.2. ([1] 1) no attributions**

[9.23.13.2.] **9.23.13.2. ([2] 2) no attributions**

NBC20 Div.B 9.23.13.3. (first printing)

[9.23.13.3.] **9.23.13.3. ([1] 1) no attributions**

[9.23.13.3.] **9.23.13.3. ([2] 2) no attributions**

NBC20 Div.B 9.23.16.1. (first printing)

[9.23.16.1.] **9.23.16.1. ([1] 1) [F20-OS2.1,OS2.3,OS2.5] [F22-OS2.3,OS2.4,OS2.5]**

[9.23.16.1.] **9.23.16.1. ([1] 1) [F20-OP2.1,OP2.3,OP2.5] [F22-OP2.3,OP2.4,OP2.5]**

[9.23.16.1.] **9.23.16.1. ([1] 1) [F20,F22-OH1.1,OH1.2,OH1.3]**

NBC20 Div.B 9.23.16.5. (first printing)

[9.23.16.5.] **9.23.16.5. ([1] 1) [F20-OS2.1,OS2.3,OS2.5] [F22-OS2.3,OS2.5]**

[9.23.16.5.] **9.23.16.5. ([1] 1) [F20-OP2.1,OP2.3,OP2.5] [F22-OP2.3,OP2.5]**

[9.23.16.5.] **9.23.16.5. ([1] 1) [F20,F22-OH1.1,OH1.2,OH1.3]**

[9.23.16.5.] **9.23.16.5. ([1] 1) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.16.5.] **9.23.16.5. ([2] 2) [F20-OS2.1,OS2.3,OS2.5] [F22-OS2.3,OS2.4,OS2.5]**

[9.23.16.5.] **9.23.16.5. ([2] 2) [F20-OP2.1,OP2.3,OP2.5] [F22-OP2.3,OP2.4,OP2.5]**

[9.23.16.5.] **9.23.16.5. ([2] 2) [F20,F22-OS1.2]** Applies to assemblies required to provide fire resistance.

[9.23.16.5.] **9.23.16.5. ([2] 2) [F20,F22-OH1.1,OH1.2,OH1.3]**

[9.23.16.5.] **9.23.16.5. ([3] 3) no attributions**

NBC20 Div.B 9.27.5.4.(2) (first printing)

[9.27.5.4.] **9.27.5.4. ([1] 2) [F20-OH1.1,OH1.2,OH1.3]**

[9.27.5.4.] 9.27.5.4. ([1] 2) [F20-OS2.1,OS2.3]

Submit a comment

Proposed Change 2030

Code Reference(s):	**NBC20 Div.B 9.31.2.3. (first printing)**
Subject:	Accessibility, Visitability and Adaptability of Dwelling Units
Title:	Reinforcing Stud Walls in Washrooms for the Future Installation of Grab Bars: Structural Strength
Description:	This proposed change introduces performance-based requirements and prescriptive pathways for material selection when reinforcing stud walls of washrooms in dwelling units for the future installation of grab bars.
Related Proposed Change(s):	PCF 1882, PCF 1884, PCF 1958, PCF 2031

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [x] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [x] Division B
- [x] Design and Construction
- [x] Housing
- [x] Large Buildings
- [x] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

General information

See the summary for subject Accessibility, Visitability and Adaptability of Dwelling Units.

Problem

Stud walls in washrooms are often reinforced with materials such as solid lumber blocking, plywood or oriented strandboard (OSB) sheathing to allow grab bars to be installed in locations other than attached directly to the studs while still complying with the NBC requirements for structural strength (which stipulate that grab bars, where provided, must resist 1.3 kN applied horizontally and vertically).

However, the NBC does not provide guidance for designers or builders in terms of how to select the reinforcing materials and methods of attaching the material to the studs, so that grab bars attached to the reinforcing material comply with the applicable requirements for structural strength.

This situation can create a problem for designers and builders who may not have the resources to demonstrate that their material selection and method of attaching the material to the studs allows grab bars to meet the requirements for structural strength and provides an appropriate level of safety to users.

Justification

This proposed change introduces a performance-based requirement and prescriptive compliance options that would allow the reinforcement of stud walls in washrooms to support grab bars and meet the NBC requirements for structural strength. The compliance options address the following:

- reinforcement material and its thickness, and
- method of attaching the material to the stud walls where wood studs are provided.

By introducing a performance-based requirement for reinforcing washroom walls in a way that allows grab bars to meet NBC requirements for structural strength, the proposed change would also provide designers with flexibility in terms of material selection and the method of attaching the material to different types of stud walls.

By providing prescriptive options in conjunction with the performance-based requirement, this proposed change would also reduce the cost and inconvenience for designers and builders who may not have the resources to show that their material selection or method of mounting to the studs is adequate.

Both the performance-based requirement and prescriptive options would limit the probability that a grab bar would detach from the wall during use and cause a fall or fall-related injury to users.

PROPOSED CHANGE

NBC20 Div.B 9.31.2.3. (first printing)

[9.31.2.3.] 9.31.2.3. Grab Bars

[1] 1) Where~~n~~ provided, grab bars shall be capable of resisting a load of not less than 1.3 kN applied vertically or horizontally.

[2] --) Where stud walls in a *dwelling unit* are reinforced to support the present or future installation of grab bars between the studs, the reinforcement shall be designed to allow grab bars to comply with Sentence (1), using an appropriate

[a] --) combination of reinforcement material and thickness, and

[b] --) method of attaching the reinforcement material to the studs.
(See Note A-9.31.2.3.(2).)

[3] --) Options for compliance with Clause (2)(a) include but are not limited to

[a] --) solid lumber having a minimum thickness of 38 mm (see Note A-9.31.2.3.(3)(a)), and

[b] --) OSB or plywood sheathing having a minimum thickness of 25.4 mm (see Note A-9.31.2.3.(3)(b)).

[4] --) Where the stud walls have wood studs and the combination of reinforcement material and thickness conforms to Clause (3)(a), options for compliance with Clause (2)(b) include those listed in Table 9.31.2.3.

Table [9.31.2.3.]
Compliance Options for the Attachment of Solid Lumber to Wood Studs
Forming Part of Sentence 9.31.2.3.(4)

Fastener Type	Minimum Length of Fastener, mm	Minimum Number of Fasteners to Connect each piece of Material to the Studs (1)		Minimum Spacing, mm (2)	
		End-fastened	Toe-fastened	Fastener Spacing	Edge Spacing
Nails (3)	63	5	4	32.0	19.0
No. 8 wood screws	76	3	3	44.0	25.4
No. 10 wood screws	89	3	2	50.8	25.4

Notes to Table [9.31.2.3.] :

(1) The minimum number of fasteners applies to each end of each piece of lumber used as reinforcement.

(2) Smaller fastener and edge spacings may be acceptable for certain types of lumber.

(3) The values provided in this Table have been determined based on nails having a nominal diameter of 3.25 mm.

[5] --) Where the reinforcement material is attached to wood studs and the combination of reinforcement material and thickness conforms to Clause (3)(b), options for compliance with Clause (2)(b) include attaching the reinforcement material

[a] --) with No. 10 or No. 12 wood screws that have a minimum length of 50.8 mm, and

[b] --) using a minimum of 3 screws per stud spanned by the material.

(See Note A-9.31.2.3.(5).)

[6] --) Where the reinforcement material is installed behind other materials, gaps are not permitted between the reinforcement and the outer materials. (See Note A-9.31.2.3.(6).)

[7] --) Where a grab bar having a minimum of two flanges is provided in accordance with Sentence (1), options for fastening wood screws per flange of the grab bar to the wall include the use of a minimum of 3 No. 10 or No. 12 wood screws that penetrate at least

[a] --) 32 mm into solid lumber, or

[b] --) 25.4 mm into OSB or plywood.

Note A-9.31.2.3.(2) Compliance Options for Reinforcements for Grab Bar Installation.

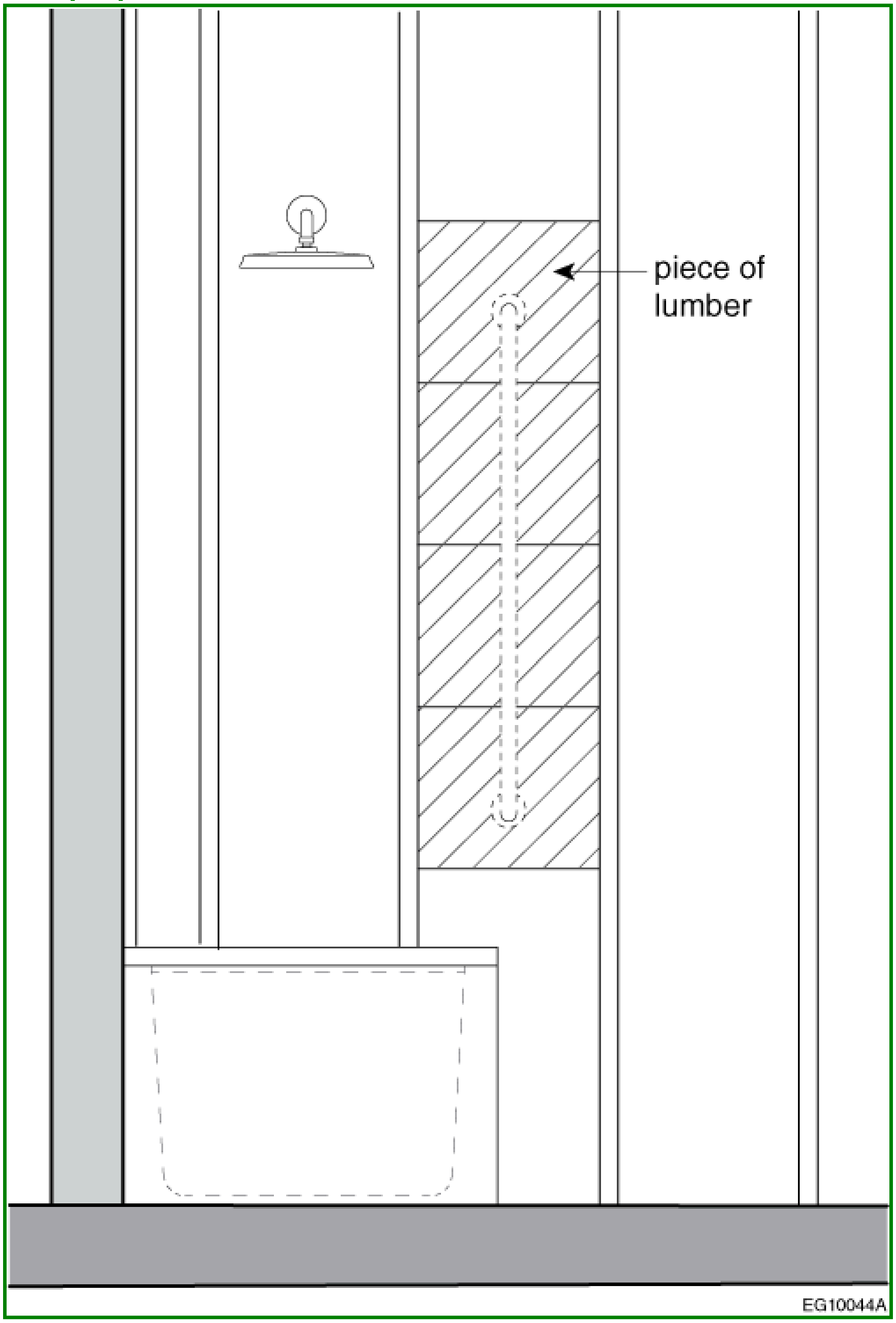
Sentence 9.31.2.3.(2) is intended to provide designers with the flexibility to choose the material used to reinforce the stud walls in washrooms, the thickness of the material, the type of studs, and the method of attaching the material to the studs. Designers may use any combination of material and thickness, stud type, and method of attachment, as long as they demonstrate that the combination allows grab bars to comply with the requirement of Sentence 9.31.2.3.(1) grab bars to resist a load of at least 1.3 kN applied horizontally and vertically.

Sentences 9.31.2.3.(3) and (5) provide prescriptive options for designers who do not wish to use the performance-based requirement set out in Sentence 9.31.2.3.(2). Sentence 9.31.2.3.(3) addresses the material and thickness, and Sentences 9.31.2.3.(4) and (5) address the method of attaching the material to the studs, in the case of wood studs.

Note A-9.31.2.3.(3)(a) Lumber Reinforcement.

Multiple pieces of lumber may be used as reinforcement to achieve the desired wall coverage, as illustrated in Figure A-9.31.2.3.(3)(a).

Figure [A-9.31.2.3.(3)(a)]
Multiple pieces of lumber used as reinforcement



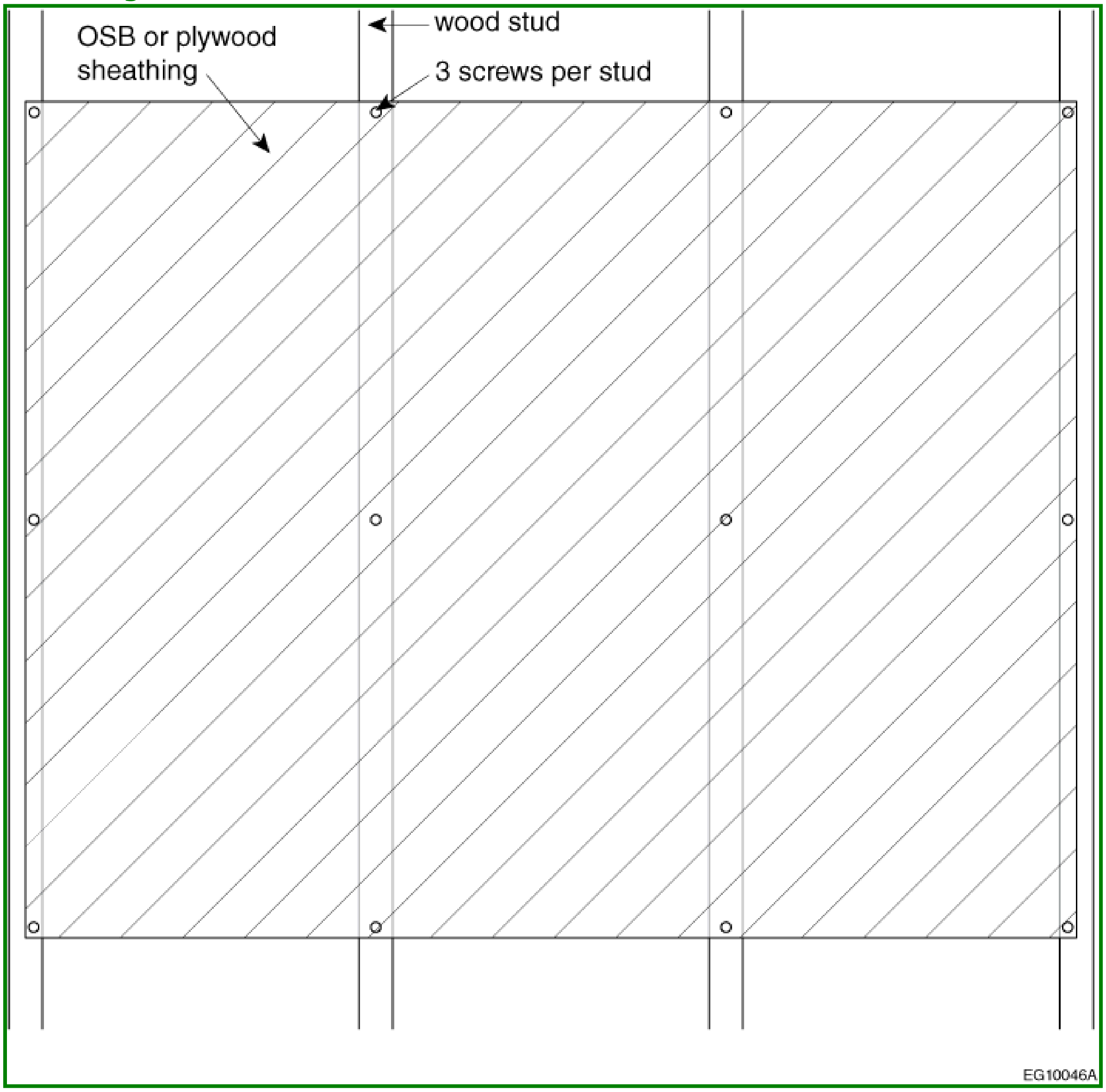
Note A-9.31.2.3.(3)(b) Minimum Thickness of Sheathing.

The minimum thickness of OSB or plywood sheathing can be achieved by using a single piece of 25.4 mm sheathing or by combining two sheets (one 9.5 mm thick and one 15.9 mm thick, or both 12.7 mm thick) with adhesive.

Note A-9.31.2.3.(5) Attachment of Sheathing to Wood Studs.

Figure A-9.31.2.3.(5) illustrates an example of an acceptable configuration for attachment of OSB or plywood sheathing to wood studs with a minimum of 3 screws per stud.

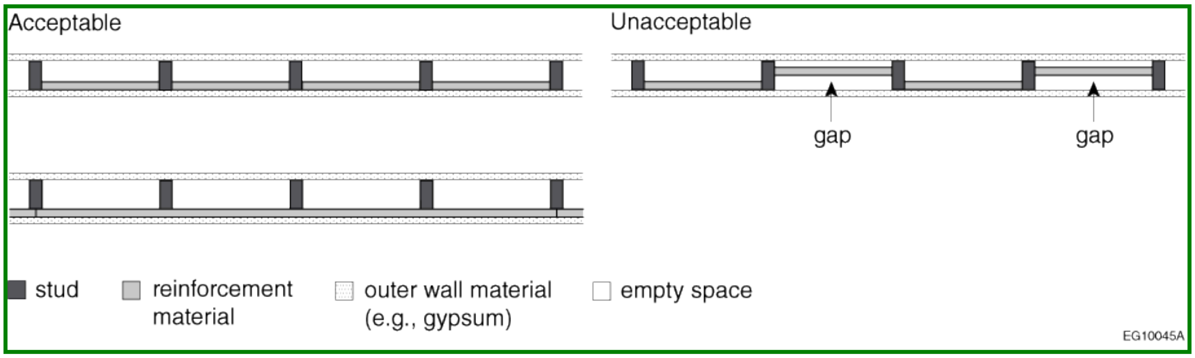
Figure [A-9.31.2.3.(5)]
Example of an acceptable configuration for the attachment of OSB or plywood sheathing to wood studs



Note A-9.31.2.3.(6) Contact Between Reinforcement and Other Materials in the Wall.

Since the structural strength calculations that support Article 9.31.2.3. assume that the reinforcement material is in full contact with the outer wall material (e.g., gypsum) that it is installed behind, gaps between these materials are not permitted. Figure A-9.31.2.3.(6) illustrates examples of wall assemblies with acceptable and unacceptable configurations of the reinforcement material with respect to the outer wall material. In the unacceptable configuration, there are gaps between some of the pieces of reinforcement material and the outer wall material that they are installed behind.

Figure [A-9.31.2.3.(6)]
Top view of examples of wall assemblies with acceptable and unacceptable configurations of the reinforcement material with respect to the outer wall material



Impact analysis

Financial Impact

This proposed change, on its own, does not introduce new costs because the NBC does not presently require the reinforcement of washroom walls.

In cases where washroom walls are reinforced (e.g., to comply with building codes in Nova Scotia, Ontario, Quebec and BC), designers typically have to demonstrate that their selection of materials and the method of attachment to the studs would allow grab bars to meet the NBC requirements for structural strength. Thus, the performance-based requirement is consistent with current practice. By introducing prescriptive options, the costs to designers, builders and owners may be reduced by removing the need to demonstrate compliance with the performance-based requirement.

The proposed change does not yet provide options for steel studs; in this case, the designer would need to demonstrate compliance with the performance-based requirements, consistent with current practice in the provinces that already require some form of reinforcement to washroom walls where stud walls are provided.

The proposed change also does not address masonry walls, which require different approaches to the installation of grab bars.

Impact on Safety

This proposed change, on its own, does not affect washroom safety because it does not require the installation of grab bars. However, where grab bars are installed using reinforcement (as opposed to the wall studs), the proposed change would make it easier for designers and builders to select materials that support grab bars in compliance with the NBC requirements for structural strength.

Impact on the Provinces and Territories

Multiple provinces require that washroom walls in dwelling units be reinforced to support the future installation of grab bars. Ontario and Nova Scotia require reinforcement in all dwelling units, Quebec requires reinforcement to washroom walls in all dwelling units in multi-unit residential buildings, and BC and Alberta require reinforcement in dwelling units designated as adaptable. However, none of these provinces and territories provide prescriptive options for the reinforcement materials or method of attachment to the studs. By providing prescriptive options, this proposed change would reduce the costs for designers, builders and owners should they not wish to demonstrate that their selection of reinforcement materials allows grab bars to meet the NBC requirements for structural strength.

Enforcement implications

The performance-based requirements can be evaluated by reviewing the supporting calculations.

The prescriptive options can be evaluated using visual inspection and a tape measure.

Who is affected

Designers and builders would have compliance options for reinforcing washroom walls to support grab bars that comply with the NBC requirements for structural strength.

Homeowners would be less likely to encounter grab bars installed using reinforcement that does not provide adequate structural strength.

Authorities having jurisdiction would need to become familiar with and enforce this proposed change.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 9.31.2.3. (first printing)

[9.31.2.3.] **9.31.2.3. ([1] 1) [F20-OS3.1]**

[9.31.2.3.] -- ([2] --) [F20-OS2.1]

[9.31.2.3.] -- ([2] --) [F30-OS3.1] [F20-OS3.1]

[9.31.2.3.] -- ([3] --) [F20-OS2.1]

[9.31.2.3.] -- ([3] --) [F30-OS3.1] [F20-OS3.1]

[9.31.2.3.] -- ([3] --) no attributions

[9.31.2.3.] -- ([4] --) no attributions

[9.31.2.3.] -- ([4] --) [F20-OS2.1]

[9.31.2.3.] -- ([4] --) [F30-OS3.1] [F20-OS3.1]

[9.31.2.3.] -- ([5] --) no attributions

[9.31.2.3.] -- ([5] --) [F20-OS2.1]

[9.31.2.3.] -- ([5] --) [F30-OS3.1] [F20-OS3.1]

[9.31.2.3.] -- ([6] --) [F20-OS2.1]

[9.31.2.3.] -- ([7] --) [F20-OS2.1]

[9.31.2.3.] -- ([7] --) no attributions

[9.31.2.3.] -- ([7] --) [F30-OS3.1] [F20-OS3.1]

Submit a comment

Proposed Change 2042

Code Reference(s):	**NBC20 Div.B 9.36. (first printing)**
Subject:	Energy Efficiency for Houses
Title:	Energy Performance Tier 1 of the Prescriptive Path
Description:	This proposed change provides energy-efficiency requirements for compliance with Tier 1 of the energy performance compliance prescriptive path.
Related Proposed Change(s):	PCF 1823, PCF 1830

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [x] Housing
- [ ] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [x] Building Envelope
- [x] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

The 2020 edition of the National Building Code of Canada (NBC) introduced energy-efficiency performance tiers in Section 9.36. of Division B, with increasing levels of improvement for buildings and houses, to provide authorities having jurisdiction with the option to adopt the energy performance level most suitable to their needs.

Although performance modeling is common in the industry, many Code users have requested that prescriptive compliance paths remain in the National Model Codes to provide simplicity in achieving energy compliance.

The current structure of the Codes does not make it clear to Code users how to comply with the tiered prescriptive compliance path in order to achieve the energy-efficiency targets required for Energy Performance Tier 1. Failure to clarify the Tier 1 prescriptive compliance path could force Code users to rely on performance-based requirements that use energy modeling to achieve the Tier 1 energy-efficiency targets. This could prevent compliance with Tier 1 for Code users who do not have access to modeling.

Justification

This proposed change adds prescriptive Tier 1 to align with the tiered performance path in Subsection 9.36.7. and the points-based prescriptive trade-off path in Subsection 9.36.8.

The proposed prescriptive requirements for Tier 1 would provide a baseline for energy performance improvement in higher tiers. This proposed change provides clear direction for Code users for compliance with Tier 1 by following the existing prescriptive requirements and specifications in the Code for the design and construction of the building envelope, HVAC and service water heating system.

In addition to the tiered energy performance path in Subsection 9.36.7. and the tiered points-based prescriptive trade-off path in Subsection 9.36.8., the prescriptive path provides an additional option for compliance in the Code.

PROPOSED CHANGE

NBC20 Div.B 9.36. (first printing)

[9.36.] 9.36. Energy Efficiency

[9.36.1.] 9.36.1. General

[9.36.1.1.] 9.36.1.1. Scope

[9.36.1.2.] 9.36.1.2. Definitions

[9.36.1.3.] 9.36.1.3. Compliance and Application

(See Note A-9.36.1.3.)

[1] **1)** Except as provided in Sentences (2) to (6), *buildings* shall comply with

[a] a) the prescriptive or trade-off requirements in Subsections 9.36.2. to 9.36.4.,

[b] b) the performance requirements in Subsection 9.36.5.,

[c] c) the tiered performance requirements in Subsection 9.36.7.,

[d] d) the tiered points-based prescriptive trade-off requirements in Subsection 9.36.8., ~~or~~

[e] --) the tiered prescriptive requirements in Subsection 9.36.9., or

[f] e) the NECB.

[2] **2)** Subsections 9.36.2. to 9.36.4. and 9.36.9. apply to

[a] a) *buildings* of *residential occupancy* to which Part 9 applies,

[b] b) *buildings* containing *business and personal services*, *mercantile* or *low-hazard industrial occupancies* to which Part 9 applies whose combined total *floor area* does not exceed 300 m^2, excluding

parking garages that serve *residential occupancies*, and

[c] c) *buildings* containing a mix of the *residential* and non-*residential occupancies* described in Clauses (a) and (b).

[3] **3)** Subsection 9.36.5. and 9.36.7. apply only to

[a] a) houses with or without a *secondary suite*, and

[b] b) *buildings* containing only *dwelling units* and common spaces whose total *floor area* does not exceed 20% of the total *floor area* of the *building*.

(See Note A-9.36.1.3.(3).)

[4] **4)** Subsection 9.36.8. applies only to *buildings* of *residential occupancy* to which Part 9 applies.

[5] **5)** *Buildings* containing non-*residential occupancies* whose combined total *floor area* exceeds 300 m^2 or *medium-hazard industrial occupancies* shall comply with the NECB.

[6] **6)** *Buildings* or portions of *buildings* that are not required to be *conditioned spaces* are exempted from the requirements of this Section. (See Note A-9.36.1.3.(6).)

[9.36.2.] 9.36.2. Building Envelope

[9.36.2.1.] 9.36.2.1. Scope and Application

[9.36.2.2.] 9.36.2.2. Determination of Thermal Characteristics of Materials, Components and Assemblies

[9.36.2.3.] 9.36.2.3. Calculation of Ceiling, Wall, Fenestration and Door Areas

[9.36.2.4.] 9.36.2.4. Calculation of Effective Thermal Resistance of Assemblies

[9.36.2.5.] 9.36.2.5. Continuity of Insulation

[9.36.2.6.] 9.36.2.6. Thermal Characteristics of Above-ground Opaque Building Assemblies

[9.36.2.7.] 9.36.2.7. Thermal Characteristics of Fenestration, Doors and Skylights

[9.36.2.8.] 9.36.2.8. Thermal Characteristics of Building Assemblies Below-Grade or in Contact with the Ground

[9.36.2.9.] 9.36.2.9. Airtightness

[9.36.2.10.] 9.36.2.10. Construction of Air Barrier Details

[9.36.2.11.] 9.36.2.11. Trade-off Options for Above-ground Building Envelope Components and Assemblies

[9.36.3.] 9.36.3. HVAC Requirements

[9.36.3.1.] 9.36.3.1. Scope and Application

[9.36.3.2.] 9.36.3.2. Equipment and Ducts

[9.36.3.3.] 9.36.3.3. Air Intake and Outlet Dampers

[9.36.3.4.] 9.36.3.4. Piping for Heating and Cooling Systems

[9.36.3.5.] 9.36.3.5. Equipment for Heating and Air-conditioning Systems

[9.36.3.6.] 9.36.3.6. Temperature Controls

[9.36.3.7.] 9.36.3.7. Humidification

[9.36.3.8.] 9.36.3.8. Heat Recovery from Dehumidification in Spaces with an Indoor Pool or Hot Tub

[9.36.3.9.] 9.36.3.9. Heat Recovery from Ventilation Systems

[9.36.3.10.] 9.36.3.10. Equipment Efficiency

[9.36.3.11.] 9.36.3.11. Solar Thermal Systems

[9.36.4.] 9.36.4. Service Water Heating Systems

[9.36.4.1.] 9.36.4.1. Scope and Application

[9.36.4.2.] 9.36.4.2. Equipment Efficiency

[9.36.4.3.] 9.36.4.3. Solar Domestic Hot Water Systems

[9.36.4.4.] 9.36.4.4. Piping

[9.36.4.5.] 9.36.4.5. Controls

[9.36.4.6.] 9.36.4.6. Indoor Swimming Pool Equipment Controls

[9.36.5.] 9.36.5. Energy Performance Compliance

[9.36.5.1.] 9.36.5.1. Scope and Application

[9.36.5.2.] 9.36.5.2. Definitions

[9.36.5.3.] 9.36.5.3. Compliance

[9.36.5.4.] 9.36.5.4. Calculation Methods

[9.36.5.5.] 9.36.5.5. Climatic Data

[9.36.5.6.] 9.36.5.6. Building Envelope Calculations

[9.36.5.7.] 9.36.5.7. HVAC System Calculations

[9.36.5.8.] 9.36.5.8. Service Water Heating System Calculations

[9.36.5.9.] 9.36.5.9. General Requirements for Modeling the Proposed House

[9.36.5.10.] 9.36.5.10. Modeling Building Envelope of Proposed House

[9.36.5.11.] 9.36.5.11. Modeling HVAC System of Proposed House

[9.36.5.12.] 9.36.5.12. Modeling Service Water Heating System of Proposed House

[9.36.5.13.] 9.36.5.13. General Requirements for Modeling the Reference House

[9.36.8.9.] 9.36.8.9. Energy Conservation Measures for HVAC Systems

[9.36.8.10.] 9.36.8.10. Energy Conservation Measures for Service Water Heating Equipment

[9.36.8.11.] 9.36.8.11. Energy Conservation Points for Building Volume

[9.36.9.] -- Tiered Energy Performance Compliance: Tier 1 Prescriptive Path

[9.36.9.1.] --- Scope and Application

[1] --) This Subsection is concerned with achieving compliance with Energy Performance Tier 1, as specified in Table 9.36.7.2., through prescriptive requirements.

[2] --) This Subsection applies only to *buildings* that are equipped with a heat- or energy-recovery ventilator conforming to Article 9.36.3.9.

[9.36.9.2.] --- Compliance

[1] --) Compliance with this Subsection shall be achieved by

- [a] --) designing and constructing the *building* envelope in accordance with Subsection 9.36.2. (see Note A-9.36.9.3.(1)(a)),
- [b] --) designing and constructing systems and equipment for heating, ventilating or air-conditioning in accordance with Subsection 9.36.3., and
- [c] --) designing and constructing systems and equipment for service water heating in accordance with Subsection 9.36.4.

Note A-9.36.9.3.(1)(a) Building Envelope Compliance.

Since, according to Sentence 9.36.9.1.(2), the installation of a heat- or energy-recovery ventilator is required for compliance under the Tier 1 prescriptive path, less stringent requirements for the effective thermal resistance of above-ground opaque assemblies and assemblies below-grade or in contact with the ground can be applied in accordance with Tables 9.36.2.6.-B and 9.36.2.8.-B, respectively.

Impact analysis

The Tier 1 prescriptive requirements point to the requirements of Subsections 9.36.2. to 9.36.4. of the NBC and align with the tiered performance path in Subsection 9.36.7. and the points-based prescriptive trade-off path in Subsection 9.36.8. of the NBC 2020.

There are no additional cost implications.

Enforcement implications

This proposed change could be enforced by the infrastructure currently available to enforce the Code. This proposed change would facilitate the effective enforcement of the energy requirements in the Code.

Who is affected

Regulators, builders, designers, engineers, architects, contractors and consultants would be affected in provinces and territories where Tier 1 energy requirements for housing are adopted.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 9.36. (first printing)

[9.36.1.1.] 9.36.1.1. ([1] 1) no attributions

[9.36.1.2.] 9.36.1.2. ([1] 1) no attributions

[9.36.1.2.] 9.36.1.2. ([2] 2) no attributions

[9.36.1.2.] 9.36.1.2. ([3] 3) no attributions

[9.36.1.2.] 9.36.1.2. ([4] 4) no attributions

[9.36.1.2.] 9.36.1.2. ([5] 5) no attributions

[9.36.1.2.] 9.36.1.2. ([6] 6) no attributions

[9.36.1.2.] 9.36.1.2. ([7] 7) no attributions

[9.36.1.2.] 9.36.1.2. ([8] 8) no attributions

[9.36.1.3.] 9.36.1.3. ([1] 1) no attributions

[9.36.1.3.] 9.36.1.3. ([1] 1) ([f] e)

[9.36.1.3.] 9.36.1.3. ([2] 2) no attributions

[9.36.1.3.] 9.36.1.3. ([2] 2) no attributions

[9.36.1.3.] 9.36.1.3. ([3] 3) no attributions

[9.36.1.3.] 9.36.1.3. ([4] 4) no attributions

[9.36.1.3.] 9.36.1.3. ([5] 5) no attributions

[9.36.1.3.] 9.36.1.3. ([6] 6) no attributions

[9.36.2.1.] 9.36.2.1. ([1] 1) no attributions

[9.36.2.1.] 9.36.2.1. ([2] 2) no attributions

[9.36.2.1.] 9.36.2.1. ([3] 3) no attributions

[9.36.2.1.] 9.36.2.1. ([4] 4) no attributions

[9.36.2.1.] 9.36.2.1. ([5] 5) no attributions

[9.36.2.2.] 9.36.2.2. ([1] 1) [F92-OE1.1]

[9.36.2.2.] 9.36.2.2. ([2] 2) [F92-OE1.1]

[9.36.2.2.] 9.36.2.2. ([3] 3) [F92-OE1.1]

[9.36.2.2.] 9.36.2.2. ([4] 4) [F92-OE1.1]

[9.36.2.2.] 9.36.2.2. ([5] 5) [F92-OE1.1]

[9.36.2.3.] 9.36.2.3. ([1] 1) no attributions

[9.36.2.3.] 9.36.2.3. ([2] 2) no attributions

[9.36.2.3.] 9.36.2.3. ([3] 3) no attributions

[9.36.2.3.] 9.36.2.3. ([4] 4) no attributions

[9.36.2.3.] 9.36.2.3. ([5] 5) no attributions

[9.36.2.4.] 9.36.2.4. ([1] 1) [F92-OE1.1]

[9.36.2.4.] 9.36.2.4. ([2] 2) no attributions

[9.36.2.4.] 9.36.2.4. ([3] 3) [F92-OE1.1]

[9.36.2.4.] 9.36.2.4. ([4] 4) no attributions

[9.36.2.5.] 9.36.2.5. ([1] 1) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([2] 2) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([3] 3) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([4] 4) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([5] 5) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([6] 6) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([7] 7) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([8] 8) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([9] 9) [F92-OE1.1]

[9.36.2.5.] 9.36.2.5. ([10] 10) no attributions

[9.36.2.6.] 9.36.2.6. ([1] 1) [F92-OE1.1]

[9.36.2.6.] 9.36.2.6. ([2] 2) [F92-OE1.1]

[9.36.2.6.] 9.36.2.6. ([3] 3) [F92-OE1.1]

[9.36.2.6.] 9.36.2.6. ([4] 4) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([1] 1) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([2] 2) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([3] 3) no attributions

[9.36.2.7.] 9.36.2.7. ([3] 3) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([4] 4) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([5] 5) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([6] 6) no attributions

[9.36.2.7.] 9.36.2.7. ([7] 7) [F92-OE1.1]

[9.36.2.7.] 9.36.2.7. ([8] 8) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([1] 1) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([2] 2) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([3] 3) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([4] 4) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([5] 5) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([6] 6) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([7] 7) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([8] 8) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([9] 9) [F92-OE1.1]

[9.36.2.8.] 9.36.2.8. ([10] 10) no attributions

[9.36.2.9.] 9.36.2.9. ([1] 1) [F90-OE1.1]

[9.36.2.9.] 9.36.2.9. ([2] 2) [F90-OE1.1]

[9.36.2.9.] 9.36.2.9. ([3] 3) [F90-OE1.1]

[9.36.2.9.] 9.36.2.9. ([4] 4) [F90-OE1.1]

[9.36.2.9.] 9.36.2.9. ([5] 5) [F90-OE1.1]

[9.36.2.9.] 9.36.2.9. ([6] 6) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([1] 1) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([2] 2) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([3] 3) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([4] 4) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([5] 5) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([6] 6) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([7] 7) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.2.10.] 9.36.2.10. ([8] 8) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([9] 9) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([10] 10) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([11] 11) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([12] 12) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([13] 13) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([14] 14) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([15] 15) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([16] 16) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([17] 17) [F90-OE1.1]

[9.36.2.10.] 9.36.2.10. ([18] 18) [F90-OE1.1]

[9.36.2.11.] 9.36.2.11. ([1] 1) no attributions

[9.36.2.11.] 9.36.2.11. ([2] 2) [F92-OE1.1]

[9.36.2.11.] 9.36.2.11. ([2] 2) no attributions

[9.36.2.11.] 9.36.2.11. ([3] 3) [F92-OE1.1]

[9.36.2.11.] 9.36.2.11. ([3] 3) no attributions

[9.36.2.11.] 9.36.2.11. ([4] 4) [F92-OE1.1]

[9.36.2.11.] 9.36.2.11. ([5] 5) [F92-OE1.1]

[9.36.2.11.] 9.36.2.11. ([6] 6) [F92-OE1.1]

[9.36.2.11.] 9.36.2.11. ([7] 7) [F92-OE1.1]

[9.36.2.11.] 9.36.2.11. ([8] 8) [F92-OE1.1]

[9.36.3.1.] 9.36.3.1. ([1] 1) no attributions

[9.36.3.1.] 9.36.3.1. ([2] 2) no attributions

[9.36.3.2.] 9.36.3.2. ([1] 1) [F95-OE1.1]

[9.36.3.2.] 9.36.3.2. ([2] 2) no attributions

[9.36.3.2.] 9.36.3.2. ([3] 3) [F91,F93-OE1.1]

[9.36.3.2.] 9.36.3.2. ([4] 4) [F91,F93-OE1.1]

[9.36.3.2.] 9.36.3.2. ([5] 5) no attributions

[9.36.3.2.] 9.36.3.2. ([5] 5) [F91,F93-OE1.1]

[9.36.3.3.] 9.36.3.3. ([1] 1) [F91,F95-OE1.1]

[9.36.3.3.] 9.36.3.3. ([2] 2) [F91,F95-OE1.1]

[9.36.3.3.] 9.36.3.3. ([3] 3) no attributions

[9.36.3.3.] 9.36.3.3. ([4] 4) no attributions

[9.36.3.4.] 9.36.3.4. ([1] 1) no attributions

[9.36.3.4.] 9.36.3.4. ([2] 2) [F93-OE1.1]

[9.36.3.5.] 9.36.3.5. ([1] 1) [F98-OE1.1]

[9.36.3.6.] 9.36.3.6. ([1] 1) [F95-OE1.1]

[9.36.3.6.] 9.36.3.6. ([1] 1) no attributions

[9.36.3.6.] 9.36.3.6. ([2] 2) [F95,F98-OE1.1]

[9.36.3.6.] 9.36.3.6. ([3] 3) [F95-OE1.1]

[9.36.3.6.] 9.36.3.6. ([4] 4) [F95-OE1.1]

[9.36.3.6.] 9.36.3.6. ([5] 5) [F95-OE1.1]

[9.36.3.6.] 9.36.3.6. ([6] 6) [F95-OE1.1]

[9.36.3.6.] 9.36.3.6. ([7] 7) [F95-OE1.1]

[9.36.3.7.] 9.36.3.7. ([1] 1) [F95-OE1.1]

[9.36.3.8.] 9.36.3.8. ([1] 1) [F95,F100-OE1.1]

[9.36.3.8.] 9.36.3.8. ([2] 2) no attributions

[9.36.3.8.] 9.36.3.8. ([3] 3) no attributions

[9.36.3.8.] 9.36.3.8. ([4] 4) [F98,F100-OE1.1]

[9.36.3.8.] 9.36.3.8. ([5] 5) [F98,F100-OE1.1]

[9.36.3.9.] 9.36.3.9. ([1] 1) no attributions

[9.36.3.9.] 9.36.3.9. ([2] 2) [F95,F100-OE1.1]

[9.36.3.9.] 9.36.3.9. ([3] 3) [F95,F100-OE1.1]

[9.36.3.9.] 9.36.3.9. ([4] 4) [F95,F98,F100-OE1.1]

[9.36.3.10.] 9.36.3.10. ([1] 1) [F95,F98,F99-OE1.1]

[9.36.3.10.] 9.36.3.10. ([2] 2) [F95,F98,F99-OE1.1]

[9.36.3.10.] 9.36.3.10. ([3] 3) no attributions

[9.36.3.11.] 9.36.3.11. ([1] 1) [F95,F98,F99-OE1.1]

[9.36.3.11.] 9.36.3.11. ([2] 2) no attributions

[9.36.3.11.] 9.36.3.11. ([3] 3) [F93,F96-OE1.1]

[9.36.4.1.] 9.36.4.1. ([1] 1) no attributions

[9.36.4.1.] 9.36.4.1. ([2] 2) no attributions

[9.36.4.2.] 9.36.4.2. ([1] 1) [F96,F98-OE1.1]

[9.36.4.2.] 9.36.4.2. ([2] 2) [F93,F96-OE1.1]

[9.36.4.2.] 9.36.4.2. ([3] 3) [F98-OE1.1]

[9.36.4.3.] 9.36.4.3. ([1] 1) [F96,F98-OE1.1]

[9.36.4.3.] 9.36.4.3. ([2] 2) no attributions

[9.36.4.3.] 9.36.4.3. ([3] 3) [F93,F96-OE1.1]

[9.36.4.4.] 9.36.4.4. ([1] 1) [F93,F96-OE1.1]

[9.36.4.4.] 9.36.4.4. ([2] 2) [F93,F96-OE1.1]

[9.36.4.4.] 9.36.4.4. ([3] 3) [F93,F96-OE1.1]

[9.36.4.5.] 9.36.4.5. ([1] 1) [F96-OE1.1]

[9.36.4.6.] 9.36.4.6. ([1] 1) [F96-OE1.1]

[9.36.4.6.] 9.36.4.6. ([2] 2) [F96-OE1.1]

[9.36.5.1.] 9.36.5.1. ([1] 1) no attributions

[9.36.5.1.] 9.36.5.1. ([2] 2) no attributions

[9.36.5.2.] 9.36.5.2. ([1] 1) no attributions

[9.36.5.2.] 9.36.5.2. ([2] 2) no attributions

[9.36.5.3.] 9.36.5.3. ([1] 1) no attributions

[9.36.5.3.] 9.36.5.3. ([2] 2) [F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.5.3.] 9.36.5.3. ([3] 3) [F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.5.3.] 9.36.5.3. ([4] 4) [F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.5.3.] 9.36.5.3. ([5] 5) [F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.5.3.] 9.36.5.3. ([6] 6) [F99-OE1.1]

[9.36.5.4.] 9.36.5.4. ([1] 1) no attributions

[9.36.5.4.] 9.36.5.4. ([2] 2) no attributions

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[9.36.5.4.] 9.36.5.4. ([4] 4) [F99-OE1.1]

[9.36.5.4.] 9.36.5.4. ([5] 5) [F95,F99-OE1.1]

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[9.36.5.4.] 9.36.5.4. ([7] 7) [F95,F99-OE1.1]

[9.36.5.4.] 9.36.5.4. ([8] 8) [F99-OE1.1]

[9.36.5.4.] 9.36.5.4. ([9] 9) [F99-OE1.1]

[9.36.5.4.] 9.36.5.4. ([10] 10) [F90,F99-OE1.1]

[9.36.5.4.] 9.36.5.4. ([11] 11) [F90,F99-OE1.1]

[9.36.5.5.] 9.36.5.5. ([1] 1) [F99-OE1.1]

[9.36.5.5.] 9.36.5.5. ([2] 2) [F99-OE1.1]

[9.36.5.5.] 9.36.5.5. ([3] 3) [F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([1] 1) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([2] 2) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([3] 3) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([4] 4) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([5] 5) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([6] 6) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([7] 7) [F92,F93,F95,F96,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([8] 8) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([9] 9) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([10] 10) [F92,F99-OE1.1]

[9.36.5.6.] 9.36.5.6. ([11] 11) [F92,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([1] 1) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([2] 2) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([3] 3) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([4] 4) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([5] 5) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([6] 6) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([7] 7) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([8] 8) [F95,F99-OE1.1]

[9.36.5.7.] 9.36.5.7. ([9] 9) [F95,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([1] 1) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([2] 2) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([3] 3) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([4] 4) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([5] 5) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([6] 6) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([7] 7) [F96,F99-OE1.1]

[9.36.5.8.] 9.36.5.8. ([8] 8) [F96,F99-OE1.1]

[9.36.5.9.] 9.36.5.9. ([1] 1) [F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([1] 1) [F92,F95,F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([2] 2) no attributions

[9.36.5.10.] 9.36.5.10. ([3] 3) no attributions

[9.36.5.10.] 9.36.5.10. ([4] 4) [F92,F95,F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([5] 5) [F92,F95,F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([6] 6) [F92,F95,F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([7] 7) [F92,F95,F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([8] 8) no attributions

[9.36.5.10.] 9.36.5.10. ([9] 9) [F90,F91,F92,F95,F99-OE1.1]

[9.36.5.10.] 9.36.5.10. ([10] 10) [F90,F91,F92,F93,F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([1] 1) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([2] 2) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([3] 3) [F92,F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([4] 4) [F95,F99,F100-OE1.1]

[9.36.5.11.] 9.36.5.11. ([5] 5) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([6] 6) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([7] 7) no attributions

[9.36.5.11.] 9.36.5.11. ([8] 8) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([9] 9) [F95,F99-OE1.1]

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[9.36.5.11.] 9.36.5.11. ([11] 11) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([12] 12) [F95,F99,F100-OE1.1]

[9.36.5.11.] 9.36.5.11. ([13] 13) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([14] 14) [F95,F99,F100-OE1.1]

[9.36.5.11.] 9.36.5.11. ([15] 15) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([16] 16) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([17] 17) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([18] 18) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([19] 19) [F95,F99-OE1.1]

[9.36.5.11.] 9.36.5.11. ([20] 20) [F95,F99-OE1.1]

[9.36.5.12.] 9.36.5.12. ([1] 1) [F96,F99-OE1.1]

[9.36.5.12.] 9.36.5.12. ([2] 2) no attributions

[9.36.5.13.] 9.36.5.13. ([1] 1) [F99-OE1.1]

[9.36.5.13.] 9.36.5.13. ([2] 2) [F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([1] 1) [F92,F95,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([2] 2) [F90,F91,F92,F95,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([3] 3) [F92,F95,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([4] 4) [F92,F95,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([5] 5) [F92,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([6] 6) [F92,F95,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([7] 7) [F92,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([8] 8) [F92,F99-OE1.1]

[9.36.5.14.] 9.36.5.14. ([9] 9) [F92,F99,F95-OE1.1]

[9.36.5.14.] 9.36.5.14. ([10] 10) [F92,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([1] 1) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([2] 2) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([3] 3) [F95,F99,F100-OE1.1]

[9.36.5.15.] 9.36.5.15. ([4] 4) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([5] 5) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([6] 6) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([7] 7) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([8] 8) [F95,F99,F100-OE1.1]

[9.36.5.15.] 9.36.5.15. ([9] 9) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([10] 10) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([11] 11) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([12] 12) [F95,F99,F100-OE1.1]

[9.36.5.15.] 9.36.5.15. ([13] 13) [F95,F99,F100-OE1.1]

[9.36.5.15.] 9.36.5.15. ([14] 14) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([15] 15) [F95,F99-OE1.1]

[9.36.5.15.] 9.36.5.15. ([16] 16) [F95,F99-OE1.1]

[9.36.5.16.] 9.36.5.16. ([1] 1) [F95,F99-OE1.1]

[9.36.5.16.] 9.36.5.16. ([2] 2) [F95,F99-OE1.1]

[9.36.5.16.] 9.36.5.16. ([3] 3) [F95,F99-OE1.1]

[9.36.6.1.] 9.36.6.1. ([1] 1) no attributions

[9.36.6.2.] 9.36.6.2. ([1] 1) no attributions

[9.36.6.3.] 9.36.6.3. ([1] 1) no attributions

[9.36.6.3.] 9.36.6.3. ([1] 1) [F90-OE1.1]

[9.36.6.3.] 9.36.6.3. ([2] 2) no attributions

[9.36.6.3.] 9.36.6.3. ([3] 3) no attributions

[9.36.6.4.] 9.36.6.4. ([1] 1) no attributions

[9.36.6.4.] 9.36.6.4. ([1] 1) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.6.4.] 9.36.6.4. ([2] 2) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.6.4.] 9.36.6.4. ([3] 3) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.6.4.] 9.36.6.4. ([4] 4) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.7.1.] 9.36.7.1. ([1] 1) no attributions

[9.36.7.1.] 9.36.7.1. ([2] 2) no attributions

[9.36.7.2.] 9.36.7.2. ([1] 1) no attributions

[9.36.7.2.] 9.36.7.2. ([1] 1) [F90,F91,F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.7.3.] 9.36.7.3. ([1] 1) no attributions

[9.36.7.3.] 9.36.7.3. ([2] 2) [F95-OE1.1]

[9.36.7.3.] 9.36.7.3. ([3] 3) no attributions

[9.36.7.3.] 9.36.7.3. ([3] 3) [F90,F91,F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.7.3.] 9.36.7.3. ([4] 4) no attributions

[9.36.7.3.] 9.36.7.3. ([5] 5) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.7.3.] 9.36.7.3. ([6] 6) no attributions

[9.36.7.3.] 9.36.7.3. ([6] 6) [F99-OE1.1]

[9.36.7.3.] 9.36.7.3. ([7] 7) [F99-OE1.1]

[9.36.7.3.] 9.36.7.3. ([8] 8) [F90,F91,F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.7.3.] 9.36.7.3. ([9] 9) [F90,F91,F92,F93,F95,F100-OE1.1]

[9.36.8.1.] 9.36.8.1. ([1] 1) no attributions

[9.36.8.2.] 9.36.8.2. ([1] 1) no attributions

[9.36.8.2.] 9.36.8.2. ([1] 1) [F90,F91,F92,F93,F95,F96,F98,F99,F100-OE1.1]

[9.36.8.4.] 9.36.8.4. ([1] 1) no attributions

[9.36.8.5.] 9.36.8.5. ([1] 1) no attributions

[9.36.8.5.] 9.36.8.5. ([2] 2) [F92-OE1.1]

[9.36.8.5.] 9.36.8.5. ([3] 3) [F92-OE1.1]

[9.36.8.5.] 9.36.8.5. ([4] 4) no attributions

[9.36.8.5.] 9.36.8.5. ([4] 4) [F92-OE1.1]

[9.36.8.5.] 9.36.8.5. ([5] 5) no attributions

[9.36.8.5.] 9.36.8.5. ([5] 5) [F92-OE1.1]

[9.36.8.5.] 9.36.8.5. ([6] 6) [F92-OE1.1]

[9.36.8.5.] 9.36.8.5. ([7] 7) [F92-OE1.1]

[9.36.8.6.] 9.36.8.6. ([1] 1) [F92-OE1.1]

[9.36.8.6.] 9.36.8.6. ([2] 2) no attributions

[9.36.8.6.] 9.36.8.6. ([3] 3) no attributions

[9.36.8.6.] 9.36.8.6. ([3] 3) [F92-OE1.1]

[9.36.8.6.] 9.36.8.6. ([4] 4) [F92-OE1.1]

[9.36.8.7.] 9.36.8.7. ([1] 1) no attributions

[9.36.8.7.] 9.36.8.7. ([2] 2) [F92-OE1.1]

[9.36.8.7.] 9.36.8.7. ([3] 3) [F92-OE1.1]

[9.36.8.7.] 9.36.8.7. ([4] 4) no attributions

[9.36.8.8.] 9.36.8.8. ([1] 1) no attributions

[9.36.8.8.] 9.36.8.8. ([2] 2) [F90-OE1.1]

[9.36.8.9.] 9.36.8.9. ([1] 1) no attributions

[9.36.8.9.] 9.36.8.9. ([2] 2) no attributions

[9.36.8.9.] 9.36.8.9. ([3] 3) no attributions

[9.36.8.9.] 9.36.8.9. ([3] 3) [F95,F100-OE1.1]

[9.36.8.9.] 9.36.8.9. ([4] 4) [F95-OE1.1]

[9.36.8.10.] 9.36.8.10. ([1] 1) no attributions

[9.36.8.10.] 9.36.8.10. ([2] 2) no attributions

[9.36.8.10.] 9.36.8.10. ([3] 3) [F96-OE1.1]

[9.36.8.11.] 9.36.8.11. ([1] 1) [F95-OE1.1]

[9.36.8.11.] 9.36.8.11. ([2] 2) [F95-OE1.1]

[9.36.9.1.] -- ([1] --) no attributions

[9.36.9.1.] -- ([2] --) no attributions

[9.36.9.2.] -- ([1] --) no attributions

Submit a comment

Proposed Change 2032

Code Reference(s):	**NBC20 Div.B 10.9. (first printing)**
Subject:	Alteration of Existing Buildings — Housing and Small Buildings
Title:	Heat Transfer, Air Leakage and Condensation Control Requirements
Description:	This proposed change introduces requirements for the continuity of air barrier systems in existing buildings subjected to alteration.
Related Proposed Change(s):	PCF 1825, PCF 1827, PCF 1828, PCF 2033, PCF 2051

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [ ] Accessibility
- [x] Building Envelope
- [x] Heating, Ventilating and Air Conditioning
- [x] Division B
- [x] Design and Construction
- [x] Housing
- [ ] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [x] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

General information

See the summary for subject Alteration of Existing Buildings.

Problem

The existing provisions in Section 9.25. of Division B of the National Building Code of Canada (NBC) that concern heat transfer, air leakage and condensation control lack clarity regarding the need for the continuity of air barrier systems in housing and small buildings subjected to alteration.

Specifically, more explicit guidelines are needed to address penetrations in floors-on-ground, access hatches, sump pits, and cracks in floors and walls.

A concise and comprehensive new provision is required to ensure the robustness of air barrier systems, especially where alterations affect below-grade components, to limit the probability of the infiltration of soil gas, which could lead to negative effects on the air quality of indoor spaces, which could lead to harm to persons.

Justification

The NBC lacks explicit guidance on penetrations in floors-on-ground, access hatches, sump pits, and cracks in floors and walls in existing buildings subjected to alteration. These omissions pose a risk to the overall energy efficiency of a building, which may lead to wasted energy and diminished thermal performance.

This proposed change aims to provide clear requirements for maintaining the integrity of the air barrier system to ensure that alterations do not compromise the building's energy efficiency. By addressing these specific issues in proposed Part 10, this proposed change would enhance the effectiveness of the Code requirements, promote energy efficiency practices, and reinforce the importance of a well-maintained air barrier system in housing and small buildings.

PROPOSED CHANGE

NBC20 Div.B 10.9. (first printing)

[10.9.] -- Housing and Small Buildings

[10.9.1.] -- Heat Transfer, Air Leakage and Condensation Control

[10.9.1.1.] --- Continuity of the Air Barrier System
(See Note A-10.9.1.1. (PCF 2051).)

[1] --) Where the continuity of the below-grade *air barrier system* is adversely affected by an *alteration*, or where a continuous *air barrier system* does not exist throughout the extent of the *alteration*, where accessible,

- [a] --) cracks in masonry walls, concrete walls, and floors-on-ground shall be sealed,
- [b] --) floors-on-ground shall conform to Sentence 9.25.3.6.(5),
- [c] --) penetrations of a floor-on-ground shall conform to Sentence 9.25.3.6.(6),
- [d] --) penetrations of the *air barrier system* shall conform to Sentence 9.25.3.3.(6), and
- [e] --) access hatches and sump pit covers shall conform to Sentence 9.25.3.3.(7).

Impact analysis

According to Statistics Canada, the greatest number of permits were issued for single-family houses in the late 1980s, peaking at around 130 000 permits annually [1]. For the purpose of providing a simplified calculation for estimating the cost-benefit of alterations, a demonstrative house (circa 1984–1995, two-storey, single detached, 2 000 ft.^{2}–2 500 ft.^{2} of heated floor area and with a natural gas-fired furnace) in London, Ontario, (Zone 6) was used from a study conducted by CanmetENERGY [2].

Benefits

This proposed change ensures that in the case of an alteration, the probability of the infiltration of soil gas is reduced by decreasing the air leakage through the foundation, floors-on-ground and any penetrations thereof. This reduces the risk of negative effects on the air quality of indoor spaces, which could lead to harm to persons.

Note that it is impossible to explore all permutations of alterations occurring to all existing dwelling units in Canada, so it is not feasible to determine the reduction factor range for the infiltration of soil gas.

In the case of radon, the actual reduction factor would be dependent on multiple factors including the existing below-grade air barrier system, the extent of the alteration, the radon concentration and permeability of the ground under the house (which is extremely variable and not predictable), and the ventilation systems, heating systems and size of the house. Similarly, the radon reduction potential for soil gas barriers installed in new construction is reported to be highly variable [3]. Nevertheless, sealing cracks and other openings in the foundation is considered a basic component of most approaches to radon reduction and can help increase their effectiveness [4].

In summary, it is expected that failing to maintain the below-grade air barrier system could increase the infiltration of soil gas, whereas sealing all penetrations within the extent of an alteration is expected to always benefit the indoor air quality in the house by reducing the infiltration of soil gas from below grade.

Costs

Using the building archetype described above to comply with proposed Clauses 10.9.1.1.(1)(a) and (b), a flexible sealant can be used. A half-litre container of flexible sealant costs $20 [5], and two containers may be needed, for a total cost of $40. Hiring a tradesperson in London to do the installation, which may require three hours of labour at roughly $50 per hour, would cost a total of $150.

To satisfy proposed Clauses 10.9.1.1.(1)(b) and (d), tubes of acoustical sealant are needed, which cost approximately $15 per 825 mL tube [6]. Assuming that the extent of the alteration to the archetype house is the basement, this may require up to four tubes of sealant (using a 6.35 mm bead of sealant, as recommended for maximum performance), for a total cost of $60.

To comply with proposed Clause 10.9.1.1.(1)(e), weather stripping is needed, which can cost between $15 and $25 per roll [7], and a sump pit cover can cost $130 [8]. A floor drain that is compliant with proposed Clause 10.9.1.1.(1)(c) should be installed, which costs approximately $27 [9]. Assuming that all of these changes and costs were required, the total cost, including labour, would be approximately $432.

References

[1] Statistics Canada: https://www150.statcan.gc.ca/n1/pub/11-630-x/11-630-x2015007-eng.htm

[2] Behan, K., and Szczepanowski, R. 2022. Residential Archetyping for Energy Efficiency Programs. Clean Air Partnership. Available at: https://www.cleanairpartnership.org/wp-content/uploads/2023/01/Archetyping-Guide-For-Energy-Efficiency-Programs-1.pdf

[3] World Health Organization. 2009. WHO Handbook on Indoor Radon: A Public Health Perspective. Available at: https://www.who.int/publications/i/item/9789241547673

[4] Health Canada. 2023. Radon Reduction Guide for Canadians. Available at: https://www.canada.ca/content/dam/hc-sc/documents/services/environmental-workplace-health/reports-publications/radiation/radon-reduction-guide-canadians-hc.pdf

[5] Source of pricing: https://www.homedepot.ca/product/flex-seal-liquid-clear-16-oz-liquid-rubber-sealant-coating/1001720796

[6] Source of pricing: https://www.homedepot.ca/product/lepage-pl-acousti-seal-sound-absorbing-vapor-barrier-adhesive-black-flexible-825ml/1000409510

[7] Source of pricing: https://www.canadiantire.ca/en/cat/tools-hardware/exterior-repair-maintenance-supplies/weatherstripping-DC0001772.html

[8] Source of pricing: https://www.homedepot.com/p/Everbilt-Radon-Mitigation-Basin-Cover-THD1085/300484358

[9] Source of pricing: https://www.radondetect.ca/Dranjer-D-R2-floor-drain.html

Enforcement implications

It is expected that having a consistent set of provisions that apply to the alteration of existing buildings would help reduce the administrative and enforcement work of assessing the degree to which any particular requirement could be relaxed without affecting the level of performance of the building with respect to the Code objectives.

This proposed change would aid enforcement by identifying the work necessary to maintain the integrity of the air barrier system.

Who is affected

Designers, engineers and architects: This proposed change clarifies the requirements for the continuity of air barrier systems in existing buildings subjected to alteration. This proposed change is expected to eliminate potential confusion about the requirements related to an alteration, thus easing the design process.

Builders and renovators: This proposed change is expected to reduce unnecessary work by clarifying the application of air leakage requirements in existing buildings subjected to alteration.

Building officials: This proposed change is expected to reduce confusion about how to regulate air barrier systems related to the alteration of existing buildings.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 10.9. (first printing)

[10.9.1.1.] -- ([1] --) ([a] --) [F40-OH1.1]

[10.9.1.1.] -- ([1] --) ([b] --)

[10.9.1.1.] -- ([1] --) ([c] --)

[10.9.1.1.] -- ([1] --) ([d] --)

[10.9.1.1.] -- ([1] --) ([e] --)

Submit a comment

Proposed Change 2033

Code Reference(s):	**NBC20 Div.B 10.9. (first printing)**
Subject:	Alteration of Existing Buildings — Housing and Small Buildings
Title:	Ventilation Systems in Existing Buildings Subjected to Alteration
Description:	This proposed change introduces requirements for ventilation systems in existing buildings subjected to alteration.
Related Proposed Change(s):	PCF 1825, PCF 1827, PCF 1828, PCF 2032, PCF 2051

This change could potentially affect the following topic areas:

- ☐ Division A
- ☑ Division B
- ☐ Division C
- ☐ Design and Construction
- ☐ Building operations
- ☑ Housing
- ☑ Small Buildings
- ☐ Large Buildings
- ☐ Fire Protection
- ☐ Occupant safety in use
- ☐ Accessibility
- ☐ Structural Requirements
- ☑ Building Envelope
- ☑ Energy Efficiency
- ☑ Heating, Ventilating and Air Conditioning
- ☐ Plumbing
- ☐ Construction and Demolition Sites

General information

See the summary for subject Alteration of Existing Buildings.

Problem

The provisions in Section 9.32. of the National Building Code of Canada (NBC) that address ventilation, specifically heating-season mechanical ventilation, are unclear in their application to the alteration of existing buildings. Currently, the NBC lacks clarity on the requirements for ventilation systems when alterations lead to increased airtightness of the air barrier system or replacement of service water heating or space-heating equipment, particularly fuel-fired appliances. In the latter context, changes to vented appliances that lead to the alteration of a chimney or other external vent could cause backdrafting or spillage due to changes in the stack effect. This situation may result in inconsistent ventilation practices in existing buildings subjected to alteration, potentially compromising indoor air quality and overall occupant health.

In proposed Part 10, it is necessary to provide clear and comprehensive provisions for heating-season mechanical ventilation, especially in the context of alterations that impact an existing building's air barrier system or replace service water heating or space-heating equipment.

Justification

This proposed change is essential to address identified shortcomings in the regulation of heating-season mechanical ventilation for existing buildings subjected to alteration. Lack of clarity regarding the requirements for alterations that impact the air barrier system or replace fuel-fired appliances leaves room for misinterpretation and a potential decrease in ventilation performance. This proposed change streamlines the requirements for ventilation systems, limiting the probability that increased airtightness resulting from alterations or the replacement of fuel-fired appliances compromises indoor air quality. By explicitly defining the minimum requirements for ventilation in these specific scenarios, this proposed change intends to protect occupant health and well-being while improving energy performance.

PROPOSED CHANGE

NBC20 Div.B 10.9. (first printing)

[10.9.] -- Housing and Small Buildings

[10.9.1.] -- Ventilation

[10.9.1.1.] --- Required Ventilation

(See Note A-10.9.1.1.)

[1] --) Except where there is an existing kitchen or bathroom exhaust device that is ducted to the outdoors, a ventilation system shall be provided in accordance with Article 9.32.1.2. where an *alteration*

- [a] --) increases the airtightness of the *air barrier system*, or
- [b] --) replaces a fuel-fired space- or water-heating *appliance* of other than *direct-vented* or *mechanically-vented* types with an *appliance* that is not fuel-fired or that is of *direct-vented* or *mechanically-vented* type.

[2] --) The ventilation system required by Sentence (1) shall conform to

- [a] --) Clause 9.32.3.1.(1)(a), or
- [b] --) Articles 9.32.3.3. to 9.32.3.5. and 9.32.3.8. to 9.32.3.13.

Note A-10.9.1.1. Required Ventilation.

Article 10.9.1.1. is intended to prevent adverse effects on the indoor air quality of a building due to an alteration that reduces the natural air change rate, such as an improvement of the building's airtightness or the removal or sealing of a natural draft chimney. If the replacement of the HVAC or service water heating system or its components results in an abandoned inlet opening in a chimney or vent, the opening should be closed by an approved method to make the chimney or vent safe. Consideration should also be given to removing and sealing a dedicated make-up air vent if the provision of make-up air is no longer required for the replacement system or components or for any other equipment identified in Article 9.32.3.8.

Impact analysis

According to Statistics Canada, the greatest number of permits were issued for single-family houses in the late 1980s, peaking at around 130 000 permits annually [1]. For the purpose of providing a simplified calculation for estimating the cost-benefit of alterations, a demonstrative house (circa 1984–1995, two-storey, single detached, 2 000 $ft.^2$ to 2 500 $ft.^2$ of heated floor area and natural gas-fired furnace) in London, Ontario, (Zone 6) was used from a study conducted by CanmetEnergy [2].

Benefits

This proposed change ensures that, in the case of an alteration to an existing building, the risk is reduced of the entry of carbon monoxide gas into the living space of a dwelling unit that may result from excessive negative pressure created by the inadequate replacement of indoor air with outdoor air. In addition, this proposed change reduces the risk of harm to persons due to negative effects on the indoor air quality and inadequate thermal comfort of persons resulting from:

- inadequate ventilation, and
- inadequate control of
  - relative humidity,
  - indoor air temperatures,
  - airborne pollutants,
  - oxygen and other components necessary for breathable air, and
  - condensation, which could lead to the generation of pollutants from biological growth or from materials that become unstable on wetting.

Cost

The costs associated with complying with proposed Sentence 10.9.1.1.(2) only apply where there is no existing bathroom or kitchen exhaust device ducted to the outdoors. According to a Canada Mortgage and Housing Corporation report from 1990, more than 70% of new houses have bathroom or kitchen exhaust fans, which means only approximately 30% of new houses would be affected [3].

In those cases, balanced ventilation could be achieved in conformance to Clause 9.32.3.1.1.(a) or Articles 9.32.3.3. to 9.32.3.5. and 9.32.3.8. to 9.32.3.13.with use of a bathroom fan and furnace return air from a duct to the outdoors, where a forced-air heating system is present. Balanced ventilation is achieved by measuring the exhaust flow of the bathroom fan and setting the air flow in a duct to bring an equal amount of outside air to the return air plenum. Only the principal ventilation system at normal operating exhaust capacity, as required in Article 9.32.3.3., would need to be balanced in accordance with NBC requirements (the measurement and balancing is the same as that required for heat-recovery ventilation (HRV)/energy-recovery ventilation (ERV) systems). The high exhaust rate for supplemental exhaust, as described in Article 9.32.3.7., is not required to have balanced incoming air. While the material costs for this approach are expected to be lower, the labour costs are expected to be high for the installation of the ductwork and interlocking of the bathroom and furnace fans.

Another approach for compliance is the installation of a wall- or ceiling-mounted standalone ERV system, which differs from a whole-house ERV system that is connected to the furnace. This approach is expected to cost less than if not the equivalent of the above approach, given lower labour costs despite a higher material cost. The cost of this approach is estimated to be $730 [4] for the ERV, $127.87 for a wall cap with Styrofoam adaptor [4], $89.77 for flexible insulated ducting [5], $100 for wiring, and $500 for five hours of labour (HVAC professional and electrician), totalling $1 547.64. It is expected that this ERV system would use the wiring present in the existing building to power the bathroom light.

References

(1) Statistics Canada. Evolution of housing in Canada, 1957 to 2014. May 17, 2018. https://www150.statcan.gc.ca/n1/pub/11-630-x/11-630-x2015007-eng.htm.
(2) Behan, K. and Szczepanowski, R. Residential Archetyping for Energy Efficiency — A Guide for Canadian Municipalities. Toronto: Clean Air Partnership, 2022.
(3) Hamlin, T., Forman, J. and Lubun, M. Ventilation and Airtightness in New Detached Canadian Housing. Ottawa: Canada Mortgage and Housing Corporation, 1990.
(4) Source of pricing: https://www.amazon.ca.
(5) Source of pricing: https://www.homedepot.ca.

Enforcement implications

It is expected that a consistent set of provisions that apply to the alteration of existing buildings would help reduce administrative and enforcement work of assessing the degree to which any particular requirement could be relaxed without affecting the level of performance of the building with respect to the Code objectives.

This proposed change would aid enforcement by identifying the work necessary to mitigate negative consequences for ventilation due to an alteration that improves energy performance.

Who is affected

For designers, engineers and architects, this proposed change would clarify the requirements for the ventilation system of an existing building subjected to alteration. This proposed change is expected to remove potential confusion about the requirements for an alteration, thus facilitating the design process.

For builders and renovators, this proposed change is expected to reduce unnecessary work by clarifying the application of the requirements for the ventilation system in existing buildings subjected to alteration.

For buildings officials, this proposed change is expected to reduce confusion about how ventilation systems in existing buildings subjected to alteration should be regulated.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 10.9. (first printing)

[10.9.1.1.] -- ([1] --) no attributions

[10.9.1.1.] -- ([1] --) [F40,F50,F53-OS3.4]

[10.9.1.1.] -- ([1] --) [F40,F50,F52-OH1.1] [F51,F52-OH1.2]

[10.9.1.1.] -- ([2] --) no attributions

[10.9.1.1.] -- ([2] --) [F40-OH1.1]

Submit a comment

Proposed Change 2051

Code Reference(s):	**NBC20 Div.B 10.9. (first printing)**
Subject:	Alteration of Existing Buildings — Housing and Small Buildings
Title:	Explanatory Note 10.9.1.1. for Continuity of the Air Barrier System
Description:	This proposed change introduces explanatory Note 10.9.1.1. to clarify requirements for the continuity of air barrier systems that apply to the alteration of existing buildings.
Related Proposed Change(s):	PCF 1825, PCF 1827, PCF 1828, PCF 2032, PCF 2033

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [x] Housing
- [x] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [x] Building Envelope
- [x] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [x] Plumbing
- [ ] Construction and Demolition Sites

General information

See the summary for subject Alteration of Existing Buildings.

Problem

There is confusion among Code users about the extent of the work necessary to comply with the provisions related to maintaining the continuity of air barrier systems during the alteration of existing buildings. This confusion can result in increased administrative and enforcement efforts when assessing the degree to which any particular requirement could be relaxed without affecting the level of performance of the building with respect to the Code objectives. This confusion could lead to the unnecessary enforcement of certain provisions and add unnecessary costs to the alteration. Although PCF 2032 addresses this problem, further explanation of the intended meaning of the provision may be required.

Justification

The addition of an explanatory Note provides further clarification that the proposed change in PCF 2032 applies only to the area exposed by, made accessible by or within the extent of the alteration. This proposed change is intended to limit the probability of unnecessary work being performed, which will limit unnecessary additional costs.

PROPOSED CHANGE

NBC20 Div.B 10.9. (first printing)

[10.9.] -- Housing and Small Buildings (PCF 2032)

[10.9.1.] -- Heat Transfer, Air Leakage and Condensation Control (PCF 2032)

[10.9.1.1.] --- Continuity of the Air Barrier System (PCF 2032)

(See Note A-10.9.1.1.)

Note A-10.9.1.1. Application of Article 10.9.1.1.

Article 10.9.1.1. applies only to the area that is exposed or made accessible by the alteration or is within the extent of the alteration. For example, where a bathroom is added to an existing basement, Article 10.9.1.1. applies to the area of the floor slab and walls that is opened for the installation of plumbing fixtures for the new bathroom and not to other areas of the below-grade air barrier system.

Impact analysis

There is no additional cost related to this proposed change. There is a potential reduction in cost by preventing confusion about the extent of the work required to comply with the provisions related to maintaining the continuity of air barrier systems during alterations to existing buildings (PCF 2032). For example, during an alteration, a crack in a foundation wall that is exposed by, made accessible by or within the extent of the alteration would need to be sealed. However, Article 10.9.1.1. (PCF 2032) does not apply to foundation walls that are not within the extent of the alteration.

Enforcement implications

It is expected that having a consistent set of provisions that apply to the alteration of existing buildings would help reduce the administrative and enforcement work of assessing the degree to which any particular requirement could be relaxed without affecting the level of performance of the building with respect to the Code objectives.

This proposed change would aid enforcement by identifying the work necessary to maintain the integrity of the air barrier system.

Who is affected

Designers, engineers and architects: This proposed change clarifies the requirements for the continuity of air barrier systems in existing buildings subjected to alteration. This explanatory Note is expected to eliminate potential confusion about the requirements related to an alteration, thus easing the design process.

Builders and renovators: This proposed change is expected to reduce unnecessary work when compared to previous alterations on other projects where a more conservative approach may have been taken when interpreting the air leakage provisions for existing buildings.

Building officials: This proposed change is expected to reduce confusion about how to regulate air barrier systems related to the alteration of existing buildings.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 10.9. (first printing)

N/A

Submit a comment

Proposed Change 1979

Code Reference(s):	**NBC20 Div.B Appendix C (first printing)**
Subject:	Climatic Loads
Title:	Updated Climatic Data
Description:	This proposed change updates Appendix C, including Table-C2, to incorporate the effects of climate change.
Related Code Change Request(s):	CCR 1639
Related Proposed Change(s):	PCF 1980, PCF 2018, PCF 2048

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [x] Housing
- [x] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [x] Structural Requirements
- [ ] Building Envelope
- [x] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [x] Plumbing
- [ ] Construction and Demolition Sites

Problem

In previous editions of the National Building Code of Canada (NBC) climatic data provided in Table C-2 in Appendix C were based on historical weather observations collected and analyzed by Environment and Climate Change Canada (ECCC). It was assumed that climatic data were time-independent (or stationary). However, in the face of extensive evidence that the climate is changing across Canada, this practice raises real safety concerns for the design of buildings.

To assess the impacts of climate change trends on the climatic data and their associated climatic loads and load combinations specified in the NBC, future climatic data sets have been developed by ECCC [1] based on the current body of research in climate modelling. These models simulate how the climate statistics are likely to change in various regions of Canada between 2024 and 2100 under various greenhouse gas (GHG) emissions scenarios called representative concentration pathways (RCPs). An

RCP is a greenhouse gas concentration time profile. Four RCPs were used for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) in 2014: RCP2.6, RCP4.5, RCP6 and RCP8.5 (corresponding to radiative forcing values of 2.6 W/m^2, 4.5 W/m^2, 6 W/m^2 and 8.5 W/m^2, respectively, in 2100). These pathways represent different future greenhouse gas concentration time profiles that are possible depending on the volume of greenhouse gases emitted.

There has been international recognition in recent decades that the earth's climate is changing, with the potential to create higher structural loads and more adverse environmental conditions than currently specified based on historical observations. The consequences of this pose an increased risk to building structural integrity and functionality, and occupant life safety. More frequent high-heat events also increase risk to occupant life safety.

In addition to the need to update NBC Table C-2 to account for climate change effects, it was recognized that the current approach to establishing design wind and snow loads, referred to as the "uniform hazard" approach, does not result in uniform reliability of building performance across the country. In order to harmonize performance expectations of buildings under these load effects, a new methodology is proposed to define the climatic loads, called the "uniform risk" approach, in which the ultimate load is specified directly with an implied load factor of 1.0, similar to current earthquake design practice.

Justification

The results of targeted research conducted by ECCC [1] specifically designed to address the effect of future projections of climatic conditions were accounted for in the update of each parameter of NBC Table C-2. The proposed approach for building design is based on a 50-year time horizon (from 2025 to 2075) and the RCP8.5 future emissions scenario, corresponding to a 2.5°C global warming compared to the 1986-2016 baseline period. The projected future values are applied to the parameters in NBC Table C-2 using the following approach.

For parameters used for structural and building envelope design, such as the effects of snow, rain, wind and moisture, if the projected future value in the 50-year time horizon is greater than the current updated value calculated from historical observations, the projected value is used. If the future value is projected to decrease, the current value is retained. This approach, called the "Minimax Method," assures that over the 50-year time horizon the annual risk of failure does not exceed that which has historically been considered as acceptable. For some variables, such as temperature, the governing case for design may be the minimum, while for others, such as wind and snow, it is the maximum. For instance, for wind, projections mostly show increases in reference pressure in the future, making the last year of service life the governing case; for snow, projections mostly show decreases in snow load in the future, making the first year of service life the worst case. This is deemed an appropriate approach that ensures that the NBC Table C-2 values reflect the maximum loads expected that correspond to the specified annual probability of exceedance.

The non-stationarity of future climate due to the impact of climate change is embedded in NBC Table C-2 using climate change factors derived from regional averages using the Minimax approach [2], [3]. For reference design wind pressures, most areas in Canada have a climate change factor of 1.05, while locations in Ontario, the Atlantic provinces and west of 120°W in British Columbia have a climate change factor of 1.1. For ground snow loads, excepting the northern territories where a climate change factor of 1.05 applies, most regions have a climate change factor of 1.0, as the governing scenario is based on the present climate. The Minimax approach to adopt future values is also applied to the other parameters, using the future change factors from the targeted research results. For some parameters, such as the one-day and 15-minute rainfalls, there are increases at all locations. For the moisture index, future values are applied at locations where the moisture load increases, and the values remain unchanged elsewhere.

In future updates of NBC Table C-2 values, it is expected that current values at that time will be updated to a new baseline period. Projected future values, based on ongoing research, will also be updated and referenced to the same new baseline period. In this way, both the current and future values will be reset to reflect current knowledge at the time of the future update, and the future values using the Minimax Method for this update will not be compounded in future updates.

Terminology is also affected by the effects of a changing climate. Low-probability events have often been described as having a return period which, in a stationary (non-changing) climate, is defined as the average interval in years between such events. The reciprocal of the return period is defined as the annual exceedance probability. For instance, a 50-year return period event has an annual probability of 1/50 or 0.02. In a changing climate, the definition of the return period as an interval between events is not accurate. As a result, low-probability events are now identified with their annual exceedance probability rather than return period, since the annual probability can and often will change over time. For instance, a 50-year return period event is now described as a "1/50 annual probability event," or sometimes just as the "1/50 value."

The uniform risk approach for wind results in a new 1/500 annual probability wind pressure value to reflect the ultimate load. In thunderstorm-prone regions, for wind values at low probabilities such as 1/500, the separate analysis of convective (e.g., thunderstorm) and synoptic (e.g., active low-pressure system with an embedded weather front) wind events generally results in higher wind values than the usual (up to the 2020 edition of the NBC) approach of analyzing the commingled convective and synoptic wind events as a single data set. This effect is not significant at higher annual probabilities, such as 1/10 and 1/50. In addition to future values applied with the Minimax approach, the 500-year wind pressure values also account for the separate analysis of convective and synoptic wind events.

For parameters related to temperature and heating and cooling loads, such as degree-days below 18°C and 15°C, and January and July design temperatures, future values corresponding to a 50-year time horizon and RCP8.5 emissions scenario are applied in a similarly appropriate approach. Since warming is projected to occur for all locations, the current values for degree-day data and January design temperatures are all retained.

Analysis of the energy performance of buildings does not indicate an increased risk of overheating in buildings when cooling systems are provided and sized using historical July temperature data, in the context of a future climate scenario.

However, sizing mechanical cooling systems based on future 50-year July temperature projections could result in oversized cooling equipment, which could increase construction costs. Also, the equipment may never experience the elevated temperature condition during its service life, which is considerably less than 50 years. Oversized cooling equipment can decrease energy efficiency and increase energy costs. The resulting oversizing could make equipment short-cycling worse and lead to inability of the equipment to meet latent loads, resulting in potentially excessive indoor humidity levels. In addition, short-cycling will decrease the service life of equipment. For the purpose of cooling system equipment design, NBC Table C-2 provides July temperature data based on historical observations.

Further work is proposed on the use of future climatic data in energy codes.

Extensive changes to the climatic design data in NBC Table C-2 and related documentation in NBC Appendix C implement the approach described above.

References

[1] Cannon, A.J., Jeong, D.I., Zhang, X., and Zwiers, F. W. Climate-Resilient Buildings and Core Public Infrastructure: An Assessment of the Impact of Climate Change on Climatic Design Data in Canada. Environment and Climate Change Canada, Ottawa, ON, 2020.

[2] Hong, H.P., Tang, Q., Yang, S.C., Cui, X.Z., Cannon, A.J., Lounis, Z., and Irwin, P. Calibration of the design wind load and snow load considering the historical climate statistics and climate change effects. Structural Safety, Vol. 93, 10213, 2021.

[3] Li, S.H., Irwin, P., Lounis, Z., Attar, A., Dale, J., Gibbons, M., and Beaulieu, S. Effects of Nonstationarity of Extreme Wind Speeds and Ground Snow Loads in a Future Canadian Changing Climate. Natural Hazards Review, Vol. 23, No. 4, 04022022, 2022.

PROPOSED CHANGE

Appendix C Climatic and Seismic Information for Building Design in Canada

Footnote: This information is included for explanatory purposes only and does not form part of the requirements.

Introduction

~~The great diversity of climate in Canada has a considerable effect on the performance of buildings; consequently, building design must reflect this diversity.~~ This Appendix briefly describes how climatic design values are computed and provides recommended design data for ~~a number of cities, towns, and lesser populated~~680 locations across Canada. Through the use of such data, appropriate allowances can be made for climate variations in different localities of Canada and the National Building Code can be applied nationally.

The climatic design data presented in Table C-2 are based on weather observations collected by the Meteorological Service of Canada, Environment and Climate Change Canada (ECCC), and include the effects of future projections of climatic conditions where appropriate. The data were researched and analyzed for the ~~Canadian Commission on Building and Fire Codes~~Canadian Board for Harmonized Construction Codes by ~~Environment and Climate Change~~ ~~Canada~~ECCC (they also include results from projects by other agencies).

As it is not practical to list values for all ~~municipalities~~locations in Canada, recommended climatic design values for locations not listed can be obtained by e-mail from the Engineering Climate Services Unit of ECCC~~Environment and Climate Change Canada~~ at scg-ecs@ec.gc.ca. It should be noted~~, however,~~ that these recommended values may differ from the legal requirements set by provincial, territorial or municipal building authorities.

The information on seismic hazard given in this Appendix has been provided by Natural Resources Canada.

General

The choice of climatic elements tabulated in this Appendix and the form in which they are expressed have been dictated largely by the requirements for specific values in several sections of this Code. These elements include ground snow loads, wind pressures, design temperatures, heating degree-days, one-day and 15-minute rainfalls, ~~and~~ annual total precipitation values, and winter average temperatures and wind speeeds. The following notes briefly explain the significance of these particular elements in building design, and indicate which weather observations were used and how they were analyzed to yield the required design values.

Table C-2 lists design weather recommendations and elevations for over ~~600~~ 680 locations, which have been chosen based on a variety of reasons. Many incorporated cities and towns with significant populations are included unless located close to larger cities. For sparsely populated areas, many smaller towns and villages are listed. Other locations have been added to the list when the demand for climatic design recommendations at these sites has been significant. The named locations refer to the specific latitude and longitude defined by the Gazetteer of Canada (Natural Resources Canada), available from ~~Publishing and Depository Services Canada~~the Government of Canada Publications Directorate, ~~Public Works and Government Services Canada~~Public Services and Procurement Canada~~,~~ ~~Ottawa, Ontario K1A 0S5~~ (www.publications.gc.ca). The elevations are given in metres and refer to heights above sea level.

Almost all of the weather observations used in preparing Table C-2 were, of necessity, observed at inhabited locations. To estimate design values for arbitrary locations, the observed or computed values for the weather stations were mapped and interpolated appropriately. Where possible, adjustments have been applied for the influence of elevation and known topographical effects. Such influences include the tendency of cold air to collect in depressions, for precipitation to increase with elevation, and for generally stronger winds near large bodies of water. Elevations have been added to Table C-2 because of their potential to significantly influence climatic design values.

Since interpolation from the values in Table C-2 to other locations may not be valid due to local and other effects, Environment and Climate Change Canada will provide climatic design element recommendations for locations not listed in Table C-2. Local effects are particularly significant in mountainous areas, where the values apply only to populated valleys and not to the mountain slopes and high passes, where very different conditions are known to exist.

Changing and Variable Climates

Climate is not static. At any location, weather and climatic conditions vary from season to season, year to year, and over longer time periods (climate cycles). This has always been the case. In fact, evidence is mounting that the climates of Canada are changing and will continue to change significantly into future. When estimating climatic design loads, this variability can be considered using appropriate statistical analysis, data records spanning sufficient periods, and meteorological judgement. ~~The analysis generally assumes that the past climate will be representative of the future climate.~~

Past and ongoing modifications to atmospheric chemistry (from greenhouse gas emissions and land use changes) are expected to alter most climatic regimes in the future despite the success of the most ambitious greenhouse gas mitigation plans.(1) Some regions could see an increase in the frequency and intensity of many weather extremes, which will accelerate weathering processes. Consequently, many buildings will need to be designed, maintained and operated to adequately withstand ever changing climatic loads.

Similar to global trends, the last decade in Canada was noted as the warmest in instrumented record. Canada has warmed, on average, at almost twice the rate of the global average increase, while the western Arctic is warming at a rate that is unprecedented over the past 400 years.(1) Mounting evidence from Arctic communities indicates that rapid changes to climate in the North have resulted in melting permafrost and impacts from other climate changes have affected nearly every type of built structure. Furthermore, analyses of Canadian precipitation data shows that many regions of the country have, on average, also been tending towards wetter conditions.(1) In the United States, where the density of climate monitoring stations is greater, a number of studies have found an unambiguous upward trend in the frequency of heavy to extreme precipitation events, with these increases coincident with a general upward trend in the total amount of precipitation. Climate change model results, based on an ensemble of global climate models worldwide, project that future climate warming rates will be greatest in higher latitude countries such as Canada.(2)

The analysis used to estimate the climatic design data for previous editions of the NBC assumed that the past climate would be representative of the future climate. Starting in the 2025 edition, the climatic design data incorporate the effects of future projections of climatic conditions that are based on the current body of research in climate modeling. The models used in the analysis simulate how the climate statistics are likely to change in various regions of Canada from the present to 2100 under various greenhouse gas emissions scenarios called representative concentration pathways (RCPs).

An RCP is a greenhouse gas concentration time profile. Four RCPs were used for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report in 2014:

RCP2.6, RCP4.5, RCP6 and RCP8.5 (corresponding to radiative forcing values of 2.6 W/m^2, 4.5 W/m^2, 6 W/m^2 and 8.5 W/m^2, respectively, in 2100). These pathways represent different future greenhouse gas concentration time profiles that are possible depending on the volume of greenhouse gases emitted.

In targeted projects reported by Cannon et al.,[14] Gaur et al.,[15] the Pacific Climate Impacts Consortium,[16] and RWDI,[17][18] global climate models augmented with nested regional models provided projected future values of the climatic data in Table C-2 for average global warming levels of 0.5°C to 3.5°C, in increments of 0.5°C, relative to a 1986–2016 baseline. The projected future changes to the climatic data were incorporated in a calibration to derive climate change factors reflecting regional averages.[19] The climatic values listed in Table C-2 were obtained by applying the “Minimax” method and a target-reliability-based approach,[19][20] as described in the following.

For structural design parameters, such as wind and snow loads, the projected future values were determined for an average global warming of 2.5°C over a 50-year time horizon, corresponding to emissions scenario RCP8.5. For locations where an increase is projected, the future value has been applied. For locations where a decrease is projected, the current value has been retained. This approach is deemed appropriate to protect life safety by ensuring that structures are designed to withstand the highest loads for the climatic conditions expected in the 50-year time horizon.

Similarly, for heating- and cooling-related parameters, such as design temperatures and degree-days below 18°C and 15°C, the projected future values were determined for an average global warming of 2.5°C over the same 50-year time horizon, corresponding to emissions scenario RCP8.5. For locations where the heating or cooling load is projected to increase, the future value has been applied. For locations where the load is projected to decrease, the current value has been retained. According to this approach, since warming is projected for all locations in Canada, the current values have been retained for degree-days below 18°C and 15°C and for January design temperatures, whereas projected future changes have been applied to July dry-bulb and wet-bulb design temperatures.

It is expected that, in future editions of the Code, the current values will be updated based on recent observations, reflecting changes that are occurring, and will correspond to the baseline observational period on which the future climate projections will be based. The future climate projections will be updated based on improved climate models developed by the international scientific community, whose results are released periodically by the IPCC, and on improved targeted research on future projections of the climatic design data in the NBC.

January Design Temperatures

A building and its heating system should be designed to maintain the inside temperature at some pre-determined level. To achieve this, it is necessary to know the most severe weather conditions under which the system will be expected to function satisfactorily. ~~Failure to maintain the inside temperature at the pre-determined level will not usually be serious if the temperature drop is not great and if the duration is not long.~~ The outside conditions used for design should, therefore, not be the most severe in many years, but should be the somewhat less severe conditions that are occasionally but not greatly exceeded.

The January design temperatures are based on an analysis of January air temperatures only. Wind and solar radiation also affect the inside temperature of most buildings and may need to be considered for energy-efficient design.

The January design temperature is defined as the lowest temperature at or below which only a certain small percentage of the hourly outside air temperatures in January occur. In the past, a total of 158 stations with records from all or part of the period 1951-66 formed the basis for calculation of the 2.5 and 1% January temperatures. Where necessary, the data were adjusted for consistency. Since most of the temperatures were observed at airports, design values for the core areas of large cities could be 1 or 2°C milder, although the values for the outlying areas are probably about the same as for the airports. No adjustments were made for this urban island heat effect. The design values for the next 20 to 30 years will probably differ from these tabulated values due to year-to-year climate variability and global climate change resulting from the impact of human activities on atmospheric chemistry.

The design temperatures were reviewed and updated using hourly temperature observations from 480 stations for a 25-year period up to 2006 with at least 8 years of complete data. These data are consistent with data shown for Canadian locations in the 2009 Handbook of Fundamentals(3) published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The most recent 25 years of record were used to provide a balance between accounting for trends in the climate and the sampling variation owing to year-to-year variation. The 1% and 2.5% values used for the design conditions represent percentiles of the cumulative frequency distribution of hourly temperatures and correspond to January temperatures that are colder for 8 and 19 hours, respectively, on average over the long term.

The 2.5% January design temperature is the value ordinarily used in the design of heating systems. In special cases, when the control of inside temperature is more critical, the 1% value may be used. Other temperature-dependent climatic design parameters may be considered for future ~~issues~~editions of the Code~~this document~~.

Projected future changes to the January design temperatures, corresponding to an average global warming of 2.5°C, are available. For the locations in Table C-2, the average projected increase in the January design temperatures is about 5°C, with warming projected at all locations. Accordingly, projected future changes have not been applied.

July Design Temperatures

A building and its cooling and dehumidifying system should be designed to maintain the inside temperature and humidity at certain pre-determined levels. To achieve this, it is necessary to know the most severe weather conditions under which the system is expected to function satisfactorily. Failure to maintain the inside temperature and humidity at the pre-determined levels will usually not be serious if the increases in temperature and humidity are not great and the duration is not long. The outside conditions used for design should, therefore, not be the most severe in many years, but should be the somewhat less severe conditions that are occasionally but not greatly exceeded.

The summer design temperatures in this Appendix are based on an analysis of July air temperatures and humidity values~~humidities~~. Wind and solar radiation also affect the inside temperature of most buildings and may, in some cases, be more important than the outside air temperature. More complete summer and winter design information can be obtained from Environment and Climate Change Canada.

The July ~~design~~ dry-bulb and wet-bulb design temperatures were reviewed and updated using hourly temperature observations from 480 stations for a 25-year period up to 2006. These data are consistent with data shown for Canadian locations in the 2009 Handbook of Fundamentals(3) published by ASHRAE. As with January design temperatures, data from the most recent 25-year period were analyzed to reflect any recent climatic changes or variations. The 2.5% values used for the dry- and wet-bulb design conditions represent percentiles of the cumulative frequency distribution of hourly dry- and wet-bulb temperatures and correspond to July temperatures that are higher for 19 hours on average over the long term.

Projected future changes to the July design temperatures, corresponding to an average global warming of 2.5°C, are available. For the locations in Table C-2, the average projected increase in the July dry-bulb design temperatures is about 4.1°C, with warming projected at all locations. The average projected increase in the July wet-bulb design temperatures is about 3.4°C, with warming projected at all locations. These projected future increases are applied to the “historical” July design temperatures, which were updated based on historical observations, to provide the “future” July design temperatures.

Analysis of the energy performance of buildings does not indicate an increased risk of overheating in buildings when mechanical cooling systems are provided and sized using historical July temperatures in the context of a future climate scenario. However, sizing mechanical cooling systems based on future 50-year July temperature projections could result in oversized cooling equipment, which could increase construction costs. Also, the equipment may never experience the elevated temperature condition during its expected service life, which is considerably less than 50 years.

Oversized cooling equipment could decrease the building's energy efficiency and increase energy costs. The oversizing could also lead to increased short-cycling of equipment and to inability of the equipment to meet latent loads, resulting in potentially excessive indoor humidity levels. In addition, increased short-cycling could decrease the service life of the equipment. Therefore, for the purpose of the design of mechanical cooling system equipment, Table C-2 provides July temperatures based on historical observations.

Heating Degree-Days

The rate of consumption of fuel or energy required to keep the interior of a small building at 21°C when the outside air temperature is below 18°C is roughly proportional to the difference between 18°C and the outside temperature. Wind speed, solar radiation, the extent to which the building is exposed to these elements and the internal heat sources also affect the heat required and may have to be considered for energy-efficient design. For average conditions of wind, radiation, exposure, and internal sources, however, the proportionality with the temperature difference generally still holds.

Since the fuel required is also proportional to the duration of the cold weather, a convenient method of combining these elements of temperature and time is to add the differences between 18°C and the mean temperature for every day in the year when the mean temperature is below 18°C. It is assumed that no heat is required when the mean outside air temperature for the day is 18°C or higher.

Although more sophisticated computer simulations using other forms of weather data have now almost completely replaced degree-day-based calculation methods for estimating annual heating energy consumption, degree-days remain a useful indicator of relative severity of climate and can form the basis for certain climate-related Code requirements.

The degree-days below 18°C were compiled for 1300 stations for the 25-year period ending in 2006. This analysis period is consistent with the one used to derive the design temperatures described above and with the approach used by ASHRAE.[3]

A difference of only one Celsius degree in the mean annual temperature will cause a difference of 250 to 350 in the Celsius degree-days. Since differences of 0.5 of a Celsius degree in the mean annual temperature are quite likely to occur between two stations in the same town, heating degree-days cannot be relied on to an accuracy of less than about 100 degree-days.

Heating degree-day values for the core areas of larger cities can be 200 to 400 degree-days less (warmer) than for the surrounding fringe areas. The observed degree-days, which are based on daily temperature observations, are often most representative of rural settings or the fringe areas of cities.

Projected future changes to the heating degree-day values, corresponding to an average global warming of 2.5°C, are available. For the locations in Table C-2, with warming projected at all locations, the average projected decrease in the degree-days below 18°C values is about 1 100 degree-days. Accordingly, projected future changes have not been applied.

Degree-days below 15°C values, which are useful for building heating calculations, are provided in the 2025 edition of the NBC. These values are based on an ECCC analysis of observations from 1407 stations for the period from 1991 to 2020.

Snow Loads

The roof of a building should be designed~~able~~ to safely support the snow loads expected during the building's service life~~the greatest weight of snow that is likely to accumulate on it in many years~~. Some observations of snow on roofs have been made in Canada, but not enough to form the basis for estimating roof snow loads throughout the country. Similarly, observations of the weight, or water equivalent, of the snow on the ground have not been available in digital form in the past. The observations of roof loads and water equivalents are very useful, as noted below, but the measured depth of snow on the ground is used to provide the basic information for a consistent set of snow loads.

As reported by Newark et al.,[5] in the 1990 to 2020 editions of the NBC, ~~Theestimation of~~ the design snow load on a roof was estimated from snow depth observations using a procedure that involves the following steps:

1. The depth of snow on the ground~~, which has~~ having an annual probability of exceedance of 1-in-50~~,~~ is computed.
2. The appropriate specific weight is selected and used to convert snow depth to

loads, S_s.
3. The load, S_r, which is due to rain falling on the snow, is computed.
4. Because the accumulation of snow on roofs is often different from that on the ground, adjustments are applied to the ground snow load to provide a design snow load on a roof.

~~The annual maximum depth of snow on the ground has been assembled for 1618 stations for which data has been recorded by the Meteorological Service of Canada (MSC). The period of record used varied from station to station, ranging from 7 to 38 years. These data were analyzed using a Gumbel extreme value distribution fitted using the method of moments(4) as reported by Newark et al.(5) The resulting values are the snow depths, which have a probability of 1-in-50 of being exceeded in any one year.~~

The specific weight of old snow generally ranges from 2 to 5 kN/m^3, and it is usually assumed in Canada that 1 kN/m^3 is the average for new snow. Average specific weights of the seasonal snow pack have been derived for different regions across the country(6) and an appropriate value has been assigned to each weather station. Typically, the values average 2.01 kN/m^3 east of the continental divide (except for 2.94 kN/m^3 north of the treeline), and range from 2.55 to 4.21 kN/m^3 west of the divide. The product of the 1-in-50 snow depth and the average specific weight of the seasonal snow pack at a station is converted to the snow load (SL) in units of kilopascals (kPa).

~~Except for the mountainous areas of western Canada, the values of the ground snow load at MSC stations were normalized assuming a linear variation of the load above sea level in order to account for the effects of topography. They were then smoothed using an uncertainty-weighted moving-area average in order to minimize the uncertainty due to snow depth sampling errors and site-specific variations. Interpolation from analyzed maps of the smooth normalized values yielded a value for each location in Table C-2, which could then be converted to the listed code values (S_s) by means of an equation in the form:~~

$$\cancel{S_s = \text{smooth normalized SL} + bZ}$$

~~where b is the assumed rate of change of SL with elevation at the location and Z is the location's elevation above mean sea level (MSL). Although they are listed in Table C-2 to the nearest tenth of a kilopascal, values of S_s typically have an uncertainty of about 20%. Areas of sparse data in northern Canada were an exception to this procedure. In these regions, an analysis was made of the basic SL values. The effects of topography, variations due to local climates, and smoothing were all subjectively assessed. The values derived in this fashion were used to modify those derived objectively.~~

~~For the mountainous areas of British Columbia, Yukon, and the foothills area of Alberta, a more complex procedure was required to account for the variation of loads with terrain and elevation. Since the MSC observational network often does not have sufficient coverage to detail this variability in mountainous areas, additional snow course observations were obtained from the provincial and territorial governments of British Columbia, Yukon, and Alberta. The additional data allowed detailed local analysis of ground snow loads on a valley-by-valley basis. Similar to other studies, the data indicated that snow loads above a critical or reference level increased according to either a linear or quadratic relation with elevation. The determination of whether the increase with elevation was linear or quadratic, the rate of the increase and the critical~~

~~or reference elevation were found to be specific to the valley and mountain ranges considered. At valley levels below the critical elevation, the loads generally varied less significantly with elevation. Calculated valley- and range-specific regression relations were then used to describe the increase of load with elevation and to normalize the MSC snow observations to a critical or reference level. These normalized values were smoothed using a weighted moving-average.~~

~~Tabulated values cannot be expected to indicate all the local differences in S_s. For this reason, especially in complex terrain areas, values should not be interpolated from Table C-2 for unlisted locations. The values of S_s in the Table apply for the elevation and the latitude and longitude of the location, as defined by the Gazetteer of Canada. Values at other locations can be obtained from Environment and Climate Change Canada.~~

The heaviest loads frequently occur when the snow is wetted by rain, thus the rain load, S_r, was estimated to the nearest 0.1 kPa and is provided in Table C-2. When values of S_r are added to S_s, this provides a 1/50 annual probability ~~1-in-50-year~~ estimate of the combined ground snow and rain load. The values of S_r are based on an analysis of about 2100 weather station values of the 1/50 annual probability ~~1-in-50-year~~ one-day maximum rain amount. This ~~return period~~ annual probability value is appropriate because the rain amounts correspond approximately to the joint frequency of occurrence of the one-day rain on maximum snow packs. For the purpose of estimating rain on snow, the individual observed one-day rain amounts were constrained to be less than or equal to the snow pack water equivalent, which was estimated by a snow pack accumulation model reported by Bruce and Clark.(7)

The results from surveys of snow loads on roofs indicate that average roof loads are generally less than loads on the ground. The conditions under which the design snow load on the roof may be taken as a percentage of the ground snow load are given in Subsection 4.1.6. The Code also permits further decreases in design snow loads for steeply sloping roofs, but requires substantial increases for roofs where snow accumulation may be more rapid due to such factors as drifting. Recommended adjustments are given in the "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)".

The ground snow load values, S_s, were updated for the 2015 edition of the Code using a similar approach to the one used for the ground snow load update in the 1990 edition. The Gumbel extreme value distribution was fitted to the annual maxima of daily snow depth observations made at over 1400 weather stations, which were compiled from 1990 onward—to as recently as 2012 for some stations—to calculate the ~~50-year return period~~1/50 annual probability snow depth. The ~~50-year~~1/50 annual probability ground snow load was then calculated for each weather station by combining the ~~50-year~~ 1/50 annual probability snow pack depth with the assigned snow pack density, as described above. ~~The S_s values for each location in Table C-2 were compared with the updated weather station values and revised accordingly. As a result, S_s values remain unchanged for about 84% of the locations, have increased for 11% of the locations, and have decreased for 4% of the locations. The greatest proportion of increases was for locations in the Yukon, Northwest Territories, and Nunavut.~~

In the 2025 edition of the NBC, the 1/50 annual probability S_s and S_r values are unchanged from the previous edition, except that projected future changes, corresponding to an average global warming of 2.5°C, have been applied using the Minimax approach (i.e., increases have been applied where the projected future values are higher, and the current values have been retained where the projected future values are lower). According to RWDI,[18] the projected future values are lower for locations in southern Canada (the 10 provinces) and higher for locations in northern Canada (Yukon, Northwest Territories and Nunavut) where a future change factor of 1.05 has been applied.

> Footnote: Annual probability is now used to describe low-probability events instead of return period, which was frequently used previously. In an unchanging climate, the return period is defined as the average interval, in years, within which a given value occurs or is exceeded. It is the reciprocal of the annual exceedance probability. For instance, a 50-year return period value has a probability of 1/50, or 0.02, of being exceeded in any year. In a changing climate, the interpretation of return period as an average interval is not strictly accurate; rather, the return period is defined only as the reciprocal of the annual exceedance probability, which can change over time. The term "return period" is no longer used to refer to the frequency of certain climate events. The term "annual probability" is now used for this purpose (e.g., "1/50 annual probability" or sometimes "1/50 event" or "1-in-50 event").

Significantly, in the 2025 edition of the NBC, the 1/1000 annual probability S_s and S_r values are provided to facilitate the change to the "uniform risk" approach, in which the climatic design loads are specified directly at the ultimate load levels. Further details regarding the uniform risk approach can be found in the Commentary entitled Limit States Design in the "Structural Commentaries (User's Guide – NBC 2025: Part 4 of Division B)."

In previous editions of the Code in which the "uniform hazard" approach was used, the calculation of roof snow loads for ultimate limit state design for strength involved applying a load factor of 1.5 to the 1/50 S_s and S_r values for all locations. The application of the 1.5 load factor to the 1/50 annual probability S_s and S_r values results in equivalent 1/1000 annual probability S_s and S_r values. However, the actual 1/1000 values depend on the distribution of the annual maximum values used in the extreme value analysis and vary regionally across Canada, resulting in varying degrees of risk and hence structural reliability.

The uniform risk approach adopted in the 2025 edition uses the actual 1/1000 S_s values calculated using regional data and a load factor reduced to 1.0. As reported by RWDI,[18] the 1/1000 S_s values were calculated using statistical properties of the annual maximum snow depth series used for the most recent snow load update in the 2015 edition. These actual 1/1000 S_s values reflect regional extreme snow characteristics. The 1.5 load factor applied to the 1/50 snow loads is equivalent to a 1.0 factor applied to the actual 1/1000 snow loads, averaged across Canada.

As for the 1/50 annual probability S_s and S_r values, projected future changes, corresponding to an average global warming of of 2.5°C, have been applied to the 1/1000 annual probability S_s and S_r values using the same Minimax approach and future change factors (i.e., 1.05 for Yukon, Northwest Territories and Nunavut).

In the 2025 edition of the NBC, values of the winter average temperature, T_{ws}, and winter average wind speed, V_{ws}, are provided in Table C-2 for use in roof snow drift calculations. The T_{ws} and V_{ws} values are the average dry-bulb temperature and average wind speed (at a height of 10 m in open terrain) when the hourly dry-bulb temperature is lower than 0°C, respectively. These values are based on an ECCC analysis of hourly observations from 592 stations for the period 2014 to 2022. No projected future climate change factors have been applied.

Annual Total Precipitation

Total precipitation is the sum in millimetres of the measured depth of rainwater and the estimated or measured water equivalent of the snow (typically estimated as 0.1 of the measured depth of snow, since the average density of fresh snow is about 0.1 that of water).

The average annual total precipitation amounts in Table C-2 have been interpolated from an analysis of precipitation observations from 1379 stations for the 30-year period from 1961 to 1990.

Projected future changes to the annual average total precipitation values, corresponding to an average global warming of 2.5°C, have been applied. The values for all locations have increased, with an average increase of 12%.

Annual Rainfall

The total amount of rain that normally falls in one year is frequently used as a general indication of the wetness of a climate, and is therefore included in this Appendix. See also Moisture Index below.

Projected future changes to the annual average rainfall values, corresponding to an average global warming of 2.5°C, have been applied. The values for all locations have increased, with an average increase of 22%.

Rainfall Intensity

Roof drainage systems are designed to carry off rainwater from the most intense rainfall that is likely to occur. A certain amount of time is required for the rainwater to flow across and down the roof before it enters the gutter or drainage system. This results in the smoothing out of the most rapid changes in rainfall intensity. The drainage system, therefore, need only cope with the flow of rainwater produced by the average rainfall intensity over a period of a few minutes, which can be called the concentration time.

In Canada, it has been customary to use the 15-minute rainfall that will probably be exceeded on an average of once in 10 years. The concentration time for small roofs is much less than 15 minutes and hence the design intensity will be exceeded more frequently than with a 1/10 annual probability. ~~once in 10 years.~~ The safety factors in the NPC will probably reduce the frequency to a reasonable value and, in addition, the occasional failure of a roof drainage system will not be particularly serious in most cases.

The rainfall intensity values were updated for the 2010 edition of the Code using observations of annual maximum 15-minute rainfall amounts from 485 stations with 10 or more years of record, including data up to 2007 for some stations. ~~Ten-year return period~~ ~~v~~Values with a 1/10 annual probability—the 15-minute rainfall having a probability of 1-in-10 of being exceeded in any year—were calculated by fitting the annual maximum values to the Gumbel extreme value distribution[4] using the method of moments. The updated values are compiled from the most recent short-duration rainfall intensity-duration-frequency (IDF) graphs and tables available from Environment and Climate Change Canada.

It is very difficult to estimate the pattern of rainfall intensity in mountainous areas, where precipitation is extremely variable and rainfall intensity can be much greater than in other types of areas. Many of the observations for these areas were taken at locations in valley bottoms or in extensive, fairly level areas.

Projected future changes to the rainfall intensity values, corresponding to an average global warming of 2.5°C, have been applied. The values for all locations have increased, with an average increase of about 29%.

One-Day Rainfall

If for any reason a roof drainage system becomes ineffective, the accumulation of rainwater may be great enough in some cases to cause a significant increase in the load on the roof. In previous editions of this information, it had been common practice to use the maximum one-day rainfall ever observed for estimating the additional load. Since the length of record for weather stations in Canada is quite variable, the maximum one-day rainfall amounts in previous editions often reflected the variable length of record at nearby stations as much as the climatology. As a result, the maximum values often differed greatly within relatively small areas where little difference should be expected. The current values have been standardized to represent the one-day rainfall amounts that have 1 chance in 50 of being exceeded in any one year ~~or the 1-in-50-year return value one-day rainfalls~~.

The one-day rainfall values were updated using daily rainfall observations from more than 3500 stations with 10 years or more of record, including data up to 2008 for some stations. The 50-year return period values were calculated by fitting the annual maximum one-day rainfall observations to the Gumbel extreme value distribution using the method of moments.[4]

Rainfall frequency observations can vary considerably over time and space. This is especially true for mountainous areas, where elevation effects can be significant. In other areas, small-scale intense storms or local influences can produce significant spatial variability in the data. As a result, the analysis incorporates some spatial smoothing.

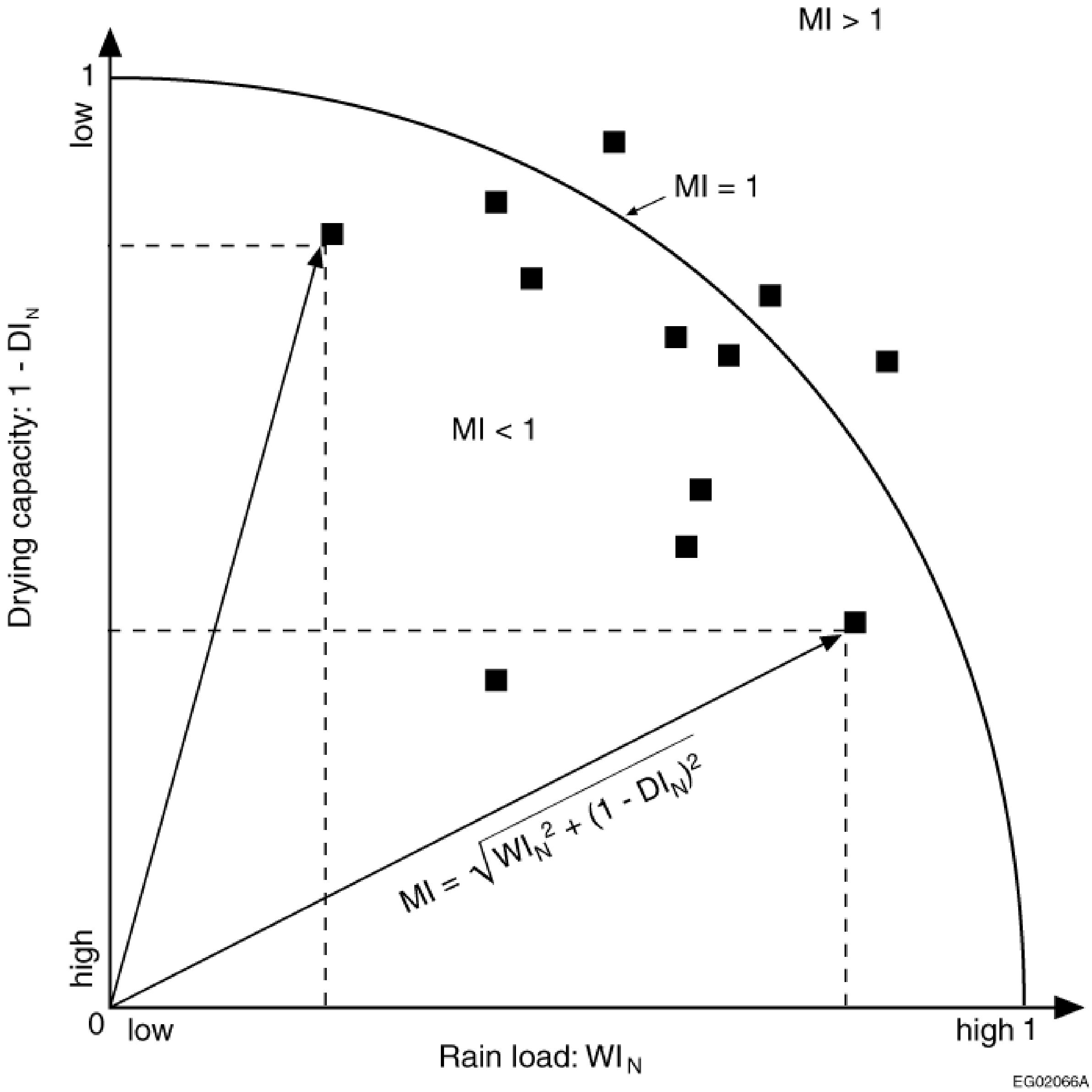
Projected future changes to the one-day rainfall values, corresponding to an average global warming of 2.5°C, have been applied. The values for all locations have increased, with an average increase of about 29%.

Determination of Moisture Index (MI)

The relationship between WI and DI to correctly define moisture loading on a wall is not known. The MI values provided in the Table are based on the root mean square values of WI and 1~~-~~–DI, with those values equally weighted. This is illustrated in Figure C-1. The resultant MI values are sufficiently consistent with industry's understanding of climate severity with respect to moisture loading as to allow limits to be identified for the purpose of specifying where additional protection from precipitation is required.

Projected future values (based on fractional changes) of moisture index, corresponding to an average global warming of 2.5°C, are available from Gaur et al.[(15)] For locations where the moisture index is projected to increase (two thirds of the locations), the future value has been applied. For locations where the moisture index is projected to decrease, the current value has been retained.

Figure [C-1] C-1
Derivation of moisture index (MI) based on normalized values for wetting index (WI) and drying index (DI)



Note to Figure C-1:

(1) MI equals the hypotenuse of the triangle defined by WI_N and 1~~-~~–DI_N

Driving Rain Wind Pressure (DRWP)

The presence of rainwater on the face of a building, with or without wind, must be addressed in the design and construction of the building envelope so as to minimize the entry of water into the assembly. Wind pressure on the windward faces of a building will promote the flow of water through any open joints or cracks in the facade.

Driving rain wind pressure (DRWP) is the wind load that is coincident with rain, measured or calculated at a height of 10 m. The values provided in the Table represent the loads for which there is 1 chance in 5 of being reached or exceeded in any one year, or a probability of 20% within any one year. Approximate adjustments for height can be made using the values for C_e given in Sentence 4.1.7.3.(5) as a multiplier.

Because of inaccuracies in developing the DRWP values related to the averaging of extreme wind pressures, the actual heights of recording anemometers, and the use of estimated rather than measured rainfall values, the values are considered to be higher than actual loads.(8)(9) Thus the actual probability of reaching or exceeding the DRWP in a particular location is less than 20% per year and these values can be considered to be conservative.

DRWP can be used to determine the height to which wind will drive rainwater up enclosed vertical conduits. This provides a conservative estimate of the height needed for fins in window extrusions and end dams on flashings to control water ingress. This height can be calculated as:

$$\text{height of water, mm} = \text{DRWP}/10\text{, Pa}$$

Note that the pressure difference across the building envelope may be augmented by internal pressures induced in the building interior by the wind. These additional pressures can be estimated using the information provided in the Commentary entitled Wind Load and Effects of the "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)".

Projected future changes to the DRWP values, corresponding to an average global warming of 2.5°C, have been applied. The values for all locations have increased, with an average increase of 9%.

Wind Effects

All structures need to be designed to ensure that the main structural system and all secondary components, such as cladding and appurtenances, will withstand the pressures and suctions caused by the strongest wind likely to blow at that location in many years. Some flexible structures, such as tall buildings, slender towers and bridges, also need to be designed to minimize excessive wind-induced oscillations or vibrations.

At any time, the wind acting upon a structure can be treated as a mean or time-averaged component and as a gust or unsteady component. For a small structure, which is completely enveloped by wind gusts, it is only the peak gust velocity that needs to be considered. For a large structure, the wind gusts are not well correlated over its different parts and the effects of individual gusts become less significant. The "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)" evaluates the mean pressure acting on a structure, provides appropriate adjustments for building height and exposure and for the influence of the surrounding terrain and topography (including wind speed-up for hills), and then incorporates the effects of wind gusts by means of the gust factor, which varies according to the type of structure and the size of the area over which the pressure acts.

The wind speeds and corresponding velocity pressures used in the Code are regionally representative or reference values. The reference wind speeds are nominal one-hour averages of wind speeds representative of the 10 m height in flat open terrain corresponding to Exposure A or open terrain in the terminology of the "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)". The reference wind speeds and wind velocity pressures are based on long-term wind records observed at a large number of weather stations across Canada.

Reference wind velocity pressures in the 1961 to 2005 editions of the Code since 1961 were based mostly on records of hourly averaged wind speeds (i.e. the number of miles of wind passing an anemometer in an hour) from over 100 stations with 10 to 22 years of observations ending in the 1950s. The wind pressure values derived from these measurements represented true hourly wind pressures.

The reference wind velocity pressures were reviewed and updated for the 2010 edition of the Code. The primary data set used for the analysis comprised wind records compiled from about 135 stations with hourly averaged wind speeds and from 465 stations with aviation (one- or two-minute average) speeds or surface weather (ten-minute average) speeds observed once per hour at the top of the hour; the periods of record used ranged from 10 to 54 years. In addition, peak wind gust records from 400 stations with periods of record ranging from 10 to 43 years were used. Peak wind gusts (gust durations of approximately 3 to 7 seconds) were used to supplement the primary once-per-hour observations in the analysis.

Several steps were involved in updating the reference wind values. Where needed, speeds were adjusted to represent the standard anemometer height above ground of 10 m. The data from years when the anemometer at a station was installed on the top of a lighthouse or building were eliminated from the analysis since it is impractical to adjust for the effects of wind flow over the structure. (Most anemometers were moved to 10 m towers by the 1960s.) Wind speeds of the various observation types—hourly averaged, aviation, surface weather and peak wind gust—were adjusted to account for different measure durations to represent a one-hour averaging period and to account for differences in the surface roughness of flat open terrain at observing stations.

The annual maximum wind speed data was fitted to the Gumbel distribution using the method of moments[(4)] to calculate hourly wind speeds having the annual probability of occurrence of 1-in-10 and 1-in-50 ~~(10-year and 50-year return periods)~~. The values were plotted on maps, then analyzed and abstracted for the locations in Table C-2.

The wind velocity pressures, q, were calculated in Pascals using the following equation:

$$q = \frac{1}{2} \rho V^2$$

where ρ is an average air density for the windy months of the year and V is wind speed in metres per second. While air density depends on both air temperature and atmospheric pressure, the density of dry air at 0°C and standard atmospheric pressure of 1.2929 kg/m^3 was used as an average value for the wind pressure calculations. As explained by Boyd[(10)], this value is within 10% of the monthly average air densities for most of Canada in the windy part of the year.

As a result of the updating procedure for the 2010 edition of the Code, the 1-in-50 reference wind velocity pressures remained unchanged for most of the locations listed in Table C-2; both increases and decreases were noted for the remaining locations. Many of the decreases resulted from the fact that anemometers at most of the stations used in the previous analysis were installed on lighthouses, airport hangers and other structures. Wind speeds on the tops of buildings are often much higher compared to those registered by a standard 10 m tower. Eliminating anemometer data recorded on the tops of buildings from the analysis resulted in lower values at several locations.

For the 2020 edition of the Code, the reference wind velocity pressures were updated to reflect the new data collected in the approximately 10 years since the previous update for the 2010 edition. Only data collected at stations with a period of record of at least 20 years were used in the analysis. As a result, the data set comprised wind records from 368 hourly and 222 daily peak wind gust stations with periods of record ranging from 20 to 65 years. The annual maximum wind speed data were fitted to the Gumbel distribution.

The 1-in-50 hourly wind speeds, after adjusting for roughness to represent open exposure, were mapped and compared to the NBC 2015 values for the locations in Table C-2. This updating procedure resulted in small changes to the 1-in-50 reference wind velocity pressures for 60 locations.

The 1-in-10 reference wind velocity pressures were updated using the same procedure, except that regional values of the coefficient of variation were used in the calculations instead of the national value used previously. This procedure resulted in small changes to the 1-in-10 reference wind velocity pressures for 322 locations, including many for which there was no change to the 1-in-50 reference wind velocity pressure.

Wind speeds that have a 1-in-~~"~~n~~"~~ chance of being exceeded in any year, where n < 50, can be calculated from the wind speeds corresponding to the 1-in-10 and 1-in-50 ~~return period~~ values in Table C-2 using the following equation:

$$V_{1/n} = \frac{1}{1.4565}\left\{V_{1/50} + 0.4565V_{1/10} + \frac{V_{1/50} - V_{1/10}}{1.1339} \times 1n\frac{-0.0339}{1n\left(1 - 1/n\right)}\right\}$$

Table C-1 has been arranged to give pressures to the nearest one-hundredth of a kPa and their corresponding wind speeds. The value of ~~"~~q~~"~~ in kPa is assumed to be equal to 0.00064645 V^2, where V is given in m/s.

Significant changes to wind loads are introduced in the 2025 edition of the NBC based on recent work reported by RWDI.[17][18] As described above for snow loads, a "uniform risk" approach has been developed for wind loads. Since the 1.4 load factor applied to the 1/50 wind pressures is equivalent to a 1.0 factor applied to 1/500 wind pressures, averaged across Canada, the 1/500 wind pressures are now provided in Table C-2. These values were calculated from the NBC 2020 1/10 and 1/50 wind pressure values for each location using the equations above for q (as a function of wind speed and air density) and $V_{1/n}$, the 1/n annual probability wind speed. The 1/500 wind pressures calculated in this way account for the regional statistical properties of the extreme wind events, a necessary characteristic for the uniform risk approach.

Explicitly expressing extreme wind events at the low annual exceedance probability of 1/500 (i.e., 0.002 or 0.2%) requires accounting for a physical characteristic of extreme winds, as explained below.

In the 2020 and previous editions of the Code, the extreme wind return levels were calculated using the annual maximum observed wind speeds from all wind events, regardless of their cause. There are two common causes of extreme winds in Canada. The most common cause is synoptic wind events corresponding to large mid-latitude low-pressure systems, generally with embedded weather fronts, that result in moderate to high wind speeds, often over extensive areas. Much of Canada is also prone to convective wind events, most commonly associated with thunderstorm and related events, the extremes of which have different statistical characteristics compared to synoptic wind events.

The RWDI project[17] involved separating the annual extremes of wind events by virtue of long-term daily observations of "day with thunderstorm" and of peak gust speed. The annual extremes of the convective and synoptic wind events were analyzed separately, and their respective extreme value frequency distributions were combined using the following equation:

$$\frac{1}{R_T} = 1 - \left(1 - \frac{1}{R_S}\right)\left(1 - \frac{1}{R_C}\right)$$

where R_S is the annual exceedance probability of synoptic wind events, R_C is annual exceedance probability of convective wind events, and R_T is the annual exceedance probability of the combined convective and synoptic probability distributions. For thunderstorm-prone regions, the 1/500 wind speed calculated for the combined statistical results is generally higher than the 1/500 event calculated using the single annual maximum series of the commingled synoptic and convective wind events. Note that this effect is not significant for 1/50 events but needs to be accounted for with lower-probability events.

Based on a recent ECCC project using daily thunderstorm and peak gust speed observations, as described above, from 190 stations with at least 10 years of observations for the period from 1955 to 2022, a thunderstorm surcharge factor, T_S, was developed to account for this characteristic of extreme wind events. From the correlation between the annual average number of thunderstorm days and the ratio of the 1/500 gust speed for combined data sets compared to commingled data sets, the following T_S values (applied to wind pressure) were obtained: 1.1 for locations with more than 20 thunderstorm days per year, 1.05 for locations with 8 to 20 thunderstorm days per year, and 1.0 (i.e., no change) for locations with fewer than 8 thunderstorm days per year. The T_S = 1.1 factor applies from southeastern British Columbia, across the southern Prairies, to southern Ontario and Quebec. The T_S = 1.05 factor applies from the western British Columbia interior, across the northern portions of the Prairies, Ontario and Quebec, to Atlantic Canada, except Newfoundland and Labrador. The T_S = 1.0 factor applies to the outer coasts of Canada and the North. These T_S values have only been applied to the 1/500 wind pressure values.

Projected future changes, corresponding to an average global warming of 2.5°C, as recommended by RWDI,[18] have been applied to the 1/10, 1/50, and 1/500 wind pressure values in Table C-2. The projected future changes are all increases, by a factor of either 1.05 or 1.1.

Table [C-2] C-2
Climatic Design Data for Selected Locations in Canada

Province and Location	Elev., m	Design Temperature						Degree-Days Below 18°C	Degree-Days Below 15°C	15 Min. Rain, mm	One Day Rain, 1/50, mm	Ann. Rain, mm	Moist. Index	Ann. Tot. Ppn., mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Snow Load, kPa, 1/1000		Hourly Wind Pressures, kPa			Winter Average	
		January		July 2.5%																				
				Historical (1)		Future																		
		2.5% °C	1% °C	Dry °C	Wet °C	Dry °C	Wet °C									S_s	S_r	S_s	S_r	1/10	1/50	1/500	Temperature, °C	Wind Speed, m/s
British Columbia																								
100 Mile House	1040	-30	-32	29	17	34	21	5030	4040	~~10~~ 13	~~48~~ 61	~~300~~ 450	0.4	~~425~~ 530	~~60~~ 80	2.6	0.3	3.7	0.4	~~0.27~~ 0.30	~~0.35~~ 0.39	0.55	-7	2.8
Abbotsford	70	-8	-10	29	20	35	25	2860	2000	~~12~~ 15	~~112~~ 140	~~1525~~ 1690	1.6	~~1600~~ 1630	~~160~~ 170	2	0.3	3.2	0.5	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	3.7
Agassiz	15	-9	-11	31	21	37	26	2750	1900	~~8~~ 10	~~128~~ 162	~~1650~~ 2100	~~1.7~~ 1.8	~~1700~~ 1750	~~160~~ 180	2.4	0.7	3.8	1.1	~~0.35~~ 0.39	~~0.47~~ 0.52	0.77	-4	5.1
Alberni	12	-5	-8	31	19	37	24	3100	2220	~~10~~ 12	~~144~~ 178	~~1900~~ 2130	~~2.0~~ 2.2	~~2000~~ 2140	~~220~~ 240	2.6	0.4	4.2	0.6	~~0.24~~ 0.26	~~0.32~~ 0.35	0.5	-2	1
Ashcroft	305	-24	-27	34	20	39	24	3700	2790	~~10~~ 13	~~37~~ 47	~~250~~ 380	0.3	~~300~~ 370	~~80~~ 110	1.7	0.1	2.5	0.2	~~0.29~~ 0.32	~~0.38~~ 0.42	0.61	-5	1.1
Bamfield	20	-2	-4	23	17	28	21	3080	2060	~~13~~ 16	~~170~~ 208	~~2870~~ 3060	~~3.0~~ 3.2	~~2890~~ 3010	~~280~~ 300	1	0.4	1.6	0.7	~~0.38~~ 0.42	~~0.50~~ 0.55	0.77	-2	2
Beatton River	840	-37	-39	26	18	31	22	6300	5230	~~15~~ 19	~~64~~ 81	~~330~~ 430	0.5	~~450~~ 540	~~80~~ 90	3.3	0.1	4.6	0.1	~~0.23~~ 0.25	~~0.30~~ 0.33	0.47	-12	2.5
Bella Bella	25	-5	-7	23	18	28	22	3180	2150	~~13~~ 16	~~145~~ 180	~~2715~~ 2990	~~2.8~~ 3.4	~~2800~~ 2910	~~350~~ 380	2.6	0.8	4.2	1.3	~~0.40~~ 0.44	~~0.50~~ 0.55	0.73	-2	2.5
Bella Coola	40	-14	-18	27	19	33	24	3560	2660	~~10~~ 13	~~140~~ 183	~~1500~~ 2240	~~1.9~~ 2.3	~~1700~~ 1810	~~350~~ 420	4.5	0.8	7	1.2	~~0.29~~ 0.32	~~0.39~~ 0.43	0.61	-3	2.1
Burns Lake	755	-31	-34	26	17	32	22	5450	4430	~~12~~ 15	~~54~~ 69	~~300~~ 460	0.6	~~450~~ 550	~~100~~ 120	3.4	0.2	4.8	0.3	~~0.29~~ 0.32	~~0.39~~ 0.43	0.64	-8	1
Cache Creek	455	-24	-27	34	20	39	24	3700	2790	~~10~~ 13	~~37~~ 47	~~250~~ 370	0.3	~~300~~ 380	~~80~~ 110	1.7	0.2	2.5	0.3	~~0.29~~ 0.32	~~0.39~~ 0.43	0.64	-5	1.1
Campbell River	20	-5	-7	26	18	32	23	3000	2130	~~10~~ 13	~~116~~ 145	~~1500~~ 1800	~~1.6~~ 1.7	~~1600~~ 1740	~~260~~ 280	2.8	0.4	4.5	0.7	~~0.41~~ 0.45	~~0.48~~ 0.53	0.65	-3	2
Carmi	845	-24	-26	31	19	36	23	4750	3770	~~10~~ 13	~~64~~ 81	~~325~~ 490	~~0.4~~ 0.5	~~550~~ 660	~~60~~ 80	3.6	0.2	5.2	0.3	~~0.29~~ 0.30	~~0.38~~ 0.40	0.58	-4	2.5

Castlegar	430	-18	-20	32	20	37	24	3580	2680	~~10~~ 13	~~54~~ 69	~~560~~ 820	~~0.6~~ 0.8	~~700~~ 780	~~60~~ 70	4.2	0.1	6	0.1	~~0.26~~ 0.27	~~0.34~~ 0.36	0.52	-4	2
Chetwynd	605	-35	-38	27	18	33	22	5500	4480	~~15~~ 19	~~70~~ 88	~~400~~ 520	0.6	~~625~~ 740	~~60~~ 70	2.4	0.2	3.5	0.3	~~0.30~~ 0.33	~~0.40~~ 0.44	0.65	-9	2.2
Chilliwack	10	-9	-11	30	20	36	25	2780	1920	~~8~~ 10	~~139~~ 175	~~1625~~ 1970	~~1.7~~ 1.8	~~1700~~ 1750	~~160~~ 180	2.2	0.3	3.5	0.5	~~0.35~~ 0.39	~~0.47~~ 0.52	0.74	-4	4.5
Comox	15	-7	-9	27	18	33	23	2930	2220	~~10~~ 13	~~106~~ 133	~~1175~~ 1360	~~1.3~~ 1.4	~~1200~~ 1290	~~260~~ 290	2.4	0.4	3.8	0.6	~~0.41~~ 0.45	~~0.48~~ 0.53	0.65	-2	2.1
Courtenay	10	-7	-9	28	18	34	23	2930	2220	~~10~~ 13	~~106~~ 133	~~1400~~ 1630	~~1.5~~ 1.6	~~1450~~ 1560	~~260~~ 290	2.4	0.4	3.8	0.6	~~0.41~~ 0.45	~~0.48~~ 0.53	0.65	-2	2.1
Cranbrook	910	-26	-28	32	18	37	22	4400	3450	~~12~~ 15	~~59~~ 75	~~275~~ 380	0.3	~~400~~ 440	~~100~~ 120	3	0.2	4.4	0.3	~~0.25~~ 0.26	~~0.33~~ 0.35	0.53	-7	1.6
Crescent Valley	585	-18	-20	31	20	36	24	3650	2740	~~10~~ 13	~~54~~ 69	~~675~~ 990	~~0.8~~ 1.0	~~850~~ 940	~~80~~ 100	4.2	0.1	6	0.1	~~0.25~~ 0.26	~~0.33~~ 0.35	0.51	-4	2.2
Crofton	5	-4	-6	28	19	34	24	2880	2020	~~8~~ 10	~~86~~ 106	~~925~~ 1000	~~1.1~~ 1.2	~~950~~ 990	~~160~~ 180	1.8	0.2	2.9	0.3	~~0.32~~ 0.35	~~0.40~~ 0.44	0.58	-2	1
Dawson Creek	665	-38	-40	27	18	32	22	5900	4860	~~18~~ 23	~~75~~ 95	~~325~~ 420	0.5	~~475~~ 570	~~100~~ 110	2.5	0.2	3.6	0.3	~~0.30~~ 0.33	~~0.40~~ 0.44	0.65	-11	2.2
Dease Lake	800	-37	-40	24	15	29	19	6730	5630	~~10~~ 13	~~45~~ 58	~~265~~ 390	0.6	~~425~~ 490	~~50~~ 60	2.8	0.1	3.9	0.1	~~0.23~~ 0.25	~~0.30~~ 0.33	0.45	-11	1.9
Dog Creek	450	-28	-30	29	17	34	21	4800	3820	~~10~~ 12	~~48~~ 60	~~275~~ 400	0.4	~~375~~ 480	~~100~~ 140	1.8	0.2	2.7	0.3	~~0.27~~ 0.30	~~0.35~~ 0.39	0.55	-7	2.9
Duncan	10	-6	-8	28	19	33	24	2980	2110	~~8~~ 10	~~103~~ 126	~~1000~~ 1100	~~1.1~~ 1.2	~~1050~~ 1120	~~180~~ 200	1.8	0.4	2.9	0.6	~~0.31~~ 0.34	~~0.39~~ 0.43	0.57	-2	1
Elko	1065	-28	-31	30	19	35	23	4600	3630	~~13~~ 17	~~64~~ 81	~~440~~ 590	0.5	~~650~~ 710	~~100~~ 120	3.6	0.2	5.3	0.3	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-8	2
Fernie	1010	-27	-30	30	19	35	23	4750	3770	~~13~~ 16	~~118~~ 150	~~860~~ 1140	0.9	~~1175~~ 1290	~~100~~ 120	4.5	0.2	6.5	0.3	~~0.30~~ 0.32	~~0.40~~ 0.42	0.65	-8	2.2
Fort Nelson	465	-39	-42	28	18	32	22	6710	5740	~~15~~ 19	~~70~~ 90	~~325~~ 430	0.6	~~450~~ 550	~~80~~ 90	2.4	0.1	3.3	0.1	~~0.23~~ 0.25	~~0.30~~ 0.33	0.47	-13	1.8
Fort St. John	685	-35	-37	26	18	31	22	5750	4710	~~15~~ 19	~~72~~ 91	~~320~~ 420	0.5	~~475~~ 580	~~100~~ 110	2.8	0.1	4.1	0.1	~~0.29~~ 0.32	~~0.39~~ 0.43	0.64	-11	3.9
Glacier	1145	-27	-30	27	17	33	22	5800	4760	~~10~~ 13	~~70~~ 91	~~625~~ 900	~~0.8~~ 0.9	~~1500~~ 1620	~~80~~ 100	9.4	0.2	12.3	0.3	~~0.24~~ 0.25	~~0.32~~ 0.34	0.52	-7	1.7
Golden	790	-27	-30	30	17	36	22	4750	3770	~~10~~ 13	~~55~~ 71	~~325~~ 450	0.6	~~500~~ 540	~~100~~ 130	3.7	0.2	5	0.3	~~0.26~~ 0.27	~~0.35~~ 0.37	0.58	-7	1.4
Gold River	120	-8	-11	31	18	37	23	3230	2350	~~13~~ 16	~~200~~ 248	~~2730~~ 3100	~~2.8~~ 3.1	~~2850~~ 3030	~~250~~ 270	2.8	0.6	4.7	1	~~0.24~~ 0.26	~~0.32~~ 0.35	0.5	-2	1.8
Grand Forks	565	-19	-22	34	20	39	24	3820	2900	~~10~~ 13	~~48~~ 61	~~390~~ 570	~~0.5~~ 0.6	~~475~~ 560	~~80~~ 90	2.8	0.1	4	0.1	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-4	2

Greenwood	745	-20	-23	34	20	39	24	4100	3160	~~10~~ 13	~~64~~ 81	~~430~~ 640	~~0.5~~ 0.6	~~550~~ 650	~~80~~ 100	3.6	0.1	5.2	0.1	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-4	2
Hope	40	-13	-15	31	20	37	25	2820	2130	~~8~~ 10	~~139~~ 177	~~1825~~ 2510	~~1.9~~ 2.0	~~1900~~ 1980	~~140~~ 160	2.8	0.7	4.4	1.1	~~0.47~~ 0.52	~~0.63~~ 0.69	1.03	-4	6
Jordan River	20	-1	-3	22	17	27	22	2900	1900	~~12~~ 15	~~170~~ 208	~~2300~~ 2520	~~2.4~~ 2.6	~~2370~~ 2510	~~250~~ 270	1.2	0.4	2	0.7	~~0.44~~ 0.48	~~0.55~~ 0.61	0.79	-2	2
Kamloops	355	-23	-25	34	20	38	24	3450	2670	~~13~~ 17	~~42~~ 53	~~225~~ 340	0.2	~~275~~ 340	~~80~~ 100	1.8	0.2	2.6	0.3	~~0.30~~ 0.33	~~0.40~~ 0.44	0.65	-6	2.9
Kaslo	545	-17	-20	30	19	35	23	3830	2910	~~10~~ 13	~~55~~ 70	~~660~~ 950	~~0.8~~ 0.9	~~850~~ 930	~~80~~ 100	2.8	0.1	4	0.1	~~0.23~~ 0.24	~~0.31~~ 0.33	0.51	-5	1.8
Kelowna	350	-17	-20	33	20	38	24	3400	2510	~~12~~ 15	~~43~~ 54	~~260~~ 390	0.3	~~325~~ 390	~~80~~ 120	1.7	0.1	2.5	0.2	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-5	1.6
Kimberley	1090	-25	-27	31	18	36	22	4650	3680	~~12~~ 15	~~59~~ 75	~~350~~ 480	0.4	~~500~~ 550	~~100~~ 130	3	0.2	4.3	0.3	~~0.25~~ 0.26	~~0.33~~ 0.35	0.53	-7	1.6
Kitimat Plant	15	-16	-18	25	16	31	21	3750	2830	~~13~~ 17	~~193~~ 250	~~2100~~ 2900	~~2.2~~ 2.7	~~2500~~ 2680	~~220~~ 260	5.5	0.8	8.4	1.2	~~0.36~~ 0.40	~~0.48~~ 0.53	0.75	-5	5
Kitimat Townsite	130	-16	-18	24	16	30	21	3900	2980	~~13~~ 17	~~171~~ 221	~~1900~~ 2620	~~2.0~~ 2.4	~~2300~~ 2460	~~220~~ 260	6.5	0.8	9.8	1.2	~~0.36~~ 0.40	~~0.48~~ 0.53	0.75	-5	5
Ladysmith	80	-7	-9	27	19	32	24	2920	2130	~~8~~ 10	~~97~~ 119	~~1075~~ 1180	~~1.2~~ 1.3	~~1160~~ 1220	~~180~~ 200	2.4	0.4	3.9	0.7	~~0.32~~ 0.35	~~0.40~~ 0.44	0.58	-2	1.5
Langford	80	-4	-6	27	19	33	23	2750	1770	~~9~~ 11	~~135~~ 166	~~1095~~ 1250	~~1.2~~ 1.3	~~1125~~ 1240	~~220~~ 250	1.8	0.3	3	0.5	~~0.32~~ 0.35	~~0.40~~ 0.44	0.58	-2	3.3
Lillooet	245	-21	-23	34	20	39	24	3400	2610	~~10~~ 13	~~70~~ 89	~~300~~ 470	0.3	~~350~~ 420	~~100~~ 150	2.1	0.1	3.2	0.2	~~0.33~~ 0.36	~~0.44~~ 0.48	0.72	-5	2
Lytton	325	-17	-20	35	20	40	24	3300	2410	~~10~~ 13	~~70~~ 89	~~330~~ 510	0.3	~~425~~ 490	~~80~~ 110	2.8	0.3	4.3	0.5	~~0.32~~ 0.35	~~0.43~~ 0.47	0.7	-5	1.7
Mackenzie	765	-34	-38	27	17	33	21	5550	4530	~~10~~ 13	~~50~~ 64	~~350~~ 490	0.5	~~650~~ 720	~~60~~ 70	5.1	0.2	7.1	0.3	~~0.25~~ 0.28	~~0.32~~ 0.35	0.5	-8	1.6
Masset	10	-5	-7	17	15	21	18	3700	2600	~~13~~ 16	~~80~~ 98	~~1350~~ 1510	~~1.5~~ 1.6	~~1400~~ 1530	~~400~~ 430	1.8	0.4	2.9	0.6	~~0.50~~ 0.55	~~0.61~~ 0.67	0.86	-2	1.7
McBride	730	-29	-32	29	18	36	23	4980	3990	~~13~~ 17	~~54~~ 69	~~475~~ 670	0.6	~~650~~ 700	~~60~~ 70	4.3	0.2	6.2	0.3	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2
McLeod Lake	695	-35	-37	27	17	33	21	5450	4430	~~10~~ 13	~~50~~ 64	~~350~~ 490	0.5	~~650~~ 720	~~60~~ 70	4.1	0.2	5.7	0.3	~~0.25~~ 0.28	~~0.32~~ 0.35	0.5	-8	2
Merritt	570	-24	-27	34	20	39	24	3900	2980	~~8~~ 10	~~54~~ 68	~~240~~ 370	0.2	~~310~~ 370	~~80~~ 110	1.8	0.3	2.7	0.4	~~0.33~~ 0.36	~~0.44~~ 0.48	0.72	-6	1.1
Mission City	45	-9	-11	30	20	36	25	2850	1990	~~13~~ 16	~~123~~ 154	~~1650~~ 1850	1.7	~~1700~~ 1730	~~160~~ 180	2.4	0.3	3.8	0.5	~~0.32~~ 0.35	~~0.43~~ 0.47	0.67	-3	4
Montrose	615	-16	-18	32	20	37	24	3600	2690	~~10~~ 13	~~54~~ 69	~~480~~ 690	~~0.6~~ 0.8	~~700~~ 780	~~60~~ 70	4.1	0.1	5.8	0.1	~~0.26~~ 0.27	~~0.35~~ 0.37	0.55	-4	1.5

Nakusp	445	-20	-22	31	20	36	24	3560	2660	~~10~~ 13	~~60~~ 77	~~650~~ 940	~~0.8~~ 1.0	~~850~~ 940	~~60~~ 80	4.4	0.1	6.2	0.1	~~0.25~~ 0.26	~~0.33~~ 0.35	0.51	-4	1.2
Nanaimo	15	-6	-8	27	19	33	24	2920	2130	~~10~~ 12	~~91~~ 113	~~1000~~ 1110	~~1.1~~ 1.2	~~1050~~ 1120	~~200~~ 220	2.1	0.4	3.5	0.7	~~0.38~~ 0.42	~~0.48~~ 0.53	0.7	-2	3
Nelson	600	-18	-20	31	20	36	24	3500	2600	~~10~~ 13	~~59~~ 75	~~460~~ 670	~~0.6~~ 0.8	~~700~~ 770	~~60~~ 70	4.2	0.1	5.9	0.1	~~0.25~~ 0.26	~~0.33~~ 0.35	0.51	-4	2.3
Ocean Falls	10	-10	-12	23	17	28	22	3400	2510	~~13~~ 16	~~260~~ 327	~~4150~~ 4830	~~4.2~~ 5.4	~~4300~~ 4460	~~350~~ 380	3.9	0.8	6.2	1.3	~~0.44~~ 0.48	~~0.59~~ 0.65	0.92	-3	2.1
Osoyoos	285	-14	-17	35	21	40	25	3100	2220	~~10~~ 13	~~48~~ 61	~~275~~ 420	0.3	~~310~~ 380	~~60~~ 80	1.1	0.1	1.6	0.2	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-4	1.8
Parksville	40	-6	-8	26	19	32	24	2990	2320	~~10~~ 12	~~91~~ 113	~~1200~~ 1350	~~1.3~~ 1.4	~~1250~~ 1340	~~200~~ 220	2	0.4	3.2	0.7	~~0.40~~ 0.44	~~0.48~~ 0.53	0.66	-2	2
Penticton	350	-15	-17	33	20	38	24	3350	2460	~~10~~ 13	~~48~~ 61	~~275~~ 420	0.3	~~300~~ 370	~~60~~ 90	1.3	0.1	1.9	0.2	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-4	3.4
Port Alberni	15	-5	-8	31	19	37	24	3100	2220	~~10~~ 12	~~161~~ 199	~~1900~~ 2120	~~2.0~~ 2.1	~~2000~~ 2140	~~240~~ 260	2.6	0.4	4.2	0.6	~~0.24~~ 0.26	~~0.32~~ 0.35	0.5	-2	1
Port Alice	25	-3	-6	26	17	31	21	3010	2000	~~13~~ 16	~~200~~ 244	~~3300~~ 3540	~~3.4~~ 3.6	~~3340~~ 3500	~~220~~ 230	1.1	0.4	1.8	0.7	~~0.24~~ 0.26	~~0.32~~ 0.35	0.5	-2	1.5
Port Hardy	5	-5	-7	20	16	25	20	3440	2370	~~13~~ 16	~~150~~ 184	~~1775~~ 1950	~~1.9~~ 2.0	~~1850~~ 1930	~~220~~ 240	0.9	0.4	1.5	0.7	~~0.36~~ 0.40	~~0.48~~ 0.53	0.75	-2	2.8
Port McNeill	5	-5	-7	22	17	27	21	3410	2350	~~13~~ 16	~~128~~ 157	~~1750~~ 1930	~~1.9~~ 2.0	~~1850~~ 1950	~~260~~ 280	1.1	0.4	1.8	0.7	~~0.36~~ 0.40	~~0.48~~ 0.53	0.75	-2	2.8
Port Renfrew	20	-3	-5	24	17	29	21	2900	1900	~~13~~ 16	~~200~~ 244	~~3600~~ 3860	~~3.6~~ 3.9	~~3675~~ 3860	~~270~~ 290	1.1	0.4	1.8	0.7	~~0.42~~ 0.46	~~0.52~~ 0.57	0.75	-2	2.5
Powell River	10	-7	-9	26	18	32	23	3100	2220	~~10~~ 13	~~80~~ 101	~~1150~~ 1360	~~1.3~~ 1.5	~~1200~~ 1270	~~220~~ 250	1.7	0.4	2.7	0.6	~~0.39~~ 0.43	~~0.48~~ 0.53	0.68	-2	1.2
Prince George	580	-32	-36	28	18	34	22	4720	3750	~~15~~ 19	~~54~~ 68	~~425~~ 600	~~0.6~~ 0.7	~~600~~ 710	~~80~~ 100	3.4	0.2	4.8	0.3	~~0.28~~ 0.31	~~0.37~~ 0.41	0.63	-8	3
Prince Rupert	20	-13	-15	19	15	24	19	3900	2770	~~13~~ 16	~~160~~ 201	~~2750~~ 3160	~~2.8~~ 3.1	~~2900~~ 3070	~~240~~ 260	1.9	0.4	2.9	0.6	~~0.43~~ 0.47	~~0.54~~ 0.59	0.78	-3	2.5
Princeton	655	-24	-29	33	19	39	24	4250	3300	~~10~~ 13	~~43~~ 54	~~235~~ 370	0.4	~~350~~ 400	~~80~~ 110	2.9	0.6	4.3	0.9	~~0.27~~ 0.30	~~0.36~~ 0.40	0.59	-6	1
Qualicum Beach	10	-7	-9	27	19	33	24	2990	2320	~~10~~ 12	~~96~~ 119	~~1200~~ 1350	~~1.3~~ 1.4	~~1250~~ 1340	~~200~~ 220	2	0.4	3.3	0.7	~~0.41~~ 0.45	~~0.48~~ 0.53	0.65	-2	2
Queen Charlotte City	35	-6	-8	21	16	25	20	3520	2440	~~13~~ 16	~~110~~ 135	~~1300~~ 1430	~~1.5~~ 1.6	~~1350~~ 1460	~~360~~ 390	1.8	0.4	2.9	0.6	~~0.50~~ 0.55	~~0.61~~ 0.67	0.86	-2	2
Quesnel	475	-31	-33	30	17	36	21	4650	3680	~~10~~ 13	~~50~~ 63	~~380~~ 550	~~0.5~~ 0.6	~~525~~ 630	~~80~~ 100	3	0.1	4.4	0.2	~~0.24~~ 0.26	~~0.31~~ 0.34	0.51	-7	1.8
Revelstoke	440	-20	-23	31	19	36	23	4000	3070	~~13~~ 17	~~55~~ 71	~~625~~ 910	~~0.8~~ 0.9	~~950~~ 1030	~~80~~ 100	7.2	0.1	9.9	0.1	~~0.24~~ 0.25	~~0.32~~ 0.34	0.52	-5	1.7

Salmon Arm	425	-19	-24	33	21	38	25	3650	2740	~~13~~ 17	~~48~~ 61	~~400~~ 580	~~0.5~~ 0.6	~~525~~ 610	~~80~~ 100	3.5	0.1	4.9	0.1	~~0.29~~ 0.30	~~0.39~~ 0.41	0.61	-5	1.1
Sandspit	5	-4	-6	18	15	22	19	3450	2380	~~13~~ 16	~~86~~ 105	~~1300~~ 1430	~~1.5~~ 1.6	~~1350~~ 1460	~~500~~ 540	1.8	0.4	2.9	0.7	~~0.59~~ 0.65	~~0.72~~ 0.79	1.01	-2	6.3
Sechelt	25	-6	-8	27	20	33	25	2680	1830	~~10~~ 13	~~75~~ 94	~~1140~~ 1310	~~1.3~~ 1.5	~~1200~~ 1250	~~160~~ 180	1.8	0.4	3	0.7	~~0.38~~ 0.42	~~0.48~~ 0.53	0.7	-2	1.4
Sidney	10	-4	-6	26	18	32	22	2850	1860	~~8~~ 10	~~96~~ 118	~~825~~ 900	~~1.0~~ 1.1	~~850~~ 900	~~160~~ 180	1.1	0.2	1.8	0.3	~~0.34~~ 0.37	~~0.42~~ 0.46	0.61	-2	3.3
Smithers	500	-29	-31	26	17	32	22	5040	4050	~~13~~ 17	~~60~~ 77	~~325~~ 510	0.6	~~500~~ 580	~~120~~ 150	3.5	0.2	4.9	0.3	~~0.30~~ 0.33	~~0.40~~ 0.44	0.62	-7	1.7
Smith River	660	-45	-47	26	17	30	21	7100	5980	~~10~~ 13	~~64~~ 82	~~300~~ 400	0.6	~~500~~ 590	40	2.8	0.1	3.9	0.1	~~0.24~~ 0.26	~~0.30~~ 0.33	0.46	-14	1.9
Sooke	20	-1	-3	21	16	27	20	2900	1900	~~9~~ 11	~~130~~ 159	~~1250~~ 1410	~~1.4~~ 1.5	~~1280~~ 1390	~~220~~ 250	1.3	0.3	2.2	0.5	~~0.38~~ 0.42	~~0.48~~ 0.53	0.7	-2	2
Squamish	5	-9	-11	29	20	35	25	2950	2080	~~10~~ 13	~~140~~ 182	~~2050~~ 2610	~~2.1~~ 2.6	~~2200~~ 2290	~~160~~ 190	2.8	0.7	4.3	1.1	~~0.38~~ 0.42	~~0.50~~ 0.55	0.77	-3	3
Stewart	10	-17	-20	25	16	31	21	4350	3400	~~13~~ 17	~~135~~ 181	~~1300~~ 2010	~~1.5~~ 1.7	~~1900~~ 2090	~~180~~ 210	7.9	0.8	11.4	1.2	~~0.27~~ 0.30	~~0.36~~ 0.40	0.56	-7	2
Tahsis	25	-4	-6	26	18	32	23	3150	2120	~~13~~ 16	~~200~~ 246	~~3845~~ 4250	~~3.9~~ 4.3	~~3900~~ 4110	~~300~~ 330	1.1	0.4	1.8	0.7	~~0.26~~ 0.29	~~0.34~~ 0.37	0.52	-2	1
Taylor	515	-35	-37	26	18	31	22	5720	4690	~~15~~ 19	~~72~~ 91	~~320~~ 420	0.5	~~450~~ 540	~~100~~ 110	2.3	0.1	3.3	0.2	~~0.30~~ 0.33	~~0.40~~ 0.44	0.65	-11	3.9
Terrace	60	-19	-21	27	17	33	22	4150	3210	~~13~~ 17	~~120~~ 156	~~950~~ 1420	~~1.1~~ 1.2	~~1150~~ 1250	~~200~~ 240	5.4	0.6	8	0.9	~~0.27~~ 0.30	~~0.36~~ 0.40	0.56	-5	5.2
Tofino	10	-2	-4	20	16	25	20	3150	2120	~~13~~ 16	~~193~~ 237	~~3275~~ 3490	~~3.4~~ 3.7	~~3300~~ 3450	~~300~~ 320	1.1	0.4	1.8	0.7	~~0.51~~ 0.56	~~0.68~~ 0.75	1.06	-2	1.5
Trail	440	-14	-17	33	20	38	24	3600	2690	~~10~~ 13	~~54~~ 69	~~580~~ 830	~~0.7~~ 0.9	~~700~~ 790	~~60~~ 70	4.1	0.1	5.7	0.1	~~0.26~~ 0.27	~~0.35~~ 0.37	0.55	-4	1.5
Ucluelet	5	-2	-4	18	16	23	20	3120	2100	~~13~~ 16	~~180~~ 221	~~3175~~ 3370	~~3.3~~ 3.6	~~3200~~ 3330	~~280~~ 300	1	0.4	1.7	0.7	~~0.51~~ 0.56	~~0.68~~ 0.75	1.06	-2	1.5
Vancouver Region																								
Burnaby (Simon Fraser Univ.)	330	-7	-9	25	17	31	22	3100	2220	~~10~~ 13	~~150~~ 189	~~1850~~ 2120	~~1.9~~ 2.4	~~1950~~ 2020	~~160~~ 180	2.9	0.7	4.7	1.1	~~0.35~~ 0.39	~~0.47~~ 0.52	0.74	-3	2.9
Cloverdale	10	-8	-10	29	20	35	25	2700	1850	~~10~~ 12	~~112~~ 139	~~1350~~ 1470	1.4	~~1400~~ 1440	~~160~~ 170	2.5	0.2	4	0.3	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	1.7
Haney	10	-9	-11	30	20	36	25	2840	1980	~~10~~ 13	~~134~~ 168	~~1800~~ 2030	~~1.9~~ 2.0	~~1950~~ 2000	~~160~~ 180	2.4	0.2	3.9	0.3	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	1.7
Ladner	3	-6	-8	27	19	33	24	2600	1750	~~10~~ 12	~~80~~ 99	~~1000~~ 1080	~~1.1~~ 1.4	~~1050~~ 1090	~~160~~ 170	1.3	0.2	2.1	0.3	~~0.37~~ 0.41	~~0.46~~ 0.51	0.66	-3	1.7

Langley	15	-8	-10	29	20	35	25	2700	1850	~~10~~ 12	~~112~~ 139	~~1450~~ 1590	1.5	~~1500~~ 1540	~~160~~ 170	2.4	0.2	3.9	0.3	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	1.7
New Westminster	10	-8	-10	29	19	35	24	2800	1940	~~10~~ 12	~~134~~ 167	~~1500~~ 1680	~~1.6~~ 2.0	~~1575~~ 1630	~~160~~ 180	2.3	0.2	3.7	0.3	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	1.7
North Vancouver	135	-7	-9	26	19	32	24	2910	2050	~~12~~ 15	~~150~~ 188	~~2000~~ 2250	~~2.1~~ 2.6	~~2100~~ 2170	~~160~~ 180	3	0.3	4.7	0.5	~~0.34~~ 0.37	~~0.45~~ 0.50	0.69	-3	1
Richmond	5	-7	-9	27	19	33	24	2800	1940	~~10~~ 12	~~86~~ 107	~~1070~~ 1170	~~1.2~~ 1.5	~~1100~~ 1140	~~160~~ 180	1.5	0.2	2.4	0.3	~~0.36~~ 0.40	~~0.45~~ 0.50	0.65	-3	2.5
Surrey (88 Ave & 156 St.)	90	-8	-10	29	20	35	25	2750	1900	~~10~~ 12	~~128~~ 159	~~1500~~ 1640	1.6	~~1575~~ 1620	~~160~~ 170	2.4	0.3	3.8	0.5	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	1.7
Vancouver (City Hall)	40	-7	-9	28	20	34	25	2825	1970	~~10~~ 12	~~112~~ 140	~~1325~~ 1470	~~1.4~~ 1.7	~~1400~~ 1450	~~160~~ 180	1.8	0.2	2.9	0.3	~~0.34~~ 0.37	~~0.45~~ 0.50	0.69	-3	2.5
Vancouver (Granville St. & 41st Ave)	120	-6	-8	28	20	34	25	2925	2060	~~10~~ 12	~~107~~ 133	~~1325~~ 1460	~~1.4~~ 1.7	~~1400~~ 1450	~~160~~ 180	1.9	0.3	3	0.5	~~0.36~~ 0.40	~~0.45~~ 0.50	0.65	-3	2.5
West Vancouver	45	-7	-9	28	19	34	24	2950	2080	~~12~~ 15	~~150~~ 188	~~1600~~ 1800	~~1.7~~ 2.1	~~1700~~ 1760	~~160~~ 180	2.4	0.2	3.8	0.3	~~0.36~~ 0.40	~~0.48~~ 0.53	0.75	-3	2
Vernon	405	-20	-23	33	20	38	24	3600	2690	~~13~~ 17	~~43~~ 55	~~350~~ 510	~~0.4~~ 0.5	~~400~~ 480	~~80~~ 110	2.2	0.1	3.2	0.1	~~0.30~~ 0.32	~~0.40~~ 0.42	0.62	-5	1.5
Victoria Region																								
Victoria	10	-4	-6	24	17	30	21	2650	1730	~~8~~ 10	~~91~~ 112	~~800~~ 910	~~1.0~~ 1.1	~~825~~ 910	~~220~~ 250	1.1	0.2	1.8	0.3	~~0.46~~ 0.51	~~0.57~~ 0.63	0.81	-2	4.7
Victoria (Gonzales Hts)	65	-4	-6	24	17	30	21	2700	1690	~~9~~ 11	~~91~~ 112	~~600~~ 680	~~0.8~~ 0.9	~~625~~ 690	~~220~~ 250	1.5	0.3	2.5	0.5	~~0.46~~ 0.51	~~0.57~~ 0.63	0.81	-2	4.7
Victoria (Mt Tolmie)	125	-6	-8	24	16	30	20	2700	1730	~~9~~ 11	~~91~~ 112	~~775~~ 860	~~1.0~~ 1.1	~~800~~ 860	~~220~~ 250	2.1	0.3	3.5	0.5	~~0.46~~ 0.48	~~0.57~~ 0.60	0.78	-2	4
Whistler	665	-17	-20	30	20	36	25	4180	3240	~~10~~ 13	~~85~~ 112	~~845~~ 1330	~~1.0~~ 1.2	~~1215~~ 1300	~~160~~ 200	9.5	0.9	13.9	1.3	~~0.24~~ 0.26	~~0.32~~ 0.35	0.5	-4	1
White Rock	30	-5	-7	25	20	31	25	2620	1770	~~10~~ 12	~~80~~ 99	~~1065~~ 1160	1.2	~~1100~~ 1140	~~160~~ 170	2	0.2	3.3	0.3	~~0.33~~ 0.36	~~0.44~~ 0.48	0.68	-3	1.7
Williams Lake	615	-30	-33	29	17	34	21	4400	3450	~~10~~ 13	~~48~~ 61	~~350~~ 520	~~0.5~~ 0.6	~~425~~ 540	~~80~~ 100	2.4	0.2	3.6	0.3	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-7	2.9
Youbou	200	-5	-8	31	19	36	24	3050	2180	~~10~~ 12	~~161~~ 198	~~2000~~ 2190	~~2.1~~ 2.2	~~2100~~ 2220	~~200~~ 220	3.5	0.7	5.6	1.1	~~0.26~~ 0.29	~~0.32~~ 0.35	0.45	-2	1
Alberta																								
Athabasca	515	-35	-38	27	19	32	23	6000	5000	~~18~~ 23	~~86~~ 109	~~370~~ 440	0.6	~~480~~ 550	80	1.5	0.1	2.1	0.1	~~0.27~~ 0.28	~~0.36~~ 0.38	0.59	-10	2.4
Banff	1400	-31	-33	27	16	33	20	5500	4520	~~18~~ 23	~~65~~ 82	~~300~~ 370	0.6	~~500~~ 550	~~120~~ 140	3.3	0.1	4.8	0.1	~~0.26~~ 0.27	~~0.32~~ 0.34	0.47	-8	2.3

Barrhead	645	-33	-36	27	19	32	23	5740	4750	~~20~~ 25	~~86~~ 109	~~375~~ 450	0.6	~~475~~ 550	100	1.7	0.1	2.5	0.2	~~0.35~~ 0.37	~~0.44~~ 0.46	0.67	-11	2
Beaverlodge	730	-36	-39	28	18	33	22	5700	4710	~~20~~ 25	~~86~~ 109	~~315~~ 410	0.5	~~470~~ 560	~~100~~ 110	2.4	0.1	3.5	0.2	~~0.27~~ 0.28	~~0.36~~ 0.38	0.56	-10	2.1
Brooks	760	-32	-34	32	20	37	24	4880	3940	~~18~~ 23	~~86~~ 108	~~260~~ 320	0.3	~~340~~ 400	~~220~~ 230	1.2	0.1	1.8	0.2	~~0.35~~ 0.37	~~0.44~~ 0.46	0.67	-10	3.8
Calgary	1045	-30	-32	28	17	34	21	5000	4050	~~23~~ 29	~~103~~ 129	~~325~~ 390	0.4	~~425~~ 480	~~220~~ 240	1.1	0.1	1.6	0.2	~~0.38~~ 0.40	~~0.48~~ 0.50	0.74	-9	3.4
Campsie	660	-33	-36	27	19	32	23	5750	4760	~~20~~ 25	~~86~~ 109	~~375~~ 450	0.6	~~475~~ 550	100	1.7	0.1	2.5	0.2	~~0.33~~ 0.35	~~0.44~~ 0.46	0.72	-11	1.8
Camrose	740	-33	-35	29	19	34	23	5500	4520	~~20~~ 25	~~86~~ 109	~~355~~ 420	0.5	~~470~~ 540	160	2	0.1	2.9	0.1	~~0.31~~ 0.33	~~0.39~~ 0.41	0.6	-10	2.9
Canmore	1320	-31	-33	28	17	34	21	5400	4430	~~18~~ 23	~~86~~ 108	~~325~~ 390	0.6	~~500~~ 560	~~120~~ 140	3.2	0.1	4.6	0.1	~~0.30~~ 0.32	~~0.37~~ 0.39	0.55	-8	2.3
Cardston	1130	-29	-32	30	19	35	23	4700	3770	~~20~~ 25	~~108~~ 136	~~340~~ 410	0.4	~~550~~ 630	~~140~~ 150	1.5	0.1	2.2	0.2	~~0.58~~ 0.61	~~0.72~~ 0.76	1.04	-9	4.7
Claresholm	1030	-30	-32	30	18	35	22	4680	3750	~~15~~ 19	~~97~~ 122	~~310~~ 370	0.4	~~440~~ 510	~~200~~ 210	1.3	0.1	1.9	0.2	~~0.46~~ 0.48	~~0.58~~ 0.61	0.89	-9	3.8
Cold Lake	540	-35	-38	28	19	33	23	5860	4860	~~18~~ 23	~~81~~ 104	~~320~~ 380	0.5	~~430~~ 480	140	1.7	0.1	2.5	0.1	~~0.29~~ 0.30	~~0.38~~ 0.40	0.61	-11	2.8
Coleman	1320	-31	-34	29	18	34	22	5210	4250	~~15~~ 19	~~86~~ 108	~~400~~ 500	0.5	~~550~~ 610	~~120~~ 140	2.7	0.3	4	0.4	~~0.50~~ 0.53	~~0.63~~ 0.66	0.97	-8	2.7
Coronation	790	-32	-34	30	19	36	23	5640	4660	~~20~~ 25	~~92~~ 117	~~300~~ 360	0.5	~~400~~ 460	~~200~~ 220	1.9	0.1	2.8	0.2	~~0.30~~ 0.32	~~0.37~~ 0.39	0.55	-10	4.3
Cowley	1175	-29	-32	29	18	34	22	4810	3870	~~15~~ 19	~~92~~ 116	~~310~~ 380	0.4	~~525~~ 600	~~140~~ 150	1.6	0.1	2.3	0.2	~~0.81~~ 0.85	~~1.01~~ 1.06	1.47	-9	4
Drumheller	685	-32	-34	30	18	36	22	5050	4100	~~20~~ 25	~~86~~ 109	~~300~~ 360	0.4	~~375~~ 430	~~220~~ 230	1.2	0.1	1.7	0.1	~~0.35~~ 0.37	~~0.44~~ 0.46	0.67	-10	2
Edmonton	645	-30	-33	28	19	34	23	5120	4160	~~23~~ 29	~~97~~ 123	~~360~~ 430	0.5	~~460~~ 520	~~160~~ 170	1.7	0.1	2.5	0.2	~~0.36~~ 0.38	~~0.45~~ 0.47	0.68	-10	3
Edson	920	-34	-37	27	18	32	22	5750	4760	~~18~~ 22	~~81~~ 101	~~450~~ 550	0.6	~~570~~ 660	100	2.1	0.1	3	0.1	~~0.37~~ 0.39	~~0.46~~ 0.48	0.69	-9	2.2
Embarras Portage	220	-41	-43	28	19	32	23	7100	6040	~~12~~ 16	~~81~~ 105	~~250~~ 310	0.6	~~390~~ 450	80	2.2	0.1	3	0.1	~~0.28~~ 0.29	~~0.37~~ 0.39	0.57	-14	2.9
Fairview	670	-37	-40	27	18	32	22	5840	4850	~~15~~ 19	~~86~~ 109	~~330~~ 420	0.5	~~450~~ 530	~~100~~ 110	2.4	0.1	3.5	0.2	~~0.26~~ 0.27	~~0.35~~ 0.37	0.55	-11	2.8
Fort MacLeod	945	-30	-32	31	19	36	23	4600	3670	~~16~~ 20	~~97~~ 122	~~300~~ 360	0.4	~~425~~ 490	~~180~~ 190	1.2	0.1	1.8	0.2	~~0.54~~ 0.57	~~0.68~~ 0.71	0.99	-9	3.8
Fort McMurray	255	-38	-40	28	19	33	23	6250	5230	~~13~~ 17	~~86~~ 111	~~340~~ 410	0.5	~~460~~ 520	60	1.5	0.1	2.1	0.1	~~0.28~~ 0.29	~~0.35~~ 0.37	0.53	-12	3.2

Fort Saskatchewan	610	-32	-35	28	19	34	23	5420	4450	~~20~~ 25	~~86~~ 109	~~350~~ 410	0.5	~~425~~ 480	~~140~~ 150	1.6	0.1	2.3	0.1	~~0.34~~ 0.36	~~0.43~~ 0.45	0.66	-10	2
Fort Vermilion	270	-41	-43	28	18	32	22	6700	5660	~~13~~ 17	~~70~~ 90	~~250~~ 310	0.5	~~380~~ 440	~~60~~ 70	2.1	0.1	3	0.1	~~0.23~~ 0.24	~~0.30~~ 0.32	0.45	-14	3.1
Grande Prairie	650	-36	-39	27	18	32	22	5790	4800	~~20~~ 25	~~86~~ 109	~~315~~ 400	0.5	~~450~~ 540	120	2.2	0.1	3.2	0.2	~~0.32~~ 0.34	~~0.43~~ 0.45	0.7	-11	2.9
Habay	335	-41	-43	28	18	32	22	6750	5710	~~13~~ 17	~~70~~ 90	~~275~~ 350	0.5	~~425~~ 500	~~60~~ 70	2.4	0.1	3.4	0.1	~~0.23~~ 0.24	~~0.30~~ 0.32	0.45	-14	2
Hardisty	615	-33	-36	30	19	36	23	5640	4660	~~20~~ 26	~~81~~ 104	~~325~~ 390	0.5	~~425~~ 480	~~140~~ 150	1.7	0.1	2.5	0.2	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-10	4
High River	1040	-31	-32	28	17	33	21	4900	3960	~~18~~ 23	~~97~~ 122	~~300~~ 360	0.4	~~425~~ 480	~~200~~ 210	1.3	0.1	1.9	0.1	~~0.52~~ 0.55	~~0.65~~ 0.68	0.99	-9	2.8
Hinton	990	-34	-38	27	17	33	21	5500	4520	~~13~~ 16	~~81~~ 101	~~375~~ 460	0.6	~~500~~ 580	~~100~~ 110	2.6	0.1	3.7	0.1	~~0.37~~ 0.39	~~0.46~~ 0.48	0.69	-9	2
Jasper	1060	-31	-34	28	17	34	22	5300	4330	~~12~~ 15	~~76~~ 96	~~300~~ 390	0.5	~~400~~ 450	~~80~~ 100	3	0.1	4.3	0.1	~~0.26~~ 0.27	~~0.32~~ 0.34	0.47	-9	1.7
Keg River	420	-40	-42	28	18	32	22	6520	5490	~~13~~ 17	~~70~~ 89	~~310~~ 390	0.5	~~450~~ 530	~~80~~ 90	2.4	0.1	3.5	0.1	~~0.23~~ 0.24	~~0.30~~ 0.32	0.45	-13	3
Lac La Biche	560	-35	-38	28	19	33	23	6100	5090	~~15~~ 19	~~86~~ 109	~~375~~ 440	0.6	~~475~~ 540	80	1.6	0.1	2.3	0.1	~~0.27~~ 0.28	~~0.36~~ 0.38	0.59	-11	2.4
Lacombe	855	-33	-36	28	19	34	23	5500	4520	~~23~~ 29	~~92~~ 116	~~350~~ 420	0.5	~~450~~ 520	~~180~~ 190	1.9	0.1	2.8	0.1	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-10	2.3
Lethbridge	910	-30	-32	31	19	36	23	4500	3580	~~20~~ 25	~~97~~ 122	~~250~~ 310	0.3	~~390~~ 450	~~200~~ 210	1.2	0.1	1.8	0.2	~~0.53~~ 0.56	~~0.66~~ 0.69	0.96	-9	4
Manning	465	-39	-41	27	18	32	22	6300	5280	~~13~~ 16	~~76~~ 96	~~280~~ 350	0.5	~~390~~ 460	~~80~~ 90	2.3	0.1	3.3	0.2	~~0.23~~ 0.24	~~0.30~~ 0.32	0.45	-13	2.8
Medicine Hat	705	-31	-34	32	19	37	23	4540	3610	~~23~~ 29	~~92~~ 116	~~250~~ 300	0.3	~~325~~ 370	~~220~~ 230	1.1	0.1	1.6	0.2	~~0.38~~ 0.40	~~0.48~~ 0.50	0.71	-9	3.6
Peace River	330	-37	-40	27	18	32	22	6050	5040	~~15~~ 19	~~81~~ 103	~~300~~ 380	0.5	~~390~~ 460	~~100~~ 110	2.2	0.1	3.2	0.2	~~0.24~~ 0.25	~~0.32~~ 0.34	0.5	-11	3.5
Pincher Creek	1130	-29	-32	29	18	34	22	4740	3800	~~16~~ 20	~~103~~ 130	~~325~~ 400	0.4	~~575~~ 650	~~140~~ 150	1.5	0.1	2.2	0.2	~~0.77~~ 0.81	~~0.96~~ 1.01	1.39	-9	4.6
Ranfurly	670	-34	-37	29	19	34	23	5700	4710	~~18~~ 23	~~92~~ 118	~~325~~ 380	0.5	~~420~~ 480	100	1.9	0.1	2.7	0.1	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-10	3.6
Red Deer	855	-32	-35	28	19	34	23	5550	4570	~~20~~ 25	~~97~~ 122	~~375~~ 450	0.5	~~475~~ 550	~~200~~ 210	1.8	0.1	2.6	0.1	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-10	2.8
Rocky Mountain House	985	-32	-34	27	18	33	22	5640	4660	~~20~~ 25	~~92~~ 115	~~425~~ 510	0.6	~~550~~ 630	~~120~~ 130	1.9	0.1	2.7	0.1	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-10	1.9
Slave Lake	590	-35	-38	26	19	31	23	5850	4850	~~15~~ 19	~~81~~ 102	~~380~~ 450	0.6	~~500~~ 570	80	1.9	0.1	2.8	0.2	~~0.28~~ 0.29	~~0.37~~ 0.39	0.6	-11	3.5

Stettler	820	-32	-34	30	19	36	23	5300	4330	~~20~~ 25	~~97~~ 123	~~370~~ 440	0.5	~~450~~ 520	~~200~~ 210	1.9	0.1	2.7	0.1	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-10	4.2
Stony Plain	710	-32	-35	28	19	33	23	5300	4330	~~23~~ 29	~~97~~ 122	~~410~~ 490	0.5	~~540~~ 620	~~120~~ 130	1.7	0.1	2.5	0.2	~~0.36~~ 0.38	~~0.45~~ 0.47	0.68	-10	2.9
Suffield	755	-31	-34	32	20	37	24	4770	3830	~~20~~ 25	~~86~~ 108	~~230~~ 280	0.2	~~325~~ 380	~~220~~ 230	1.3	0.1	1.9	0.2	~~0.39~~ 0.41	~~0.49~~ 0.51	0.75	-10	4.5
Taber	815	-31	-33	31	19	36	23	4580	3650	~~20~~ 25	~~92~~ 115	~~260~~ 320	0.3	~~370~~ 430	~~200~~ 210	1.2	0.1	1.8	0.2	~~0.50~~ 0.53	~~0.63~~ 0.66	0.93	-9	3.8
Turner Valley	1215	-31	-32	28	17	33	21	5220	4260	~~20~~ 25	~~97~~ 122	~~350~~ 420	0.5	~~600~~ 670	~~180~~ 190	1.4	0.1	2	0.2	~~0.52~~ 0.55	~~0.65~~ 0.68	0.99	-9	3.2
Valleyview	700	-37	-40	27	18	32	22	5600	4620	~~18~~ 23	~~86~~ 108	~~360~~ 450	0.5	~~490~~ 570	80	2.3	0.1	3.4	0.2	~~0.34~~ 0.36	~~0.42~~ 0.44	0.64	-10	3.7
Vegreville	635	-34	-37	29	19	34	23	5780	4790	~~18~~ 23	~~86~~ 110	~~325~~ 380	0.5	~~410~~ 460	100	1.9	0.1	2.8	0.1	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-11	3.8
Vermilion	580	-35	-38	29	19	35	23	5740	4750	~~18~~ 23	~~86~~ 111	~~310~~ 370	0.5	~~410~~ 460	100	1.7	0.1	2.5	0.2	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-11	3.2
Wagner	585	-35	-38	26	19	31	23	5850	4850	~~15~~ 19	~~81~~ 102	~~380~~ 450	0.6	~~500~~ 570	80	1.9	0.1	2.8	0.2	~~0.28~~ 0.29	~~0.37~~ 0.39	0.6	-11	3.5
Wainwright	675	-33	-36	29	19	35	23	5700	4710	~~20~~ 26	~~81~~ 104	~~310~~ 370	0.5	~~425~~ 480	~~120~~ 130	2	0.1	2.9	0.2	~~0.29~~ 0.30	~~0.36~~ 0.38	0.54	-11	3.7
Wetaskiwin	760	-33	-35	29	19	34	23	5500	4520	~~23~~ 29	~~86~~ 109	~~400~~ 480	0.6	~~500~~ 570	~~160~~ 170	2	0.1	2.9	0.1	~~0.31~~ 0.33	~~0.39~~ 0.41	0.6	-10	3.4
Whitecourt	690	-33	-36	27	19	32	23	5650	4670	~~20~~ 25	~~97~~ 122	~~440~~ 530	0.6	~~550~~ 640	80	1.9	0.1	2.8	0.1	~~0.28~~ 0.29	~~0.37~~ 0.39	0.6	-9	3.1
Wimborne	975	-31	-34	29	18	35	22	5310	4340	~~23~~ 29	~~92~~ 116	~~325~~ 390	0.5	~~450~~ 520	~~200~~ 210	1.6	0.1	2.3	0.1	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-9	3.7
Saskatchewan																								
Assiniboia	740	-32	-34	31	21	36	25	5180	4300	~~25~~ 32	~~81~~ 103	~~290~~ 340	0.3	~~375~~ 420	~~240~~ 260	1.6	0.1	2.4	0.2	~~0.39~~ 0.41	~~0.49~~ 0.51	0.75	-10	4.7
Battrum	700	-32	-34	32	20	37	24	5080	4210	~~23~~ 29	~~81~~ 103	~~270~~ 320	0.4	~~350~~ 390	~~260~~ 280	1.2	0.1	1.8	0.2	~~0.43~~ 0.45	~~0.54~~ 0.57	0.82	-10	4.5
Biggar	645	-34	-36	30	20	35	24	5720	4820	~~23~~ 30	~~81~~ 105	~~270~~ 320	0.4	~~350~~ 390	~~180~~ 200	2.1	0.1	3.1	0.2	~~0.36~~ 0.38	~~0.45~~ 0.47	0.68	-11	4
Broadview	600	-34	-35	30	21	35	25	5760	4850	~~25~~ 32	~~103~~ 134	~~320~~ 380	0.5	~~420~~ 470	~~160~~ 170	1.7	0.1	2.5	0.1	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	3.7
Dafoe	530	-35	-37	29	21	34	25	5860	4950	~~20~~ 26	~~92~~ 121	~~300~~ 350	0.5	~~380~~ 430	~~140~~ 150	1.7	0.1	2.5	0.1	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-11	4
Dundurn	525	-35	-37	30	21	35	25	5600	4700	~~23~~ 30	~~86~~ 112	~~275~~ 330	0.4	~~380~~ 430	~~180~~ 190	1.5	0.1	2.2	0.2	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	4.2

Estevan	565	-32	-34	32	22	37	25	5340	4450	~~28~~ 36	~~92~~ 120	~~330~~ 390	0.4	~~420~~ 480	~~200~~ 220	1.6	0.1	2.4	0.2	~~0.41~~ 0.43	~~0.52~~ 0.55	0.81	-11	4.7
Hudson Bay	370	-36	-38	29	21	34	25	6280	5350	~~20~~ 26	~~81~~ 105	~~340~~ 400	0.6	~~450~~ 500	80	2	0.1	2.8	0.1	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-12	2.9
Humboldt	565	-36	-38	28	21	33	25	6000	5080	~~20~~ 26	~~86~~ 113	~~320~~ 380	0.5	~~375~~ 420	140	2.1	0.1	3	0.1	~~0.31~~ 0.33	~~0.39~~ 0.41	0.6	-12	4
Island Falls	305	-39	-41	27	20	32	24	7100	6130	~~18~~ 24	~~76~~ 99	~~370~~ 440	0.6	~~510~~ 570	80	2.1	0.1	2.9	0.1	~~0.26~~ 0.27	~~0.35~~ 0.37	0.58	-14	1.8
Kamsack	455	-34	-37	29	22	34	26	6040	5120	~~20~~ 26	~~97~~ 126	~~360~~ 420	0.6	~~450~~ 500	120	2.1	0.2	3	0.3	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4
Kindersley	685	-33	-35	31	20	36	24	5550	4650	~~23~~ 29	~~81~~ 103	~~260~~ 310	0.4	~~325~~ 370	~~200~~ 220	1.4	0.1	2.1	0.2	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	4.8
Lloydminster	645	-34	-37	28	20	34	24	5880	4970	~~18~~ 23	~~81~~ 105	~~310~~ 370	0.5	~~430~~ 490	120	2	0.1	2.9	0.2	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4.6
Maple Creek	765	-31	-34	31	20	36	24	4780	3920	~~25~~ 32	~~81~~ 102	~~275~~ 330	0.3	~~380~~ 430	~~220~~ 240	1.2	0.1	1.8	0.2	~~0.36~~ 0.38	~~0.45~~ 0.47	0.68	-10	3.3
Meadow Lake	480	-38	-40	28	20	33	24	6280	5350	~~18~~ 23	~~81~~ 104	~~320~~ 380	0.5	~~450~~ 510	120	1.7	0.1	2.4	0.1	~~0.30~~ 0.32	~~0.40~~ 0.42	0.65	-12	3.6
Melfort	455	-36	-38	28	21	33	25	6050	5130	~~20~~ 26	~~81~~ 106	~~310~~ 370	0.5	~~410~~ 460	120	2.1	0.1	3	0.1	~~0.28~~ 0.29	~~0.36~~ 0.38	0.57	-12	3.9
Melville	550	-34	-36	29	21	34	25	5880	4970	~~23~~ 30	~~97~~ 127	~~340~~ 400	0.5	~~410~~ 460	160	1.7	0.1	2.4	0.1	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4.5
Moose Jaw	545	-32	-34	31	21	36	25	5270	4390	~~25~~ 32	~~86~~ 111	~~270~~ 320	0.3	~~360~~ 400	~~200~~ 210	1.4	0.1	2.1	0.2	~~0.41~~ 0.43	~~0.52~~ 0.55	0.81	-10	4.7
Nipawin	365	-37	-39	28	21	33	25	6300	5370	~~20~~ 26	~~76~~ 99	~~340~~ 400	0.6	~~450~~ 510	100	2	0.1	2.9	0.1	~~0.30~~ 0.32	~~0.38~~ 0.40	0.59	-12	4
North Battleford	545	-34	-36	29	20	34	24	5900	4990	~~20~~ 26	~~81~~ 105	~~280~~ 330	0.5	~~370~~ 420	~~120~~ 130	1.7	0.1	2.5	0.2	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	4.1
Prince Albert	435	-37	-40	28	21	33	25	6100	5180	~~20~~ 26	~~81~~ 105	~~320~~ 380	0.5	~~410~~ 460	140	1.9	0.1	2.7	0.1	~~0.30~~ 0.32	~~0.38~~ 0.40	0.59	-12	3.3
Qu'Appelle	645	-34	-36	30	22	35	26	5620	4720	~~25~~ 33	~~97~~ 127	~~340~~ 400	0.5	~~430~~ 480	~~160~~ 170	1.7	0.1	2.5	0.2	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-11	4.8
Regina	575	-34	-36	31	21	36	25	5600	4700	~~28~~ 37	~~103~~ 134	~~300~~ 350	0.4	~~365~~ 410	~~200~~ 210	1.4	0.1	2.1	0.2	~~0.39~~ 0.41	~~0.49~~ 0.51	0.75	-11	5.2
Rosetown	595	-34	-36	31	20	36	24	5620	4720	~~23~~ 30	~~81~~ 104	~~260~~ 310	0.4	~~330~~ 370	~~200~~ 220	1.7	0.1	2.5	0.2	~~0.39~~ 0.41	~~0.49~~ 0.51	0.75	-11	3.9
Saskatoon	500	-35	-37	30	21	35	25	5700	4800	~~23~~ 30	~~86~~ 112	~~265~~ 310	0.4	~~350~~ 390	~~160~~ 170	1.7	0.1	2.5	0.2	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	4.4
Scott	645	-34	-36	30	20	35	24	5960	5040	~~20~~ 26	~~81~~ 105	~~270~~ 320	0.4	~~360~~ 410	~~140~~ 150	1.9	0.1	2.8	0.2	~~0.36~~ 0.38	~~0.45~~ 0.47	0.68	-11	3.5

Strasbourg	545	-34	-36	30	22	35	26	5600	4700	~~25~~ 33	~~92~~ 120	~~300~~ 360	0.4	~~390~~ 440	~~180~~ 190	1.5	0.1	2.2	0.2	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-11	4.5
Swift Current	750	-31	-34	31	20	36	24	5150	4270	~~25~~ 32	~~81~~ 103	~~260~~ 310	0.3	~~350~~ 400	~~240~~ 260	1.4	0.1	2	0.2	~~0.43~~ 0.45	~~0.54~~ 0.57	0.82	-10	6
Uranium City	265	-42	-44	26	19	30	22	7500	6510	~~12~~ 16	~~54~~ 72	~~300~~ 370	0.6	~~360~~ 410	100	2	0.1	2.7	0.1	~~0.27~~ 0.28	~~0.36~~ 0.38	0.56	-16	2.8
Weyburn	575	-33	-35	31	23	36	27	5400	4510	~~28~~ 36	~~97~~ 126	~~320~~ 380	0.4	~~400~~ 450	~~200~~ 210	1.8	0.1	2.7	0.2	~~0.38~~ 0.40	~~0.48~~ 0.50	0.74	-11	4.7
Yorkton	510	-34	-37	29	21	34	25	6000	5080	~~23~~ 30	~~97~~ 127	~~350~~ 410	0.5	~~440~~ 490	140	1.9	0.1	2.7	0.1	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4.6
Manitoba																								
Beausejour	245	-33	-35	29	23	33	26	5680	4780	~~28~~ 37	~~103~~ 135	~~430~~ 510	0.6	~~530~~ 590	~~180~~ 200	2	0.2	2.9	0.3	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-12	3.3
Boissevain	510	-32	-34	30	23	34	26	5500	4610	~~28~~ 37	~~119~~ 155	~~390~~ 460	0.5	~~510~~ 570	~~180~~ 190	2.2	0.2	3.2	0.3	~~0.41~~ 0.43	~~0.52~~ 0.55	0.81	-11	4.5
Brandon	395	-33	-35	30	22	35	25	5760	4850	~~28~~ 37	~~108~~ 141	~~375~~ 440	0.6	~~460~~ 520	~~180~~ 200	2.1	0.2	3	0.3	~~0.39~~ 0.41	~~0.49~~ 0.51	0.75	-11	4.7
Churchill	10	-38	-40	25	18	29	22	8950	7890	~~12~~ 17	~~76~~ 106	~~265~~ 330	0.8	~~410~~ 470	~~260~~ 280	3	0.2	4.3	0.3	~~0.43~~ 0.45	~~0.55~~ 0.58	0.82	-16	5.9
Dauphin	295	-33	-35	30	22	35	26	5900	4990	~~28~~ 36	~~103~~ 133	~~400~~ 480	0.6	~~490~~ 550	~~160~~ 170	1.9	0.2	2.8	0.3	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4
Flin Flon	300	-38	-40	27	20	32	24	6440	5500	~~18~~ 23	~~81~~ 106	~~340~~ 400	0.6	~~475~~ 530	80	2.2	0.2	3	0.3	~~0.28~~ 0.29	~~0.35~~ 0.37	0.53	-14	3
Gimli	220	-34	-36	29	23	33	26	5800	4890	~~28~~ 37	~~108~~ 141	~~410~~ 490	0.7	~~530~~ 600	~~180~~ 190	1.9	0.2	2.7	0.3	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-12	4.1
Island Lake	240	-36	-38	27	20	31	23	6900	5940	~~18~~ 24	~~86~~ 114	~~380~~ 460	0.7	~~550~~ 620	80	2.6	0.2	3.6	0.3	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-14	3.3
Lac du Bonnet	260	-34	-36	29	23	33	26	5730	4830	~~28~~ 37	~~103~~ 134	~~445~~ 530	0.7	~~560~~ 630	~~180~~ 190	1.9	0.2	2.7	0.3	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-12	2.8
Lynn Lake	350	-40	-42	27	19	31	23	7770	6770	~~18~~ 24	~~86~~ 113	~~310~~ 370	0.6	~~490~~ 550	100	2.4	0.2	3.4	0.3	~~0.29~~ 0.30	~~0.37~~ 0.39	0.55	-15	2
Morden	300	-31	-33	30	24	34	27	5400	4510	~~28~~ 37	~~119~~ 156	~~420~~ 500	0.6	~~520~~ 580	~~180~~ 200	2.2	0.2	3.3	0.3	~~0.41~~ 0.43	~~0.52~~ 0.55	0.81	-10	3.7
Neepawa	365	-32	-34	29	23	34	26	5760	4850	~~28~~ 36	~~108~~ 141	~~410~~ 490	0.6	~~470~~ 530	~~180~~ 200	2.2	0.2	3.3	0.3	~~0.35~~ 0.37	~~0.44~~ 0.46	0.67	-11	4
Pine Falls	220	-34	-36	28	23	32	26	5900	4990	~~25~~ 33	~~97~~ 126	~~440~~ 520	0.7	~~420~~ 470	~~180~~ 190	1.9	0.2	2.7	0.3	~~0.31~~ 0.33	~~0.39~~ 0.41	0.6	-12	4
Portage la Prairie	260	-31	-33	30	23	34	26	5600	4700	~~28~~ 37	~~108~~ 142	~~390~~ 460	0.5	~~525~~ 590	~~180~~ 200	2.1	0.2	3.1	0.3	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	4

Rivers	465	-34	-36	29	23	33	26	5840	4930	~~28~~ 37	~~108~~ 141	~~370~~ 440	0.6	~~460~~ 520	~~180~~ 200	2.1	0.2	3	0.3	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-12	4.4
Sandilands	365	-32	-34	29	23	33	26	5650	4750	~~28~~ 36	~~113~~ 147	~~460~~ 540	0.6	~~550~~ 610	~~180~~ 190	2.2	0.2	3.2	0.3	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4
Selkirk	225	-33	-35	29	23	33	26	5700	4800	~~28~~ 37	~~108~~ 142	~~420~~ 500	0.6	~~500~~ 560	~~180~~ 200	1.9	0.2	2.8	0.3	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-11	4.5
Split Lake	175	-38	-40	27	19	31	23	7900	6890	~~18~~ 24	~~76~~ 102	~~325~~ 400	0.7	~~500~~ 570	120	2.5	0.2	3.5	0.3	~~0.31~~ 0.33	~~0.39~~ 0.41	0.57	-15	3.4
Steinbach	270	-33	-35	29	23	33	26	5700	4800	~~28~~ 37	~~108~~ 141	~~440~~ 520	0.6	~~500~~ 560	~~180~~ 200	2	0.2	3	0.3	~~0.32~~ 0.34	~~0.40~~ 0.42	0.61	-11	4.1
Swan River	335	-34	-37	29	22	34	26	6100	5180	~~20~~ 26	~~92~~ 119	~~370~~ 440	0.6	~~500~~ 560	120	2	0.2	2.8	0.3	~~0.28~~ 0.29	~~0.35~~ 0.37	0.53	-12	3.5
The Pas	270	-36	-38	28	21	33	25	6480	5540	~~18~~ 23	~~81~~ 105	~~330~~ 390	0.6	~~450~~ 500	160	2.2	0.2	3.1	0.3	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-13	3.4
Thompson	205	-40	-43	27	19	31	23	7600	6600	~~18~~ 24	~~86~~ 114	~~350~~ 420	0.6	~~540~~ 610	100	2.4	0.2	3.3	0.3	~~0.28~~ 0.29	~~0.36~~ 0.38	0.54	-15	2.9
Virden	435	-33	-35	30	23	34	26	5620	4720	~~28~~ 37	~~108~~ 141	~~350~~ 410	0.5	~~460~~ 520	~~180~~ 200	2	0.2	2.8	0.3	~~0.36~~ 0.38	~~0.46~~ 0.48	0.72	-11	4
Winnipeg	235	-33	-35	30	23	34	26	5670	4770	~~28~~ 37	~~108~~ 142	~~415~~ 490	0.6	~~500~~ 560	~~180~~ 200	1.9	0.2	2.8	0.3	~~0.36~~ 0.38	~~0.45~~ 0.47	0.68	-11	5.2
Ontario																								
Ailsa Craig	230	-17	-19	30	23	34	26	3840	3050	~~25~~ 32	~~103~~ 131	~~800~~ 920	0.9	~~950~~ 1030	~~180~~ 200	2.2	0.4	3.2	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.5
Ajax	95	-20	-22	30	23	34	26	3820	3030	~~23~~ 30	~~92~~ 118	~~760~~ 880	0.9	~~825~~ 900	~~160~~ 170	1	0.4	1.5	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4
Alexandria	80	-24	-26	30	23	34	26	4600	3740	~~25~~ 32	~~103~~ 133	~~800~~ 950	~~0.9~~ 1.0	~~975~~ 1090	160	2.4	0.4	3.4	0.6	~~0.31~~ 0.34	~~0.40~~ 0.44	0.67	-8	3.8
Alliston	220	-23	-25	29	23	33	26	4200	3380	~~28~~ 36	~~113~~ 145	~~690~~ 800	0.8	~~875~~ 960	~~120~~ 130	2	0.4	2.9	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	3.5
Almonte	120	-26	-28	30	23	34	26	4620	3760	~~25~~ 32	~~97~~ 125	~~730~~ 870	~~0.8~~ 0.9	~~800~~ 890	140	2.5	0.4	3.6	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	3.8
Armstrong	340	-37	-40	28	21	32	24	6500	5530	~~23~~ 30	~~97~~ 126	~~525~~ 640	0.8	~~725~~ 820	~~100~~ 110	2.7	0.4	3.8	0.6	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-12	2.3
Arnprior	85	-27	-29	30	23	34	26	4680	3820	~~23~~ 30	~~86~~ 111	~~630~~ 750	~~0.8~~ 0.9	~~775~~ 870	140	2.5	0.4	3.6	0.6	~~0.29~~ 0.32	~~0.37~~ 0.41	0.61	-8	3.5
Atikokan	400	-33	-35	29	22	33	25	5750	4810	~~25~~ 32	~~103~~ 133	~~570~~ 680	0.8	~~760~~ 850	~~100~~ 110	2.4	0.3	3.4	0.4	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	1.7
Attawapiskat	10	-37	-39	28	21	32	24	7100	6120	~~18~~ 25	~~81~~ 112	~~450~~ 580	0.8	~~650~~ 750	~~160~~ 170	2.8	0.3	3.9	0.4	~~0.30~~ 0.33	~~0.41~~ 0.45	0.68	-13	4

Aurora	270	-21	-23	30	23	34	26	4210	3390	~~28~~ 36	~~108~~ 139	~~700~~ 810	0.8	~~800~~ 880	~~140~~ 150	2	0.4	2.9	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-7	3.5
Bancroft	365	-28	-31	29	23	33	26	4740	3870	~~25~~ 32	~~92~~ 118	~~720~~ 840	0.9	~~900~~ 980	~~100~~ 110	3.1	0.4	4.3	0.6	~~0.25~~ 0.28	~~0.32~~ 0.35	0.52	-8	1.6
Barrie	245	-24	-26	29	23	33	26	4380	3540	~~28~~ 36	~~97~~ 125	~~700~~ 820	0.8	~~900~~ 990	~~120~~ 130	2.5	0.4	3.6	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	3.6
Barriefield	100	-22	-24	28	23	32	26	3990	3190	~~23~~ 29	~~108~~ 138	~~780~~ 890	1	~~950~~ 1020	~~160~~ 170	2.1	0.4	3	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-7	4.3
Beaverton	240	-24	-26	30	23	34	26	4300	3470	~~25~~ 32	~~108~~ 139	~~720~~ 830	0.9	~~950~~ 1030	~~120~~ 130	2.2	0.4	3.2	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	4.8
Belleville	90	-22	-24	29	23	33	26	3910	3110	~~23~~ 29	~~97~~ 124	~~760~~ 870	0.9	~~850~~ 920	~~180~~ 190	1.7	0.4	2.4	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-7	4
Belmont	260	-17	-19	30	24	34	27	3840	3050	~~25~~ 32	~~97~~ 123	~~850~~ 970	1	~~950~~ 1030	~~180~~ 200	1.7	0.4	2.5	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	3.5
Borden (CFB)	225	-23	-25	29	23	33	26	4300	3470	~~28~~ 36	~~103~~ 133	~~690~~ 800	~~0.8~~ 0.9	~~875~~ 960	~~120~~ 130	2.2	0.4	3.2	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-6	3.6
Bracebridge	310	-26	-28	29	23	33	26	4800	3920	~~25~~ 32	~~103~~ 132	~~830~~ 960	1	~~1050~~ 1120	~~120~~ 130	3.1	0.4	4.3	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-8	2
Bradford	240	-23	-25	30	23	34	26	4280	3450	~~28~~ 36	~~108~~ 139	~~680~~ 790	0.8	~~800~~ 880	~~120~~ 130	2.1	0.4	3	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	3.5
Brampton	215	-19	-21	30	23	34	26	4100	3290	~~28~~ 36	~~119~~ 152	~~720~~ 840	0.8	~~820~~ 900	~~140~~ 150	1.3	0.4	1.9	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	5
Brantford	205	-18	-20	30	23	34	26	3900	3110	~~23~~ 29	~~103~~ 131	~~780~~ 900	0.9	~~850~~ 930	~~160~~ 170	1.3	0.4	1.9	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-6	4.4
Brighton	95	-21	-23	29	23	33	26	4000	3200	~~23~~ 29	~~94~~ 121	~~760~~ 870	0.9	~~850~~ 920	~~160~~ 170	1.6	0.4	2.3	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	3.8
Brockville	85	-23	-25	29	23	33	26	4060	3250	~~25~~ 32	~~103~~ 132	~~770~~ 900	0.9	~~975~~ 1070	180	2.2	0.4	3.1	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-8	3.2
Burk's Falls	305	-26	-28	29	22	33	25	5020	4120	~~25~~ 32	~~97~~ 125	~~810~~ 950	0.9	~~1010~~ 1090	120	2.7	0.4	3.7	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2.5
Burlington	80	-17	-19	31	23	35	26	3740	2960	~~23~~ 29	~~103~~ 131	~~770~~ 890	0.9	~~850~~ 930	~~160~~ 170	1.1	0.4	1.6	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	4
Cambridge	295	-18	-20	29	23	33	26	4100	3290	~~25~~ 32	~~113~~ 144	~~800~~ 920	0.9	~~890~~ 970	~~160~~ 170	1.6	0.4	2.3	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-6	4.4
Campbellford	150	-23	-26	30	23	34	26	4280	3450	~~25~~ 32	~~97~~ 125	~~730~~ 840	0.9	~~850~~ 930	~~160~~ 170	1.7	0.4	2.4	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-7	2.2
Cannington	255	-24	-26	30	23	34	26	4310	3480	~~25~~ 32	~~108~~ 139	~~740~~ 860	0.9	~~950~~ 1030	~~120~~ 130	2.2	0.4	3.2	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	3.5
Carleton Place	135	-25	-27	30	23	34	26	4600	3740	~~25~~ 32	~~97~~ 124	~~730~~ 870	~~0.8~~ 0.9	~~850~~ 950	160	2.5	0.4	3.6	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	2.8

Cavan	200	-23	-25	30	23	34	26	4400	3560	~~25~~ 32	~~97~~ 125	~~740~~ 850	0.9	~~850~~ 920	~~140~~ 150	2	0.4	2.9	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-7	3.3
Centralia	260	-17	-19	30	23	34	26	3800	3010	~~25~~ 32	~~103~~ 131	~~820~~ 940	1	~~1000~~ 1080	~~180~~ 200	2.3	0.4	3.3	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.5
Chapleau	425	-35	-38	27	21	31	24	5900	4950	~~20~~ 26	~~97~~ 126	~~530~~ 640	0.7	~~850~~ 950	80	3.6	0.4	5.1	0.6	~~0.23~~ 0.25	~~0.30~~ 0.33	0.5	-10	3.5
Chatham	180	-16	-18	31	24	34	27	3470	2710	~~28~~ 35	~~103~~ 130	~~800~~ 910	0.9	~~850~~ 930	~~180~~ 190	1	0.4	1.5	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-5	5
Chesley	275	-19	-21	29	22	33	25	4320	3490	~~28~~ 36	~~103~~ 132	~~810~~ 940	0.9	~~1125~~ 1210	~~140~~ 150	2.8	0.4	4	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	4
Clinton	280	-17	-19	29	23	33	26	4150	3330	~~25~~ 32	~~103~~ 132	~~810~~ 930	0.9	~~1000~~ 1080	~~160~~ 170	2.6	0.4	3.8	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-6	5
Coboconk	270	-25	-27	30	23	34	26	4500	3650	~~25~~ 32	~~108~~ 139	~~740~~ 850	0.9	~~950~~ 1030	~~120~~ 130	2.5	0.4	3.5	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-7	2
Cobourg	90	-21	-23	29	23	33	26	3980	3180	~~23~~ 30	~~94~~ 121	~~760~~ 870	0.9	~~825~~ 900	~~160~~ 170	1.2	0.4	1.7	0.6	~~0.38~~ 0.42	~~0.49~~ 0.54	0.81	-6	3.6
Cochrane	245	-34	-36	29	21	33	24	6200	5240	~~20~~ 26	~~92~~ 121	~~575~~ 700	0.8	~~875~~ 980	80	2.8	0.3	3.9	0.4	~~0.27~~ 0.30	~~0.35~~ 0.39	0.55	-12	3.8
Colborne	105	-21	-23	29	23	33	26	3980	3180	~~23~~ 30	~~94~~ 121	~~760~~ 870	0.9	~~850~~ 930	~~160~~ 170	1.6	0.4	2.3	0.6	~~0.38~~ 0.42	~~0.49~~ 0.54	0.81	-6	3.6
Collingwood	190	-21	-23	29	23	33	26	4180	3360	~~28~~ 36	~~97~~ 124	~~720~~ 840	0.9	~~950~~ 1030	~~160~~ 170	2.7	0.4	3.9	0.6	~~0.30~~ 0.33	~~0.39~~ 0.43	0.65	-6	3.7
Cornwall	35	-23	-25	30	23	34	26	4250	3420	~~25~~ 32	~~103~~ 132	~~780~~ 930	~~0.9~~ 1.0	~~960~~ 1080	180	2.2	0.4	3	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	3.1
Corunna	185	-16	-18	31	24	34	27	3600	2830	~~25~~ 32	~~100~~ 126	~~760~~ 870	0.9	~~800~~ 880	~~180~~ 190	1	0.4	1.5	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-5	4.7
Deep River	145	-29	-32	30	22	34	25	4900	3980	~~23~~ 30	~~92~~ 118	~~650~~ 780	0.8	~~850~~ 950	~~100~~ 110	2.5	0.4	3.5	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	3.2
Deseronto	85	-22	-24	29	23	33	26	4070	3260	~~23~~ 29	~~92~~ 118	~~760~~ 870	0.9	~~900~~ 980	~~160~~ 170	1.9	0.4	2.8	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-7	4
Dorchester	260	-18	-20	30	24	34	27	3900	3110	~~28~~ 36	~~103~~ 131	~~850~~ 970	1	~~950~~ 1030	~~180~~ 200	1.9	0.4	2.7	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.4
Dorion	200	-33	-35	28	21	32	24	5950	5000	~~20~~ 26	~~103~~ 133	~~550~~ 670	0.8	~~725~~ 810	~~160~~ 170	2.8	0.4	4	0.6	~~0.29~~ 0.32	~~0.39~~ 0.43	0.67	-10	3.3
Dresden	185	-16	-18	31	24	34	27	3750	2970	~~28~~ 35	~~97~~ 122	~~760~~ 870	0.8	~~820~~ 900	~~180~~ 190	1	0.4	1.5	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-6	4.2
Dryden	370	-34	-36	28	22	32	25	5850	4940	~~25~~ 32	~~97~~ 126	~~550~~ 660	0.7	~~700~~ 780	~~120~~ 130	2.4	0.3	3.4	0.4	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	3.9
Dundalk	525	-22	-24	29	22	33	25	4700	3830	~~28~~ 36	~~108~~ 139	~~750~~ 870	0.9	~~1080~~ 1170	~~150~~ 160	3.2	0.4	4.6	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-7	3.8

Dunnville	175	-15	-17	30	24	34	27	3660	2890	~~23~~ 29	~~108~~ 137	~~830~~ 960	1	~~950~~ 1040	~~160~~ 170	2	0.4	3	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	3.8
Durham	340	-20	-22	29	22	33	25	4340	3510	~~28~~ 36	~~103~~ 132	~~815~~ 950	0.9	~~1025~~ 1110	~~140~~ 150	2.8	0.4	4	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-7	3.8
Dutton	225	-16	-18	31	24	35	27	3700	2920	~~28~~ 35	~~92~~ 116	~~850~~ 970	1	~~925~~ 1010	~~180~~ 190	1.3	0.4	1.9	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4
Earlton	245	-33	-36	29	22	33	25	5730	4790	~~23~~ 30	~~92~~ 120	~~560~~ 670	0.8	~~820~~ 910	~~120~~ 130	3.1	0.4	4.3	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-11	4.2
Edison	365	-34	-36	28	22	32	25	5740	4840	~~25~~ 32	~~108~~ 140	~~510~~ 610	0.7	~~680~~ 760	~~120~~ 130	2.4	0.3	3.4	0.4	~~0.23~~ 0.25	~~0.31~~ 0.34	0.53	-11	3.9
Elliot Lake	380	-26	-28	29	21	33	24	4950	4030	~~23~~ 30	~~108~~ 139	~~630~~ 740	0.8	~~950~~ 1030	~~160~~ 170	2.9	0.4	4.1	0.6	~~0.30~~ 0.33	~~0.38~~ 0.42	0.62	-8	4
Elmvale	220	-24	-26	29	23	33	26	4200	3380	~~28~~ 36	~~97~~ 125	~~720~~ 840	0.9	~~950~~ 1030	~~140~~ 150	2.6	0.4	3.7	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-6	3.7
Embro	310	-19	-21	30	23	34	26	3950	3150	~~28~~ 36	~~113~~ 144	~~830~~ 950	0.9	~~950~~ 1030	~~160~~ 180	2	0.4	2.9	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.4
Englehart	205	-33	-36	29	22	33	25	5800	4860	~~23~~ 30	~~92~~ 120	~~600~~ 720	0.8	~~880~~ 980	~~100~~ 110	2.8	0.4	3.9	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-11	4.2
Espanola	220	-25	-27	29	21	33	24	4920	4000	~~23~~ 30	~~108~~ 139	~~650~~ 760	0.8	~~840~~ 910	~~160~~ 170	2.3	0.4	3.3	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-8	4
Exeter	265	-17	-19	30	23	34	26	3900	3110	~~25~~ 32	~~113~~ 144	~~810~~ 930	0.9	~~975~~ 1050	~~180~~ 200	2.4	0.4	3.4	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5
Fenelon Falls	260	-25	-27	30	23	34	26	4440	3600	~~25~~ 32	~~108~~ 139	~~730~~ 840	0.9	~~950~~ 1030	~~120~~ 130	2.3	0.4	3.3	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	2
Fergus	400	-20	-22	29	23	33	26	4300	3470	~~28~~ 36	~~108~~ 138	~~760~~ 880	0.9	~~925~~ 1010	~~160~~ 170	2.2	0.4	3.2	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-6	4.3
Forest	215	-16	-18	31	23	35	26	3740	2960	~~25~~ 32	~~103~~ 131	~~810~~ 930	~~1.0~~ 1.1	~~875~~ 960	~~160~~ 170	2	0.4	2.9	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.7
Fort Erie	180	-15	-17	30	24	34	27	3650	2880	~~23~~ 29	~~108~~ 137	~~860~~ 1000	1	~~1020~~ 1120	~~160~~ 170	2.3	0.4	3.4	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	5
Fort Erie (Ridgeway)	190	-15	-17	30	24	34	27	3600	2830	~~25~~ 32	~~108~~ 137	~~860~~ 1000	1	~~1000~~ 1100	~~160~~ 170	2.3	0.4	3.4	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	5
Fort Frances	340	-33	-35	29	22	33	25	5440	4550	~~25~~ 32	~~108~~ 139	~~570~~ 680	0.7	~~725~~ 810	~~120~~ 130	2.3	0.3	3.3	0.4	~~0.23~~ 0.25	~~0.31~~ 0.34	0.53	-11	3.2
Gananoque	80	-22	-24	28	23	32	26	4010	3210	~~23~~ 29	~~103~~ 132	~~760~~ 870	0.9	~~900~~ 980	180	2.1	0.4	3	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-7	3.8
Geraldton	345	-36	-39	28	21	32	24	6450	5490	~~20~~ 26	~~86~~ 112	~~550~~ 670	0.8	~~725~~ 810	~~100~~ 110	2.9	0.4	4	0.6	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	2.5
Glencoe	215	-16	-18	31	24	35	27	3680	2900	~~28~~ 35	~~103~~ 130	~~800~~ 910	0.9	~~925~~ 1010	~~180~~ 190	1.5	0.4	2.2	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-6	4.2

Goderich	185	-16	-18	29	23	33	26	4000	3200	~~25~~ 32	~~92~~ 117	~~810~~ 930	1	~~950~~ 1030	~~180~~ 200	2.4	0.4	3.5	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5.3
Gore Bay	205	-24	-26	28	22	32	25	4700	3830	~~23~~ 30	~~92~~ 118	~~640~~ 750	0.8	~~860~~ 930	~~160~~ 170	2.6	0.4	3.7	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-8	4.3
Graham	495	-35	-37	29	22	33	25	5940	4990	~~23~~ 30	~~97~~ 126	~~570~~ 680	0.8	~~750~~ 830	~~140~~ 150	2.6	0.3	3.7	0.4	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	2.5
Gravenhurst (Muskoka Airport)	255	-26	-28	29	23	33	26	4760	3890	~~25~~ 32	~~103~~ 132	~~790~~ 910	0.9	~~1050~~ 1120	~~120~~ 130	2.7	0.4	3.8	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-8	2
Grimsby	85	-16	-18	30	23	34	26	3520	2760	~~23~~ 29	~~108~~ 138	~~760~~ 880	0.9	~~875~~ 960	~~160~~ 170	0.9	0.4	1.3	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	4.5
Guelph	340	-19	-21	29	23	33	26	4270	3440	~~28~~ 36	~~103~~ 132	~~770~~ 890	0.9	~~875~~ 950	~~140~~ 150	1.9	0.4	2.7	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-6	4.5
Guthrie	280	-24	-26	29	23	33	26	4300	3470	~~28~~ 36	~~103~~ 133	~~700~~ 810	0.8	~~950~~ 1030	~~120~~ 130	2.5	0.4	3.6	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	3.5
Haileybury	210	-32	-35	30	22	34	25	5600	4660	~~23~~ 30	~~92~~ 120	~~590~~ 710	0.8	~~820~~ 910	~~120~~ 130	2.4	0.4	3.3	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-11	3.9
Haldimand (Caledonia)	190	-18	-20	30	23	34	26	3750	2970	~~23~~ 29	~~108~~ 138	~~810~~ 930	0.9	~~875~~ 960	~~160~~ 170	1.2	0.4	1.8	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4.5
Haldimand (Hagersville)	215	-17	-19	30	23	34	26	3760	2980	~~25~~ 32	~~97~~ 123	~~840~~ 970	1	~~875~~ 950	~~160~~ 170	1.3	0.4	1.9	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-6	4.5
Haliburton	335	-27	-29	29	23	33	26	4840	3960	~~25~~ 32	~~92~~ 118	~~780~~ 910	0.9	~~980~~ 1060	~~100~~ 110	2.9	0.4	4	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-8	2
Halton Hills (Georgetown)	255	-19	-21	30	23	34	26	4200	3380	~~28~~ 36	~~119~~ 152	~~750~~ 870	0.8	~~850~~ 930	~~140~~ 150	1.4	0.4	2	0.6	~~0.29~~ 0.32	~~0.37~~ 0.41	0.61	-6	4.8
Hamilton	90	-17	-19	31	23	35	26	3460	2700	~~23~~ 29	~~108~~ 138	~~810~~ 930	0.9	~~875~~ 960	~~160~~ 170	1.1	0.4	1.6	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-6	3.5
Hanover	270	-19	-21	29	22	33	25	4300	3470	~~28~~ 36	~~103~~ 132	~~790~~ 920	0.9	~~1050~~ 1130	~~140~~ 150	2.6	0.4	3.8	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-7	3.8
Hastings	200	-24	-26	30	23	34	26	4280	3450	~~25~~ 32	~~92~~ 118	~~730~~ 840	0.9	~~840~~ 910	~~140~~ 150	2	0.4	2.8	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-7	3
Hawkesbury	50	-25	-27	30	23	34	26	4610	3750	~~23~~ 30	~~103~~ 133	~~800~~ 950	~~0.9~~ 1.0	~~925~~ 1030	160	2.3	0.4	3.2	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	3.8
Hearst	245	-35	-37	29	21	33	24	6450	5490	~~20~~ 26	~~86~~ 113	~~520~~ 640	0.7	~~825~~ 930	80	2.8	0.3	3.9	0.4	~~0.23~~ 0.25	~~0.30~~ 0.33	0.47	-12	3.5
Honey Harbour	180	-24	-26	29	23	33	26	4300	3470	~~25~~ 32	~~97~~ 124	~~710~~ 820	0.9	~~1050~~ 1120	~~160~~ 170	2.7	0.4	3.8	0.6	~~0.30~~ 0.33	~~0.39~~ 0.43	0.65	-7	4
Hornepayne	360	-37	-40	28	21	32	24	6340	5380	~~20~~ 26	~~93~~ 121	~~420~~ 510	0.7	~~750~~ 840	80	3.3	0.4	4.5	0.6	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	3
Huntsville	335	-26	-29	29	22	33	25	4850	3970	~~25~~ 32	~~103~~ 132	~~800~~ 930	0.9	~~1000~~ 1080	120	2.9	0.4	4	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-8	2

Ingersoll	280	-18	-20	30	23	34	26	3920	3120	~~28~~ 36	~~108~~ 138	~~840~~ 960	1	~~950~~ 1030	~~180~~ 200	1.7	0.4	2.4	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.4
Iroquois Falls	275	-33	-36	29	21	33	24	6100	5150	~~20~~ 26	~~86~~ 113	~~575~~ 700	0.8	~~825~~ 920	100	2.9	0.3	4	0.4	~~0.29~~ 0.32	~~0.37~~ 0.41	0.58	-11	3.5
Jellicoe	330	-36	-39	28	21	32	24	6400	5440	~~20~~ 26	~~86~~ 112	~~550~~ 670	0.8	~~750~~ 840	~~100~~ 110	2.7	0.4	3.8	0.6	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	2.3
Kapuskasing	245	-34	-36	29	21	33	24	6250	5290	~~20~~ 26	~~86~~ 113	~~550~~ 670	0.8	~~825~~ 930	100	3	0.3	4.2	0.4	~~0.24~~ 0.26	~~0.31~~ 0.34	0.49	-12	3.9
Kemptville	90	-25	-27	30	23	34	26	4540	3690	~~25~~ 32	~~92~~ 118	~~750~~ 880	~~0.9~~ 1.0	~~925~~ 1030	160	2.3	0.4	3.3	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	2.3
Kenora	370	-33	-35	28	22	32	25	5630	4730	~~25~~ 32	~~113~~ 146	~~515~~ 610	0.6	~~630~~ 700	120	2.5	0.3	3.6	0.4	~~0.23~~ 0.25	~~0.31~~ 0.34	0.53	-11	2.9
Killaloe	185	-28	-31	30	22	34	25	4960	4070	~~23~~ 30	~~86~~ 110	~~680~~ 820	0.8	~~825~~ 920	120	2.7	0.4	3.9	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2
Kincardine	190	-17	-19	28	22	32	25	3890	3100	~~25~~ 32	~~92~~ 118	~~800~~ 930	1	~~950~~ 1030	~~180~~ 190	2.6	0.4	3.8	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5.3
Kingston	80	-22	-24	28	23	32	26	4000	3200	~~23~~ 29	~~108~~ 138	~~780~~ 890	1	~~950~~ 1020	~~180~~ 190	2.1	0.4	3	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-7	4.3
Kinmount	295	-26	-28	29	23	33	26	4600	3740	~~25~~ 32	~~108~~ 139	~~750~~ 870	0.9	~~950~~ 1030	~~120~~ 130	2.7	0.4	3.8	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-7	2
Kirkland Lake	325	-33	-36	29	22	33	25	6000	5050	~~23~~ 30	~~92~~ 120	~~600~~ 720	0.8	~~875~~ 970	100	2.9	0.3	4	0.4	~~0.30~~ 0.33	~~0.39~~ 0.43	0.62	-11	3.8
Kitchener	335	-19	-21	29	23	33	26	4200	3380	~~28~~ 36	~~119~~ 152	~~780~~ 900	0.9	~~925~~ 1010	~~140~~ 150	2	0.4	2.9	0.6	~~0.29~~ 0.32	~~0.37~~ 0.41	0.61	-6	4.5
Kitchenuhmaykoosib / Big Trout Lake	215	-38	-40	26	20	30	23	7450	–	~~18~~ 24	~~92~~ 123	~~400~~ 490	0.8	~~600~~ 680	150	3.2	0.2	4.6	0.3	~~0.31~~ 0.34	~~0.42~~ 0.46	0.69	-14	3.7
Lakefield	240	-24	-26	30	23	34	26	4330	3500	~~25~~ 32	~~92~~ 118	~~720~~ 830	0.9	~~850~~ 920	~~140~~ 150	2.2	0.4	3.1	0.6	~~0.30~~ 0.33	~~0.38~~ 0.42	0.62	-7	2
Lansdowne House	240	-38	-40	28	21	32	24	7150	6160	~~23~~ 30	~~92~~ 122	~~500~~ 610	0.8	~~680~~ 770	~~140~~ 150	3	0.2	4.2	0.3	~~0.24~~ 0.26	~~0.32~~ 0.35	0.52	-13	3.5
Leamington	190	-15	-17	31	24	34	27	3400	2650	~~28~~ 35	~~113~~ 142	~~800~~ 910	0.9	~~875~~ 960	~~180~~ 190	0.8	0.4	1.2	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-5	5
Lindsay	265	-24	-26	30	23	34	26	4320	3490	~~25~~ 32	~~103~~ 133	~~720~~ 830	0.8	~~850~~ 930	~~140~~ 150	2.3	0.4	3.3	0.6	~~0.30~~ 0.33	~~0.38~~ 0.42	0.62	-7	2.5
Lion's Head	185	-19	-21	27	22	31	25	4300	3470	~~25~~ 32	~~103~~ 132	~~700~~ 820	0.9	~~950~~ 1020	~~180~~ 190	2.7	0.4	3.9	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.1
Listowel	380	-19	-21	29	23	33	26	4300	3470	~~28~~ 36	~~119~~ 152	~~800~~ 920	0.9	~~1000~~ 1080	~~160~~ 170	2.6	0.4	3.8	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-6	4.5
London	245	-18	-20	30	24	34	27	3900	3110	~~28~~ 36	~~103~~ 131	~~825~~ 940	0.9	~~975~~ 1060	~~180~~ 200	1.9	0.4	2.8	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.4

Lucan	300	-17	-19	30	23	34	26	3900	3110	~~25~~ 32	~~113~~ 144	~~810~~ 930	0.9	~~1000~~ 1090	~~180~~ 200	2.3	0.4	3.3	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.6
Maitland	85	-23	-25	29	23	33	26	4080	3270	~~25~~ 32	~~103~~ 132	~~770~~ 900	~~0.9~~ 1.0	~~975~~ 1070	180	2.2	0.4	3.1	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-8	3.2
Markdale	425	-20	-22	29	22	33	25	4500	3650	~~28~~ 36	~~103~~ 132	~~820~~ 960	0.9	~~1050~~ 1130	~~160~~ 170	3.2	0.4	4.6	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-6	3.6
Markham	175	-21	-23	31	24	35	27	4000	3200	~~25~~ 32	~~86~~ 110	~~720~~ 830	0.8	~~825~~ 900	~~140~~ 150	1.3	0.4	1.9	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4.2
Martin	485	-35	-37	29	22	33	25	5900	4950	~~25~~ 32	~~103~~ 133	~~560~~ 670	0.8	~~750~~ 830	~~120~~ 130	2.6	0.3	3.7	0.4	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	2.8
Matheson	265	-33	-36	29	21	33	24	6080	5130	~~20~~ 26	~~86~~ 113	~~580~~ 700	0.8	~~825~~ 920	100	2.8	0.3	3.9	0.4	~~0.30~~ 0.33	~~0.39~~ 0.43	0.62	-11	3.5
Mattawa	165	-29	-31	30	22	34	25	5050	4130	~~23~~ 30	~~86~~ 111	~~700~~ 830	0.9	~~875~~ 960	~~100~~ 110	2.1	0.4	2.9	0.6	~~0.25~~ 0.28	~~0.32~~ 0.35	0.52	-9	3.2
Midland	190	-24	-26	29	23	33	26	4200	3380	~~25~~ 32	~~97~~ 124	~~740~~ 860	0.9	~~1060~~ 1140	~~160~~ 170	2.7	0.4	3.9	0.6	~~0.30~~ 0.33	~~0.39~~ 0.43	0.65	-6	3.7
Milton	200	-18	-20	30	23	34	26	3920	3120	~~25~~ 32	~~125~~ 160	~~750~~ 870	0.9	~~850~~ 930	~~160~~ 170	1.3	0.4	1.9	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-6	4.5
Milverton	370	-19	-21	29	23	33	26	4200	3380	~~28~~ 36	~~108~~ 138	~~800~~ 920	0.9	~~1050~~ 1140	~~160~~ 170	2.4	0.4	3.5	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-6	4.6
Minden	270	-27	-29	29	23	33	26	4640	3780	~~25~~ 32	~~97~~ 124	~~780~~ 900	0.9	~~1010~~ 1090	~~100~~ 110	2.7	0.4	3.7	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-8	2
Mississauga	160	-18	-20	30	23	34	26	3880	3090	~~25~~ 32	~~113~~ 145	~~720~~ 830	0.9	~~800~~ 880	~~160~~ 170	1.1	0.4	1.6	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-5	5.2
Mississauga (Lester B. Pearson Int'l Airport)	170	-20	-22	31	24	35	27	3890	–	~~26~~ 33	~~108~~ 138	~~685~~ 790	0.8	~~790~~ 870	~~160~~ 170	1.1	0.4	1.6	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	5.2
Mississauga (Port Credit)	75	-18	-20	29	23	33	26	3780	3000	~~25~~ 32	~~108~~ 138	~~720~~ 830	0.9	~~800~~ 880	~~160~~ 170	0.9	0.4	1.3	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5.2
Mitchell	335	-18	-20	29	23	33	26	4100	3290	~~28~~ 36	~~113~~ 144	~~810~~ 930	0.9	~~1050~~ 1140	~~160~~ 170	2.4	0.4	3.5	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	4.5
Moosonee	10	-36	-38	28	22	32	25	6800	5820	~~18~~ 25	~~81~~ 111	~~500~~ 630	0.8	~~700~~ 790	~~160~~ 170	2.7	0.3	3.8	0.4	~~0.26~~ 0.29	~~0.35~~ 0.39	0.58	-12	4
Morrisburg	75	-23	-25	30	23	34	26	4370	3530	~~25~~ 32	~~103~~ 132	~~800~~ 940	~~0.9~~ 1.0	~~950~~ 1050	180	2.3	0.4	3.2	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	3.5
Mount Forest	420	-21	-24	28	22	32	25	4700	3830	~~28~~ 36	~~103~~ 132	~~740~~ 860	0.9	~~940~~ 1020	~~140~~ 150	2.7	0.4	3.9	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-7	3.3
Nakina	325	-36	-38	28	21	32	24	6500	5530	~~20~~ 26	~~86~~ 113	~~540~~ 660	0.8	~~750~~ 850	~~100~~ 110	2.8	0.4	3.8	0.5	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-12	2.7

Nanticoke (Jarvis)	205	-17	-18	30	23	34	26	3700	2920	~~28~~ 36	~~108~~ 137	~~840~~ 970	1	~~900~~ 980	~~160~~ 170	1.4	0.4	2.1	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.5
Nanticoke (Port Dover)	180	-15	-17	30	24	34	27	3600	2830	~~25~~ 32	~~108~~ 137	~~860~~ 990	1	~~950~~ 1030	~~140~~ 150	1.2	0.4	1.8	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-5	5
Napanee	90	-22	-24	29	23	33	26	4140	3320	~~23~~ 29	~~92~~ 118	~~770~~ 880	0.9	~~900~~ 970	~~160~~ 170	1.9	0.4	2.8	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-7	4
Newcastle	115	-20	-22	30	23	34	26	3990	3190	~~23~~ 30	~~86~~ 111	~~760~~ 880	0.9	~~830~~ 900	~~160~~ 170	1.5	0.4	2.2	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4
Newcastle (Bowmanville)	95	-20	-22	30	23	34	26	4000	–	~~23~~ 30	~~86~~ 110	~~760~~ 880	0.9	~~830~~ 910	~~160~~ 170	1.4	0.4	2	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4
New Liskeard	180	-32	-35	30	22	34	25	5570	4630	~~23~~ 30	~~92~~ 120	~~570~~ 680	0.8	~~810~~ 900	~~100~~ 110	2.6	0.4	3.6	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-11	4.2
Newmarket	185	-22	-24	30	23	34	26	4260	3430	~~28~~ 36	~~108~~ 139	~~700~~ 810	0.8	~~800~~ 880	~~140~~ 150	2	0.4	2.9	0.6	~~0.30~~ 0.33	~~0.38~~ 0.42	0.62	-7	3.5
Niagara Falls	210	-16	-18	30	23	34	26	3600	2830	~~23~~ 29	~~96~~ 122	~~810~~ 940	0.9	~~950~~ 1040	~~160~~ 170	1.8	0.4	2.7	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-5	4
North Bay	210	-28	-30	28	22	32	25	5150	4230	~~25~~ 32	~~95~~ 123	~~775~~ 920	0.9	~~975~~ 1060	120	2.2	0.4	3	0.6	~~0.27~~ 0.30	~~0.34~~ 0.37	0.54	-9	4.4
Norwood	225	-24	-26	30	23	34	26	4320	3490	~~25~~ 32	~~92~~ 118	~~720~~ 830	0.8	~~850~~ 930	~~120~~ 130	2.1	0.4	3	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-7	2
Oakville	90	-18	-20	30	23	34	26	3760	2980	~~23~~ 29	~~97~~ 124	~~750~~ 870	0.9	~~850~~ 930	~~160~~ 170	1.1	0.4	1.6	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-5	5.2
Orangeville	430	-21	-23	29	23	33	26	4450	3610	~~28~~ 36	~~108~~ 139	~~730~~ 850	0.8	~~875~~ 960	~~140~~ 150	2.3	0.4	3.3	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	4
Orillia	230	-25	-27	29	23	33	26	4260	3430	~~25~~ 32	~~103~~ 132	~~740~~ 860	0.9	~~1000~~ 1080	~~120~~ 130	2.4	0.4	3.4	0.6	~~0.28~~ 0.31	~~0.36~~ 0.40	0.59	-7	3.5
Oshawa	110	-19	-21	30	23	34	26	3860	3070	~~23~~ 30	~~86~~ 110	~~760~~ 880	0.9	~~875~~ 950	~~160~~ 170	1.4	0.4	2	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4
Ottawa (Metropolitan)																								
Ottawa (Barrhaven)	98	-25	-27	30	23	34	26	4500	3600	~~25~~ 32	~~92~~ 119	~~750~~ 890	~~0.8~~ 0.9	~~900~~ 1000	160	2.4	0.4	3.5	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	4.4
Ottawa (City Hall)	70	-25	-27	30	23	34	26	4440	3650	~~23~~ 30	~~86~~ 111	~~750~~ 890	~~0.8~~ 0.9	~~900~~ 1000	160	2.4	0.4	3.4	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	3.5
Ottawa (Kanata)	98	-25	-27	30	23	34	26	4520	3670	~~25~~ 32	~~92~~ 118	~~730~~ 870	~~0.8~~ 0.9	~~900~~ 1000	160	2.5	0.4	3.6	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	4.4
Ottawa (M-C Int'l Airport)	125	-25	-27	30	23	34	26	4500	3650	~~24~~ 31	~~89~~ 115	~~750~~ 890	~~0.8~~ 0.9	~~900~~ 1000	160	2.4	0.4	3.5	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	4.4
Ottawa (Orléans)	70	-26	-28	30	23	33	26	4500	3650	~~23~~ 30	~~91~~ 118	~~750~~ 890	~~0.8~~ 0.9	~~900~~ 1000	160	2.4	0.4	3.4	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	3.5

Owen Sound	215	-19	-21	29	22	33	25	4030	3220	~~28~~ 36	~~113~~ 145	~~760~~ 890	0.9	~~1075~~ 1150	~~160~~ 170	2.8	0.4	4	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4
Pagwa River	185	-35	-37	28	21	32	24	6500	5530	~~20~~ 26	~~86~~ 113	~~540~~ 660	0.8	~~825~~ 930	80	2.7	0.4	3.6	0.5	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-12	2.7
Paris	245	-18	-20	30	23	34	26	4000	3200	~~23~~ 29	~~96~~ 122	~~790~~ 910	0.9	~~925~~ 1010	~~160~~ 170	1.4	0.4	2	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-6	4.2
Parkhill	205	-16	-18	31	23	35	26	3800	3010	~~25~~ 32	~~103~~ 131	~~800~~ 920	0.9	~~925~~ 1010	~~180~~ 200	2.1	0.4	3.1	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5
Parry Sound	215	-24	-26	28	22	32	25	4640	3780	~~23~~ 30	~~97~~ 124	~~820~~ 950	1	~~1050~~ 1110	~~160~~ 170	2.8	0.4	4	0.6	~~0.30~~ 0.33	~~0.39~~ 0.43	0.65	-8	3.7
Pelham (Fonthill)	230	-15	-17	30	23	34	26	3690	2910	~~23~~ 29	~~96~~ 122	~~820~~ 950	0.9	~~950~~ 1040	~~160~~ 170	2.1	0.4	3.1	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-6	4
Pembroke	125	-28	-31	30	23	34	26	4980	4090	~~23~~ 30	~~105~~ 135	~~640~~ 770	0.8	~~825~~ 930	100	2.5	0.4	3.5	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2.7
Penetanguishene	220	-24	-26	29	23	33	26	4200	3380	~~25~~ 32	~~97~~ 124	~~720~~ 830	0.9	~~1050~~ 1120	~~160~~ 170	2.8	0.4	4	0.6	~~0.30~~ 0.33	~~0.39~~ 0.43	0.65	-7	3.7
Perth	130	-25	-27	30	23	34	26	4540	3690	~~25~~ 32	~~92~~ 118	~~730~~ 860	0.8	~~900~~ 1000	140	2.3	0.4	3.3	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	2.3
Petawawa	135	-29	-31	30	23	34	26	4980	4090	~~23~~ 30	~~92~~ 118	~~640~~ 770	0.8	~~825~~ 920	100	2.6	0.4	3.6	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2.7
Peterborough	200	-23	-25	30	23	34	26	4400	3560	~~25~~ 32	~~92~~ 118	~~710~~ 820	0.8	~~840~~ 910	~~140~~ 150	2	0.4	2.9	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-7	2.8
Petrolia	195	-16	-18	31	24	34	27	3640	2870	~~25~~ 32	~~108~~ 137	~~810~~ 930	0.9	~~920~~ 1010	~~180~~ 200	1.3	0.4	1.9	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.2
Pickering (Dunbarton)	85	-19	-21	30	23	34	26	3800	3010	~~23~~ 29	~~92~~ 118	~~730~~ 840	0.9	~~825~~ 900	~~140~~ 150	1	0.4	1.5	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4
Picton	95	-21	-23	29	23	33	26	3980	3180	~~23~~ 29	~~92~~ 117	~~770~~ 890	0.9	~~940~~ 1020	~~160~~ 170	2	0.4	2.9	0.6	~~0.38~~ 0.42	~~0.49~~ 0.54	0.81	-6	4.5
Plattsville	300	-19	-21	29	23	33	26	4150	3330	~~28~~ 36	~~103~~ 132	~~820~~ 940	0.9	~~950~~ 1030	~~140~~ 150	1.9	0.4	2.8	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-6	4.2
Point Alexander	150	-29	-32	30	22	34	25	4960	4040	~~23~~ 30	~~92~~ 118	~~650~~ 780	0.8	~~850~~ 950	~~100~~ 110	2.5	0.4	3.5	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	3.2
Port Burwell	195	-15	-17	30	24	34	27	3800	3010	~~25~~ 32	~~92~~ 117	~~930~~ 1060	1.1	~~1000~~ 1090	~~180~~ 190	1.2	0.4	1.7	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-5	5
Port Colborne	180	-15	-17	30	24	34	27	3600	2830	~~23~~ 29	~~108~~ 137	~~850~~ 990	1	~~1000~~ 1100	~~160~~ 170	2.1	0.4	3.1	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	5
Port Elgin	205	-17	-19	28	22	32	25	4100	3290	~~25~~ 32	~~92~~ 118	~~790~~ 920	0.9	~~850~~ 920	~~180~~ 190	2.8	0.4	4	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5.3
Port Hope	100	-21	-23	29	23	33	26	3970	3170	~~23~~ 30	~~94~~ 121	~~760~~ 880	0.9	~~825~~ 900	~~180~~ 190	1.2	0.4	1.7	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4

Port Perry	270	-22	-24	30	23	34	26	4260	3430	~~25~~ 32	~~97~~ 125	~~720~~ 830	0.8	~~850~~ 930	~~140~~ 150	2.4	0.4	3.5	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-7	3.4
Port Stanley	180	-15	-17	31	24	35	27	3850	3060	~~25~~ 32	~~92~~ 117	~~940~~ 1070	1.1	~~975~~ 1060	~~180~~ 190	1.2	0.4	1.7	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-5	5
Prescott	90	-23	-25	29	23	33	26	4120	3310	~~25~~ 32	~~103~~ 132	~~770~~ 900	~~0.9~~ 1.0	~~975~~ 1080	180	2.2	0.4	3.1	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-8	3.2
Princeton	280	-18	-20	30	23	34	26	4000	3200	~~25~~ 32	~~97~~ 124	~~810~~ 930	0.9	~~925~~ 1010	~~160~~ 170	1.5	0.4	2.2	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-6	4.2
Raith	475	-34	-37	28	22	32	25	5900	4950	~~23~~ 30	~~97~~ 125	~~570~~ 690	0.8	~~750~~ 840	~~120~~ 130	2.7	0.4	3.8	0.6	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	2.3
Rayside-Balfour (Chelmsford)	270	-28	-30	29	21	33	24	5200	4280	~~25~~ 32	~~92~~ 119	~~650~~ 770	0.8	~~850~~ 930	~~180~~ 190	2.5	0.4	3.5	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-9	3.8
Red Lake	360	-35	-37	28	21	32	26	6220	5290	~~20~~ 26	~~92~~ 120	~~470~~ 560	0.7	~~630~~ 700	~~120~~ 130	2.6	0.3	3.7	0.4	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	3.5
Renfrew	115	-27	-30	30	23	34	26	4900	4020	~~23~~ 30	~~97~~ 125	~~620~~ 740	~~0.8~~ 0.9	~~810~~ 910	140	2.5	0.4	3.5	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	3.5
Richmond Hill	230	-21	-23	31	24	35	27	4000	3200	~~25~~ 32	~~97~~ 125	~~740~~ 860	0.8	~~850~~ 930	~~140~~ 150	1.5	0.4	2.2	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	3.5
Rockland	50	-26	-28	30	23	34	26	4600	3740	~~23~~ 30	~~92~~ 119	~~780~~ 920	~~0.9~~ 1.0	~~950~~ 1050	160	2.4	0.4	3.3	0.6	~~0.31~~ 0.34	~~0.40~~ 0.44	0.67	-8	3.5
Sarnia	190	-16	-18	31	24	34	27	3750	2970	~~25~~ 32	~~100~~ 126	~~750~~ 860	0.9	~~825~~ 910	~~180~~ 190	1.1	0.4	1.6	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.7
Sault Ste. Marie	190	-25	-28	29	22	33	25	4960	4040	~~23~~ 30	~~97~~ 125	~~660~~ 780	~~0.9~~ 1.0	~~950~~ 1030	~~200~~ 210	3.1	0.4	4.5	0.6	~~0.33~~ 0.36	~~0.44~~ 0.48	0.75	-8	4.1
Schreiber	310	-34	-36	27	21	31	24	5960	5010	~~20~~ 26	~~103~~ 134	~~600~~ 730	0.8	~~850~~ 940	~~160~~ 170	3.3	0.4	4.7	0.6	~~0.29~~ 0.32	~~0.39~~ 0.43	0.67	-10	3
Seaforth	310	-17	-19	30	23	34	26	4100	3290	~~25~~ 32	~~108~~ 138	~~810~~ 930	0.9	~~1025~~ 1110	~~160~~ 170	2.5	0.4	3.6	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	5
Shelburne	495	-22	-24	29	23	33	26	4700	3830	~~28~~ 36	~~108~~ 139	~~740~~ 860	0.9	~~900~~ 980	~~150~~ 160	3.1	0.4	4.4	0.6	~~0.31~~ 0.34	~~0.40~~ 0.44	0.67	-7	3.5
Simcoe	210	-17	-19	30	24	34	27	3700	2920	~~28~~ 36	~~113~~ 144	~~860~~ 990	1	~~950~~ 1030	~~160~~ 170	1.3	0.4	1.9	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	4
Sioux Lookout	375	-34	-36	28	22	32	25	5950	5030	~~25~~ 32	~~97~~ 126	~~520~~ 620	0.7	~~710~~ 790	~~100~~ 110	2.6	0.3	3.7	0.4	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-12	3
Smiths Falls	130	-25	-27	30	23	34	26	4540	3690	~~25~~ 32	~~92~~ 118	~~730~~ 860	~~0.8~~ 0.9	~~850~~ 940	140	2.3	0.4	3.3	0.6	~~0.32~~ 0.35	~~0.41~~ 0.45	0.67	-8	2.5
Smithville	185	-16	-18	30	23	34	26	3650	2880	~~23~~ 29	~~108~~ 137	~~800~~ 920	0.9	~~900~~ 980	~~160~~ 170	1.5	0.4	2.2	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-6	4.2
Smooth Rock Falls	235	-34	-36	29	21	33	24	6250	5290	~~20~~ 26	~~92~~ 121	~~560~~ 680	0.8	~~850~~ 950	80	2.7	0.3	3.8	0.4	~~0.25~~ 0.28	~~0.32~~ 0.35	0.5	-11	3.9

Southampton	180	-17	-19	28	22	32	25	4100	3290	~~25~~ 32	~~92~~ 118	~~800~~ 930	1	~~830~~ 900	~~180~~ 190	2.7	0.4	3.9	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5.3
South River	355	-27	-29	29	22	33	25	5090	4190	~~25~~ 32	~~103~~ 132	~~830~~ 980	1	~~975~~ 1060	120	2.8	0.4	3.9	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2.5
St. Catharines	105	-16	-18	30	23	34	26	3540	2780	~~23~~ 29	~~92~~ 117	~~770~~ 890	0.9	~~850~~ 930	~~160~~ 170	1	0.4	1.5	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-5	4.5
St. Marys	310	-18	-20	30	23	34	26	4000	3200	~~28~~ 36	~~108~~ 138	~~820~~ 940	1	~~1025~~ 1110	~~160~~ 180	2.2	0.4	3.2	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.5
St. Thomas	225	-16	-18	31	24	35	27	3780	3000	~~25~~ 32	~~103~~ 131	~~900~~ 1030	1	~~975~~ 1060	~~180~~ 190	1.4	0.4	2	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.7
Stirling	120	-23	-25	30	23	34	26	4220	3400	~~25~~ 32	~~97~~ 124	~~740~~ 850	0.9	~~850~~ 930	~~120~~ 130	1.7	0.4	2.4	0.6	~~0.31~~ 0.34	~~0.40~~ 0.44	0.67	-7	2.2
Stratford	360	-18	-20	29	23	33	26	4050	3240	~~28~~ 36	~~113~~ 144	~~820~~ 940	1	~~1050~~ 1140	~~160~~ 170	2.3	0.4	3.4	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	4.5
Strathroy	225	-17	-19	31	24	35	27	3780	3000	~~25~~ 32	~~103~~ 131	~~770~~ 880	0.9	~~950~~ 1040	~~180~~ 200	1.9	0.4	2.8	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.7
Sturgeon Falls	205	-28	-30	29	21	33	24	5200	4280	~~25~~ 32	~~95~~ 123	~~700~~ 830	0.9	~~910~~ 990	140	2.4	0.4	3.3	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	4.4
Sudbury	275	-28	-30	29	21	33	24	5180	4260	~~25~~ 32	~~97~~ 125	~~650~~ 770	0.8	~~875~~ 950	~~200~~ 210	2.5	0.4	3.6	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-9	4.5
Sundridge	340	-27	-29	29	22	33	25	5080	4180	~~25~~ 32	~~97~~ 125	~~840~~ 990	1	~~975~~ 1060	120	2.8	0.4	3.9	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2.5
Tavistock	340	-19	-21	29	23	33	26	4100	3290	~~28~~ 36	~~113~~ 144	~~820~~ 940	1	~~1010~~ 1100	~~160~~ 170	2.1	0.4	3	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	4.5
Temagami	300	-30	-33	30	22	34	25	5420	4490	~~23~~ 30	~~92~~ 119	~~650~~ 780	0.8	~~875~~ 970	~~120~~ 130	2.6	0.4	3.6	0.6	~~0.29~~ 0.32	~~0.37~~ 0.41	0.61	-10	3.9
Thamesford	280	-19	-21	30	23	34	26	3950	3150	~~28~~ 36	~~108~~ 138	~~820~~ 940	0.9	~~975~~ 1050	~~160~~ 180	1.9	0.4	2.7	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4.4
Thedford	205	-16	-18	31	23	35	26	3710	2930	~~25~~ 32	~~103~~ 131	~~810~~ 930	~~1.0~~ 1.1	~~900~~ 980	~~180~~ 200	2.1	0.4	3.1	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	5
Thunder Bay	210	-31	-33	29	21	33	24	5650	4710	~~23~~ 30	~~108~~ 139	~~560~~ 690	0.8	~~710~~ 790	~~160~~ 180	2.9	0.4	4.2	0.6	~~0.29~~ 0.32	~~0.39~~ 0.43	0.67	-10	3.3
Tillsonburg	215	-17	-19	30	24	34	27	3840	3050	~~25~~ 32	~~103~~ 131	~~880~~ 1000	1	~~980~~ 1060	~~160~~ 170	1.3	0.4	1.9	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	3.5
Timmins	300	-34	-36	29	21	33	24	5940	4990	~~20~~ 26	~~108~~ 141	~~560~~ 680	0.8	~~875~~ 980	100	3.1	0.3	4.3	0.4	~~0.27~~ 0.30	~~0.35~~ 0.39	0.55	-11	3.5
Timmins (Porcupine)	295	-34	-36	29	21	33	24	6000	5050	~~20~~ 26	~~103~~ 135	~~560~~ 680	0.8	~~875~~ 980	100	2.9	0.3	4	0.4	~~0.29~~ 0.32	~~0.37~~ 0.41	0.58	-11	3.5
Toronto Metropolitan Region																								

Etobicoke	160	-20	-22	31	24	35	27	3800	3010	~~26~~ 33	~~108~~ 138	~~720~~ 830	0.8	~~800~~ 880	~~160~~ 170	1.1	0.4	1.6	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4
North York	175	-20	-22	31	24	35	27	3760	2980	~~25~~ 32	~~108~~ 138	~~730~~ 840	0.8	~~850~~ 930	~~150~~ 160	1.2	0.4	1.7	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4
Scarborough	180	-20	-22	31	24	35	27	3800	3010	~~25~~ 32	~~92~~ 118	~~730~~ 840	0.9	~~825~~ 900	~~160~~ 170	1.2	0.4	1.8	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4
Toronto (City Hall)	90	-18	-20	31	23	35	26	3520	2760	~~25~~ 32	~~97~~ 124	~~720~~ 830	0.9	~~820~~ 900	~~160~~ 170	0.9	0.4	1.3	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-5	4
Trenton	80	-22	-24	29	23	33	26	4110	3300	~~23~~ 29	~~97~~ 124	~~760~~ 870	0.9	~~850~~ 920	~~160~~ 170	1.6	0.4	2.3	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4
Trout Creek	330	-27	-29	29	22	33	25	5100	4200	~~25~~ 32	~~103~~ 133	~~780~~ 920	0.9	~~975~~ 1060	120	2.7	0.4	3.7	0.6	~~0.27~~ 0.30	~~0.35~~ 0.39	0.58	-9	2.5
Uxbridge	275	-22	-24	30	23	34	26	4240	3410	~~25~~ 32	~~103~~ 133	~~700~~ 810	0.8	~~850~~ 930	~~140~~ 150	2.4	0.4	3.5	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.68	-7	3.4
Vaughan (Woodbridge)	165	-20	-22	31	24	35	27	4100	3290	~~26~~ 33	~~113~~ 145	~~700~~ 810	0.8	~~800~~ 880	~~140~~ 150	1.1	0.4	1.6	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4
Vittoria	215	-15	-17	30	24	34	27	3680	2900	~~25~~ 32	~~113~~ 143	~~880~~ 1010	1	~~950~~ 1030	~~160~~ 170	1.3	0.4	1.9	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.8
Walkerton	275	-18	-20	30	22	34	25	4300	3470	~~28~~ 36	~~103~~ 132	~~790~~ 920	0.9	~~1025~~ 1110	~~160~~ 170	2.7	0.4	3.9	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-7	3.8
Wallaceburg	180	-16	-18	31	24	34	27	3600	2830	~~28~~ 35	~~97~~ 122	~~760~~ 870	0.9	~~825~~ 910	~~180~~ 190	0.9	0.4	1.3	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	4.5
Waterloo	330	-19	-21	29	23	33	26	4200	3380	~~28~~ 36	~~119~~ 152	~~780~~ 900	0.9	~~925~~ 1010	~~160~~ 170	2	0.4	2.9	0.6	~~0.29~~ 0.32	~~0.37~~ 0.41	0.61	-6	4.5
Watford	240	-17	-19	31	24	35	27	3740	2960	~~25~~ 32	~~108~~ 137	~~790~~ 900	0.9	~~950~~ 1040	~~160~~ 180	1.9	0.4	2.8	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.5
Wawa	290	-34	-36	26	21	30	24	5840	4900	~~20~~ 26	~~93~~ 120	~~725~~ 880	0.9	~~950~~ 1040	~~160~~ 170	3.4	0.4	4.8	0.6	~~0.30~~ 0.33	~~0.39~~ 0.43	0.65	-10	3.5
Welland	180	-15	-17	30	23	34	26	3670	2900	~~23~~ 29	~~103~~ 131	~~840~~ 970	1	~~975~~ 1070	~~160~~ 170	2	0.4	3	0.6	~~0.34~~ 0.37	~~0.43~~ 0.47	0.69	-6	4
West Lorne	215	-16	-18	31	24	35	27	3700	2920	~~28~~ 35	~~103~~ 130	~~840~~ 960	1	~~900~~ 980	~~180~~ 190	1.3	0.4	1.9	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	5
Whitby	85	-20	-22	30	23	34	26	3820	3030	~~23~~ 30	~~86~~ 110	~~760~~ 880	0.9	~~850~~ 930	~~160~~ 170	1.2	0.4	1.8	0.6	~~0.37~~ 0.41	~~0.48~~ 0.53	0.8	-6	4
Whitby (Brooklin)	160	-20	-22	30	23	34	26	4010	3210	~~23~~ 30	~~86~~ 110	~~770~~ 890	0.9	~~850~~ 930	~~140~~ 150	1.9	0.4	2.8	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.74	-6	3.8
White River	375	-39	-42	28	21	32	24	6150	5200	~~20~~ 26	~~92~~ 120	~~575~~ 700	0.8	~~825~~ 910	~~100~~ 110	3.6	0.4	5	0.6	~~0.22~~ 0.24	~~0.30~~ 0.33	0.52	-11	3
Wiarton	185	-19	-21	29	22	33	25	4300	3470	~~25~~ 32	~~103~~ 132	~~740~~ 870	0.9	~~1000~~ 1070	~~180~~ 190	2.7	0.4	3.9	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4.1

Windsor	185	-16	-18	32	24	35	27	3400	2650	~~28~~ 35	~~103~~ 130	~~800~~ 910	0.9	~~900~~ 990	~~180~~ 190	0.8	0.4	1.2	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-5	5
Wingham	310	-18	-20	30	23	34	26	4220	3400	~~28~~ 36	~~108~~ 138	~~780~~ 900	0.9	~~1050~~ 1140	~~160~~ 170	2.6	0.4	3.8	0.6	~~0.36~~ 0.40	~~0.46~~ 0.51	0.75	-6	4
Woodstock	300	-19	-21	30	23	34	26	3910	3110	~~28~~ 36	~~113~~ 144	~~830~~ 950	0.9	~~930~~ 1010	~~160~~ 180	1.9	0.4	2.7	0.6	~~0.34~~ 0.37	~~0.44~~ 0.48	0.73	-6	4.2
Wyoming	215	-16	-18	31	24	34	27	3700	2920	~~25~~ 32	~~103~~ 130	~~815~~ 930	0.9	~~900~~ 990	~~180~~ 200	1.6	0.4	2.4	0.6	~~0.37~~ 0.41	~~0.47~~ 0.52	0.76	-6	4.2
Québec																								
Acton Vale	95	-24	-27	30	23	34	26	4620	3790	~~21~~ 27	~~107~~ 138	~~860~~ 1010	~~1.0~~ 1.1	~~1050~~ 1170	180	2.3	0.4	3.4	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3.5
Alma	110	-31	-33	28	22	32	25	5800	4860	~~20~~ 26	~~91~~ 119	~~700~~ 850	~~0.9~~ 1.0	~~950~~ 1070	~~160~~ 170	3.3	0.4	4.6	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-11	3.8
Amos	295	-34	-36	28	21	32	24	6160	5210	~~20~~ 26	~~91~~ 119	~~670~~ 810	0.9	~~920~~ 1030	100	3.2	0.3	4.3	0.4	~~0.25~~ 0.26	~~0.32~~ 0.34	0.47	-11	3.8
Aylmer	90	-25	-28	30	23	34	26	4520	3620	~~23~~ 30	~~91~~ 117	~~730~~ 870	~~0.8~~ 0.9	~~900~~ 1000	160	2.5	0.4	3.6	0.6	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3.5
Baie-Comeau	60	-27	-29	25	19	29	22	6020	5070	~~16~~ 21	~~91~~ 119	~~680~~ 850	~~1.0~~ 1.1	~~1000~~ 1140	~~220~~ 240	4.3	0.4	6.2	0.6	~~0.39~~ 0.41	~~0.50~~ 0.53	0.75	-9	4.8
Baie-Saint-Paul	20	-27	-29	28	21	32	24	5280	4350	~~18~~ 23	~~102~~ 133	~~730~~ 900	~~0.9~~ 1.0	~~1000~~ 1150	~~180~~ 200	3.4	0.6	4.8	0.8	~~0.37~~ 0.39	~~0.48~~ 0.50	0.73	-10	3.5
Beauport	45	-26	-29	28	22	32	25	5100	4180	~~20~~ 26	~~107~~ 140	~~980~~ 1180	~~1.1~~ 1.2	~~1200~~ 1340	~~200~~ 210	3.4	0.6	4.8	0.8	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-9	4
Bedford	55	-24	-26	29	23	33	26	4420	3610	~~23~~ 29	~~91~~ 117	~~880~~ 1040	~~1.0~~ 1.1	~~1260~~ 1410	160	2.1	0.4	3.1	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	2.8
Beloeil	25	-24	-26	30	23	34	26	4500	3680	~~23~~ 30	~~91~~ 118	~~840~~ 1000	~~1.0~~ 1.1	~~1025~~ 1150	~~180~~ 190	2.4	0.4	3.6	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	3.5
Brome	210	-25	-27	29	23	33	26	4730	3880	~~23~~ 29	~~96~~ 123	~~990~~ 1170	~~1.1~~ 1.2	~~1240~~ 1380	160	2.5	0.4	3.6	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	3
Brossard	15	-24	-26	30	23	34	26	4420	3610	~~23~~ 30	~~91~~ 118	~~800~~ 960	~~0.9~~ 1.0	~~1025~~ 1160	~~180~~ 190	2.4	0.4	3.6	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	4.3
Buckingham	130	-26	-28	30	23	33	26	4880	3970	~~23~~ 30	~~91~~ 118	~~810~~ 960	~~0.9~~ 1.0	~~990~~ 1100	160	2.6	0.4	3.6	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	2.2
Campbell's Bay	115	-28	-30	30	23	34	26	4900	3980	~~23~~ 30	~~96~~ 124	~~700~~ 840	~~0.8~~ 0.9	~~850~~ 950	140	2.6	0.4	3.6	0.6	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-9	2.8
Chambly	20	-24	-26	30	23	34	26	4450	3630	~~23~~ 30	~~91~~ 118	~~850~~ 1010	~~1.0~~ 1.1	~~1000~~ 1130	~~160~~ 170	2.3	0.4	3.4	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	3.5
Coaticook	295	-25	-27	28	22	32	25	4750	3840	~~23~~ 29	~~96~~ 123	~~860~~ 1020	~~1.0~~ 1.1	~~1060~~ 1170	~~160~~ 170	2.3	0.6	3.3	0.9	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3

Contrecoeur	10	-25	-27	30	23	34	26	4500	3680	~~20~~ 26	~~102~~ 133	~~810~~ 970	~~0.9~~ 1.0	~~1000~~ 1120	~~180~~ 190	2.8	0.4	4.1	0.6	~~0.34~~ 0.36	~~0.43~~ 0.45	0.66	-8	3.5
Cowansville	120	-25	-27	29	23	33	26	4540	3710	~~23~~ 30	~~91~~ 117	~~940~~ 1110	~~1.0~~ 1.1	~~1150~~ 1280	160	2.3	0.4	3.4	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	2.8
Deux-Montagnes	25	-25	-27	29	23	33	26	4440	3630	~~23~~ 30	~~96~~ 125	~~820~~ 980	~~0.9~~ 1.0	~~1025~~ 1160	~~160~~ 170	2.4	0.4	3.5	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	3.5
Dolbeau	120	-32	-34	28	22	32	25	6250	5290	~~22~~ 29	~~91~~ 120	~~670~~ 820	~~0.9~~ 1.0	~~900~~ 1020	~~140~~ 150	3.5	0.3	4.8	0.4	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-12	3.8
Drummondville	85	-26	-28	30	23	34	26	4700	3860	~~22~~ 29	~~107~~ 139	~~870~~ 1030	~~1.0~~ 1.1	~~1075~~ 1200	180	2.5	0.4	3.6	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	3.8
Farnham	60	-24	-26	29	23	33	26	4500	3680	~~23~~ 30	~~96~~ 123	~~910~~ 1080	~~1.0~~ 1.1	~~1050~~ 1180	180	2.5	0.4	3.7	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	2.8
Fort-Coulonge	110	-28	-30	30	23	34	26	4950	4030	~~23~~ 30	~~96~~ 124	~~720~~ 860	0.9	~~900~~ 1010	100	2.5	0.4	3.5	0.6	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-9	3
Gagnon	545	-34	-36	24	19	28	22	7600	6600	~~17~~ 22	~~80~~ 105	~~580~~ 730	~~0.9~~ 1.0	~~925~~ 1060	~~140~~ 160	4.6	0.4	6.4	0.6	~~0.30~~ 0.32	~~0.39~~ 0.41	0.6	-14	3.7
Gaspé	55	-25	-26	26	20	30	23	5500	4570	~~19~~ 25	~~118~~ 153	~~760~~ 970	~~1.0~~ 1.1	~~1100~~ 1260	~~300~~ 330	4.3	0.6	6.2	0.9	~~0.37~~ 0.39	~~0.48~~ 0.50	0.73	-8	3.5
Gatineau	95	-25	-28	30	23	34	26	4600	3690	~~23~~ 30	~~91~~ 118	~~790~~ 940	~~0.9~~ 1.0	~~950~~ 1060	160	2.5	0.4	3.6	0.6	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3.2
Gracefield	175	-28	-31	30	23	34	26	5080	4160	~~23~~ 30	~~96~~ 124	~~700~~ 830	0.9	~~950~~ 1050	140	2.6	0.4	3.7	0.6	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-9	2.2
Granby	120	-25	-27	29	23	33	26	4500	3680	~~23~~ 30	~~102~~ 131	~~940~~ 1110	~~1.0~~ 1.1	~~1175~~ 1310	160	2.3	0.4	3.4	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	2.5
Harrington Harbour	30	-27	-29	19	16	23	20	6150	5200	~~15~~ 20	~~96~~ 127	~~900~~ 1120	~~1.2~~ 1.4	~~1150~~ 1280	~~300~~ 330	4.9	0.6	7	0.9	~~0.56~~ 0.59	~~0.72~~ 0.76	1.03	-9	5
Havre-Saint-Pierre	5	-27	-29	22	18	26	22	6100	5150	~~15~~ 20	~~96~~ 126	~~780~~ 960	~~1.1~~ 1.2	~~1125~~ 1250	~~300~~ 340	4.1	0.6	5.9	0.9	~~0.49~~ 0.51	~~0.63~~ 0.66	0.95	-9	5
Hemmingford	75	-24	-26	30	23	34	26	4380	3570	~~23~~ 29	~~91~~ 116	~~770~~ 920	~~0.9~~ 1.0	~~1025~~ 1160	160	2.4	0.4	3.6	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	3
Hull	65	-25	-28	30	23	34	26	4550	3650	~~23~~ 30	~~91~~ 117	~~730~~ 870	~~0.8~~ 0.9	~~900~~ 1000	160	2.4	0.4	3.5	0.6	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3.2
Iberville	35	-24	-26	29	23	33	26	4450	3630	~~23~~ 30	~~91~~ 118	~~880~~ 1050	~~1.0~~ 1.1	~~1010~~ 1140	160	2.2	0.4	3.3	0.6	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3
Inukjuak	5	-36	-38	21	15	26	19	9150	8100	~~9~~ 13	~~54~~ 79	~~270~~ 370	0.9	~~420~~ 510	~~240~~ 270	4.1	0.2	5.9	0.3	~~0.37~~ 0.39	~~0.48~~ 0.50	0.69	-15	5.4
Joliette	45	-26	-28	29	23	33	26	4720	3870	~~21~~ 27	~~102~~ 133	~~790~~ 940	~~0.9~~ 1.0	~~1000~~ 1120	~~160~~ 170	3.1	0.4	4.4	0.6	~~0.28~~ 0.29	~~0.36~~ 0.38	0.57	-8	2.5
Kuujjuaq	25	-37	-39	24	17	29	21	8550	7520	~~9~~ 13	~~54~~ 75	~~280~~ 380	0.8	~~525~~ 640	~~260~~ 290	4.8	0.2	7.1	0.3	~~0.47~~ 0.49	~~0.60~~ 0.63	0.85	-14	4

Kuujjuarapik	20	-36	-38	25	17	29	20	7990	6980	~~12~~ 17	~~80~~ 113	~~410~~ 540	0.9	~~610~~ 720	~~180~~ 200	4.2	0.3	6	0.4	~~0.37~~ 0.39	~~0.48~~ 0.50	0.69	-13	4.6
Lachute	65	-26	-28	29	23	33	26	4640	4570	~~23~~ 30	~~96~~ 125	~~910~~ 1080	~~1.0~~ 1.1	~~1075~~ 1200	~~160~~ 170	2.4	0.4	3.4	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	2.8
Lac-Mégantic	420	-27	-29	27	22	31	25	5180	4470	~~23~~ 29	~~91~~ 117	~~790~~ 950	~~0.9~~ 1.0	~~1025~~ 1150	160	3.2	0.6	4.6	0.9	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3.5
La Malbaie	25	-26	-28	28	21	32	24	5400	3800	~~18~~ 23	~~102~~ 133	~~640~~ 790	~~0.8~~ 0.9	~~900~~ 1040	~~180~~ 200	3.1	0.6	4.3	0.8	~~0.37~~ 0.39	~~0.48~~ 0.50	0.73	-9	3.5
La Pocatière	55	-24	-26	28	22	32	25	5160	4240	~~18~~ 23	~~102~~ 133	~~675~~ 830	~~0.9~~ 1.0	~~965~~ 1110	~~180~~ 190	3.2	0.6	4.5	0.9	~~0.39~~ 0.41	~~0.50~~ 0.53	0.75	-8	4.3
La Tuque	165	-30	-32	29	22	33	25	5500	4260	~~23~~ 30	~~96~~ 125	~~720~~ 870	~~0.9~~ 1.0	~~930~~ 1040	~~160~~ 170	3.4	0.4	4.7	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-10	2.1
Lennoxville	155	-28	-30	29	22	33	25	4700	3790	~~23~~ 29	~~96~~ 123	~~850~~ 1000	~~1.0~~ 1.1	~~1100~~ 1220	160	2.1	0.6	3.1	0.9	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-8	2.9
Léry	30	-24	-26	29	23	33	26	4420	3610	~~23~~ 30	~~91~~ 118	~~800~~ 960	~~0.9~~ 1.0	~~950~~ 1070	~~180~~ 190	2.3	0.4	3.4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.5
Loretteville	100	-26	-29	28	22	32	25	5200	4280	~~20~~ 26	~~102~~ 133	~~980~~ 1180	~~1.1~~ 1.2	~~1225~~ 1370	~~200~~ 210	3.7	0.6	5.1	0.8	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-9	3
Louiseville	15	-25	-28	29	23	33	26	4900	4030	~~20~~ 26	~~102~~ 134	~~800~~ 960	~~0.9~~ 1.0	~~1025~~ 1150	160	2.9	0.4	4.1	0.6	~~0.34~~ 0.36	~~0.43~~ 0.45	0.66	-9	3
Magog	215	-26	-28	29	23	33	26	4730	3880	~~23~~ 29	~~96~~ 123	~~860~~ 1010	~~1.0~~ 1.1	~~1125~~ 1250	160	2.3	0.4	3.4	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3.5
Malartic	325	-33	-36	29	21	33	24	6200	5240	~~20~~ 26	~~86~~ 112	~~640~~ 770	0.8	~~900~~ 1000	~~100~~ 110	3.3	0.3	4.4	0.4	~~0.25~~ 0.26	~~0.32~~ 0.34	0.47	-11	3.6
Maniwaki	180	-30	-32	29	22	33	25	5280	4350	~~23~~ 30	~~96~~ 124	~~700~~ 830	0.9	~~900~~ 990	~~100~~ 110	2.4	0.4	3.4	0.6	~~0.24~~ 0.25	~~0.31~~ 0.33	0.49	-9	2.2
Masson	50	-26	-28	30	23	33	26	4610	3700	~~23~~ 30	~~91~~ 118	~~790~~ 930	~~0.9~~ 1.0	~~975~~ 1080	160	2.4	0.4	3.3	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	3.2
Matane	5	-24	-26	24	20	28	23	5510	4580	~~18~~ 23	~~91~~ 119	~~640~~ 800	~~0.9~~ 1.0	~~1050~~ 1200	~~220~~ 250	3.7	0.4	5.3	0.6	~~0.43~~ 0.45	~~0.55~~ 0.58	0.82	-8	6
Mont-Joli	90	-24	-26	26	21	30	24	5370	4440	~~18~~ 23	~~91~~ 119	~~610~~ 760	~~0.8~~ 0.9	~~920~~ 1050	~~220~~ 240	4.1	0.4	6	0.6	~~0.41~~ 0.43	~~0.52~~ 0.55	0.77	-8	5.9
Mont-Laurier	225	-29	-32	29	22	33	25	5320	4390	~~24~~ 31	~~102~~ 132	~~790~~ 940	0.9	~~1000~~ 1110	~~160~~ 170	2.6	0.4	3.6	0.6	~~0.23~~ 0.24	~~0.30~~ 0.32	0.47	-10	2.2
Montmagny	10	-25	-28	28	22	32	25	5090	4170	~~20~~ 26	~~102~~ 133	~~880~~ 1070	~~1.0~~ 1.1	~~1090~~ 1230	~~180~~ 190	2.9	0.6	4	0.8	~~0.37~~ 0.39	~~0.47~~ 0.49	0.73	-9	4
Montréal Region																								
Beaconsfield	25	-24	-26	30	23	34	26	4440	3630	~~23~~ 30	~~91~~ 118	~~780~~ 930	~~0.9~~ 1.0	~~950~~ 1070	~~180~~ 190	2.3	0.4	3.4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.5

Dorval	25	-24	-26	30	23	34	26	4400	3590	~~23~~ 30	~~91~~ 118	~~760~~ 910	~~0.9~~ 1.0	~~940~~ 1060	~~180~~ 190	2.4	0.4	3.3	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	4
Laval	35	-24	-26	29	23	33	26	4500	3680	~~23~~ 30	~~96~~ 125	~~830~~ 990	~~0.9~~ 1.0	~~1025~~ 1160	~~160~~ 170	2.6	0.4	3.9	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.5
Montréal (City Hall)	20	-23	-26	30	23	34	26	4200	3410	~~23~~ 30	~~96~~ 125	~~830~~ 990	~~0.9~~ 1.0	~~1025~~ 1160	~~180~~ 190	2.6	0.4	4	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	3.5
Montréal-Est	25	-23	-26	30	23	34	26	4470	3650	~~23~~ 30	~~96~~ 125	~~830~~ 990	~~0.9~~ 1.0	~~1025~~ 1150	~~180~~ 190	2.7	0.4	4	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	3.5
Montréal-Nord	20	-24	-26	30	23	34	26	4470	3650	~~23~~ 30	~~96~~ 125	~~830~~ 990	~~0.9~~ 1.0	~~1025~~ 1150	~~160~~ 170	2.6	0.4	3.9	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.5
Outremont	105	-23	-26	30	23	34	26	4300	3500	~~23~~ 30	~~96~~ 125	~~820~~ 980	~~0.9~~ 1.0	~~1025~~ 1160	~~180~~ 190	2.8	0.4	4.2	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	3.5
Pierrefonds	25	-24	-26	30	23	34	26	4430	3620	~~23~~ 30	~~96~~ 125	~~800~~ 960	~~0.9~~ 1.0	~~960~~ 1080	~~180~~ 190	2.4	0.4	3.5	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.5
Sainte-Anne-de-Bellevue	35	-24	-26	29	23	33	26	4460	3640	~~23~~ 30	~~96~~ 125	~~780~~ 940	~~0.9~~ 1.0	~~960~~ 1080	~~180~~ 190	2.3	0.4	3.4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.3
Saint-Lambert	15	-23	-26	30	23	34	26	4400	3590	~~23~~ 30	~~96~~ 125	~~810~~ 970	~~0.9~~ 1.0	~~1050~~ 1180	~~160~~ 170	2.5	0.4	3.8	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	4
Saint-Laurent	45	-23	-26	30	23	34	26	4270	3470	~~23~~ 30	~~96~~ 125	~~790~~ 940	~~0.9~~ 1.0	~~950~~ 1070	~~160~~ 170	2.5	0.4	3.7	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	3.5
Verdun	20	-23	-26	30	23	34	26	4200	3410	~~23~~ 30	~~91~~ 118	~~780~~ 930	~~0.9~~ 1.0	~~1025~~ 1160	~~180~~ 190	2.5	0.4	3.8	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	3.5
Nicolet (Gentilly)	15	-25	-28	29	23	33	26	4900	3980	~~20~~ 26	~~107~~ 140	~~860~~ 1030	~~1.0~~ 1.1	~~1025~~ 1150	~~160~~ 170	2.8	0.4	4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-9	3.5
Nitchequon	545	-39	-41	23	19	27	22	8100	7080	~~15~~ 20	~~70~~ 93	~~500~~ 640	~~0.9~~ 1.0	~~825~~ 960	~~140~~ 160	3.5	0.3	4.6	0.4	~~0.29~~ 0.30	~~0.37~~ 0.39	0.55	-14	3.7
Noranda	305	-33	-36	29	21	33	24	6050	5100	~~20~~ 26	~~91~~ 119	~~650~~ 780	0.8	~~875~~ 970	~~100~~ 110	3.2	0.3	4.3	0.4	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-11	3.5
Percé	5	-21	-24	25	19	29	23	5400	4470	~~16~~ 21	~~107~~ 139	~~1000~~ 1260	~~1.2~~ 1.3	~~1300~~ 1480	~~300~~ 330	3.8	0.6	5.5	0.9	~~0.49~~ 0.51	~~0.63~~ 0.66	0.95	-7	5.1
Pincourt	25	-24	-26	29	23	33	26	4480	3660	~~23~~ 30	~~96~~ 124	~~780~~ 940	~~0.9~~ 1.0	~~950~~ 1070	~~180~~ 190	2.3	0.4	3.4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.3
Plessisville	145	-26	-28	29	23	33	26	5100	4180	~~21~~ 27	~~107~~ 139	~~890~~ 1060	~~1.0~~ 1.1	~~1150~~ 1280	180	2.8	0.6	4.1	0.9	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	3.2
Port-Cartier	20	-28	-30	25	19	29	22	6060	5110	~~15~~ 20	~~106~~ 139	~~730~~ 940	~~1.0~~ 1.1	~~1125~~ 1280	~~300~~ 330	4.1	0.4	5.8	0.6	~~0.42~~ 0.44	~~0.54~~ 0.57	0.8	-9	4
Puvirnituq	5	-36	-38	23	16	29	21	9200	8150	~~7~~ 10	~~54~~ 79	~~210~~ 300	0.9	~~375~~ 460	~~240~~ 280	4.5	0.2	6.5	0.3	~~0.47~~ 0.49	~~0.60~~ 0.63	0.85	-16	5.4
Québec City Region																								

Ancienne-Lorette	35	-25	-28	28	23	32	26	5130	4210	~~20~~ 26	~~102~~ 133	~~940~~ 1130	~~1.1~~ 1.2	~~1200~~ 1340	~~200~~ 210	3.4	0.6	4.7	0.8	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	4
Lévis	50	-25	-28	28	22	32	25	5050	4130	~~20~~ 26	~~107~~ 140	~~920~~ 1110	~~1.0~~ 1.1	~~1200~~ 1340	~~160~~ 170	3.3	0.6	4.6	0.8	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	4
Québec	120	-25	-28	28	22	32	25	5080	4160	~~20~~ 26	~~107~~ 140	~~925~~ 1110	~~1.0~~ 1.1	~~1210~~ 1350	~~200~~ 210	3.6	0.6	5	0.8	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3.5
Sainte-Foy	115	-25	-28	28	23	32	26	5100	4180	~~20~~ 26	~~107~~ 140	~~940~~ 1130	~~1.1~~ 1.2	~~1200~~ 1340	~~180~~ 190	3.7	0.6	5.1	0.8	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3.5
Sillery	10	-25	-28	28	23	32	26	5070	4150	~~20~~ 26	~~107~~ 140	~~930~~ 1120	~~1.1~~ 1.2	~~1200~~ 1340	~~200~~ 210	3.1	0.6	4.2	0.8	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3.5
Richmond	150	-25	-27	29	22	33	25	4700	3860	~~23~~ 30	~~96~~ 124	~~870~~ 1030	~~1.0~~ 1.1	~~1060~~ 1170	160	2.4	0.6	3.5	0.9	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-9	3.5
Rimouski	30	-25	-27	26	20	30	23	5300	4370	~~18~~ 23	~~91~~ 119	~~640~~ 800	~~0.8~~ 0.9	~~890~~ 1020	~~200~~ 220	3.8	0.4	5.5	0.6	~~0.41~~ 0.43	~~0.52~~ 0.55	0.77	-8	5
Rivière-du-Loup	55	-25	-27	26	21	30	24	5380	4450	~~18~~ 23	~~91~~ 119	~~660~~ 820	~~0.8~~ 0.9	~~900~~ 1040	~~180~~ 190	3.5	0.6	5	0.9	~~0.39~~ 0.41	~~0.50~~ 0.53	0.75	-8	4
Roberval	100	-31	-33	28	21	32	24	5750	4810	~~22~~ 29	~~91~~ 119	~~590~~ 720	0.8	~~910~~ 1030	~~140~~ 150	3.5	0.3	5	0.4	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-11	3.8
Rock Island	160	-25	-27	29	23	33	26	4850	3990	~~23~~ 29	~~91~~ 116	~~900~~ 1060	~~1.0~~ 1.1	~~1125~~ 1250	160	2	0.4	2.9	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3
Rosemère	25	-24	-26	29	23	33	26	4550	3720	~~23~~ 30	~~96~~ 125	~~840~~ 1000	~~1.0~~ 1.1	~~1050~~ 1180	~~160~~ 170	2.6	0.4	3.8	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	3.3
Rouyn	300	-33	-36	29	21	33	24	6050	5100	~~20~~ 26	~~91~~ 119	~~650~~ 780	0.8	~~900~~ 1000	~~100~~ 110	3.1	0.3	4.2	0.4	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-11	3.5
Saguenay	10	-30	-32	28	22	32	25	5700	4760	~~18~~ 23	~~86~~ 112	~~710~~ 860	~~0.9~~ 1.0	~~975~~ 1090	~~140~~ 150	2.7	0.4	3.7	0.6	~~0.28~~ 0.29	~~0.36~~ 0.38	0.54	-10	4.2
Saguenay (Bagotville)	5	-31	-33	28	21	32	24	5700	4760	~~18~~ 23	~~86~~ 112	~~690~~ 840	~~0.9~~ 1.0	~~925~~ 1040	~~160~~ 180	2.7	0.4	3.7	0.6	~~0.30~~ 0.32	~~0.38~~ 0.40	0.56	-10	4.2
Saguenay (Jonquière)	135	-30	-32	28	22	32	25	5650	4710	~~18~~ 23	~~86~~ 112	~~710~~ 860	~~0.9~~ 1.0	~~925~~ 1040	~~160~~ 170	3.1	0.4	4.2	0.5	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-10	4.2
Saguenay (Kénogami)	140	-30	-32	28	22	32	25	5650	4710	~~18~~ 23	~~86~~ 112	~~690~~ 840	~~0.9~~ 1.0	~~925~~ 1040	~~160~~ 170	3.1	0.4	4.2	0.5	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-10	4.2
Sainte-Agathe-des-Monts	360	-28	-30	28	22	32	25	5390	4470	~~23~~ 30	~~96~~ 124	~~820~~ 970	~~1.0~~ 1.1	~~1170~~ 1290	140	3.4	0.4	4.6	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	2.2
Saint-Eustache	35	-25	-27	29	23	33	26	4500	3680	~~23~~ 30	~~96~~ 125	~~820~~ 980	~~0.9~~ 1.0	~~1025~~ 1160	~~160~~ 170	2.4	0.4	3.5	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	3.3
Saint-Félicien	105	-32	-34	28	22	32	25	5850	4900	~~22~~ 29	~~91~~ 119	~~570~~ 700	0.8	~~900~~ 1020	~~140~~ 150	3.5	0.3	4.9	0.4	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-11	3.8
Saint-Georges-de-Cacouna	35	-25	-27	26	21	30	24	5400	4470	~~18~~ 23	~~91~~ 119	~~660~~ 820	~~0.9~~ 1.0	~~925~~ 1070	~~180~~ 190	3.2	0.6	4.6	0.9	~~0.39~~ 0.41	~~0.50~~ 0.53	0.75	-8	4

Saint-Hubert	25	-24	-26	30	23	34	26	4490	3670	~~23~~ 30	~~91~~ 118	~~820~~ 980	~~0.9~~ 1.0	~~1020~~ 1150	~~180~~ 190	2.5	0.4	3.7	0.6	~~0.34~~ 0.36	~~0.44~~ 0.46	0.69	-8	4.6
Saint-Hubert-de-Rivière-du-Loup	310	-26	-28	26	21	30	24	5520	4590	~~22~~ 29	~~91~~ 118	~~740~~ 910	~~0.9~~ 1.0	~~1025~~ 1170	~~180~~ 190	4.4	0.6	6.3	0.9	~~0.31~~ 0.33	~~0.40~~ 0.42	0.61	-8	3
Saint-Hyacinthe	35	-24	-27	30	23	34	26	4500	3680	~~21~~ 27	~~91~~ 118	~~840~~ 1000	~~1.0~~ 1.1	~~1030~~ 1150	160	2.3	0.4	3.3	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3.5
Saint-Jean-sur-Richelieu	35	-24	-26	29	23	33	26	4450	3630	~~23~~ 30	~~91~~ 118	~~880~~ 1050	~~1.0~~ 1.1	~~1010~~ 1140	180	2.2	0.4	3.3	0.6	~~0.32~~ 0.34	~~0.41~~ 0.43	0.64	-8	3
Saint-Jérôme	95	-26	-28	29	23	33	26	4820	3960	~~23~~ 30	~~96~~ 125	~~830~~ 990	~~1.0~~ 1.1	~~1025~~ 1150	~~160~~ 170	2.7	0.4	3.9	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	2.5
Saint-Jovite	230	-29	-31	28	22	32	25	5250	4340	~~23~~ 30	~~96~~ 124	~~810~~ 960	~~1.0~~ 1.1	~~1025~~ 1130	160	2.8	0.4	3.8	0.5	~~0.26~~ 0.27	~~0.33~~ 0.35	0.51	-9	2.2
Saint-Lazare / Hudson	60	-24	-26	30	23	34	26	4520	3700	~~23~~ 30	~~96~~ 124	~~750~~ 900	~~0.9~~ 1.0	~~950~~ 1070	~~180~~ 190	2.3	0.4	3.4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3
Saint-Nicolas	65	-25	-28	28	22	32	25	4990	4070	~~20~~ 26	~~102~~ 133	~~890~~ 1070	~~1.0~~ 1.1	~~1200~~ 1340	~~200~~ 210	3.5	0.6	4.9	0.8	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-9	4
Salaberry-de-Valleyfield	50	-23	-25	29	23	33	26	4400	3590	~~23~~ 30	~~96~~ 124	~~760~~ 910	~~0.9~~ 1.0	~~900~~ 1020	180	2.3	0.4	3.4	0.6	~~0.33~~ 0.35	~~0.42~~ 0.44	0.65	-8	3.1
Schefferville	550	-37	-39	24	16	28	20	8550	7520	~~13~~ 17	~~64~~ 86	~~410~~ 540	0.8	~~800~~ 950	~~180~~ 200	4.5	0.3	6.4	0.4	~~0.33~~ 0.35	~~0.42~~ 0.44	0.59	-15	4.2
Senneterre	310	-34	-36	29	21	33	24	6180	5220	~~22~~ 29	~~91~~ 119	~~740~~ 890	0.9	~~925~~ 1030	~~100~~ 110	3.3	0.3	4.6	0.4	~~0.25~~ 0.26	~~0.32~~ 0.34	0.47	-11	3.8
Sept-Îles	5	-29	-31	24	18	28	22	6200	5240	~~15~~ 20	~~106~~ 139	~~760~~ 960	~~1.0~~ 1.1	~~1125~~ 1270	~~300~~ 330	4.1	0.4	6	0.6	~~0.42~~ 0.44	~~0.54~~ 0.57	0.8	-9	3.9
Shawinigan	60	-26	-29	29	23	33	26	5050	4130	~~22~~ 29	~~102~~ 133	~~820~~ 980	~~1.0~~ 1.1	~~1050~~ 1180	~~180~~ 190	3.1	0.4	4.3	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	2.2
Shawville	170	-27	-30	30	23	34	26	4880	3970	~~23~~ 30	~~96~~ 124	~~670~~ 800	~~0.8~~ 0.9	~~880~~ 990	160	2.8	0.4	4	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	2.8
Sherbrooke	185	-28	-30	29	23	33	26	4700	3790	~~23~~ 29	~~96~~ 123	~~900~~ 1060	~~1.0~~ 1.1	~~1100~~ 1220	160	2.2	0.6	3.2	0.9	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-8	3.1
Sorel	10	-25	-27	29	23	33	26	4550	3720	~~20~~ 26	~~102~~ 133	~~800~~ 960	~~0.9~~ 1.0	~~975~~ 1100	~~180~~ 190	2.8	0.4	4.1	0.6	~~0.34~~ 0.36	~~0.43~~ 0.45	0.66	-8	3.5
Sutton	185	-25	-27	29	23	33	26	4600	3770	~~23~~ 29	~~96~~ 123	~~990~~ 1170	~~1.1~~ 1.2	~~1260~~ 1400	160	2.4	0.4	3.5	0.6	~~0.29~~ 0.30	~~0.37~~ 0.39	0.58	-8	2.8
Tadoussac	65	-26	-28	27	21	31	24	5450	4520	~~18~~ 23	~~96~~ 125	~~700~~ 880	~~0.9~~ 1.0	~~1000~~ 1150	~~180~~ 190	3.7	0.4	5.3	0.6	~~0.41~~ 0.43	~~0.52~~ 0.55	0.77	-10	6.9
Témiscaming	240	-30	-32	30	22	34	25	5020	4100	~~23~~ 30	~~96~~ 124	~~730~~ 870	0.9	~~940~~ 1030	100	2.5	0.4	3.3	0.5	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-9	2.7
Terrebonne	20	-25	-27	29	23	33	26	4500	3680	~~23~~ 30	~~96~~ 124	~~830~~ 990	~~0.9~~ 1.0	~~1025~~ 1150	~~160~~ 170	2.6	0.4	3.8	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	3.5

Thetford Mines	330	-26	-28	28	22	32	25	5120	4200	~~22~~ 28	~~107~~ 138	~~950~~ 1130	~~1.1~~ 1.2	~~1230~~ 1370	160	3.5	0.6	5	0.9	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	3.2
Thurso	50	-26	-28	30	23	34	26	4820	3910	~~23~~ 30	~~91~~ 118	~~800~~ 940	~~0.9~~ 1.0	~~950~~ 1050	160	2.4	0.4	3.3	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	2.5
Trois-Rivières	25	-25	-28	29	23	33	26	4900	3980	~~20~~ 26	~~107~~ 140	~~860~~ 1030	~~1.0~~ 1.1	~~1050~~ 1180	~~180~~ 190	2.8	0.4	4	0.6	~~0.34~~ 0.36	~~0.43~~ 0.45	0.66	-9	3.1
Val-des-Sources	245	-26	-28	29	22	33	25	4800	3890	~~23~~ 30	~~96~~ 124	~~870~~ 1030	~~1.0~~ 1.1	~~1050~~ 1160	160	2.8	0.6	4.1	0.9	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	3.4
Val-d'Or	310	-33	-36	29	21	33	24	6180	5220	~~20~~ 26	~~86~~ 113	~~640~~ 770	0.8	~~925~~ 1030	~~100~~ 110	3.4	0.3	4.7	0.4	~~0.25~~ 0.26	~~0.32~~ 0.34	0.47	-11	3.8
Varennes	15	-24	-26	30	23	34	26	4500	3680	~~23~~ 30	~~96~~ 125	~~810~~ 970	~~0.9~~ 1.0	~~1000~~ 1130	~~160~~ 170	2.6	0.4	3.8	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-8	3.8
Verchères	15	-24	-26	30	23	34	26	4450	3630	~~23~~ 30	~~96~~ 125	~~810~~ 970	~~0.9~~ 1.0	~~1000~~ 1130	~~160~~ 170	2.7	0.4	3.9	0.6	~~0.34~~ 0.36	~~0.43~~ 0.45	0.66	-8	3.8
Victoriaville	125	-26	-28	29	23	33	26	4900	3980	~~21~~ 27	~~102~~ 132	~~850~~ 1010	~~1.0~~ 1.1	~~1100~~ 1220	180	2.6	0.6	3.8	0.9	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-9	3.5
Ville-Marie	200	-31	-34	30	22	34	25	5550	4610	~~23~~ 30	~~96~~ 125	~~630~~ 750	0.8	~~825~~ 910	~~120~~ 130	2.3	0.4	3.1	0.6	~~0.31~~ 0.33	~~0.40~~ 0.42	0.64	-11	4.2
Wakefield	120	-27	-30	30	23	34	26	4820	3910	~~23~~ 30	~~91~~ 117	~~780~~ 930	~~0.9~~ 1.0	~~1020~~ 1140	160	2.4	0.4	3.5	0.6	~~0.27~~ 0.28	~~0.34~~ 0.36	0.52	-8	2.2
Waterloo	205	-25	-27	29	23	33	26	4650	3810	~~23~~ 30	~~96~~ 123	~~980~~ 1160	~~1.1~~ 1.2	~~1250~~ 1390	160	2.5	0.4	3.6	0.6	~~0.27~~ 0.28	~~0.35~~ 0.37	0.55	-8	3
Windsor	150	-25	-27	29	23	33	26	4700	3860	~~23~~ 30	~~96~~ 123	~~930~~ 1100	~~1.0~~ 1.1	~~1075~~ 1190	160	2.3	0.4	3.4	0.6	~~0.25~~ 0.26	~~0.32~~ 0.34	0.5	-8	3.5
New Brunswick																								
Alma	5	-21	-23	26	20	29	23	4500	3600	~~18~~ 23	~~144~~ 183	~~1175~~ 1360	~~1.3~~ 1.5	~~1450~~ 1600	~~260~~ 270	2.6	0.6	3.9	0.9	~~0.37~~ 0.41	~~0.48~~ 0.53	0.76	-7	4.5
Bathurst	10	-23	-26	30	22	34	25	5020	4100	~~20~~ 26	~~106~~ 137	~~775~~ 970	~~0.9~~ 1.0	~~1020~~ 1180	~~180~~ 200	4.1	0.6	5.9	0.9	~~0.37~~ 0.41	~~0.48~~ 0.53	0.76	-8	4
Boiestown	65	-25	-28	29	21	33	24	4900	–	~~20~~ 26	~~96~~ 123	~~800~~ 970	~~0.9~~ 1.0	~~1075~~ 1210	~~180~~ 200	3.6	0.6	5.1	0.9	~~0.30~~ 0.33	~~0.39~~ 0.43	0.62	-8	2.8
Campbellton	30	-26	-28	29	22	33	25	5500	4570	~~20~~ 26	~~107~~ 139	~~725~~ 910	~~0.9~~ 1.0	~~1025~~ 1180	~~180~~ 200	4.3	0.4	6	0.6	~~0.35~~ 0.39	~~0.45~~ 0.50	0.7	-8	4.1
Edmundston	160	-27	-29	28	22	32	25	5320	4500	~~23~~ 30	~~91~~ 118	~~750~~ 920	~~0.9~~ 1.0	~~1000~~ 1130	~~160~~ 180	3.4	0.6	4.8	0.9	~~0.30~~ 0.33	~~0.38~~ 0.42	0.59	-9	2
Fredericton	15	-24	-27	29	22	33	25	4670	3760	~~22~~ 28	~~112~~ 143	~~900~~ 1070	~~1.0~~ 1.1	~~1100~~ 1240	~~160~~ 180	3.1	0.6	4.5	0.9	~~0.30~~ 0.33	~~0.38~~ 0.42	0.59	-7	3.5
Gagetown	20	-24	-26	29	22	32	25	4460	3560	~~20~~ 26	~~112~~ 143	~~900~~ 1060	~~1.0~~ 1.1	~~1125~~ 1260	~~180~~ 190	2.8	0.6	4.1	0.9	~~0.31~~ 0.34	~~0.40~~ 0.44	0.64	-7	3.5

Grand Falls	115	-27	-30	28	22	32	25	5300	4450	~~23~~ 30	~~107~~ 139	~~850~~ 1040	~~1.0~~ 1.1	~~1100~~ 1250	~~160~~ 180	3.6	0.6	5.1	0.8	~~0.30~~ 0.33	~~0.38~~ 0.42	0.59	-8	2.2
Miramichi	5	-24	-26	30	22	34	25	4950	4030	~~20~~ 26	~~96~~ 124	~~825~~ 1030	~~1.0~~ 1.2	~~1050~~ 1210	~~200~~ 220	3.4	0.6	4.8	0.9	~~0.32~~ 0.35	~~0.41~~ 0.45	0.64	-7	3.2
Moncton	20	-23	-25	28	21	31	24	4680	3770	~~20~~ 26	~~112~~ 143	~~850~~ 1020	~~1.0~~ 1.2	~~1175~~ 1330	~~220~~ 240	3	0.6	4.3	0.9	~~0.39~~ 0.43	~~0.50~~ 0.55	0.79	-7	5.2
Oromocto	20	-24	-26	29	22	33	25	4650	3740	~~22~~ 28	~~112~~ 143	~~900~~ 1060	~~1.0~~ 1.1	~~1110~~ 1250	~~160~~ 170	3	0.6	4.4	0.9	~~0.30~~ 0.33	~~0.39~~ 0.43	0.62	-7	3.5
Sackville	15	-22	-24	27	21	30	24	4590	3680	~~18~~ 23	~~112~~ 143	~~975~~ 1160	~~1.1~~ 1.2	~~1175~~ 1320	~~220~~ 240	2.5	0.6	3.7	0.9	~~0.38~~ 0.42	~~0.49~~ 0.54	0.77	-7	4.5
Saint Andrews	35	-22	-24	25	20	28	23	4680	3770	~~19~~ 24	~~123~~ 156	~~1000~~ 1130	~~1.2~~ 1.3	~~1200~~ 1310	~~220~~ 230	2.8	0.6	4.1	0.9	~~0.35~~ 0.39	~~0.45~~ 0.50	0.7	-7	4.5
Saint John	5	-22	-24	25	20	28	23	4570	3670	~~18~~ 23	~~139~~ 176	~~1100~~ 1250	~~1.3~~ 1.4	~~1425~~ 1560	~~260~~ 270	2.3	0.6	3.4	0.9	~~0.41~~ 0.45	~~0.53~~ 0.58	0.83	-7	4.5
Shippagan	5	-22	-24	28	21	32	24	4930	4010	~~18~~ 23	~~96~~ 124	~~800~~ 1000	~~1.0~~ 1.1	~~1050~~ 1200	~~260~~ 290	3.4	0.6	4.7	0.8	~~0.49~~ 0.54	~~0.63~~ 0.69	0.99	-7	4.8
St. George	35	-21	-23	25	20	28	23	4680	3770	~~18~~ 23	~~123~~ 156	~~1000~~ 1130	~~1.2~~ 1.3	~~1200~~ 1310	~~220~~ 230	2.8	0.6	4.2	0.9	~~0.35~~ 0.39	~~0.45~~ 0.50	0.7	-7	4.5
St. Stephen	20	-24	-26	28	22	31	25	4700	3790	~~20~~ 25	~~123~~ 156	~~1000~~ 1150	~~1.2~~ 1.3	~~1160~~ 1280	~~180~~ 190	2.9	0.6	4.2	0.9	~~0.33~~ 0.36	~~0.42~~ 0.46	0.65	-7	4
Woodstock	60	-26	-29	30	22	34	25	4910	3990	~~22~~ 28	~~107~~ 138	~~875~~ 1050	~~1.0~~ 1.1	~~1100~~ 1250	~~160~~ 180	3.1	0.6	4.4	0.9	~~0.29~~ 0.32	~~0.37~~ 0.41	0.58	-8	2.4
Nova Scotia																								
Amherst	25	-21	-24	27	21	31	24	4500	3600	~~18~~ 23	~~118~~ 150	~~950~~ 1130	~~1.1~~ 1.2	~~1150~~ 1290	~~220~~ 240	2.4	0.6	3.5	0.9	~~0.37~~ 0.41	~~0.48~~ 0.53	0.76	-6	4.3
Antigonish	10	-17	-20	27	21	31	24	4510	3610	~~15~~ 19	~~123~~ 156	~~1100~~ 1290	~~1.3~~ 1.4	~~1250~~ 1380	~~240~~ 250	2.3	0.6	3.5	0.9	~~0.42~~ 0.46	~~0.54~~ 0.59	0.84	-5	4.6
Bridgewater	10	-15	-17	27	20	30	23	4140	3250	~~16~~ 20	~~144~~ 181	~~1300~~ 1450	~~1.5~~ 1.7	~~1475~~ 1600	~~260~~ 280	1.9	0.6	2.9	0.9	~~0.43~~ 0.47	~~0.55~~ 0.61	0.85	-5	4
Canso	5	-13	-15	25	20	29	23	4400	3500	~~15~~ 19	~~123~~ 155	~~1325~~ 1470	~~1.5~~ 1.6	~~1400~~ 1510	260	1.7	0.6	2.5	0.9	~~0.48~~ 0.53	~~0.61~~ 0.67	0.95	-4	7.5
Debert	45	-21	-24	27	21	31	24	4500	3600	~~18~~ 23	~~118~~ 150	~~1000~~ 1180	~~1.2~~ 1.3	~~1200~~ 1350	~~240~~ 260	2.1	0.6	3.1	0.9	~~0.37~~ 0.41	~~0.48~~ 0.53	0.76	-6	3.8
Digby	35	-15	-17	25	20	28	23	4020	3130	~~15~~ 19	~~130~~ 163	~~1100~~ 1240	~~1.3~~ 1.4	~~1275~~ 1380	~~260~~ 270	2.2	0.6	3.2	0.9	~~0.43~~ 0.47	~~0.55~~ 0.61	0.85	-4	5
Greenwood (CFB)	28	-18	-20	29	22	32	25	4140	3250	~~16~~ 20	~~118~~ 149	~~925~~ 1060	~~1.1~~ 1.2	~~1100~~ 1210	~~280~~ 290	2.7	0.6	4	0.9	~~0.42~~ 0.46	~~0.54~~ 0.59	0.84	-5	4.2
Halifax Region																								

Dartmouth	10	-16	-18	26	20	29	23	4100	3210	~~18~~ 23	~~144~~ 181	~~1250~~ 1380	~~1.4~~ 1.6	~~1400~~ 1510	~~280~~ 290	1.6	0.6	2.4	0.9	~~0.45~~ 0.50	~~0.58~~ 0.64	0.91	-5	3.9
Halifax	55	-16	-18	26	20	29	23	4000	3110	~~17~~ 21	~~150~~ 189	~~1350~~ 1490	~~1.5~~ 1.7	~~1500~~ 1610	~~280~~ 290	1.9	0.6	2.8	0.9	~~0.45~~ 0.50	~~0.58~~ 0.64	0.91	-5	3.9
Kentville	25	-18	-20	28	21	31	24	4130	3240	~~17~~ 22	~~118~~ 149	~~950~~ 1100	~~1.1~~ 1.2	~~1200~~ 1340	~~260~~ 270	2.6	0.6	3.9	0.9	~~0.42~~ 0.46	~~0.54~~ 0.59	0.84	-5	3.2
Liverpool	20	-16	-18	27	20	30	23	3990	3100	~~16~~ 20	~~150~~ 188	~~1325~~ 1450	~~1.5~~ 1.6	~~1425~~ 1530	~~280~~ 290	1.7	0.6	2.5	0.9	~~0.48~~ 0.53	~~0.61~~ 0.67	0.95	-5	4.1
Lockeport	5	-14	-16	25	20	28	23	4000	3110	~~18~~ 22	~~139~~ 173	~~1250~~ 1360	~~1.4~~ 1.5	~~1450~~ 1550	~~280~~ 290	1.4	0.6	2.1	0.9	~~0.47~~ 0.52	~~0.60~~ 0.66	0.94	-4	5.5
Louisbourg	5	-15	-17	26	20	30	23	4530	3630	~~15~~ 19	~~118~~ 149	~~1300~~ 1460	~~1.5~~ 1.7	~~1500~~ 1620	300	2.1	0.7	3.2	1.1	~~0.51~~ 0.56	~~0.65~~ 0.72	1	-5	6
Lunenburg	25	-15	-17	26	20	29	23	4140	3250	~~16~~ 20	~~144~~ 181	~~1300~~ 1440	~~1.5~~ 1.7	~~1450~~ 1570	~~260~~ 270	1.9	0.6	2.8	0.9	~~0.48~~ 0.53	~~0.61~~ 0.67	0.95	-5	4.1
New Glasgow	30	-19	-21	27	21	31	24	4320	3420	~~15~~ 19	~~135~~ 171	~~975~~ 1150	~~1.1~~ 1.2	~~1200~~ 1340	~~260~~ 280	2.2	0.6	3.2	0.9	~~0.43~~ 0.47	~~0.55~~ 0.61	0.85	-6	4.6
North Sydney	20	-16	-19	27	21	31	24	4500	3600	~~15~~ 19	~~123~~ 156	~~1200~~ 1370	~~1.4~~ 1.6	~~1475~~ 1600	300	2.4	0.6	3.6	0.9	~~0.46~~ 0.51	~~0.59~~ 0.65	0.92	-5	5.6
Pictou	25	-19	-21	27	21	31	24	4310	3410	~~15~~ 19	~~107~~ 136	~~950~~ 1120	~~1.1~~ 1.2	~~1175~~ 1310	~~260~~ 280	2.2	0.6	3.3	0.9	~~0.43~~ 0.47	~~0.55~~ 0.61	0.85	-6	4.6
Port Hawkesbury	40	-17	-19	27	21	31	24	4500	3600	~~15~~ 19	~~128~~ 162	~~1325~~ 1500	~~1.5~~ 1.6	~~1450~~ 1580	260	2.1	0.6	3.2	0.9	~~0.48~~ 0.53	~~0.61~~ 0.67	0.95	-5	4.9
Springhill	185	-20	-23	27	21	31	24	4540	3640	~~18~~ 23	~~118~~ 150	~~1075~~ 1270	~~1.2~~ 1.3	~~1175~~ 1320	~~220~~ 240	3.1	0.6	4.6	0.9	~~0.37~~ 0.41	~~0.48~~ 0.53	0.76	-6	4
Stewiacke	25	-20	-22	27	21	30	24	4400	3500	~~18~~ 23	~~128~~ 162	~~1050~~ 1200	~~1.2~~ 1.3	~~1250~~ 1380	~~240~~ 250	1.8	0.6	2.7	0.9	~~0.39~~ 0.43	~~0.50~~ 0.55	0.79	-6	4.5
Sydney	5	-16	-19	27	21	31	24	4530	3630	~~15~~ 19	~~123~~ 156	~~1200~~ 1360	~~1.4~~ 1.6	~~1475~~ 1600	300	2.3	0.6	3.5	0.9	~~0.46~~ 0.51	~~0.59~~ 0.65	0.92	-5	5.6
Tatamagouche	25	-20	-23	27	21	31	24	4380	3480	~~18~~ 23	~~118~~ 150	~~875~~ 1040	~~1.1~~ 1.2	~~1150~~ 1290	~~260~~ 280	2.2	0.6	3.3	0.9	~~0.43~~ 0.47	~~0.55~~ 0.61	0.85	-6	4.6
Truro	25	-20	-22	27	21	30	24	4500	3600	~~18~~ 23	~~118~~ 150	~~1000~~ 1170	~~1.2~~ 1.3	~~1175~~ 1310	~~240~~ 260	2	0.6	2.9	0.9	~~0.37~~ 0.41	~~0.48~~ 0.53	0.76	-6	3.5
Wolfville	35	-19	-21	28	21	31	24	4140	3250	~~17~~ 22	~~118~~ 149	~~975~~ 1140	~~1.1~~ 1.2	~~1175~~ 1310	~~260~~ 280	2.6	0.6	3.9	0.9	~~0.42~~ 0.46	~~0.54~~ 0.59	0.84	-5	3.2
Yarmouth	10	-14	-16	22	19	25	22	3990	3100	~~19~~ 24	~~135~~ 168	~~1125~~ 1230	~~1.3~~ 1.4	~~1260~~ 1350	~~280~~ 290	1.8	0.6	2.7	0.9	~~0.44~~ 0.48	~~0.56~~ 0.62	0.87	-4	5.2
Prince Edward Island																								
Charlottetown	5	-20	-22	26	21	30	24	4460	3650	~~16~~ 20	~~107~~ 136	~~900~~ 1070	~~1.1~~ 1.2	~~1150~~ 1290	~~350~~ 380	2.7	0.6	4	0.9	~~0.44~~ 0.48	~~0.56~~ 0.62	0.87	-6	5

Souris	5	-19	-21	27	21	31	24	4550	3650	~~15~~ 19	~~112~~ 142	~~950~~ 1120	~~1.1~~ 1.2	~~1130~~ 1250	~~350~~ 370	2.7	0.6	4.1	0.9	~~0.45~~ 0.50	~~0.58~~ 0.64	0.91	-6	5
Summerside	10	-20	-22	27	21	31	24	4600	3690	~~16~~ 20	~~112~~ 143	~~825~~ 1000	~~1.0~~ 1.1	~~1060~~ 1210	~~350~~ 390	3.1	0.6	4.6	0.9	~~0.47~~ 0.52	~~0.60~~ 0.66	0.94	-6	5.5
Tignish	10	-20	-22	27	21	31	24	4770	3860	~~16~~ 20	~~96~~ 123	~~800~~ 970	~~1.0~~ 1.1	~~1100~~ 1250	~~350~~ 390	3.2	0.6	4.7	0.9	~~0.51~~ 0.56	~~0.66~~ 0.73	1.04	-5	7.5
Newfoundland and Labrador																								
Argentia	15	-12	-14	21	18	25	22	4600	3620	~~15~~ 19	~~107~~ 136	~~1250~~ 1420	~~1.5~~ 1.6	~~1400~~ 1490	~~400~~ 410	2.4	0.7	3.5	1	~~0.59~~ 0.65	~~0.75~~ 0.83	1.11	-4	6.5
Bonavista	15	-14	-16	24	19	28	22	5000	4000	~~18~~ 23	~~96~~ 122	~~825~~ 1010	~~1.1~~ 1.2	~~1010~~ 1110	~~400~~ 430	3.1	0.6	4.7	0.9	~~0.66~~ 0.73	~~0.84~~ 0.92	1.24	-4	7.5
Buchans	255	-24	-27	27	20	31	24	5250	4240	~~13~~ 17	~~107~~ 138	~~850~~ 1090	~~1.0~~ 1.1	~~1125~~ 1290	~~200~~ 210	4.7	0.6	6.8	0.9	~~0.47~~ 0.52	~~0.60~~ 0.66	0.89	-6	5
Cape Harrison	5	-29	-31	26	16	30	20	6900	5920	~~10~~ 13	~~106~~ 143	~~475~~ 660	~~0.9~~ 1.0	~~950~~ 1080	~~350~~ 400	6.3	0.4	9.3	0.6	~~0.47~~ 0.52	~~0.60~~ 0.66	0.89	-9	6
Cape Race	5	-11	-13	19	18	23	22	4900	3900	~~18~~ 23	~~130~~ 164	~~1425~~ 1570	~~1.7~~ 1.8	~~1550~~ 1620	400	2.3	0.7	3.4	1	~~0.82~~ 0.90	~~1.05~~ 1.16	1.56	-4	7.5
Channel-Port aux Basques	5	-13	-15	19	18	23	22	5000	4000	~~13~~ 17	~~123~~ 157	~~1175~~ 1340	~~1.4~~ 1.5	~~1520~~ 1630	~~450~~ 460	3.6	0.7	5.5	1.1	~~0.61~~ 0.67	~~0.78~~ 0.86	1.16	-4	8.3
Corner Brook	35	-16	-18	26	20	30	23	4760	3770	~~13~~ 17	~~91~~ 117	~~875~~ 1080	~~1.1~~ 1.3	~~1190~~ 1310	~~300~~ 320	3.7	0.6	5.3	0.9	~~0.43~~ 0.47	~~0.55~~ 0.61	0.81	-6	5
Gander	125	-18	-20	27	20	31	24	5110	4110	~~18~~ 23	~~91~~ 117	~~775~~ 1010	~~1.0~~ 1.1	~~1180~~ 1350	~~280~~ 310	3.7	0.6	5.4	0.9	~~0.47~~ 0.52	~~0.60~~ 0.66	0.89	-5	6.3
Grand Bank	5	-14	-15	20	18	24	22	4550	3570	~~15~~ 19	~~123~~ 157	~~1350~~ 1540	~~1.6~~ 1.8	~~1525~~ 1640	~~400~~ 410	2.4	0.7	3.6	1	~~0.58~~ 0.64	~~0.74~~ 0.81	1.1	-4	6.5
Grand Falls	60	-26	-29	27	20	31	24	5020	4020	~~15~~ 19	~~86~~ 111	~~775~~ 1010	~~1.0~~ 1.1	~~1030~~ 1190	~~240~~ 260	3.4	0.6	4.9	0.9	~~0.47~~ 0.52	~~0.60~~ 0.66	0.89	-6	5.5
Happy Valley-Goose Bay	15	-31	-32	27	19	31	23	6670	5700	~~18~~ 24	~~80~~ 107	~~575~~ 750	~~0.8~~ 0.9	~~960~~ 1120	~~160~~ 180	5.3	0.4	7.7	0.6	~~0.33~~ 0.36	~~0.42~~ 0.46	0.62	-11	4.7
Labrador City	550	-36	-38	24	17	28	20	7710	6710	~~15~~ 20	~~70~~ 92	~~500~~ 630	~~0.8~~ 0.9	~~880~~ 1020	~~140~~ 160	4.8	0.3	6.8	0.4	~~0.31~~ 0.34	~~0.40~~ 0.44	0.61	-14	4
St. Anthony	10	-25	-27	22	18	26	22	6440	5380	~~13~~ 17	~~86~~ 112	~~800~~ 1070	~~1.1~~ 1.3	~~1280~~ 1440	~~450~~ 500	6.1	0.6	8.9	0.9	~~0.68~~ 0.75	~~0.87~~ 0.96	1.3	-8	7.5
Stephenville	25	-16	-18	24	19	28	23	4850	3860	~~14~~ 18	~~102~~ 131	~~1000~~ 1200	~~1.2~~ 1.3	~~1275~~ 1390	~~350~~ 370	4.1	0.6	6.1	0.9	~~0.45~~ 0.50	~~0.58~~ 0.64	0.87	-5	6.1
St. John's	65	-15	-16	24	20	28	23	4800	3810	~~18~~ 23	~~118~~ 148	~~1200~~ 1330	~~1.4~~ 1.6	~~1575~~ 1650	~~400~~ 420	2.9	0.7	4.4	1.1	~~0.61~~ 0.67	~~0.78~~ 0.86	1.16	-4	7.5
Twin Falls	425	-35	-37	24	17	28	21	7790	6880	~~15~~ 20	~~70~~ 93	~~500~~ 640	~~0.9~~ 1.0	~~950~~ 1110	~~120~~ 130	4.8	0.4	6.8	0.6	~~0.31~~ 0.34	~~0.40~~ 0.44	0.61	-14	4

Wabana	75	-15	-17	24	20	27	23	4750	3760	~~18~~ 23	~~112~~ 141	~~1125~~ 1280	~~1.3~~ 1.4	~~1500~~ 1590	~~400~~ 430	3	0.7	4.6	1.1	~~0.59~~ 0.65	~~0.75~~ 0.83	1.11	-4	4.8
Wabush	550	-36	-38	24	17	28	20	7710	6710	~~15~~ 20	~~70~~ 92	~~500~~ 630	~~0.8~~ 0.9	~~880~~ 1020	~~140~~ 160	4.8	0.3	6.8	0.4	~~0.31~~ 0.34	~~0.40~~ 0.44	0.61	-14	4
Yukon																								
Aishihik	920	-44	-46	23	15	27	19	7500	6500	~~8~~ 10	~~43~~ 56	~~190~~ 270	0.6	~~275~~ 340	~~40~~ 60	~~1.9~~ 2.0	0.1	3	0.2	~~0.27~~ 0.28	~~0.38~~ 0.40	0.6	-14	2.2
Dawson	330	-50	-51	26	16	30	19	8120	7100	~~10~~ 13	~~49~~ 65	~~200~~ 270	0.6	~~350~~ 440	~~40~~ 50	~~2.9~~ 3.0	0.1	4.4	0.2	~~0.22~~ 0.23	~~0.31~~ 0.33	0.48	-17	2
Destruction Bay	815	-43	-45	23	14	27	18	7800	6790	~~8~~ 10	~~49~~ 64	~~190~~ 290	0.6	~~300~~ 380	~~80~~ 140	~~1.9~~ 2.0	0.1	3	0.2	~~0.42~~ 0.44	~~0.60~~ 0.63	0.96	-14	2.3
Faro	670	-46	-47	25	16	29	20	7300	6310	~~10~~ 13	~~33~~ 43	~~215~~ 300	0.6	~~315~~ 380	~~40~~ 50	~~2.3~~ 2.4	0.1	3.6	0.2	~~0.26~~ 0.27	~~0.35~~ 0.37	0.55	-14	2.3
Haines Junction	600	-45	-47	24	14	29	18	7100	6120	~~8~~ 10	~~51~~ 66	~~145~~ 230	0.6	~~315~~ 400	~~180~~ 310	~~2.2~~ 2.3	0.1	3.3	0.2	~~0.24~~ 0.25	~~0.34~~ 0.36	0.54	-11	2.5
Snag	595	-51	-53	23	16	27	19	8300	7280	~~8~~ 10	~~59~~ 77	~~290~~ 390	0.6	~~350~~ 440	~~40~~ 50	~~2.2~~ 2.3	0.1	3.4	0.2	~~0.22~~ 0.23	~~0.31~~ 0.33	0.48	-17	2.2
Teslin	690	-42	-44	24	15	28	19	6770	5800	~~10~~ 13	~~38~~ 49	~~200~~ 300	0.5	~~340~~ 400	~~40~~ 50	~~3.0~~ 3.2	0.1	4.6	0.2	~~0.26~~ 0.27	~~0.34~~ 0.36	0.49	-12	2.2
Watson Lake	685	-46	-48	26	16	30	20	7470	6470	~~10~~ 13	~~54~~ 69	~~250~~ 360	0.6	~~410~~ 510	~~60~~ 70	~~3.2~~ 3.4	0.1	4.9	0.2	~~0.26~~ 0.27	~~0.35~~ 0.37	0.55	-15	2
Whitehorse	655	-41	-43	25	15	30	19	6580	5610	~~8~~ 10	~~43~~ 56	~~170~~ 260	0.5	~~275~~ 340	~~40~~ 60	~~2.0~~ 2.1	0.1	3.2	0.2	~~0.29~~ 0.30	~~0.38~~ 0.40	0.56	-11	3.7
Northwest Territories																								
Aklavik	5	-42	-44	26	17	29	20	9600	8540	~~6~~ 8	~~49~~ 69	~~115~~ 170	0.7	~~250~~ 310	~~60~~ 80	~~2.8~~ 2.9	0.1	4.3	0.2	~~0.31~~ 0.33	~~0.40~~ 0.42	0.58	-17	2.9
Behchokǫ̀ / Rae-Edzo	160	-42	-44	25	17	28	20	8300	7280	~~10~~ 13	~~60~~ 81	~~175~~ 230	0.6	~~275~~ 330	~~80~~ 90	~~2.3~~ 2.4	0.1	3.5	0.2	~~0.31~~ 0.33	~~0.40~~ 0.42	0.58	-17	3.5
Echo Bay / Port Radium	195	-42	-44	22	16	25	19	9300	8250	~~8~~ 11	~~60~~ 82	~~160~~ 210	0.7	~~250~~ 310	~~80~~ 90	~~3.0~~ 3.2	0.1	4.7	0.2	~~0.41~~ 0.43	~~0.53~~ 0.56	0.79	-17	4.4
Fort Good Hope	100	-43	-45	28	18	31	21	8700	7660	~~9~~ 12	~~60~~ 82	~~140~~ 190	0.6	~~280~~ 340	~~80~~ 90	~~2.9~~ 3.0	0.1	4.6	0.2	~~0.34~~ 0.36	~~0.44~~ 0.46	0.63	-17	2.8
Fort McPherson	25	-44	-46	26	17	29	20	9150	8100	~~6~~ 8	~~50~~ 70	~~145~~ 200	0.7	~~315~~ 390	~~60~~ 80	~~3.2~~ 3.4	0.1	5	0.2	~~0.31~~ 0.33	~~0.40~~ 0.42	0.61	-17	2.3
Fort Providence	150	-40	-43	28	18	32	21	7620	6620	~~10~~ 13	~~71~~ 94	~~210~~ 270	0.6	~~350~~ 420	~~100~~ 110	~~2.4~~ 2.5	0.1	3.6	0.2	~~0.27~~ 0.28	~~0.35~~ 0.37	0.53	-16	3
Fort Resolution	160	-40	-42	26	18	30	21	7750	6740	~~10~~ 13	~~60~~ 80	~~175~~ 230	0.6	~~300~~ 360	~~140~~ 160	~~2.3~~ 2.4	0.1	3.5	0.2	~~0.30~~ 0.32	~~0.39~~ 0.41	0.6	-16	3.3

Fort Simpson	120	-42	-44	28	19	31	22	7660	6660	~~12~~ 16	~~76~~ 100	~~225~~ 290	0.6	~~360~~ 430	80	~~2.3~~ 2.4	0.1	3.3	0.1	~~0.30~~ 0.32	~~0.39~~ 0.41	0.6	-16	2.4
Fort Smith	205	-41	-43	28	19	32	22	7300	6310	~~10~~ 13	~~65~~ 86	~~250~~ 310	0.6	~~350~~ 410	~~80~~ 90	~~2.3~~ 2.4	0.2	3.5	0.3	~~0.30~~ 0.32	~~0.39~~ 0.41	0.6	-15	2.7
Hay River	45	-38	-41	27	18	31	21	7550	6550	~~10~~ 13	~~60~~ 79	~~200~~ 260	0.6	~~325~~ 390	~~140~~ 160	~~2.4~~ 2.5	0.1	3.7	0.2	~~0.27~~ 0.28	~~0.35~~ 0.37	0.5	-16	3.3
Inuvik	45	-43	-45	26	17	30	20	9600	8540	~~6~~ 9	~~49~~ 69	~~115~~ 160	0.7	~~425~~ 530	~~60~~ 80	~~3.1~~ 3.3	0.1	4.9	0.2	~~0.31~~ 0.33	~~0.40~~ 0.42	0.58	-16	2.6
Mould Bay	5	-44	-46	11	8	15	12	12900	11730	~~3~~ 5	~~33~~ 52	~~25~~ 40	0.9	~~100~~ 140	~~140~~ 210	~~1.5~~ 1.6	0.1	2.3	0.2	~~0.45~~ 0.47	~~0.58~~ 0.61	0.87	-20	4.3
Norman Wells	65	-43	-45	28	18	31	21	8510	7480	~~9~~ 12	~~60~~ 81	~~165~~ 220	0.6	~~320~~ 390	80	~~3.0~~ 3.2	0.1	4.9	0.2	~~0.34~~ 0.36	~~0.44~~ 0.46	0.63	-17	3.1
Tungsten	1340	-49	-51	26	16	30	20	7700	6700	~~10~~ 13	~~44~~ 57	~~315~~ 430	0.8	~~640~~ 750	~~40~~ 50	~~4.3~~ 4.5	0.1	6.7	0.2	~~0.34~~ 0.36	~~0.44~~ 0.46	0.66	-16	3
Ulukhaktok / Holman	10	-39	-41	18	12	23	16	10700	9600	~~3~~ 4	~~44~~ 65	~~80~~ 120	0.9	~~250~~ 310	~~120~~ 140	~~2.1~~ 2.2	0.1	3.3	0.2	~~0.67~~ 0.70	~~0.86~~ 0.90	1.23	-18	4.9
Wrigley	80	-42	-44	28	18	31	21	8050	7040	~~10~~ 13	~~54~~ 71	~~220~~ 290	0.6	~~350~~ 420	80	~~2.8~~ 2.9	0.1	4.3	0.2	~~0.30~~ 0.32	~~0.39~~ 0.41	0.6	-16	3
Yellowknife	160	-41	-44	25	17	29	20	8170	7150	~~10~~ 13	~~60~~ 81	~~175~~ 230	0.6	~~275~~ 330	~~100~~ 110	~~2.2~~ 2.3	0.1	3.4	0.2	~~0.31~~ 0.33	~~0.40~~ 0.42	0.58	-17	3.8
Nunavut																								
Alert	5	-43	-44	13	8	18	12	13030	11860	~~3~~ 4	~~22~~ 32	~~20~~ 30	1	~~150~~ 200	~~100~~ 140	~~2.6~~ 2.7	0.1	4	0.2	~~0.59~~ 0.62	~~0.75~~ 0.79	1.06	-22	4.3
Arctic Bay	15	-42	-44	14	10	19	14	11900	10760	~~3~~ 4	~~38~~ 56	~~60~~ 100	0.9	~~150~~ 200	~~160~~ 200	~~2.4~~ 2.5	0.1	3.9	0.2	~~0.43~~ 0.45	~~0.55~~ 0.58	0.78	-20	4
Arviat	5	-40	-41	22	16	27	20	9850	8780	~~8~~ 12	~~65~~ 94	~~225~~ 290	0.9	~~300~~ 350	~~240~~ 260	~~3.0~~ 3.2	0.2	4.9	0.3	~~0.45~~ 0.47	~~0.58~~ 0.61	0.83	-19	6.6
Baker Lake	5	-42	-44	23	15	28	19	10700	9600	~~5~~ 7	~~55~~ 80	~~160~~ 210	0.8	~~260~~ 310	~~180~~ 200	~~3.4~~ 3.6	0.2	5.5	0.3	~~0.42~~ 0.44	~~0.54~~ 0.57	0.77	-20	6.5
Eureka	5	-47	-48	12	8	17	12	13500	12310	~~3~~ 4	~~27~~ 39	~~25~~ 40	1	~~70~~ 90	~~100~~ 140	~~1.6~~ 1.7	0.1	2.5	0.2	~~0.43~~ 0.45	~~0.55~~ 0.58	0.78	-21	4.3
Igluligaarjuk / Chesterfield Inlet	10	-40	-41	20	14	25	18	10500	9410	~~5~~ 7	~~60~~ 88	~~175~~ 240	0.9	~~270~~ 320	~~240~~ 270	~~3.6~~ 3.8	0.2	6	0.3	~~0.44~~ 0.46	~~0.56~~ 0.59	0.79	-19	6.7
Iqaluit	45	-40	-41	17	12	21	16	9980	8900	~~5~~ 7	~~58~~ 83	~~200~~ 310	0.9	~~433~~ 550	~~200~~ 230	~~2.9~~ 3.0	0.2	4.7	0.3	~~0.51~~ 0.54	~~0.65~~ 0.68	0.91	-16	4.8
Iqaluktuuttiaq / Cambridge Bay	15	-41	-44	18	13	23	17	11670	10540	~~4~~ 6	~~38~~ 58	~~70~~ 100	0.9	~~140~~ 170	~~100~~ 120	~~1.9~~ 2.0	0.1	3	0.2	~~0.39~~ 0.41	~~0.50~~ 0.53	0.71	-21	5
Isachsen	10	-46	-48	12	9	17	13	13600	12410	~~3~~ 5	~~27~~ 42	~~25~~ 40	1	~~75~~ 100	~~140~~ 180	~~1.9~~ 2.0	0.1	3.1	0.2	~~0.47~~ 0.49	~~0.60~~ 0.63	0.85	-20	4.3

Kangiqiniq / Rankin Inlet	10	-41	-42	21	15	26	19	10500	9410	~~5~~ 7	~~65~~ 95	~~180~~ 240	0.9	~~250~~ 300	~~240~~ 270	~~3.0~~ 3.2	0.2	4.9	0.3	~~0.47~~ 0.49	~~0.60~~ 0.63	0.85	-19	6.7
Kanngiqtugaapik / Clyde River	5	-40	-42	14	10	19	14	11300	10180	~~5~~ 7	~~44~~ 61	~~55~~ 90	0.9	~~225~~ 280	~~220~~ 270	~~4.2~~ 4.4	0.2	6.8	0.3	~~0.43~~ 0.45	~~0.55~~ 0.58	0.78	-17	5
Kugluktuk / Coppermine	10	-41	-43	23	16	27	19	10300	9210	~~6~~ 9	~~65~~ 94	~~140~~ 190	0.8	~~150~~ 180	~~80~~ 90	~~3.4~~ 3.6	0.1	5.4	0.2	~~0.36~~ 0.38	~~0.46~~ 0.48	0.65	-19	5.1
Nottingham Island	30	-37	-39	16	13	21	17	10000	8920	~~5~~ 8	~~54~~ 81	~~175~~ 260	0.9	~~325~~ 410	~~200~~ 230	~~4.7~~ 4.9	0.2	7.5	0.3	~~0.61~~ 0.64	~~0.78~~ 0.82	1.1	-17	7
Resolute	25	-42	-43	11	9	16	13	12360	11210	~~3~~ 5	~~27~~ 42	~~50~~ 80	0.9	~~140~~ 180	~~180~~ 220	~~2.0~~ 2.1	0.1	3.2	0.2	~~0.46~~ 0.48	~~0.59~~ 0.62	0.84	-19	6.1
Resolution Island	5	-32	-34	12	10	16	14	9000	7960	~~5~~ 7	~~71~~ 99	~~240~~ 350	0.9	~~550~~ 650	~~200~~ 220	~~5.5~~ 5.8	0.2	9	0.3	~~0.96~~ 1.01	~~1.23~~ 1.29	1.74	-14	9.5
Salliq / Coral Harbour	15	-41	-42	20	14	25	18	10720	9620	~~5~~ 7	~~65~~ 97	~~150~~ 210	0.9	~~280~~ 350	~~200~~ 230	~~3.8~~ 4.0	0.2	6.2	0.3	~~0.45~~ 0.47	~~0.58~~ 0.61	0.83	-18	5.5

Note to Table [C-2] C-2:

(1) July design temperatures based on historical observations are provided for the design of mechanical cooling systems.

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Impact analysis

The following summarizes the updates to the climatic design parameters forming part of NBC Table C-2. The revisions are to account for potential future climate change effects expected over the 50-year design life of buildings and building components.

January 2.5% design temperatures ($T_{Jan2.5}$)

This parameter is used for the design of heating systems in buildings. The values of this parameter are projected to increase for all locations in the future as a consequence of climate warming; therefore, the current historical NBC values are deemed appropriate and are recommended to continue to be used for design. Overall, no change to the NBC 2020 design values of this parameter is proposed.

January 1% design temperatures (T_{Jan1})

This parameter is also used for the design of heating systems in buildings. The values of this parameter are projected to increase for all locations in the future as a consequence of climate warming; therefore, the current historical NBC values are considered appropriate and are recommended to continue to be used for design. Overall, no change to the NBC 2020 design values of this parameter is proposed.

July 2.5% dry temperatures ($T_{Juldry2.5}$)

This parameter is used for the design of cooling and dehumidifying systems in buildings. The projected values indicate an increase for all locations as a consequence of global warming. Therefore, the NBC 2020 values require updating for climate change effects expected over the design life of 50 years (typical). This updating procedure is expected to result in the following changes in value of this parameter:

Province or Territory	Number of Locations	2°C < $\Delta T_{Juldry2.5}$ ≤ 3°C	3°C < $\Delta T_{Juldry2.5}$ ≤ 4°C	4°C < $\Delta T_{Juldry2.5}$ ≤ 5°C	5°C < $\Delta T_{Juldry2.5}$ ≤ 6°C	6°C < $\Delta T_{Juldry2.5}$ ≤ 7°C
Alberta	55	0	0	7	47	1
British Columbia	108	0	5	21	80	2
Manitoba	24	0	2	22	0	0
New Brunswick	18	0	18	0	0	0
Newfoundland	18	0	17	1	0	0
Nova Scotia	25	0	25	0	0	0
Northwest Territories	17	1	13	3	0	0
Nunavut	16	0	0	15	1	0
Ontario	230	0	229	1	0	0
Prince Edward Island	4	0	4	0	0	0
Quebec	125	0	119	4	2	0
Saskatchewan	31	0	0	19	12	0
Yukon	9	0	5	4	0	0
Total	**680**	**1**	**437**	**97**	**142**	**3**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over the 50-year future timeframe range from 2.8°C to 6.5°C. A large fraction of the locations (438 out of 680) are projected to have future increases of less than or equal to 4°C, 97 locations are projected to have changes on the order of 4-5°C, 142 locations are projected to have changes on the order of 5-6°C, and 3 locations, in Alberta and British Columbia, are projected to have changes greater than 6°C. To minimize the risk of overheating, and depending on the building location, there will likely be a need for cost-effective solutions to implement fenestration shading systems or advanced fenestration and glazing design, enhanced building envelope design, and a review of the air-handing and cooling system design.

Using a July design temperature based on historical observations for the design of mechanical cooling equipment will

- reduce the risk of oversized cooling equipment
- maintain energy efficiency and energy costs for cooling
- minimize equipment short-cycling and maintain service life of equipment
- reduce the risk of excessive indoor humidity levels

July 2.5% wet temperatures ($T_{Julwet2.5}$)

This parameter is used for the design of cooling and dehumidifying systems in buildings. The values of this parameter are projected to increase at all locations as a consequence of global warming. Accordingly, the NBC 2020 values require updating for climate change effects expected over the design life of typical building cooling and dehumidifying systems (50 years). This updating procedure is expected to result in the following changes in the value of this parameter:

Province or Territory	Number of Locations	1°C < $\Delta T_{Julwet2.5}$ ≤ 2°C	2°C < $\Delta T_{Julwet2.5}$ ≤ 3°C	3°C < $\Delta T_{Julwet2.5}$ ≤ 4°C	4°C < $\Delta T_{Julwet2.5}$ ≤ 5°C	5°C < $\Delta T_{Julwet2.5}$ ≤ 6°C
Alberta	55	0	0	21	34	0
British Columbia	108	0	0	16	92	0
Manitoba	24	0	1	23	0	0
New Brunswick	18	0	0	18	0	0
Newfoundland	18	0	0	18	0	0
Nova Scotia	25	0	5	20	0	0
Northwest Territories	17	0	3	14	0	0
Nunavut	16	0	0	8	8	0
Ontario	230	0	218	12	0	0
Prince Edward Island	4	0	0	4	0	0
Quebec	125	0	106	17	2	0
Saskatchewan	31	0	0	27	4	0
Yukon	9	0	0	9	0	0
Total	**680**	**0**	**333**	**207**	**140**	**0**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over the 50-year future timeframe range from 2.6°C to 5°C. All locations in Manitoba, New Brunswick, Newfoundland, Nova Scotia, Northwest Territories, Ontario, Prince Edward Island and Yukon are projected to have future increases of less than or equal to 4°C, whereas some locations in Alberta, Nunavut, Quebec and Saskatchewan are projected to have future increases greater than 4°C. To minimize the risk of overheating, there will likely be a need for cost-effective solutions to implement fenestration shading systems or advanced fenestration and glazing design, enhanced building envelope design, and a review of the air-handing and cooling system design.

Using a July design temperature based on historical observations for the design of mechanical cooling equipment will

- reduce the risk of oversized cooling equipment
- maintain energy efficiency and energy costs for cooling
- minimize equipment short-cycling and maintain service life of equipment
- reduce the risk of excessive indoor humidity levels

Degree-days below 18°C (HDD18)

This parameter is used to identify the required levels of insulation in the building. The values of this parameter are projected to decrease for all locations in the future as a consequence of climate change; therefore, the current values are deemed appropriate and are recommended to continued to be used for design. Overall, no change in the NBC 2020 design values of this parameter is proposed.

15-minute rain ($Rain_{15}$)

This parameter is used for the design roof drainage systems. The values of this parameter are projected to increase at all reference locations as a consequence of climate change. Therefore, the design values require updating for climate change effects expected over the design life of buildings (50 years). This updating procedure is expected to result in the following changes in the value of this parameter:

Province or Territory	Number of Locations	$\Delta Rain_{15} \leq 20\%$	$20\% < \Delta Rain_{15} \leq 30\%$	$30\% < \Delta Rain_{15} \leq 40\%$	$40\% < \Delta Rain_{15} \leq 50\%$	$\Delta Rain_{15} > 50\%$
Alberta	55	0	55	0	0	0
British Columbia	108	0	104	4	0	0
Manitoba	24	0	3	20	1	0
New Brunswick	18	0	18	0	0	0
Newfoundland	18	0	12	6	0	0
Nova Scotia	25	0	25	0	0	0
Northwest Territories	17	0	0	13	3	1
Nunavut	16	0	0	2	10	4
Ontario	230	0	207	23	0	0
Prince Edward Island	4	0	4	0	0	0
Quebec	125	0	73	49	3	0
Saskatchewan	31	0	18	13	0	0
Yukon	9	0	5	4	0	0
Total	**680**	**0**	**524**	**134**	**17**	**5**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over the 50-year future timeframe range from 21.8% to 56.1%. A large fraction of the locations (524 out of 680) are projected to have future increases of less than or equal to 30%, whereas, 156 locations are projected to have future increases of 30% or more.

Cost impact on roof drainage systems in the NPC

Refer to "Cost Impact on Roof Drainage Systems in NPC" in the supporting document for PCF 1979 for the full cost analysis. A summary is reproduced here.

The cost impact on roof drainage system requirements per Article 2.4.1.4. in the NPC was determined for three archetypal buildings. The cost increase for upsizing the combined primary and emergency roof drainage systems due to the updated 15-minute rainfall values was calculated. This does not account for the impact of the proposed change on alternative acceptable solutions, such as scuppers. The locations impacted and the cost increase for each archetypal building are as follows:

	2-storey				10-storey				20-storey			
	Locations impacted	Min. cost diff.	Max. cost diff.	Avg. cost diff.	Locations impacted	Min. cost diff.	Max. cost diff.	Avg. cost diff.	Locations impacted	Min. cost diff.	Max. cost diff.	Avg. cost diff.
NU [(1)]	9	-	-	-	13	-	-	-	16	-	-	-
NT	17	45	743	546	16	55	2094	1503	17	45	6253	3988
YT	9	41	680	325	9	673	1770	1161	9	41	5729	2569
BC	103	45	741	384	107	55	1928	986	104	45	6241	2686
AB	42	65	2000	506	44	65	4845	1308	52	65	9600	2364
SK	26	91	1846	1319	28	82	5206	2780	28	1283	8862	5575
MB	7	91	1665	478	18	82	5184	1247	9	1277	8742	2632
ON	181	100	2029	1764	229	91	5722	3968	181	1410	9741	8711
QC	109	63	1953	1581	112	87	4732	3502	122	63	10733	6744

	2-storey				10-storey				20-storey			
	Locations impacted	Min. cost diff.	Max. cost diff.	Avg. cost diff.	Locations impacted	Min. cost diff.	Max. cost diff.	Avg. cost diff.	Locations impacted	Min. cost diff.	Max. cost diff.	Avg. cost diff.
NB	13	90	1832	1092	12	82	4439	1897	18	1273	10070	3676
PE	1	55	55	55	4	1439	1495	1453	1	55	55	55
NS	10	62	94	65	16	1514	1670	1625	17	62	1327	657
NL	13	60	688	130	12	151	1789	1144	18	60	5790	787

Note to Table:

(1) Cost data for Nunavut not available.

One-day rain ($Rain_{1day}$)

This parameter is used for design for the accumulation of rainwater on roofs. The values of this parameter are projected to increase at all locations as a consequence of climate change. Therefore, the values require updating for climate change effects expected over the design life of buildings (50 years). This updating procedure is expected to result in following changes in the values of this parameter:

Province or Territory	Number of Locations	$\Delta Rain_{1day} \le 20\%$	$20\% < \Delta Rain_{1day} \le 30\%$	$30\% < \Delta Rain_{1day} \le 40\%$	$40\% < \Delta Rain_{1day} \le 50\%$	$\Delta Rain_{1day} > 50\%$
Alberta	55	0	55	0	0	0
British Columbia	108	0	104	4	0	0
Manitoba	24	0	3	20	1	0
New Brunswick	18	0	18	0	0	0
Newfoundland	18	0	12	6	0	0
Nova Scotia	25	0	25	0	0	0
Northwest Territories	17	0	0	13	3	1
Nunavut	16	0	0	2	10	4
Ontario	230	0	207	23	0	0
Prince Edward Island	4	0	4	0	0	0
Quebec	125	0	73	49	3	0
Saskatchewan	31	0	18	13	0	0
Yukon	9	0	5	4	0	0
Total	**680**	**0**	**524**	**134**	**17**	**5**

Across the 680 locations in NBC Table C-2, the projected changes in the value of this parameter over the 50-year future timeframe range from 21.8% to 56.1%. A large fraction of the locations (524 out of 680) are projected to have future increases of less than or equal to 30%, whereas 156 locations are projected to have future increases of 30% or more.

To account for the projected increase in the amount of rain that may fall in a day, and thus to avoid water accumulation and ponding on the roof, the design of the drainage systems would be adjusted, as the value of this parameter would affect the drainage design of flat roofs. The design of the drainage system would need to consider both the number of control flow roof drains and scuppers, and their proper sizing. In the future, there will be a need to design roof areas to drain accumulated water that may result from greater rain loads from the roof.

Moisture index (MI)

This parameter is used to define the minimum levels of protection from precipitation to be provided by cladding assemblies on exterior walls. The following is a summary of the projected changes in values of this parameter as a consequence of climate change over a 50-year horizon, which corresponds to the typical design life of buildings (50 years):

Province or Territory	Number of Locations	ΔMI ≤ -10%	-10% < ΔMI≤ 0	0 < ΔMI≤ 10%	10% < ΔMI≤ 20%	ΔMI > 20%
Alberta	55	5	46	4	0	0
British Columbia	108	0	11	52	21	24
Manitoba	24	4	20	0	0	0
New Brunswick	18	0	0	5	13	0
Newfoundland	18	0	0	5	13	0
Nova Scotia	25	0	0	12	13	0
Northwest Territories	17	0	17	0	0	0
Nunavut	16	0	13	3	0	0
Ontario	230	0	63	167	0	0
Prince Edward Island	4	0	0	2	2	0
Quebec	125	0	1	110	14	0
Saskatchewan	31	26	5	0	0	0
Yukon	9	0	7	2	0	0
Total	**680**	**35**	**183**	**362**	**76**	**24**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over a 50-year future timeframe range from -19.4% to 29.4%. A large fraction of the locations (545 out of 680) are projected to have changes of up to ±10%. A total of 35 locations, located in the prairie provinces of Alberta, Manitoba and Saskatchewan, are projected to have future decreases of greater than 10%, whereas 24 locations, all located in British Columbia, are projected to have future increases of greater than 20%.

The worst-case MI values are recommended for design. This implies that, for locations where future decreases in MI are projected, the current values of MI are recommended for the design of cladding assemblies on exterior walls, whereas for locations where future increases in MI are projected, the future projected values of MI are recommended for design. Overall, 462 locations are projected to have future increases in MI, and 218 locations are projected to have future decreases. Out of the 462 locations projected to have future increases, only 265 locations are associated with projected changes large enough to not be rounded off within one decimal point (the level of accuracy to which MI values are reported in the NBC). Accordingly, the current MI values are updated to increased future projected MI values for these 265 locations and kept unchanged for other locations.

With these changes in MI design values, a cavity between the cladding and the membrane sheathing will be required at 82 additional locations (shown in Figure 1) to minimize the probability of moisture accumulation inboard of the cladding.

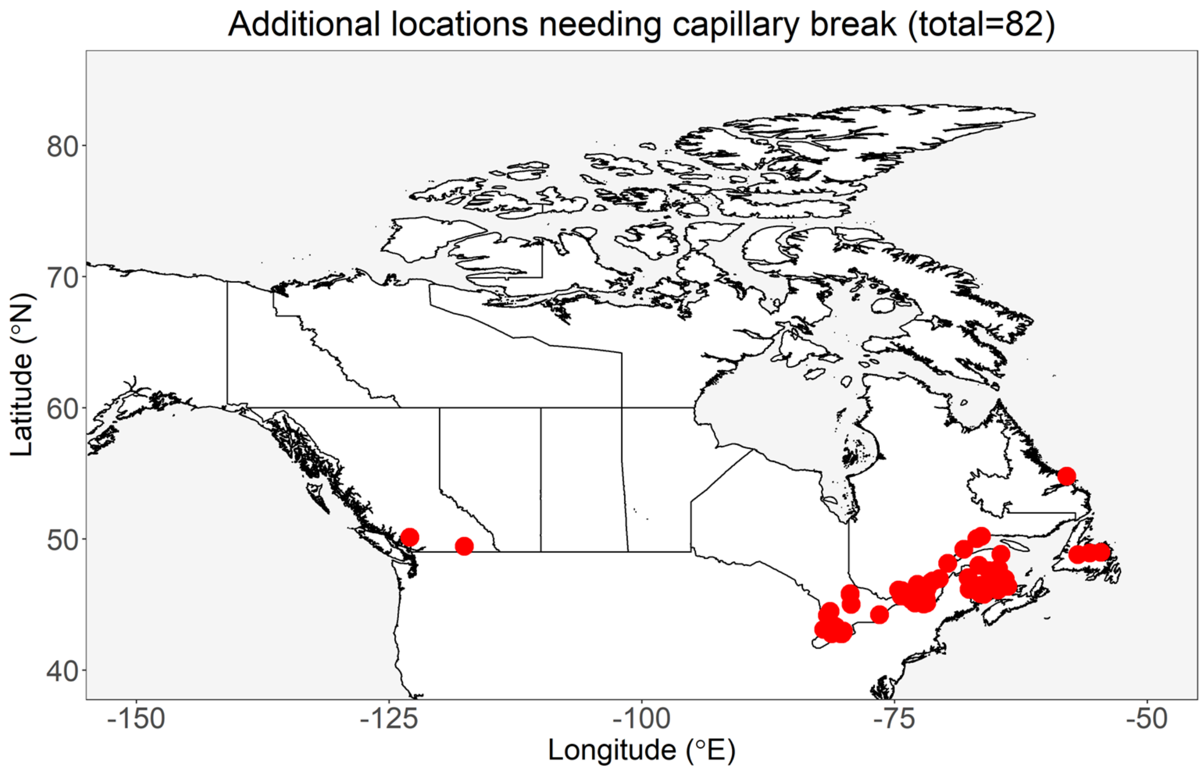

Figure 1. Additional locations in NBC Table C-2 that will require a capillary break for protection from potential moisture damage in the building envelope, taking climate change effects into consideration.

Cost impact on NBC Part 9 of updated moisture index values

Refer to "Cost Impact on Part 9 of Updated Moisture Index Values" in the supporting document for PCF 1979 for the full cost analysis. A summary is reproduced here.

The cost impact with respect to NBC Part 9 requirements for termite and decay protection per NBC 9.3.2.9.(3)(b) was determined for the 56 locations with a moisture index moving from less than or equal to 1 to greater than 1 due to the updated moisture index values. The locations impacted and the cost increases for a sample wood deck using preservative-treated instead of untreated lumber are as follows:

	Northern					Prairies				Atlantic				
	NT	NU	YT	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	National
Total locations impacted	0	0	0	4	0	0	0	2	37	8	2	0	3	56
Cost difference per deck ($)	n/a	n/a	n/a	289.20	n/a	n/a	n/a	271.91	435.24	444.62	444.62	n/a	544.17	415.89

The cost impact with respect to NBC Part 9 requirements for minimum protection from precipitation ingress per NBC Sentence 9.27.2.2.(5) was determined for the 53 new locations that will require a capillary break between the first and second planes of protection due to the updated moisture index values. The material and installation costs for vertical strapping between the cladding and sheathing to provide a capillary break were calculated for an archetypal house. The locations impacted and the cost increase per unit are as follows:

	Northern					Prairies				Atlantic				
	NT	NU	YT	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	National
Total locations impacted	0	0	0	1	0	0	0	2	37	8	2	0	3	53
Cost per unit ($)	n/a	n/a	n/a	1706	n/a	n/a	n/a	1666	1653	1226	1226	n/a	1520	1391

Driving rain wind pressure (DRWP)

This parameter is used for the design of wall assemblies to help ensure that incidental water entry into the assembly is minimized and for the selection of fenestration products. The following is a summary of the projected changes in the values of this parameter as a consequence of climate change over the typical design life of buildings (50 years):

Province or Territory	Number of Locations	ΔDRWP ≤ -5%	-5% < ΔDRWP ≤ 0	0 < ΔDRWP ≤ 5%	5% < ΔDRWP ≤ 10%	ΔDRWP > 10%
Alberta	55	0	3	23	21	8
British Columbia	108	0	0	0	42	66
Manitoba	24	0	4	3	12	5
New Brunswick	18	0	0	2	10	6
Newfoundland	18	0	0	5	7	6
Nova Scotia	25	0	1	13	10	1
Northwest Territories	17	0	0	2	6	9
Nunavut	16	0	0	0	2	14
Ontario	230	0	16	35	169	10
Prince Edward Island	4	0	0	1	1	2
Quebec	125	0	14	43	53	15
Saskatchewan	31	1	5	12	11	2
Yukon	9	0	0	0	0	9
Total	**680**	**1**	**43**	**139**	**344**	**153**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over a 50-year future timeframe range from -5.4% to 17.8%. A large fraction of the locations (636 out of 680) are projected to have future increases in DRWP, whereas 44 locations are projected to have future decreases. Out of the 636 locations projected to have future increases, 548 locations are projected to have changes large enough to not be rounded off within zero decimal places (the level of accuracy to which DRWP values are reported in the NBC). Accordingly, the current DRWP values are updated to increased future projected values for these 548 locations, for the design of wall assemblies and selection of fenestration products, and the current DRWP values are retained for the other locations. The design to ensure the watertightness of waterproofing systems around windows and doors would also need to account for the change in DRWP at locations where the increase is larger than 10% (i.e., for 153 locations).

Cost impact on NBC Part 9 of updated DRWP values

Refer to "Cost Impact on Part 9 of Updated Driving Rain Wind Pressure (DRWP) values" in the supporting document for PCF 1979 for the full cost analysis. A summary is reproduced here.

The cost impact with respect to NBC Part 9 requirements for flashing installation per NBC Clause 9.27.3.8.(4)(c) was determined for 74 locations where the required end-dam height will be increased due to the updated DRWP values. The cost increase of extending the end-dam height of window flashing was calculated for an archetypal house. The locations impacted and the cost increase per unit are as follows:

	Northern					Prairies				Atlantic				
	NT	NU	YT	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	National
Total locations impacted	0	4	1	21	0	3	1	0	9	3	4	16	12	74
Total cost of extra flashing per unit ($)	n/a	(1)	4.09	4.96	n/a	1.43	1.36	n/a	2.86	2.04	2.67	1.42	3.54	1.88

Note to Table:

(1) Cost data for Nunavut not available.

1/10 hourly wind pressure (Q_{10})

The following is a summary of changes projected in the values of this parameter as a consequence of climate change over the typical design life of buildings (50 years):

Province or Territory	Number of Locations	$\Delta Q_{10} \leq 0\%$	$0\% < \Delta Q_{10} \leq 5\%$	$5\% < \Delta Q_{10} \leq 10\%$	$10\% < \Delta Q_{10} \leq 15\%$	$\Delta Q_{10} > 15\%$
Alberta	55	0	26	29	0	0
British Columbia	108	0	15	48	45	0
Manitoba	24	0	10	14	0	0
New Brunswick	18	0	0	4	14	0
Newfoundland	18	0	0	8	10	0
Nova Scotia	25	0	0	11	14	0
Northwest Territories	17	0	5	12	0	0
Nunavut	16	0	11	5	0	0
Ontario	230	0	0	92	138	0
Prince Edward Island	4	0	0	2	2	0
Quebec	125	0	63	62	0	0
Saskatchewan	31	0	9	22	0	0
Yukon	9	0	9	0	0	0
Total	**680**	**0**	**148**	**309**	**223**	**0**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over a 50-year future timeframe range from 3.5% to 12%. Since all locations are projected to have future increases in Q_{10}, these increased values are applied as the future projected values. The 1-in-10 reference wind velocity pressure, Q_{10}, is used for the determination of the wind-induced accelerations of buildings for serviceability (see the Commentary entitled Wind Load and Effects in the "Structural Commentaries (User's Guide – NBC 2020: Part 4 of Division B)"). The climate change factor for Q_{10} is similar to that for Q_{500} (and Q_{50}); modest increases in building accelerations can be expected. Except for very tall buildings, acceptable accelerations will probably still be obtained without a significant change to structural design. For tall buildings that are very dynamically sensitive, the increase in Q_{10} may result in some additional structural costs to comply with serviceability criteria with respect to acceleration. Very dynamically sensitive tall buildings are required to be assessed through testing in a wind tunnel, which often allows significant optimization of the structure to be achieved.

1/50 hourly wind pressure (Q_{50})

The following is a summary of the changes projected in the values of this parameter as a consequence of climate change over the typical design life of buildings (50 years):

Province or Territory	Number of Locations	$\Delta Q_{50} \leq 0\%$	$0\% < \Delta Q_{50} \leq 5\%$	$5\% < \Delta Q_{50} \leq 10\%$	$10\% < \Delta Q_{50} \leq 15\%$	$\Delta Q_{50} > 15\%$
Alberta	55	0	55	0	0	0
British Columbia	108	0	23	85	0	0
Manitoba	24	0	24	0	0	0
New Brunswick	18	0	0	18	0	0
Newfoundland	18	0	0	18	0	0
Nova Scotia	25	0	0	25	0	0
Northwest Territories	17	0	17	0	0	0
Nunavut	16	0	16	0	0	0
Ontario	230	0	0	230	0	0
Prince Edward Island	4	0	0	4	0	0

Province or Territory	Number of Locations	$\Delta Q_{50} \leq$ 0%	0% < $\Delta Q_{50} \leq$ 5%	5% < $\Delta Q_{50} \leq$ 10%	10% < $\Delta Q_{50} \leq$ 15%	ΔQ_{50} > 15%
Quebec	125	0	125	0	0	0
Saskatchewan	31	0	31	0	0	0
Yukon	9	0	9	0	0	0
Total	**680**	**0**	**300**	**380**	**0**	**0**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over a 50-year future timeframe range from 5% to 10%. Since all locations are projected to have future increases in Q_{50}, the increased values are applied as the future projected values. Where the increases are higher than 5%, the total deflection of the building may be affected in terms of serviceability and comfort; therefore, the design of the building would need to be verified with respect to increased wind loads and, where warranted, the stiffness of building structural systems would need to be increased to ensure compliance with the serviceability requirements in the NBC 2025. As well, the design of cladding and roofing systems would need to account for increased strength of their connections. The locations where there are increases in reference wind velocity pressure would likely have increases to the cost of the building structure of less than 5%. This, in turn, would increase the total construction cost by less than 0.5%. Considering that these projected cost increases would be more than offset by improved safety and the prevention of wind-related failures, such cost increases are entirely reasonable.

Cost impact on NBC Part 9 of updated 1/50 hourly wind pressure

Refer to "Cost impact of climatic load changes on Part 9: Future projected climate data for snow and wind loads (PCF 1979)" in the supporting document for PCF 1979 for the full cost analysis. A summary is reproduced here.

For structural sufficiency of glass (NBC Sentence 9.6.1.3.(2)), a 128.5 m^2, 2-storey detached home, which contained five differently sized windows with glass areas between 0.57 m^2 and 1.43 m^2, was used as the archetype. In 649 of the 680 locations in NBC Table C-2, the 1-in-50 hourly wind pressures remained below the maximum limits provided in NBC Tables 9.6.1.3.-A, 9.6.1.3.-B and 9.6.1.3.-C before and after the change, resulting in no impact. In 3 of the 31 locations with a potential impact—Cowley, AB; Cape Race, NL; and Resolution Island, NU—the 1-in-50 hourly wind pressure before and after the proposed change exceeded the maximum value of 1.0 kPa provided in the prescriptive table in the NBC; this would require consultation with the window manufacturer for glass thickness and would likely have a cost impact. For the remaining 28 locations, there would be an increased cost for windows of $126.98 to $353.51.

For nailing of framing (nailing of roof trusses, rafters and joists to wall framing; NBC Sentence 9.23.3.4.(3)), a 120 m^2 bungalow was used as the archetype. Due to the proposed change, 6 new locations—Argentia, NL; Channel-Port aux Basques, NL; Grand Bank, NL; St. John's, NL; Wabana, NL; and Nottingham Island, NU—will have 1-in-50 hourly wind pressures that are equal to or exceed 0.8 kPa, and roof trusses, rafters or joists would be required to be tied to wall framing with connectors that can resist 3 kN of roof uplift. For 6 these locations, the number of galvanized steel connectors required was calculated to be approximately 72, resulting in a cost increase of $437.04.

For fasteners for sheathing (NBC Article 9.23.3.5.), a 128.5 m^2, 2-storey detached house was used as the archetype. In 667 of the 680 locations in NBC Table C-2, the 1-in-50 hourly wind pressures remained below 0.8 kPa, resulting in no impact. Seven of the 13 remaining locations already have a 1-in-50 hourly wind pressure greater than 0.8 kPa in the current NBC Table C-2, resulting in no impact. The same 6 locations noted above will have 1-in-50 hourly wind pressures that exceed 0.8 kPa due to the proposed change, resulting in the following impacts:

- For roof sheathing, the 6 new locations would require larger fasteners and fasteners spaced at 50 mm within 1 m of the roof edge. The cost increase using common wire nails was estimated to be $468.68 for each location.
- For wall sheathing, the 6 new locations would require braced wall panels with wood-based wall sheathing, resulting in a cost increase of $1,125.30 for each location.

For anchorage of building frames (NBC Sentence 9.23.6.1.(3)), the same 6 new locations noted above will have 1-in-50 hourly wind pressures that exceed 0.8 kPa, resulting in an increase in the number of anchor bolts by 15 for a total cost increase of $94.20.

For required roof sheathing (NBC Sentence 9.23.16.1.(1)), a 128.5 m^2 2-storey detached bungalow was used as the archetype. The same 6 locations noted above would be impacted by the proposed change and be required to meet Subsection 9.23.16. The cost increase for going from a sheathing deemed too thin for truss spacing in NBC Sentence 9.23.16.7.(2) to a compliant plywood sheathing was approximately $168.82.

For lumber roof sheathing (NBC Article 9.23.16.5.), the roof area of a 128.5 m^2 2-storey detached house was used as the archetype. The same 6 locations noted above would be impacted by the proposed change and be required to have lumber roof sheathing installed diagonally instead of horizontally, per NBC Sentence 9.23.16.5., resulting in a cost increase of approximately $311.67 for each location.

For the attachment of cladding to flat insulating concrete form (ICF) wall units (NBC Sentence 9.27.5.4.(2)), a 128.5 m^2 2-storey detached house was used as the archetype. In 612 of the 680 locations in NBC Table C-2, the 1-in-50 hourly wind pressure is equal to or less than 0.6 kPa before and after the proposed change, resulting in no impact. In 34 of the remaining 68 locations, the 1-in-50 hourly wind pressure is greater than 0.6 kPa before and after the proposed change, so the impact is assumed to be minimal and would account for additional fasteners. The greatest impact would be experienced where the 1-in-50 hourly wind pressure increases from equal to or less than 0.60 kPa to more than 0.6 kPa after the proposed change, which occurs in the remaining 34 locations. This resulted in an approximate cost increase of $2,009.15 in these locations, representing the different material costs for fasteners into concrete, the additional labour, and the reduced daily output to attach the furring through the flat ICF wall units into the solid concrete back-up wall.

1/50 snow load S_s (S_{s50})

The following is a summary of the changes projected in the values of this parameter as a consequence of climate change over the typical design life of buildings (50 years):

Province or Territory	Number of Locations	ΔS_{s50} < 0%	ΔS_{s50} = 0%	0% < ΔS_{s50} ≤ 2%	2% < ΔS_{s50} < 5%	ΔS_{s50}= 5%
Alberta	55	0	55	0	0	0
British Columbia	108	0	108	0	0	0
Manitoba	24	0	24	0	0	0
New Brunswick	18	0	18	0	0	0
Newfoundland	18	0	18	0	0	0
Nova Scotia	25	0	25	0	0	0
Northwest Territories	17	0	0	0	0	17
Nunavut	16	0	0	0	0	16
Ontario	230	0	230	0	0	0
Prince Edward Island	4	0	4	0	0	0
Quebec	125	0	125	0	0	0
Saskatchewan	31	0	31	0	0	0
Yukon	9	0	0	0	0	9
Total	**680**	**0**	**638**	**0**	**0**	**42**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over a 50-year future timeframe range from 0% to 5%. All 638 locations in the provinces of Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan are projected to have no change in S_{s50} in the future; accordingly, the design values for these locations remain the same as the current values. For the remaining 42 locations in the Northwest Territories, Nunavut and Yukon, a future increase in snow loads of 5% is projected and, as such, the future projected values are the recommended design values for those locations. Although the projected increase in snow loading in the North is greater than 4%, it is anticipated that this proposed change will have a negligible effect on total building costs in the future.

1/50 snow load S_r (S_{r50})

The following is a summary of the changes projected in the values of this parameter as a consequence of climate change over the typical design life of buildings (50 years):

Province or Territory	Number of Locations	ΔS_{r50} < 0%	ΔS_{r50} = 0%	0% < ΔS_{r50} ≤ 2%	2% < ΔS_{r50} < 5%	ΔS_{r50}= 5%
Alberta	55	0	55	0	0	0
British Columbia	108	0	108	0	0	0
Manitoba	24	0	24	0	0	0
New Brunswick	18	0	18	0	0	0
Newfoundland	18	0	18	0	0	0
Nova Scotia	25	0	25	0	0	0

Province or Territory	Number of Locations	ΔS_{r50} < 0%	ΔS_{r50} = 0%	0% < ΔS_{r50} ≤ 2%	2% < ΔS_{r50} < 5%	ΔS_{r50}= 5%
Northwest Territories	17	0	0	0	0	17
Nunavut	16	0	0	0	0	16
Ontario	230	0	230	0	0	0
Prince Edward Island	4	0	4	0	0	0
Quebec	125	0	125	0	0	0
Saskatchewan	31	0	31	0	0	0
Yukon	9	0	0	0	0	9
Total	**680**	**0**	**638**	**0**	**0**	**42**

Across the 680 locations in NBC Table C-2, the projected changes in the values of this parameter over a 50-year future timeframe range from 0% to 5%. All 638 locations in the provinces of Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan are projected to have no change in S_{r50} in the future; accordingly, the design values for these locations remain the same as the current values. For the remaining 42 locations in the Northwest Territories, Nunavut and Yukon, a future increase in snow loads of 5% is projected and, as such, the future projected values are the recommended design values for those locations. Although the projected increase in snow loading in the North is higher than 4%, it is anticipated that this proposed change will have a negligible effect on total building costs in the future.

Cost impact on NBC Part 9 of updated 1/50 snow loads

Refer to "Cost impact of climatic load changes on Part 9: Future projected climate data for snow and wind loads (PCF 1979)" in the supporting document for PCF 1979 for the full cost analysis. A summary is reproduced here.

For platforms subject to snow and occupancy loads (NBC Sentence 9.4.2.3.(1)), a 3.5 m by 4 m exterior platform was assessed as the archetype. Of the 42 locations impacted by the updated 1/50 snow loads, 29 locations had specified snow loads less than 1.9 kPa before and after the proposed change, resulting in no impact. Of the 13 remaining locations, 6 locations had specified snow loads that remained within the same range before and after the proposed change, resulting in no impact. Of the 7 remaining locations, using the archetype, span tables, and costs from RSMeans, only 2 locations had a cost increase—$47.77 in Tungsten, NT, and $126.43 in Kugluktuk/Coppermine, NU.

For performance of windows, doors and skylights (NBC Sentence 9.7.3.1.(2)), the magnitude of the cost impact could not be determined without industry knowledge of the structural design of skylights, including the capacity of the skylight frames and glazing.

For columns (NBC Sub 9.17.1.1.(1)(b)(ii)), a 2.44 m by 4 m exterior platform that is raised 3 m from the ground by 3 columns was assessed. In 41 of the 42 locations impacted by the updated 1/50 snow loads, the sum of the specified snow load and the occupancy load remained below 4.8 kPa before and after the proposed change, resulting in no impact. It was found that there was no change in cost in the last location—Resolution Island, NU—as the same column size was applicable before and after the change.

For ridge support (NBC Sentence 9.23.14.8.(5) and NBC Table 9.23.14.8.), a 120 m^2 bungalow was used as the archetype. In 32 of the 42 locations impacted by the updated 1/50 snow loads, the specified snow load remained within the same range before and after the proposed change, resulting in no impact. Of the 10 remaining locations, 3 were not impacted because the same number of nails were sufficient before and after the proposed change. In the 7 remaining locations, the maximum number of additional nails required was 3 nails, resulting in an additional material cost of $5.45 in Eureka, NU.

For ICF lintels (NBC Sentence 9.20.17.4.(3) and NBC Span Tables 9.20.17.4.-A, 9.20.17.4.-B and 9.20.17.4.-C), an approximately 120 m^2 bungalow was used as the archetype, assuming 150 mm thick ICF walls. ICF lintel sizes before and after the proposed change were analyzed where the ground snow load exceeded 3.33 kPa. In 31 of the 42 locations impacted by the updated 1/50 snow loads, the ICF lintel size was sufficient to support the snow load before and after the proposed change, resulting in no impact. In Resolution Island, NU, the ground snow load exceeded both those listed in the NBC span tables and those provided by an ICF manufacturer and will likely require a structural engineer to design using NBC Part 4 with additional material and labour costs. For the 10 remaining locations in the Yukon, Northwest Territories and Nunavut, there was an increased cost for ICF lintels of $6.71 to $32.63.

For spans for joists, rafters and beams (NBC Sentence 9.23.4.2.(1)), an approximately 120 m^2 bungalow was used as the archetype. In 38 of the 42 locations impacted by the updated 1/50 snow loads, the specified snow load before and after the proposed change remained within the same range, resulting in no impact. The impacts on the remaining 4 locations—Fort Smith, NT; Tungsten, NT; Eureka, NU; and, Kugluktuk, NU—are as follows:

- For roof joists (NBC Span Tables 9.23.4.2.-D and 9.23.4.2.-E), there was no impact in Fort Smith, NT, and Tungsten, NT, because the same roof joist size was sufficient before and after the proposed change. The cost increase in Eureka, NU, and Kugluktuk, NU, was approximately $1,850.00.
- For roof rafters (NBC Span Tables 9.23.4.2.-F and 9.23.4.2.-G), there was no impact in Kugluktuk, NU because the size of the roof rafters was sufficient before and after the proposed change. There was a cost increase of $255.30 to $1,342.89 in the 3 remaining locations.
- For built-up ridge beams and lintels supporting the roof (NBC Span Table 9.23.4.2.-L), there was no impact in Tungsten, NT, because the size of the built-up ridge beam was sufficient before and after the proposed change. There was a cost increase of $140.24 to $262.66 in the 3 remaining locations.
- For lintels of various wood species (NBC Span Tables 9.23.12.3.-A, 9.23.12.3.-B, 9.23.12.3.-C and 9.23.12.3.-D), there was a cost increase in all 4 locations of $32.13 to $84.47.

Uniform hazard vs. uniform risk
The introduction of new data for snow and wind loads reflects a change in the approach used to assess reliability in NBC Part 4 from "uniform hazard" to "uniform risk":

- New specified wind and snow load values are proposed that reflect a uniform risk by reducing the current load factors of 1.4 and 1.5, respectively, to 1.0 and by using 500-year recurrence wind loads and 1000-year recurrence snow loads.
- New parameters, winter average temperature and wind speed, are introduced (for snow drifting calculations on roofs).

The impacts of these changes are addressed in PCF 1980, which incorporates proposed climate-related changes in NBC Part 4, including the uniform risk approach.

Most importantly, this new approach will provide a more uniform level of safety across the country, depending on the site-specific climate, that accounts for climate projections over a 50-year horizon but keeps the same target level of safety (currently, a probability of failure of 0.001 during the 50-year assumed service life). In addition, this will harmonize the approach used for climatic loads with the approach used for seismic effects (2475-year recurrence of design earthquake).

Overall, the proposed changes to NBC Table C-2 will result in buildings with a lower risk of failure during their entire service compared to past practice. While the changes in some locations may seem significant, the proposed approach remains reasonably simple and is not disruptive to the current practice.

In most cases, it is expected that common construction methods, material spacings and design considerations would prove to be resilient enough that no significant additional measures or costs would be needed to satisfy the engineering design resulting from the shift to the proposed uniform risk approach and climate change factors.

Enforcement implications

There are no foreseeable enforcement implications.

Who is affected

Designers, architects, building regulators and building owners.

Supporting Document(s)

Cost Impact of PCF 1979 (cost_impact_of_pcf_1979.pdf)

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

N/A

Submit a comment

Proposed Change 1651

Code Reference(s):	**NECB20 Div.B 4.1.1.2.(2) (first printing)** **NECB20 Div.B 5.1.1.2.(2) (first printing)**
Subject:	Defined Terms
Title:	Use of the Defined Term "Occupancy" in the NECB
Description:	This proposed change removes the defined term "occupancy" from provisions where its use could cause confusion.
Related Code Change Request(s):	CCR 1390, CCR 1668, CCR 1708
Related Proposed Change(s):	PCF 1721

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [x] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

The use of the defined term "occupancy" in Sentences 4.1.1.2.(2) and 5.1.1.2.(2) of Division B of the National Energy Code of Canada for Buildings (NECB) is causing confusion among Code users.

Although "occupancy" has the same definition in the National Building Code of Canada (NBC) and the NECB, it serves a different purpose in each Code. In the NBC, it is used to describe the level of risk of a building for occupants and adjacent properties and to describe the requirements for the construction and protection of the building.

However, in the NECB, "occupancy" is used in the context of describing energy use requirements. The NECB also uses building or space types to describe the intended use of a building or part of a building for the purposes of describing the energy use requirements.

Justification

To avoid confusion and misinterpretation, the defined term "occupancy" should be removed from the NECB provisions that aim to describe energy use requirements for buildings.

PROPOSED CHANGE

[4.1.1.2.] 4.1.1.2. Application

[1] 2) This Part does not apply to the following lighting systems:

[a] a) emergency lighting that is automatically off during normal hours of *building* operation,

[b] b) lighting within *dwelling units*, and

[c] c) lighting in *buildings* or parts of *buildings* and in certain exterior spaces associated with the *building* where it can be shown that ~~the nature of the *occupancy*~~ ~~makes~~ it is impractical to apply these requirements (see Note A-4.1.1.2.(2)(c)).

[5.1.1.2.] 5.1.1.2. Application

[1] 2) A heating, ventilating or air-conditioning system or part thereof may be exempted from some or all of the requirements in this Part where it can be shown that ~~the nature of the *occupancy* or the type of heating, ventilating or air-conditioning equipment used makes~~ it is impractical to apply these requirements. (See Note A-5.1.1.2.(2).)

Impact analysis

This proposed change has no cost implications since the new term clarifies that the NECB requirements apply regardless of the type of occupancy.

Enforcement implications

This change can be enforced by the infrastructure currently available to enforce this Code.

Who is affected

Designers, engineers, builders, energy advisors and building officials.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[4.1.1.2.] 4.1.1.2. ([1] 2) no attributions

[5.1.1.2.] 5.1.1.2. ([1] 2) no attributions

Submit a comment

Proposed Change 2018

Code Reference(s):	**NECB20 Div.B Appendix C (first printing)**
Subject:	NECB Climatic Values
Title:	Updated Climatic Data
Description:	This proposed change updates Table C-1 to incorporate the effects of climate change.
Related Proposed Change(s):	PCF 1979, PCF 1980, PCF 2048

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [x] Building Envelope
- [x] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

In previous editions of the National Energy Code of Canada for Buildings (NECB), climatic data provided in Table C-1 were based on historical weather observations collected and analyzed by Environment and Climate Change Canada (ECCC). It was assumed that climatic data were time-independent (or stationary). However, in the face of extensive evidence that the climate is changing across Canada, this practice raises concerns for the design of buildings.

To assess the impacts of climate change trends on the climatic data and their associated climatic loads specified in the NECB, future climatic data sets have been developed by ECCC [1], based on the current body of research in climate modeling. These models simulate how the climate statistics are likely to change in various regions of Canada between 2024 and 2100 under various greenhouse gas (GHG) emissions scenarios called representative concentration pathways (RCPs). An RCP is a greenhouse gas concentration time profile. Four RCPs were used for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) in 2014: RCP2.6, RCP4.5, RCP6 and RCP8.5 (corresponding to radiative forcing values of 2.6 W/m^2, 4.5 W/m^2, 6 W/m^2 and 8.5 W/m^2, respectively, in 2100). These pathways represent different future greenhouse gas concentration time profiles that are possible depending on the volume of greenhouse gases emitted.

There has been international recognition in recent decades that the earth’s climate is changing, with the potential to create higher climatic loads and more adverse environmental conditions than currently specified based on historical observations. The consequences of this pose an increased risk to building integrity and functionality, and occupant life safety. More frequent high heat events also increase risk to occupant life safety.

Justification

The results of targeted research conducted by ECCC [1] specifically designed to address the effect of future projections of climatic conditions were accounted for in the update of each parameter of Table C-1. The proposed approach for building design is based on a 50-year time horizon (from 2025 to 2075) and the RCP8.5 future emissions scenario, corresponding to a 2.5°C global warming compared to the 1986–2016 baseline period. The projected future values are applied to the Table C-1 parameters using the following approach.

For parameters used for building envelope design, such as the effects of snow, rain, wind and moisture, if the projected future value in the 50-year time horizon is greater than the current updated value calculated from historical observations, the projected value is used. If the future value is projected to decrease, the current value is retained. This approach, called the Minimax Method, assures that over the 50-year time horizon the annual risk of failure does not exceed that which has historically been considered as acceptable. For some variables, such as temperature, the governing case for design may be the minimum, while for others, such as wind, it is the maximum. For instance, for wind, projections mostly show increases in reference pressure in future, making the last year of service life the governing case; for heating degree-days, projections show a general warming trend, potentially making the first year of service life the worst. This is deemed an appropriate approach that ensures that the Table C-1 values reflect the maximum loads expected that correspond to the specified annual probability of exceedance.

The non-stationarity of future climate due to the impact of climate change is embedded in Table C-1 using climate change factors derived from regional averages using the Minimax approach [2]. For reference design wind pressures, most areas in Canada have a climate change factor of 1.05, while locations in Ontario, the Atlantic provinces, and west of 120°W in British Columbia have a climate change factor of 1.1. The Minimax approach to adopt future values is applied to the other parameters using the future change factors from the targeted research results.

In future updates of Table C-1 values, it is expected that observed values will be updated to a new baseline period. Projected future values, based on ongoing research, will also be updated and referenced to the same new baseline period. In this way, both the observed and projected values will be reset to reflect knowledge at the time of the update. The projected values in this update that use the Minimax approach will not be compounded in future updates to Table C-1.

Terminology is also affected by the effects of a changing climate. Low-probability events have often been described as having a return period which, in a stationary (non-changing) climate, is defined as the average interval in years between such events. The reciprocal of the return period is defined as the annual exceedance probability. For instance, a 50-year return period event has an annual probability of 1/50 or 0.02. In a changing climate, the definition of the return period as an interval between events is not accurate. As a result, low-probability events are now identified with their annual exceedance probability rather than return period, since the annual probability can and often will change over time. For instance, a 50-year return period event is now described as a “1/50 annual probability event”, or sometimes just as the "1/50 value".

The uniform risk approach for wind results in a new 1/500 annual probability wind pressure value to reflect the ultimate load. In thunderstorm-prone regions, for wind values at low probabilities such as 1/500, the separate analysis of convective (e.g., thunderstorm) and synoptic (e.g., active low-pressure system with an embedded weather front) wind events generally results in higher wind values than the usual (up to the NECB 2020 edition) approach of analyzing the commingled convective and synoptic wind events as a single data set. This effect is not significant at higher annual probabilities such as 1/10 and 1/50. In addition to future values applied with the Minimax approach, the 500-year wind pressure values also account for the separate analysis of convective and synoptic wind events.

For parameters related to temperature and heating and cooling loads, such as degree-days below 18°C and 15°C, and January and July design temperatures, future values corresponding to a 50-year time horizon and RCP8.5 emissions scenario are applied in a similarly appropriate approach. Since warming is projected to occur for all locations, the current values for degree-day parameters and January design temperatures are all retained. The projected future values that reflect increased temperatures are applied to the July design temperatures. For cooling applications, the use of design temperatures mostly relates to occupant comfort; considering the prospect of more extreme heat events, applying future warmer temperatures also reduces the risk of future heat-related ill-health and mortality for occupants.

Analysis of the energy performance of buildings does not indicate an increased risk of overheating in buildings when mechanical cooling systems are provided and sized using historical July temperature data in the context of a future climate scenario.

However, sizing mechanical cooling systems based on future 50-year July temperature projections could result in oversized cooling equipment, which could increase construction costs. Also, the equipment may never experience the elevated temperature condition during its service life, which is considerably less than 50 years. Oversized cooling equipment can decrease energy efficiency and increase energy costs. The resulting oversizing could make equipment short-cycling worse and lead to inability of the equipment to meet latent loads, resulting in potentially excessive indoor humidity levels. In addition, short-cycling will decrease the service life of equipment. For the purposes of the design of mechanical cooling system equipment, Table C-1 provides July temperature data based on historical observations.

Further work is proposed on the use of future climate data in energy codes.

Extensive changes to the climate design data in Table C-1 and related documentation implement this approach.

PROPOSED CHANGE

NECB20 Div.B Appendix C (first printing)

Climatic Information for Building Design in Canada

Table C-1, which is referenced in Sentence 1.1.4.1.(1), represents a partial reproduction of Table C-2 of Division B of the NBC (see the section on Climatic and Seismic Information for Building Design in Canada in the NBC for further information on these climatic data categories). ~~The additional data for "Degree-Days Below 15°C" was developed by Environment and Climate Change Canada for inclusion in the NECB.~~

Table [C-1] C-1
Design Data for Selected Locations in Canada

Province and Location	Elev., m	Design Temperature				Degree-Days Below 18°C	Degree-Days Below 15°C	Hourly Wind Pressures, kPa (1)	
		January		July 2.5%					
		2.5% °C	1% °C	Historical (2)	Future			1/10	1/50

				Dry °C	Wet °C	Dry °C	Wet °C				
British Columbia											
100 Mile House	1040	-30	-32	29	17	34	21	5030	4040	~~0.27~~ 0.30	~~0.35~~ 0.39
Abbotsford	70	-8	-10	29	20	35	25	2860	2000	~~0.33~~ 0.36	~~0.44~~ 0.48
Agassiz	15	-9	-11	31	21	37	26	2750	1900	~~0.35~~ 0.39	~~0.47~~ 0.52
Alberni	12	-5	-8	31	19	37	24	3100	2220	~~0.24~~ 0.26	~~0.32~~ 0.35
Ashcroft	305	-24	-27	34	20	39	24	3700	2790	~~0.29~~ 0.32	~~0.38~~ 0.42
Bamfield	20	-2	-4	23	17	28	21	3080	2060	~~0.38~~ 0.42	~~0.50~~ 0.55
Beatton River	840	-37	-39	26	18	31	22	6300	5230	~~0.23~~ 0.25	~~0.30~~ 0.33
Bella Bella	25	-5	-7	23	18	28	22	3180	2150	~~0.40~~ 0.44	~~0.50~~ 0.55
Bella Coola	40	-14	-18	27	19	33	24	3560	2660	~~0.29~~ 0.32	~~0.39~~ 0.43
Burns Lake	755	-31	-34	26	17	32	22	5450	4430	~~0.29~~ 0.32	~~0.39~~ 0.43
Cache Creek	455	-24	-27	34	20	39	24	3700	2790	~~0.29~~ 0.32	~~0.39~~ 0.43
Campbell River	20	-5	-7	26	18	32	23	3000	2130	~~0.41~~ 0.45	~~0.48~~ 0.53
Carmi	845	-24	-26	31	19	36	23	4750	3770	~~0.29~~ 0.30	~~0.38~~ 0.40
Castlegar	430	-18	-20	32	20	37	24	3580	2680	~~0.26~~ 0.27	~~0.34~~ 0.36
Chetwynd	605	-35	-38	27	18	33	22	5500	4480	~~0.30~~ 0.33	~~0.40~~ 0.44
Chilliwack	10	-9	-11	30	20	36	25	2780	1920	~~0.35~~ 0.39	~~0.47~~ 0.52
Comox	15	-7	-9	27	18	33	23	2930	2220	~~0.41~~ 0.45	~~0.48~~ 0.53
Courtenay	10	-7	-9	28	18	34	23	2930	2220	~~0.41~~ 0.45	~~0.48~~ 0.53

Cranbrook	910	-26	-28	32	18	37	22	4400	3450	~~0.25~~ 0.26	~~0.33~~ 0.35
Crescent Valley	585	-18	-20	31	20	36	24	3650	2740	~~0.25~~ 0.26	~~0.33~~ 0.35
Crofton	5	-4	-6	28	19	34	24	2880	2020	~~0.32~~ 0.35	~~0.40~~ 0.44
Dawson Creek	665	-38	-40	27	18	32	22	5900	4860	~~0.30~~ 0.33	~~0.40~~ 0.44
Dease Lake	800	-37	-40	24	15	29	19	6730	5630	~~0.23~~ 0.25	~~0.30~~ 0.33
Dog Creek	450	-28	-30	29	17	34	21	4800	3820	~~0.27~~ 0.30	~~0.35~~ 0.39
Duncan	10	-6	-8	28	19	33	24	2980	2110	~~0.31~~ 0.34	~~0.39~~ 0.43
Elko	1065	-28	-31	30	19	35	23	4600	3630	~~0.30~~ 0.32	~~0.40~~ 0.42
Fernie	1010	-27	-30	30	19	35	23	4750	3770	~~0.30~~ 0.32	~~0.40~~ 0.42
Fort Nelson	465	-39	-42	28	18	32	22	6710	5740	~~0.23~~ 0.25	~~0.30~~ 0.33
Fort St. John	685	-35	-37	26	18	31	22	5750	4710	~~0.29~~ 0.32	~~0.39~~ 0.43
Glacier	1145	-27	-30	27	17	33	22	5800	4760	~~0.24~~ 0.25	~~0.32~~ 0.34
Golden	790	-27	-30	30	17	36	22	4750	3770	~~0.26~~ 0.27	~~0.35~~ 0.37
Gold River	120	-8	-11	31	18	37	23	3230	2350	~~0.24~~ 0.26	~~0.32~~ 0.35
Grand Forks	565	-19	-22	34	20	39	24	3820	2900	~~0.30~~ 0.32	~~0.40~~ 0.42
Greenwood	745	-20	-23	34	20	39	24	4100	3160	~~0.30~~ 0.32	~~0.40~~ 0.42
Hope	40	-13	-15	31	20	37	25	2820	2130	~~0.47~~ 0.52	~~0.63~~ 0.69
Jordan River	20	-1	-3	22	17	27	22	2900	1900	~~0.44~~ 0.48	~~0.55~~ 0.61
Kamloops	355	-23	-25	34	20	38	24	3450	2670	~~0.30~~ 0.33	~~0.40~~ 0.44
Kaslo	545	-17	-20	30	19	35	23	3830	2910	~~0.23~~ 0.24	~~0.31~~ 0.33

Kelowna	350	-17	-20	33	20	38	24	3400	2510	~~0.30~~ 0.32	~~0.40~~ 0.42
Kimberley	1090	-25	-27	31	18	36	22	4650	3680	~~0.25~~ 0.26	~~0.33~~ 0.35
Kitimat Plant	15	-16	-18	25	16	31	21	3750	2830	~~0.36~~ 0.40	~~0.48~~ 0.53
Kitimat Townsite	130	-16	-18	24	16	30	21	3900	2980	~~0.36~~ 0.40	~~0.48~~ 0.53
Ladysmith	80	-7	-9	27	19	32	24	2920	2130	~~0.32~~ 0.35	~~0.40~~ 0.44
Langford	80	-4	-6	27	19	33	23	2750	1770	~~0.32~~ 0.35	~~0.40~~ 0.44
Lillooet	245	-21	-23	34	20	39	24	3400	2610	~~0.33~~ 0.36	~~0.44~~ 0.48
Lytton	325	-17	-20	35	20	40	24	3300	2410	~~0.32~~ 0.35	~~0.43~~ 0.47
Mackenzie	765	-34	-38	27	17	33	21	5550	4530	~~0.25~~ 0.28	~~0.32~~ 0.35
Masset	10	-5	-7	17	15	21	18	3700	2600	~~0.50~~ 0.55	~~0.61~~ 0.67
McBride	730	-29	-32	29	18	36	23	4980	3990	~~0.27~~ 0.30	~~0.35~~ 0.39
McLeod Lake	695	-35	-37	27	17	33	21	5450	4430	~~0.25~~ 0.28	~~0.32~~ 0.35
Merritt	570	-24	-27	34	20	39	24	3900	2980	~~0.33~~ 0.36	~~0.44~~ 0.48
Mission City	45	-9	-11	30	20	36	25	2850	1990	~~0.32~~ 0.35	~~0.43~~ 0.47
Montrose	615	-16	-18	32	20	37	24	3600	2690	~~0.26~~ 0.27	~~0.35~~ 0.37
Nakusp	445	-20	-22	31	20	36	24	3560	2660	~~0.25~~ 0.26	~~0.33~~ 0.35
Nanaimo	15	-6	-8	27	19	33	24	2920	2130	~~0.38~~ 0.42	~~0.48~~ 0.53
Nelson	600	-18	-20	31	20	36	24	3500	2600	~~0.25~~ 0.26	~~0.33~~ 0.35
Ocean Falls	10	-10	-12	23	17	28	22	3400	2510	~~0.44~~ 0.48	~~0.59~~ 0.65
Osoyoos	285	-14	-17	35	21	40	25	3100	2220	~~0.30~~ 0.32	~~0.40~~ 0.42

Parksville	40	-6	-8	26	19	32	24	2990	2320	~~0.40~~ 0.44	~~0.48~~ 0.53
Penticton	350	-15	-17	33	20	38	24	3350	2460	~~0.30~~ 0.32	~~0.40~~ 0.42
Port Alberni	15	-5	-8	31	19	37	24	3100	2220	~~0.24~~ 0.26	~~0.32~~ 0.35
Port Alice	25	-3	-6	26	17	31	21	3010	2000	~~0.24~~ 0.26	~~0.32~~ 0.35
Port Hardy	5	-5	-7	20	16	25	20	3440	2370	~~0.36~~ 0.40	~~0.48~~ 0.53
Port McNeill	5	-5	-7	22	17	27	21	3410	2350	~~0.36~~ 0.40	~~0.48~~ 0.53
Port Renfrew	20	-3	-5	24	17	29	21	2900	1900	~~0.42~~ 0.46	~~0.52~~ 0.57
Powell River	10	-7	-9	26	18	32	23	3100	2220	~~0.39~~ 0.43	~~0.48~~ 0.53
Prince George	580	-32	-36	28	18	34	22	4720	3750	~~0.28~~ 0.31	~~0.37~~ 0.41
Prince Rupert	20	-13	-15	19	15	24	19	3900	2770	~~0.43~~ 0.47	~~0.54~~ 0.59
Princeton	655	-24	-29	33	19	39	24	4250	3300	~~0.27~~ 0.30	~~0.36~~ 0.40
Qualicum Beach	10	-7	-9	27	19	33	24	2990	2320	~~0.41~~ 0.45	~~0.48~~ 0.53
Queen Charlotte City	35	-6	-8	21	16	25	20	3520	2440	~~0.50~~ 0.55	~~0.61~~ 0.67
Quesnel	475	-31	-33	30	17	36	21	4650	3680	~~0.24~~ 0.26	~~0.31~~ 0.34
Revelstoke	440	-20	-23	31	19	36	23	4000	3070	~~0.24~~ 0.25	~~0.32~~ 0.34
Salmon Arm	425	-19	-24	33	21	38	25	3650	2740	~~0.29~~ 0.30	~~0.39~~ 0.41
Sandspit	5	-4	-6	18	15	22	19	3450	2380	~~0.59~~ 0.65	~~0.72~~ 0.79
Sechelt	25	-6	-8	27	20	33	25	2680	1830	~~0.38~~ 0.42	~~0.48~~ 0.53
Sidney	10	-4	-6	26	18	32	22	2850	1860	~~0.34~~ 0.37	~~0.42~~ 0.46
Smithers	500	-29	-31	26	17	32	22	5040	4050	~~0.30~~ 0.33	~~0.40~~ 0.44

Smith River	660	-45	-47	26	17	30	21	7100	5980	~~0.24~~ 0.26	~~0.30~~ 0.33
Sooke	20	-1	-3	21	16	27	20	2900	1900	~~0.38~~ 0.42	~~0.48~~ 0.53
Squamish	5	-9	-11	29	20	35	25	2950	2080	~~0.38~~ 0.42	~~0.50~~ 0.55
Stewart	10	-17	-20	25	16	31	21	4350	3400	~~0.27~~ 0.30	~~0.36~~ 0.40
Tahsis	25	-4	-6	26	18	32	23	3150	2120	~~0.26~~ 0.29	~~0.34~~ 0.37
Taylor	515	-35	-37	26	18	31	22	5720	4690	~~0.30~~ 0.33	~~0.40~~ 0.44
Terrace	60	-19	-21	27	17	33	22	4150	3210	~~0.27~~ 0.30	~~0.36~~ 0.40
Tofino	10	-2	-4	20	16	25	20	3150	2120	~~0.51~~ 0.56	~~0.68~~ 0.75
Trail	440	-14	-17	33	20	38	24	3600	2690	~~0.26~~ 0.27	~~0.35~~ 0.37
Ucluelet	5	-2	-4	18	16	23	20	3120	2100	~~0.51~~ 0.56	~~0.68~~ 0.75
Vancouver Region											
Burnaby (Simon Fraser Univ.)	330	-7	-9	25	17	31	22	3100	2220	~~0.35~~ 0.39	~~0.47~~ 0.52
Cloverdale	10	-8	-10	29	20	35	25	2700	1850	~~0.33~~ 0.36	~~0.44~~ 0.48
Haney	10	-9	-11	30	20	36	25	2840	1980	~~0.33~~ 0.36	~~0.44~~ 0.48
Ladner	3	-6	-8	27	19	33	24	2600	1750	~~0.37~~ 0.41	~~0.46~~ 0.51
Langley	15	-8	-10	29	20	35	25	2700	1850	~~0.33~~ 0.36	~~0.44~~ 0.48
New Westminster	10	-8	-10	29	19	35	24	2800	1940	~~0.33~~ 0.36	~~0.44~~ 0.48
North Vancouver	135	-7	-9	26	19	32	24	2910	2050	~~0.34~~ 0.37	~~0.45~~ 0.50
Richmond	5	-7	-9	27	19	33	24	2800	1940	~~0.36~~ 0.40	~~0.45~~ 0.50
Surrey (88 Ave & 156 St.)	90	-8	-10	29	20	35	25	2750	1900	~~0.33~~ 0.36	~~0.44~~ 0.48

Vancouver (City Hall)	40	-7	-9	28	20	34	25	2825	1970	~~0.34~~ 0.37	~~0.45~~ 0.50
Vancouver (Granville St. & 41st Ave)	120	-6	-8	28	20	34	25	2925	2060	~~0.36~~ 0.40	~~0.45~~ 0.50
West Vancouver	45	-7	-9	28	19	34	24	2950	2080	~~0.36~~ 0.40	~~0.48~~ 0.53
Vernon	405	-20	-23	33	20	38	24	3600	2690	~~0.30~~ 0.32	~~0.40~~ 0.42
Victoria Region											
Victoria	10	-4	-6	24	17	30	21	2650	1730	~~0.46~~ 0.51	~~0.57~~ 0.63
Victoria (Gonzales Hts)	65	-4	-6	24	17	30	21	2700	1690	~~0.46~~ 0.51	~~0.57~~ 0.63
Victoria (Mt Tolmie)	125	-6	-8	24	16	30	20	2700	1730	~~0.46~~ 0.48	~~0.57~~ 0.60
Whistler	665	-17	-20	30	20	36	25	4180	3240	~~0.24~~ 0.26	~~0.32~~ 0.35
White Rock	30	-5	-7	25	20	31	25	2620	1770	~~0.33~~ 0.36	~~0.44~~ 0.48
Williams Lake	615	-30	-33	29	17	34	21	4400	3450	~~0.27~~ 0.30	~~0.35~~ 0.39
Youbou	200	-5	-8	31	19	36	24	3050	2180	~~0.26~~ 0.29	~~0.32~~ 0.35
Alberta											
Athabasca	515	-35	-38	27	19	32	23	6000	5000	~~0.27~~ 0.28	~~0.36~~ 0.38
Banff	1400	-31	-33	27	16	33	20	5500	4520	~~0.26~~ 0.27	~~0.32~~ 0.34
Barrhead	645	-33	-36	27	19	32	23	5740	4750	~~0.35~~ 0.37	~~0.44~~ 0.46
Beaverlodge	730	-36	-39	28	18	33	22	5700	4710	~~0.27~~ 0.28	~~0.36~~ 0.38
Brooks	760	-32	-34	32	20	37	24	4880	3940	~~0.35~~ 0.37	~~0.44~~ 0.46
Calgary	1045	-30	-32	28	17	34	21	5000	4050	~~0.38~~ 0.40	~~0.48~~ 0.50
Campsie	660	-33	-36	27	19	32	23	5750	4760	~~0.33~~ 0.35	~~0.44~~ 0.46

Camrose	740	-33	-35	29	19	34	23	5500	4520	~~0.31~~ 0.33	~~0.39~~ 0.41
Canmore	1320	-31	-33	28	17	34	21	5400	4430	~~0.30~~ 0.32	~~0.37~~ 0.39
Cardston	1130	-29	-32	30	19	35	23	4700	3770	~~0.58~~ 0.61	~~0.72~~ 0.76
Claresholm	1030	-30	-32	30	18	35	22	4680	3750	~~0.46~~ 0.48	~~0.58~~ 0.61
Cold Lake	540	-35	-38	28	19	33	23	5860	4860	~~0.29~~ 0.30	~~0.38~~ 0.40
Coleman	1320	-31	-34	29	18	34	22	5210	4250	~~0.50~~ 0.53	~~0.63~~ 0.66
Coronation	790	-32	-34	30	19	36	23	5640	4660	~~0.30~~ 0.32	~~0.37~~ 0.39
Cowley	1175	-29	-32	29	18	34	22	4810	3870	~~0.81~~ 0.85	~~1.01~~ 1.06
Drumheller	685	-32	-34	30	18	36	22	5050	4100	~~0.35~~ 0.37	~~0.44~~ 0.46
Edmonton	645	-30	-33	28	19	34	23	5120	4160	~~0.36~~ 0.38	~~0.45~~ 0.47
Edson	920	-34	-37	27	18	32	22	5750	4760	~~0.37~~ 0.39	~~0.46~~ 0.48
Embarras Portage	220	-41	-43	28	19	32	23	7100	6040	~~0.28~~ 0.29	~~0.37~~ 0.39
Fairview	670	-37	-40	27	18	32	22	5840	4850	~~0.26~~ 0.27	~~0.35~~ 0.37
Fort MacLeod	945	-30	-32	31	19	36	23	4600	3670	~~0.54~~ 0.57	~~0.68~~ 0.71
Fort McMurray	255	-38	-40	28	19	33	23	6250	5230	~~0.28~~ 0.29	~~0.35~~ 0.37
Fort Saskatchewan	610	-32	-35	28	19	34	23	5420	4450	~~0.34~~ 0.36	~~0.43~~ 0.45
Fort Vermilion	270	-41	-43	28	18	32	22	6700	5660	~~0.23~~ 0.24	~~0.30~~ 0.32
Grande Prairie	650	-36	-39	27	18	32	22	5790	4800	~~0.32~~ 0.34	~~0.43~~ 0.45
Habay	335	-41	-43	28	18	32	22	6750	5710	~~0.23~~ 0.24	~~0.30~~ 0.32
Hardisty	615	-33	-36	30	19	36	23	5640	4660	~~0.29~~ 0.30	~~0.36~~ 0.38

High River	1040	-31	-32	28	17	33	21	4900	3960	~~0.52~~ 0.55	~~0.65~~ 0.68
Hinton	990	-34	-38	27	17	33	21	5500	4520	~~0.37~~ 0.39	~~0.46~~ 0.48
Jasper	1060	-31	-34	28	17	34	22	5300	4330	~~0.26~~ 0.27	~~0.32~~ 0.34
Keg River	420	-40	-42	28	18	32	22	6520	5490	~~0.23~~ 0.24	~~0.30~~ 0.32
Lac La Biche	560	-35	-38	28	19	33	23	6100	5090	~~0.27~~ 0.28	~~0.36~~ 0.38
Lacombe	855	-33	-36	28	19	34	23	5500	4520	~~0.32~~ 0.34	~~0.40~~ 0.42
Lethbridge	910	-30	-32	31	19	36	23	4500	3580	~~0.53~~ 0.56	~~0.66~~ 0.69
Manning	465	-39	-41	27	18	32	22	6300	5280	~~0.23~~ 0.24	~~0.30~~ 0.32
Medicine Hat	705	-31	-34	32	19	37	23	4540	3610	~~0.38~~ 0.40	~~0.48~~ 0.50
Peace River	330	-37	-40	27	18	32	22	6050	5040	~~0.24~~ 0.25	~~0.32~~ 0.34
Pincher Creek	1130	-29	-32	29	18	34	22	4740	3800	~~0.77~~ 0.81	~~0.96~~ 1.01
Ranfurly	670	-34	-37	29	19	34	23	5700	4710	~~0.29~~ 0.30	~~0.36~~ 0.38
Red Deer	855	-32	-35	28	19	34	23	5550	4570	~~0.32~~ 0.34	~~0.40~~ 0.42
Rocky Mountain House	985	-32	-34	27	18	33	22	5640	4660	~~0.29~~ 0.30	~~0.36~~ 0.38
Slave Lake	590	-35	-38	26	19	31	23	5850	4850	~~0.28~~ 0.29	~~0.37~~ 0.39
Stettler	820	-32	-34	30	19	36	23	5300	4330	~~0.29~~ 0.30	~~0.36~~ 0.38
Stony Plain	710	-32	-35	28	19	33	23	5300	4330	~~0.36~~ 0.38	~~0.45~~ 0.47
Suffield	755	-31	-34	32	20	37	24	4770	3830	~~0.39~~ 0.41	~~0.49~~ 0.51
Taber	815	-31	-33	31	19	36	23	4580	3650	~~0.50~~ 0.53	~~0.63~~ 0.66
Turner Valley	1215	-31	-32	28	17	33	21	5220	4260	~~0.52~~ 0.55	~~0.65~~ 0.68

Valleyview	700	-37	-40	27	18	32	22	5600	4620	~~0.34~~ 0.36	~~0.42~~ 0.44
Vegreville	635	-34	-37	29	19	34	23	5780	4790	~~0.29~~ 0.30	~~0.36~~ 0.38
Vermilion	580	-35	-38	29	19	35	23	5740	4750	~~0.29~~ 0.30	~~0.36~~ 0.38
Wagner	585	-35	-38	26	19	31	23	5850	4850	~~0.28~~ 0.29	~~0.37~~ 0.39
Wainwright	675	-33	-36	29	19	35	23	5700	4710	~~0.29~~ 0.30	~~0.36~~ 0.38
Wetaskiwin	760	-33	-35	29	19	34	23	5500	4520	~~0.31~~ 0.33	~~0.39~~ 0.41
Whitecourt	690	-33	-36	27	19	32	23	5650	4670	~~0.28~~ 0.29	~~0.37~~ 0.39
Wimborne	975	-31	-34	29	18	35	22	5310	4340	~~0.32~~ 0.34	~~0.40~~ 0.42
Saskatchewan											
Assiniboia	740	-32	-34	31	21	36	25	5180	4300	~~0.39~~ 0.41	~~0.49~~ 0.51
Battrum	700	-32	-34	32	20	37	24	5080	4210	~~0.43~~ 0.45	~~0.54~~ 0.57
Biggar	645	-34	-36	30	20	35	24	5720	4820	~~0.36~~ 0.38	~~0.45~~ 0.47
Broadview	600	-34	-35	30	21	35	25	5760	4850	~~0.36~~ 0.38	~~0.46~~ 0.48
Dafoe	530	-35	-37	29	21	34	25	5860	4950	~~0.29~~ 0.30	~~0.37~~ 0.39
Dundurn	525	-35	-37	30	21	35	25	5600	4700	~~0.36~~ 0.38	~~0.46~~ 0.48
Estevan	565	-32	-34	32	22	37	25	5340	4450	~~0.41~~ 0.43	~~0.52~~ 0.55
Hudson Bay	370	-36	-38	29	21	34	25	6280	5350	~~0.29~~ 0.30	~~0.37~~ 0.39
Humboldt	565	-36	-38	28	21	33	25	6000	5080	~~0.31~~ 0.33	~~0.39~~ 0.41
Island Falls	305	-39	-41	27	20	32	24	7100	6130	~~0.26~~ 0.27	~~0.35~~ 0.37
Kamsack	455	-34	-37	29	22	34	26	6040	5120	~~0.32~~ 0.34	~~0.40~~ 0.42

Kindersley	685	-33	-35	31	20	36	24	5550	4650	~~0.36~~ 0.38	~~0.46~~ 0.48
Lloydminster	645	-34	-37	28	20	34	24	5880	4970	~~0.32~~ 0.34	~~0.40~~ 0.42
Maple Creek	765	-31	-34	31	20	36	24	4780	3920	~~0.36~~ 0.38	~~0.45~~ 0.47
Meadow Lake	480	-38	-40	28	20	33	24	6280	5350	~~0.30~~ 0.32	~~0.40~~ 0.42
Melfort	455	-36	-38	28	21	33	25	6050	5130	~~0.28~~ 0.29	~~0.36~~ 0.38
Melville	550	-34	-36	29	21	34	25	5880	4970	~~0.32~~ 0.34	~~0.40~~ 0.42
Moose Jaw	545	-32	-34	31	21	36	25	5270	4390	~~0.41~~ 0.43	~~0.52~~ 0.55
Nipawin	365	-37	-39	28	21	33	25	6300	5370	~~0.30~~ 0.32	~~0.38~~ 0.40
North Battleford	545	-34	-36	29	20	34	24	5900	4990	~~0.36~~ 0.38	~~0.46~~ 0.48
Prince Albert	435	-37	-40	28	21	33	25	6100	5180	~~0.30~~ 0.32	~~0.38~~ 0.40
Qu'Appelle	645	-34	-36	30	22	35	26	5620	4720	~~0.33~~ 0.35	~~0.42~~ 0.44
Regina	575	-34	-36	31	21	36	25	5600	4700	~~0.39~~ 0.41	~~0.49~~ 0.51
Rosetown	595	-34	-36	31	20	36	24	5620	4720	~~0.39~~ 0.41	~~0.49~~ 0.51
Saskatoon	500	-35	-37	30	21	35	25	5700	4800	~~0.36~~ 0.38	~~0.46~~ 0.48
Scott	645	-34	-36	30	20	35	24	5960	5040	~~0.36~~ 0.38	~~0.45~~ 0.47
Strasbourg	545	-34	-36	30	22	35	26	5600	4700	~~0.33~~ 0.35	~~0.42~~ 0.44
Swift Current	750	-31	-34	31	20	36	24	5150	4270	~~0.43~~ 0.45	~~0.54~~ 0.57
Uranium City	265	-42	-44	26	19	30	22	7500	6510	~~0.27~~ 0.28	~~0.36~~ 0.38
Weyburn	575	-33	-35	31	23	36	27	5400	4510	~~0.38~~ 0.40	~~0.48~~ 0.50
Yorkton	510	-34	-37	29	21	34	25	6000	5080	~~0.32~~ 0.34	~~0.40~~ 0.42

Manitoba										
Beausejour	245	-33	-35	29	23	33	26	5680	4780	~~0.32~~ 0.34	~~0.41~~ 0.43
Boissevain	510	-32	-34	30	23	34	26	5500	4610	~~0.41~~ 0.43	~~0.52~~ 0.55
Brandon	395	-33	-35	30	22	35	25	5760	4850	~~0.39~~ 0.41	~~0.49~~ 0.51
Churchill	10	-38	-40	25	18	29	22	8950	7890	~~0.43~~ 0.45	~~0.55~~ 0.58
Dauphin	295	-33	-35	30	22	35	26	5900	4990	~~0.32~~ 0.34	~~0.40~~ 0.42
Flin Flon	300	-38	-40	27	20	32	24	6440	5500	~~0.28~~ 0.29	~~0.35~~ 0.37
Gimli	220	-34	-36	29	23	33	26	5800	4890	~~0.32~~ 0.34	~~0.40~~ 0.42
Island Lake	240	-36	-38	27	20	31	23	6900	5940	~~0.29~~ 0.30	~~0.37~~ 0.39
Lac du Bonnet	260	-34	-36	29	23	33	26	5730	4830	~~0.29~~ 0.30	~~0.37~~ 0.39
Lynn Lake	350	-40	-42	27	19	31	23	7770	6770	~~0.29~~ 0.30	~~0.37~~ 0.39
Morden	300	-31	-33	30	24	34	27	5400	4510	~~0.41~~ 0.43	~~0.52~~ 0.55
Neepawa	365	-32	-34	29	23	34	26	5760	4850	~~0.35~~ 0.37	~~0.44~~ 0.46
Pine Falls	220	-34	-36	28	23	32	26	5900	4990	~~0.31~~ 0.33	~~0.39~~ 0.41
Portage la Prairie	260	-31	-33	30	23	34	26	5600	4700	~~0.36~~ 0.38	~~0.46~~ 0.48
Rivers	465	-34	-36	29	23	33	26	5840	4930	~~0.36~~ 0.38	~~0.46~~ 0.48
Sandilands	365	-32	-34	29	23	33	26	5650	4750	~~0.32~~ 0.34	~~0.40~~ 0.42
Selkirk	225	-33	-35	29	23	33	26	5700	4800	~~0.32~~ 0.34	~~0.41~~ 0.43
Split Lake	175	-38	-40	27	19	31	23	7900	6890	~~0.31~~ 0.33	~~0.39~~ 0.41
Steinbach	270	-33	-35	29	23	33	26	5700	4800	~~0.32~~ 0.34	~~0.40~~ 0.42

Swan River	335	-34	-37	29	22	34	26	6100	5180	~~0.28~~ 0.29	~~0.35~~ 0.37
The Pas	270	-36	-38	28	21	33	25	6480	5540	~~0.29~~ 0.30	~~0.37~~ 0.39
Thompson	205	-40	-43	27	19	31	23	7600	6600	~~0.28~~ 0.29	~~0.36~~ 0.38
Virden	435	-33	-35	30	23	34	26	5620	4720	~~0.36~~ 0.38	~~0.46~~ 0.48
Winnipeg	235	-33	-35	30	23	34	26	5670	4770	~~0.36~~ 0.38	~~0.45~~ 0.47
Ontario											
Ailsa Craig	230	-17	-19	30	23	34	26	3840	3050	~~0.37~~ 0.41	~~0.48~~ 0.53
Ajax	95	-20	-22	30	23	34	26	3820	3030	~~0.37~~ 0.41	~~0.48~~ 0.53
Alexandria	80	-24	-26	30	23	34	26	4600	3740	~~0.31~~ 0.34	~~0.40~~ 0.44
Alliston	220	-23	-25	29	23	33	26	4200	3380	~~0.28~~ 0.31	~~0.36~~ 0.40
Almonte	120	-26	-28	30	23	34	26	4620	3760	~~0.32~~ 0.35	~~0.41~~ 0.45
Armstrong	340	-37	-40	28	21	32	24	6500	5530	~~0.22~~ 0.24	~~0.30~~ 0.33
Arnprior	85	-27	-29	30	23	34	26	4680	3820	~~0.29~~ 0.32	~~0.37~~ 0.41
Atikokan	400	-33	-35	29	22	33	25	5750	4810	~~0.22~~ 0.24	~~0.30~~ 0.33
Attawapiskat	10	-37	-39	28	21	32	24	7100	6120	~~0.30~~ 0.33	~~0.41~~ 0.45
Aurora	270	-21	-23	30	23	34	26	4210	3390	~~0.34~~ 0.37	~~0.44~~ 0.48
Bancroft	365	-28	-31	29	23	33	26	4740	3870	~~0.25~~ 0.28	~~0.32~~ 0.35
Barrie	245	-24	-26	29	23	33	26	4380	3540	~~0.28~~ 0.31	~~0.36~~ 0.40
Barriefield	100	-22	-24	28	23	32	26	3990	3190	~~0.37~~ 0.41	~~0.47~~ 0.52
Beaverton	240	-24	-26	30	23	34	26	4300	3470	~~0.28~~ 0.31	~~0.36~~ 0.40

Belleville	90	-22	-24	29	23	33	26	3910	3110	~~0.34~~ 0.37	~~0.43~~ 0.47
Belmont	260	-17	-19	30	24	34	27	3840	3050	~~0.37~~ 0.41	~~0.47~~ 0.52
Borden (CFB)	225	-23	-25	29	23	33	26	4300	3470	~~0.28~~ 0.31	~~0.36~~ 0.40
Bracebridge	310	-26	-28	29	23	33	26	4800	3920	~~0.27~~ 0.30	~~0.35~~ 0.39
Bradford	240	-23	-25	30	23	34	26	4280	3450	~~0.28~~ 0.31	~~0.36~~ 0.40
Brampton	215	-19	-21	30	23	34	26	4100	3290	~~0.34~~ 0.37	~~0.44~~ 0.48
Brantford	205	-18	-20	30	23	34	26	3900	3110	~~0.33~~ 0.36	~~0.42~~ 0.46
Brighton	95	-21	-23	29	23	33	26	4000	3200	~~0.37~~ 0.41	~~0.48~~ 0.53
Brockville	85	-23	-25	29	23	33	26	4060	3250	~~0.34~~ 0.37	~~0.44~~ 0.48
Burk's Falls	305	-26	-28	29	22	33	25	5020	4120	~~0.27~~ 0.30	~~0.35~~ 0.39
Burlington	80	-17	-19	31	23	35	26	3740	2960	~~0.36~~ 0.40	~~0.46~~ 0.51
Cambridge	295	-18	-20	29	23	33	26	4100	3290	~~0.28~~ 0.31	~~0.36~~ 0.40
Campbellford	150	-23	-26	30	23	34	26	4280	3450	~~0.32~~ 0.35	~~0.41~~ 0.45
Cannington	255	-24	-26	30	23	34	26	4310	3480	~~0.28~~ 0.31	~~0.36~~ 0.40
Carleton Place	135	-25	-27	30	23	34	26	4600	3740	~~0.32~~ 0.35	~~0.41~~ 0.45
Cavan	200	-23	-25	30	23	34	26	4400	3560	~~0.34~~ 0.37	~~0.44~~ 0.48
Centralia	260	-17	-19	30	23	34	26	3800	3010	~~0.37~~ 0.41	~~0.48~~ 0.53
Chapleau	425	-35	-38	27	21	31	24	5900	4950	~~0.23~~ 0.25	~~0.30~~ 0.33
Chatham	180	-16	-18	31	24	34	27	3470	2710	~~0.34~~ 0.37	~~0.43~~ 0.47
Chesley	275	-19	-21	29	22	33	25	4320	3490	~~0.35~~ 0.39	~~0.45~~ 0.50

Clinton	280	-17	-19	29	23	33	26	4150	3330	~~0.36~~ 0.40	~~0.46~~ 0.51
Coboconk	270	-25	-27	30	23	34	26	4500	3650	~~0.27~~ 0.30	~~0.35~~ 0.39
Cobourg	90	-21	-23	29	23	33	26	3980	3180	~~0.38~~ 0.42	~~0.49~~ 0.54
Cochrane	245	-34	-36	29	21	33	24	6200	5240	~~0.27~~ 0.30	~~0.35~~ 0.39
Colborne	105	-21	-23	29	23	33	26	3980	3180	~~0.38~~ 0.42	~~0.49~~ 0.54
Collingwood	190	-21	-23	29	23	33	26	4180	3360	~~0.30~~ 0.33	~~0.39~~ 0.43
Cornwall	35	-23	-25	30	23	34	26	4250	3420	~~0.32~~ 0.35	~~0.41~~ 0.45
Corunna	185	-16	-18	31	24	34	27	3600	2830	~~0.37~~ 0.41	~~0.47~~ 0.52
Deep River	145	-29	-32	30	22	34	25	4900	3980	~~0.27~~ 0.30	~~0.35~~ 0.39
Deseronto	85	-22	-24	29	23	33	26	4070	3260	~~0.34~~ 0.37	~~0.43~~ 0.47
Dorchester	260	-18	-20	30	24	34	27	3900	3110	~~0.37~~ 0.41	~~0.47~~ 0.52
Dorion	200	-33	-35	28	21	32	24	5950	5000	~~0.29~~ 0.32	~~0.39~~ 0.43
Dresden	185	-16	-18	31	24	34	27	3750	2970	~~0.34~~ 0.37	~~0.43~~ 0.47
Dryden	370	-34	-36	28	22	32	25	5850	4940	~~0.22~~ 0.24	~~0.30~~ 0.33
Dundalk	525	-22	-24	29	22	33	25	4700	3830	~~0.33~~ 0.36	~~0.42~~ 0.46
Dunnville	175	-15	-17	30	24	34	27	3660	2890	~~0.36~~ 0.40	~~0.46~~ 0.51
Durham	340	-20	-22	29	22	33	25	4340	3510	~~0.34~~ 0.37	~~0.44~~ 0.48
Dutton	225	-16	-18	31	24	35	27	3700	2920	~~0.37~~ 0.41	~~0.47~~ 0.52
Earlton	245	-33	-36	29	22	33	25	5730	4790	~~0.35~~ 0.39	~~0.45~~ 0.50
Edison	365	-34	-36	28	22	32	25	5740	4840	~~0.23~~ 0.25	~~0.31~~ 0.34

Elliot Lake	380	-26	-28	29	21	33	24	4950	4030	~~0.30~~ 0.33	~~0.38~~ 0.42
Elmvale	220	-24	-26	29	23	33	26	4200	3380	~~0.28~~ 0.31	~~0.36~~ 0.40
Embro	310	-19	-21	30	23	34	26	3950	3150	~~0.37~~ 0.41	~~0.48~~ 0.53
Englehart	205	-33	-36	29	22	33	25	5800	4860	~~0.32~~ 0.35	~~0.41~~ 0.45
Espanola	220	-25	-27	29	21	33	24	4920	4000	~~0.33~~ 0.36	~~0.42~~ 0.46
Exeter	265	-17	-19	30	23	34	26	3900	3110	~~0.37~~ 0.41	~~0.48~~ 0.53
Fenelon Falls	260	-25	-27	30	23	34	26	4440	3600	~~0.28~~ 0.31	~~0.36~~ 0.40
Fergus	400	-20	-22	29	23	33	26	4300	3470	~~0.28~~ 0.31	~~0.36~~ 0.40
Forest	215	-16	-18	31	23	35	26	3740	2960	~~0.37~~ 0.41	~~0.48~~ 0.53
Fort Erie	180	-15	-17	30	24	34	27	3650	2880	~~0.36~~ 0.40	~~0.46~~ 0.51
Fort Erie (Ridgeway)	190	-15	-17	30	24	34	27	3600	2830	~~0.36~~ 0.40	~~0.46~~ 0.51
Fort Frances	340	-33	-35	29	22	33	25	5440	4550	~~0.23~~ 0.25	~~0.31~~ 0.34
Gananoque	80	-22	-24	28	23	32	26	4010	3210	~~0.37~~ 0.41	~~0.47~~ 0.52
Geraldton	345	-36	-39	28	21	32	24	6450	5490	~~0.22~~ 0.24	~~0.30~~ 0.33
Glencoe	215	-16	-18	31	24	35	27	3680	2900	~~0.34~~ 0.37	~~0.43~~ 0.47
Goderich	185	-16	-18	29	23	33	26	4000	3200	~~0.37~~ 0.41	~~0.48~~ 0.53
Gore Bay	205	-24	-26	28	22	32	25	4700	3830	~~0.34~~ 0.37	~~0.44~~ 0.48
Graham	495	-35	-37	29	22	33	25	5940	4990	~~0.22~~ 0.24	~~0.30~~ 0.33
Gravenhurst (Muskoka Airport)	255	-26	-28	29	23	33	26	4760	3890	~~0.28~~ 0.31	~~0.36~~ 0.40
Grimsby	85	-16	-18	30	23	34	26	3520	2760	~~0.36~~ 0.40	~~0.46~~ 0.51

Guelph	340	-19	-21	29	23	33	26	4270	3440	~~0.28~~ 0.31	~~0.36~~ 0.40
Guthrie	280	-24	-26	29	23	33	26	4300	3470	~~0.28~~ 0.31	~~0.36~~ 0.40
Haileybury	210	-32	-35	30	22	34	25	5600	4660	~~0.34~~ 0.37	~~0.44~~ 0.48
Haldimand (Caledonia)	190	-18	-20	30	23	34	26	3750	2970	~~0.34~~ 0.37	~~0.44~~ 0.48
Haldimand (Hagersville)	215	-17	-19	30	23	34	26	3760	2980	~~0.36~~ 0.40	~~0.46~~ 0.51
Haliburton	335	-27	-29	29	23	33	26	4840	3960	~~0.27~~ 0.30	~~0.35~~ 0.39
Halton Hills (Georgetown)	255	-19	-21	30	23	34	26	4200	3380	~~0.29~~ 0.32	~~0.37~~ 0.41
Hamilton	90	-17	-19	31	23	35	26	3460	2700	~~0.36~~ 0.40	~~0.46~~ 0.51
Hanover	270	-19	-21	29	22	33	25	4300	3470	~~0.34~~ 0.37	~~0.44~~ 0.48
Hastings	200	-24	-26	30	23	34	26	4280	3450	~~0.32~~ 0.35	~~0.41~~ 0.45
Hawkesbury	50	-25	-27	30	23	34	26	4610	3750	~~0.32~~ 0.35	~~0.41~~ 0.45
Hearst	245	-35	-37	29	21	33	24	6450	5490	~~0.23~~ 0.25	~~0.30~~ 0.33
Honey Harbour	180	-24	-26	29	23	33	26	4300	3470	~~0.30~~ 0.33	~~0.39~~ 0.43
Hornepayne	360	-37	-40	28	21	32	24	6340	5380	~~0.22~~ 0.24	~~0.30~~ 0.33
Huntsville	335	-26	-29	29	22	33	25	4850	3970	~~0.27~~ 0.30	~~0.35~~ 0.39
Ingersoll	280	-18	-20	30	23	34	26	3920	3120	~~0.37~~ 0.41	~~0.48~~ 0.53
Iroquois Falls	275	-33	-36	29	21	33	24	6100	5150	~~0.29~~ 0.32	~~0.37~~ 0.41
Jellicoe	330	-36	-39	28	21	32	24	6400	5440	~~0.22~~ 0.24	~~0.30~~ 0.33
Kapuskasing	245	-34	-36	29	21	33	24	6250	5290	~~0.24~~ 0.26	~~0.31~~ 0.34
Kemptville	90	-25	-27	30	23	34	26	4540	3690	~~0.32~~ 0.35	~~0.41~~ 0.45

Kenora	370	-33	-35	28	22	32	25	5630	4730	~~0.23~~ 0.25	~~0.31~~ 0.34
Killaloe	185	-28	-31	30	22	34	25	4960	4070	~~0.27~~ 0.30	~~0.35~~ 0.39
Kincardine	190	-17	-19	28	22	32	25	3890	3100	~~0.37~~ 0.41	~~0.48~~ 0.53
Kingston	80	-22	-24	28	23	32	26	4000	3200	~~0.37~~ 0.41	~~0.47~~ 0.52
Kinmount	295	-26	-28	29	23	33	26	4600	3740	~~0.27~~ 0.30	~~0.35~~ 0.39
Kirkland Lake	325	-33	-36	29	22	33	25	6000	5050	~~0.30~~ 0.33	~~0.39~~ 0.43
Kitchener	335	-19	-21	29	23	33	26	4200	3380	~~0.29~~ 0.32	~~0.37~~ 0.41
Kitchenuhmaykoosib / Big Trout Lake	215	-38	-40	26	20	30	23	7450	–	~~0.31~~ 0.34	~~0.42~~ 0.46
Lakefield	240	-24	-26	30	23	34	26	4330	3500	~~0.30~~ 0.33	~~0.38~~ 0.42
Lansdowne House	240	-38	-40	28	21	32	24	7150	6160	~~0.24~~ 0.26	~~0.32~~ 0.35
Leamington	190	-15	-17	31	24	34	27	3400	2650	~~0.37~~ 0.41	~~0.47~~ 0.52
Lindsay	265	-24	-26	30	23	34	26	4320	3490	~~0.30~~ 0.33	~~0.38~~ 0.42
Lion's Head	185	-19	-21	27	22	31	25	4300	3470	~~0.37~~ 0.41	~~0.48~~ 0.53
Listowel	380	-19	-21	29	23	33	26	4300	3470	~~0.34~~ 0.37	~~0.43~~ 0.47
London	245	-18	-20	30	24	34	27	3900	3110	~~0.37~~ 0.41	~~0.47~~ 0.52
Lucan	300	-17	-19	30	23	34	26	3900	3110	~~0.37~~ 0.41	~~0.48~~ 0.53
Maitland	85	-23	-25	29	23	33	26	4080	3270	~~0.34~~ 0.37	~~0.44~~ 0.48
Markdale	425	-20	-22	29	22	33	25	4500	3650	~~0.32~~ 0.35	~~0.41~~ 0.45
Markham	175	-21	-23	31	24	35	27	4000	3200	~~0.34~~ 0.37	~~0.44~~ 0.48
Martin	485	-35	-37	29	22	33	25	5900	4950	~~0.22~~ 0.24	~~0.30~~ 0.33

Matheson	265	-33	-36	29	21	33	24	6080	5130	~~0.30~~ 0.33	~~0.39~~ 0.43
Mattawa	165	-29	-31	30	22	34	25	5050	4130	~~0.25~~ 0.28	~~0.32~~ 0.35
Midland	190	-24	-26	29	23	33	26	4200	3380	~~0.30~~ 0.33	~~0.39~~ 0.43
Milton	200	-18	-20	30	23	34	26	3920	3120	~~0.34~~ 0.37	~~0.43~~ 0.47
Milverton	370	-19	-21	29	23	33	26	4200	3380	~~0.34~~ 0.37	~~0.43~~ 0.47
Minden	270	-27	-29	29	23	33	26	4640	3780	~~0.27~~ 0.30	~~0.35~~ 0.39
Mississauga	160	-18	-20	30	23	34	26	3880	3090	~~0.34~~ 0.37	~~0.44~~ 0.48
Mississauga (Lester B. Pearson Int'l Airport)	170	-20	-22	31	24	35	27	3890	–	~~0.34~~ 0.37	~~0.44~~ 0.48
Mississauga (Port Credit)	75	-18	-20	29	23	33	26	3780	3000	~~0.37~~ 0.41	~~0.48~~ 0.53
Mitchell	335	-18	-20	29	23	33	26	4100	3290	~~0.35~~ 0.39	~~0.45~~ 0.50
Moosonee	10	-36	-38	28	22	32	25	6800	5820	~~0.26~~ 0.29	~~0.35~~ 0.39
Morrisburg	75	-23	-25	30	23	34	26	4370	3530	~~0.32~~ 0.35	~~0.41~~ 0.45
Mount Forest	420	-21	-24	28	22	32	25	4700	3830	~~0.32~~ 0.35	~~0.41~~ 0.45
Nakina	325	-36	-38	28	21	32	24	6500	5530	~~0.22~~ 0.24	~~0.30~~ 0.33
Nanticoke (Jarvis)	205	-17	-18	30	23	34	26	3700	2920	~~0.37~~ 0.41	~~0.48~~ 0.53
Nanticoke (Port Dover)	180	-15	-17	30	24	34	27	3600	2830	~~0.37~~ 0.41	~~0.48~~ 0.53
Napanee	90	-22	-24	29	23	33	26	4140	3320	~~0.34~~ 0.37	~~0.43~~ 0.47
Newcastle	115	-20	-22	30	23	34	26	3990	3190	~~0.37~~ 0.41	~~0.48~~ 0.53
Newcastle (Bowmanville)	95	-20	-22	30	23	34	26	4000	–	~~0.37~~ 0.41	~~0.48~~ 0.53

New Liskeard	180	-32	-35	30	22	34	25	5570	4630	~~0.34~~ 0.37	~~0.43~~ 0.47
Newmarket	185	-22	-24	30	23	34	26	4260	3430	~~0.30~~ 0.33	~~0.38~~ 0.42
Niagara Falls	210	-16	-18	30	23	34	26	3600	2830	~~0.34~~ 0.37	~~0.43~~ 0.47
North Bay	210	-28	-30	28	22	32	25	5150	4230	~~0.27~~ 0.30	~~0.34~~ 0.37
Norwood	225	-24	-26	30	23	34	26	4320	3490	~~0.32~~ 0.35	~~0.41~~ 0.45
Oakville	90	-18	-20	30	23	34	26	3760	2980	~~0.37~~ 0.41	~~0.47~~ 0.52
Orangeville	430	-21	-23	29	23	33	26	4450	3610	~~0.28~~ 0.31	~~0.36~~ 0.40
Orillia	230	-25	-27	29	23	33	26	4260	3430	~~0.28~~ 0.31	~~0.36~~ 0.40
Oshawa	110	-19	-21	30	23	34	26	3860	3070	~~0.37~~ 0.41	~~0.48~~ 0.53
Ottawa (Metropolitan)											
Ottawa (Barrhaven)	98	-25	-27	30	23	34	26	4500	3600	~~0.32~~ 0.35	~~0.41~~ 0.45
Ottawa (City Hall)	70	-25	-27	30	23	34	26	4440	3650	~~0.32~~ 0.35	~~0.41~~ 0.45
Ottawa (Kanata)	98	-25	-27	30	23	34	26	4520	3670	~~0.32~~ 0.35	~~0.41~~ 0.45
Ottawa (M-C Int'l Airport)	125	-25	-27	30	23	34	26	4500	3650	~~0.32~~ 0.35	~~0.41~~ 0.45
Ottawa (Orléans)	70	-26	-28	30	23	33	26	4500	3650	~~0.32~~ 0.35	~~0.41~~ 0.45
Owen Sound	215	-19	-21	29	22	33	25	4030	3220	~~0.34~~ 0.37	~~0.44~~ 0.48
Pagwa River	185	-35	-37	28	21	32	24	6500	5530	~~0.22~~ 0.24	~~0.30~~ 0.33
Paris	245	-18	-20	30	23	34	26	4000	3200	~~0.33~~ 0.36	~~0.42~~ 0.46
Parkhill	205	-16	-18	31	23	35	26	3800	3010	~~0.37~~ 0.41	~~0.48~~ 0.53
Parry Sound	215	-24	-26	28	22	32	25	4640	3780	~~0.30~~ 0.33	~~0.39~~ 0.43

Pelham (Fonthill)	230	-15	-17	30	23	34	26	3690	2910	~~0.33~~ 0.36	~~0.42~~ 0.46
Pembroke	125	-28	-31	30	23	34	26	4980	4090	~~0.27~~ 0.30	~~0.35~~ 0.39
Penetanguishene	220	-24	-26	29	23	33	26	4200	3380	~~0.30~~ 0.33	~~0.39~~ 0.43
Perth	130	-25	-27	30	23	34	26	4540	3690	~~0.32~~ 0.35	~~0.41~~ 0.45
Petawawa	135	-29	-31	30	23	34	26	4980	4090	~~0.27~~ 0.30	~~0.35~~ 0.39
Peterborough	200	-23	-25	30	23	34	26	4400	3560	~~0.32~~ 0.35	~~0.41~~ 0.45
Petrolia	195	-16	-18	31	24	34	27	3640	2870	~~0.37~~ 0.41	~~0.47~~ 0.52
Pickering (Dunbarton)	85	-19	-21	30	23	34	26	3800	3010	~~0.37~~ 0.41	~~0.48~~ 0.53
Picton	95	-21	-23	29	23	33	26	3980	3180	~~0.38~~ 0.42	~~0.49~~ 0.54
Plattsville	300	-19	-21	29	23	33	26	4150	3330	~~0.33~~ 0.36	~~0.42~~ 0.46
Point Alexander	150	-29	-32	30	22	34	25	4960	4040	~~0.27~~ 0.30	~~0.35~~ 0.39
Port Burwell	195	-15	-17	30	24	34	27	3800	3010	~~0.37~~ 0.41	~~0.47~~ 0.52
Port Colborne	180	-15	-17	30	24	34	27	3600	2830	~~0.36~~ 0.40	~~0.46~~ 0.51
Port Elgin	205	-17	-19	28	22	32	25	4100	3290	~~0.37~~ 0.41	~~0.48~~ 0.53
Port Hope	100	-21	-23	29	23	33	26	3970	3170	~~0.37~~ 0.41	~~0.48~~ 0.53
Port Perry	270	-22	-24	30	23	34	26	4260	3430	~~0.34~~ 0.37	~~0.44~~ 0.48
Port Stanley	180	-15	-17	31	24	35	27	3850	3060	~~0.37~~ 0.41	~~0.47~~ 0.52
Prescott	90	-23	-25	29	23	33	26	4120	3310	~~0.34~~ 0.37	~~0.44~~ 0.48
Princeton	280	-18	-20	30	23	34	26	4000	3200	~~0.33~~ 0.36	~~0.42~~ 0.46
Raith	475	-34	-37	28	22	32	25	5900	4950	~~0.22~~ 0.24	~~0.30~~ 0.33

Rayside-Balfour (Chelmsford)	270	-28	-30	29	21	33	24	5200	4280	~~0.35~~ 0.39	~~0.45~~ 0.50
Red Lake	360	-35	-37	28	21	32	24	6220	5290	~~0.22~~ 0.24	~~0.30~~ 0.33
Renfrew	115	-27	-30	30	23	34	26	4900	4020	~~0.27~~ 0.30	~~0.35~~ 0.39
Richmond Hill	230	-21	-23	31	24	35	27	4000	3200	~~0.34~~ 0.37	~~0.44~~ 0.48
Rockland	50	-26	-28	30	23	34	26	4600	3740	~~0.31~~ 0.34	~~0.40~~ 0.44
Sarnia	190	-16	-18	31	24	34	27	3750	2970	~~0.37~~ 0.41	~~0.47~~ 0.52
Sault Ste. Marie	190	-25	-28	29	22	33	25	4960	4040	~~0.33~~ 0.36	~~0.44~~ 0.48
Schreiber	310	-34	-36	27	21	31	24	5960	5010	~~0.29~~ 0.32	~~0.39~~ 0.43
Seaforth	310	-17	-19	30	23	34	26	4100	3290	~~0.35~~ 0.39	~~0.45~~ 0.50
Shelburne	495	-22	-24	29	23	33	26	4700	3830	~~0.31~~ 0.34	~~0.40~~ 0.44
Simcoe	210	-17	-19	30	24	34	27	3700	2920	~~0.35~~ 0.39	~~0.45~~ 0.50
Sioux Lookout	375	-34	-36	28	22	32	25	5950	5030	~~0.22~~ 0.24	~~0.30~~ 0.33
Smiths Falls	130	-25	-27	30	23	34	26	4540	3690	~~0.32~~ 0.35	~~0.41~~ 0.45
Smithville	185	-16	-18	30	23	34	26	3650	2880	~~0.33~~ 0.36	~~0.42~~ 0.46
Smooth Rock Falls	235	-34	-36	29	21	33	24	6250	5290	~~0.25~~ 0.28	~~0.32~~ 0.35
Southampton	180	-17	-19	28	22	32	25	4100	3290	~~0.37~~ 0.41	~~0.48~~ 0.53
South River	355	-27	-29	29	22	33	25	5090	4190	~~0.27~~ 0.30	~~0.35~~ 0.39
St. Catharines	105	-16	-18	30	23	34	26	3540	2780	~~0.36~~ 0.40	~~0.46~~ 0.51
St. Marys	310	-18	-20	30	23	34	26	4000	3200	~~0.37~~ 0.41	~~0.47~~ 0.52
St. Thomas	225	-16	-18	31	24	35	27	3780	3000	~~0.37~~ 0.41	~~0.47~~ 0.52

Stirling	120	-23	-25	30	23	34	26	4220	3400	~~0.31~~ 0.34	~~0.40~~ 0.44
Stratford	360	-18	-20	29	23	33	26	4050	3240	~~0.35~~ 0.39	~~0.45~~ 0.50
Strathroy	225	-17	-19	31	24	35	27	3780	3000	~~0.37~~ 0.41	~~0.47~~ 0.52
Sturgeon Falls	205	-28	-30	29	21	33	24	5200	4280	~~0.27~~ 0.30	~~0.35~~ 0.39
Sudbury	275	-28	-30	29	21	33	24	5180	4260	~~0.36~~ 0.40	~~0.46~~ 0.51
Sundridge	340	-27	-29	29	22	33	25	5080	4180	~~0.27~~ 0.30	~~0.35~~ 0.39
Tavistock	340	-19	-21	29	23	33	26	4100	3290	~~0.35~~ 0.39	~~0.45~~ 0.50
Temagami	300	-30	-33	30	22	34	25	5420	4490	~~0.29~~ 0.32	~~0.37~~ 0.41
Thamesford	280	-19	-21	30	23	34	26	3950	3150	~~0.37~~ 0.41	~~0.48~~ 0.53
Thedford	205	-16	-18	31	23	35	26	3710	2930	~~0.37~~ 0.41	~~0.48~~ 0.53
Thunder Bay	210	-31	-33	29	21	33	24	5650	4710	~~0.29~~ 0.32	~~0.39~~ 0.43
Tillsonburg	215	-17	-19	30	24	34	27	3840	3050	~~0.34~~ 0.37	~~0.44~~ 0.48
Timmins	300	-34	-36	29	21	33	24	5940	4990	~~0.27~~ 0.30	~~0.35~~ 0.39
Timmins (Porcupine)	295	-34	-36	29	21	33	24	6000	5050	~~0.29~~ 0.32	~~0.37~~ 0.41
Toronto Metropolitan Region											
Etobicoke	160	-20	-22	31	24	35	27	3800	3010	~~0.34~~ 0.37	~~0.44~~ 0.48
North York	175	-20	-22	31	24	35	27	3760	2980	~~0.34~~ 0.37	~~0.44~~ 0.48
Scarborough	180	-20	-22	31	24	35	27	3800	3010	~~0.37~~ 0.41	~~0.47~~ 0.52
Toronto (City Hall)	90	-18	-20	31	23	35	26	3520	2760	~~0.34~~ 0.37	~~0.44~~ 0.48
Trenton	80	-22	-24	29	23	33	26	4110	3300	~~0.37~~ 0.41	~~0.47~~ 0.52

Trout Creek	330	-27	-29	29	22	33	25	5100	4200	~~0.27~~ 0.30	~~0.35~~ 0.39
Uxbridge	275	-22	-24	30	23	34	26	4240	3410	~~0.33~~ 0.36	~~0.42~~ 0.46
Vaughan (Woodbridge)	165	-20	-22	31	24	35	27	4100	3290	~~0.34~~ 0.37	~~0.44~~ 0.48
Vittoria	215	-15	-17	30	24	34	27	3680	2900	~~0.37~~ 0.41	~~0.47~~ 0.52
Walkerton	275	-18	-20	30	22	34	25	4300	3470	~~0.36~~ 0.40	~~0.46~~ 0.51
Wallaceburg	180	-16	-18	31	24	34	27	3600	2830	~~0.35~~ 0.39	~~0.45~~ 0.50
Waterloo	330	-19	-21	29	23	33	26	4200	3380	~~0.29~~ 0.32	~~0.37~~ 0.41
Watford	240	-17	-19	31	24	35	27	3740	2960	~~0.37~~ 0.41	~~0.47~~ 0.52
Wawa	290	-34	-36	26	21	30	24	5840	4900	~~0.30~~ 0.33	~~0.39~~ 0.43
Welland	180	-15	-17	30	23	34	26	3670	2900	~~0.34~~ 0.37	~~0.43~~ 0.47
West Lorne	215	-16	-18	31	24	35	27	3700	2920	~~0.37~~ 0.41	~~0.47~~ 0.52
Whitby	85	-20	-22	30	23	34	26	3820	3030	~~0.37~~ 0.41	~~0.48~~ 0.53
Whitby (Brooklin)	160	-20	-22	30	23	34	26	4010	3210	~~0.35~~ 0.39	~~0.45~~ 0.50
White River	375	-39	-42	28	21	32	24	6150	5200	~~0.22~~ 0.24	~~0.30~~ 0.33
Wiarton	185	-19	-21	29	22	33	25	4300	3470	~~0.34~~ 0.37	~~0.44~~ 0.48
Windsor	185	-16	-18	32	24	35	27	3400	2650	~~0.37~~ 0.41	~~0.47~~ 0.52
Wingham	310	-18	-20	30	23	34	26	4220	3400	~~0.36~~ 0.40	~~0.46~~ 0.51
Woodstock	300	-19	-21	30	23	34	26	3910	3110	~~0.34~~ 0.37	~~0.44~~ 0.48
Wyoming	215	-16	-18	31	24	34	27	3700	2920	~~0.37~~ 0.41	~~0.47~~ 0.52
Québec											

Acton Vale	95	-24	-27	30	23	34	26	4620	3790	~~0.27~~ 0.28	~~0.35~~ 0.37
Alma	110	-31	-33	28	22	32	25	5800	4860	~~0.27~~ 0.28	~~0.35~~ 0.37
Amos	295	-34	-36	28	21	32	24	6160	5210	~~0.25~~ 0.26	~~0.32~~ 0.34
Aylmer	90	-25	-28	30	23	34	26	4520	3620	~~0.32~~ 0.34	~~0.41~~ 0.43
Baie-Comeau	60	-27	-29	25	19	29	22	6020	5070	~~0.39~~ 0.41	~~0.50~~ 0.53
Baie-Saint-Paul	20	-27	-29	28	21	32	24	5280	4350	~~0.37~~ 0.39	~~0.48~~ 0.50
Beauport	45	-26	-29	28	22	32	25	5100	4180	~~0.33~~ 0.35	~~0.42~~ 0.44
Bedford	55	-24	-26	29	23	33	26	4420	3610	~~0.29~~ 0.30	~~0.37~~ 0.39
Beloeil	25	-24	-26	30	23	34	26	4500	3680	~~0.29~~ 0.30	~~0.37~~ 0.39
Brome	210	-25	-27	29	23	33	26	4730	3880	~~0.29~~ 0.30	~~0.37~~ 0.39
Brossard	15	-24	-26	30	23	34	26	4420	3610	~~0.34~~ 0.36	~~0.44~~ 0.46
Buckingham	130	-26	-28	30	23	33	26	4880	3970	~~0.31~~ 0.33	~~0.40~~ 0.42
Campbell's Bay	115	-28	-30	30	23	34	26	4900	3980	~~0.25~~ 0.26	~~0.32~~ 0.34
Chambly	20	-24	-26	30	23	34	26	4450	3630	~~0.31~~ 0.33	~~0.40~~ 0.42
Coaticook	295	-25	-27	28	22	32	25	4750	3840	~~0.27~~ 0.28	~~0.35~~ 0.37
Contrecoeur	10	-25	-27	30	23	34	26	4500	3680	~~0.34~~ 0.36	~~0.43~~ 0.45
Cowansville	120	-25	-27	29	23	33	26	4540	3710	~~0.29~~ 0.30	~~0.37~~ 0.39
Deux-Montagnes	25	-25	-27	29	23	33	26	4440	3630	~~0.29~~ 0.30	~~0.37~~ 0.39
Dolbeau	120	-32	-34	28	22	32	25	6250	5290	~~0.27~~ 0.28	~~0.35~~ 0.37
Drummondville	85	-26	-28	30	23	34	26	4700	3860	~~0.27~~ 0.28	~~0.35~~ 0.37

Farnham	60	-24	-26	29	23	33	26	4500	3680	~~0.29~~ 0.30	~~0.37~~ 0.39
Fort-Coulonge	110	-28	-30	30	23	34	26	4950	4030	~~0.25~~ 0.26	~~0.32~~ 0.34
Gagnon	545	-34	-36	24	19	28	22	7600	6600	~~0.30~~ 0.32	~~0.39~~ 0.41
Gaspé	55	-25	-26	26	20	30	23	5500	4570	~~0.37~~ 0.39	~~0.48~~ 0.50
Gatineau	95	-25	-28	30	23	34	26	4600	3690	~~0.32~~ 0.34	~~0.41~~ 0.43
Gracefield	175	-28	-31	30	23	34	26	5080	4160	~~0.25~~ 0.26	~~0.32~~ 0.34
Granby	120	-25	-27	29	23	33	26	4500	3680	~~0.27~~ 0.28	~~0.35~~ 0.37
Harrington Harbour	30	-27	-29	19	16	23	20	6150	5200	~~0.56~~ 0.59	~~0.72~~ 0.76
Havre-Saint-Pierre	5	-27	-29	22	18	26	22	6100	5150	~~0.49~~ 0.51	~~0.63~~ 0.66
Hemmingford	75	-24	-26	30	23	34	26	4380	3570	~~0.31~~ 0.33	~~0.40~~ 0.42
Hull	65	-25	-28	30	23	34	26	4550	3650	~~0.32~~ 0.34	~~0.41~~ 0.43
Iberville	35	-24	-26	29	23	33	26	4450	3630	~~0.32~~ 0.34	~~0.41~~ 0.43
Inukjuak	5	-36	-38	21	15	26	19	9150	8100	~~0.37~~ 0.39	~~0.48~~ 0.50
Joliette	45	-26	-28	29	23	33	26	4720	3870	~~0.28~~ 0.29	~~0.36~~ 0.38
Kuujjuaq	25	-37	-39	24	17	29	21	8550	7520	~~0.47~~ 0.49	~~0.60~~ 0.63
Kuujjuarapik	20	-36	-38	25	17	29	20	7990	6980	~~0.37~~ 0.39	~~0.48~~ 0.50
Lachute	65	-26	-28	29	23	33	26	4640	4570	~~0.31~~ 0.33	~~0.40~~ 0.42
Lac-Mégantic	420	-27	-29	27	22	31	25	5180	4470	~~0.27~~ 0.28	~~0.35~~ 0.37
La Malbaie	25	-26	-28	28	21	32	24	5400	3800	~~0.37~~ 0.39	~~0.48~~ 0.50
La Pocatière	55	-24	-26	28	22	32	25	5160	4240	~~0.39~~ 0.41	~~0.50~~ 0.53

La Tuque	165	-30	-32	29	22	33	25	5500	4260	~~0.27~~ 0.28	~~0.35~~ 0.37
Lennoxville	155	-28	-30	29	22	33	25	4700	3790	~~0.25~~ 0.26	~~0.32~~ 0.34
Léry	30	-24	-26	29	23	33	26	4420	3610	~~0.33~~ 0.35	~~0.42~~ 0.44
Loretteville	100	-26	-29	28	22	32	25	5200	4280	~~0.32~~ 0.34	~~0.41~~ 0.43
Louiseville	15	-25	-28	29	23	33	26	4900	4030	~~0.34~~ 0.36	~~0.43~~ 0.45
Magog	215	-26	-28	29	23	33	26	4730	3880	~~0.27~~ 0.28	~~0.35~~ 0.37
Malartic	325	-33	-36	29	21	33	24	6200	5240	~~0.25~~ 0.26	~~0.32~~ 0.34
Maniwaki	180	-30	-32	29	22	33	25	5280	4350	~~0.24~~ 0.25	~~0.31~~ 0.33
Masson	50	-26	-28	30	23	33	26	4610	3700	~~0.31~~ 0.33	~~0.40~~ 0.42
Matane	5	-24	-26	24	20	28	23	5510	4580	~~0.43~~ 0.45	~~0.55~~ 0.58
Mont-Joli	90	-24	-26	26	21	30	24	5370	4440	~~0.41~~ 0.43	~~0.52~~ 0.55
Mont-Laurier	225	-29	-32	29	22	33	25	5320	4390	~~0.23~~ 0.24	~~0.30~~ 0.32
Montmagny	10	-25	-28	28	22	32	25	5090	4170	~~0.37~~ 0.39	~~0.47~~ 0.49
Montréal Region											
Beaconsfield	25	-24	-26	30	23	34	26	4440	3630	~~0.33~~ 0.35	~~0.42~~ 0.44
Dorval	25	-24	-26	30	23	34	26	4400	3590	~~0.34~~ 0.36	~~0.44~~ 0.46
Laval	35	-24	-26	29	23	33	26	4500	3680	~~0.33~~ 0.35	~~0.42~~ 0.44
Montréal (City Hall)	20	-23	-26	30	23	34	26	4200	3410	~~0.34~~ 0.36	~~0.44~~ 0.46
Montréal-Est	25	-23	-26	30	23	34	26	4470	3650	~~0.34~~ 0.36	~~0.44~~ 0.46
Montréal-Nord	20	-24	-26	30	23	34	26	4470	3650	~~0.33~~ 0.35	~~0.42~~ 0.44

Outremont	105	-23	-26	30	23	34	26	4300	3500	~~0.34~~ 0.36	~~0.44~~ 0.46
Pierrefonds	25	-24	-26	30	23	34	26	4430	3620	~~0.33~~ 0.35	~~0.42~~ 0.44
Sainte-Anne-de-Bellevue	35	-24	-26	29	23	33	26	4460	3640	~~0.33~~ 0.35	~~0.42~~ 0.44
Saint-Lambert	15	-23	-26	30	23	34	26	4400	3590	~~0.34~~ 0.36	~~0.44~~ 0.46
Saint-Laurent	45	-23	-26	30	23	34	26	4270	3470	~~0.34~~ 0.36	~~0.44~~ 0.46
Verdun	20	-23	-26	30	23	34	26	4200	3410	~~0.34~~ 0.36	~~0.44~~ 0.46
Nicolet (Gentilly)	15	-25	-28	29	23	33	26	4900	3980	~~0.33~~ 0.35	~~0.42~~ 0.44
Nitchequon	545	-39	-41	23	19	27	22	8100	7080	~~0.29~~ 0.30	~~0.37~~ 0.39
Noranda	305	-33	-36	29	21	33	24	6050	5100	~~0.27~~ 0.28	~~0.35~~ 0.37
Percé	5	-21	-24	25	19	29	23	5400	4470	~~0.49~~ 0.51	~~0.63~~ 0.66
Pincourt	25	-24	-26	29	23	33	26	4480	3660	~~0.33~~ 0.35	~~0.42~~ 0.44
Plessisville	145	-26	-28	29	23	33	26	5100	4180	~~0.27~~ 0.28	~~0.35~~ 0.37
Port-Cartier	20	-28	-30	25	19	29	22	6060	5110	~~0.42~~ 0.44	~~0.54~~ 0.57
Puvirnituq	5	-36	-38	23	16	29	21	9200	8150	~~0.47~~ 0.49	~~0.60~~ 0.63
Québec City Region											
Ancienne-Lorette	35	-25	-28	28	23	32	26	5130	4210	~~0.32~~ 0.34	~~0.41~~ 0.43
Lévis	50	-25	-28	28	22	32	25	5050	4130	~~0.32~~ 0.34	~~0.41~~ 0.43
Québec	120	-25	-28	28	22	32	25	5080	4160	~~0.32~~ 0.34	~~0.41~~ 0.43
Sainte-Foy	115	-25	-28	28	23	32	26	5100	4180	~~0.32~~ 0.34	~~0.41~~ 0.43
Sillery	10	-25	-28	28	23	32	26	5070	4150	~~0.32~~ 0.34	~~0.41~~ 0.43

Richmond	150	-25	-27	29	22	33	25	4700	3860	~~0.25~~ 0.26	~~0.32~~ 0.34
Rimouski	30	-25	-27	26	20	30	23	5300	4370	~~0.41~~ 0.43	~~0.52~~ 0.55
Rivière-du-Loup	55	-25	-27	26	21	30	24	5380	4450	~~0.39~~ 0.41	~~0.50~~ 0.53
Roberval	100	-31	-33	28	21	32	24	5750	4810	~~0.27~~ 0.28	~~0.35~~ 0.37
Rock Island	160	-25	-27	29	23	33	26	4850	3990	~~0.27~~ 0.28	~~0.35~~ 0.37
Rosemère	25	-24	-26	29	23	33	26	4550	3720	~~0.31~~ 0.33	~~0.40~~ 0.42
Rouyn	300	-33	-36	29	21	33	24	6050	5100	~~0.27~~ 0.28	~~0.35~~ 0.37
Saguenay	10	-30	-32	28	22	32	25	5700	4760	~~0.28~~ 0.29	~~0.36~~ 0.38
Saguenay (Bagotville)	5	-31	-33	28	21	32	24	5700	4760	~~0.30~~ 0.32	~~0.38~~ 0.40
Saguenay (Jonquière)	135	-30	-32	28	22	32	25	5650	4710	~~0.27~~ 0.28	~~0.35~~ 0.37
Saguenay (Kénogami)	140	-30	-32	28	22	32	25	5650	4710	~~0.27~~ 0.28	~~0.35~~ 0.37
Sainte-Agathe-des-Monts	360	-28	-30	28	22	32	25	5390	4470	~~0.27~~ 0.28	~~0.35~~ 0.37
Saint-Eustache	35	-25	-27	29	23	33	26	4500	3680	~~0.29~~ 0.30	~~0.37~~ 0.39
Saint-Félicien	105	-32	-34	28	22	32	25	5850	4900	~~0.27~~ 0.28	~~0.35~~ 0.37
Saint-Georges-de-Cacouna	35	-25	-27	26	21	30	24	5400	4470	~~0.39~~ 0.41	~~0.50~~ 0.53
Saint-Hubert	25	-24	-26	30	23	34	26	4490	3670	~~0.34~~ 0.36	~~0.44~~ 0.46
Saint-Hubert-de-Rivière-du-Loup	310	-26	-28	26	21	30	24	5520	4590	~~0.31~~ 0.33	~~0.40~~ 0.42
Saint-Hyacinthe	35	-24	-27	30	23	34	26	4500	3680	~~0.27~~ 0.28	~~0.35~~ 0.37
Saint-Jean-sur-Richelieu	35	-24	-26	29	23	33	26	4450	3630	~~0.32~~ 0.34	~~0.41~~ 0.43
Saint-Jérôme	95	-26	-28	29	23	33	26	4820	3960	~~0.29~~ 0.30	~~0.37~~ 0.39

Saint-Jovite	230	-29	-31	28	22	32	25	5250	4340	~~0.26~~ 0.27	~~0.33~~ 0.35
Saint-Lazare / Hudson	60	-24	-26	30	23	34	26	4520	3700	~~0.33~~ 0.35	~~0.42~~ 0.44
Saint-Nicolas	65	-25	-28	28	22	32	25	4990	4070	~~0.33~~ 0.35	~~0.42~~ 0.44
Salaberry-de-Valleyfield	50	-23	-25	29	23	33	26	4400	3590	~~0.33~~ 0.35	~~0.42~~ 0.44
Schefferville	550	-37	-39	24	16	28	20	8550	7520	~~0.33~~ 0.35	~~0.42~~ 0.44
Senneterre	310	-34	-36	29	21	33	24	6180	5220	~~0.25~~ 0.26	~~0.32~~ 0.34
Sept-Îles	5	-29	-31	24	18	28	22	6200	5240	~~0.42~~ 0.44	~~0.54~~ 0.57
Shawinigan	60	-26	-29	29	23	33	26	5050	4130	~~0.27~~ 0.28	~~0.35~~ 0.37
Shawville	170	-27	-30	30	23	34	26	4880	3970	~~0.27~~ 0.28	~~0.35~~ 0.37
Sherbrooke	185	-28	-30	29	23	33	26	4700	3790	~~0.25~~ 0.26	~~0.32~~ 0.34
Sorel	10	-25	-27	29	23	33	26	4550	3720	~~0.34~~ 0.36	~~0.43~~ 0.45
Sutton	185	-25	-27	29	23	33	26	4600	3770	~~0.29~~ 0.30	~~0.37~~ 0.39
Tadoussac	65	-26	-28	27	21	31	24	5450	4520	~~0.41~~ 0.43	~~0.52~~ 0.55
Témiscaming	240	-30	-32	30	22	34	25	5020	4100	~~0.25~~ 0.26	~~0.32~~ 0.34
Terrebonne	20	-25	-27	29	23	33	26	4500	3680	~~0.31~~ 0.33	~~0.40~~ 0.42
Thetford Mines	330	-26	-28	28	22	32	25	5120	4200	~~0.27~~ 0.28	~~0.35~~ 0.37
Thurso	50	-26	-28	30	23	34	26	4820	3910	~~0.31~~ 0.33	~~0.40~~ 0.42
Trois-Rivières	25	-25	-28	29	23	33	26	4900	3980	~~0.34~~ 0.36	~~0.43~~ 0.45
Val-des-Sources	245	-26	-28	29	22	33	25	4800	3890	~~0.27~~ 0.28	~~0.35~~ 0.37
Val-d'Or	310	-33	-36	29	21	33	24	6180	5220	~~0.25~~ 0.26	~~0.32~~ 0.34

Varennes	15	-24	-26	30	23	34	26	4500	3680	~~0.31~~ 0.33	~~0.40~~ 0.42
Verchères	15	-24	-26	30	23	34	26	4450	3630	~~0.34~~ 0.36	~~0.43~~ 0.45
Victoriaville	125	-26	-28	29	23	33	26	4900	3980	~~0.27~~ 0.28	~~0.35~~ 0.37
Ville-Marie	200	-31	-34	30	22	34	25	5550	4610	~~0.31~~ 0.33	~~0.40~~ 0.42
Wakefield	120	-27	-30	30	23	34	26	4820	3910	~~0.27~~ 0.28	~~0.34~~ 0.36
Waterloo	205	-25	-27	29	23	33	26	4650	3810	~~0.27~~ 0.28	~~0.35~~ 0.37
Windsor	150	-25	-27	29	23	33	26	4700	3860	~~0.25~~ 0.26	~~0.32~~ 0.34
New Brunswick											
Alma	5	-21	-23	26	20	29	23	4500	3600	~~0.37~~ 0.41	~~0.48~~ 0.53
Bathurst	10	-23	-26	30	22	34	25	5020	4100	~~0.37~~ 0.41	~~0.48~~ 0.53
Boiestown	65	-25	-28	29	21	33	24	4900	–	~~0.30~~ 0.33	~~0.39~~ 0.43
Campbellton	30	-26	-28	29	22	33	25	5500	4570	~~0.35~~ 0.39	~~0.45~~ 0.50
Edmundston	160	-27	-29	28	22	32	25	5320	4500	~~0.30~~ 0.33	~~0.38~~ 0.42
Fredericton	15	-24	-27	29	22	33	25	4670	3760	~~0.30~~ 0.33	~~0.38~~ 0.42
Gagetown	20	-24	-26	29	22	32	25	4460	3560	~~0.31~~ 0.34	~~0.40~~ 0.44
Grand Falls	115	-27	-30	28	22	32	25	5300	4450	~~0.30~~ 0.33	~~0.38~~ 0.42
Miramichi	5	-24	-26	30	22	34	25	4950	4030	~~0.32~~ 0.35	~~0.41~~ 0.45
Moncton	20	-23	-25	28	21	31	24	4680	3770	~~0.39~~ 0.43	~~0.50~~ 0.55
Oromocto	20	-24	-26	29	22	33	25	4650	3740	~~0.30~~ 0.33	~~0.39~~ 0.43
Sackville	15	-22	-24	27	21	30	24	4590	3680	~~0.38~~ 0.42	~~0.49~~ 0.54

Saint Andrews	35	-22	-24	25	20	28	23	4680	3770	~~0.35~~ 0.39	~~0.45~~ 0.50
Saint John	5	-22	-24	25	20	28	23	4570	3670	~~0.41~~ 0.45	~~0.53~~ 0.58
Shippagan	5	-22	-24	28	21	32	24	4930	4010	~~0.49~~ 0.54	~~0.63~~ 0.69
St. George	35	-21	-23	25	20	28	23	4680	3770	~~0.35~~ 0.39	~~0.45~~ 0.50
St. Stephen	20	-24	-26	28	22	31	25	4700	3790	~~0.33~~ 0.36	~~0.42~~ 0.46
Woodstock	60	-26	-29	30	22	34	25	4910	3990	~~0.29~~ 0.32	~~0.37~~ 0.41
Nova Scotia											
Amherst	25	-21	-24	27	21	31	24	4500	3600	~~0.37~~ 0.41	~~0.48~~ 0.53
Antigonish	10	-17	-20	27	21	31	24	4510	3610	~~0.42~~ 0.46	~~0.54~~ 0.59
Bridgewater	10	-15	-17	27	20	30	23	4140	3250	~~0.43~~ 0.47	~~0.55~~ 0.61
Canso	5	-13	-15	25	20	29	23	4400	3500	~~0.48~~ 0.53	~~0.61~~ 0.67
Debert	45	-21	-24	27	21	31	24	4500	3600	~~0.37~~ 0.41	~~0.48~~ 0.53
Digby	35	-15	-17	25	20	28	23	4020	3130	~~0.43~~ 0.47	~~0.55~~ 0.61
Greenwood (CFB)	28	-18	-20	29	22	32	25	4140	3250	~~0.42~~ 0.46	~~0.54~~ 0.59
Halifax Region											
Dartmouth	10	-16	-18	26	20	29	23	4100	3210	~~0.45~~ 0.50	~~0.58~~ 0.64
Halifax	55	-16	-18	26	20	29	23	4000	3110	~~0.45~~ 0.50	~~0.58~~ 0.64
Kentville	25	-18	-20	28	21	31	24	4130	3240	~~0.42~~ 0.46	~~0.54~~ 0.59
Liverpool	20	-16	-18	27	20	30	23	3990	3100	~~0.48~~ 0.53	~~0.61~~ 0.67
Lockeport	5	-14	-16	25	20	28	23	4000	3110	~~0.47~~ 0.52	~~0.60~~ 0.66
Louisbourg	5	-15	-17	26	20	30	23	4530	3630	~~0.51~~ 0.56	~~0.65~~ 0.72

Lunenburg	25	-15	-17	26	20	29	23	4140	3250	~~0.48~~ 0.53	~~0.61~~ 0.67
New Glasgow	30	-19	-21	27	21	31	24	4320	3420	~~0.43~~ 0.47	~~0.55~~ 0.61
North Sydney	20	-16	-19	27	21	31	24	4500	3600	~~0.46~~ 0.51	~~0.59~~ 0.65
Pictou	25	-19	-21	27	21	31	24	4310	3410	~~0.43~~ 0.47	~~0.55~~ 0.61
Port Hawkesbury	40	-17	-19	27	21	31	24	4500	3600	~~0.48~~ 0.53	~~0.61~~ 0.67
Springhill	185	-20	-23	27	21	31	24	4540	3640	~~0.37~~ 0.41	~~0.48~~ 0.53
Stewiacke	25	-20	-22	27	21	30	24	4400	3500	~~0.39~~ 0.43	~~0.50~~ 0.55
Sydney	5	-16	-19	27	21	31	24	4530	3630	~~0.46~~ 0.51	~~0.59~~ 0.65
Tatamagouche	25	-20	-23	27	21	31	24	4380	3480	~~0.43~~ 0.47	~~0.55~~ 0.61
Truro	25	-20	-22	27	21	30	24	4500	3600	~~0.37~~ 0.41	~~0.48~~ 0.53
Wolfville	35	-19	-21	28	21	31	24	4140	3250	~~0.42~~ 0.46	~~0.54~~ 0.59
Yarmouth	10	-14	-16	22	19	25	22	3990	3100	~~0.44~~ 0.48	~~0.56~~ 0.62
Prince Edward Island											
Charlottetown	5	-20	-22	26	21	30	24	4460	3650	~~0.44~~ 0.48	~~0.56~~ 0.62
Souris	5	-19	-21	27	21	31	24	4550	3650	~~0.45~~ 0.50	~~0.58~~ 0.64
Summerside	10	-20	-22	27	21	31	24	4600	3690	~~0.47~~ 0.52	~~0.60~~ 0.66
Tignish	10	-20	-22	27	21	31	24	4770	3860	~~0.51~~ 0.56	~~0.66~~ 0.73
Newfoundland and Labrador											
Argentia	15	-12	-14	21	18	25	22	4600	3620	~~0.59~~ 0.65	~~0.75~~ 0.83
Bonavista	15	-14	-16	24	19	28	22	5000	4000	~~0.66~~ 0.73	~~0.84~~ 0.92

Buchans	255	-24	-27	27	20	31	24	5250	4240	~~0.47~~ 0.52	~~0.60~~ 0.66
Cape Harrison	5	-29	-31	26	16	30	20	6900	5920	~~0.47~~ 0.52	~~0.60~~ 0.66
Cape Race	5	-11	-13	19	18	23	22	4900	3900	~~0.82~~ 0.90	~~1.05~~ 1.16
Channel-Port aux Basques	5	-13	-15	19	18	23	22	5000	4000	~~0.61~~ 0.67	~~0.78~~ 0.86
Corner Brook	35	-16	-18	26	20	30	23	4760	3770	~~0.43~~ 0.47	~~0.55~~ 0.61
Gander	125	-18	-20	27	20	31	24	5110	4110	~~0.47~~ 0.52	~~0.60~~ 0.66
Grand Bank	5	-14	-15	20	18	24	22	4550	3570	~~0.58~~ 0.64	~~0.74~~ 0.81
Grand Falls	60	-26	-29	27	20	31	24	5020	4020	~~0.47~~ 0.52	~~0.60~~ 0.66
Happy Valley-Goose Bay	15	-31	-32	27	19	31	23	6670	5700	~~0.33~~ 0.36	~~0.42~~ 0.46
Labrador City	550	-36	-38	24	17	28	20	7710	6710	~~0.31~~ 0.34	~~0.40~~ 0.44
St. Anthony	10	-25	-27	22	18	26	22	6440	5380	~~0.68~~ 0.75	~~0.87~~ 0.96
Stephenville	25	-16	-18	24	19	28	23	4850	3860	~~0.45~~ 0.50	~~0.58~~ 0.64
St. John's	65	-15	-16	24	20	28	23	4800	3810	~~0.61~~ 0.67	~~0.78~~ 0.86
Twin Falls	425	-35	-37	24	17	28	21	7790	6880	~~0.31~~ 0.34	~~0.40~~ 0.44
Wabana	75	-15	-17	24	20	27	23	4750	3760	~~0.59~~ 0.65	~~0.75~~ 0.83
Wabush	550	-36	-38	24	17	28	20	7710	6710	~~0.31~~ 0.34	~~0.40~~ 0.44
Yukon											
Aishihik	920	-44	-46	23	15	27	19	7500	6500	~~0.27~~ 0.28	~~0.38~~ 0.40
Dawson	330	-50	-51	26	16	30	19	8120	7100	~~0.22~~ 0.23	~~0.31~~ 0.33
Destruction Bay	815	-43	-45	23	14	27	18	7800	6790	~~0.42~~ 0.44	~~0.60~~ 0.63

Faro	670	-46	-47	25	16	29	20	7300	6310	~~0.26~~ 0.27	~~0.35~~ 0.37
Haines Junction	600	-45	-47	24	14	29	18	7100	6120	~~0.24~~ 0.25	~~0.34~~ 0.36
Snag	595	-51	-53	23	16	27	19	8300	7280	~~0.22~~ 0.23	~~0.31~~ 0.33
Teslin	690	-42	-44	24	15	28	19	6770	5800	~~0.26~~ 0.27	~~0.34~~ 0.36
Watson Lake	685	-46	-48	26	16	30	20	7470	6470	~~0.26~~ 0.27	~~0.35~~ 0.37
Whitehorse	655	-41	-43	25	15	30	19	6580	5610	~~0.29~~ 0.30	~~0.38~~ 0.40
Northwest Territories											
Aklavik	5	-42	-44	26	17	29	20	9600	8540	~~0.31~~ 0.33	~~0.40~~ 0.42
Behchokǫ̀ / Rae-Edzo	160	-42	-44	25	17	28	20	8300	7280	~~0.31~~ 0.33	~~0.40~~ 0.42
Echo Bay / Port Radium	195	-42	-44	22	16	25	19	9300	8250	~~0.41~~ 0.43	~~0.53~~ 0.56
Fort Good Hope	100	-43	-45	28	18	31	21	8700	7660	~~0.34~~ 0.36	~~0.44~~ 0.46
Fort McPherson	25	-44	-46	26	17	29	20	9150	8100	~~0.31~~ 0.33	~~0.40~~ 0.42
Fort Providence	150	-40	-43	28	18	32	21	7620	6620	~~0.27~~ 0.28	~~0.35~~ 0.37
Fort Resolution	160	-40	-42	26	18	30	21	7750	6740	~~0.30~~ 0.32	~~0.39~~ 0.41
Fort Simpson	120	-42	-44	28	19	31	22	7660	6660	~~0.30~~ 0.32	~~0.39~~ 0.41
Fort Smith	205	-41	-43	28	19	32	22	7300	6310	~~0.30~~ 0.32	~~0.39~~ 0.41
Hay River	45	-38	-41	27	18	31	21	7550	6550	~~0.27~~ 0.28	~~0.35~~ 0.37
Inuvik	45	-43	-45	26	17	30	20	9600	8540	~~0.31~~ 0.33	~~0.40~~ 0.42
Mould Bay	5	-44	-46	11	8	15	12	12900	11730	~~0.45~~ 0.47	~~0.58~~ 0.61
Norman Wells	65	-43	-45	28	18	31	21	8510	7480	~~0.34~~ 0.36	~~0.44~~ 0.46

Tungsten	1340	-49	-51	26	16	30	20	7700	6700	~~0.34~~ 0.36	~~0.44~~ 0.46
Ulukhaktok / Holman	10	-39	-41	18	12	23	16	10700	9600	~~0.67~~ 0.70	~~0.86~~ 0.90
Wrigley	80	-42	-44	28	18	31	21	8050	7040	~~0.30~~ 0.32	~~0.39~~ 0.41
Yellowknife	160	-41	-44	25	17	29	20	8170	7150	~~0.31~~ 0.33	~~0.40~~ 0.42
Nunavut											
Alert	5	-43	-44	13	8	18	12	13030	11860	~~0.59~~ 0.62	~~0.75~~ 0.79
Arctic Bay	15	-42	-44	14	10	19	14	11900	10760	~~0.43~~ 0.45	~~0.55~~ 0.58
Arviat	5	-40	-41	22	16	27	20	9850	8780	~~0.45~~ 0.47	~~0.58~~ 0.61
Baker Lake	5	-42	-44	23	15	28	19	10700	9600	~~0.42~~ 0.44	~~0.54~~ 0.57
Eureka	5	-47	-48	12	8	17	12	13500	12310	~~0.43~~ 0.45	~~0.55~~ 0.58
Igluligaarjuk / Chesterfield Inlet	10	-40	-41	20	14	25	18	10500	9410	~~0.44~~ 0.46	~~0.56~~ 0.59
Iqaluit	45	-40	-41	17	12	21	16	9980	8900	~~0.51~~ 0.54	~~0.65~~ 0.68
Iqaluktuuttiaq / Cambridge Bay	15	-41	-44	18	13	23	17	11670	10540	~~0.39~~ 0.41	~~0.50~~ 0.53
Isachsen	10	-46	-48	12	9	17	13	13600	12410	~~0.47~~ 0.49	~~0.60~~ 0.63
Kangiqiniq / Rankin Inlet	10	-41	-42	21	15	26	19	10500	9410	~~0.47~~ 0.49	~~0.60~~ 0.63
Kanngiqtugaapik / Clyde River	5	-40	-42	14	10	19	14	11300	10180	~~0.43~~ 0.45	~~0.55~~ 0.58
Kugluktuk / Coppermine	10	-41	-43	23	16	27	19	10300	9210	~~0.36~~ 0.38	~~0.46~~ 0.48
Nottingham Island	30	-37	-39	16	13	21	17	10000	8920	~~0.61~~ 0.64	~~0.78~~ 0.82

Resolute	25	-42	-43	11	9	16	13	12360	11210	~~0.46~~ 0.48	~~0.59~~ 0.62
Resolution Island	5	-32	-34	12	10	16	14	9000	7960	~~0.96~~ 1.01	~~1.23~~ 1.29
Salliq / Coral Harbour	15	-41	-42	20	14	25	18	10720	9620	~~0.45~~ 0.47	~~0.58~~ 0.61

Notes to Table [C-1] C-1:

(1) The hourly wind pressure data are used in Subclause 3.2.4.3.(2)(b)(ii).

(2) July design temperatures based on historical observations are provided for the design of mechanical cooling systems. See Note A-Table C-1.

Note A-Table C-1 Historical July Design Temperatures.

Analysis of the energy performance of buildings does not indicate an increased risk of overheating in buildings when mechanical cooling systems are provided and sized using historical July temperatures in the context of a future climate scenario. However, sizing mechanical cooling systems based on future 50-year July temperature projections could result in oversized cooling equipment, which could increase construction costs. Also, the equipment may never experience the elevated temperature condition during its expected service life, which is considerably less than 50 years.

Oversized cooling equipment could decrease the building's energy efficiency and increase energy costs. The oversizing could also lead to increased short-cycling of equipment and to inability of the equipment to meet latent loads, resulting in potentially excessive indoor humidity levels. In addition, increased short-cycling could decrease the service life of the equipment.

Therefore, for the purpose of the design of mechanical cooling system equipment, Table C-1 provides July temperatures based on historical observations.

Impact analysis

The following summarizes the updates to the climate design parameters forming part of NECB Table C-1. The revisions are to account for the potential future climate change effects expected over the 50-year design life of buildings and building components.

January 2.5% Design Temperatures

This parameter is used for the design of heating systems in buildings. The values of this parameter are projected to increase for all reference locations in the future as a consequence of climate warming; therefore, the current historical NECB values are deemed appropriate and are recommended to continue to be used for design. Overall, no change to the NECB 2020 design values of this parameter is expected.

January 1% Design Temperatures

This parameter is also used to design heating systems in buildings. The values of this parameter are projected to increase for all locations in the future as a consequence of climate warming; therefore, the current historical NECB values are considered appropriate and are recommended to continue to be used for design. Overall, no change to the NECB 2020 design values of this parameter is expected.

July 2.5% Dry and Wet Temperatures

This parameter is used for the design of cooling and dehumidifying systems in buildings. To minimize the risk of overheating, the projected values of this parameter are provided for the design of fenestration shading systems, design of advanced fenestration and glazing, and design of the enhanced building envelope. However, for the design of air handling and mechanical cooling equipment, the historical observed values for this parameter are maintained.

Using a July design temperature based on historical observations for the design of mechanical cooling equipment will

- reduce the risk of oversized cooling equipment
- maintain energy efficiency and energy costs for cooling
- minimize equipment short-cycling and maintain service life of equipment
- reduce the risk of excessive indoor humidity levels

Degree Days below 18ºC

This parameter is used to identify the required levels of insulation in the building. The values for this parameter are projected to decrease for all locations in the future as a consequence of climate change; therefore, the current values are deemed appropriate and are recommended to continue to be used for design. Overall, no change to the NECB 2020 design values of this parameter is expected.

1/10 hourly wind pressure (Q_{10})

Table 1 is a summary of changes projected for values of this parameter as a consequence of climate change over the typical design life of buildings (50 years).

Table 1. 1/10 Hourly Wind Pressure

Province or Territory	Number of Locations	$\Delta Q_{10} \le 0\%$	$0\% < \Delta Q_{10} \le 5\%$	$5\% < \Delta Q_{10} \le 10\%$	$10\% < \Delta Q_{10} \le 15\%$	$\Delta Q_{10} > 15\%$
British Columbia	108	0	15	48	45	0
Alberta	55	0	26	29	0	0
Saskatchewan	31	0	9	22	0	0
Manitoba	24	0	10	14	0	0
Ontario	230	0	0	92	138	0
Quebec	125	0	63	62	0	0
New Brunswick	18	0	0	4	14	0
Nova Scotia	25	0	0	11	14	0
Prince Edward Island	4	0	0	2	2	0
Newfoundland and Labrador	18	0	0	8	10	0
Yukon	9	0	9	0	0	0

Table 1. 1/10 Hourly Wind Pressure (Continued)

Province or Territory	Number of Locations	$\Delta Q_{10} \le 0\%$	$0\% < \Delta Q_{10} \le 5\%$	$5\% < \Delta Q_{10} \le 10\%$	$10\% < \Delta Q_{10} \le 15\%$	$\Delta Q_{10} > 15\%$
Northwest Territories	17	0	5	12	0	0
Nunavut	16	0	11	5	0	0
Total	**680**	**0**	**148**	**309**	**223**	**0**

Across the 680 locations over a 50-year future timeframe, the projected changes in values of this parameter increase ranging from 3.5% to 12%. Since all locations are projected with future increases in Q_{10}, these increased values are the future projected values.

1/50 hourly wind pressure (Q_{50})

Table 2 is a summary of the changes projected for values of this parameter as a consequence of climate change over the typical design life of buildings (50 years).

Table 2. 1/50 Hourly Wind Pressure

Province or Territory	Number of Locations	$\Delta Q_{50} \le 0\%$	$0\% < \Delta Q_{50} \le 5\%$	$5\% < \Delta Q_{50} \le 10\%$	$10\% < \Delta Q_{50} \le 15\%$	$\Delta Q_{50} > 15\%$
British Columbia	108	0	23	85	0	0
Alberta	55	0	55	0	0	0
Saskatchewan	31	0	31	0	0	0
Manitoba	24	0	24	0	0	0
Ontario	230	0	0	230	0	0
Quebec	125	0	125	0	0	0
New Brunswick	18	0	0	18	0	0
Nova Scotia	25	0	0	25	0	0
Prince Edward Island	4	0	0	4	0	0
Newfoundland and Labrador	18	0	0	18	0	0
Yukon	9	0	9	0	0	0
Northwest Territories	17	0	17	0	0	0
Nunavut	16	0	16	0	0	0
Total	**680**	**0**	**300**	**380**	**0**	**0**

Across the 680 locations over a 50-year future timeframe, the projected changes in this parameter range from 5% to 10%. Since all locations are projected with future increases in Q_{50}, the increased values are the future projected values. Where changes are greater than 5%, the design of air barriers would need to account for increased pressure.

References

(1) Cannon, A.J., Jeong, D.I., Zhang, X., and F. W. Zwiers. Climate-resilient buildings and core public infrastructure 2020: an assessment of the impact of climate change on climatic design data in Canada. Issued by Environment and Climate Change Canada. 2020.

(2) Hong, H. P., Tang, Q., Yang, S. C., Cui, X. Z., Cannon, A. J., Lounis, Z., and Irwin, P. (2021). Calibration of the design wind load and snow load considering the historical climate statistics and climate change effects. *Structural Safety*, 93, 102135.

Enforcement implications

There are no foreseeable enforcement implications.

Who is affected

Designers, architects, building regulators and building owners.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NECB20 Div.B Appendix C (first printing)

N/A

Submit a comment

Proposed Change 1721

Code Reference(s):	**NECB20 Div.C 2.2.1.1.(2) (first printing)** **NECB20 Div.C 2.2.2.1.(2) (first printing)**
Subject:	Administrative Requirements - Use of Defined Terms
Title:	Use of the Defined Term "Occupancy" in Division C of the NECB
Description:	This proposed change removes the defined term "occupancy" from provisions where its use could cause confusion in Division C of the NECB
Related Code Change Request(s):	CCR 1390, CCR 1668, CCR 1708
Related Proposed Change(s):	PCF 1651

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division C
- [ ] Building operations
- [ ] Small Buildings
- [ ] Fire Protection
- [ ] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Division B
- [x] Design and Construction
- [ ] Housing
- [x] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [x] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

The use of the defined term "occupancy" in Sentences 2.2.1.1.(2) and 2.2.2.1.(2) of Division C of the National Energy Code of Canada for Buildings (NECB) is causing confusion among Code users. The intent of the NECB is to describe the intended use of a space within a building or part of a building to provide energy use requirements.

The NECB also uses building or space types to describe the intended use of a building or part of a building for the purposes of providing energy use requirements.

Failing to clarify the terminology would lead to varying interpretations among Code users, which would lead to an inconsistent application of the Code and affect the degree of conformance across the country.

Justification

To avoid confusion and misinterpretation, the defined term "occupancy" should be removed from the NECB provisions that aim to provide energy use requirements.

Removing the defined term "occupancy" would clarify for Code users that energy use requirements, such as those for lighting, may change as the intended use of the space changes (e.g., from retail area to warehouse), although the occupancy classification (e.g., mercantile occupancy) does not change.

PROPOSED CHANGE

[2.2.1.1.] 2.2.1.1. Conformance with Administrative Requirements

[1] 2) The *authority having jurisdiction* may exempt a *building* or part thereof from some or all of the requirements of this Code where it can be shown that ~~the nature or duration of the *occupancy*~~ ~~makes~~ it is impractical to apply them. (See Note A-2.2.1.1.(2).)

[2.2.2.1.] 2.2.2.1. General Information Required

[1] 2) Plans shall be drawn to scale and shall indicate the nature and extent of the work ~~and proposed *occupancy*~~ in sufficient detail to establish that, when completed, the work ~~and the~~ ~~proposed *occupancy*~~ will conform to this Code.

Impact analysis

This proposed change has no cost implications since the new term clarifies that the NECB requirements apply regardless of the type of occupancy.

Enforcement implications

This proposed change can be enforced by the current infrastructure without requiring further training.

Who is affected

Designers, engineers, builders, energy advisors and building officials.

Submit a comment

Proposed Change 1919

Code Reference(s):	**NFC20 Div.A 2.1.1.2. (first printing)**
Subject:	Large Farm Buildings (General)
Title:	Introduction of the OP3 Sub-Objective for Large Farm Buildings in the NFC
Description:	This proposed change facilitates the introduction of the spatial separation sub-objective (OP3) for farm building requirements in the NFC by revising Sentence 2.1.1.2.(2) of Division A.
Related Proposed Change(s):	PCF 1777, PCF 1918, PCF 1935, PCF 1936

This change could potentially affect the following topic areas:

- [x] Division A
- [ ] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [x] Large Buildings
- [x] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

In the 2015-2020 Code cycle, new technical requirements for large farm buildings were developed for publication in the 2020 editions of the National Building Code of Canada (NBC) and the National Fire Code of Canada (NFC). The new requirements were intended to address the Codes' life safety (OS) objectives, following the initial direction provided by the Canadian Commission on Building and Fire Codes (CCBFC).

In the course of this work, the CCBFC was consulted on whether spatial separation requirements should also be considered for farm buildings. In September 2019, the Executive Committee (EC) of the CCBFC, after consulting with the provinces and territories, requested that the Joint Task Group drafting the provisions "follow the normal Code development process when developing requirements for spatial separation."

Due to time limitations, spatial separation requirements for farm buildings were not included in the 2020 editions of the NBC and NFC, nor were the OP3 sub-objective or intent statements. As such, there is a need to continue this work, which was deferred from the 2015-2020 Code cycle with the intention that these requirements and objectives would be included in the 2025 editions of these Codes.

For the 2020-2025 Code cycle, the Province of Ontario led the work to develop spatial separation requirements for large farm buildings in the NBC. Codes Canada expanded the application of the OP3 sub-objective to existing requirements in the NBC and introduced relevant intent statements where appropriate, as directed by the EC.

However, Sentence 2.1.1.2.(2) of Division A of the NFC 2020 indicates that OP objectives do not apply to farm buildings, which conflicts with the direction provided by the EC in September 2019. This conflict needs to be resolved to allow new and future proposed changes related to the introduction of the OP3 sub-objective to proceed.

Justification

Sentence 2.1.1.2.(2) of Division A should be revised, as it is in conflict with the direction provided by the EC of the CCBFC. The revision will permit the OP3 spatial separation sub-objective and related technical requirements to be considered for farm buildings in the NFC.

PROPOSED CHANGE

[2.1.1.2.] **2.1.1.2. Application of Objectives**

[1] **1)** Except as provided in Sentence (2), the objectives described in this Part apply

[a] a) to all *buildings* and facilities covered in this Code (see Article 1.1.1.1.), and

[b] b) only to the extent that they relate to compliance with this Code as required in Article 1.2.1.1.

[2] **2)** Objective OP, Fire Protection of Buildings and Facilities, except for~~(including~~ Sub-Objective~~s OP1, Fire Protection of the Building or Facility, and~~ OP3, Protection of Adjacent Buildings or Facilities from Fire~~)~~, does not apply to *farm buildings*.

Impact analysis

No new costs or technical requirements would be introduced by this proposed change. Rather, the change would allow the OP3 sub-objective to be considered for farm buildings in the NFC.

Future technical requirements related to spatial separation may impact farm building use and construction costs. These requirements would be evaluated separately, with impact analyses that are specific to the proposed technical requirements in question.

Enforcement implications

This proposed change does not on its own introduce any technical requirements that would need to be enforced by authorities having jurisdiction (AHJs), but AHJs should be aware that the OP3 sub-objective now applies to farm buildings in the NFC.

Who is affected

Affected persons would include AHJs, architects, engineers, contractors and building owners, since they should be made aware that the OP3 sub-objective now applies to farm buildings.

Submit a comment

Proposed Change 1776

Code Reference(s):	**NFC20 Div.B 4.3.5.2. (first printing)** **NFC20 Div.B 4.3.11.3. (first printing)**
Subject:	Storage Tanks
Title:	Addition of the OH5 Sub-Objective to Relevant Provisions in NFC Part 4
Description:	This proposed change adds the OH5 sub-objective and related intent statements to provisions in the NFC related to the location of vent pipe outlets for aboveground and underground storage tanks.
Related Code Change Request(s):	CCR 1818
Related Proposed Change(s):	PCF 1691

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [x] Design and Construction
- [ ] Building operations
- [ ] Housing
- [x] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

Articles 4.3.5.2. and 4.3.11.3. of Division B of the National Fire Code of Canada (NFC) provide requirements for the location of vent pipe outlets for aboveground storage tanks and the installation of vents for underground storage tanks, respectively.

Currently, only the OS1 Fire Safety sub-objective is assigned to Article 4.3.5.2., while both OS1 Fire Safety and OH5 Hazardous Substances Containment sub-objectives are assigned to Sentences 4.3.11.3.(1) to (5).

In addition to the fire safety concerns, a health risk is also addressed by the two Articles as many people are sensitive to the odours released from flammable or combustible components. Therefore, both OS1 Fire Safety and OH5 Hazardous

Substances Containment sub-objectives should be assigned to the relevant Sentences in Articles 4.3.5.2. and 4.3.11.3. to clarify the sub-objectives and intent of the Code provisions.

Justification

This proposed change clarifies the sub-objectives and intent of the Code provisions.

EXISTING PROVISION

4.3.5.2. Location of Vent Pipe Outlets

1) Normal vent pipe outlets for *storage tanks* of Class I liquids
- a) shall be located outside *buildings* not less than
  - i) 3.5 m above the adjacent ground level, and
  - ii) 1.5 m from any *building* opening, and
- b) shall discharge so that flammable vapours will not enter the *building* or be trapped near any part of the *building*.

2) Normal vent pipe outlets for *storage tanks* of Class II or IIIA liquids shall discharge outside *buildings* not less than
- a) 2 m above the adjacent ground level, and
- b) 1.5 m from any *building* opening.

3) Emergency vent outlets for *storage tanks* shall discharge outside *buildings* not less than 1.5 m from any *building* opening and from any combustible component of any *building*'s exterior wall.

4.3.11.3. Installation

1) Vent pipe outlets from underground *storage tanks* for Class I liquids
- a) shall be located outside *buildings* higher than the fill pipe openings but not less than
  - i) 3.5 m above the adjacent ground level,
  - ii) 1.5 m from any *building* opening, and
  - iii) 7.5 m from any dispenser, and
- b) shall discharge so that flammable vapours will not enter *building* openings or be trapped near any part of the *building*.

2) Vent pipe outlets from underground *storage tanks* for Class II or IIIA liquids shall be located outside *buildings* at a height that is above the fill pipe opening but not less than 2 m above finished ground level.

3) Vent pipes from underground *storage tanks* for *flammable liquids* or *combustible liquids* shall not be obstructed by any device that may cause excessive back pressure, except that vent pipes from underground *storage tanks* for Class II or IIIA liquids are permitted to be fitted with return bends, coarse screens or other devices to minimize the entry of foreign material.

4) Vent piping shall enter the *storage tank* through the top of the tank and shall not extend into the tank more than 25 mm.

5) Vent piping shall be

- a) installed so that any nominally horizontal run shall slope towards the *storage tank*,
- b) constructed without traps,
- c) adequately supported to prevent sagging, and
- d) where necessary, protected against mechanical damage.

6) Vent piping shall be tested for leaks at the commissioning stage in conformance with Clause 4.4.1.2.(1)(a).

PROPOSED CHANGE

[4.3.5.2.] 4.3.5.2. Location of Vent Pipe Outlets

[4.3.11.3.] 4.3.11.3. Installation

[1] **1)** Vent pipe outlets from underground *storage tanks* for Class I liquids

- [a] a) shall be located outside *buildings* higher than the fill pipe openings but not less than
  - [i] i) 3.5 m above the adjacent ground level,
  - [ii] ii) 1.5 m from any *building* opening, and
  - [iii] iii) 7.5 m from any dispenser, and
- [b] b) shall discharge so that flammable vapours will not enter *building* openings or be trapped near any part of the *building*.

[2] **2)** Vent pipe outlets from underground *storage tanks* for Class II or IIIA liquids shall be located outside *buildings* ~~at a height that is above the fill pipe openingbut not less than 2 m above finished ground level.~~

- [a] --) above the fill pipe opening,
- [b] --) not less than 2 m above finished ground level, and
- [c] --) not less than 1.5 m from any building opening (PCF 1691-2025).

[3] **3)** Vent pipes from underground *storage tanks* for *flammable liquids* or *combustible liquids* shall not be obstructed by any device that may cause excessive back pressure, except that vent pipes from underground *storage tanks* for Class II or IIIA liquids are permitted to be fitted with return bends, coarse screens or other devices to minimize the entry of foreign material.

[4] **4)** Vent piping shall enter the *storage tank* through the top of the tank and shall not extend into the tank more than 25 mm.

[5] **5)** Vent piping shall be

[a] a) installed so that any nominally horizontal run shall slope towards the *storage tank*,

[b] b) constructed without traps,

[c] c) adequately supported to prevent sagging, and

[d] d) where necessary, protected against mechanical damage.

[6] **6)** Vent piping shall be tested for leaks at the commissioning stage in conformance with Clause 4.4.1.2.(1)(a).

Impact analysis

This proposed change clarifies the sub-objectives and intent of the Code requirements. It facilitates the interpretation and enforcement of the current Code requirements. No additional cost is associated with this proposed change.

Enforcement implications

Enforcement can be achieved by the existing means and resources used to check the compliance of the installation of vents for aboveground and underground storage tanks.

The proposed change is expected to make enforcement easier as it clarifies the sub-objectives and intent of the requirements.

Who is affected

Designers, manufacturers, contractors, building owners, building officials and fire officials would benefit from this clarification.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[4.3.5.2.] 4.3.5.2. ([1] 1) [F01-OS1.1]

[4.3.5.2.] 4.3.5.2. ([1] 1) [F44-OH5] Applies to the requirement for the vent pipe outlets to be located not less than 1.5 m from any *building* opening.

[4.3.5.2.] 4.3.5.2. ([2] 2) [F01-OS1.1]

[4.3.5.2.] 4.3.5.2. ([2] 2) [F44-OH5] Applies to the requirement for the vent pipe outlets to be located not less than 1.5 m from any *building* opening.

[4.3.5.2.] 4.3.5.2. ([3] 3) [F01-OS1.1]

[4.3.5.2.] 4.3.5.2. ([3] 3) [F44-OH5] Applies to the requirement for the vent pipe outlets to be located not less than 1.5 m from any *building* opening.

[4.3.11.3.] **4.3.11.3. ([1] 1) [F01-OS1.1]**

[4.3.11.3.] **4.3.11.3. ([1] 1) ([a] a) [F43-OS1.1]** Applies to the vent pipe outlets being higher than the fill pipe openings.

[4.3.11.3.] **4.3.11.3. ([1] 1) ([a] a) [F43-OH5]** Applies to the vent pipe outlets being higher than the fill pipe openings.

[4.3.11.3.] 4.3.11.3. ([1] 1) ([a] a)([ii] ii),([b] b) [F44-OH5]

[4.3.11.3.] **4.3.11.3. ([2] 2) [F01-OS1.1]** ~~Applies to portion of Code text: "Vent pipe outlets from underground *storage tanks* for Class II or IIIA liquids shall be located outside *buildings* …"~~

[4.3.11.3.] **4.3.11.3. ([2] 2) ([a] --) [F43-OS1.1]** ~~Applies to the requirement for vent pipe outlets to be located outside *buildings* at a height that is above the fill pipe opening.~~

[4.3.11.3.] **4.3.11.3. ([2] 2) ([a] --) [F43-OH5]** ~~Applies to the requirement for the vent pipe outlets to be located outside *buildings* at a height that is above the fill pipe opening.~~

[4.3.11.3.] **4.3.11.3. ([2] 2) ([b] --) [F01-OS1.1]** ~~Applies to the requirement for vent pipe outlets to be located outside *buildings* at not less than 2 m above finished ground level.~~

[4.3.11.3.] 4.3.11.3. ([2] 2) ([c] --) [F01,F44-OS1.1]

[4.3.11.3.] 4.3.11.3. ([2] 2) ([c] --) [F44-OH5]

[4.3.11.3.] **4.3.11.3. ([3] 3) [F20,F81-OS1.1]** Applies to the requirement for vent pipes to not be obstructed by any device that may cause excessive back pressure.

[4.3.11.3.] **4.3.11.3. ([3] 3) [F20,F81-OH5]** Applies to the requirement for vent pipes to not be obstructed by any device that may cause excessive back pressure.

[4.3.11.3.] **4.3.11.3. ([3] 3) no attributions**

[4.3.11.3.] **4.3.11.3. ([4] 4) [F20,F81-OS1.1]**

[4.3.11.3.] **4.3.11.3. ([4] 4) [F20,F81-OH5]**

[4.3.11.3.] **4.3.11.3. ([5] 5) ([a] a),([b] b),([c] c) [F81,F20-OS1.1]**

[4.3.11.3.] **4.3.11.3. ([5] 5) ([d] d) [F81-OS1.1]**

[4.3.11.3.] **4.3.11.3. ([5] 5) ([a] a),([b] b),([c] c) [F81,F20-OH5]**

[4.3.11.3.] **4.3.11.3. ([5] 5) ([d] d) [F81-OH5]**

[4.3.11.3.] **4.3.11.3. ([6] 6) no attributions**

Submit a comment

Proposed Change 1936

Code Reference(s):	**NFC20 Div.B 4.12.1. (first printing)**
Subject:	Large Farm Buildings (General)
Title:	OP3 Sub-Objective and Intent Statements for Large Farm Buildings in the NFC
Description:	This proposed change introduces the OP3 sub-objective and intent statements for large farm buildings requirements in the NFC.
Related Proposed Change(s):	PCF 1777, PCF 1918, PCF 1919, PCF 1935

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [x] Building operations
- [ ] Small Buildings
- [x] Fire Protection
- [ ] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [x] Division B
- [x] Design and Construction
- [ ] Housing
- [ ] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

In 2015-2020 Code cycle, new technical requirements for large farm buildings were developed for publication in the 2020 editions of the National Building Code of Canada (NBC) and National Fire Code of Canada (NFC). The new requirements were intended to address the Codes' occupant safety (OS) objectives, following the initial direction provided by the Canadian Commission on Building and Fire Codes (CCBFC).

In the course of this work, the CCBFC was consulted on whether spatial separation should also be considered for farm buildings. In September 2019, the Executive Committee (EC) of the CCBFC, after consulting the provinces and territories, requested that the Joint Task Group drafting the provisions "follow the normal Code development process when developing requirements for spatial separation."

Due to the time limitations, spatial separation requirements for farm buildings were not included in the 2020 editions of the NBC and NFC, nor were the OP3 sub-objective or intent statements. As such, there is a need to continue this work, which was deferred from the 2015-2020 Code cycle with the intention that these requirements and objectives would be included in the 2025 editions of these Codes.

For the 2020-2025 Code cycle, the Province of Ontario led the work to develop spatial separation requirements for large farm buildings in the NBC. Codes Canada expanded the application of the OP3 sub-objective to existing requirements in the NBC and introduced relevant intent statements where appropriate, as directed by the EC.

Justification

This proposed change attributes the existing requirements in the NFC 2020 to relevant functional statements and the OP3 sub-objective, and also adds relevant intent statements where appropriate.

This proposed change completes the work that was deferred from the previous Code cycle.

The responsible Standing Committees will review the proposed change and approve by consensus, if deemed appropriate, without needing to send this proposed change for public review.

PROPOSED CHANGE

[4.12.1.] 4.12.1. Scope

[4.12.1.1.] 4.12.1.1. Application

[4.12.1.2.] 4.12.1.2. Containers and Tanks

[4.12.1.3.] 4.12.1.3. Pesticide Storage Areas

Impact analysis

This proposed change is a clarification of the intent to help Code users in the farming industry interpret the existing requirements for large farm buildings. No change is proposed to be made to the requirements themselves, so there is no associated cost.

Enforcement implications

This proposed change and addition to the intent statements and the OP3 sub-objective of farm building requirements, respectively, would assist regulators in the interpretation and enforcement of the requirements in their jurisdictions. The authorities having jurisdiction (AHJs) should be aware that the current requirements address the OP3 spatial separation sub-objective in addition to the OS safety objectives of the NFC. No need for training is anticipated since the AHJs are already familiar with the functional statements and objectives of the NFC.

Who is affected

Affected persons include authorities having jurisdiction, architects, engineers, building owners, and contractors.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[4.12.1.1.] 4.12.1.1. ([1] 1) no attributions

[4.12.1.2.] 4.12.1.2. ([1] 1) [F02,~~F01~~-OS1.1]

[4.12.1.2.] 4.12.1.2. ([1] 1) [F03-OP3.1] Applies to the minimum distance of 12 m and designated indoor storage.

[4.12.1.2.] 4.12.1.2. ([2] 2) [F02-OS1.1] [F03-OS1.2]

[4.12.1.2.] 4.12.1.2. ([2] 2) [F03-OP3.1] Applies to the minimum distance of 12 m.

[4.12.1.2.] 4.12.1.2. ([3] 3) [F03-OS1.2]

[4.12.1.2.] 4.12.1.2. ([3] 3) [F03-OP3.1] Applies to the minimum distance of 1.5 m.

[4.12.1.2.] 4.12.1.2. ([4] 4) no attributions

[4.12.1.3.] 4.12.1.3. ([1] 1) [F31,F34-OS3.4]

Submit a comment

Proposed Change 1959

Code Reference(s):	**NPC20 Div.A 1.2.2.2.(1) (first printing)** **NPC20 Div.A 1.4.1.2.(1) (first printing)** **NPC20 Div.A 3.2.1.1. (first printing)**
Subject:	Defined Terms
Title:	Replacement of the Defined Term "Fixture" with "Plumbing Fixture"
Description:	This proposed change revises the defined term “fixture” in the NPC to “plumbing fixture.”
Related Proposed Change(s):	PCF 1690, PCF 1692, PCF 2014

This change could potentially affect the following topic areas:

- [x] Division A
- [ ] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [ ] Housing
- [ ] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [x] Heating, Ventilating and Air Conditioning
- [x] Plumbing
- [ ] Construction and Demolition Sites

Problem

In the National Building Code of Canada (NBC), the National Energy Code of Canada for Buildings (NECB) and the National Fire Code of Canada (NFC), “fixture” is a non-defined term that is variously used to refer to lighting fixtures, furnishings or equipment, ceiling fixtures, etc. In the National Plumbing Code of Canada (NPC), however, “fixture” is a defined term that refers to “a receptacle, appliance, apparatus or other device that discharges sewage or clear-water waste, and includes a floor drain.”

The varied use of the term “fixture” across the Codes may create confusion for Code users. Clarification of the defined term in the NPC is needed to reduce the risk of interpretation errors, which could lead to improper application of Code requirements.

Justification

The proposed change would clarify the existing defined term “fixture” in the NPC with the addition of a qualifier, “plumbing,” to ensure that there is no doubt as to when the term is being used to refer to plumbing fixtures as defined in the Code. This clarification would limit the probability of confusion for Code users and the risk of related compliance issues.

The change would also

- replace the defined term “fixture” with “plumbing fixture” everywhere else that it is referenced in Division A of the NPC for consistency, and
- expand the definition of the term by adding “neutralized condensate” to the list of waste types discharged by the receptacle or device.

The addition of “neutralized condensate” to the definition was proposed in response to the growth in high-efficiency appliances whose combustion byproducts include water and other chemicals typically defined as condensate. These condensates are generally considered to be compatible with most plumbing systems but may have an elevated acidity. The industry has developed processes to neutralize the acidity of condensate waste and discharge it into plumbing systems for disposal with the rest of the plumbing waste stream. The reference to this highly specialized activity was proposed to minimize the risk of condensate from high-efficiency appliances being confused with condensation from other water collection technologies or processes in other mechanical systems.

Note: A proposed change to a defined term does not need to identify every accompanying revision that would be made to the Code, only those that require the attention of Code users. The revised term would automatically apply wherever the current defined term is used.

PROPOSED CHANGE

[1.2.2.2.] 1.2.2.2. Used Materials and Equipment

[1] **1)** Used materials and equipment, including *plumbing fixtures*, shall not be reused unless they meet the requirements of this Code for new materials and equipment and are otherwise satisfactory for their intended use.

[1.4.1.2.] 1.4.1.2. Defined Terms

[1] **1)** The words and terms in italics in this Code shall have the following meanings (an asterisk (*) following a defined word or term indicates that the definition for that word or term is taken from the NBC):

Air break means the unobstructed vertical distance between the lowest point of an *indirectly connected sanitary drainage pipe* and the *flood level rim* of the *plumbing fixture* into which it discharges. (See Note A-2.3.3.11.(2) of Division B.)

Air gap means the unobstructed vertical distance through air between the lowest point of a water supply outlet and the *flood level rim* of the *plumbing fixture* or device into which the outlet discharges. (See Note A-2.6.2.9.(2) of Division B.)

Bathroom group means a group of ~~plumbing~~*plumbing fixtures* installed in the same room, consisting of one domestic-type lavatory, one water closet and either one bathtub (with or without a shower) or one one-head shower.

Circuit vent means a *vent pipe* that serves a number of *plumbing fixtures* and connects to the *fixture drain* of the most upstream *plumbing fixture*.

Drainage system means an assembly of pipes, fittings, *plumbing fixtures*, *traps* and appurtenances that is used to convey *sewage*, *clear-water waste* or *storm water* to a public sewer or a *private sewage disposal system*, but does not include *subsoil drainage pipes*. (See Figure A-1.4.1.2.(1)-F in Note A-1.4.1.2.(1).)

Dual vent means a *vent pipe* that serves 2 *plumbing fixtures* and connects at the junction of the *trap arms*. (See Figure A-1.4.1.2.(1)-G in Note A-1.4.1.2.(1).)

Emergency floor drain means a *plumbing fixture* for the purposes of overflow protection that does not receive regular discharge from other *plumbing fixtures*, other than from a *trap* primer. (See Appendix A.)

Plumbing ~~F~~*fixture* means a receptacle, appliance, apparatus or other device that discharges *sewage*, ~~or~~ *clear-water waste*~~,~~ or neutralized condensate and includes a floor drain.

Fixture drain means the pipe that connects a *trap* serving a *plumbing fixture* to another part of a *drainage system*.

Fixture outlet pipe means a pipe that connects the waste opening of a *fixture* to the *trap* serving the *plumbing fixture*. (See Figure A-1.4.1.2.(1)-H in Note A-1.4.1.2.(1).)

Fixture unit (as applying to *water distribution systems*) means the unit of measure based on the rate of supply, time of operation and frequency of use of a *plumbing fixture* or outlet that expresses the hydraulic load that is imposed by that *plumbing fixture* or outlet on the supply system.

Flood level rim means the top edge at which water can overflow from a *plumbing fixture* or device. (See Figure A-1.4.1.2.(1)-B in Note A-1.4.1.2.(1).)

Individual vent means a *vent pipe* that serves one *plumbing fixture*.

Private use (as applying to the classification of ~~plumbing~~*plumbing fixtures*) means *plumbing fixtures* in residences and apartments, in private bathrooms of hotels, and in similar installations in other *buildings* for one family or an individual.

Public use (as applying to the classification of ~~plumbing~~*plumbing fixtures*) means *plumbing fixtures* in general washrooms of schools, gymnasiums, hotels, bars, public comfort stations and other installations where *plumbing fixtures* are installed so that their use is unrestricted.

Storey for the purposes of this Code, means the interval between 2 successive floor levels, including mezzanine floors that contain ~~plumbing~~*plumbing fixtures*, or between a floor level and roof.

Trap standard means the *trap* for a *plumbing fixture* that is integral with the support for the *plumbing fixture*.

Water distribution system means an assembly of pipes, fittings, valves and appurtenances that conveys water from the *water service pipe* or *private water supply system* to water supply outlets, *plumbing fixtures*, appliances and devices.

Wet vent means a *sanitary drainage pipe* that also serves as a *vent pipe* and extends from the most downstream wet-vented *plumbing fixture* connection to the most upstream *plumbing fixture* connection. (See Note A-2.5.8.1.(2) of Division B.)

Note A-1.4.1.2.(1) Defined Terms.

Emergency Floor Drains

There are two types of floor drains. One is an emergency floor drain installed to avoid flooding in a building from any pipe or plumbing fixture failure. The other encompasses floor drains installed to receive discharge from specific pieces of equipment; this type is defined as a plumbing fixture.

[3.2.1.1.] 3.2.1.1. Functional Statements

[1] **1)** The objectives of this Code are achieved by measures, such as those described in the acceptable solutions in Division B, that are intended to allow the *plumbing system* to perform the following functions (see Note A-3.2.1.1.(1)):

F01 To minimize the risk of accidental ignition.

F02 To limit the severity and effects of fire or explosions.

F20 To support and withstand expected loads and forces.

F21 To limit or accommodate dimensional change.

F30 To minimize the risk of injury to persons as a result of tripping, slipping, falling, contact, drowning or collision.

F31 To minimize the risk of injury to persons as a result of contact with hot surfaces or substances.

F40 To limit the level of contaminants.

F41 To minimize the risk of generation of contaminants.

F43 To minimize the risk of release of hazardous substances.

F45 To minimize the risk of the spread of disease through communal shower facilities.

F46 To minimize the risk of contamination of *potable* water.

F62 To facilitate the dissipation of water and moisture from the *building*.

F70 To provide *potable* water.

F71 To provide facilities for personal hygiene.

F72 To provide facilities for the sanitary disposal of human and domestic wastes.

F80 To resist deterioration resulting from expected service conditions.

F81 To minimize the risk of malfunction, interference, damage, tampering, lack of use or misuse.

F82 To minimize the risk of inadequate performance due to improper maintenance or lack of maintenance.

F130 To limit the unnecessary demand and/or consumption of water for *plumbing fixtures*.

F131 To limit the unnecessary demand and/or consumption of water for fittings.

Impact analysis

There are no cost implications to the proposed change, as the clarification of the defined term does not impact the application of the provisions in which it is used.

The proposed change would provide clarification and consistency. No additional enforcement measures or materials would be needed.

Enforcement implications

This proposed change would assist building designers and regulators, as the definition would be clearer.

Who is affected

Building designers, regulators and contractors.

Submit a comment

Proposed Change 1706

Code Reference(s):	**NPC20 Div.A 1.4.1.2. (first printing)**
Subject:	Defined Terms
Title:	Definitions of "Washroom" and Related Terminology
Description:	This proposed change introduces a definition for the term “washroom” and clarifies the related terms "private use" and "public use" to align the NPC with the NBC.
Related Proposed Change(s):	PCF 1707

This change could potentially affect the following topic areas:

- [x] Division A
- [ ] Division B
- [ ] Division C
- [x] Design and Construction
- [x] Building operations
- [x] Housing
- [x] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [x] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [x] Plumbing
- [ ] Construction and Demolition Sites

Problem

The following terms may create confusion when used in the context of the National Model Codes: “toilet,” “water closet” (or “WC”), “washroom,” “rest room,” and “bathroom.” Also, these terms may appear at times to have the same meaning. Although these terms are used in common language, the intended meanings as used in the Codes may differ.

To resolve the current confusion and to resolve conflicts between the National Plumbing Code of Canada (NPC) and the National Building Code of Canada (NBC), the terms “washroom”, “public washroom” and “private washroom” should be defined. The existing definitions of the terms “private use” and “public use” should also be revised to resolve conflicts between the Codes when related to actual installations.

Justification

Adding definitions for “washroom”, “public washroom” and “private washroom”, and revising the definitions for “public use” and “private use” may help to clarify the intended meanings of these terms as used in the NPC and Parts of the NBC to better support enforcement of the Codes. It was noted that definitions based on the term “washroom” (e.g., “public washroom”, “private washroom”) may better align with the NBC rather than definitions based on the term “use” (e.g., “public use”, “private use”) that currently exist in the NPC.

PROPOSED CHANGE

[1.4.1.2.] 1.4.1.2. Defined Terms

[1] 1) The words and terms in italics in this Code shall have the following meanings (an asterisk (*) following a defined word or term indicates that the definition for that word or term is taken from the NBC):

Private use (as applying to the classification of plumbing *fixtures*) means *fixtures* in residences and apartments, in private ~~bathrooms~~washrooms of hotels, and in similar installations in other *buildings* for one family or an individual.

Private washroom means a *washroom* containing plumbing *fixtures* intended for *private use*.

Public use (as applying to the classification of plumbing *fixtures*) means *fixtures* that are not intended for *private use*~~in general washrooms of schools, gymnasiums, hotels, bars, public comfort stations and other installations where *fixtures* are installed so that their use is unrestricted~~.

Public washroom means a *washroom* containing plumbing *fixtures* intended for *public use*.

Washroom means a room containing at least one water closet and at least one lavatory or similar *fixture* for hand-washing. (See Note A-1.4.1.2.(1).)

Note A-1.4.1.2.(1) Defined Terms.

Washroom

The fixture units of a bathroom group within a washroom may be counted in the usual manner, regardless of the presence of partitions.

Impact analysis

This proposed change would reduce conflict between the NBC and the NPC for Code users by using consistent terminology and definitions to clarify the intended meanings of commonly used terms. If approved, the proposed change could result in a larger number of existing washrooms being designated “public washrooms.” There may be increased cost in some installations, but overall the cost impact should be minor.

Enforcement implications

This proposed change would assist authorities having jurisdiction by preventing certain conflicts between the requirements of the NPC and the NBC that apply to “public washrooms” and “private washrooms.” The prescriptive plumbing requirements of the NPC, which ensure proper water and drain line sizing, would then align with the prescriptive building requirements of the NBC for required fixtures.

Aligning the requirements of both Codes supports consistent installation regardless of which discipline has priority or the order of enforcement.

Who is affected

Building officials, plumbing officials, building owners, and designers of commercial buildings.

Submit a comment

Proposed Change 1782

Code Reference(s):	**NPC20 Div.B 2.2.1.3. (first printing)**
Subject:	Piping
Title:	Identification of Storm and Sanitary Drainage Systems
Description:	This proposed change adds requirements for the identification of storm and sanitary drainage systems.
Related Code Change Request(s):	CCR 1629, CCR 1630

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [ ] Design and Construction
- [ ] Building operations
- [ ] Housing
- [x] Small Buildings
- [x] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [x] Plumbing
- [ ] Construction and Demolition Sites

Problem

The National Plumbing Code of Canada (NPC) establishes requirements for sanitary and storm drainage piping, but it does not currently require this piping to be identified in the field. Similarity in the colour and shape of building drains has resulted in multiple cases of cross-connection between sanitary and storm drainage systems.

The pre-servicing of lots is very common in the industry. In some cases, servicing is completed years later, which can result in cross-connection between sanitary and storm drainage systems if municipal plumbing inspectors and contractors cannot differentiate between the two service lines.

Instances of cross-connection on some sites have resulted in the need for costly replacement of buried piping. Cross-connections can also result in harm to system users if they come into contact with unsanitary water. Finally, water treatment is an expensive and energy-intensive process, and wasting treated water is costly and increases energy consumption.

Justification

The proposed change would require piping systems to be permanently marked to allow contractors and municipal plumping inspectors to differentiate between the various pipe applications in the field, with different options for marking determined by the authority having jurisdiction (AHJ). The change would improve alignment between the NPC and provincial and territorial requirements, as provinces such as Ontario have guidelines for marking and labelling different pipe services. The change would thus be a step towards harmonization with provincial and territorial requirements.

Proper marking of piping systems would help prevent cross-connection of pipes and thus reduce costs associated with repairs and insurance claims as well as municipal costs to pump, convey and treat extraneous flow directed to the wrong system.

Cross-connection of pipes also contributes heavily to raw sewage spills into watercourses. Sewer discharges into the environment are costly and can have significant environmental and health impacts.

PROPOSED CHANGE

[2.2.1.3.] 2.2.1.3. Identification

[1] **1)** Every length of pipe and every fitting shall

[a] a) have cast, stamped or indelibly marked on it the maker's name or mark and the weight or class or quality of the product, ~~or~~and

[b] b) be marked permanently in accordance with the relevant standard.

[2] **2)** ~~Markings required in Sentence (1) shall be visible after installation.~~*Sanitary drainage systems* connected to a public *sanitary sewer*, a public *combined sewer* or a *private sewage disposal system* and *storm drainage systems* connected to a public *storm sewer*, a public *combined sewer* or a designated *storm water* disposal location shall be identified by a permanent means of identification accepted by the authority having jurisdiction. (See Note A-2.2.1.3.(2).)

Note A-2.2.1.3.(2) Identification of Buried Pipe

Examples of permanent means of identification for buried pipe include permanent factory-applied writing on the pipe and utility-marking tape buried between the top of the pipe and the finished ground level.

Impact analysis

Manufacturers or contractors would be required to provide markings on piping products. In the latter case, this would most likely be in the form of a tape or marking added to the pipe during installation. The actual pipe products would not change and the marking would be applied on site. The cost of materials and the time required to add a tape marker or paint strip would not be excessive for the installer/contractor.

The proposed change would help to reduce operations and maintenance costs and prevent sanitary sewer discharges into the environment.

Enforcement implications

Enforcement of the proposed requirements would require additional monitoring. In addition to ensuring that there are no cross-connections, AHJs would need to check that the pipes are properly marked with their intended use.

The marking of pipes would assist engineers, inspectors and AHJs in following the planned flow and in other quality control measures.

Who is affected

Contractors, engineers and AHJs.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[2.2.1.3.] 2.2.1.3. ([1] 1) no attributions

[2.2.1.3.] 2.2.1.3. ([2] 2) [F43-OH5]

Submit a comment

Proposed Change 2007

Code Reference(s):	**NPC20 Div.B 2.2.10.6. (first printing)**
Subject:	Other
Title:	Automatic Shutoff of Lavatory Water Flow in Public Washrooms
Description:	This proposed change removes Sentence 2.2.10.6.(5) of the NPC to eliminate the conflict with Sentence 3.7.2.3.(4) of the NBC.

This change could potentially affect the following topic areas:

- [ ] Division A
- [x] Division B
- [ ] Division C
- [ ] Design and Construction
- [x] Building operations
- [ ] Housing
- [ ] Small Buildings
- [ ] Large Buildings
- [ ] Fire Protection
- [ ] Occupant safety in use
- [ ] Accessibility
- [ ] Structural Requirements
- [ ] Building Envelope
- [ ] Energy Efficiency
- [ ] Heating, Ventilating and Air Conditioning
- [x] Plumbing
- [ ] Construction and Demolition Sites

Problem

Currently, a conflict exists between Sentence 2.2.10.6.(5) of Division B of the National Plumbing Code of Canada (NPC) and Sentence 3.7.2.3.(4) of Division B of the National Building Code of Canada (NBC).

NBC Sentence 3.7.2.3.(4) allows for the manual operation of lavatories as well as automatic operation. However, NPC Sentence 2.2.10.6.(5) states "[e]ach lavatory in a public washroom shall be equipped with a device capable of automatically shutting off the flow of water when the lavatory is not in use."

The conflict between the NPC’s requirement for automatic shutoff of the lavatory and the NBC’s permission of optional manual operation may lead to potential confusion for Code users, who refer to the NPC and the NBC for applicable requirements for lavatories.

Justification

Eliminating NPC Sentence 2.2.10.6.(5) would resolve the current conflict between the provisions of the NPC and the NBC and eliminate confusion for Code users.

This proposed change would ensure that requirements in both the NBC and NPC are harmonized. It would also limit the probability that lavatory supply fittings in public washrooms would not have an integral means of stopping water flow.

PROPOSED CHANGE

NPC20 Div.B 2.2.10.6. (first printing)

[2.2.10.6.] 2.2.10.6. Valves, and Supply and Waste Fittings

[1] 1) Supply fittings shall conform to

[a] a) ASME A112.18.1/CSA B125.1, "Plumbing Supply Fittings", or

[b] b) CSA B125.3, "Plumbing fittings".

[2] 2) Except for lavatories in healthcare facilities, emergency eye washes, and emergency showers, supply fittings and individual shower heads shall have an integral means of limiting the maximum water flow rate to that specified in Table 2.2.10.6. (See Note A-2.2.10.6.(2).)

Table [2.2.10.6.] 2.2.10.6.
Water Flow Rates from Supply Fittings
Forming Part of Sentence [2.2.10.6.] 2.2.10.6.([2] 2)

Supply Fittings	Maximum Water Flow Rate, L/min
Lavatory supply fittings	
private	5.7
public	1.9
Kitchen supply fittings (except those in industrial, commercial or institutional kitchens)	8.3
Shower heads	7.6

[3] 3) An automatic compensating valve serving an individual shower head addressed in Sentence (1) shall have a water flow rate equal to or less than the shower head it serves. (See Note A-2.2.10.6.(3).)

[4] 4) Where multiple shower heads installed in a public showering facility are served by one temperature control, each shower head shall be equipped with a device capable of automatically shutting off the flow of water when the shower head is not in use. (See Note A-2.2.10.6.(4) ~~and (5)~~.)

~~[5] 5)~~ ~~Each lavatory in a public washroom shall be equipped with a device capable of automatically shutting off the flow of water when the lavatory is not in use. (See Note A-2.2.10.6.(4) and (5).)~~

[6] **6)** Waste fittings shall conform to ASME A112.18.2/CSA B125.2, "Plumbing Waste Fittings".

[7] **7)** Manually operated valves of *NPS* 4 or less for use in *plumbing systems* shall conform to ASME A112.4.14/CSA B125.14, "Manually Operated Valves for Use in Plumbing Systems". (See Note A-2.2.10.6.(7).)

Note A-2.2.10.6.(4) ~~and (5)~~ Automatic Shut-off of Water Flow.

Examples of water shut-off devices include occupant sensors and self-closing valves.

Impact analysis

There is no cost impact as the requirements were previously included in the NPC and the NBC.

Enforcement implications

Removing this conflict would lead to consistency and guide the authorities having jurisdiction when enforcing these requirements across multiple disciplines.

Who is affected

Building and plumbing officials, owners, and designers of commercial buildings.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NPC20 Div.B 2.2.10.6. (first printing)

[2.2.10.6.] **2.2.10.6. ([1] 1) [F80-OP5]**

[2.2.10.6.] **2.2.10.6. ([2] 2) [F131-OE1.2]**

[2.2.10.6.] **2.2.10.6. ([3] 3) [F30-OS3.1]**

[2.2.10.6.] **2.2.10.6. ([3] 3) [F31-OS3.2]**

[2.2.10.6.] 2.2.10.6. ([4] 4) [F131-OE1.2]

~~**[2.2.10.6.] 2.2.10.6. ([5] 5) [F131-OE1.2]**~~

[2.2.10.6.] 2.2.10.6. ([6] 6) [F80-OH2.1,OH2.3]

[2.2.10.6.] 2.2.10.6. ([7] 7) [F81-OP5]

[2.2.10.6.] 2.2.10.6. ([7] 7) [F46-OH2.2]

Submit a comment

Proposed Change 1731

Code Reference(s):	**NPC20 Div.B 2.6.2. (first printing)**
Subject:	Potable Water Systems
Title:	Protection of the Potable Water System
Description:	This proposed change introduces a reference to CSA B214:21, "Installation code for hydronic heating systems."
Related Code Change Request(s):	CCR 1081

This change could potentially affect the following topic areas:

- [ ] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [ ] Accessibility
- [ ] Building Envelope
- [ ] Heating, Ventilating and Air Conditioning
- [x] Division B
- [ ] Design and Construction
- [x] Housing
- [x] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [x] Plumbing
- [ ] Construction and Demolition Sites

Problem

The fluid in a hydronic heating system can be potable water. Since this water travels in the potable water system for human consumption and can also circulate in a hydronic heating system without a heat exchanger, there is a risk of contamination of the potable water system. To avoid this risk, the National Plumbing Code of Canada (NPC) should reference a standard that takes these heating systems into account and requires them to meet certain conditions.

Justification

This proposed change adds a reference to a new standard, CSA B214:21, “Installation code for hydronic heating systems,” which provides the requirements for hydronic systems for the protection of the potable water system where potable water is used for heating purposes.

This proposed change would reduce the possibility of building occupants being exposed to unsanitary conditions, which could lead to illness due to the consumption of contaminated water.

PROPOSED CHANGE

[2.6.2.] 2.6.2. Protection from Contamination

[2.6.2.1.] 2.6.2.1. Connection of Systems

[2.6.2.2.] 2.6.2.2. Back-Siphonage

[2.6.2.3.] 2.6.2.3. Backflow Caused by Back Pressure

[2.6.2.4.] 2.6.2.4. Backflow from Fire Protection Systems

[2.6.2.5.] 2.6.2.5. Separation of Water Supply Systems

[2.6.2.6.] 2.6.2.6. Premise Isolation

[2.6.2.7.] 2.6.2.7. Hose Bibb

[2.6.2.8.] 2.6.2.8. Cleaning of Systems

[2.6.2.9.] 2.6.2.9. Air Gap

[2.6.2.10.] 2.6.2.10. Vacuum Breakers

[2.6.2.11.] 2.6.2.11. Tank-Type Water Closets

[2.6.2.12.] 2.6.2.12. Backflow Preventers

[2.6.2.13.] --- Protection of the Potable Water System

[1] --) A hydronic heating system that uses a *potable water system* as its fluid source shall conform to CSA B214:2021, “Installation code for hydronic heating systems.”

Impact analysis

This proposed change would have the positive impact of aligning the NPC with the National Building Code of Canada (NBC), which already references CSA B214 in Parts 6 and 9. This proposed change would also align the NPC with current industry practice by limiting the probability that hydronic heating systems using potable water as fluid would be improperly installed. As a result, these systems would meet an acceptable level of performance and safety when used.

Adding a reference to the standard would also provide clarification of the Code requirements to designers, contractors and manufacturers.

There is no cost impact as this standard is already referenced in the NBC.

Enforcement implications

Inspectors, authorities having jurisdiction and other service providers would need to ensure that hydronic heating systems are installed in accordance with the standard, which may require training for building officials.

Who is affected

Designers, specifiers, manufacturers, building owners, building officials, occupants and contractors.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[2.6.2.1.] 2.6.2.1. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.1.] 2.6.2.1. ([2] 2) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.1.] 2.6.2.1. ([3] 3) [F70,F81,F82-OH2.2,OH2.3]

[2.6.2.2.] 2.6.2.2. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.2.] 2.6.2.2. ([2] 2) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.3.] 2.6.2.3. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.3.] 2.6.2.3. ([2] 2) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.3.] 2.6.2.3. ([3] 3) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.4.] 2.6.2.4. ([1] 1) no attributions

[2.6.2.4.] 2.6.2.4. ([2] 2) [F46,F70,F81-OH2.1,OH2.2,OH2.3]

[2.6.2.4.] 2.6.2.4. ([3] 3) [F46,F70,F81-OH2.1,OH2.2,OH2.3]

[2.6.2.4.] 2.6.2.4. ([4] 4) [F46,F70,F81-OH2.1,OH2.2,OH2.3]

[2.6.2.5.] 2.6.2.5. ([1] 1) [F46,F70,F81-OH2.2]

[2.6.2.5.] 2.6.2.5. ([1] 1) no attributions

[2.6.2.6.] 2.6.2.6. ([1] 1) [F70,F81,F82-OH2.1,OH2.2,OH2.3]

[2.6.2.7.] 2.6.2.7. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.8.] 2.6.2.8. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.9.] 2.6.2.9. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.9.] 2.6.2.9. ([2] 2) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.10.] 2.6.2.10. ([1] 1) no attributions

[2.6.2.10.] 2.6.2.10. ([2] 2) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.10.] 2.6.2.10. ([3] 3) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.10.] 2.6.2.10. ([4] 4) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.11.] 2.6.2.11. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.12.] 2.6.2.12. ([1] 1) [F70,F81,F46-OH2.1,OH2.2,OH2.3]

[2.6.2.13.] -- ([1] --) [F46-OH2.2]