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Proposed Change 1829

Code Reference(s):	**NBC20 Div.B 10.9.36. (first printing)**
Subject:	Alteration of Existing Buildings
Title:	Thermal Characteristics of Above-Ground Opaque Building Assemblies
Description:	This proposed change introduces requirements for the thermal characteristics of above-ground opaque building assemblies in existing buildings subjected to alteration.
Related Proposed Change(s):	PCF 1812, PCF 1813, PCF 1824, PCF 1826, PCF 1839, PCF 1850

This change could potentially affect the following topic areas:

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

General information

See the summary for subject Alteration of Existing Buildings.

Problem

See the "Problem" section of the summary for the subject Alteration of Existing Buildings.

When a voluntary alteration is made to above-ground opaque building assemblies in an existing building, there is an opportunity to improve the energy performance of the building assembly. This proposed change provides the requirements for the thermal characteristics of above-ground opaque walls subjected to alteration.

If the thermal characteristics of the above-ground opaque building assemblies do not achieve the required performance after an alteration, excessive energy would be consumed.

Justification

When alterations are made to above-ground opaque building assemblies in an existing building, there is an opportunity to upgrade the performance level of the building assembly to increase the overall energy performance of the building, thereby minimizing the incremental cost of the upgrade.

This proposed change aims to clarify the requirements for authorities having jurisdiction, designers and building professionals. The enhanced clarity would ensure that building owners could benefit from energy performance upgrades while avoiding an undue burden, ultimately promoting energy efficiency and reducing the incremental cost of the upgrade.

PROPOSED CHANGE

[10.9.36.] -- Energy Efficiency

[10.9.36.1.] --- Thermal Characteristics of Above-Ground Opaque Building Assemblies

(See Note A-10.9.36.1. and 10.9.36.2.-2025.) (See also Note A-10.1.1.1.(1)-2025 (PCF 1824).)

[1] --) Except for maintenance and repair, and except as provided in Sentence (7), where above-ground opaque *building* assemblies are subjected to *alteration*, the effective thermal resistance of the *building* assembly shall conform to Sentences (3) to (6).

[2] --) Where insulation is installed to meet the requirements of Sentence (1), all applicable requirements in Part 9 shall be met. (See Note A-10.9.36.1.(2).)

[3] --) Except as provided in Sentence (7), where the stud cavity of an exterior wall or the interior unfinished surface of an exterior mass wall is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the effective thermal resistance of the wall shall

[a] --) be assessed in accordance with Article 9.36.2.2., and

[b] --) conform to Article 9.36.2.6.

[4] --) Except as provided in Sentence (7), where the space above a ceiling below attic is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the effective thermal resistance of the ceiling shall

[a] --) be assessed in accordance with to Article 9.36.2.2., and

[b] --) conform to Article 9.36.2.6.

[5] --) Except as provided in Sentence (7), where the joist cavity of a cathedral ceiling or flat roof is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the effective thermal resistance of the ceiling or roof shall

[a] --) be assessed in accordance with Article 9.36.2.2., and

[b] --) conform to Article 9.36.2.6.

[6] --) Except as provided in Sentence (7), where the joist cavity of a floor over unheated space is exposed or made accessible by the *alteration* or is within the extent of the *alteration*, the effective thermal resistance of the floor shall

[a] --) be assessed in accordance with Article 9.36.2.2., and

[b] --) conform to Article 9.36.2.6.

[7] --) Except as provided in Sentence (8), where the effective thermal resistance of the *building* assembly cannot be improved to meet the requirements of Sentences (2) to (6) due to construction limitations, structural constraints or loss of functionality of the space, the effective thermal resistance shall be improved to the extent possible. (See Note A-10.9.36.1.(7) and 10.9.36.2.(7)-2025.)

[8] --) Where the effective thermal resistance of the *building* assembly cannot be improved in accordance with Sentence (7), another above-ground opaque *building* assembly within the extent of the *alteration* is permitted to be upgraded in accordance with Sentence 9.36.2.11.(2).

Note A-10.9.36.1. and 10.9.36.2.-2025 (PCF 1850) Thermal Characteristics of Building Assemblies.

If the thermal performance of an area of existing insulation is compromised, the existing insulation should be replaced. The three main issues that affect the thermal performance of cavity insulation are as follows:

1. Improper installation: This condition results from insufficient quality assurance and quality control during the original construction of the wall. The most common problems related to improper installation include
   - missing sections of insulation,
   - overly compressed insulation, and
   - gaps between the insulation and the surrounding construction element (e.g., studs, plates, exterior sheathing).

   All of these issues reduce the thermal resistance of the insulation and/or allow heat energy to bypass the insulation.
2. Settlement over time: Certain types of loose-fill insulation will slowly settle or compress over time after installation. This settlement may occur more frequently with “blown-in” insulation, as the original loft of the installation can be decreased by gravity. As a result, the insulation has an increased density and a lower thermal resistance; thus, the original thermal performance of the design is compromised.

3. Deterioration of the cavity environment: Air and moisture movement within the cavity may result in dirt, moisture and/or mould accumulation within the insulation and cavity. These accumulations affect the thermal performance of the insulation by reducing the volume of still air captured by the insulation, which reduces the thermal resistance.

Further information on best practices for the installation of insulation can be found in the following:

- Canadian Home Builders' Association (CHBA) (2021), "Renovators' Manual,"
- ASTM C1015-17, "Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation,"
- ASTM C1320-20, "Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction,"
- ASTM C1848-17a, "Standard Practice for Installation of High-Pressure Spray Polyurethane Foam Insulation for the Building Enclosure Significance and Use Achieving Quality Insulation Installation. Online at Insulation Installation,"
- North American Insulation Manufacturers Association (NAIMA) website (www.insulationinstitute.org),
- NAIMA B1402-12, "Recommendations for Installing Mineral Fiber Insulation in Residential and Other Light-Frame Construction," and
- ANSI/RESNET/ICC 301-2019, "Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units using an Energy Rating Index."

Note A-10.9.36.1.(2) Applicable Part 9 Requirements.

When increasing the effective thermal resistance of walls, ceilings below attics, floors over unheated spaces, cathedral ceilings, or flat roofs, it is important to review Part 9 to confirm that all relevant requirements are met. As a result of Sentence 10.9.36.1.(2), the desired design approach may be constrained by the following Part 9 requirements, for example:

- Subsection 9.10.3., Ratings,
- Subsection 9.10.14., Spatial Separation Between Buildings,
- Subsection 9.10.15., Spatial Separation Between Houses,
- Article 9.10.17.10., Protection of Foamed Plastics,
- Section 9.19., Roof Spaces,
- Section 9.25., Heat Transfer, Air Leakage and Condensation Control,
- Subsection 9.25.5., Properties and Position of Materials in the Building Envelope,
- Article 9.27.3.8., Flashing Installation, or
- Section 9.29., Interior Wall and Ceiling Finishes

Note A-10.9.36.1.(7) and 10.9.36.2.(7)-2025 (PCF 1850) Improvement of Effective Thermal Resistance.

The term "to the extent possible" is used to provide flexibility in response to the conditions encountered in the alteration of an existing building. In some instances and in certain locations, achieving the required effective thermal resistance will not be feasible in the alteration of an existing building. For example, the installation of

insulation may be prevented or made difficult by the following:

- existing mechanical and electrical elements that are not intended to be changed in the alteration,
- existing structural components (e.g., walls, columns or beams) that obstruct the installation of insulation,
- stairwells located against an existing exterior wall, since Part 9 requirements might not permit the addition of insulation or since reconstructing or relocating the stairwell might require significant effort and cost,
- existing doors framed close to the existing wall that are not being changed as part of the alteration,
- a small room in a very old house, where adding 100 mm (4 in.) of insulation on the interior of exterior walls would make the room unusable (e.g., as a small bedroom or washroom) without rerouting building services or substantially reconstructing walls or structural supports.

"To the extent possible" is intended to encourage increasing thermal resistance as much as possible within these limitations. It is important to understand that there will be instances where upgrading, for example, the installation of additional insulation, will not be possible and that this is an acceptable outcome for specific locations.

The installation of any insulating materials should be implemented in a manner that manages the risk of undesirable consequences, such as condensation, especially where parts of the building envelope are insulated to a lower thermal resistance level than required or where insulation is added on the inside of a masonry wall, which may exacerbate the degradation of the masonry.

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].

Note that it is impossible to explore all permutations of alterations occurring in the country. As such, this representative case has been selected to provide an illustrative example. The actual energy savings would greatly differ (i.e., may be understated or overstated), as they are based on the current thermal resistance value of the above-ground opaque building assemblies being subjected to alteration.

Where the building envelope is improved by this proposed change (and where additional insulation would not have been added otherwise), the amount of energy required to heat the building is typically expected to be nearly 30% less than that of the original building envelope. Up to 12% of energy savings can be contributed from the improved thermal resistance of above-ground building assemblies. This statement

implies that the potential annual average energy savings would be around $36 per year (i.e., 12% of 30% of $995, which is the annual average natural gas bill for Canadian residences [3]).

The incremental cost of the installation of blown-in glass fibre insulation in a ceiling below attic to an RSI value of 8.67, assuming an initial RSI value of 5.28, would be $\$8.39/m^2$, for a total cost of up to $780 for the archetype house.

The incremental cost of the installation of additional batt insulation to the exterior above-ground walls to an RSI value of 2.97, assuming an initial RSI value of 1.94, is $\$2.47/m^2$, for a total cost of up to $456 for the entire archetype house.

References

(1) Statistics Canada. Housing Permit.

(2) Clean Air Partnership. Archetyping Guide for Energy-Efficiency Programs, www.cleanairpartnership.org

(3) Canadian Gas Association. Natural Gas Facts, www.cga.ca

Enforcement implications

It is expected that 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 improve the energy performance of an alteration.

Who is affected

Designers, engineers, architects, building officials, manufacturers, suppliers and energy advisors.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[10.9.36.1.] -- ([1] --) no attributions

[10.9.36.1.] -- ([2] --) no attributions

[10.9.36.1.] -- ([3] --)

[10.9.36.1.] -- ([3] --) [F92-OE1.1]

[10.9.36.1.] -- ([4] --) no attributions

[10.9.36.1.] -- ([4] --) [F92-OE1.1]

[10.9.36.1.] -- ([5] --) no attributions

[10.9.36.1.] -- ([5] --) [F92-OE1.1]

[10.9.36.1.] -- ([6] --) no attributions

[10.9.36.1.] -- ([6] --) [F92-OE1.1]

[10.9.36.1.] -- ([7] --) no attributions

[10.9.36.1.] -- ([8] --) [F92-OE1.1]