Ontario's 2024 Building Code

Introducing Key Changes to Part 4: Structural Design

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Building and Development Branch
Planning and Growth Division

Disclaimer

- The information contained within this slide deck is intended for general information purposes only. It only highlights key changes of the Building Code. It is not intended as legal or technical advice and it should not be relied on as such. Code users are strongly advised to consult the official records for specific legislative and regulatory requirements, including Ontario's 2024 Building Code, O. Reg. 163/24 as amended by O. Reg. 203/24, 2020 National Building Code and Ontario Amendment Document (May 15, 2024) for the full extent and the exact wording of the changes.

Purpose

- To ensure smooth transition to 2024 Building Code, this deck is intended to inform ministry partners and stakeholders about key changes implemented in Part 4, Structural Design in Ontario's 2024 Building Code.

- The changes are intended to reduce existing variations with the National Building Code (NBC), align with new provisions introduced through 2020 National Construction Codes, and address Ontario-Specific changes.

Effective Date

- The 2024 Building Code comes into effect on January 1, 2025.

- There will be a three-month grace period until March 31, 2025, for applications for which drawings were substantially complete before January 1, 2025.

Content

The following Items will be covered:

- ❑ Importance Category / Post Disaster Buildings
- ❑ Serviceability Load Combination
- ❑ Loads for Exterior Areas Subject to Vehicular Traffic
- ❑ Changes to Snow Load Calculations
- ❑ Changes to Wind Load Calculations
- ❑ Changes to Earthquake Design
- ❑ Changes to Align with the National Building Code Wording
- ❑ Storage Racks
- ❑ Ontario-Specific Changes

Post Disaster Buildings (1.4.1.2. / Div. A) Importance Categories (4.1.2.1.)

- The definition of post-disaster buildings has been modified in 1.4.1.2. of Division A, impacting snow, wind and earthquake design of buildings based on importance categories of buildings in 4.1.2.1.
- Post disaster buildings have been expanded to include:
  - Control centres for natural gas distribution
  - Control centres for air, land and marine transportation
  - Sewage treatment facilities
  - Water storage facilities
  - All water treatment facilities

Post Disaster Buildings (1.4.1.2. / Div. A) Importance Categories (4.1.2.1.)

- The definition also includes the following, unless it is exempted by the principal authority
  - Emergency response facilities
  - Fire, rescue and police stations
  - Communication facilities

Load Combinations for Serviceability (4.1.3.4.)

- Moves User's Guide – NBC 2015: Part 4 of Division B material on load combinations for serviceability to the main body of the Code.
  - Load combinations to check deflections limits for materials not subject to creep, materials subject to creep
    - Principal and companion loads – or principal loads only
    - Importance factors for environmental loads applied
    - Includes creep induced deflection as per the applicable design standard(s)
  - A signpost for guidance on vibration serviceability in the Structural Commentaries (User's Guide – NBC 2020) is introduced.

Loads for Roof Parking Decks and Exterior Areas Subject to Vehicular Traffic (4.1.5.5.)

- Expands the design requirements for roof parking decks and exterior areas accessible to vehicular traffic to ensure that such areas will be designed for the combination of live load and snow load appropriate for their intended use.
  - The greater of:
    - Load combination including live and snow loads with companion load factor for snow reduced from 1.0 to 0.2.
    - Snow and rain loads

Snow Load for Roofs with a Mean Height Lower than 2 m (Sentence 4.1.6.2.(2))

- Clarifies the basic snow roof factor, C_b, for roofs with a mean height less than $1 + S_s/\gamma$, in m, above grade,
  - C_b shall be taken as 1.0
    - vs. C_b less than one for higher roofs
  - The effect of wind tending to drift snow off a roof is diminished when the roof/structural slab is at or in close proximity to the ground level.

Snow Loads for Roofs with Solar Panels (4.1.6.16.)

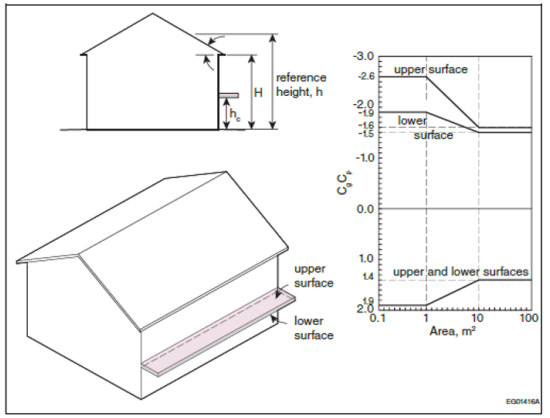
- Introduces requirements for the determination of design snow loads for roofs with solar panels.
  - Considers the most critical effect of two load cases:
    - Snow load on roof without solar array
    - Snow load on roof with solar array
  - Factors C_s (slope factor) and C_a (accumulation factor) are tuned to account for the effect of solar panels
  - Solar panels are classified as:
    - Parallel Flush, Parallel Raised or Tilted depending on their angle and distance above the roof compared to snow accumulation height, $C_b C_w S_s/\gamma$.

Canopies and Parapets (4.1.7.12.)

- Introduces provisions for the wind load design of attached canopies on low buildings.

  - Canopies are different from roof overhangs
  - Change based on wind tunnel tests

Figure 4.1.7.12.-A
Gust Pressure Coefficients on the Upper and Lower Surfaces of Attached Canopies With no Gap Between the Canopy and the Building
Forming Part of Sentence 4.1.7.12.(2)



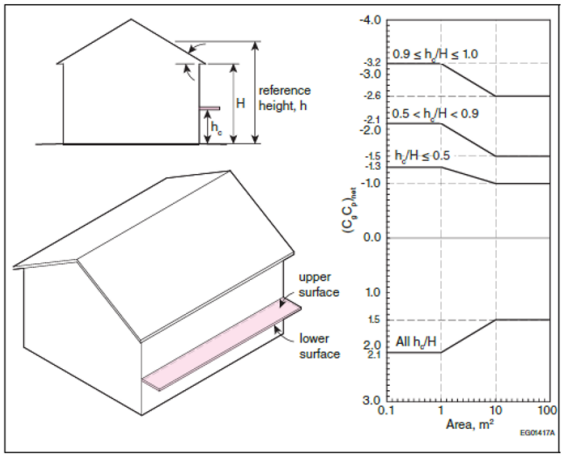
$$p = I_W \, q \, C_e \, C_t \, C_g \, C_p$$

(Design of fastener of the top and soffit elements)

$$P_{net} = I_W \, q \, C_e \, C_t \, (C_g \, C_p)_{net}$$

Design of the structure of the canopy

Figure 4.1.7.12.-B
Net Gust Pressure Coefficients on Attached Canopies, Considering Simultaneous Contributions from the Upper and Lower Surfaces of the Canopy
Forming Part of Sentence 4.1.7.12.(2)



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Wind Loads for Roofs with Solar Panels (4.1.7.13.)

- Introduces provisions for roof-mounted solar panels that are based on material from the "Structural Commentaries (User's Guide – NBC 2015: Part 4 of Division B)."
  - Considers the most critical effect of two load cases:
    - Wind load on roof without solar array
    - Wind load on roof with solar array
  - Wind load calculated using

$$p = I_W \, q \, C_e \, C_t \, C_g \, C_p \, E \, \gamma_a$$

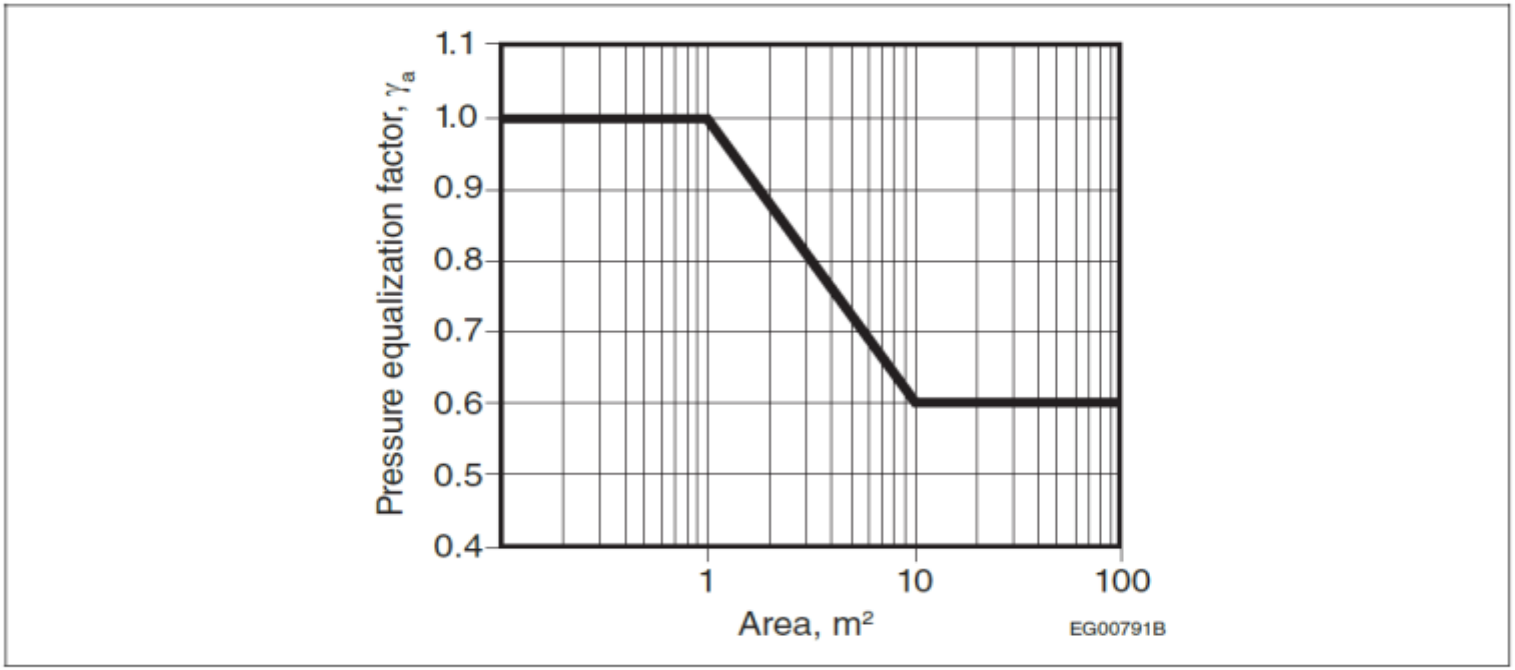
Where:

E and γ_a are the edge factor and pressure equalization factor

Wind Loads for Roofs with Solar Panels (4.1.7.13.)

Pressure equalization factor

Figure 4.1.7.13.-A
Pressure Equalization Factor, γ_a, for Solar Panels or Arrays Mounted on Roofs of Buildings of Any Height
Forming Part of Clause 4.1.7.13.(3)(b)



$$p = I_W \, q \, C_e \, C_t \, C_g \, C_p \, E \, \gamma_a$$

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NBC Seismic Hazard Tool (4.1.8.4. and SB-1)

[2020 National Building Code of Canada Seismic Hazard Tool (rncan.gc.ca)]

NBC 2020 Seismic Hazard Tool

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NBC Seismic Hazard Tool (4.1.8.4. and SB-1)

Earthquake Design (Cont'd)

NBC 2020 Seismic Hazard Tool

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_S	X_C
Latitude (°)	43.688
Longitude (°)	-79.761

Please select one of the tabs below.

NBC 2020 | Additional Values | Plots | API | Background Information

The 5%-damped spectral acceleration ($S_a(T,X)$, where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_C)$	$S_a(0.5, X_C)$	$S_a(1.0, X_C)$	$S_a(2.0, X_C)$	$S_a(5.0, X_C)$	$S_a(10.0, X_C)$	$PGA(X_C)$	$PGV(X_C)$
0.267	0.171	0.0927	0.0437	0.0115	0.00394	0.139	0.111

4.1.8.1 and 4.1.8.4.:
2% probability of exceedance in 50 years

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NBC Seismic Hazard Tool (4.1.8.4. and SB-1)

Earthquake Design (Cont'd)

Seismic hazard values for Brampton for Site Class, A, C, E

NBC 2020 Seismic Hazard Tool

$S_a(0.2, X_A)$	$S_a(0.5, X_A)$	$S_a(1.0, X_A)$	$S_a(2.0, X_A)$	$S_a(5.0, X_A)$	$S_a(10.0, X_A)$	$PGA(X_A)$	$PGV(X_A)$
0.152	0.0861	0.0461	0.0219	0.00596	0.00231	0.113	0.0605

$S_a(0.2, X_C)$	$S_a(0.5, X_C)$	$S_a(1.0, X_C)$	$S_a(2.0, X_C)$	$S_a(5.0, X_C)$	$S_a(10.0, X_C)$	$PGA(X_C)$	$PGV(X_C)$
0.267	0.171	0.0927	0.0437	0.0115	0.00394	0.139	0.111

$S_a(0.2, X_E)$	$S_a(0.5, X_E)$	$S_a(1.0, X_E)$	$S_a(2.0, X_E)$	$S_a(5.0, X_E)$	$S_a(10.0, X_E)$	$PGA(X_E)$	$PGV(X_E)$
0.342	0.335	0.201	0.0958	0.0252	0.0077	0.213	0.215

NBC 2015 table

Location	Seismic Data							
	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	$S_a(5.0)$	$S_a(10.0)$	PGA	PGV
Brampton	0.168	0.096	0.052	0.0260	0.0064	0.0025	0.106	0.074

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Seismic Categories (4.1.8.5.)

- Seismic categories are introduced, more user-friendly, to represent the expected magnitude of inertial seismic force in a more realistic manner.
  - Seismic categories determined based on limits for $I_E S(0.2)$ and $I_E S(1.0)$
  - Affects triggering thresholds in Section 4.1.8. in its entirety
  - The Seismic Category of a building shall be taken as the more severe of the categories determined based on $I_E S(0.2)$ and $I_E S(1.0)$, irrespective of the fundamental lateral period of the building.

New Sloped Column Irregularity and Related Requirements (Table 4.1.8.6.)

- A definition of sloped column irregularity is introduced in Table 4.1.8.6., Structural Irregularities, and requirements for buildings with sloped columns are added.
  - The presence of inclined vertical members in a building leads to a coupling of its horizontal and vertical vibrational modes.
  - Introduces requirements that address the adverse effects of sloped columns in buildings
    - Post-disaster buildings shall not have Type 10 irregularities where the seismic category is SC3 or SC4.
    - High Importance Category buildings shall not have Type 10 irregularities where the seismic category is SC4.

New Steel SFRS: Moderately Ductile Steel Plate Walls (Table 4.1.8.9.)

- Revises Table 4.1.8.9. to include two new systems:
  - Moderately Ductile Steel Truss Moment-Resisting Frames
    - R_dR_o of 3.5 and 1.6
    - No limit on the height for SC1 and SC2
    - A limit of 50 and 30 m for SC3 and SC4, respectively
    - Requirements in Annex L of CSA S16-19
  - Moderately Ductile Steel Plate Walls
    - R_dR_o of 3.5 and 1.3
    - No limit on the height for SC1 and SC2
    - A limit of 40 m for SC3 and SC4
    - Requirements in 27.10 of CSA S16-19

Revise Requirements for Irregularity Type 9 (4.1.8.11.(9))

- Revise requirements for Irregularity Type 9 buildings with high irregularity ratio, $\alpha \geq 0.2$ in high-hazard seismic areas.
  - It requires non-linear dynamic analysis to account for complex aspects of the building response like:
    - Considering vertical ground accelerations
    - Reduced allowable sidesway movement by 40%
    - Vertical response of the building mass

Elements of Structures, Non-Structural Component (4.1.8.18.)

- The lateral earthquake force calculations in Sentence 4.1.8.18.(1) have been revised for clarity and to align with the 2020 NBC.
  - For non-structural elements and components of buildings, they must be designed for a specified lateral earthquake force V_P, distributed according to the distribution of mass as per the revised formula:

$$V_p = 0.3\ S(0.2)\ I_E S_p W_p$$

Foundations (Section 4.2.)

- The term “qualified person" in Section 4.2. has been replaced by “professional engineer” to harmonize with the 2020 NBC, see examples below:
  - Under Article 4.2.2.1., a subsurface investigation, including groundwater conditions must be carried out, by or under the direction of a professional engineer.
  - Under Article 4.2.4.1., design basis, communication, interaction and coordination must take place between the designer and the professional engineer responsible for the geotechnical aspects of the project.

Design of Storage Racks (4.4.3.1.)

- New provisions mandate that storage racks are required to comply with structural design loads identified in the Building Code.
  - This change would ensure the same level of safety for storage racks as other structures.
  - Now that their design is addressed in Part 4, it is a shift from current practice considering storage racks as industrial furniture and dealing with its connection to building.

Manure Storage Tanks (4.4.5) Relocated to Part 2

- Requirements for Manure Storage Tanks in 4.4.5. have been moved to Part 2, Farm Buildings.
  - OBC Part 4 requirements are maintained and combined with NBC requirements in Article 2.3.2.5. Additional requirements adopted from the 2020 NBC include:
    - Liquid manure tanks are of Normal Importance (2.3.1.1.(3))
    - Top of liquid manure tanks subject to any occupancy or environmental loads must be designed to the appropriate loads.
    - Walls and partitions of liquid manure tanks must be designed for internal pressure based on fluid density of 10 kN/m^3 or anticipated ice pressure.

Questions?

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