Township of
Leeds and the
Thousand Islands

Division B Part 4
Structural Design Changes

Highlight Areas

Key Changes

Wind Load

Earthquake Load and Effects

Division B Part 4 – Key Changes

1.4.1.2./Div A Post Disaster Buildings

- Post disaster buildings expanded to include control centers for natural gas distribution, air and marine transportation, sewage treatment, water storage and water treatment facilities
- The definition also includes Emergency response facilities, Fire, rescue and police stations and Communication facilities (unless exempted by the municipality)

4.1.3.4 Load Combinations for Serviceability

- 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 deflection 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

Limit State	Structural Parameter	Load Case	Load Combinations	
			Principal Loads	Companion Loads
Deflection for materials **not subject to creep**	Deflection of the structure or of components of the structure [1]	1 2 3	1.0**D** + 1.0**L** 1.0**D** + 1.0**W** 1.0**D** + 1.0**S**	0.3**W** or 0.3**S** 0.3**L**[2] or 0.3**S** 0.3**W** or 0.3**L**[2]
Deflection for materials **subject to creep**	Total deflection of the structure or of components of the structure [3]	1 2 3	1.0**D** + 1.0L_s[4] + 1.0L_t[5] 1.0**D** + 1.0**W** 1.0**D** + 1.0**S**	0.3**W** or 0.3**S** 0.3**L**[2] or 0.3**S** 0.3**W** or 0.3**L**[2]
Vibration serviceability	Acceleration	(6)		

4.1.5.5. Loads for Roof and Parking Decks and Exterior Areas subject to vehicular traffic

- 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 to **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

4.1.6.2.(2) Snow Loads for roofs with a Mean Height Lower than 2m

- Clarifies the basic snow roof factor, Cb, for roofs with a mean height less than 1 + Ss/γ, in m, above grade,
  - Cb shall be taken as 1.0
    - vs. Cb 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.

4.1.6.16 Snow Loads for roofs with Solar Panels - new loading criteria

- 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 Cs (slope factor) and Ca (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, CbCwSs/γ

4.1.7.12 Canopies and Parapets - new loading criteria

- 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 p = IW q Ce Ct Cg Cp (Design of fastener of the top and soffit elements) Pnet = IW q Ce Ct (Cg Cp) net Design of the structure of the canopy .

Division B Part 4.1.7 – Wind Load

4.1.7.9 Full and Partial Wind Loading

Sentence (1) - Except where the wind loads are derived from the combined C_gC_p values determined in accordance with Article 4.1.7.6., *buildings* and structural members shall be capable of withstanding the effects of the following loads:

2024 OBC		2012 OBC
The full wind loads acting along each of the **2** principal horizontal axes considered separately,	(a)	The full wind loads acting along each of the ~~two~~ principal horizontal axes considered separately,
75% of the wind loads described in Clause (a) but offset from the central geometric axis of the *building* by 15% of its width normal to the direction of the force to produce the worst load effect,	(b)	~~The wind loads as described in Clause (a) but with 100% of the load removed from any on portion of the area,~~
75% of the wind loads described in Clause (a) but with both axes considered simultaneously, and	(c)	The wind loads as described in Clause (a) but with both axes considered simultaneously at 75% of their full value, and
56% of the wind loads described in Clause (a) but with both axes considered simultaneously and offset from the central geometric axis of the *building* by 15% of its width normal to the direction of the force.	(d)	~~The wind loads as described in Clause (c) but with 50% of these loads removed from any portion of the area~~

4.1.7.13 Wind Loads for Roofs with Solar Panels new loading criteria

- 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 = IW q Ce Ct Cg Cp E Ya Where: E and Ya are the edge factor and pressure equalization factor

4.1.8.4 and SB-1 Introduces NBC 2020 Seismic Hazard Tools

4.1.8.5 Seismic Categories

- 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 IES(0.2) and IES(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 IES(0.2) and IES(1.0), irrespective of the fundamental lateral period of the building.

Table 4.1.8.5.-B
Seismic Categories for Buildings
Forming Part of Sentence 4.1.8.5.(2)

Seismic Category(1)	$I_E S(0.2)$	$I_E S(1.0)$
SC1	$I_E S(0.2) < 0.2$	$I_E S(1.0) < 0.1$
SC2	$0.2 \le I_E S(0.2) < 0.35$	$0.1 \le I_E S(1.0) < 0.2$
SC3	$0.35 \le I_E S(0.2) \le 0.75$	$0.2 \le I_E S(1.0) \le 0.3$
SC4	$I_E S(0.2) > 0.75$	$I_E S(1.0) > 0.3$

Notes to Table 4.1.8.5.-B:
(1) The Seismic Category of a *building* shall be taken as the more severe of the categories determined on the basis of $I_E S(0.2)$ and $I_E S(1.0)$, irrespective of the fundamental lateral period of the *building*, T_a.

Division B Part 4.1.8 Earthquake Load and Effects

4.1.8.6 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

Revised Table 4.1.8.6. Structural Irregularities

Type	Irregularity Type and Definition	Notes
1	**Vertical Stiffness Irregularity** **For concrete and masonry shear walls**, vertical stiffness irregularity shall be considered to exist where the lateral stiffness of the SFRS in any storeys less than 70% of the stiffness in an adjacent storey, or less than 80% of the average stiffness in the three storeys above or below. **For all other types of SFRS, vertical stiffness irregularity shall be considered to exist where the inter storey deflection under lateral earthquake forces divided by the inter-storey height h_s, of any storey is greater than 130% of that adjacent storey.**	(3)(4)(5)
10	**Sloped Column Irregularity** **Sloped column irregularity shall be considered to exist where a vertical member that is inclined more than 2deg from the vertical supports a portion of the weight of the building in axial compression.**	(4)

4.1.8.9 New Steel SFRS: Moderately Ductile Steel Plate Walls

- **Revised Table 4.1.8.9**. to include two new systems:
  - Moderately Ductile Steel Truss Moment-Resisting Frames
    - RdRo 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
    - RdRo 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

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Table 4.1.8.9.
SFRS Ductility-Related Force Modification Factors, R_d,
Overstrength-Related Force Modification Factors, R_o, and General Restrictions[1]
Forming Part of Sentences 4.1.8.9.(1) and (5), 4.1.8.10.(5) and (6), 4.1.8.11.(12), 4.1.8.15.(9) and 4.1.8.20.(8)

Type of SFRS	R_d	R_o	Restrictions[2]			
			Seismic Category			
			SC1	SC2	SC3	SC4
Steel Structures Designed and Detailed According to CSA S16[3][4][5]						
Ductile moment-resisting frames	5.0	1.5	NL	NL	NL	NL
Moderately ductile moment-resisting frames	3.5	1.5	NL	NL	NL	NL
Limited ductility moment-resisting frames	2.0	1.3	NL	NL	60	30
Moderately ductile truss moment-resisting frames	3.5	1.6	NL	NL	50	30
Moderately ductile concentrically braced frames						
Tension-compression braces	3.0	1.3	NL	NL	40	40
Tension only braces	3.0	1.3	NL	NL	20	20
Limited ductility concentrically braced frames						
Tension-compression braces	2.0	1.3	NL	NL	60	60
Tension only braces	2.0	1.3	NL	NL	40	40
Ductile buckling-restrained braced frames	4.0	1.2	NL	NL	40	40
Ductile eccentrically braced frames	4.0	1.5	NL	NL	NL	NL
Ductile plate walls	5.0	1.6	NL	NL	NL	NL
Moderately ductile plate walls	3.5	1.3	NL	NL	40	40

2012 OBC

Table 4.1.8.9.
SFRS Ductility-Related Force Modification Factors, R_d,
Overstrength-Related Force Modification Factors, R_o, and General Restrictions[1]
Forming Part of Sentences 4.1.8.9.(1) and (5)

Type of SFRS	R_d	R_o	Restrictions[2]				
			Cases Where $I_E F_a S_a(0.2)$				Cases Where $I_E F_v S_v(1.0)$
			< 0.2	≥ 0.2 to < 0.35	≥ 0.35 to ≤ 0.75	> 0.75	> 0.3
Steel Structures Designed and Detailed According to CSA S16[3][5]							
Ductile moment-resisting frames	5.0	1.5	NL	NL	NL	NL	NL
Moderately ductile moment-resisting frames	3.5	1.5	NL	NL	NL	NL	NL
Limited ductility moment-resisting frames	2.0	1.3	NL	NL	60	30	30
Moderately ductile concentrically braced frames							
Tension-compression braces	3.0	1.3	NL	NL	40	40	40
Tension only braces	3.0	1.3	NL	NL	20	20	20
Limited ductility concentrically braced frames							
Tension-compression braces	2.0	1.3	NL	NL	60	60	60
Tension only braces	2.0	1.3	NL	NL	40	40	40
Ductile buckling-restrained braced frames	4.0	1.2	NL	NL	40	40	40
Ductile eccentrically braced frames	4.0	1.5	NL	NL	NL	NL	NL
Ductile plate walls	5.0	1.6	NL	NL	NL	NL	NL
Limited ductility plate walls	2.0	1.5	NL	NL	60	60	60

4.1.8.11.(9) Revised Requirements for Irregularity Type 9

- Revised requirements for Irregularity Type 9 buildings with high irregularity ratio, α ≥ 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

4.1.8.18 Elements of Structures, Non-Structural Component

- 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 VP, distributed according to the distribution of mass as per the revised formula: Vp= 0.3 S(0.2) IESpWp
- **Revised Table 4.1.8.18 –** Specifying that cladding panels be designed using category 1 or 2 as appropriate.

Table 4.1.8.18.
Elements of Structures and Non-Structural Components and Equipment[1]
Forming Part of Sentences 4.1.8.18.(1) to (3), (6), (7) and (16), and Clauses 4.1.8.23.(2)(c) and (3)(c)

Category	Part or Portion of *Building*	C_p	A_r	R_p
Architectural and Structural Components				
1	All exterior and interior walls, and cladding panels, except those in Category 2 or 3	1.00	1.00	2.50
2	Cantilever parapet and other cantilever walls, including cantilever cladding panels, except retaining walls	1.00	2.50	2.50
3	Exterior and interior ornamentations and appendages	1.00	2.50	2.50
4	Floors and roofs acting as diaphragms[2]	—	—	—
5	Towers, *chimneys*, smokestacks and penthouses when connected to or forming part of a *building*	1.00	2.50	2.50
6	Horizontally cantilevered floors, balconies, beams, etc.	1.00	1.00	2.50
7	Suspended ceilings, light fixtures and other attachments to ceilings with independent vertical support	1.00	1.00	2.50
8	Masonry veneer connections	1.00	1.00	1.50
9	Access floors	1.00	1.00	2.50
10	Masonry or concrete fences more than 1.8 m tall	1.00	1.00	2.50
Mechanical and Electrical Components				

4.2 Foundations - An engineer is now required for subsurface investigation, including groundwater conditions

- The term “qualified person" in Section 4.2. has been replaced by “professional engineer” to harmonize with the 2020 NBC, set 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

4.4.3.1. Design of Storage Racks – 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.

4.4.5. Manure Storage Tanks 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/m3 or anticipated ice pressure.