

http://www.nationalcodes.ca/eng/presentations/Lateral_Loads.pdf

2010 NATIONAL MODEL CONSTRUCTION CODES

Lateral Load Resistance – NBC Part 9

Cathleen Taraschuk, P. Eng. NRC Canadian Codes Centre February 2011





National Research Council Canada Conseil national de recherches Canada



Introduction



- Presentation is part of a series on the 2010 National Model Construction Codes
- Model codes developed by Canadian Commission on Building and Fire Codes
- These codes must be adopted by provincial/territorial authorities to become law



Overview

- General Background
- Technical Principles
- Summary of Basic Code Change Proposals
- Trade-Off Code Change Proposals



Part 9 Lateral Loads

- General Background
- Technical Principles
- Summary of Basic Code Change Proposals
- Trade-Off Code Change Proposals

General Issue

- Conventional house construction
 - Exterior and interior walls
 - Redundant paths of travel







General Issue – cont'd

- Narrow lots, panoramic views
 - Small wall area in front
- Open concept
 - Few interior walls





Background

- 2005 NBC Part 9 does not contain explicit requirements for resistance against lateral loads
- Proposed code changes for 2005 NBC deferred
- Province requested more time
- Lateral Load Task Group formed
 - Reviewed material from last code cycle, CWC Guide, consultant reports, recent research



Part 9 Lateral Loads

- General Background
- Technical Principles
- Summary of Basic Code Change Proposals
- Trade-Off Code Change Proposals

Lateral Load Resisting System Components



- Diaphragms
- Shear walls
- Connections
 - Wall-to-wall
 - Roof-to-wall
 - Diaphragm-to-wall
 - Wall-to-foundation



Shear Force Transfer Through Building







Performance Under Wind Load





Performance Under Seismic Load





Potential Failure Locations

Roof-to-wall connection and uplift of roof sheathing





Racking failure



Potential Failure Locations



Building anchorage

Storey-to-storey connection – exterior and interior wall



Part 9 Lateral Loads

- General Background
- Technical Principles
- Summary of Basic Code Change Proposals
- Trade-Off Code Change Proposals



Categories of Wind and Seismic

Category	Wind	Seismic – light	Seismic – heavy	Requirement
	1 in 50 yr hourly wind press, kPa	Spectral response acceleration	Spectral response acceleration	
Low	HWP < 0.8	S _a (0.2) ≤ 0.7	S _a (0.2) ≤ 0.7	Same as 2005 NBC
High	0.8 ≤ HWP <1.2	0.7 < S _a (0.2) ≤ 1.2	0.7 < S _a (0.2) ≤ 1.1	Requirements in new Subsection 9.23.13.
Extreme	HWP ≥ 1.2	S _a (0.2) > 1.2	S _a (0.2) > 1.1	Part 4 or accepted practice

 $S_a(0.2)$ – Spectral Acceleration at 0.2 seconds

HWP – Hourly Wind Pressure (1-in-50 year return)



Compliance Options

		HWP		
		0.00 kPa	0.80 kPa	1.20 kPa
	0.095	Same as 2005 NBC	New 9.23.13	NBC Part 4 or CWC Guide
	0.70			
S _a (0.2)	(1.10*) 1.20	New 9.23.13.	New 9.23.13.	NBC Part 4 or CWC Guide
		NBC Part 4 or CWC Guide	NBC Part 4 or CWC Guide	NBC Part 4 or CWC Guide
* heavy co	onstruction			

High Wind Locations – 0.8 kPa \leq 1 in 50 HWP < 1.2 kPa





High Seismic Locations – $0.7 < S_a(0.2) \le 1.2$







- Bracing to resist lateral loads due to wind and earthquake
 - Braced wall panels aligned in vertical braced wall bands

Braced wall panel:

Portion of a wood-frame wall where bracing, sheathing, cladding or interior finish is designed and installed to provide required resistance to lateral loads due to wind or earthquake

Braced wall band:

Imaginary continuous straight band extending vertically and horizontally through the *building* or part of the *building*, within which *braced wall panels* are constructed

New Subsection – General Requirements



- Requirements given for
 - Alignment of braced wall panels
 - Materials used to construct braced wall panels
 - Spacing and dimensions of *braced wall panels* and *braced wall bands*



Braced Wall Band



Braced wall bands in an example building section [Clauses 9.23.13.4.(1)(a), (b) and (d)]



Braced Wall Panel Materials

- On exterior walls:
 - Plywood, oriented strandboard (OSB) or diagonal lumber sheathing
- On interior walls:
 - Required interior braced wall panels shall be sheathed or finished on both sides
 - Gypsum board interior finish allowed
 - Plywood, OSB or diagonal lumber sheathing within any 15 m interval





A – Distance between centre lines of braced wall bands

- B Distance between
- braced wall panel edges

C – Distance from end of braced wall band to end of 1st braced wall panel





A – Maximum distance between centre lines of adjacent braced wall bands

	0.70 < S _a (0.2) < 1.0	$1.0 \le S_a(0.2) \le 1.2$ or 0.80 \le HWP <1.2 kPa
A max.	10.6 m	7.6 m





B – Maximum distance between ends of adjacent required braced wall panels

	0.70 < S _a (0.2) < 1.0	$1.0 \le S_a(0.2) \le 1.2$ or $0.80 \le HWP < 1.2$ kPa
B max.	6.4 m	6.4 m





C – Maximum distance from end of braced wall band to edge of required braced wall panel

	0.70 < S _a (0.2) < 1.0	$1.0 \le S_a(0.2) \le 1.2$ or $0.80 \le HWP < 1.2$ kPa
C max.	2.4 m	2.4 m

Minimum Cumulative Length of Braced Wall Panels





Minimum Length of Individual Braced Wall Panels





600 mm minimum length when connecting to intersecting braced wall panel

750 mm minimum length, otherwise

Relaxation of Bracing Requirement (1) – Basement and Crawl Space



 Max. distance between braced wall bands, and between braced wall band and foundation wall in basement / crawl space is 15 m



braced wall panels not required in braced wall band in basement



braced wall panels required in braced wall band in basement

Relaxation of Bracing Requirement (1) – Basement and Crawl Space





Cannot be omitted since braced wall panel above is a 'strong' panel

Can be omitted since braced wall panel above is not a 'strong' panel and within 15 m there is a 'strong' panel

Relaxation of Bracing Requirement (2) – Porches



- Do not apply to perimeter of a single open or enclosed space
 - e.g. porches not projecting more than 3.5 m from building and not supporting a floor above



Relaxation of Bracing Requirement (3) – Garages



- Exemption for detached garages
- Exemption for front wall of attached garage serving single dwelling unit
 - Criteria for both is don't support floor
- Allow one large opening under certain conditions for attached garages
 - Adequate bracing on other 3 walls
 - Supporting no more than one floor above

Specifications to Address Connections for Framing



- Tie roof trusses to wall framing for 1 in 50 yr HWP >0.8 kPa
- New nailing details attach required braced wall panels to floor joists, rim joists or blocking, and to framing above and below
- Insert rim joist

Rim joist:

Outermost member in floor framing, other than blocking, be it parallel, perpendicular or on an angle to floor joists

Specifications for Fastening of Sheathing to Framing



- Enhanced requirements for roof and wall sheathing in high wind and seismic
 - Longer fastener
 - Higher fastening density for roof sheathing within
 1 m of roof edges

Specifications to Anchor Building to Foundation



 Enhanced anchor bolt detailing for high wind and seismic and more than one storey





Other Changes

- Modify "Support of Walls" where braced wall panels are required
- Modify "Bracing and Lateral Support" to prevent buckling of stud when unfinished interior wall > blocking/strapping



Part 9 Lateral Loads

- General Background
- Technical Principles
- Summary of Basic Code Change Proposals
- Trade-Off Code Change Proposals



Design Issues

- Open concept 7.6 m between braced wall bands
- Upper storey setback limit to 1.2 m
- Ability to achieve percentage of braced wall panels in exterior walls
- Open concept 6.4 m between braced wall panels
- Need to allow greater flexibility in design achieve same performance level → trade-off approach

Flexible Design – Trade-Off Provisions



- Open concept 7.6 m between braced wall bands
- Can increase spacing of braced wall bands from 7.6 m up to 10.6 m

- Braced wall band is "strong wall"



Flexible Design – Trade-Off Provisions – Cont'd



- Upper storey setback limit to 1.2 m
- One exterior upper storey wall in each orthogonal direction can be set back provided
 - Is a "strong wall" below, within 10.6 m of exterior wall
 - Floor supporting setback is sheathed with wood-based
 - Reinforced connection to exterior perpendicular walls



Flexible Design – Trade-Off Provisions – Cont'd



- Ability to achieve percentage of braced wall panels in exterior walls
- Can reduce length of braced wall panels from 40% to 25% in one exterior wall each orthogonal direction
 - Construct extra "strong wall" within 10.6 m
 - Limit ratio of upper to lower braced wall panels to 2:1
 - Strengthen diaphragm, more fasteners



Flexible Design – Trade-Off Provisions – Cont'd



- Open concept 6.4 m between braced wall panels
- Can increase spacing between braced wall panels to 7.3 m
 - Minimum length of braced wall panel increased to 1.2 m



www.nationalcodes.ca

Questions? Send them to us at <u>codes@nrc-cnrc.gc.ca</u>

Thank you!