

PROPOSED CHANGE

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MODIFICATION PROPOSÉE

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Document	NBC 2005 CNB	Document
Provision	9.23.6.1.(2); 9.23.6.1.(3)-insert 2010; 9.23.6.1.(5)-add 2010	Exigence
Committee	Housing and Small Buildings • Maisons et petits bâtiments	Comité
Minutes	TG Lateral Loads, HSB 2005-04.06.16; HSB 2005-05.06.18	Procès-verbaux

EXISTING PROVISION

9.23.6.1. Anchorage of Building Frames

1) Except as required by Sentence 9.23.6.3.(1), *building* frames shall be anchored to the *foundation* unless a structural analysis of wind and earthquake pressures shows anchorage is not required.

2) Except as provided in Article 9.23.6.3., anchorage shall be provided by embedding the ends of the first floor joists in concrete, or 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) Anchor bolts referred to in Sentence (2) shall be fastened to the sill plate with nuts and washers and shall be embedded not less than 100 mm in the *foundation* and so designed that they may be tightened without withdrawing them from the *foundation*.

PROPOSED CHANGE

Replace Sentences 9.23.6.1.(2) and (3)-2005, Insert New Sentence 9.23.6.3.(3), and Add New Sentence 9.23.6.3.(5) as follows:

Other Code Provisions Affected: None

9.23.6.1. Anchorage of Building Frames

1) Except as required by Sentence 9.23.6.3.(1), *building* frames shall be anchored to the *foundation* unless a structural analysis of wind and earthquake pressures shows anchorage is not required.

- 2) Except as provided in [Article 9.23.6.3., Sentences \(3\) and \(5\)](#), anchorage shall be provided by
- [embedding the ends of the first floor joists in concrete, or](#)
 - [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) [For *buildings* with 2 or more floors supported by frame walls that are in areas where the seismic spectral response acceleration, \$S_a\(0.2\)\$, is equal to or greater than 0.70 but not greater than 1.2 and the 1-in-50 hourly wind pressure 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](#)

- [15.9 mm diam anchor bolts located within 0.5 m of the end of the *foundation* and spaced not more than 2.4 m o.c. or](#)
- [12.7 mm diam anchor bolts located within 0.5 m of the end of the *foundation* and spaced not more than 1.7 m o.c.](#)

- 4) Anchor bolts referred to in Sentences (2) [and \(3\)](#) shall be
- [fastened to the sill plate with nuts and washers,](#)
 - [embedded not less than 100 mm in the *foundation*, and](#)
 - [so designed that they may be tightened without withdrawing them from the *foundation*.](#)

5) [Where the seismic spectral response acceleration, \$S_a\(0.2\)\$, is greater than 1.2 or the 1-in-50 hourly wind pressure is greater than 1.2 kPa, anchorage shall be designed according to Part 4.](#)

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RATIONALE

Problem

General – Addressing Lateral Loads due to Wind and Earthquake

The existing Sentence 9.4.1.1.(2) states that structures complying with the prescriptive solutions provided in Part 9 are deemed to meet the structural requirements of the Code. Appendix Note A-9.4., however, states that lateral loads such as wind and earthquake must be considered, even though these are not addressed by any calculations that may have been used in the development of the Part 9 prescriptive solutions.

Evidence from earthquakes in California and Japan indicate that light wood-frame buildings must incorporate certain construction details in order to provide an acceptable minimum level of performance when subject to earthquake loads.

In general, changes to the Code are considered where a problem has been identified, sometimes after a failure has occurred, or where approaches to design or construction have changed.

- The existing prescriptive structural requirements provided in Part 9 reflect building design that was typical in the 1950s and 1960s. In the case of housing, for example, openings in exterior walls for windows and doors were generally modest, large double-height spaces were rare, and most openings in interior walls between spaces did not exceed 2.4 m wide. Changes in building design and construction mean that the validity of the simple prescriptive structural requirements in Part 9 need to be reviewed with respect to both wind and earthquake.
- In the case of earthquake loads, failures have not occurred but it is understood that the “big one” has not yet hit the west coast. With better understanding of what does and does not effectively resist earthquake loads, the Part 9 requirements warrant review.

Proposed changes were developed for NBC 2005 Part 9 to address lateral loads due to wind and earthquake. The changes were deferred by the Canadian Commission on Building and Fire Codes (CCBFC) in response to a request from the Province of British Columbia, which requested more time to conduct studies of the proposed changes and their potential impact. The CCBFC requested that these changes be considered again in the current code development cycle taking into account the results of the BC studies. This proposed change is one of a series developed in response to the CCBFC request.

Editorial

The exception provided in Sentence (2) referring to ground anchors is already identified in Sentence (1)..

Technical

The minimum anchorage requirements currently provided are inadequate for buildings that may be subject to very high wind loads or high earthquake loads

Justification - Explanation

Editorial

The proposed change deletes unnecessary wording.

Technical

The proposed change specifies different levels of anchorage to resist sliding appropriate for buildings subject to different wind and earthquake loads.

Wind

With respect to wind load, anchorage would be required to be designed according to Part 4 in one location:

- Resolution Island NU 1.23 kPa

The proposed stronger anchor bolt requirement would affect buildings with 2 or more floor levels, including mezzanines, in 19 of the locations identified in Appendix C of the Code:

- Cape Race NF 1.05 kPa
- Cardston AB 1.02 kPa
- Cowley AB 1.00 kPa

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• Coral Harbour	NU	0.99 kPa
• Nottingham Island	NU	0.99 kPa
• Pincher Creek	AB	0.97 kPa
• Harrington-Harbour	QC	0.92 kPa
• Povungnituk	QC	0.91 kPa
• Fort MacLeod	AB	0.90 kPa
• Isachsen	NU	0.90 kPa
• Inukjuak	QC	0.90 kPa
• Clyde River	NU	0.90 kPa
• Claresholm	AB	0.87 kPa
• St Anthony	NF	0.87 kPa
• Holman	NW	0.85 kPa
• Percé	QC	0.85 kPa
• Kuujjuarapik	QC	0.83 kPa
• Lethbridge	AB	0.82 kPa
• St John's	NF	0.80 kPa

Earthquake

With respect to earthquake, anchorage would be required to be designed according to Part 4 in one location:

- La-Malbaie QC 2.30

The proposed more stringent Part 9 anchor bolt requirement would affect buildings with 2 or more floor levels, including mezzanines, in 33 of the locations identified in Appendix C of the Code:

• Victoria (Mt Tolmie)	BC	1.20
• Victoria (Gonzales Hts)	BC	1.20
• Victoria	BC	1.20
• Ucluelet	BC	1.20
• Tofino	BC	1.20
• Sidney	BC	1.20
• Rivière-du-Loup	QC	1.10
• Langley	BC	1.10
• Ladner	BC	1.10
• Duncan	BC	1.10
• Crofton	BC	1.10
• Youbou	BC	1.00
• Surrey (88 Ave & 156 St.)	BC	1.00
• Richmond	BC	1.00
• Nanaimo	BC	1.00
• Cloverdale	BC	1.00
• New Westminster	BC	0.99
• St-Georges-de-Cacouna	QC	0.98
• Haney	BC	0.97
• Vancouver (Granville & 41 Ave)	BC	0.95
• Vancouver	BC	0.94
• Burnaby (Simon Fraser Univ.)	BC	0.94
• Mission City	BC	0.93
• Abbotsford	BC	0.92
• Montmagny	QC	0.89
• West Vancouver	BC	0.88
• North Vancouver	BC	0.88

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• Tadoussac	QC	0.84
• Qualicum Beach	BC	0.82
• Port Alberni	BC	0.75
• Alberni	BC	0.75
• Chilliwack	BC	0.73
• Squamish	BC	0.72

Cost implications

Design to Part 4

Cost increases related to design to Part 4 would affect 2 locations – Resolution Island, NU and La-Malbaie, QC. The increase is likely to be in the order of **\$500**

More Stringent Part 9 Requirements for Higher Load Locations

Additional costs for fastening will apply only where frame walls support 2 or more floors in buildings in higher wind locations and high seismic load locations – 52 of 640 locations identified in Appendix C.

Average increase in cost of \$20 per single family home

Enforcement implications

Can be enforced by the available infrastructure.

In municipalities with high wind or seismic loads, will require some additional building permit application and site review to confirm that the proper design and construction approach has been taken.

Who is affected

Designers and builders with respect to design and construction.

Building officials with respect to determination of compliance.

Building owners would bear any increase in costs but would benefit from a reduced probability or degree of property loss in the case of an earthquake.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(1)

Analysis: Unchanged

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(2)

Analysis:

Attributions

[F20-OS2.1,OS2.5] [F22-OS2.5]

[F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.

Objective

OS2 Structural Safety

Attributions

[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.

Objective

OP2 Structural Sufficiency of the Building

Attributions

[F20-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.

Objective

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OH1 Indoor Conditions

Attributions

[F22-OH4] Applies to floors and elements that support floors.

Objective

OH4 Vibration and Deflection Limitation

Attributions

[F20-OS3.1] Applies to floors and elements that support floors.

Objective

OS3 Safety in Use

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(3)-2010

Analysis: New

Attributions

[F20-OS2.1,OS2.5] [F22-OS2.5]

[F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.

Objective

OS2 Structural Safety

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(3)-2010

Analysis: New

Attributions

[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.

Objective

OP2 Structural Sufficiency of the Building

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(3)-2010

Analysis: New

Attributions

[F20-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.

Objective

OH1 Indoor Conditions

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(3)-2010

Analysis: New

Attributions

[F22-OH4] Applies to floors and elements that support floors.

Objective

OH4 Vibration and Deflection Limitation

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

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Provision: 9.23.6.1.(3)-2010

Analysis: New

Attributions

[F20-OS3.1] Applies to floors and elements that support floors.

Objective

OS3 Safety in Use

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(4)-2010

Analysis: Unchanged

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(5)-2010

Analysis: New

Attributions

[F20-OS2.1,OS2.5] [F22-OS2.5]

[F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.

Objective

OS2 Structural Safety

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(5)-2010

Analysis: New

Attributions

[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.

Objective

OP2 Structural Sufficiency of the Building

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(5)-2010

Analysis: New

Attributions

[F20-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.

Objective

OH1 Indoor Conditions

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(5)-2010

Analysis: New

Attributions

[F22-OH4] Applies to floors and elements that support floors.

Objective

OH4 Vibration and Deflection Limitation

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISION

Provision: 9.23.6.1.(5)-2010

Analysis: New

Attributions

[F20-OS3.1] Applies to floors and elements that support floors.

Objective

OS3 Safety in Use

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