

STRUCTURAL DESIGN ISSUES FOR HOUSING AND SMALL BUILDINGS IN BRITISH COLUMBIA

Information Bulletin for Local Authorities, Homeowners and Developers

APEGBC PROFESSIONAL PRACTICE GUIDELINES

V2.1



Professional Engineers
and Geoscientists of BC

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■ PREFACE

APEGBC administers the *Engineers and Geoscientists Act* for the protection of the health, safety and welfare of the public as it relates to the practice of professional engineering and geoscience in British Columbia. One of the many practice disciplines covered under the Act is structural engineering including the provision of structural engineering services for *Part 9* buildings.

■ DEFINITIONS

The following definitions are specific to these guidelines. All references in the text to these terms are italicized.

Authority Having Jurisdiction (AHJ)

The government body (usually municipal) with authority to administer and enforce the *British Columbia Building Code*, the *Vancouver Building By-law* and/or local building bylaw.

Housing and Small Building

Means for the purposes of this bulletin, these types of buildings are defined under Clauses 1.3.3.3.(1) a), b), c) and d) of the *British Columbia Building Code 2012*, Clauses 1.3.3.3.(1) a), b), c) and d) of the *Vancouver Building By-law 2007* or Division A, Clauses 1.3.3.3.(1) a), b), c) and d) of the *National Building Code of Canada 2010*.

For example this would include buildings of 3 storeys or less in building height with a building area of less than 600m² that are used for residential, business, mercantile, or medium and low hazard occupancies as defined in the relevant building code.

Building Code

Means the *British Columbia Building Code 2012*, *Vancouver Building By-law 2007* (the *Vancouver Building By-law 2013* when in effect) or the *National Building Code of Canada 2010*.

Building Frame

Means the combination of components which support the building's self weight and the applicable live load based on occupancy, use of the spaces in the building and environmental loads such as wind, snow and seismic forces from earthquakes.

Structural Engineer of Record (SER)

Means the professional engineer with responsibility for the structural integrity of the *Building Frame* that includes taking overall responsibility for structural design of the whole building.

Letters of Assurance (LoAs)

Means, where they are present in the applicable *Building Code*, administrative forms that may be requested by AHJs per Division C, Part 2 of the applicable *Building Code* before permits are issued.

Part 9

Means the section of the *British Columbia Building Code 2012*, *Vancouver Building By-law 2007* (the *Vancouver Building By-law 2013* when in effect) or the *National Building Code of Canada 2010* which identifies for the category of buildings which fall within the definition of *housing and small buildings* how they are to be designed including structural design requirements.

■ INTRODUCTION

This bulletin was prepared by the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) for the benefit of those who are involved in the design and construction of *housing and small buildings*, as defined by *Part 9* of the relevant *Building Code*. Note that this bulletin is not targeted at professional engineers. For those who are interested, more detailed coverage of the technical and professional practice issues is covered in the *Guidelines for Professional Structural Engineering Services for Part 9 Buildings in British Columbia* (V3.0 July, 2014).

■ WHY THE NEED FOR THIS BULLETIN?

APEGBC wants to assist the public and AHJ's in understanding the services a professional engineer engaged in the structural design of *housing and small buildings* can provide to produce a consistent level of structural performance for those structures (especially in terms of the ability of those structures to resist windstorm or earthquake forces).

Following are the three specific issues that may apply to the construction of, renovation or addition to *housing and small buildings*:

ISSUE 1

Potential Inability of Some Modern Housing and Small Buildings to Adequately Resist Sway Forces due to Earthquakes or Wind.

The prescriptive provisions of Part 9 provide for the pre-engineered design of structural components to resist gravity loads, e.g., floor joist spans and wall stud spacing, and also lateral loads caused by earthquakes or wind, e.g., braced wall panels. Those prescriptive requirements, however, may not adequately address the design of some modern Part 9 buildings which feature open layouts, few interior walls, high ceilings with large floor openings, significantly-interrupted exterior wall framing, many windows or very large doors. In buildings with such features, a professional engineer may be required to perform the necessary checks to determine whether additional design details are required based on the extent of those features, and the severity of the local wind or earthquake hazard.

ISSUE 2

Potential Lack of Coordination of the Design of Various Individual Structural Components.

Many Part 9 buildings require one or more specialty structural components which are not covered by the prescriptive provisions of Part 9. In accordance with the *Building Code*, these specialty structural components must be designed by a professional

engineer. To ensure all structural components are designed consistently and interconnected properly, appropriate coordination of the design of such specialty structural components to the structural design of the *building frame* is important. Without such coordination, the structural integrity of the *building frame* may be compromised.

ISSUE 3

Potential Weakening of the Building Frame in a Renovation or Addition.

Section 1.1.1.2 and Section 2.2.1.1 of the *Building Code* require that an existing structure should not be weakened by renovations or additions. The lateral sway resistance of a building may be compromised by increasing the size of the openings in the floors, walls or roof elements during a renovation or addition. The net effect may be particularly difficult to evaluate for a Part 9 building since there may not have been any engineering design outside of the provisions in Part 9 in the first instance (see Issue 1).

RECOMMENDATIONS

3.1 RECOMMENDATION 1

This recommendation addresses Issue 1:
Wind and Earthquake Resistance.

The basis for the design of lateral sway resistance of *Part 9* buildings should be as follows, and, a professional engineer should be engaged as noted.

- a) If the building is of wood frame construction, then:
 - (i) If the building meets the prescriptive requirements of *Part 9*, the *Building Code* does not require the involvement of a professional engineer.
 - (ii) If a professional engineer is retained to provide professional services, as a minimum the professional engineer must design the structure in accordance with the APEGBC *Professional Practice Guidelines – Professional Structural Engineering Services for Part 9 Buildings in British Columbia*.
- b) If the building is not of wood frame construction, then:
 - (i) A professional engineer should always be engaged to design the structure in accordance with Part 4 of the *Building Code*.

3.2 RECOMMENDATION 2

This recommendation addresses Issue 2:
Coordination of Designs.

Once a professional engineer is required by the *Building Code* to provide any structural engineering services on a *Part 9* building, the same professional engineer or another professional engineer, should be engaged to determine that the designs of all structural components are consistent

with the structure's *Building Frame*. These components must include footings and foundations, beams and roof or floor trusses, each of which may be designed by a different professional engineer.

In such instances, the professional engineer providing the coordinating role must be engaged to act as the SER and the SER will then take professional responsibility for the structural integrity of the *building frame*. This also includes confirmation that a complete load path to the foundation has been provided for both gravity and lateral loads for all structural components designed by others e.g., wood trusses, beams, supporting concentration loads, open web steel joists, steel beams and steel columns. It should be noted that when *LoAs* are requested by the AHJ, it is generally the professional engineer acting as the SER who signs such letters (*Guidelines for Professional Structural Engineering Services for Part 9 Buildings in British Columbia, V3.0 July, 2014*).

3.3 RECOMMENDATION 3

This recommendation addresses Issue 3:
Renovations.

A professional engineer should be engaged to confirm that an addition or renovation to a *Part 9* building that is **not** structurally independent from the existing structure, has been designed and constructed such that the level of building performance of the entire structure is not reduced below the level that existed prior to the addition or renovation (*Guidelines for Professional Structural Engineering Services for Part 9 Buildings in British Columbia, V3.0 July, 2014 for further technical discussion*).

A structurally-independent addition or renovation should be specifically designed for lateral load resistance loads as per Recommendation 1 of this bulletin.

■ CONCLUDING REMARKS

This information bulletin has focused on the design of new *Part 9* buildings and on renovations to existing *Part 9* buildings. The increased risk of structural problems for *Part 9* buildings not designed to the standard of good engineering practice has been outlined.

It is APEGBC's position that an APEGBC member or licensee who has suitable training and experience in this field of practice is appropriately qualified for the services covered in this bulletin. An APEGBC member or licensee with the "Struct.Eng." designation is not required for the services covered in this bulletin.

Most existing *Part 9* wood frame structures have performed extremely well during earthquakes. It has been noted, however, that there is an elevated risk of poor performance for a *Part 9* building that has a significantly non-traditional layout and yet has been designed using the traditional prescriptive provisions of the *Building Code*, and not by a professional engineer in accordance with good engineering practice as recommended in Appendix A of the *Building Code*.

When considering this issue, it should be noted that the most cost-effective time for mitigating the risk to a *Part 9* building is during the initial construction phase or during an extensive renovation. It should also be noted that not all existing *Part 9* buildings in the elevated risk category would necessarily perform poorly in an earthquake. In some cases, non-structural components may help the performance of the building in unintended ways.

■ REFERENCE DOCUMENTS

- British Columbia Building Code 2012
- National Building Code of Canada 2010
- Engineering Guide for Wood Frame Construction Published by the Canadian Wood Council (CWC 2009)
- Vancouver Building Bylaw 2007 (Vancouver Building By-law 2013 when in effect)
- City of Vancouver Bulletin 2001-011-BU, Seismic Design of One and Two Family Dwellings, Revised April 19, 2007
- City of Vancouver Bulletin 2003-001-AD/BU, Guidelines for Seismic Evaluations of One and Two Family Dwellings, Revised April 19 2007
- APEGBC Guidelines for Structural Engineering Services for Part 3 Building Projects
- APEGBC Guidelines for Professional Structural Engineering Services for Part 9 Buildings in British Columbia, V3.0 July, 2014
- APEGBC Bulletin K: Letters of Assurance and Due Diligence including Appendix A – Specialty Engineer – Assurance of Professional Design and Field Review (Schedule S)
- APEGBC Guidelines for Geotechnical Engineering Services for Building Projects
- APEGBC Advice on Hiring a Professional Engineer or Professional Geoscientists in British Columbia

APEGBC Guidelines and Bulletins are available from the [APEGBC Website](#)



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