Building and Safety Policy Branch
Ministry of housing and Social Development
Amending the BC Building Code to Permit up to and including 6 Storeys of Wood-Frame Buildings of Residential Occupancy

Stage 2 Report
Recommended Building Code Changes to permit 5 and 6 Storey Wood-Frame Buildings of Residential Occupancy

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SUMMARY

Stage 2 Report – Recommended Building Code Changes to permit 5 and 6 Storey Wood-Frame Buildings of Residential Occupancy

As part of the recent initiative to amend the current BC Building Code (BCBC) to permit up to and including 6 storeys of wood-frame construction of residential occupancy, GHL Consultants Ltd (GHL) and Read Jones Christoffersen Ltd (RJC) have been requested by the Building and Safety Policy Branch of the Ministry of Housing and Social Development to prepare the following Stage 2 Report which provides the recommended Code changes to permit 5 and 6 storey wood-frame buildings in BC, as well as the associated technical and process risks identified in the Stage 1 Report.

The Stage 2 Report includes recommended Code changes and rationales to Division B, Parts 3 and 4 and the associated appendix notes. No Code change is recommended for Division B, Part 5 as it is a performance-based Code.

The Stage 2 Report must be read in conjunction with the Stage 1 Report for completeness.

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LIST OF ILLUSTRATIONS

ABBREVIATIONS

AHJ	Authority Having Jurisdiction
AIBC	Architectural Institute of British Columbia
APEGBC	Association of Professional Engineers and Geoscientists of British Columbia
BC	British Columbia
BCBC	British Columbia Building Code
BCIT	British Columbia Institute of Technology
BEEP	Building Envelope Education Program
BEP	Building Envelope Professional
BSPB	Building and Safety Policy Branch
CANCEE	Canadian National Committee on Earthquake Engineering
CMHC	Canada Mortgage and Housing Corporation
CP	Certified Professional
CAN/ULC-S101	Fire Test Standard “Fire Endurance Tests of Building Construction and Materials”
CSA	Canadian Standards Association
CSA O86	CSA Standard “Engineering Design in Wood”
EWP	Engineered Wood Product
FRR	Fire-resistance rating
GHL	GHL Consultants Ltd
Group C	Residential occupancy as defined in the 2006 BCBC
GWB	Gypsum wallboard
HPO	Homeowner Protection Office
IRC	Institute for Research in Construction
NBCC	National Building Code of Canada

NFPA	**National Fire Protection Association**
NFPA 13	**NFPA Standard “Installation of Sprinkler Systems”**
NRC	**National Research Council**
OSB	**Oriented Strandboard**
RJC	**Read Jones Christoffersen Ltd**
SEABC	**Structural Engineers Association of British Columbia**
STC	**Sound Transmission Class**
Struct.Eng	**Designated Structural Engineer**
UBC	**University of British Columbia**
ULC	**Underwriter’s Laboratory of Canada**
ULC-S101	**Fire Test Standard “Fire Endurance Tests of Building Construction and Materials”**

DISCLAIMER

This technical report is prepared by GHL and RJC for the Ministry of Housing and Social Development. The purpose of this report is to provide a professional opinion to the Ministry on the recommended Code changes to permit up to and including 6 storeys wood-frame buildings of residential occupancy. The recommended Code changes are based on GHL and RJC's work as documented in the Stage 1 Report. The work of this Stage 2 report, as well as the Stage 1 Report, is limited by the timeframe, which would normally require substantial research for a significantly greater duration. The sole objective of this report is to provide a set of recommended Code changes aimed at permitting 5 and 6 storey wood-frame buildings and addressing the related technical and process risks in fire safety, structural and building envelope designs, as have been identified in the Stage 1 Report. The work as presented in this report is based on GHL and RJC's knowledge as competent practitioners in their respective fields. GHL and RJC's work shall not be construed as exhaustive. There may be other relevant considerations for the Code change proposal not identified by GHL and RJC. It is understood that a public consultation process is being carried-out in conjunction with this report. The decision to accept the risk of any type of construction or related issue identified is a decision by the BC Government to accept the associated level of risk. Enacting, changing or amending the Building Code for BC is the authority of the BC Government by laws of British Columbia and Canada. GHL and RJC are not responsible for the decision to accept the risks. The BC Government shall be solely responsible for the act of amending the BC Building Code to permit up to and including 6 storeys of wood-frame construction of residential occupancy, or making any changes to any provisions in the Building Code. It is the BC Government's sole discretion to adopt, consider or accept any part or in full the work of GHL and RJC contained in this report. GHL and RJC shall not be responsible for any loss of any kind that may arise due to any construction, building, or structure as a result of GHL and RJC's work or any Building Code or construction regulation change in British Columbia, or anywhere. Should this report be made available to other organizations that have regulatory capacity in construction of buildings and structures for anywhere this disclaimer shall equally apply. By preparing this report GHL and RJC do not express explicitly or implicitly any social, economical or political opinion, or any other non-technical opinion, as it relates to the Code change proposal. This report is intended to be purely technical in nature. Any inquiries on this report shall be directed to the Ministry:

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1.0 BASIS OF REPORT

1.1 Stage 2 Report

As part of the recent initiative to amend the current BC Building Code (BCBC) to permit up to and including 6 storey combustible buildings of residential occupancy, GHL Consultants Ltd (GHL) and Read Jones Christoffersen Ltd (RJC) have been requested by the Building Safety and Policy Branch (BSPB) of the Ministry of Housing and Social Development to prepare the following Stage 2 Report which provides the recommended Code changes to address the technical and process risks identified in the Stage 1 Report. The Stage 2 Report includes the recommended text for the Code changes and their rationales, specifically developed to address 5 and 6 storey wood-frame building of residential occupancy. Although the recommendations are for 5 and 6 storey wood-frame buildings of residential occupancy, some of these recommendations are applicable to other buildings. Where appropriate, the report identifies the recommendations that should also be extended to include non-5 and 6 storey wood-frame buildings of residential occupancy. This Stage 2 Report shall be read in conjunction with the Stage 1 Report for completeness.

1.2 Role of GHL and RJC

The role of GHL and RJC as consultants to BSPB is to recommend, to the best of our professional knowledge, Code changes to address technical and process risks in fire safety, structural and building envelope as determined by our work in Stage 1 with respect to 5 and 6 storey wood-frame buildings. GHL and RJC are retained to address conventional wood-frame construction typical in BC; we have not been retained to address any other types of combustible construction. However, for consistency with the Code, we have used the term “combustible construction” in this report; see Section 1.5 for further discussion.

1.3 Role of the BC Building Code

The BCBC is the Building Code for British Columbia, except Vancouver where it is governed by the Vancouver Building Bylaw. The BCBC is the regulation that governs building construction in BC. The 2006 BCBC is the edition of the BCBC currently in effect, and it is an objective-based Building Code. Code compliance with the 2006 BCBC is achieved by demonstrating compliance with the Code objectives. It is noted that the design of a technically sound building depends upon many factors beyond simple compliance with the Building Code. The 2006 BCBC has the following 5 broad objectives, which are further refined into specific objectives that translate into Code requirements **[1]**:

- Safety
- Health
- Accessibility for persons with disabilities
- Fire protection of building and facilities
- Energy

As an objective-based Code, the 2006 BCBC provides 2 avenues for Code compliance. One is prescriptive through meeting the acceptable solutions in Division B. The other is by alternative solutions, which often requires technical substantiation to demonstrate that a proposed design will

achieve a level of performance that meets the minimum required by the Building Code. Division A Appendix A-1.2.1.1.(1)(a) and (b) further clarifies Code compliance via acceptable solutions and via alternative solutions.

As an objective-based Code, the BCBC does not restrict the design and construction of a building to the acceptable solutions. The Code provides an opportunity to achieve Code-compliance through alternative solutions should it be desired. It is known that 5 and 6 storeys wood-frame buildings have been built previously under equivalencies and alternative solutions, often as a "podium" structure where the first storey is noncombustible of commercial use and the remaining being residential wood-frame.

However, in the absence of an acceptable solution in Division B to specifically recognize 5 and 6 storey combustible buildings, designers and AHJs alike are not given a clear basis for the design and review of such buildings. This is because the majority of the Code requirements are largely predicated upon the construction Article determined in Subsection 3.2.2., which is determined based on building characteristics including sprinkler provision, building height, building area, and occupancy classification. Therefore, without an acceptable solution to recognize the constitution of 6 storey combustible buildings, it is difficult for designers and AHJs to justify such building, as well as any related alternative solutions, because it is difficult if not impossible to provide an analysis for a design not specifically defined in Division B.

1.4 Public Interest Decision

Changing the Building Code is a public-interest decision. The BCBC has been changed and revised since its first enactment in 1973. The act of enacting and revising the Building Code is defining the acceptable minimum level of performance for buildings in British Columbia. Risk is generally defined as the product of probability of failure and the consequence. Division B of the Building Code defines the boundaries between acceptable risk and the "unacceptable" risks referred to in the statements of the Code objectives. That is, any risk remaining once the applicable acceptable solutions in Division B have been implemented represents the residual level of risk deemed to be accepted by the broad base of British Columbians who have taken part in the consensus and legislative processes used to develop the BCBC **[1]**. Therefore, by changing the Building Code to permit up to and including 6 storeys of combustible building of residential occupancy, it is an act to acknowledge and accept all risks associated with the Code change.

1.5 Assumptions

COMBUSTIBLE CONSTRUCTION

The work presented in this report assumes traditional wood-framing construction employed in BC as requested by the Ministry. This assumption is consistently used in with respect to structural and building envelope discussion in this report as the respective Part of the Code are more specific on the type of material and construction technique. However, with respect to Division B Part 3, the term "combustible construction" is used as in terms of fire safety, the Code requirements of this Part are founded on the basis of combustible versus noncombustible construction materials, notwithstanding that the typical combustible construction in BC is wood-frame construction as limited by other Codes, standards and engineering requirements outside of Division B, Part 3. The terminology on "combustible construction" and "wood-frame" construction can generally be considered as interchangeable, except with respect to fire safety, it should be noted that combustible construction

could potentially include other types of combustible material through alternative solutions, and that GHL and RJC have only been retained to address wood-frame construction.

SCOPE OF CODE CHANGE

The work also assumes changing the Building Code with respect to fire safety, structural and building envelope requirements in Division B, Part 3, Part 4 and Part 5, respectively. GHL and RJC have not been requested to provide work relating to any other aspect of the Building Code outside of Division B, Part 3, Part 4 and Part 5, including construction fire safety. Specifically, GHL has only been requested to comment on fire safety requirements pertaining to Part 3; other requirements such as occupant safety due to building usage and accessibility as well as health requirements contained in Part 3 are not part of the scope of GHL's work. At time of report writing GHL and RJC have recommended BSPB to retain qualified professionals to address other requirements such as including but not limited to construction fire safety, as well as electrical and mechanical systems of building design.

It is assumed that the proposed 5 or 6 storey wood-frame building will not be a high building as defined in the Building Code. A high building implies significantly more complex firefighting techniques which are outside the scope of this report. High buildings are defined in Division B, Clause 3.2.6.1.(1)(d) as buildings with the uppermost floor level is more than 18m above grade.

The authors also recognize that there are issues relating to the aging population and difficulty with evacuation; however, this is a separate topic applying to all buildings, combustible or noncombustible, not just 5 and 6 storey wood-frame buildings.

ALTERNATIVE SOLUTIONS

This report relates to accepted solutions of Division B of the Code. This report is not intended to preclude Alternative Solutions to address elements outside the scope of this report, or different solutions to that provided in Division B. For example, this report is not intended to preclude Alternative Solutions for highrise buildings or other occupancies; it simply recommends Code changes in Division B to facilitate 5 and 6 storey wood-frame residential buildings.

2.0 Recommended Code Changes

This Section presents the recommended Code changes for permitting 5 and 6 storey wood-frame buildings of residential occupancy. The recommendations are aimed at addressing the technical and process risks associated with the Code change as identified in the Stage 1 Report. The Code change recommendations also takes into consideration the comments received during the Technical Advisory Group and Stakeholder's meetings held by BSPB. Subsections 2.1, 2.2 and 2.3 present the Code change recommendations relating to fire, structural and building envelope requirements of the Building Code, respectively.

For ease of reading the Code change recommendations, additions are identified by red and underlined fonts; deletions are identified by gray font; texts that are part of the current Code are left as unformatted texts.

2.1 Fire Safety (Part 3)

As stated in the Stage 1 Report, buildings are currently limited to 4 storeys due to restrictions in Division B, Part 3. In order to permit 5 and 6 storey wood-frame buildings of residential occupancy, Code changes are recommended for Part 3, in two aspects. First, Code change in Article 3.2.2.45 is recommended as the "core" Code change to explicitly permit 5 and 6 storey combustible constructions of Group C occupancy in Division B, Part 3. Second, additional Code changes are recommended to address the related technical and process risks due to the increase in building height as identified in the Stage 1 Report. It is noted that the Code change recommendations are aimed at 5 and 6 storey wood-frame buildings. However, as the principles of fire engineering generally apply to all combustible buildings, it may be appropriate to adopt the Code change recommendations for all combustible buildings. For discussion purposes, Table 1 is a summary of recommended Code changes for Division B, Part 3. The text of the recommended Code changes is presented as follows.

Table 1
Summary of the recommended Code changes for Division B, Part 3.

Item	Issue	Solution Proposed by the Code Change	Division B Reference
1	Building height	Permit 5 and 6 storeys.	3.2.2.45.(1)
2	Building area	Limit building area to 5 storey at 1440 m^2 and 6 storey at 1200 m^2.	3.2.2.45.(1)
3	Building shrinkage	An appendix note reminding designers that design of 5 and 6 storey wood-frame buildings shall include consideration for shrinkage.	A-3.2.2.45.(1)
4	Qualification of designers	An appendix note stating the need for qualified professionals and Best Practices Guides.	A-3.2.2.45.(1)
5	Fire rated floor assembly	Increase reliability of floor FRR	3.2.2.45.(5)
6	Fire rated floor assembly	An appendix note explaining the intent of item 5.	A-.2.2.45.(5)
7	Limitation on building physical height	Uppermost storey shall not exceed 18 m.	3.2.2.45.(6)
8	Exterior cladding	Noncombustible exterior cladding. Combustible cladding permitted only if it meets CAN/ULC-S134, or vinyl on GWB cladding. Also explicitly permit use of wood nailing elements when conditions are met.	3.1.4.1.(1), (3), (4), (5), and (6)
9	Use of horizontal exit	Permit the required exits in a floor area to be entirely consists of horizontal exits, if the exits lead to a floor area that has exit stairs.	3.4.1.6.(1) and (3)
10	Use of hold-open device	Permit use of hold open devices for horizontal exits.	3.1.8.12.(1)
11	Balcony sprinkler	Sprinklers in balconies exceeding 600 mm in depth.	3.2.5.13.(9)
12	Vertical concealed spaces	Address fire spread in vertical concealed spaces.	3.1.11.5.(3)
13	Exit fire separation	Increase reliability of exit fire separation.	3.4.4.1.(4)
14	Exit fire separation	Appendix A note explaining the intent of Item 14.	A-3.4.4.1.(4)
15	Limited ULC tested designs	Permit in Appendix D-2.3.3. the use of double layer designs when supported by appropriate fire test data.	D-2.3.3.(4)
16	Reference to NRC documents	Add to the current list of fire test reports in D-6.1. the NRC fire tests on floor and wall assemblies.	D-6.1

Recommended Code Change **Building Construction Requirement**
Sentence 3.2.2.45.(1)

3.2.2.45. Group C, up to ~~4~~ 6 Storeys, Sprinklered

1) A *building* classified as Group C is permitted to conform to Sentence (2) provided

a) except as permitted by Sentences 3.2.2.7.(1) and 3.2.2.18.(2), the building is *sprinklered throughout*,

b) it is not more than ~~4~~ 6 storeys in building height, and

c) it has a *building area* not more than

i) 7 200 m^2 if 1 *storey* in *building height*,
ii) 3 600 m^2 if 2 *storeys* in *building height*,
iii) 2 400 m^2 if 3 *storeys* in *building height*, ~~or~~
iv) 1 800 m^2 if 4 *storeys* in *building height*,
v) 1 440 m^2 if 5 storeys in *building height*, or
vi) 1 200 m^2 if 6 storeys in *building height*.

(See Appendix A.)

Functional Statement

None

Objective

None

Intent

To state the application of Sentence 3.2.2.45.(2).

Rationale

Article 3.2.2.45 is the existing construction Article for combustible buildings of residential occupancy up to 4 storeys. It is recommended that the Code change to permit 5 and 6 storey wood-frame buildings be provided in Article 3.2.2.45. Article 3.2.2.45 is considered as the more appropriate Article as the Article has been established for combustible construction of Group C occupancy. The Code currently divides Group C construction into several categories; the key categories include 2 hour rated noncombustible, any area, any height; 1 hour rated noncombustible, 6 storey, up to 6000 m^2; 1 hour rated combustible, 4 storey, up to 1800 m^2; and the low-rise categories (1 to 3 storeys). As Code users are already familiar with the construction categories, it would be natural to amend the Code in Article 3.2.2.45, which is the 4 storey combustible construction category.

As discussed in the Stage 1 Report, Article 3.2.2.45 currently employs a formula in apportioning building area relative to the building height, such that the resulting gross floor area is limited to a maximum of 7200 m^2:

1 storey × 7200 m^2 = 7200 m^2
2 storey × 3600 m^2 = 7200 m^2
3 storey × 2400 m^2 = 7200 m^2
4 storey × 1800 m^2 = 7200 m^2

It is recommended that the total floor area of 7200 m^2 currently in existence be kept for the 5 and 6 storey clauses. Namely, allowing 5 storeys at 1440 m^2 and 6 storeys at 1200 m^2 in Sentence (1):

5 storey × 1440 m^2 = 7200 m^2
6 storey × 1200 m^2 = 7200 m^2

By maintaining the same gross building area, the technical risks as identified in the Stage 1 Report will not likely increase; namely:

- Risk of ignition
- Risk of interior fire spread beyond point of origin
- Risk of fire spread to neighbouring buildings
- Risk of failure of sprinkler system to control fire
- Risk of occupants not able to recognize fire
- Risk of occupants not able to evacuate the building, and
- Risk of fire service unable to conduct effective operation

This is because given the same gross floor area and the same fire engineering philosophy of compartmentalization and sprinkler protection, the probability of fire occurring and the consequential losses would not change. Any risks not identified by the Code due to the use of combustible material in construction is addressed by limiting the building area to 20% of that permitted for noncombustible building.

As discussed in the Stage 1 Report, the 7200 m^2 area is selected by NRC which is intended to limit the building area of combustible buildings to 20% of that of noncombustible buildings. There are no apparent engineering principles on the selection of the 20%; however, it has been generally accepted by the public of BC as the Code has been amended through several Code change cycles. Given there is no technical substantiation at this stage to increase or decrease the 20%, the 20% is recommended in order to maintain the same level of performance that has been deemed as acceptable by the BC public.

Recommended Code Change **Appendix A A-3.2.2.45.(1)**	**Building Construction Requirement**

A-3.2.2.45.(1) 5 and 6 Storey Wood-Frame Buildings

With respect to 5 and 6 storey wood-frame buildings, care must be taken by designers to properly address shrinkage so that deterioration caused by drying will not affect the health and safety of building uses, intended use of building, or operation of building services. See 5.1.4.2. The structural engineer is required to identify building movement due to shrinkage to the design team and this should be coordinated amongst design professionals for their respective responsibilities in Division B, Parts 3, 4, 5, 6, and 7.

In addition, there are elements of 5 and 6 storey wood-frame buildings that require specialist expertise in addressing various issues such as including but not limited to fire separations, fire blocking, exterior fire spread, and mixed occupancies. Further, some local governments may not have the expertise required for building review or may not wish to accept such risks. The involvement of a specialist engineer or architect with fire engineering expertise, as well as "Best Practices Guides" currently under development will further address these issues.

Functional Statement

Not applicable

Objective

Not applicable

Intent

Not applicable

Rationale

The Appendix A notes above are recommended to address process risks identified in the Stage 1 Report.

Part 5 and the standards referenced by Part 4 specifically address concerns with shrinkage. Part 3 has no specific requirements for addressing environmental concerns. Part 5 addresses shrinkage, in 5.1.4.2. However, Part 5 is limited to the building exterior and the assemblies separating dissimilar environments. In the case of building structure, dissimilar environment is the difference between the structure environment and the completed building environment, notwithstanding this dissimilar environment must be addressed. It would appropriate to address this in Part 5 except Part 5 is limited to building envelopes and dissimilar environments after construction. A requirement to consider shrinkage would be inappropriate in Part 3. Therefore, the Appendix A note is recommended here to reminder designers the need to coordinate the effects of shrinkage in the design of 5 and 6 storey buildings

With respect to the standard of care expected of design professionals for 5 and 6 storey wood-frame buildings, currently there is no specific qualification of fire engineer although guidelines are being prepared by APEGBC. A fire engineer specialist is not recommended at this time as a requirement based on consultation with APEGBC. However, it is recommended in the Appendix A note that engineers and architects with specialized expertise in fire be involved in 5 and 6 storey projects; these persons can provide advise and take liability that local governments may not be willing to accept. Finally, when "Best Practices Guides" relating to 5 and 6 storey wood-frame buildings are released, they would represent the standard of care expected of design professionals for 5 and 6 storey wood-frame buildings.

Recommended Code Change **Sentence 3.2.2.45.(5)**	**Building Construction Requirement**

3.2.2.45. Group C, up to ~~4~~ 6 Storeys, Sprinklered

5) In a *building* that is permitted by Sentence (1) to be 5 or 6 storey in *building height*, the *fire-resistance rating* required in Clause (2)(b) and (c) shall be derived based on a minimum of 2 layers of gypsum wallboard on the underside if the assembly incorporates gypsum wallboard.

(See Appendix A.)

Functional Statement

F03, F04

Objective

OS1.2, OS1.3, OP1.2, OP1.3

Intent

To limit the probability of wallboard based floor assemblies being installed incorrectly during construction or damaged during the course of the building's lifetime.

To limit the probability that wallboard based floor assemblies exposed to fire will prematurely fail or collapse during the time required to achieve occupant safety and for emergency responders to perform their duties, which could lead to harm to persons.

Rationale

Sentence (5) is recommended to address reliability of the FRR in floors and mezzanines when the assemblies utilize GWB as the means of deriving the fire-resistance. Reliability is not an area of building construction addressed by the 2006 BCBC. There is also no proposal in the 2010 NBCC at this point to address reliability based on our review. However, it is recommended that additional measures be taken to address reliability of GWB-based floor assemblies, which is a process risk identified and further discussed in the Stage 1 Report. Participations in BSPB's Technical Advisory Group meetings by the authors in September and October, 2008 have also indicated that the fire engineering and regulatory communities are general supportive of this concept.

Recommended Code Change **Appendix A A-3.2.2.45.(5)**	**Building Construction Requirement** **Item 7 of Table 1**
A-3.2.2.45.(5) Reliability of Membrane-Based Fire Separations There is a concern with reliability of light-wood framing protected with a single layer gypsum wallboard membrane. Experience and testing by NRC have shown that two layer gypsum wallboard designs provide a high level of reliability and resistance to damage and installation error. This requirement is not intended to preclude use of tested designs that provide an appropriate degree of fire-resistance in the event of failure of the membrane.	
Functional Statement	
Not applicable	
Objective	
Not applicable	
Intent	
Not applicable	
Rationale	
It is recommended that the Appendix A notes above be included to explain the intent of the recommended Sentence 3.2.2.45.(5) and Sentence 3.4.4.1.(4).	

Recommended Code Change **Sentence 3.2.2.45.(6)**	**Building Construction Requirement**

3.2.2.45. Group C, up to ~~4~~ 6 Storeys, Sprinklered

6) In a *building* that is permitted by Sentence (1) to be 5 or 6 storeys in *building height*, the *building* shall not be more than 18 m in height, measured between *grade* and the floor level of the top *storey*.

Functional Statement

None

Objective

None

Intent

To state the application of Sentence 3.2.2.45.(6).

Rationale

Sentence (6) is recommended in order to prevent 5 and 6 storey wood-frame buildings from being built as a high building as defined by the Building Code. High buildings requirements assume interior firefighting, lengthier evacuation time and fire department access time. The requirements also deal with stack effects which become more prominent in high buildings. Without further analysis, it is not recommended at this point to permit high buildings of wood-frame construction. The wording of the 18 m limitation is intended to be consistent with current approach to high buildings in the Code. That is, allow construction requirements in Subsection 3.2.2. to determine the building height based on number of storeys and allow the 18 m criteria to the floor of the 6th storey to determine high building requirements. High building requirements are intended to address the risks associated with high buildings and are currently provided in the Code in an 'additional requirement' format (that is, Subsection 3.2.6 in addition to Subsection 3.2.2 requirements). This means Code application is currently used for 6 storey noncombustible buildings, and it is intended to keep the approach consistent, on the basis that the risk associated with combustible construction is addressed in Subsection 3.2.2.; the selection of the high building definition (ie. the 18 m) should not be based on whether the building is combustible or noncombustible at this point. As presented in the Stage 1 Report, the risks not contemplated by the Code objectives are addressed by limiting the building area to 20% of that of a noncombustible building.

Recommended Code Change **Article 3.1.3.1**	**Building Exterior Cladding**

3.1.4.1. Combustible Materials Permitted

1) Except as required by Sentences (3), (4) and (6), ~~A~~a *building* permitted to be of *combustible construction* is permitted to be constructed of *combustible materials*, with or without *noncombustible* components.

Functional Statement

None

Objective

None

Intent

To clarify that Part 3 buildings of combustible construction may be built with combustible materials, with or without noncombustible components, except the exterior wall construction for 5 and 6 storey combustible buildings.

To State the application of Sentences 3.1.4.1.(3), (4) and (6).

Rationale

The Code currently permits in Sentence 3.1.4.1.(1) combustible buildings to be constructed of combustible material. Notwithstanding this, for 5 and 6 storey wood-frame buildings, combustible exterior cladding would attribute to an increase in risk of exterior fire spread (see further discussion in the Stage 1 Report). It is therefore recommended that the use of combustible material on the exterior wall be limited by requiring the construction to conform to the proposed Sentences (3), (4) and (6).

Recommended Code Change Sentence 3.1.4.1.(3)	**Building Exterior Cladding**
3.1.4.1. Combustible Materials Permitted **3)** Exterior cladding on a 5 or 6 *storey building* permitted in Sentence 3.2.2.45.(1) shall be *noncombustible*, except as permitted in Sentence (4).	
Functional Statement	
F02, F03	
Objective	
OS1.2, OP1.2	
Intent	
To limit the probability that combustible exterior cladding on a 5 or 6 storey combustible building will contribute to the spread of fire through the exterior of the building.	
Rationale	
Sentence (3) is recommended as a 'default' measure, where 5 and 6 storey buildings shall have noncombustible exterior cladding. See also recommended Code changes Sentence 3.1.4.1.(4) and (6).	

Recommended Code Change **Sentence 3.1.4.1.(4)**	**Building Exterior Cladding**

3.1.4.1. Combustible Materials Permitted

4) Except for an *exposing building face* required by Article 3.2.3.7. to be *noncombustible*, the exterior wall in a 5 or 6 storey *building* permitted in Sentence 3.2.2.45.(1) is permitted to be clad with *combustible* cladding provided

a) the exterior wall assembly is constructed such that

i) the interior surfaces of the wall assembly are protected by a thermal barrier conforming to Sentence 3.1.5.12.(3), and

ii) the wall assembly satisfies the criteria of Sentences 3.1.5.5.(2) and (3) when subjected to testing in conformance with CAN/ULC-S134, "Fire Test of Exterior Wall Assemblies", or

b) the exterior wall assembly consists of vinyl siding over gypsum wallboard cladding.

Functional Statement

None

Objective

None

Intent

To exempt certain combustible materials from the application of Sentence 3.1.4.1.(3) if certain conditions are met, on the basis that the materials are deemed to insignificantly contribute to fire growth and spread.

Rationale

Sentence (4) is recommended to permit certain combustible exterior cladding if the exterior wall is not otherwise required by Article 3.2.3.7 to be noncombustible for exposure protection purposes. When not restricted by Article 3.2.3.7, it is recommended to permit two classes of combustible exterior cladding systems.

The first is if the exterior wall meets CAN/ULC-S134 "Fire Test for Exterior Wall Assemblies". This category of exterior wall system is taken from current Article 3.1.5.5. which permits combustible exterior walls that meets the S134 test in noncombustible buildings. This test distinguishes certain combustible claddings, which have an acceptable resistance to fire spread on exterior of a building. It is noted here that the application of Sentence 3.1.5.5.(1) for noncombustible buildings is limited to exterior non-loadbearing walls; this has however been omitted in our recommendation for Sentence 3.1.4.1.(4) for combustible buildings.

The second is if the exterior wall consists of vinyl siding over GWB cladding. This recommendation

is based on practical consideration that vinyl is commonly used as an exterior cladding. A vinyl over GWB cladding system has been found to provide an acceptable level of exterior fire spread based on the test conducted at NRC by Oleszkiewicz[1]. The NRC test predates the CAN/ULC-S134 standard and is the test for which the S134 standard is derived from. Based on our review of the test results presented by NRC, we recommend permitting vinyl on GWB as an acceptable exterior cladding system, in addition to the CAN/ULC-S134 test avenue. In view that the building is fundamentally permitted to be combustible, and that the building areas are kept to 20% of a noncombustible building, the recommendations for use of combustible cladding as discussed above is considered reasonable.

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[1] Oleszkiewicz, I., Fire and Combustible Cladding, http://irc.nrc-cnrc.gc.ca/pubs/cp/fir1_e.html (last visited October 27, 2008), Institute for Research in Construction, National Research Council Canada, Ottawa, Canada.

Recommended Code Change **Sentence 3.1.4.1.(5)**	**Building Exterior Cladding**
3.1.4.1. Combustible Materials Permitted **5)** A wall assembly permitted by Sentence (4) that includes *combustible* cladding of *fire-retardant-treated wood* shall be tested for fire exposure after the cladding has been subjected to an accelerated weather test as specified in ASTM D 2898 "Accelerated weathering of Fire-Retardant-Treated Wood for Fire Testing."
Functional Statement
None
Objective
None
Intent
To clarify that the wall assembly must be subjected to weathering tests before the fire tests to limit the probability that the weathering of the material will negatively affect its ability to minimize fire growth and spread.
Rationale
Sentence (5) is recommended for reasons of consistent application of the Code in Sentence 3.1.5.5.(4).

Recommended Code Change Sentence 3.1.4.1.(6)	**Building Exterior Cladding**

3.1.4.1. Combustible Materials Permitted

6) *Combustible* nailing elements supporting exterior cladding permitted in Sentence (3) and Clause (4)(a) are permitted, provided the horizontal air space created by the nailing elements does not exceed 25 mm.

Functional Statement

None

Objective

None

Intent

To exempt Application of Sentence 3.1.4.1.(3), which would otherwise require noncombustible exterior cladding, on the basis that the air space of 25 mm would be acceptable in limiting the probability of fire spread along the exterior wall.

Rationale

Sentence (6) is recommended to permit practical use of wood nailing elements (wood strapping), provided that the cavity (typically the rain screen) formed by the wood nailing elements is less than 25 mm in thickness. The 25 mm thickness is intended to be consistent with Clause 3.1.11.2.(2)(d).

Recommended Code Change Sentence 3.4.1.6.(1)	**Use of Horizontal Exits**

3.4.1.6 Restricted Use of Horizontal Exits

1) Except as permitted by Sentences (2) and (3), *horizontal exits* shall not comprise more than one half of the required number of *exits* from any *floor area*.

Functional Statement

F10

Objective

OS3.7

Intent

To limit the probability that persons will not have a choice of sufficient alternative exterior exit routes in the event that routes to horizontal exits are blocked or obstructed in an emergency situation, which could lead to delays in the evacuation or movement of persons to a safe place, which could lead to harm to persons.

Rationale

Modification to Sentence 3.4.1.6.(1) is recommended to also include exception for the proposed Sentence (3), which is specifically written for 5 and 6 storey wood-frame buildings.

Recommended Code Change **Use of Horizontal Exits**
Sentence 3.4.1.6.(3)

3.4.1.6 Restricted Use of Horizontal Exits

3) In a 5 or 6 storey building of residential occupancy permitted by Sentence 3.2.2.45.(1), *horizontal exits* can comprise all of the required number of *exits* from a *floor area* provided

a) doors of the *horizontal exits* are designed in conformance with Sentences 3.1.8.12.(2), (3) and (4), and

b) the *horizontal exits* lead to a *floor area* that does not have *horizontal exits* comprising more than one half of the required number of *exits* in that *floor area*.

Functional Statement

F10, F05

Objective

OS3.7

Intent

To supersede the requirements of Sentence 3.4.1.6.(1) and permit an increase in the ratio of horizontal exits to all exits to 100% for 5 and 6 storey combustible buildings on the basis that:

- 5 and 6 storey combustible buildings will be limited in building area such that the travel distance will be limited,
- such buildings are fully sprinklered, and
- the horizontal exits will lead to another building where there will be exit stairs within reasonable travel distance.

Rationale

Horizontal exits are currently restricted in Sentence 3.4.1.6.(1) to comprise up to one half (50%) of the required exits from a floor area. The intent is that the other 50% of the required exits would be a type of exit, typically an exit stair, that leads occupants to an exterior open space or public thoroughfare. Although not a specific Code objective released by NRC, it is also generally agreed by the fire engineering community that exits are also used for Fire Department access to floor areas. Therefore, having mandatory limitation on horizontal exits implicitly demands a certain number of exit stairs per building, which limits the travel distance for fire department access to a floor area.

In view of the smaller building area to be permitted for 5 and 6 storey wood-frame buildings, Sentence (3) is recommended to permit the required exits to be comprised entirely of horizontal exits, provided that the horizontal exits lead to a floor area where horizontal exits do not comprise more than one half of the required number of exits in that area. By placing the limitation in Clause (b), occupants may be in a building where there are no exit stairs; however, they would have access to exit stairs within the

floor areas immediately across the firewall. This is schematically illustrated in Figure 1. As shown, the separation distance between exit stairs will remain unchanged provided all buildings across the firewall are of the same building area. In our opinion, given the decrease in occupant load per floor and travel distance as a result of smaller building area, the reliance on horizontal exits in a building which is attached to buildings with exit stairs would not subject occupants to an undue level of risk beyond that accepted by the current Code.

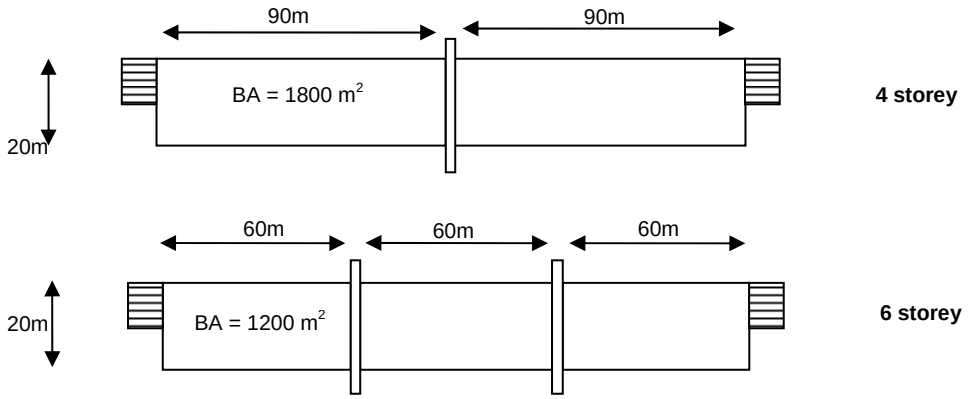

Figure 1. Schematic illustration of a typical 4 and 6 storey building layout.

Recommended Code Change Sentence 3.1.8.12.(1)	**Use of Hold Open Devices**

3.1.8.12 Hold-Open Devices

1) A hold-open device is permitted on a door in a required *fire separation*, other than an *exit stair* door in a *building* more than 3 *storeys* in *building height*, and on a door for a vestibule required by Article 3.3.5.7., provided the device is designed to release the door in conformance with Sentences (2), (3) and (4).

Functional Statement

F03

Objective

OS1.2

Intent

To exempt certain doors from the application of Sentence 3.1.8.11.(1), which would otherwise require the door to be closed after each use, if certain conditions are met to automatically close the door under fire conditions. This is to limit the probability that fire will spread from one fire compartment to another fire compartment, which could lead to harm to persons in the other fire compartment.

To state the application of Sentences 3.1.8.12.(2), (3) and (4).

Rationale

This Code change is taken from NRC's proposed Code change for the 2010 NBC (NRC Reference: NBC05-03.01.08.12.(01)-FP,UE-V3_ed.doc). Use of hold-open devices in exits have traditionally been limited to 3 storey buildings based on the assumption that stack effects would render the devices ineffective when releasing the door in a fire emergency. However, this requirement is intended to address exit stairs, where the stair shaft is a high vertical compartment, which is more susceptible to staff effects. On the other hand, firewall closures are not likely to be subjected to stack effects as it not typically installed in a high vertical space setting. The 2010 Code change proposal clarifies this understanding by adding the term 'stair' to the existing Sentence.

It considered that in 5 and 6 storey wood-frame buildings, due to the limitation in building area, firewalls will likely be used. It has been observed, and as also supported by the NRC Code change proposal, that firewall closures (horizontal exit doors) are frequently wedge or prop open for convenience purposes, compromising the integrity of the exits. In view of this, it is proposed to permit hold-open devices as proposed by NRC at this time such that unwanted alternation or obstruction that affect the proper functioning of horizontal exits can be addressed.

This recommended Code change is not specifically limited to 5 and 6 storey wood-frame buildings as NRC is proposing the Code change for all buildings.

Recommended Code Change Sentence 3.2.5.13.(9)	**Automatic Sprinkler Systems in Balconies**

3.2.5.13 Automatic Sprinkler Systems

9) Notwithstanding Sentence (1), for a 5 or 6 storey *building* permitted in Sentence 3.2.2.45.(1), automatic sprinkler protection shall be provided for all unenclosed exterior balconies where the depth of the balcony is more than 600 mm.

Functional Statement

None

Objective

None

Intent

To provide fire protection to balconies where substantial quantities of combustibles may be stored, so that fire spread from one storey to another is inhibited.

Rationale

As identified in the Stage 1 Report, in a 5 or 6 storey wood-frame building, there would be an increase in risk of exterior fire spread. The risk of ignition will not likely increase; however, the consequential loss would be greater should exterior fire spread occur. In order to address this risk, Sentence (9) is recommended to require mandatory sprinklering of balconies that are more than 600 mm in depth. The selection of the 600 mm depth is based on the current provision contained in Division B, Sentence 3.2.5.13.(9) of the City of Vancouver Building Bylaw 2007, which is used as the criteria in determining when substantial quantities of combustibles may be stored in balconies. The rationale to Sentence 3.2.5.13.(9) of the Vancouver Building Bylaw 2007 can be found on the City of Vancouver web site at http://vancouver.ca/ctyclerk/cclerk/020801/csb2.htm (last visited October 27, 2008).

Recommended Code Change **Sentence 3.1.11.5.(3)**	**Fire Stopping of Concealed Spaces**

3.1.11.5. Fire Stopping of <~~Horizontal~~ Concealed Spaces>

3) Any vertical concealed space in or attached to a 5 or 6 *storeys* building permitted in Sentence 3.2.2.45.(1) shall be separated by construction conforming to Article 3.1.11.7. into compartments such that the maximum vertical dimension is not more than 3 m and the maximum horizontal dimension is not more than

a) 20m if the exposed construction materials within the space have a *flame-spread rating* not more than 25, or

b) 10m if the exposed construction materials within the space have a *flame-spread rating* more than 25.

Functional Statement

F03, F04

Objective

OS1.2, OP1.2

Intent

To limit the probability that certain vertical concealed spaces will not be separated from certain other parts of the building, which could lead to the spread of fire within these spaces, which could lead to harm to persons.

To limit the probability that fire stopping material used to block and separate certains paces will not remain in place for a certain minimum time when subjected to fire conditions, which could lead to the spread of fire within these spaces, which could lead to harm to persons.

To state the application of Article 3.1.11.7.

Rationale

Unprotected concealed spaces are known to cause rapid fire spread. Tall wood buildings with unprotected vertical concealed spaces are particularly vulnerable as they would contribute to rapid spread of fire between storeys. The Code already consists of provisions to Subsection 3.1.11 to address concealed spaces and the need for fire stopping and fire blocking. However, review of the Code indicates that it does not explicitly address vertical concealed spaces. In view of the increased vulnerability of 5 and 6 storey wood-frame buildings with unprotected vertical concealed spaces, Sentence (3) is recommended to require fire blocking of concealed spaces into compartments. The selection of the compartment dimension is based on a fixed height of 3 m and a choice of width of 20 m or 10 m depending on the exposed surface in the concealed space. This would respectively result in volumes of 600 m^2 and 300 m^2 which are the currently established volumes in Sentence (1).

The foregoing rationale applies to all combustible buildings and it may be appropriate to extend the recommended Code change of Sentence (3) to all combustible buildings, and not just 5 and 6 storey wood-frame buildings.

Recommended Code Change Sentence 3.4.4.1.(4)	**Fire-Resistance Rating of Exit Separations**

3.4.4.1. Fire-Resistance Rating of Exit Separations

4) Where an *exit fire separation* is a gypsum wallboard based assembly in a 5 or 6 *storey building* permitted in Sentence 3.2.2.45.(1), the assembly shall consists of a minimum of 2 layers of gypsum wallboard on each side.

(See Appendix A.)

Functional Statement

F03, F05, F06

Objective

OS1.2, OS1.5, OP1.2

Intent

To limit the probability that fire will spread into an exit, which could lead to delays or ineffectiveness in fire emergency response operations, which could lead to the further spread of frie, which could lead to damage to the building.

To limit the probability that fire will spread from one floor area to another floor area by means of an exit, which could lead to damage to the building.

Rationale

Based on the comments received during the Technical Advisory Group meetings held by BSPB, there is a general concern with the reliability of an exit fire separation. It is viewed that the integrity of exits becomes significantly more important in 5 and 6 storey wood-frame buildings as they are the sole means of egress and access. In order to increase the reliability of exit fire separations, where the fire-rating of the fire separation is based on use of gypsum wallboard, it is recommended to require mandatory use of 2 layers of gypsum wallboard on each side of the separation.

Recommended Code Change Appendix A A-3.4.4.1.(4)	**Fire-Resistance Rating of Exit Separations**
A-3.4.4.1.(4) Reliability of Membrane-Based Exit Fire Separations See A-3.2.2.45.(5).	
Functional Statement	
Not applicable	
Objective	
Not applicable	
Intent	
Not applicable	
Rationale	
It is recommended that the Appendix A note above be included to reference the recommended A-3.2.2.45.(5) notes on reliability of membrane-based fire separations.	

Recommended Code Change Appendix D D-2.3.3.	**Component Additive Method**

D-2.3.3. Limitations of Component Additive Method

3) Except as permitted in D-2.3.3.(4), ~~W~~wallboard membranes are permitted to be installed in multiple layers only as listed in Table D-2.3.4.A (double 12.7 mm Type X gypsum wallboard).

4) Wallboard membranes are permitted to be installed in multiple layers where appropriate fire test data is available to demonstrate the acceptability of the installation methods. Such fire tests include but not limited to the fire tests published by NRC, entitled "Results of Fire Resistance Tests on Full-Scale Floor Assemblies – Phase II".

Functional Statement

Not applicable

Objective

Not applicable

Intent

Not applicable

Rationale

The current component additive method provided in Division B, Appendix D limits its use to assemblies with one layer of gypsum wallboard, except as noted in Sentence (3). It is recommended to amend D-2.3.3. to include Sentence (4) such that design professionals and AHJs are explicitly informed that appropriate fire tests can be used to substantiate designs with two layers of gypsum wallboard based on Appendix D.

It is noted here that Appendix A is a list of standard assemblies for Part 9 whereas Appendix D is a part of the Code that provides further information for engineers to design building fire separations.

Recommended Code Change Appendix D D-6.1.	**Referenced Fire Test Reports**

D-6.1. Fire Test Reports

(20) Sultan, M.A., Seguin, Y.P. and Leroux, P., Results of Fire Resistance Tests on Full-Scale Floor Assemblies, Internal Report IRC-IR-764, Institute for Research in Construction, National Research Council Canada, Ottawa, May 1998.

(21) Sultan, M.A., Latour, J.C., Leroux, P., Monette, R.C., Seguin, Y.P. and Henrie, J.P., Results of Fire Resistance Tests on Full-Scale Floor Assemblies – Phase II, Research Report IRC-RR-184, Institute for Research in Consturction, National Research Council Canada, Ottawa, March 2005.

(22) Sultan, M.A. and Lougheed, G.D., Results of Fire Resistance Tests on Full-Scale Gypsum Board Wall Assemblies, Internal Report IRC-IR-833, Institute for Research in Consturction, National Research Council Canada, Ottawa, August 2002.

Functional Statement

Not applicable

Objective

Not applicable

Intent

Not applicable

Rationale

The Code changes are recommended in D-6.1. to add to the list of references the IRC-NRC fire tests aimed at determining the fire-resistance of wall and floor assemblies.

2.2 Structural (Part 4)

The following are the recommended Code changes for structural aspects of the Building Code.

Recommended Code Change **Division A, Sentence 1.4.1.2.(1)**	**Defined Terms**
1.4.1.2. Defined Terms **1)** The words and terms in italics in this Code have the following meanings: *Designated structuraleEngineer (Struct. Eng.)* means a person who is registered or licensed to practice as a professional engineer under the Engineers and Geoscientist Act, and a person who is designated by the Association of Professional Engineers and Geoscientists of British Columbia as a Designated Structural Engineer *Five and six storey wood-frame structures* means buildings whose primary structural framing consists of wood for either the lateral or gravity resisting system and are designed in accordance with Division B Part 3 for combustible construction and Part 4 for structural design.	
Rationale	
The term Designated Structural Engineer (Struct. Eng.) needs to be defined as well as five and six storey wood-frame structures. These two terms will be used throughout in other sections of the Code.	

Recommended Code Change **Professional Design and Review**
Division B, Sentence 4.1.8.10.(3)

4.1.8.10 Additional System Restrictions

3) Except as required in Sentence (4), *building*s having fundaments lateral periods T_a of 1.0 s or greater and where $I_eF_vS_a(1.0)$ is greater than 0.25, walls forming part of the SFRS shall be continuous from their top to the foundation and shall not have irregularities of Type 4 or 5 as descried in Table 4.1.8.6.

4) For *five and six storey wood-frame structures* of any period and where IeFvSa(1.0) is greater than 0.25, walls forming part of the SFRS shall be continuous from their top to the foundation and shall not have irregularities of Type 4 or 5 as described in Table 4.1.8.6.

Rationale

At the current time, much work is required in reviewing appropriate seismic design requirements for five and six storey wood-frame buildings. Until this research can adequately address the effects of irregularity types 4 or 5, it will be conservative to require that shear walls are continuous from their roof to their base. This will discourage the practice of providing large open spaces on main or second floors for open spaces such as amenities. These areas will require that wood-frame shear walls not include in plane discontinuities or out of plane offsets. This may perhaps be relaxed at a later time pending the results of future research.

Recommended Code Change Division B, Article 4.4.3	**Design Basis for 5 and 6 Storey Wood-Frame Structures**

4.4.3 Five and Six Storey Wood-Frame Structures

4.4.3.1. Design Basis for Five and Six storey Wood-Frame Structures

1) The structural design for *five and six storey wood-frame structures* shall conform to CAN/CSA-O86.1-M "Engineering Design in Wood" and to "*APEGBC Guidelines for Professional Engineering Services on Five and Six Storey Wood-Frame Structures*" using the loads stipulated in Section 4.1., in accordance with limit states design in Subsection 4.1.3.

Rationale

For the first introduction of five and six storey residential structures into the building code, it is recommended that they be highlighted as a special structure. In addition to requiring the design conform to the Canadian Wood Code it is also recommended that the *APEGBC Guideline for Professional Engineering Services on Five and Six Tory Wood Frame Structures* be referenced. Currently, it is generally agreed upon by SEABC committee members reviewing considerations for higher wood frame buildings that special provisions are provided for in the design and construction of five and six storey wood-frame buildings. In practice, there are many process risks associated with the design and construction of such structures. The intent of the guide would be to ensure that these process risks would be appropriately dealt with, and guidance provided to assist engineers in design and construction requirements. Topics such as shrinkage, workmanship, load paths, and minimum drawing requirements would need to be addressed. As well, provisions for designing for lateral loads due to seismic and wind would need to be addressed. In addition, capacity design principals only now introduced into CSA086.1 2009 will need to be reviewed in lieu of taller building and likely modified to suit 5 and 6 story wood frames as well as be provided as part of the guide. It is generally agreed that the current practice for up to 4 stories will not be adequate for Five and Six stories. So it is important that such a guide be prepared in order to ensure the industry is appropriately prepared.

Although it is our opinion that the guide be in place prior to a code change and referenced from the code, the legal requirements of referencing and APEGBC guide within the code would and the timing of the Guidelines needs to be reviewed by the province and APEGBC.

A less desirable option at the discretion of the Province would be to have clause 4.4.3.1.1 reference the appendix A where the guide could be referenced. If the guide is not ready at that time, the commentary could be expanded to outline the process and technical risks and suggest that designers partaking in this work are responsible to ensure that the objective and functional statements outlined in Division B are met.

Recommended Code Change **Administrative Provisions**
Division C, Article 2.2.1.2

2.2.1.2. Structural Design

1) Except as required in Sentence (2) and (3), for design carried out in accordance with Part 4 of Division B, the *designer* shall be a *registered professional* skilled in the work concerned.

(See Appendix A.)

2) For the design of Part 3 – *five and six storey wood-frame structures* carried out in accordance with Part 4 of Division B, the designer shall be a registered professional who is designated by the Association of Professional Engineers and Geoscientists of British Columbia as a *designated structural engineer (Struct. Eng.)* and who

a) is retained to undertake the overall responsibility for the design work and field reviews of the primary structural components of a *five and six storey wood-frame structures* that falls within the scope of Article 1.3.3.2. of Division A,

b) shall apply his or her professional (P.Eng.) seal or stamp together with his or her *Struct. Eng* stamp, with signature and date to the plans and supporting documents prepared by, or under the supervision of the *designated structural engineer* in support of the building permit application, and

c) shall apply his or her professional (P.Eng.) seal or stamp together with his or her *Struct. Eng*. Stamp with signature and date to the Letters of Assurance descried in Division C, Subsection 2.2.7

3) For the concept review as defined by the Association of Professional Engineers and Geoscientists of British Columbia, the qualifications are to also require that the concept reviewer shall be a *registered professional* who is designated by the Association of Professional Engineers and Geoscientists of British Columbia as a *designated structural engineer (Struct. Eng.)*

Rationale

It is recommended that for this code cycle of five and six storey wood-frame structures that the Struct Eng designation be required. It is our opinion that load paths and proper detailing are essential to ensure that the gravity and lateral loads are adequately addressed. The current Struct Eng. Designation is generally considered a higher designation than P.Eng due to the additional qualifications required beyond what is required for the P. Eng designation. It is recommended that this higher designation be required at this time.

Wood frames structures have inherent strengths due to the nature of their form. However, this inherent strength reduces as these structures carry higher gravity and wind loads due to their increased height. A thorough understanding of load paths, appropriate design practices, and adequate detailing will be paramount. So until which time either the BCBC requires the Struct. Eng. Designation for all buildings, or it is otherwise felt that the industry is well versed in the challenges of the taller structures, requiring the higher designation of Struct. Eng. is recommended.

It is also recommended that the concept reviewer be a Designated Structural Engineer (Struct. Eng.) and that the **Province adopt a concept review schedule similar to that of Vancouver that has to be signed and sealed by the concept reviewer and submitted as part of the building permit package. This would affect all buildings and not be limited to just five and six storey wood-frame buildings.**

Recommended Code Change **Administrative Provisions**
Division C, Clause 2.2.4.3.(1).(f)

2.2.4.3. Information Required on Structural Drawings

3) Structural drawings and related documents submitted with the application to build shall indicate, in addition to those items specified in Article 2.2.4.6. and in Part 4 of Division B applicable to the specific material,

a) the name and address of the person responsible for the structural design,

b) the date of issue of the Code and standards to which the design conforms,

c) the dimensions, location and size of all structural members in sufficient detail to enable the design to be checked,

d) sufficient detail to enable the *dead loads* to be determined, and

e) all effects and loads, other than *dead loads*, used for the design of the structural members and exterior cladding.

f) total anticipated building shrinkage per floor and lateral wind and seismic drift per floor for *five and six storey wood-frame structures.*

Rationale

It is our recommendation that the practice for five and six storey wood-frame structures must require that the building movements due to shrinkage, as well as drift due to wind and seismic loads be clearly documented on the building plans. This will ensure that others involved are aware of the movements that must be accommodated for in the design and construction for five and six storey wood-frame structures. It is not the intent that these movements are not required to be provided for other structures, but we are specifically requesting that they be provided on the drawings for five and six storey wood-frame structures. We have been retained to only address 5 and 6 story wood frame structures but this requirement along with all other anticipated building movements should be applied to all buildings.

Recommended Code Change **Third Party Field Review**
Clause 2.2.7.2.(1)(c)

2.2.7.2. Owner Responsibilities

1) Before an owner obtains a building permit from an *authority having jurisdiction*, the owner shall

a) retain a coordinating registered professional to coordinate all design work and field reviews of the registered professionals required for the project in order to ascertain that (See Appendix A.)

i) the design will substantially comply with the British Columbia Building Code and other applicable enactments respecting safety, and

ii) the construction of the project will substantially comply with the British Columbia Building Code and other applicable enactments respecting safety, not including the construction safety aspects, and

b) deliver to the *authority having jurisdiction* letters, in the forms set out in Schedules A, B-1 and B-2 (See the end of Division C) (See Appendix A)

c) retain an independent third party professional engineer to field review a representative sampling of vertical and lateral resisting elements and systems for *five and six stoery wood-frame structures* to ensure that the construction generally conforms to the signed and sealed construction documents for the representative area reviewed. This review is to cover representative details for 10% of the total primary structure. The *registered professional* engineer is to provide a signed and sealed letter to the *coordinating registered professional* stating that the work reviewed generally conforms to supporting documents. The extent of the work reviewed is to be indicated. Where deficiencies in construction are noted, a letter is to be provided within 1 day of the review to the *engineer of record* and *registered coordinating professional* indicating the nature of the deficiencies.

Rationale

It is recommended at least for the first code cycle of this change that a 3rd party independent review be provided for five and six storey wood-frame structures to independently ascertain that the representative areas reviewed generally conform with the construction documents. It may be possible to eliminate this clause once it is generally agreed that the level of field reviews being provided is adequate.

2.3 Building Envelope (Part 5)

As presented in the Stage 1 Report, there is no recommended Code change for Part 5 to permit 5 and 6 storey wood-frame buildings of residential occupancy, as Part 5 is a performance-based Code.

CONCLUSION

This Stage 2 Report provides the recommended Code changes to the current 2006 BCBC with respect to fire safety and structural design requirements. No building envelope Code changes are recommended as Division B, Part 5 is a performance-based Code. The Code change recommendations are developed with the objective to permit the design and construction of 5 and 6 storey wood-frame buildings and address the associated technical and process risks, which are identified in the Stage 1 Report. Code change recommendations provided for fire are confined to Division B, Part 3, whereas for structural changes are recommended to Division A for defined terms, Division B Part 4 and Division C for administrative requirements. The Code change recommendations provided in this report shall not be construed as being exhaustive. We understand the recommendations will be made available to the BC public as part of the public consultation process.