City of Burnaby

Item 02
Meeting ..... 2009 March 23

COUNCIL REPORT

TO: CITY MANAGER **DATE:** 2009 MARCH 18

FROM: DIRECTOR PLANNING & BUILDING
FIRE CHIEF

SUBJECT: **SIX STOREY WOOD-FRAME RESIDENTIAL BUILDINGS**

PURPOSE: To provide Council with information and recommendations on the B.C. Building Code changes allowing the construction of six storey wood-frame residential buildings.

RECOMMENDATIONS:

1. **THAT** rezonings for the development of five or six storey wood-frame buildings only proceed after the concerns outlined in this report have been satisfactorily addressed.

2. **THAT** Council authorize an amendment to the Building Bylaw to include Building Specialists in the definition of Registered Professionals enabling the Chief Building Inspector to require Building Specialists for the design and field review of the construction of complex buildings.

3. **THAT** a copy of this report be sent to Honourable Rich Coleman, Minister of Housing and Social Development, requesting that the issues outlined in this report be addressed for inclusion in the B.C. Building Code.

REPORT

1.0 BACKGROUND

At the regular Council meeting of 2009 February 02, Council directed staff to provide a report on the B.C. Building Code (Code) changes allowing the construction of six storey wood-frame residential buildings. The purpose of this report is to outline the Code changes, issues arising from those changes and the impact of those changes in Burnaby.

On 2008 February 16, the Thorne Speech indicated that "we will lead the way in safe, six storey wood-frame construction that lowers building and housing costs." Premier Gordon Campbell also indicated that he wanted to support the province's forest industry by allowing higher wood-frame buildings.

In 2008 May, Housing Minister Rich Coleman announced the Province's intention to increase the maximum height for wood-frame residential buildings from four to six storeys by amending the Code.

In 2008 June, the Building and Safety Policy Branch, a branch of the Office of Housing and Construction Standards responsible for the development of the Code, started working on the Code changes. In 2008 August, the Branch hired consultants to conduct research, identify the issues to be addressed and propose Code changes to allow the construction of six storey wood-frame residential buildings.

Between 2008 July and November, staff in the Building and Safety Policy Branch worked with stakeholders to develop proposed changes to the Code. Public consultation on the proposed Code changes was conducted from 2008 November 15 to December 15.

In general, the stakeholders felt that their input was hampered by time constraints and limited background information and research. Some of the important issues outlined in this report have not been addressed and recommendations were not incorporated in the Code changes.

2.0 NEW BUILDING CODE PROVISIONS

The following new Code provisions, for residential buildings only, were enacted by Ministerial Order on 2009 January 08 and will take effect on 2009 April 06:

2.1 Building Height

The current Code permits wood-frame residential buildings up to four storeys in height. The Code changes increase the allowable height of these buildings to six storeys with a maximum dimensional height of 18 meters to the uppermost storey. The height limit of 18 meters is also the current limit for a building that would not be considered as a high-rise building.

However, in higher seismic zones, such as the Lower Mainland, the current structural requirements of the Code for wood-frame construction limit the building height between to 15 m and 20 m depending on the types of wood shear walls used to resist seismic forces. This requirement may further restrict the dimensional height and the number of storeys that can be built.

2.2 Building Area

The Code addresses the inherent difference between combustible and non-combustible construction by limiting combustible building area to 20% of that permitted for a non-combustible building of similar height. This factor is maintained with the Code changes. The building area defines the total permissible area for each floor.

The Code currently employs a formula in apportioning building area relative to the building height, such that the resulting gross floor area of all the floors is limited to a maximum of 7200 sq.m.

The current maximum area for each floor of a four storey wood-frame building is 1800 sq.m. The new maximum floor area is 1440 sq.m. for a five storey building and 1200 sq.m. for a six storey building.

By retaining the same gross floor area, the intent of the Code change is to maintain the same volume of combustible construction.

2.3 Exterior Cladding

Combustible cladding is currently permitted on a four storey residential building. The Code change limits the cladding for five storey and six storey wood-frame residential buildings to three types:

- non-combustible material,
- combustible material with certain fire-resistance, or
- fire-retardant treated wood.

The intent of the Code change is to address the risk of fire spreading up the building face.

2.4 Sprinkler System

Currently a four storey wood-frame residential building is required to have a sprinkler system conforming to NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height," The Code change requires five storey and six storey buildings to have a sprinkler system conforming to a higher standard, NFPA 13. Additional sprinkler protection will apply to balconies, closets, attic and crawl spaces.

2.5 Seismic Design

Shear walls provide resistance to lateral earthquake loads. The Code change requires the shear walls of all floors to line up over the entire height of the building. Offset or discontinuity of the shear walls weakens the structural capacity of the building structure to resist lateral earthquake loads.

3.0 ISSUES

Although the stakeholders and the public generally support the principle of allowing the construction of six storey wood-frame buildings and the Code changes do address some of the concerns raised, a number of significant technical and process issues remain. They are discussed as follows:

3.1 Technical Issues

This Section identifies technical issues and concerns that have not been addressed by the Code changes for various reasons. Municipalities have limited power under the Concurrent Authority within the Community Charter to establish bylaws that alter the technical standards or the application of the Code without the approval of the Minister.

The Charter limits municipalities to process oriented issues in relation to the Codes administration.

3.1.1. Lack of Research on Seismic Design

Code changes of this magnitude that require extensive research, testing, consultation and the development of education and training documents would normally take several years to complete. These Code changes were completed in six months. The Building and Safety Policy Branch started to work on the Code changes in 2008 June and hired two consultants in 2008 August to review primarily structural performance and fire risks inherent in six storey wood-frame buildings. The proposed changes were available for public consultation between 2008 November 15 and December 15 and were approved by the Minister in 2009 January.

The Association of Professional Engineers and Geoscientists of BC (APEGBC) and the Architectural Institute of BC (AIBC) identified a number of concerns related to issues such as fire safety, structural adequacy and material shrinkage, and stated that there was insufficient time to develop guidelines for their members prior to the implementation of the Code changes. APEGBC has submitted a proposal for funding from the Province to produce the necessary guidelines, however, the initial request was not approved. Recently the Province agreed to fund a shortened version to approximately 1/4 of the original proposal.

The Province also provided funding to Forintek, a research group, to test a six storey wood-frame building on an earthquake shaker table in Japan this summer. Forintek is also conducting some research on the structural design of six storey wood-frame buildings, both in their laboratory at the University of British Columbia and at the Colorado State University. The results are not expected to be available prior to the effective date of the Code changes in April.

Code requirements pertaining to buildings and construction materials provisions have evolved based on research and historical experience of the performance of wood-frame buildings up to four storeys. It is the view of staff that more research and consultation should be required prior to adopting the Code changes which allow an increase in the building height of wood-frame buildings to six storeys.

3.1.2. Fire Risks

Recommendations of the consultants addressing fire risks and concerns expressed by interest groups such as the Building Officials, Fire Chiefs, Professional Engineers and Architects, were not incorporated in the Code changes. Such recommendations are listed as follows:

- Increase the reliability of the fire separations between floors by using two layers of fire-rated drywalls instead of one layer;
- Limit the risk of fire spread up the exterior of the building by only allowing non-combustible cladding (and not permitting combustible materials);
- Limit the risk of fire spread up the interior of the building by providing fire blocking of vertical concealed spaces;

- Provide better exit routes by requiring non-combustible exit shafts; and
- Aide firefighting by providing high-rise measures, such as a firefighters' elevator, a voice communication system, a smoke control system and an emergency generator

The Code changes failed to address a concern pertaining to residential buildings for seniors and for assisted living. The occupants in those buildings would have difficulty negotiating six storeys of stairs in the event of an emergency.

Fire spread in wooden structures, regardless of sprinklers, is considerably more rapid than in those built of non-combustible materials (i.e. concrete). In many cases, multi-storey wooden structures have experienced catastrophic fire loss between the firewalls, along with considerable damage to the rest of the building as a direct result of the rate of fire spread. There can be a dozen or more units between the firewalls and fire intensity contributing to radiant, conductive and convective heat transmission can seriously affect their ability to stop the horizontal spread of the fire.

In a concrete building, the fire is usually contained to the area of origin and rarely spreads to other floors or units. The areas or units in concrete structures act as compartments and greatly reduce the spread of fire. If the fire is not in or affecting the safety of their unit, the occupants can stay where they are and wait for rescue if they are unable to access a fire escape route.

In a wooden structure, this is not an option. The occupants must escape the building. The potential rate of fire spread in a wood-frame building greatly reduces the time someone has to find their way out of the building. Escaping from a sixth floor is going to take longer than it does to escape from a fourth floor. This applies to firefighter escape as well.

The Code changes did not address these fire issues and may put the firefighters and the occupants of six storey wood-frame buildings at an increased risk.

3.1.3. Fire Fighting

Six storey structures require the use of high-rise firefighting tactics which are much different from those used for low-rise structures (1 - 4 storeys). The current three and four storey wooden structures create demanding challenges when fighting fires from an external upper floor access perspective. The transition from low-rise to high-rise firefighting tactics takes place for anything greater than three storeys above ground level. Firefighters are able to access third floor balconies with ground ladders but require truck aerial ladders to reach higher storeys. It is both the number of storeys and the building height from any side that determine the specific firefighting tactics used. Fires in these structures are fought using internal as well as external tactics and each complements the other. Access for aerial devices is usually an issue in apartment complexes and which floor the firefighters can get to is dependent on how close they can get to the building. As a result, internal firefighting tactics may be the only option for fires in the upper floors, a much more dangerous situation in a wooden structure than one constructed of non-combustible materials.

Fires in concrete buildings are usually compartmentalized, in other words they are contained to a cubicle like area. In concrete buildings, firefighters can attack the fire from outside the fuel load area that is burning, even if it is an inside hallway or stairwell. When fighting fire from the inside of a wooden building, they usually find themselves operating in the middle of the fuel load.

A critical component of any firefighting strategy includes searching the building for occupants requiring rescue. A six storey wooden building would take about twice the time to search as compared to a three storey building with the same available resources. With the potential of a more rapid fire spread, time becomes much more critical. A wood-frame building would require a complete initial search, while in comparison, a high-rise building constructed of non-combustible materials only requires an initial search of the immediate floor or two above the fire floor and occupants can remain in their unit if it is unsafe to exit the building.

It is common for fires in low-rise (up to 4 storeys) wood-frame apartment buildings to require more firefighting resources for a longer period of time to extinguish than for those in multi-storey structures constructed of non-combustible materials enclosing each unit. It is the potential for the rapid spread of the fire to the entire structure as well as the surrounding exposures that determines the resources assigned to the incident. Fires in wooden multi-unit apartment structures usually require responses that tax the fire fighting resources to the limit and often require the callback of off-duty personnel to support the operation and provide coverage for the remainder of the city.

3.1.4. Building Envelope

There is no additional provision in the Code changes to address the design and performance of the building envelopes of six storey wood-frame buildings. The consultants hired by the Province have cited the reason that Part 5 of the current Code, Environmental Separation, is objective-based and adequately deals with the building envelopes for buildings of different heights. It is therefore incumbent on the designer to consider the increased risks, and design accordingly.

The design and construction of building envelopes are very complex. Factors affecting the performance of the envelope of a building include knowledge and experience of the designer, detailing of the interfaces between different materials, workmanship, field reviews by the professionals and maintenance by the owners. The level of competency and knowledge of the industry and the design professionals and the standard of drawings and documents vary substantially within the industry.

Given the above factors, together with the amount of rainfall in the Lower Mainland, the addition of two extra wood-frame storeys could increase the risk of building envelope failure.

3.1.5. Material Shrinkage

There is no specific provision in the Code changes to deal with the shrinkage of wood products used in the construction of six storey wood-frame buildings.

The only reference to shrinkage is made in the Appendix of the Code that warns the designers that building movement, due to shrinkage, should be considered in the designs of cladding systems, mechanical and plumbing systems, hold-down devices for structural walls and connections to non-shrinking elements, including firewalls and elevator shafts.

3.2 Process Issues

Administrative matters may be dealt with autonomously at the local government level. Building Bylaw that establishes procedures for the administration and enforcement of the Code, such as plan review and building inspection, is not subject to concurrent authority and does not require the Minister's approval. Some of these process issues identified below may be addressed at the local government level.

3.2.1 Qualification of Professionals

Since the current Code is objective-based, it heavily relies on the design professionals to use their knowledge and experience to ensure that their design meets the objectives of the Code. One of the major concerns identified by various interest groups and the consultants hired by the Province was the need for qualified design professionals to address the technical issues identified above (fire safety, structural, building envelope and material shrinkage).

Currently, the Code requires registered architects and professional engineers to design and provide construction field reviews of six storey wood-frame residential buildings. However, the Code does not require specific training, knowledge or experience for the professionals. The certification and regulation of the practice of architects and engineers are left to AIBC and APEGBC under the authority of their respective Acts.

The Ministry of Housing and Social Development introduced Bill 10, The Housing Statues Amendment Act, on 2008 April, providing the two professional associations with authority to create categories of Building Specialists and set qualifications. It also enables the local governments to require Building Specialists, created by the two associations, to certify plans submitted for Building Permits. This provides local government with confidence that new and complex technologies are safely and effectively implemented.

APECBC has already created a category of Building Specialist called "Designated Structural Engineers" (DSE) for structural design of more complex buildings, such as those classified as Part 3 buildings by the Code. The City of Vancouver has already amended their Building Bylaw requiring DSE for all Part 3 buildings since 2007.

AIBC and APECBC are jointly working to create two more categories of Building Specialists, "Building Envelope Professionals" (BEP) for the design and field review of building envelopes and "Certified Professionals" (CP) to coordinate the permit and inspection processes. The program for BEP may be completed this year while the one for CP may take two years to finish.

The current Burnaby Building Bylaw requires that the design and field review of building envelope of a residential building, other than single and two family dwellings, shall be carried out by a Building Envelope Professional that meets the qualifications as prescribed in the Building Bylaw.

The Burnaby Building Bylaw also provides the authority to the Chief Building Inspector to require the owner to obtain the design and field review services of a "Registered Professional", an architect or a professional engineer, in respect of a permit for a building that, in the opinion of the Chief Building Inspector, the site conditions, size or complexity of a building or an aspect of a building so warrants.

In order to take advantage of the authority provided by Bill 10, it is recommended that Council authorize the amendment of the Burnaby Building Bylaw to include Building Specialists, as defined in Section 55(1) of the Community Charter, in the definition of Registered Professionals.

This amendment will enable the Chief Building Inspector to require certification of Building Specialists, such as Designated Structural Engineers, Building Envelope Professionals and Certified Professionals, for complex buildings such as all Part 3 which includes the six storey wood-frame buildings.

The benefit of this bylaw change is not only to ensure that the new and complex technologies are safely and effectively implemented but also reduces the City's liability exposure in future claims due to faulty construction.

3.2.2 Qualification of Contractors and Trades

Concerns were raised by building officials and design professionals that some of the contractors and trades do not have the experience, qualifications and/or ability to construct four storey wood-frame buildings, particularly in relation to building envelopes, fire stop systems, material shrinkage due to moisture content of wood and shear walls. Construction of six storey buildings will exaggerate the need for qualified contractors and trades.

Currently there is no mandatory qualification for contractors or trades that are responsible for the items mentioned above. The new home warranty program relies on the insurance providers to screen the general contractors; however, the insurance providers qualify contractors based more on their financial ability than their technical ability.

APEGBC's preliminary proposed design guideline for structural engineers recommended that contractors should be qualified by their past experiences or be able to demonstrate to the engineer that they have the necessary understanding and competencies to perform the work including proper installation of all details provided by the structural engineer.

Qualification of contractors and trades is a provincial matter, however, we are able to require, under our current Building Bylaw, an independent third party inspection in addition to the inspections provided by our building inspection staff to ensure certain critical building components are being installed correctly.

3.2.3 Education and Training

APEGBC is currently working on a design guideline for professional engineers to address the six storey wood-frame buildings. The guideline will be a scaled down version from the original proposal due to funding and time restraints. The guideline will cover topics such as design, drawing and review practice, shear walls, shrinkage, firewalls and elevator shafts, and hybrid systems with mix use of wood, steel, concrete and masonry.

APEGBC is hoping to have the guideline available to the engineers on or before the effective date of the Code changes. However, time would still be required to schedule seminars for education and training. It is not expected that the training would be completed until later this year.

Unfortunately, there is no specific education and training program for building officials, contractors and trades at this time.

4.0 IMPACT OF CODE CHANGES IN BURNABY

4.1 Zoning

Five and six storey wood-frame residential buildings could be accommodated through Comprehensive Development rezoning under Burnaby's existing zoning bylaw, if approved by Council.

Although the RM2 and RM3 zoning districts permit a maximum building height of three storeys, four storey residential buildings have been permitted under Comprehensive Development zoning based on these districts, at a maximum RM3 density of 1.10 Floor Area Ratio with underground parking and no amenity bonus.

Six storey residential buildings would hypothetically tend to fall within the RM4 and RM5 density range, i.e. 1.70 and 2.20 Floor Area Ratio maximums respectively (with underground parking and no amenity bonus). Given the maximum lot coverage of 25 percent and 30 percent permitted in the RM4 and RM5 districts respectively, the maximum Floor Area Ratios permitted in these zones could not be achieved in a six storey building form, except through a Comprehensive Development rezoning which increased the permitted lot coverage for a specific development.

Given the concerns outlined in this report, it is unlikely that rezoning applications for six storey wood-frame apartment buildings would be supported by staff until such time as the issues outlined in this report are addressed.

4.2 Firefighting

The President of the Fire Chiefs' Association of B.C. (FCABC) submitted a report from the Fire Services Liaison Group (FSLG) outlining some serious questions and concerns expressed by its members. Some were addressed, but a significant number still exist.

The Province announced that the changes to the Code had the support of the Office of the Fire Commissioner, a provincially run and funded agency. The request and opportunity for input came after the initial announcement.

It is critical that the safety of the occupants and firefighters be considered in any requirements relating to the construction of any structure. From a Fire Department perspective, these are not mid-rise buildings. They would require high-rise firefighting tactics. The firefighting strategy would have to be further modified, based on the combustible material construction for the reasons previously indicated.

Fire incidents would require an increased resource response to deal with the added tactical requirements compromising the ability of the Fire Department to quickly attack the fire from an offensive stance, in other words, finding the seat of the fire and extinguishing it quickly minimizing the fire loss. This is difficult enough in three storey apartment buildings. If the firefighters are forced into a defensive stance (fighting the fire from outside at a safe distance), they are only able to control the spread of the fire to adjoining exposures and extinguishment is accomplished by "surround and drown" where appliances with large nozzle are set up to pour water on the structure until the fire is out, usually resulting in catastrophic fire loss.

Even with the most up-to-date fire protection systems in place to alert occupants and slow the fire down (i.e. sprinklers), the ability for occupants to escape quickly is probably the most important factor. When an alarm sounds, all too often it is ignored and we usually find only a handful have made their way from the building. In a wooden structure, it is that much more imperative that all occupants get out safely and quickly. If there is a fire emergency, a taller building will take longer to be evacuated and, with our search taking longer to complete, fewer resources will be available initially to begin an offensive fire attack.

For these reasons, the Fire Department would not support proposals allowing wood-frame buildings of more than the current four storey limit and height restriction for these types of structures.

4.3 Permit and Inspection Process

Staff involved in the permit and inspection process of multi-storey residential buildings rely on the expertise of registered professionals, such as architect and engineers, with respect to issues regarding the building envelope, structural adequacy and building material shrinkage. If the architects and engineers are not ready or adequately prepared to deal with the design and construction implications of the six storey wood-frame buildings, staff could not support proposals to construct such buildings.

5.0 CONCLUSION

Although there is support in principle to allow six storey wood-frame building construction, the following technical and process issues remain to be addressed:

- Lack of research on seismic design;
- Fire risks to occupants;

- Firefighting;
- Building Envelope;
- Material Shrinkage;
- Qualification of Design Professionals;
- Qualification of Contractors and Trades; and
- Education and Training for those involved in design and construction

Given the concerns outlined in this report, it is recommended that:

1. Rezonings for the development of five or six storey wood-frame buildings only proceed after the concerns outlined in this report have been satisfactorily addressed.

2. Council authorize the amendment to the Building Bylaw to include Building Specialists in the definition of Registered Professionals enabling the Chief Building Inspector to require Building Specialists for the design and field review of the construction of complex buildings.

3. A copy of this report be sent to Honourable Rich Coleman, Minister of Housing and Social Development, requesting that the issues outlined in this report be addressed for inclusion in the B.C. Building Code.

B. Luksun
Director Planning & Building

R. Cook
Fire Chief

PS:ap
Q:\PATRICK\Report\BLD-SIX STOREY WOOD FRAME RES BLDG.doc

cc: Director Engineering
City Solicitor
Chief Building Inspector