NEWBuildS

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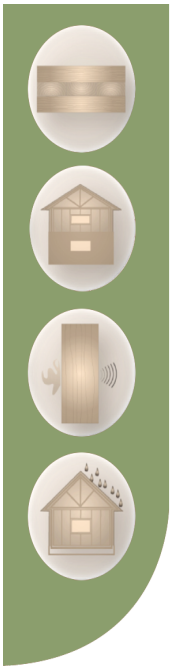

Rationalization of Life Safety - Code Requirements for Mid-rise Buildings

KEYWORDS: Fire safety, code requirements

OVERVIEW OF PROJECT

With the introduction of objective-based format in 2005 the National Building Code of Canada (NBCC) opened the door for designers to use "alternative solutions that need to achieve at least the minimum level of performance afforded by the acceptable solutions in the areas defined by a set of objectives and functional statements attributed to the applicable acceptable solution." This change to NBCC allows for a broader range of solutions provided that the intent of the code is met.

In light of this fact, the applicable acceptable solutions for combustible construction can be re-examined with respect to the objectives which those solutions are striving to achieve. Specifically, the NBCC places a number of restrictions on buildings made of combustible construction. Such restrictions include height and area limitations, requirements for specific fire resistance ratings, sprinklers, etc. Although the specific values for the limitations and requirements vary depending on occupancy types, there are various limits beyond which combustible construction is not permitted. The primary objective of this project was to study those building code restrictions in order to first understand them more fully and secondly to demonstrate what sort of impact changes to these restrictions/requirements might have on life safety and structural integrity of wood frame buildings. Using this approach, it would be possible to re-examine current building code limitations.

A thorough review of Subsection 3.2.2 of Division B of the NBCC, called "acceptable solutions", identified that combustible construction is subject to much more stringent requirements than those applicable to non-combustible construction. Specifically, these restrictions include height limitations, area limitations, requirements for sprinkler protection, requirements for fire resistance rated assemblies, and requirements for specific occupancy classifications and the exclusion of certain occupancy classifications.

KEY RESULTS

The key findings of the project are summarized under the following headings:

The importance of Fire Resistance Ratings - One key finding is related to the fire resistance ratings of building assemblies. The 1980 and 1985 NBCC commentaries and associated documents acknowledged that fire resistance ratings were of significant importance in considering the structural capabilities of a building and recognized that larger members would maintain their structural stability in a fire compared to a member of inferior dimensions (regardless of their combustible properties of these members). Additionally, the functional statements of the 2005 NBCC provide further support for the importance of fire resistance ratings. When comparing these functional statements against the various requirements, it was clear that although combustibility is a factor affecting fire spread, it is not considered as a factor affecting structural integrity. This conclusion flies in the face of the existing limitations of our current codes in that a large number of structural limitations are imposed on combustible construction despite the findings that it is truly an issue of fire

Researchers: Michael Kruszelnicki; Ehab Zalok; George Hadjisophocleous
Affiliation: Carleton University
Contact email address: George.Hadjisophocleous@carleton.ca

resistance capabilities and not a measure of "combustibility". This is an important finding as it shows that specifying a requirement for non-combustible construction may be exceeding the intent of the code itself.

External Influences - Historically, it can be seen that the codes were (and still are) subject to a number of external influences that provide some degree of exertion upon the requirements found therein. The findings showed that a number of the building code requirements were initially set in an arbitrary (albeit educated) manner. It was shown that a number of building code limitations, including building height limitations, were based on the comfort level of those establishing the requirements and on the capabilities of firefighting capabilities at the time.

Maximum building area - An indirect analysis demonstrated the mathematical basis for the height and area relationship which is consistent across nearly every occupancy of Subsection 3.2.2 of Division B of the NBCC, as an equation:

$$MaxArea = \frac{A_B}{N} \cdot C \cdot FRR \cdot SUP$$

where A_B is the baseline area permitted for the occupancy; N is the number of storeys; C is an area reduction factor applicable to combustible construction; FRR is the fire resistance rating in hours; SUP is a suppression factor (=1 if no sprinklers and access to 1 street, = 1.25 if no sprinklers and access to 2 streets, = 1.5 if no sprinklers and access to 3 streets, = 3 if building is sprinklered).

Although the mathematical basis provides a sense of cohesiveness for the applicable requirements, it fails to provide a rationale for those. Moreover, one key conclusion from this exercise is that if we are willing to accept the current historical limitations as-is, then we should be willing to accept changes to the building code that, based on the demonstrated mathematical relationship, would allow for combustible structures that exceed the current dimensional limitations.

RECOMMENDATIONS

This project showed that it is possible to provide a logical approach to dealing with combustible construction while respecting the rationale for NBCC requirements. Specific recommendations are:

- Modification to the building codes to 1) establish requirements based on the factor of fire resistance rating rather than on the factor of combustibility; 2) to classify buildings as being constructed of protected or non-protected assemblies; 3) to classify construction types of structural members as light-gauge vs. heavy-gauge to reflect the differences in fire performance of various materials based on their dimensions.
- Follow the height and area relationship equation to establish alternative solutions which would allow for combustible construction in buildings higher than those currently permitted.
- Establish performance-based criteria based on various forms of quantitative and computer-based risk models.
- Establish a holistic approach to fire protection where the design methodology more closely resembles the engineering design approach of Part 4 of the NBCC rather than the prescriptive approach of Part 3.

REPORT

Kruszelnicki, M. 2011. Rationalization of Life Safety — Code Requirements for Mid- Rise Buildings. Mater of Engineering Report, Carleton University.