# **Alternative Solutions**

### **Perspectives**

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# **Andrew Harmsworth,** M Eng, PE, P Eng, CP, FEC Principal, **GHL** Consultants Ltd

- BASc, Queen's University at Kingston, Civil Engineering
- M Eng, UBC's short lived Fire Science program
- PE Washington State, 2001
- 25 years' experience in Equivalencies and Alternative Solutions









# Fire Engineering

- Prefer "Fire Engineering"
  - Focus on Part 3
  - Fire risk analysis
  - Structural fire resistance
  - Heat transfer
  - Egress/evacuation
  - Smoke control design



# 9 Principals + staff (total 24)



David Graham, P Eng, CP Principal



Andrew Harmsworth, M Eng, P Eng, PE, CP Principal



Teddy Lai, Architect AIBC, MRAIC, CP Principal



Khash Vorell, M Eng, P Eng Associate Principal



Adam Nadem, AT.AIBC, AScT Associate Principal



Frankie Victor, AScT, BCQ Associate Principal



Jeffery Mitchell, M Eng, P Eng, CP Associate Principal



Wendy Morrison, AScT, BCQ Associate Principal

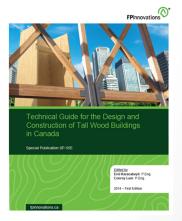


K. M. Gary Chen, MASc, P Eng Associate Principal



### Research Work

- CAN 086 Task Group on Fire (Andrew Harmsworth)
- NEWBuildS Research Network (Andrew Harmsworth,
   Board of Directors) 70 Master's and PhD Students
- Effectiveness of Sprinkler Systems after an Earthquake
- Fire Chapter, Lead Author

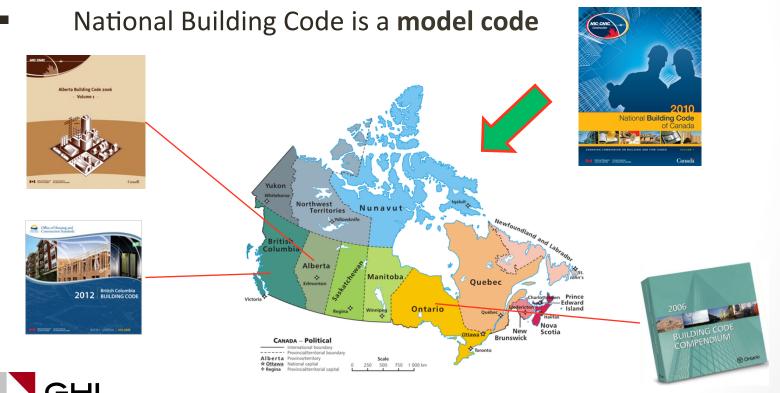




**Building Codes Philosophy** 

### The Canadian Building Code System

- Started as a "guide"
- Prescriptive , 1941 1995
- Over time, it became a restrictive document



### **Code Evolution**

Prescriptive



Objectivebased



Performancebased

- NBC up to 1995
- Many Codes around the world
- NBC since 2005

 UK, Australian & New Zealand codes

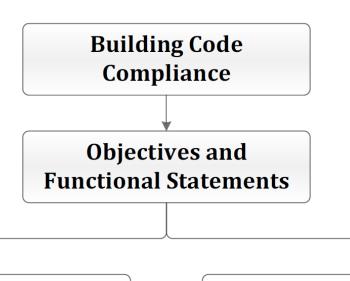


# Why Acceptable Solutions

- CCFBC recognized that there are always other ways to accomplish the goal
- A Code cannot address all solutions



# Objective-based Code Framework



### Acceptable Solutions (Division B)

- Deemed-to-satisfy solutions
- Establish level of performance

### **Alternative Solution**

- Meet the objectives and functional statements
- Provide the *same* level of performance relative to objectives and functional statements



# 2012 British Columbia BUILDING CODE

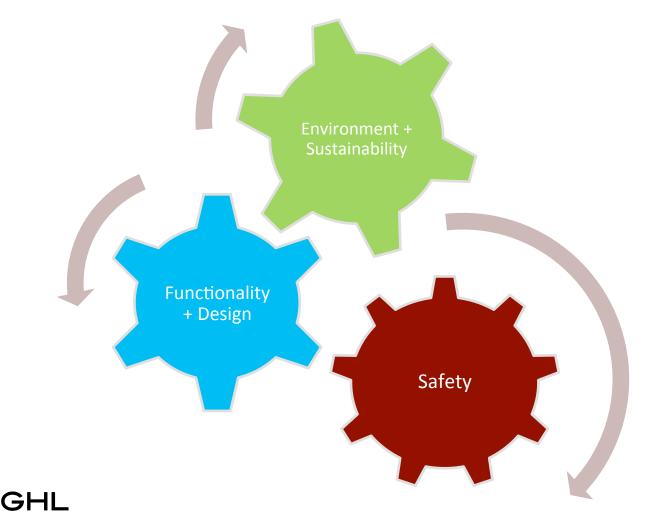
### Buildings are subject to risks:

- Code compliance ≠ no risk.
- Code compliance = risks at acceptable level.

Entering a building is just like getting into a car, there is an acceptable level of risk.



# Safety Needs to Balance Other Goals



### Other Goals



# Vancouver commits to run on 100% renewable energy

Canadian city of 600,000 people is the latest to announce it will use only green energy for electricity, transportation, heating and air conditioning within 20 years







# Compliance

### 1.2.1.1. Compliance with this Code

- Compliance with this Code shall be achieved by
  - a) complying with the applicable acceptable solutions in Division B (see Appendix A), or
  - b) **\(**using alternative solutions, accepted by the *authority having jurisdiction* under Section 2.3. of Division C, that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the applicable acceptable solutions (see Appendix A).



# **Proponent Qualification**

- 4) The Code analysis referred to in <u>Clause (2)(a)</u> shall include information about the qualifications, experience and background of the person or persons taking responsibility for the design.
  - Qualifications
  - Experience
  - Background



# Proponent

- Proponent should
  - Be Qualified
  - Have internal review processes
  - Have insurance
  - Have specific expertise
- Organizational Quality
   Management Program (OQM)





### Co-ordination

- 6) Where more than one person is responsible for the design of a building or facility that includes a proposed alternative solution, the person requesting the use of the alternative solution shall identify a single person to coordinate the preparation of the design, Code analysis and documentation referred to in this Article.
- Typically either the Proponent
- Sometimes the CRP
- May require Fire, Structural and other Engineers
- Chain of co-ordination must be clear



# Analysis and Detail

- 2) The documentation referred to in Sentence (1) shall include:

  a) a Code analysis outlining the analytical methods and rationales used to determine that <the> proposed alternative solution will achieve at least the level of performance required by Clause 1.2.1.1.(1)(b) of Division A
- Challenge is a Goldilocks one
  - Not too much detail
  - Not too little detail
- If detail is missing, don't assume it was forgotten, ask
- Often we think of issues, but are trying to keep the submission short enough
- Meet beforehand to establish consensus on what is important and what can be assumed.





### **Functional Statements**

- The functional statements are more detailed descriptions of the objectives that are intended to qualify the circumstance in which the objectives are satisfied.
- F02 To limit the severity and effects of fire or explosions.



# Objectives

The objectives define, in broad terms, the goals that the prescriptive solutions in Division B intend to achieve.



### Work in Pairs

- Objective [F02-OS1.2] To limit the severity and effects of fire or explosions so as to limit the risk of injury due to fire or explosion impacting areas beyond its point of origin.
- [F02-OP1.2] To limit the severity and effects of fire or explosions *so as* to limit the risk of damage to the building due to fire or explosion impacting areas beyond its point of origin.



### Level of Performance

Equal or better than Division B

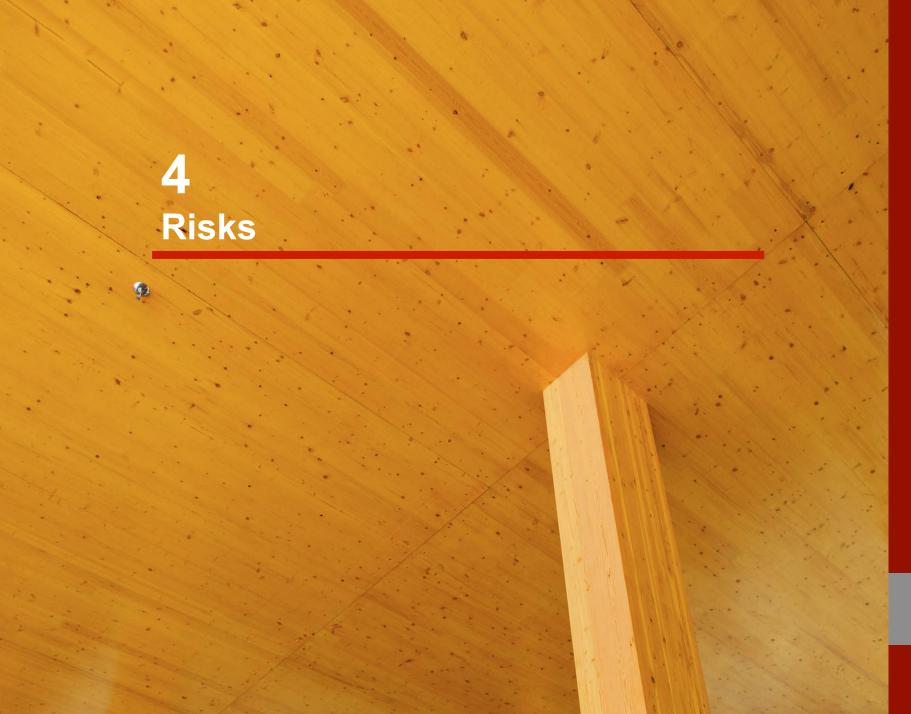
- Does NOT mean non-combustible = combustible
- Means Level of safety for occupants and firefighters of a mass timber building should be equal to a noncombustible building.



# Objectives Functional Statements

- Useful, but in my opinion not yet complete
- Necessary to assess if they are missing something
- Necessary to assess if there are other provisions of the Code that are making assumptions
- We need DEFINED LEVELS OF PERFORMANCE





# Design Risks

- Buildings are subject to risk of failure
- Division B = minimum code standard
   = boundary between 'acceptable' and
   'unacceptable' risks in building construction.
- Risk areas identified by objectives and functional statements.
- "Code compliance" = the residual risk is acceptable to the public.



### Code Comliance $\neq No Risk$

- Don't assume a Code Compliant Solution has no risk
- Alternate solutions may have a lesser risk

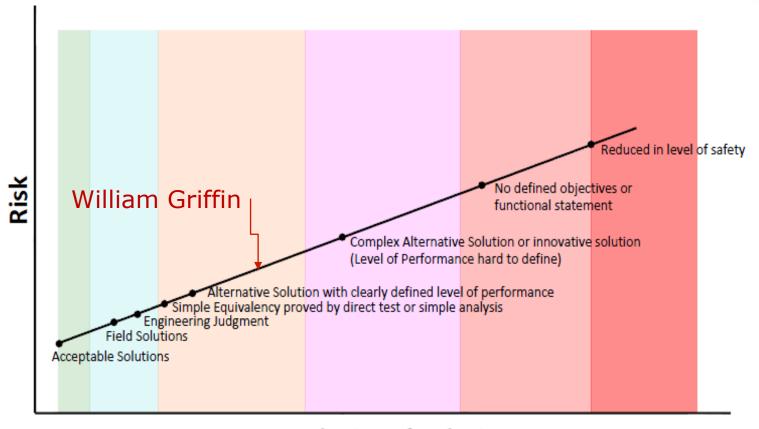


### Risk

- Assess What are the risks
- Reduce –
- Allocate who is responsible
  - proponent / professional
  - insurance



# **Assess Complexity**



### Complexity of Solution

\*NOTE: This is relative risk. An acceptable solution has a level of risk.

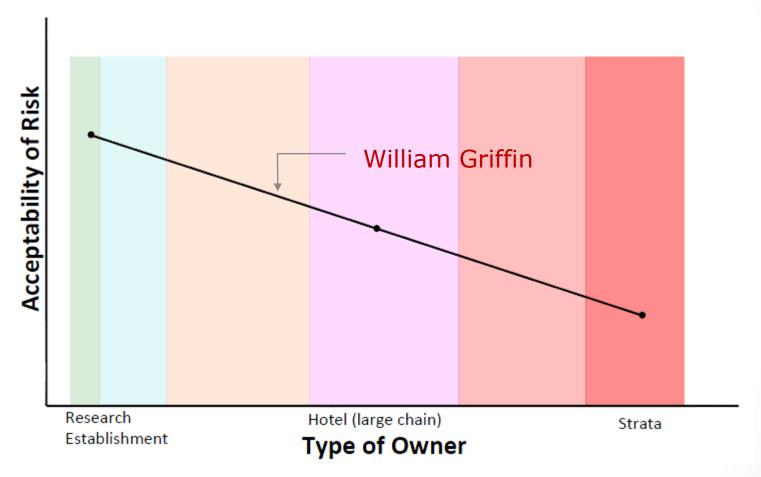


# Type of Owner

- A sophisticated owner can accept a high level of risk
- A less sophisticated owner may need additional protection
- Not provided for in the Code



# Ownership





### Potential Lower Risk

- AS May be better aligned with the issues
- AS will have more thorough review
- May address concerns not envisioned by the Code
- Issue may be less significant (eg Vehicle Exhaust)



# Comparison of Risk

	Alternative Solution GLT Mass Timber	Division B Light Steel Frame	Relative Performance
Fire control / suppression	NFPA 13 – Light Hazard; quick response	NFPA 13 – Light Hazard; quick response	AS / Division B equivalent
Fire detection	QR Sprinkler per NFPA 13; smoke and heat per CAN/ULC-S524 below mass timber roof and floor construction.	QR Sprinkler per NFPA 13, smoke and heat per BCBC 2012	AS better
Evacuation	Cumulative exiting	Exit capacity based on occupant load on a per floor basis (non-cumulative)	AS better
Emergency response	Fire access per BCBC. Multiple access points. Building area 5453m². 3 storeys.  Mass timber exists in the 2 level portion relative to West Queens Rd	Fire access per BCBC. Multiple access points. Building area – no limit. 6 storeys	AS better
Limit spread of fire	Wall FSR 25; some areas will have wood paneling up to 25mm therefore FSR 150; GLT timber FSR 37.5; acoustic ceiling tile FSR 25. Ceiling height of 3.4m (floor to floor of 4.5m).	Wall FSR 150; Ceiling FSR 10% at 150, 90% at 25. Compartment height of min. 2.1m.	AS / Division B equivalent



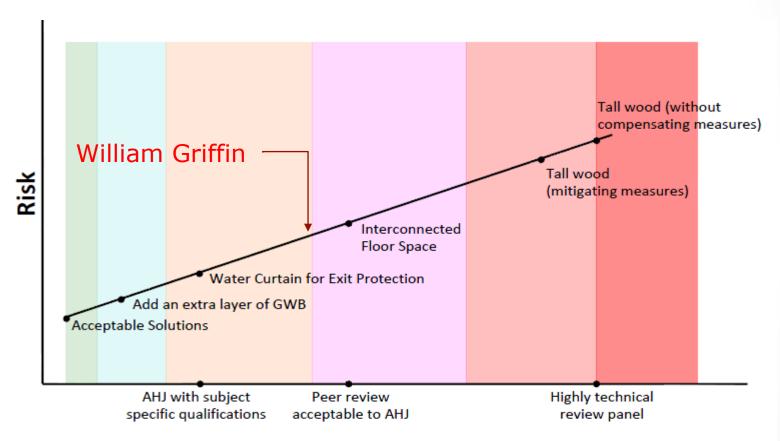


### **Review Process**

- No Review Accept Professionals' word
- Review by local building official
- Peer Review
- Complex Panel Review



### Level of Review



**Appropriate Level of Review** 



### Selection of Reviewer or Panel

 Often the proponent and Building Official can agree on a single reviewer or membership of the review panel.



- The reviewer selected by the proponent is a person who is unreasonably biased towards favourably reviewing the proposal.
- The reviewer selected by the Building Official is unreasonably biased towards rejecting the proposal.



### Recommendations

- the proponent be asked to provide 3 names of qualified Registered Professional or others with recognized expertise such as Academics, NRC Staff, Test Agency staff to the Building Official, and the Building Official selects one. (This is most appropriate if the proponent is responsible for the costs of the review).
- Alternatively, the Building Official should provide 3 names, and the proponent select the reviewer (most appropriate if the Building Official is responsible to the costs of the review).



# Low Liability

If the following are met:

- Qualified Proponent/professional
- Appropriate Review System for the complexity
- Appropriatly knowlegable and competent owner
- Appropriate insurance by owner/professionals
- Field Review

Liability of Authority is minimal, perhaps lower than for Division B solution.



# Thank you

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