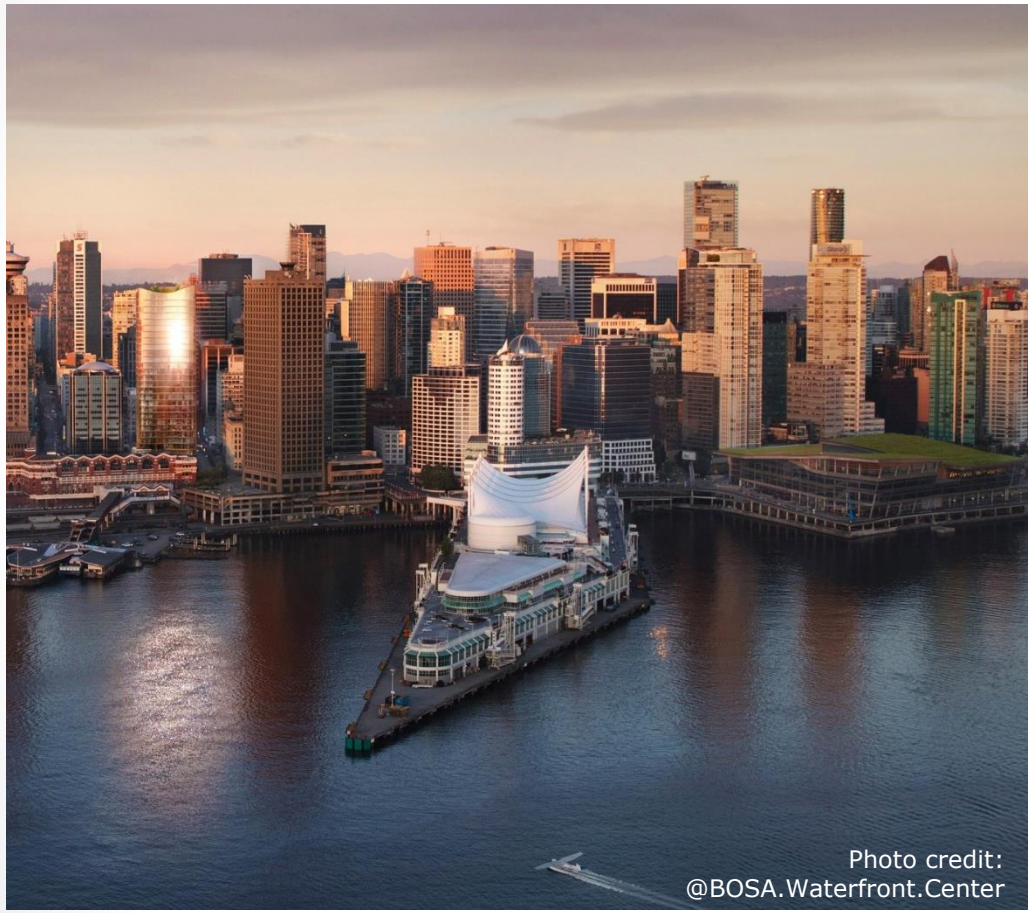
ALTERNATIVE SOLUTIONS

May 28, 2024

Andrew Harmsworth and Luke Kong
&
Tim Ryce

Territorial Acknowledgement



We respectfully acknowledge that our work takes place on the traditional unceded homelands of the Skwxwú7mesh (Squamish), xʷməθkwəy̓əm (Musqueam), and Sə́l̓ílwətaʔ/Selilwitulh (Tsleil-Waututh) Nations. This place is the unceded and ancestral territory that has been stewarded by them since time immemorial.

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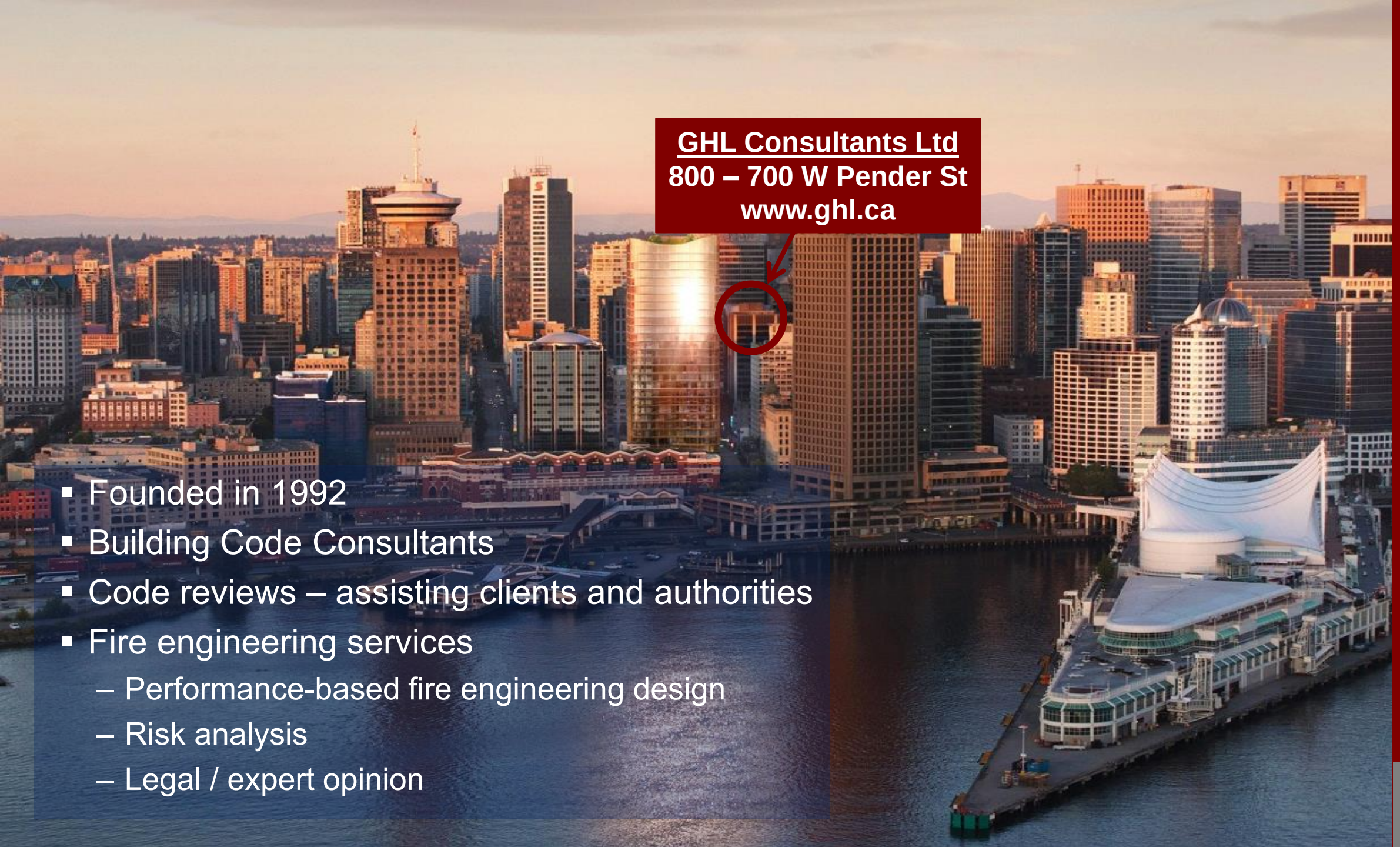

- Founded in 1992
- Building Code Consultants
- Code reviews – assisting clients and authorities
- Fire engineering services
  - Performance-based fire engineering design
  - Risk analysis
  - Legal / expert opinion

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The Code - Refresher

Where it All Begins

The Great Wall of China
(7th Century BC)

The Great Pyramid of Giza
(26th Century BC)

Taj Mahal
(Completed by 1643)

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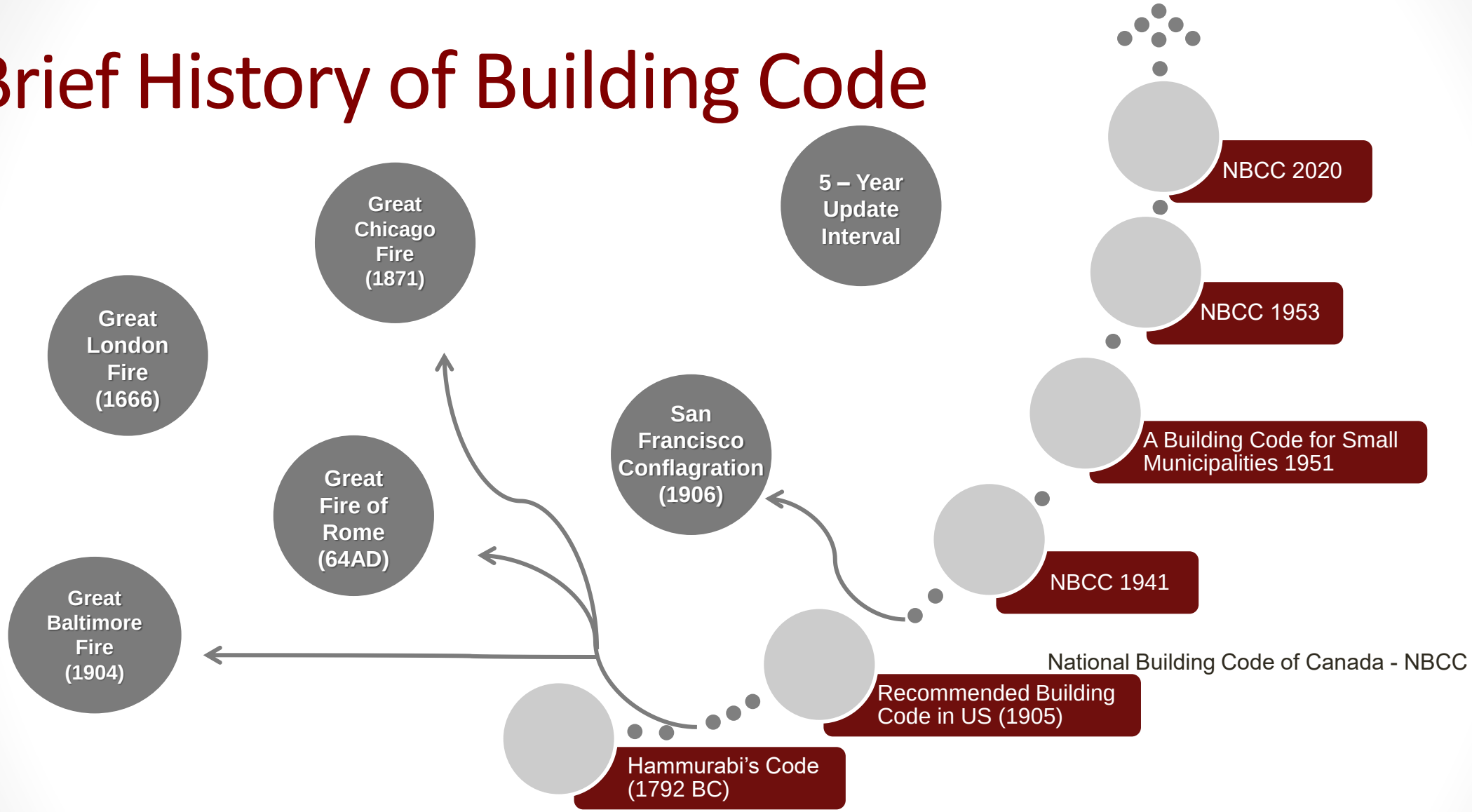
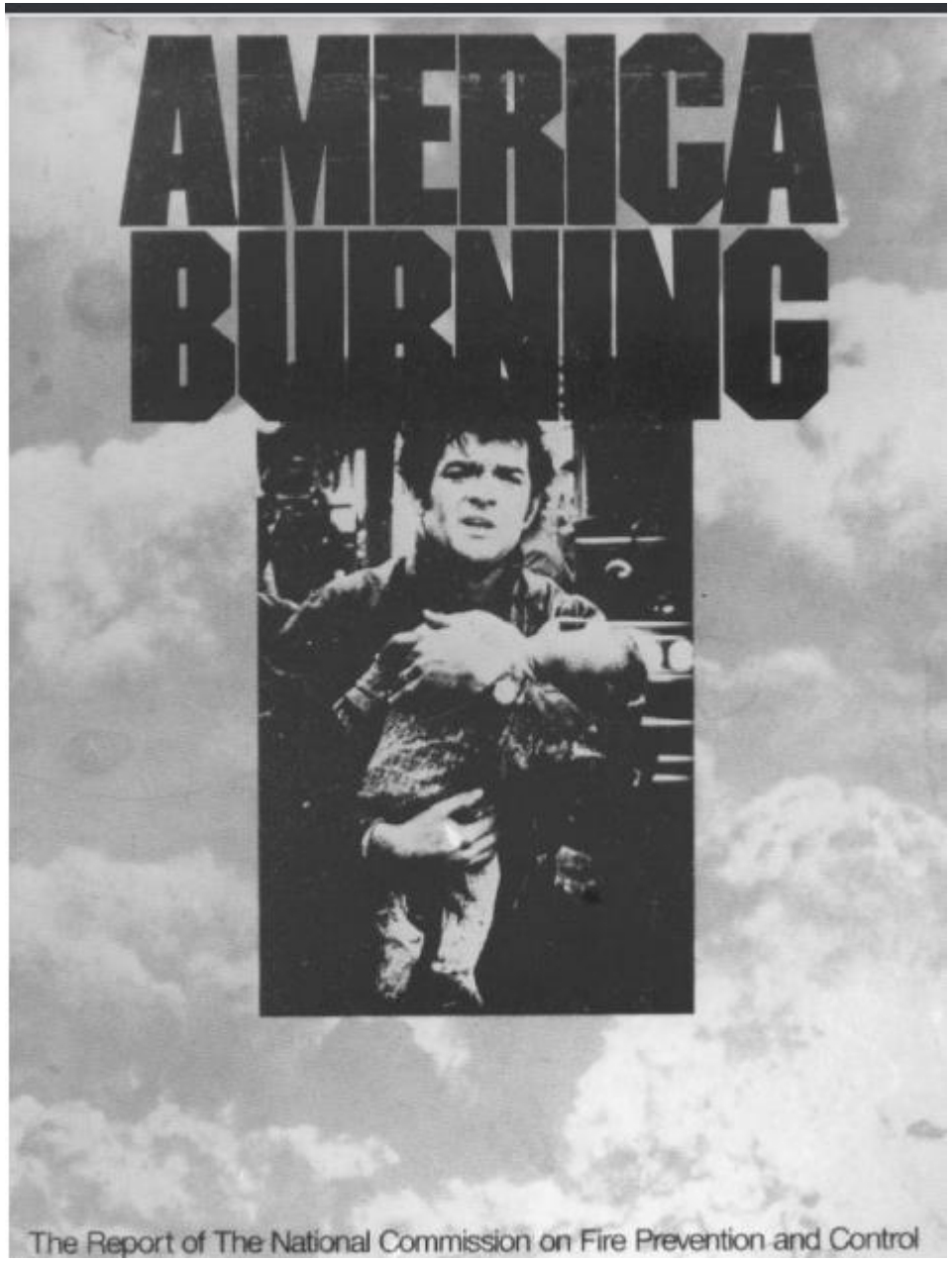
Brief History of Building Code



1970's and before

- Unacceptable level of fire deaths
- 1973 US Report
- Maximum Allowable Residential Building Height – 3 storeys
- No Mass Timber
- Start of my awareness of the issue



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Response Times - 1920

- 1920 – Human detection could be delayed, not unreasonable to say 10 to 30 minutes if fire starts in an unoccupied room.
- Fire often fully developed when Fire Department called.
- Occupants notified by Fire Department.
- Minimal sprinklers.(Coal furnace room)
- Slow response, occupants may still be in building.

Fire Safety Measures Added since 1980

- Fireblocking of cavities in frame construction
- Smoke Alarms
- Enhanced fire alarm systems
- Sprinklers – to protect occupants outside the compartment of origins (slow response)
- Better sprinklers – residential and fast response to protect occupants INSIDE the compartment of fire origin
- Enhanced reliability via monitoring and supervision

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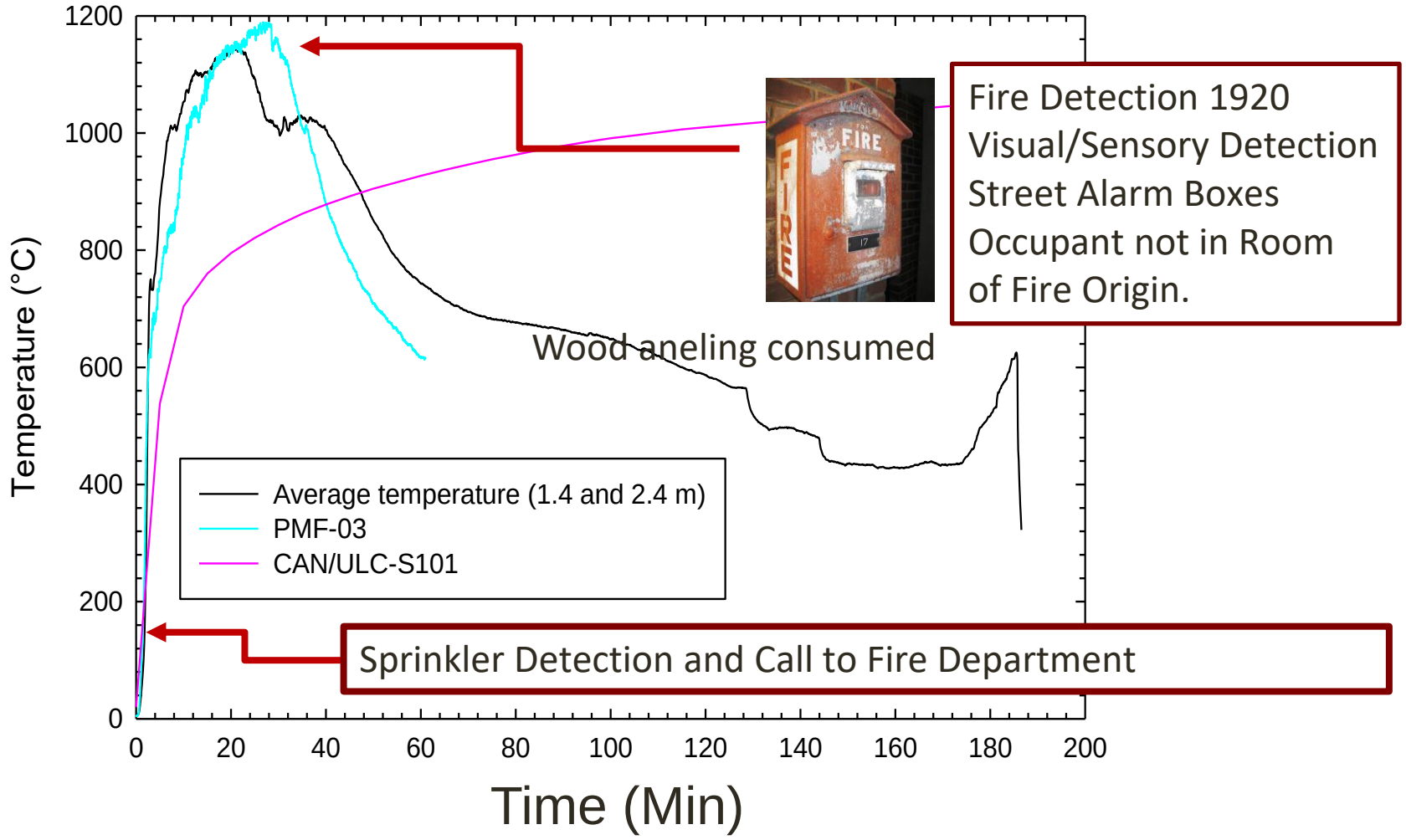
Perspective



Where are the fire deaths?

- Majority of Fire Deaths in houses.
- Majority of fire deaths in multifamily buildings – older buildings not updated
  - Mostly 3 and 4 storey frame with no fire-blocking or fire alarms.
- Modern sprinklered buildings have VERY low fire Death Rates.
- Tendency of Codes to try to resolve problems with older buildings with new measures on NEW buildings.

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My Opinion

- 1970's we had a huge problem with fire

- We compensated by piling on good ideas
  - Fire blocking
  - Fire Alarms
  - Sprinklers
  - Betters Sprinklers – residential and QR
  - Supervised and Monitored Sprinkler Systems

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- We have increased the level of safety beyond that needed.
  - Sprinkler reliability in conjunction with fire department response much higher than reported by NFPA.
  - Near zero fire deaths beyond room of origin in sprinklered buildings

Consequently,

- Some recent improvements have no measurable impact on life safety
  - Smoke dampers in residential buildings ($200 000/building)
    - In my opinion miniscule life safety value in sprinklered buildings
  - Additional firestopping in sprinklered buildings
- It is time to re-assess the decisions of the Early Codes (1905/1941)
  - Consideration of what we need in modern buildings to achieve the required or de-minimus risk lev
  - However, we also need to encourage upgrading of the Old housing stock pre-1980

Research Suggestion - Have we achieved De-Minimus Risk?

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Point Access Blocks

- New concept being considered for both BC and National Codes

Forces questioning need for 1905 recommendations in US for minimum 2 exits.

However, with modern sprinklers, fire-blocking and smoke alarms, perhaps we have increased the level of safety sufficiently that we can make these work.

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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

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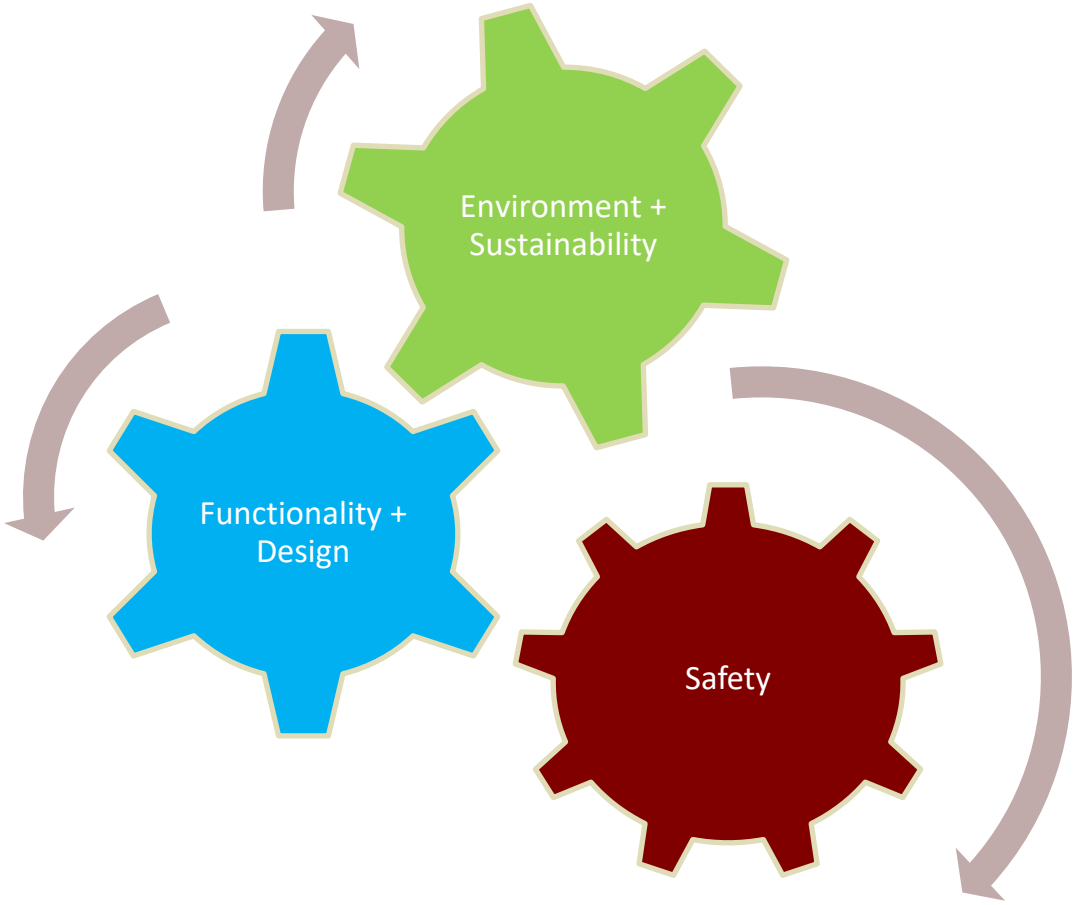
Safety Needs to Balance Other Goals



Code Evolution

Prescriptive

- NBC up to 1995
- Many Codes around the world
- Equivalencies

Objective-based

- NBC since 2005
- Alternative Solutions

Performance-based

- UK,
- Australia
- New Zealand
- Coming Soon

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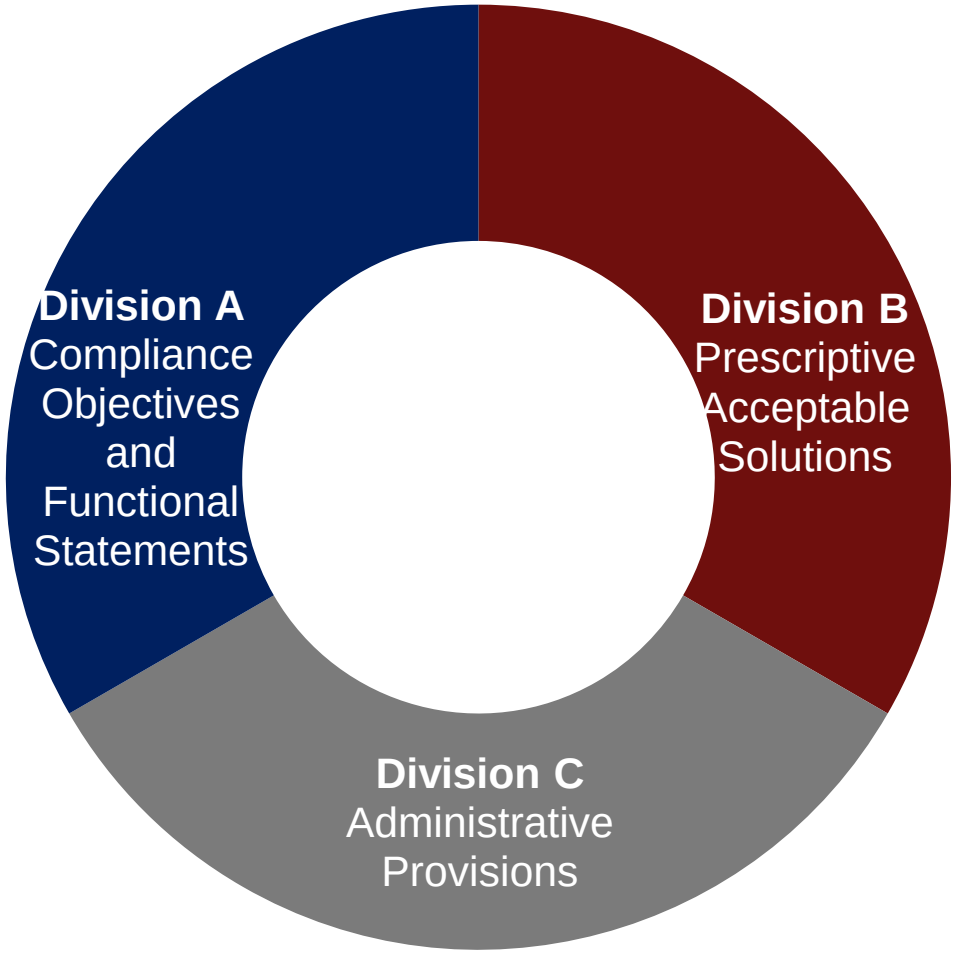
Model National Construction Codes

Objective-Based Code Structure

- Division A
  - Compliance
  - Objectives
  - Functional Statements
- Division B
  - Acceptable Solutions
- Division C
  - Administrative Provisions



Code Structure

- Division A
  - Compliance
  - Objectives
  - Functional Statements
- Division B
  - Acceptable Solutions
- Division C
  - Administrative Provisions

Alternative Solutions

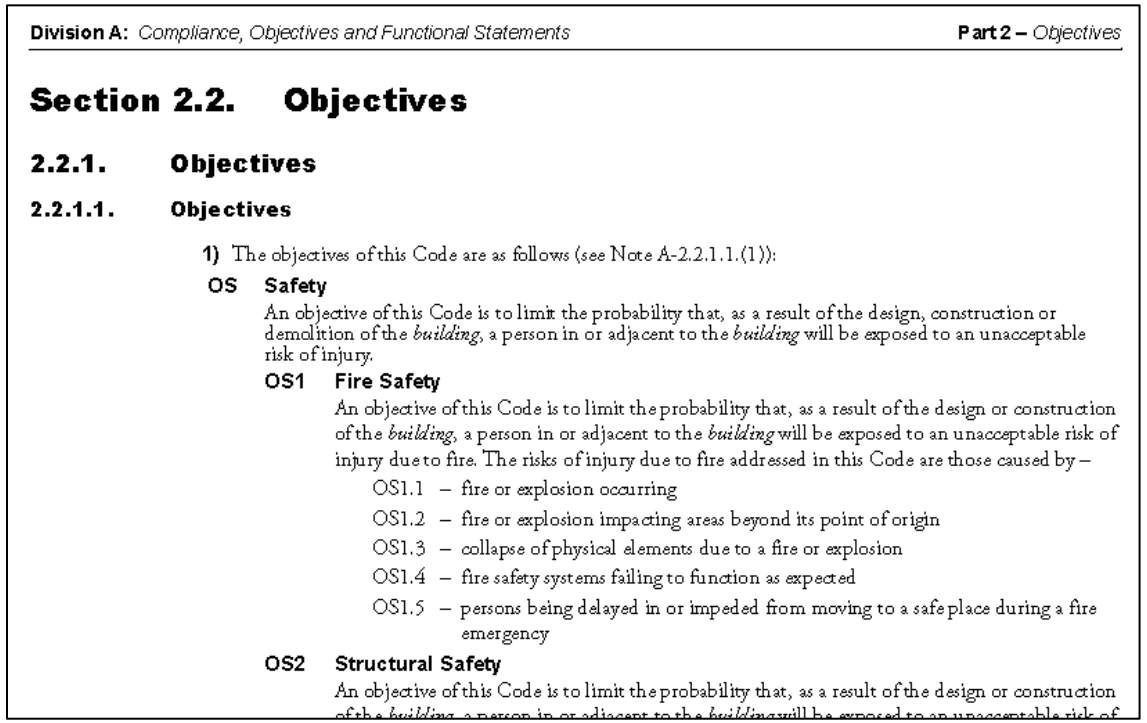
Alternative Solutions

- Provide stability and consistency to Code requirements
  - Division A remains largely unchanged since 2005
- Provide flexibility, encourage innovation, and the advancement of new technologies and solutions

Minimum Submission Requirements

- Division C, Section 2.3
  - Code Analysis
    - Applicable Objectives & Functional Statements
    - Assumptions, limiting factors, studies, and other parameters
    - Qualifications, experience, and background of the designated applicant
  - Special maintenance or operational requirements

Objectives and Functional Statements



Division A: *Compliance, Objectives and Functional Statements* **Part 2 –** *Objectives*

Section 2.2. Objectives

2.2.1. Objectives

2.2.1.1. Objectives

1) The objectives of this Code are as follows (see Note A-2.2.1.1.(1)):

OS Safety

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury.

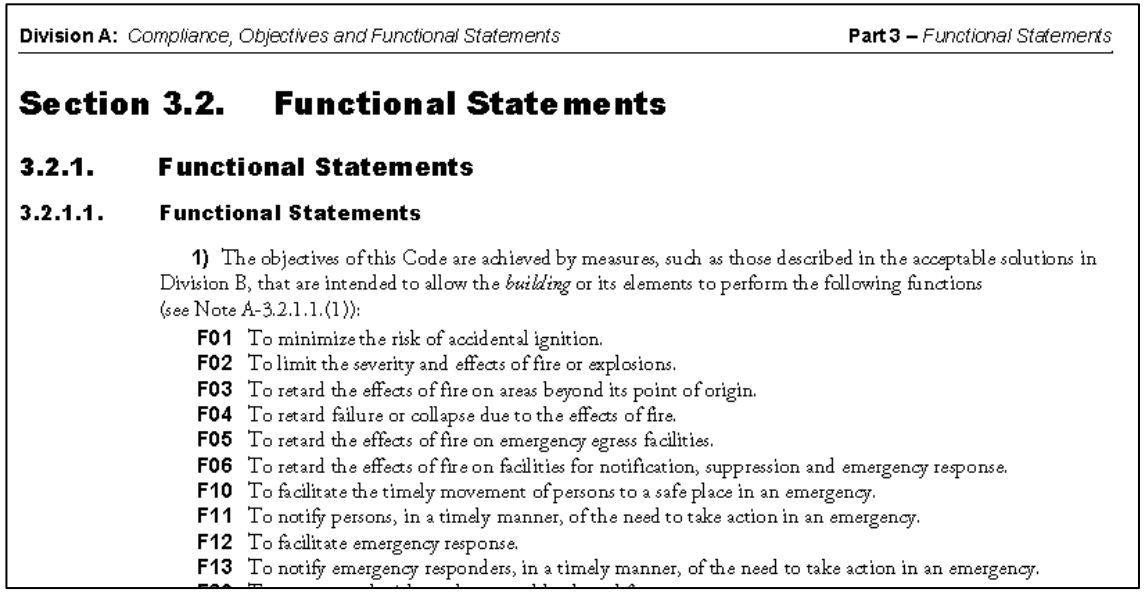
OS1 Fire Safety

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to fire. The risks of injury due to fire addressed in this Code are those caused by –

- OS1.1 – fire or explosion occurring
- OS1.2 – fire or explosion impacting areas beyond its point of origin
- OS1.3 – collapse of physical elements due to a fire or explosion
- OS1.4 – fire safety systems failing to function as expected
- OS1.5 – persons being delayed in or impeded from moving to a safe place during a fire emergency

OS2 Structural Safety

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of



Division A: *Compliance, Objectives and Functional Statements* **Part 3 –** *Functional Statements*

Section 3.2. Functional Statements

3.2.1. Functional Statements

3.2.1.1. Functional Statements

1) The objectives of this Code are achieved by measures, such as those described in the acceptable solutions in Division B, that are intended to allow the *building* or its elements to perform the following functions (see Note A-3.2.1.1.(1)):

- **F01** To minimize the risk of accidental ignition.
- **F02** To limit the severity and effects of fire or explosions.
- **F03** To retard the effects of fire on areas beyond its point of origin.
- **F04** To retard failure or collapse due to the effects of fire.
- **F05** To retard the effects of fire on emergency egress facilities.
- **F06** To retard the effects of fire on facilities for notification, suppression and emergency response.
- **F10** To facilitate the timely movement of persons to a safe place in an emergency.
- **F11** To notify persons, in a timely manner, of the need to take action in an emergency.
- **F12** To facilitate emergency response.
- **F13** To notify emergency responders, in a timely manner, of the need to take action in an emergency.

Objectives and Functional Statements

- OS and FS work in pairs
- *“There is a requirement that this FUNCTION must happen in order to meet this OBJECTIVE”*

Objectives and Functional Statements

- Example 3.1.3.1.(1) – Separation of Major Occupancies
- There is a requirement to [F03] *retard the effects of fire on areas beyond its point of origin* in order to [OS1.2] *limit the probability that, as a result of the design, construction or demolition of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury caused by fire or explosion impacting areas beyond its point of origin*.

3.1.3.1. Separation of Major Occupancies	
(1)	[F03-OS1.2]
	[F03-OP1.2]
(2)	[F03-OS1.2]

"There is a requirement that this FUNCTION must happen in order to meet this OBJECTIVE"

Determining Level of Performance

- OS/FS pairs provide *qualitative* performance criteria only
  - *Quantitative* performance criteria can be found using the acceptable solutions found in Division B
  - Therefore, assessing compliance cannot be based on OS/FS pairs alone
- The lowest level of performance of relevant acceptable solutions is the benchmark for the Alternative Solution

Role of the Building Official

- Confirm a complete application is provided

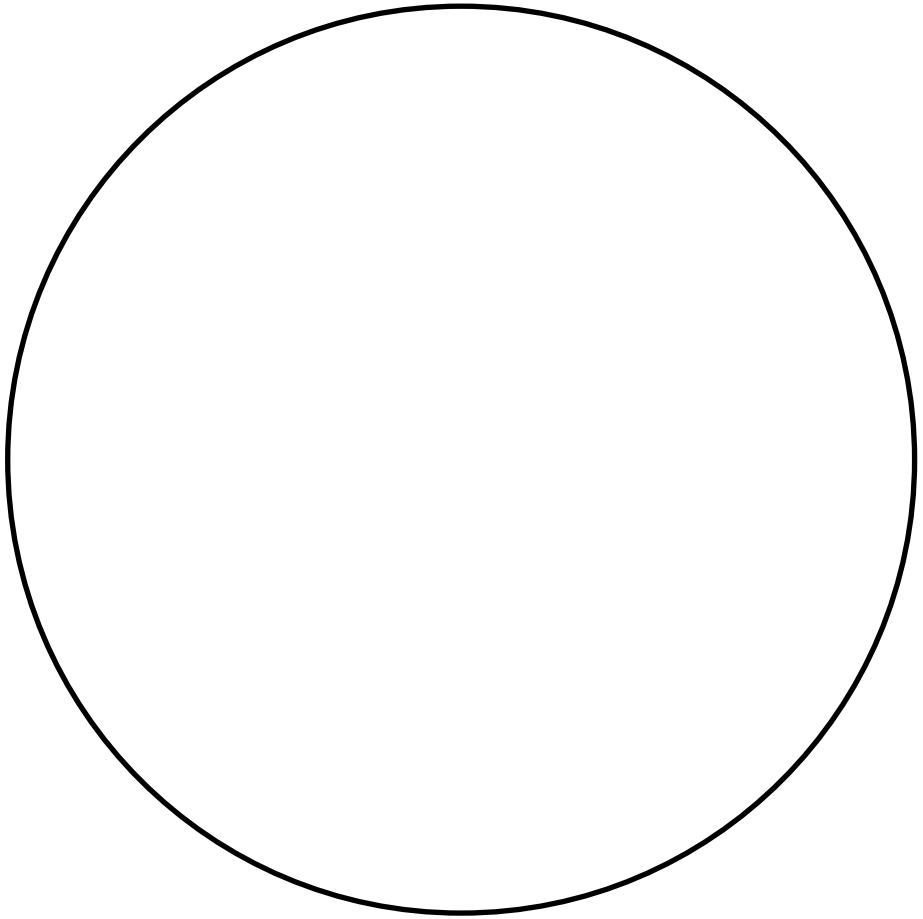
Role of the Building Official

- Confirm
- Collaborate to:
  - Determine the level of performance required to be met
  - Determine the level of risk and complexity
  - Determine the level of review required

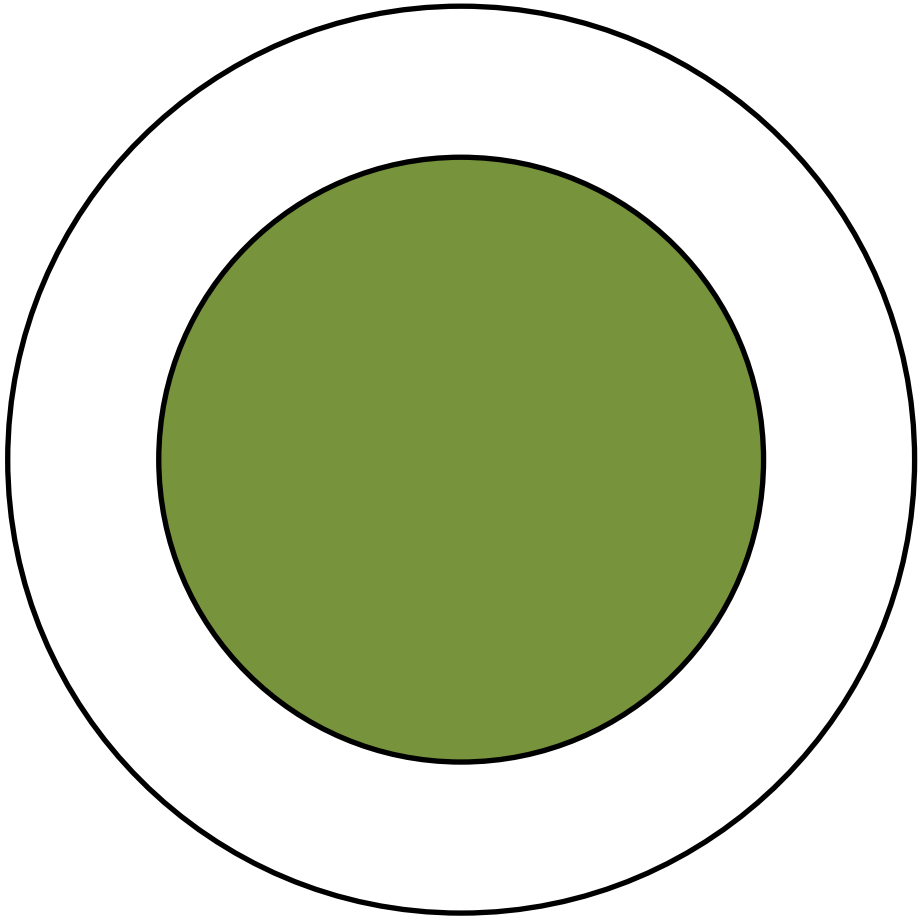
Role of the Building Official

- Confirm
- Collaborate
- Contribute your AHJ’s unique requirements and needs

Circle of Construction Knowledge



Circle of Construction Knowledge



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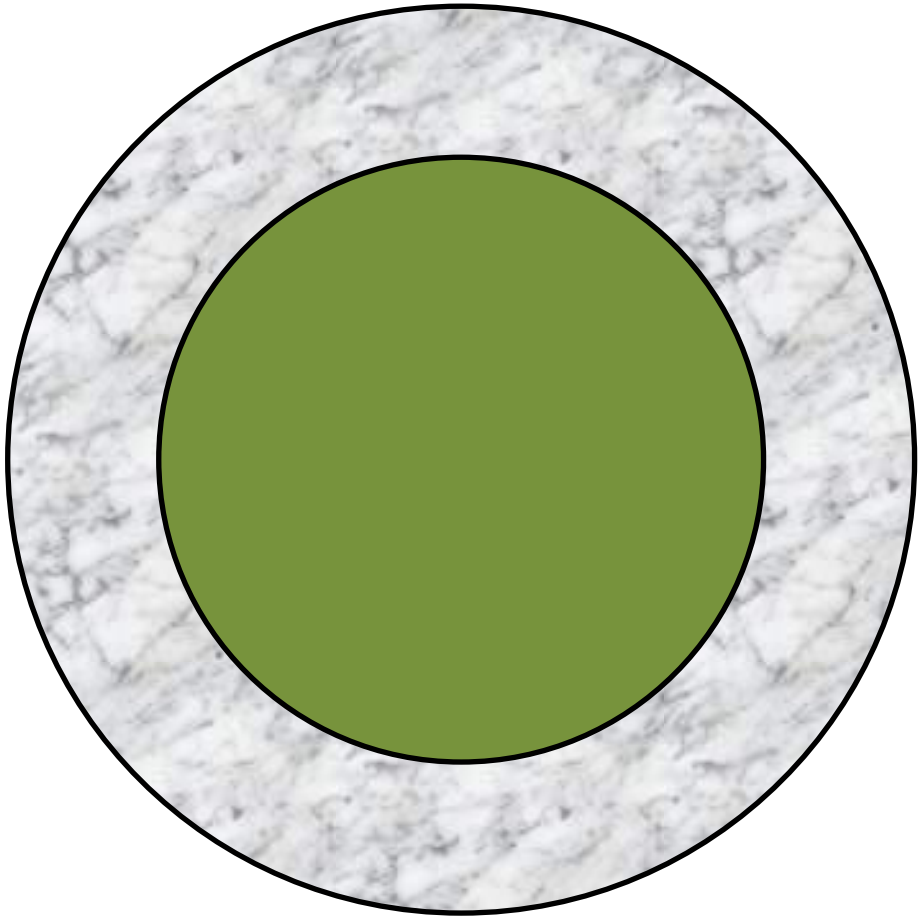

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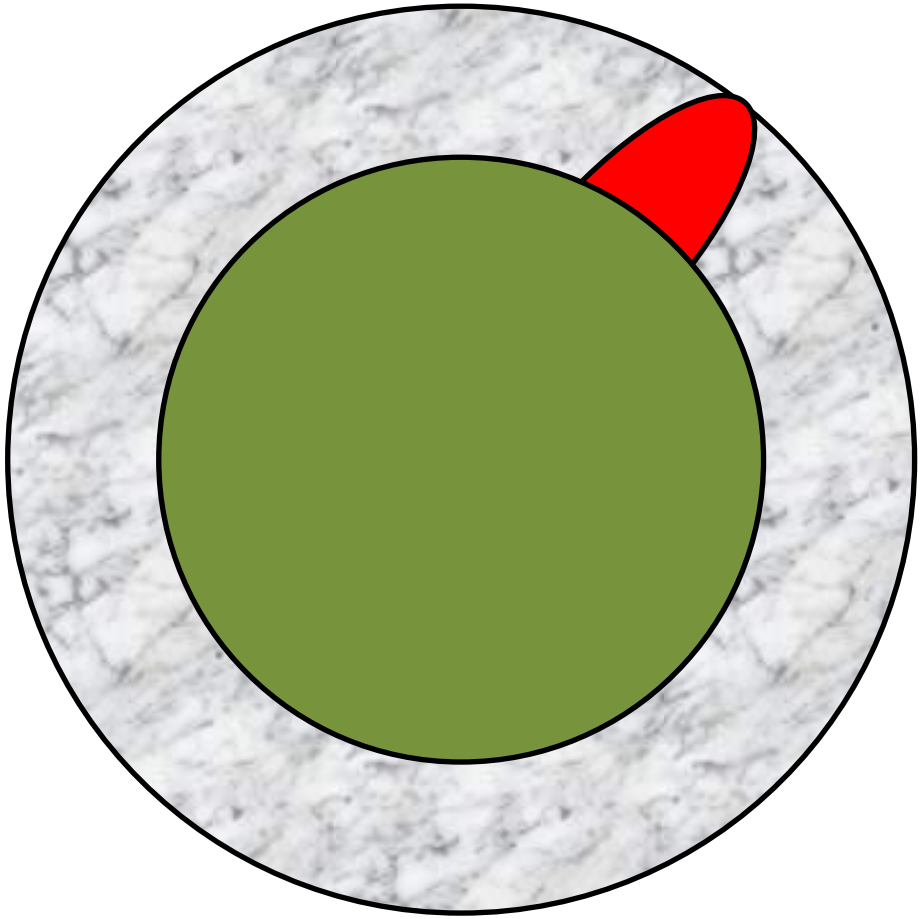

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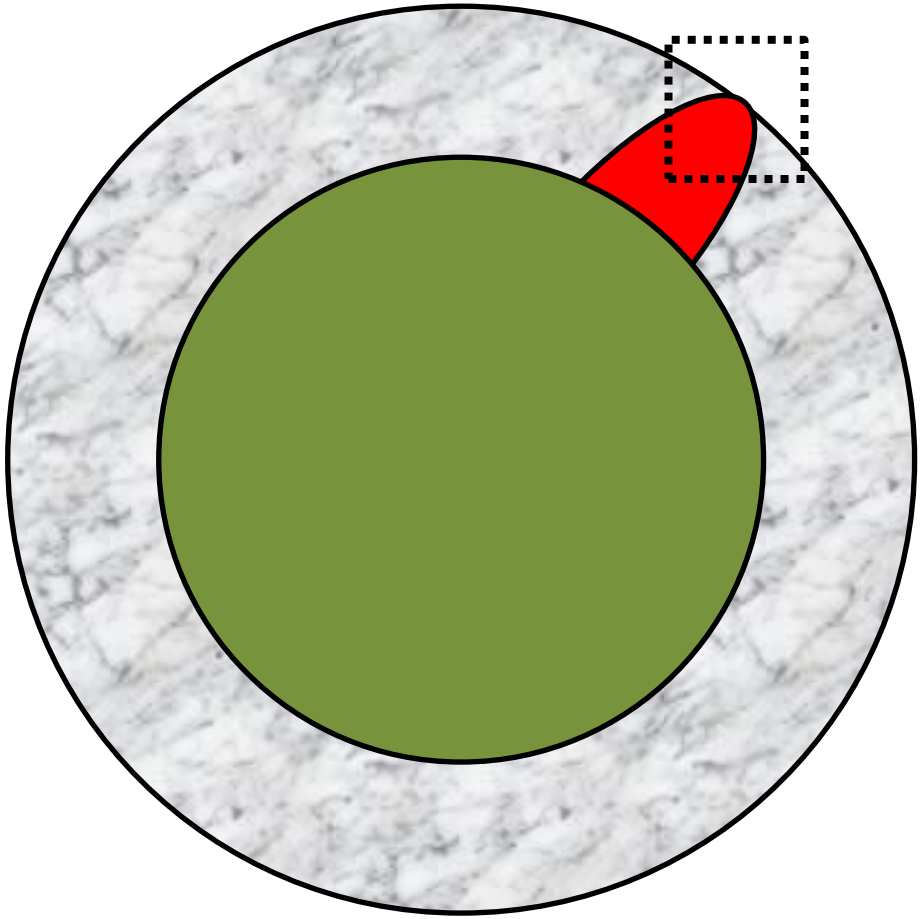

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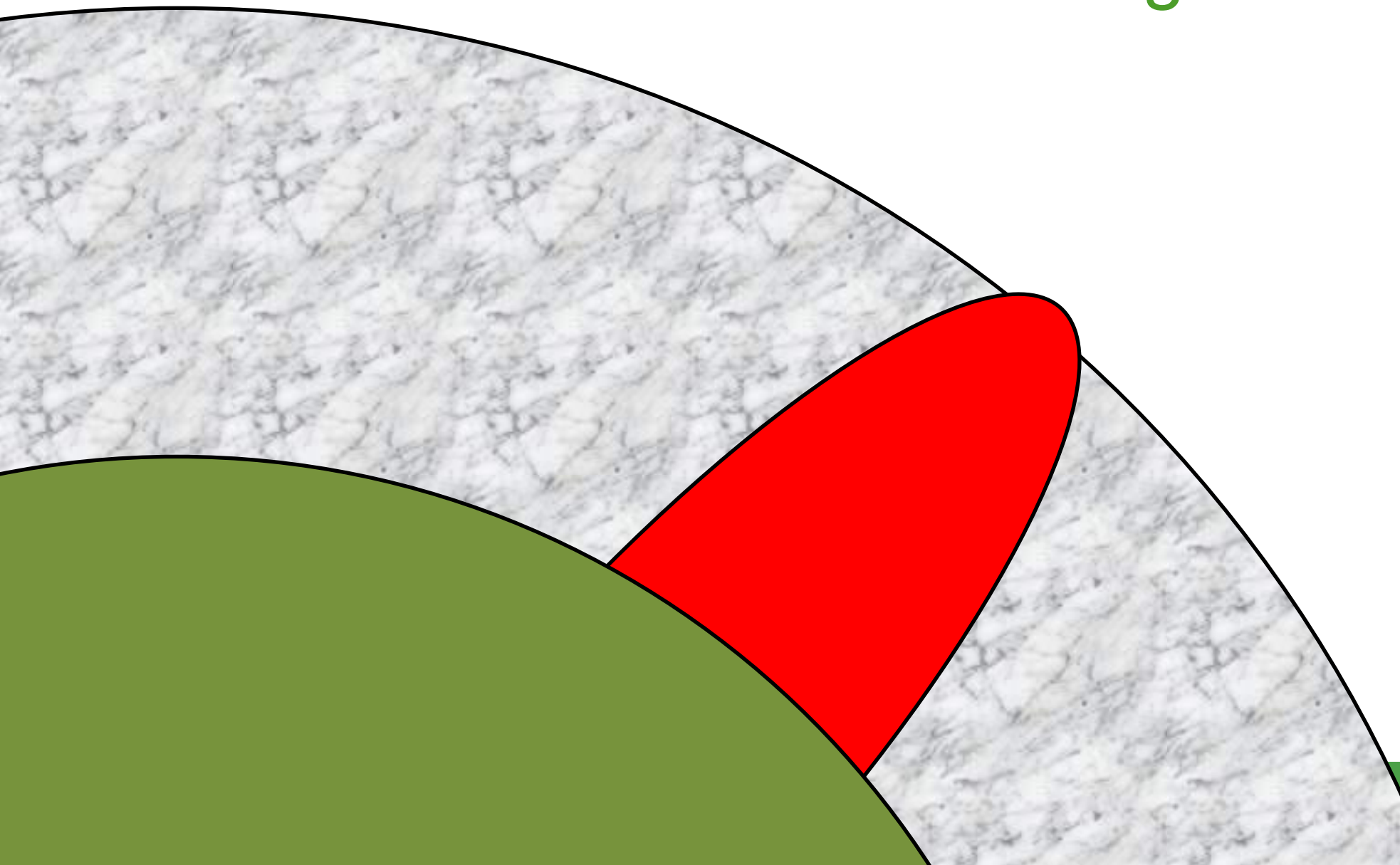

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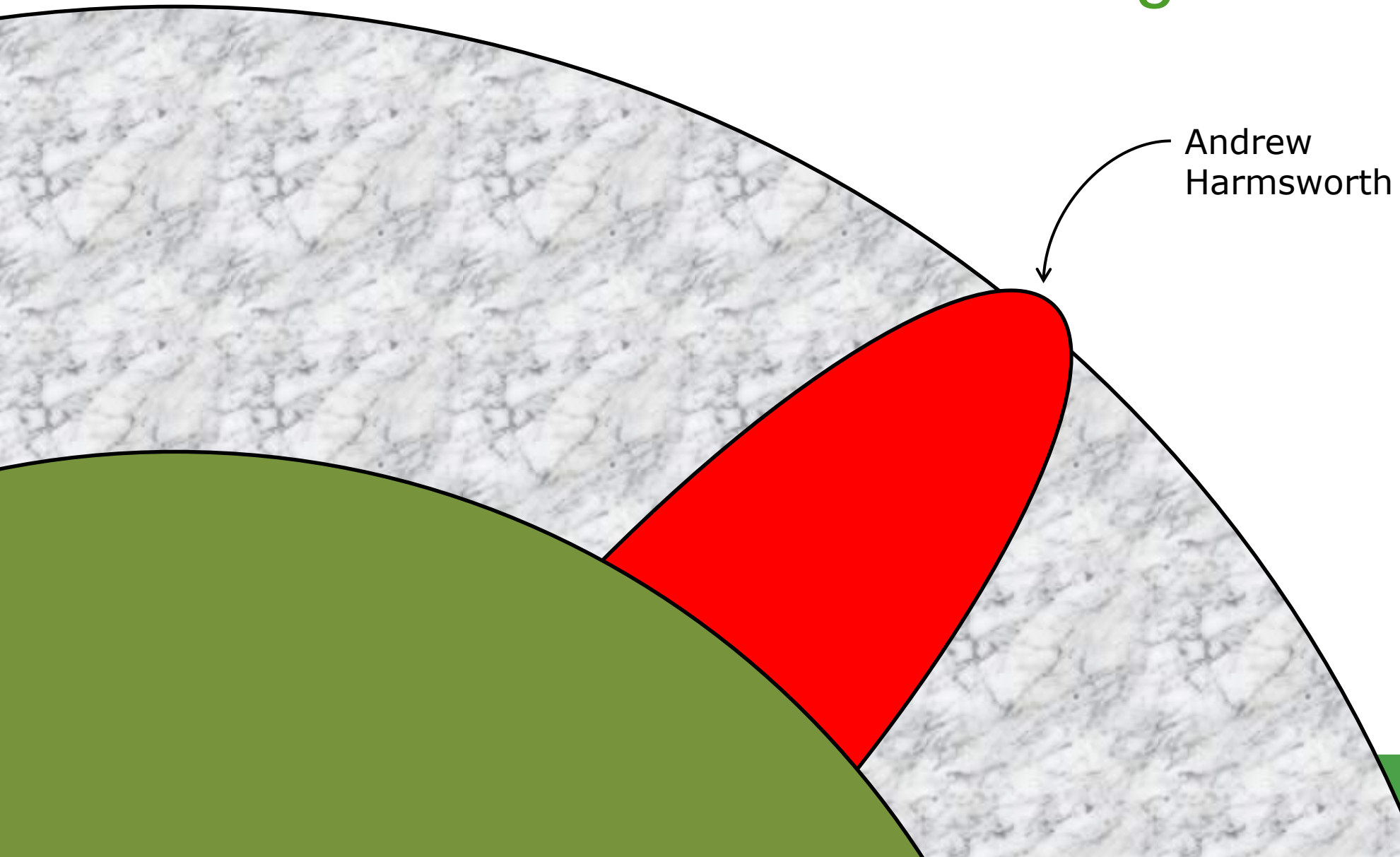

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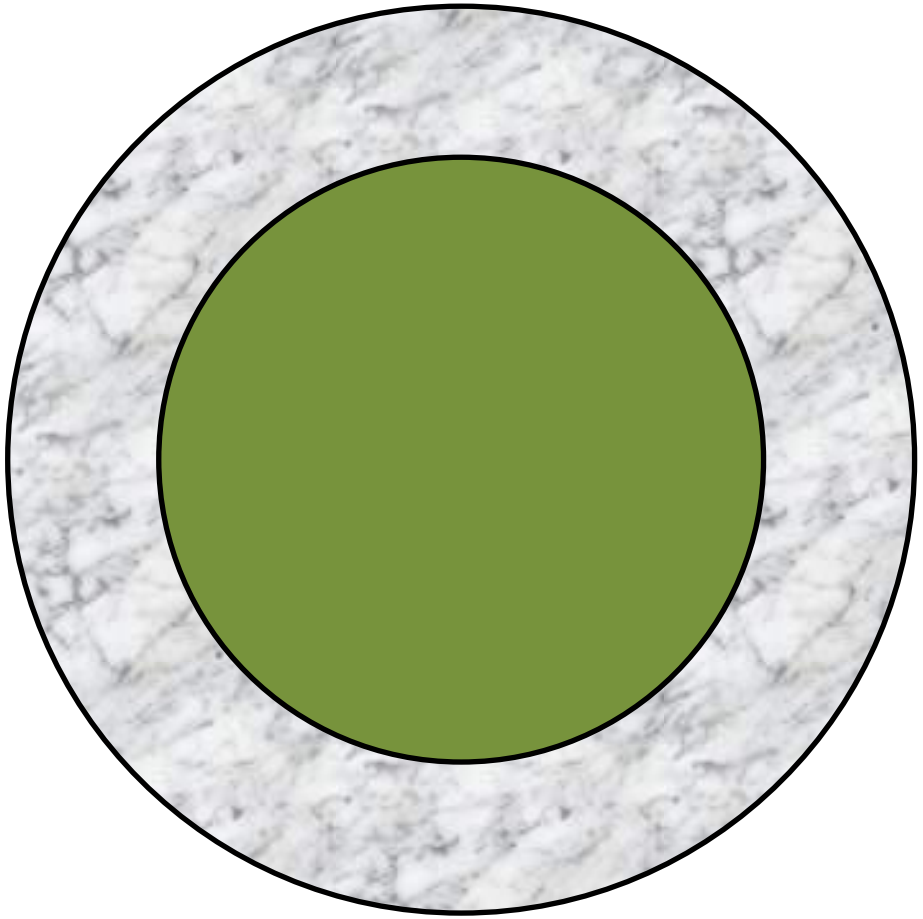

Role of the Building Official

- Confirm
- Collaborate
- Contribute
  - Advocate for local variations and needs (FD, bylaws, etc.)
  - Be a purposeful generalist
  - See the bigger picture
  - Be aware of unidentified interactions

Alternative Solutions - Differing Levels of Risk and Complexity

Categories of Solutions

- Acceptable Solutions - Division B
- Field Solutions – simple on-site decisions, ‘OK – that works’
- Engineering Judgments – minor deviations from listed designs
- Simple Equivalency proved by direct test or simple analysis
- Alternative solution with clearly defined level of performance
- Complex Alternative Solution or innovative solution (Level of Performance Hard to define)
- No defined objectives or functional statements

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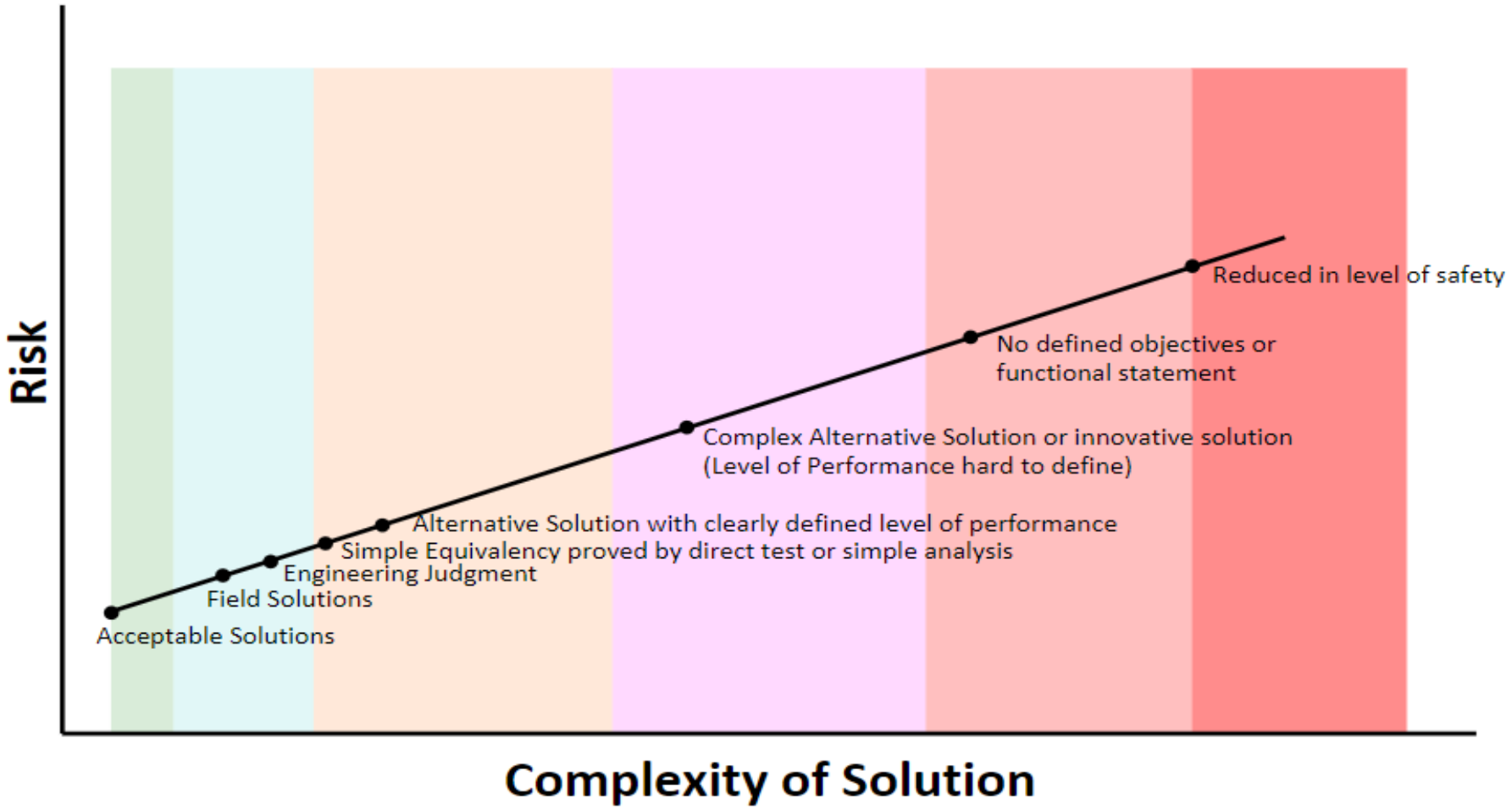
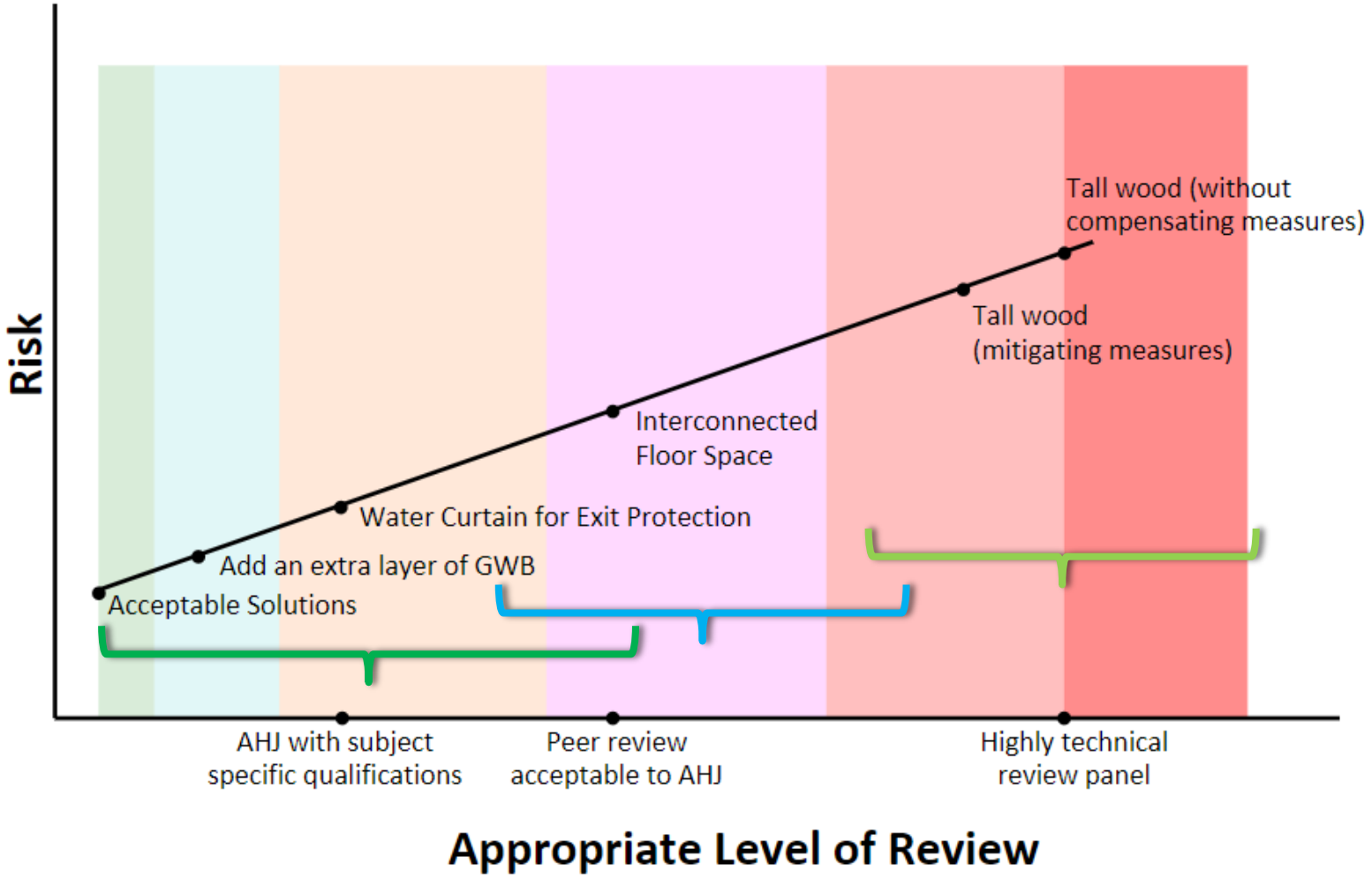


*NOTE: This is relative risk. An acceptable solution has a level of risk.

We can tie this to level of Review



Capability to Manage Risk

- Can the operator of the facility be relied upon to maintain safety protocols?

  Code does not speak to Type of Owner and ability to manage the risk

  However, it does talk of maintenance and implicitly ability of owner to manage the alternative solution

  Example :

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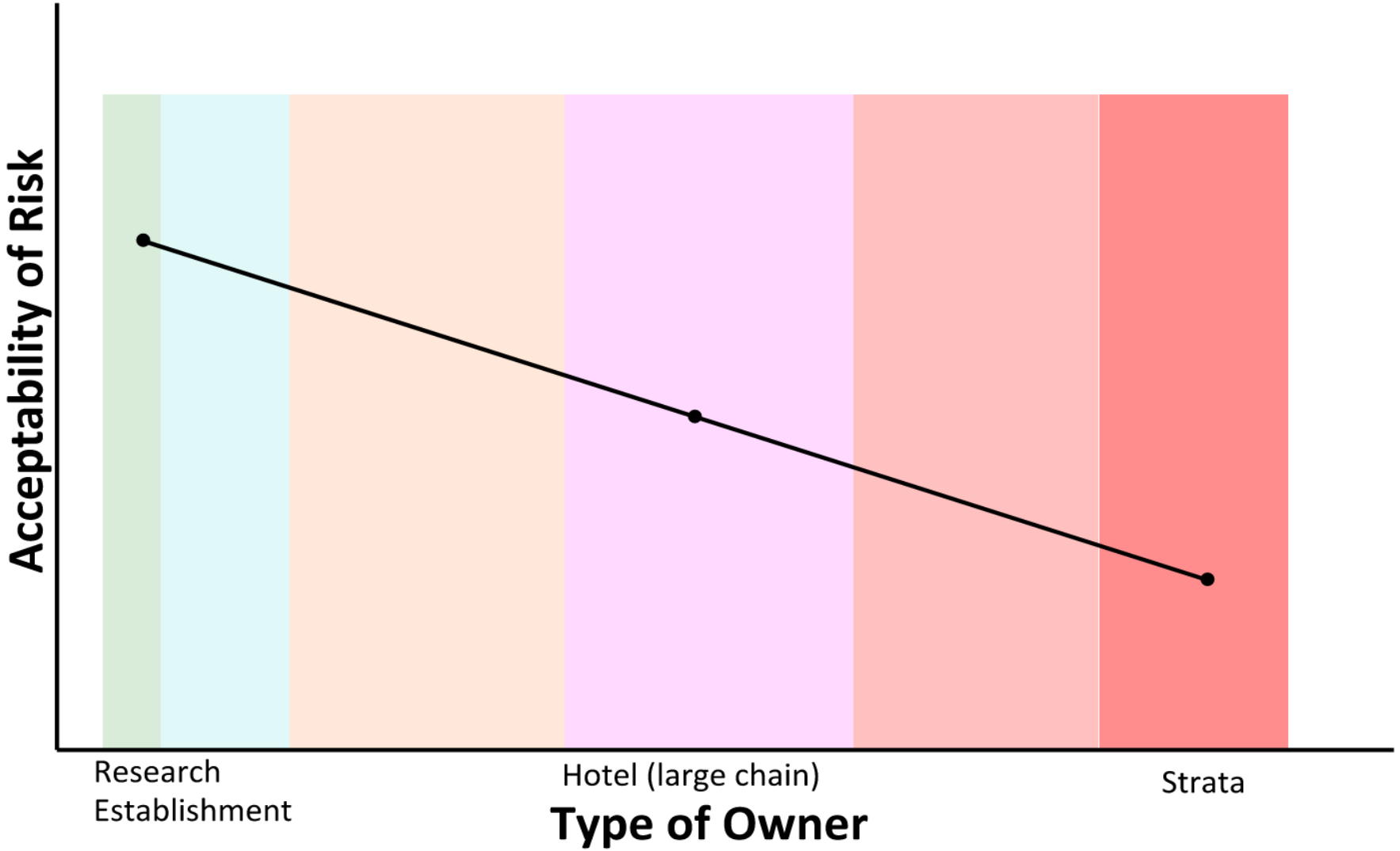
Acceptability of Risk



Challenge

What is an appropriate Level of Review?

1. Review for conformance with regulations

2. Review for technical accuracy

3. Assessment of whether it provides the level of performance, relative to the Division B solution.

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Test of An Alternative Solution

1. Does it correctly identify the applicable acceptable solution

2. Does it correctly identify the Objectives and Functional Statements

3. Does it demonstrate that is provides the appropriate level of performance.

1 and 2 can be confirmed by the Building Official.

Item 3 will depend on Building Official's capability and willingness to assess technical validity.

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Level of Performance

- Provide the same level of performance as the Acceptable Solutions in Division B
- There may be different levels of performance in Division B.
- Division B may not provide a level of performance .
- Is Division B too high, - look for other ‘levels’.
  - 3 storey unsprinklered?

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Conundrums?

The level of performance required for safety may – in some cases - not be the level of performance required by Division B:

- Parking Garage for Electric Vehicles – what is the level of performance for the CO vestibules?

- Prohibitions: Div B prohibits more than one residential unit in a building of F-2 occupancy.
  - How is that a solution – or is it an ABSENCE of a solution?
  - Division A does not help us with these questions.

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Complex Alternative Solutions

- Timed Egress models
- Fire and Smoke Modeling of Complex Atria
- Exposed Mass Timber based on analysis of fire test data
- Finite Element Modeling (common in structural)
- Numerical Risk Analysis

- Where level of performance is:
  - not well defined
  - not provided (i.e. prohibition)

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Also Complex

- Where level of performance is:
  - not well defined
  - not provided (ie prohibition)

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Realities of Code Development

- Code Committees cannot assess ALL possibilities
  - Inherently must concentrate on significant issues.

- Absence of a permission, or absence of a solution, may simply reflect lack of priority, or lack of time to address items.

- Solutions based on technology of the day when the solution was developed:
  - Doubling of building area for sprinklers dates back to 1920's
  - Predates – fire alarms, QR sprinklers, monitoring, supervision,

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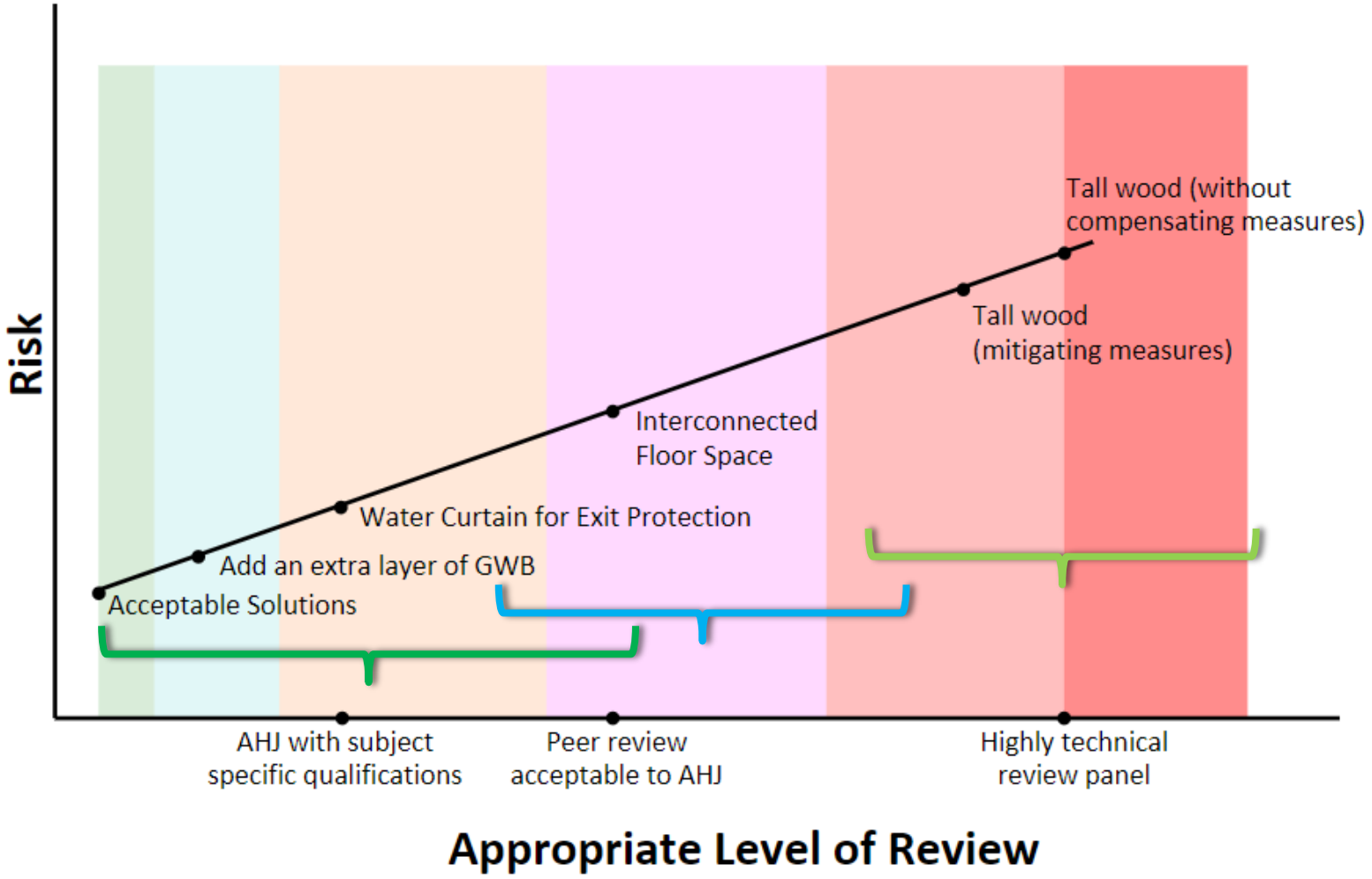
We Can Tie This To Level Of Review



Peer Reviews

Why Peer Review?

- Not possible for any one engineer to be an expert in all topics.
- Nor is it possible for an AHJ to be an expert in all subjects.
- In many cases there may be a limited number of experts.
- AHJ may not want to take on the task of ‘technical review’
  - Even if capable, AHJ may not wish to assume the liability of the technical review.

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Review Commensurate with Risk and Complexity

- A simple Alternative solution may not need an independent or peer review.
  - One of the many simple and generally acceptable alternative solutions:
    - E.g. water curtain for exit exposure protection in a smaller building
- Complex Alternative Solutions may need Peer Review.
- Highly complex, variations in level of performance may require multiple Reviewers.

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Responsibility for Engineered Design

- An Alternative Solution is an Engineered Design.
- Responsibility lies primarily with the proponent.
- EGBC and GHL can speak to Responsibility, closely tied to Liability.

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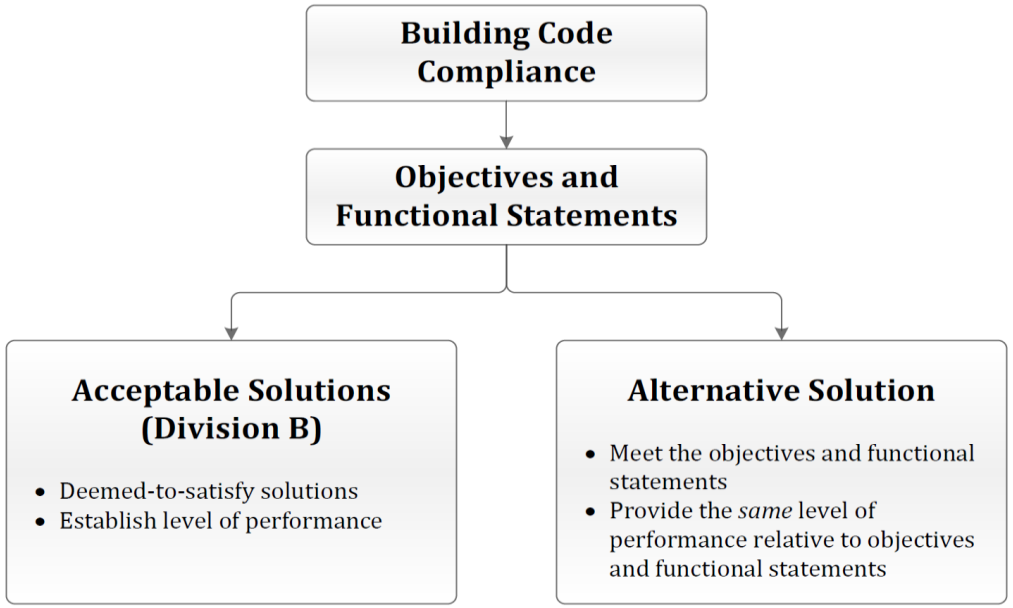
Liability of the AHJ

- An Alternative Solution process does <u>not</u> deviate from a Building Permit review/issuance/inspection process
- Recall Division A:



Liability of the AHJ

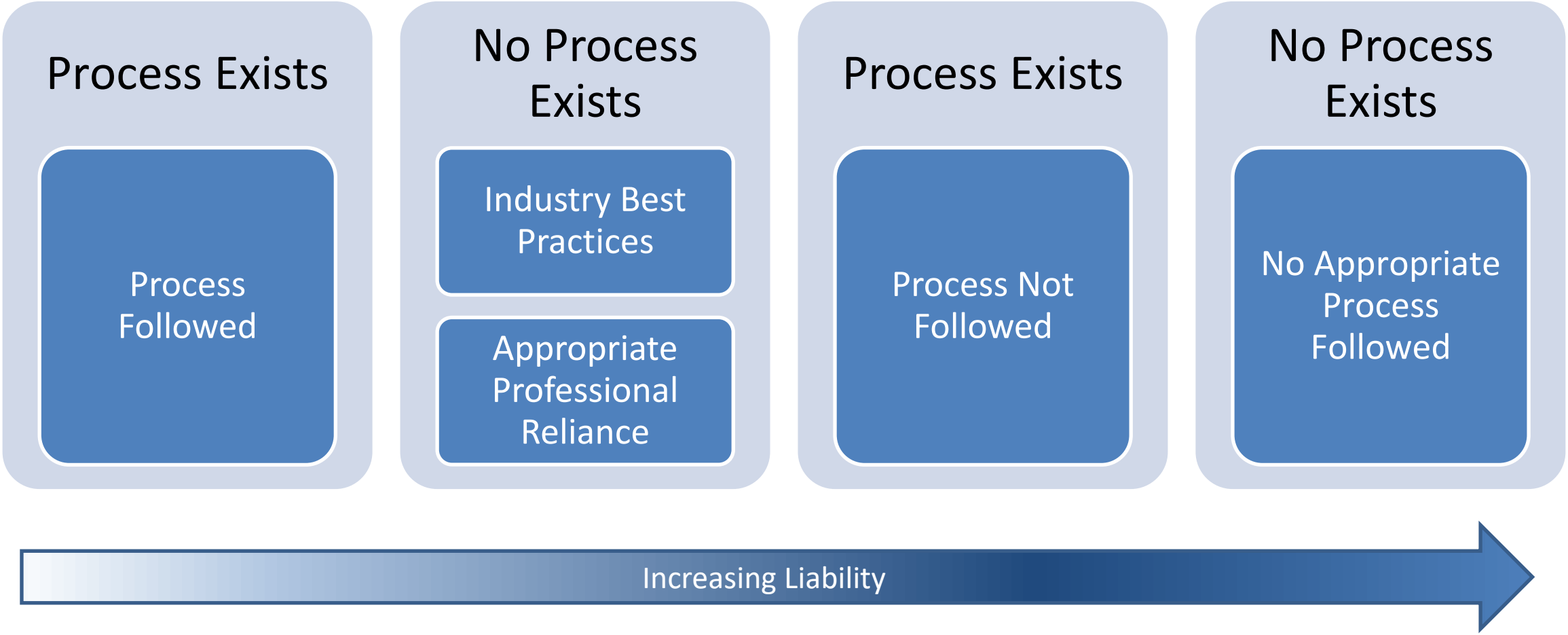
- Local Government Act – Section 743
  - Immunity in relation to approval of certified building plans
- Community Charter – Professional Reliance Discount
  - 5% (up to $500)
- Local Building Bylaw / MIA Bylaw

Liability of the AHJ

- A Building Official who relies on Peer Review takes minimal liability.

- Less Liability than a conventional plan review – as you are expected to be an expert on plan review.

AHJ Influence on Liability



Liability of the Building Official

If you follow the process:

- Liability for an Alternative Solution is minimal.
- Less than the liability for a Plan Review – because you are an expert in plan review.
- You are not expected to be an expert in an Alternative Solution.

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Levels of Review

Peer Reviewer Shall:

- Understand Scope and Intended use of the Peer Review.
- Be Competent.
- Fair, Courteous, Objective, Good Faith.
- Distinguish between Fact and Opinion.
- Be aware of and disclose Conflicts of Interest.
- Be aware of additional Requirements.

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Process

Peer Review Objectives

- To provide a second opinion of the statement required of every alternative solution:
  - *This solution will provide 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.*

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Critical Elements

- Free and open exchange between the parties:
  - Proponent
  - Authority
  - Related Parties, such as Fire Department, Engineering
  - Sometimes user groups
  - Peer Reviewer

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Role of the Building Official

- Define Process.
- Assist in selecting an appropriate peer reviewer.
  - Confirm qualifications.

- To be objective.
  - Provide the perspective of the Authority, communicate local concerns, such as those related to fire access and fire department capabilities.

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Qualifications of Peer Reviewer

- Should be a professional qualified in the area of the alternative solution:
  - Usually a Professional Engineer (P Eng or PL Eng), may be an Architect, or Scientist.

- Must have appropriate qualifications and expertise – same as the proponent per Division C.

- Should demonstrate his or her qualifications.

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Selection of Reviewer

- Ideally the proponent and the Building Official can mutually agree on a peer reviewer.

- If no agreement, it is appropriate for the Authority to ask for a two or three of Peer Reviewers who are suitable, and the proponent should have the opportunity to review fees and schedules. The Authority then selects one of the proposed reviewers.

- If the Authority is paying the costs, the Authority can propose a selection of reviewers, and the proponent then selects one.

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Limited Reviewers

- Frequently there may be a very limited number of Peer Reviewers.
- For Example, much of GHL's work is related to specific mass timber fire testing. There are very few people that are aware and capable of reviewing our work on exposed mass timber, as such review benefits from direct knowledge of the fire tests.
- Similarly for large smoke models and Atria, there may be limited reviewers.

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An Iterative Process

- It is beneficial if the peer reviewer is involved in the process early on.
- Multiple meetings are likely required throughout the process.
- In my opinion the AHJ may wish to participate in all correspondence and meetings between the peer reviewer and the proponent, or they may wish to rely on the final report.

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Who Pays

- Independent or Peer Review is best paid for by the proponent.
- Agree on the reviewer.
- Generally, owners are supportive.
- Cost savings in construction usually pay for the review.

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GHL's Perspective

- We like Peer Review.
- We welcome the opportunity to get feedback on our designs.
- We are not interested in failure.
- We have had peer reviews performed on work, both formal and informal, to confirm we are doing things correctly, even when not requested by the authority.
- Example is that we had a peer review done on our Distillery work some years ago to confirm our assumptions and approach.

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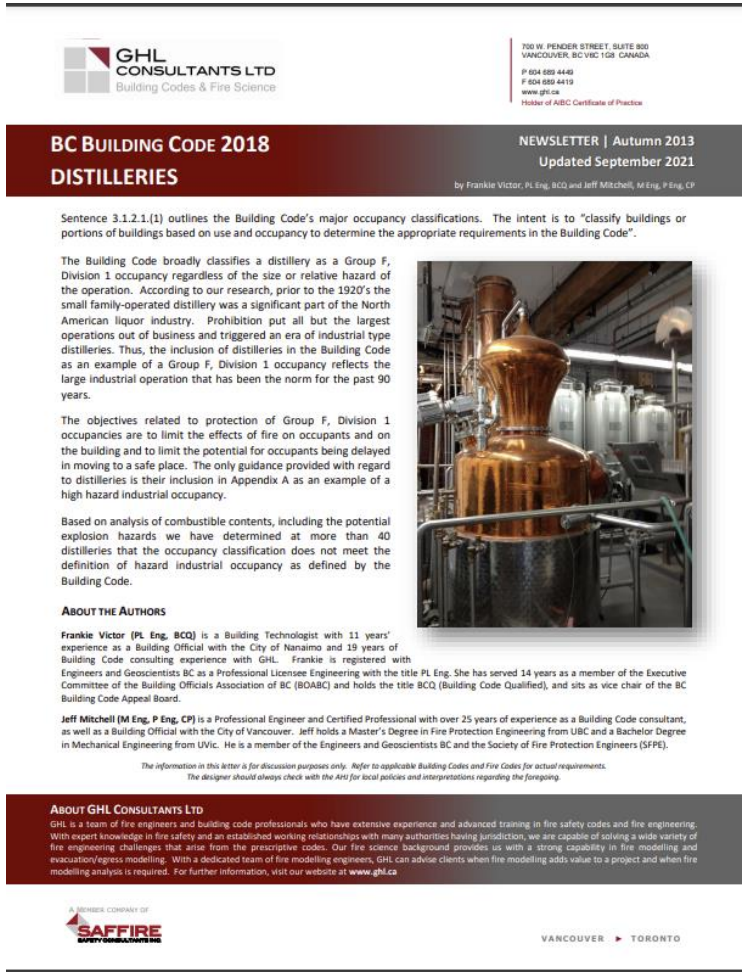
Voluntary Peer Review

Distillery Work

- New area of work for GHL in 2016
- Requested a fire engineering firm in Ontario to give us a Peer Review on one sample report for internal purposes.



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BC BUILDING CODE 2018
DISTILLERIES

NEWSLETTER | Autumn 2013
Updated September 2021

by Frankie Victor, PL Eng, BCQ and Jeff Mitchell, M Eng, P Eng, CP

Sentence 3.1.2.1.(1) outlines the Building Code's major occupancy classifications. The intent is to "classify buildings or portions of buildings based on use and occupancy to determine the appropriate requirements in the Building Code".

The Building Code broadly classifies a distillery as a Group F, Division 1 occupancy regardless of the size or relative hazard of the operation. According to our research, prior to the 1920's the small family-operated distillery was a significant part of the North American liquor industry. Prohibition put all but the largest operations out of business and triggered an era of industrial type distilleries. Thus, the inclusion of distilleries in the Building Code as an example of a Group F, Division 1 occupancy reflects the large industrial operation that has been the norm for the past 90 years.

The objectives related to protection of Group F, Division 1 occupancies are to limit the effects of fire on occupants and on the building and to limit the potential for occupants being delayed in moving to a safe place. The only guidance provided with regard to distilleries is their inclusion in Appendix A as an example of a high hazard industrial occupancy.

Based on analysis of combustible contents, including the potential explosion hazards we have determined at more than 40 distilleries that the occupancy classification does not meet the definition of hazard industrial occupancy as defined by the Building Code.

ABOUT THE AUTHORS

Frankie Victor (PL Eng, BCQ) is a Building Technologist with 11 years' experience as a Building Official with the City of Nanaimo and 19 years of Building Code consulting experience with GHL. Frankie is registered with Engineers and Geoscientists BC as a Professional Licensee Engineering with the title PL Eng. She has served 14 years as a member of the Executive Committee of the Building Officials Association of BC (BOABC) and holds the title BCQ (Building Code Qualified), and sits as vice chair of the BC Building Code Appeal Board.

Jeff Mitchell (M Eng, P Eng, CP) is a Professional Engineer and Certified Professional with over 25 years of experience as a Building Code consultant, as well as a Building Official with the City of Vancouver. Jeff holds a Master's Degree in Fire Protection Engineering from UBC and a Bachelor Degree in Mechanical Engineering from UVic. He is a member of the Engineers and Geoscientists BC and the Society of Fire Protection Engineers (SFPE).

The information in this letter is for discussion purposes only. Refer to applicable Building Codes and Fire Codes for actual requirements. The designer should always check with the AHJ for local policies and interpretations regarding the foregoing.

ABOUT GHL CONSULTANTS LTD

GHL is a team of fire engineers and building code professionals who have extensive experience and advanced training in fire safety codes and fire engineering. With expert knowledge in fire safety and an established working relationships with many authorities having jurisdiction, we are capable of solving a wide variety of fire engineering challenges that arise from the prescriptive codes. Our fire science background provides us with a strong capability in fire modelling and evacuation/egress modelling. With a dedicated team of fire modelling engineers, GHL can advise clients when fire modelling adds value to a project and when fire modelling analysis is required. For further information, visit our website at **www.ghl.ca**

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Tim's Perspective

- Administered Independent Reviews and Peer Reviews on several occasions across multiple municipalities
- Used effectively, Peer Reviews can be a gift to both the AHJ and the developer
  - Knowledge, confidence, time
- A clear process is critical for maximum effectiveness
- Competent peer reviewers are incredibly tough on each other

Initial Meeting

- Include other stakeholders – especially Fire Department for Part 3
  - For example, if it was a sewage related AL, would be Sewers department.
- Discuss qualification – Proponent and Reviewer?
- Are other parties required – other areas of expertise?
- Discuss Peer Review Process, perhaps discuss potential Peer Reviewers.
- Discuss if a team is needed.
- All parties put their concerns on the table.

Proponent Develops Alternative Solution

- Proponent considers all comments, owner's requirements and develops alternative solution.

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Peer Reviewer – collects information

- Peer Reviewer collects documentation:
  - Alternative Solution Report
  - Necessary Building documentation
  - Fire Department Comments
  - Building Official Concerns.

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Peer Reviewer Obligation – EGBC -Draft

- Hold paramount the safety, health, and welfare of the public, including the protection of the environment and the promotion of health and safety in the workplace.
- Practice only in those fields where training and ability make the registrant professionally competent.
- Have regard for the common law and any applicable enactments, federal enactments, or enactments of another province.
- Maintain competence in relevant specializations, including advances in the regulated practice and relevant science.
- Provide professional opinions that distinguish between facts, assumptions, and opinions.

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Peer Reviewer – EGBC Code of Ethics

- Avoid situations and circumstances in which there is a real or perceived conflict of interest and ensure conflicts of interest, including perceived conflicts of interest, are properly disclosed and necessary measures are taken so a conflict of interest does not bias decisions or recommendations.

- Conduct themselves with fairness, courtesy, and good faith towards clients, colleagues, and others, give credit where it is due and accept, as well as give, honest and fair professional comment.

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Peer Reviewer - Review

- Personally, I like to review the documents, develop my questions for the proponent, and allow the proponent to respond.

- Before issuing any documentation:
  - Discuss, my conclusions with the proponent.
  - Discuss verbally my conclusions with the Authority

- Prepare my written opinion.

GHL

Responsibility

- Primary Responsibility lies with the Proponent
- Peer Reviewer would take secondary liability, protected as long as they do a reasonable review.
- Building Official and Authority are, in my opinion, protected. Two competent professionals have agreed on a solution.
- This is consistent with the MIA bylaw, the Building Official relies on the professional.

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Costs

- Usually absorbed by the Proponent's client.

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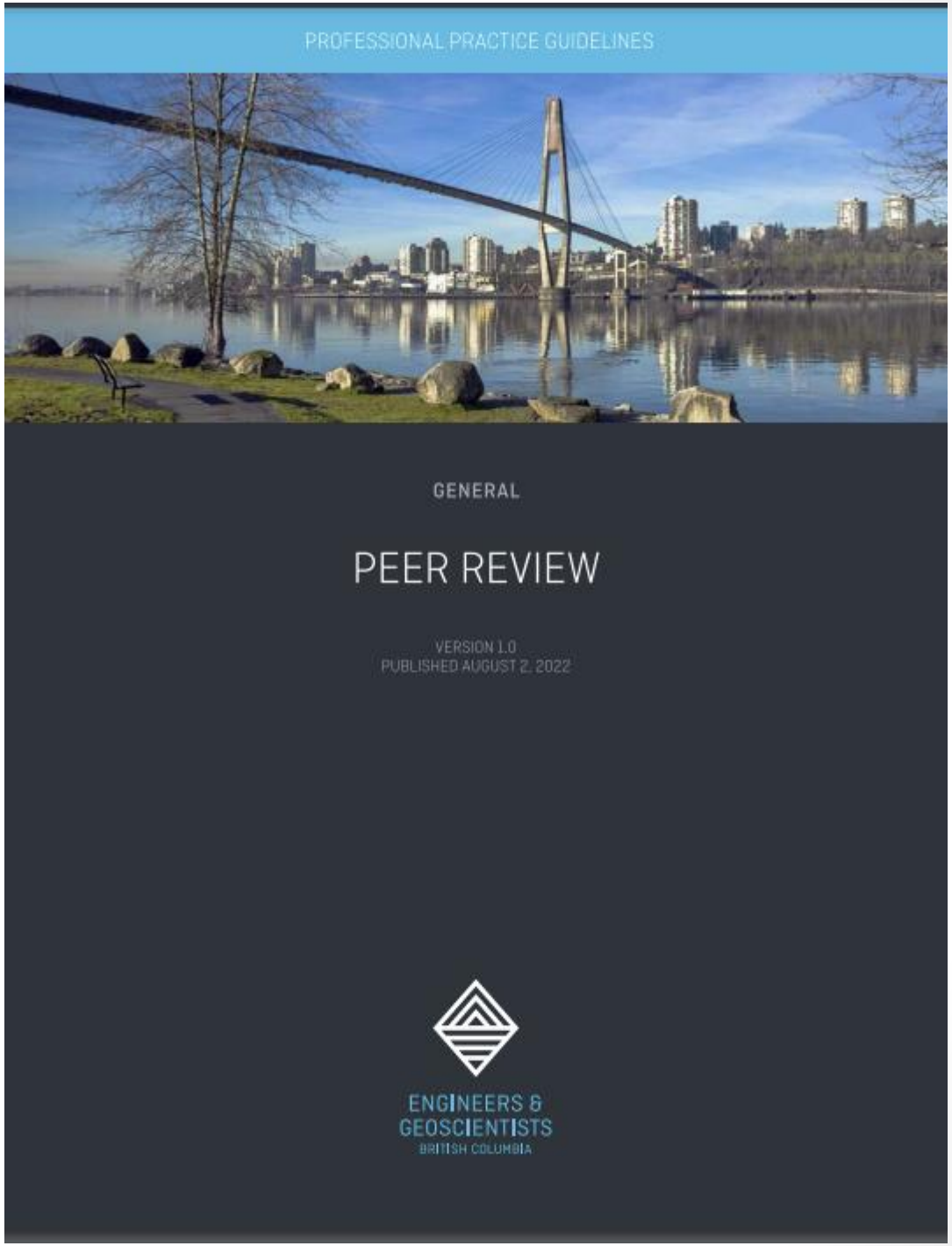
EGBC Guide

Peer Review



2.

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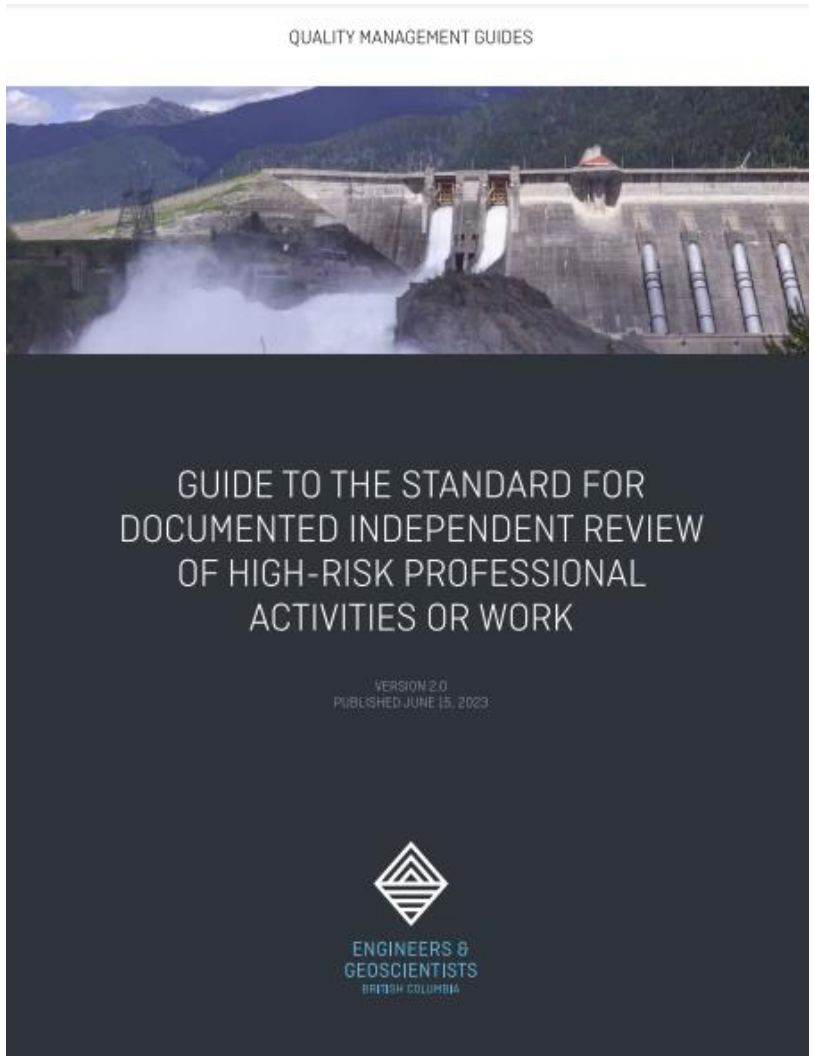
Also Useful

- Provides Added Background and more specific process for peer review.



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Also Useful

- Structural Review has some similarities to Fire Review

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Sample Peer Review Projects

Sample Projects

- Vancouver Convention Center
  - Sewage system
  - Single protected exit plus smoke control system
- Crest – North Vancouver
- The Arbour – Toronto 1- storey exposed
- UBC Tallwood House - essentially a peer review
- 2150 Keith Drive
- Structural design

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Vancouver Convention Center

- Alternative Solutions by Peer Review:
  - Single egress stair plus smoke control system for egress
  - Sewage System
- LMDG responsible for Fire related Alternative Solutions, Peer Reviewed by qualified academic, Jim Mehaffey
- GHL (Andrew Harmsworth) was CP

Crest

- 7 storey (6 on a slope) building with mass timber floors and mass timber firewalls by Adera in North Vancouver.
- Khash Vorell at GHL was the Fire Engineer of Record for the Mass Timber Firewall and 7 storey structure.
- City of North Vancouver (Tim) asked for an independent review by a professional at GHL who was not involved in the project.

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The Arbour – George Brown College

- 10 Storeys – exposed
- Toronto

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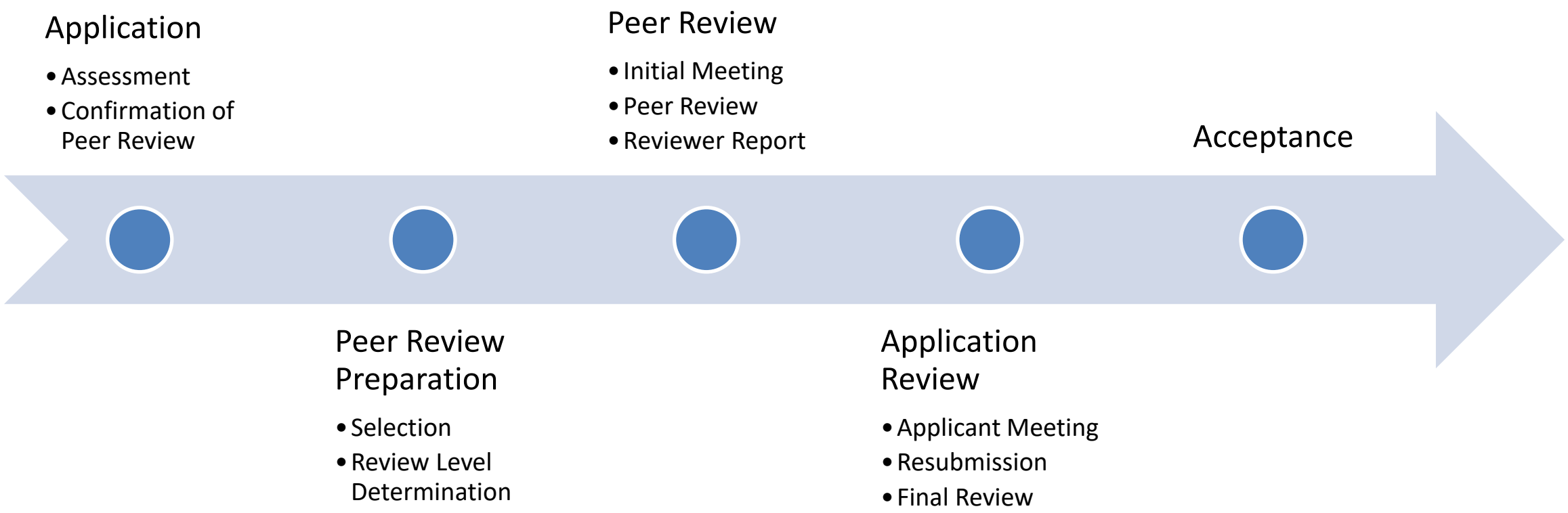
Crest – Peer Review Process



The Arbour

- 10 storey exposed mass timber.
- Joint Fire Engineers (GHL Consultants and CHM) .
- Retained International Peer Reviewer (Arup).

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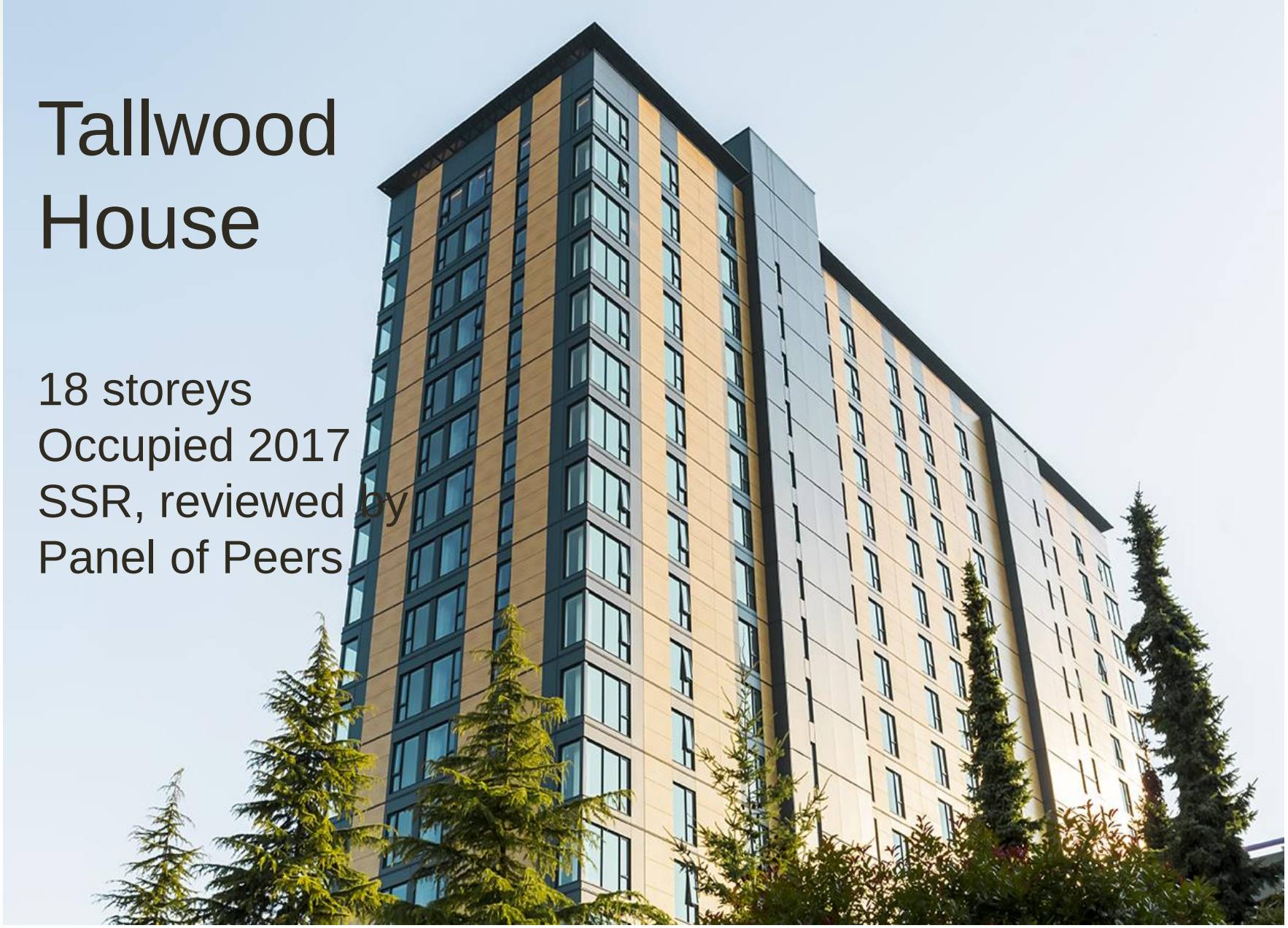
Tallwood House



18 storeys
Occupied 2017
SSR, reviewed by Panel of Peers

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SSR – but similar process

- Mass Timber was new.
- Some concerns that it may have changed the level of risk – so beyond a true alternative solution.
- BSSB retained an invited panel of experts, (appx 16) including fire and structural experts.

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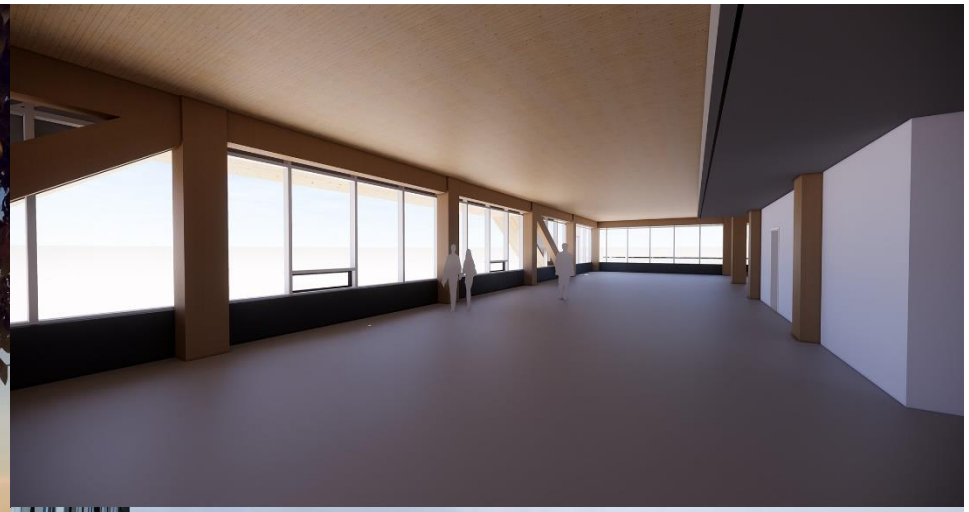
2150 Keith Drive – Fully Exposed MT



- Under Construction
- Peer Review: Fire and Structural

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Peer Review - Bylaws

- City of Toronto Building Bylaw specifically allows reliance on Peer Reviews.
- City of Vancouver has a history of Peer Review and recognizes them in the Bylaw.
- City of New Westminster has a Peer Review Bulletin.
- District of North Vancouver.

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Artistic rendering of Prototype/M5 at 2015 Main Street, Vancouver, as part of the Main Alley tech campus. (Henriquez Partners Architects/Westbank)

Peer Review Example – M5

- 24-storey Residential Building. 2h FRR.
- Concrete core, steel structure and CLT floor hybrid.
- City of Vancouver.
- Challenges: Type of construction, interior exposed wood.

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Peer Review Example – M5

- Alternative solution created and returned with comments.
- City and Client agreed peer review is appropriate.
- GHL suggested 2 potential peer reviewers (PRs)
  - Objectivity and independence, Code of Ethics
  - Technical qualifications

GHL

Peer Review Example – M5

- City, Client, GHL agreed on the selected PR.
- The Client contracted with the PR directly.
- Direct communication between GHL and PR permitted by City and Client.
- Relevant documentation distributed to PR.

GHL

Peer Review Example – M5

- Review comments

Comment No.	Section	Comment
2	General	There is very little discussion of a number of the proposed mitigating features and how they improve the performance with respect to the functional statements and objectives (such as the upgraded fire separations between suites and suite/corridor, doorway sprinklers, pressurization of corridors).
3	General	GHL to confirm that all other interior finishes, other than the exposed mass timber, will meet the VBBL for a building of noncombustible construction, or is noncombustible such as gypsum board?
4	General	The maximum areas of exposed mass timber have not been finalized. Provide final numbers.
5	General	Since more than 10% of wall and ceiling areas are to be exposed mass timber, Sentence 3.1.13.2.(4) (relating to flame-spread rating of interior finishes) also needs to be addressed in the alternative solution.
6	General	As mass timber makes up part of the exterior wall assembly, the wall assembly must meet CAN/ULC-S134, *Standard Method of Fire Test Of Exterior Wall Assemblies*. The path to compliance should be added to the alternative solution.
7	General	Connection design between steel structural elements (beams/columns) and mass timber can be challenging to meet the required fire-resistance rating. The report should address how the fire resistance rating of such connections will be achieved (e.g., gypsum board bulk heads protecting steel beams).
8	Objectives and Functional Statements (PDF pg 3)	Final sentence – "...sprinkler system has failed to operate or effectively suppress the fire." Sprinkler systems are designed to control rather than suppress fire. Suggest rewording to "control or suppress".
9	Summary of Solutions/List Mitigating Features (PDF pg 3)	Some of the features indicated as mitigating features are not mitigating features (e.g., features that improve the level of performance over and above code provisions). Examples are hybrid construction (building is required to be noncombustible), material properties of mass timber, and test data. Suggest moving items 1-7 to a separate list.
10	Alternative Solution (PDF pg. 5)	It is stated that the analysis compares the proposed hybrid construction with light steel-frame construction. However, floor assemblies would not be light steel-frame construction.
11	Compartment Fire Dynamics (PDF pg 5)	It is stated that "massive ventilation" is observed during flashover. Clarify the statement.

Comment No.	Section	Comment
12	Interior Exposed Timber (PDF pg 8)	It is indicated that 40% exposed walls are in the corner units. Clarify the method of calculation of the percentage. What walls are included in the calculation, and are windows included as well?
13	Corner Re-Radiation (PDF pg 10)	The Configuration Factors indicated rely on the windows being floor-to-ceiling, creating a gap in the mass timber between panels. It is recommended to add this information as a change in this condition could affect the results of the analysis.
14	Corner Re-Radiation (PDF pg 10)	Only the two closest panels are included in the Configuration Factor calculation, however, the further panel must also be included for a fair comparison to the experimental test set-up.
15	Building Height (PDF pg 12)	Under Firefighting, it is noted that the risk to emergency responders "is not expected to be significantly higher than a noncombustible building." The performance must be demonstrated to be as good or better than a noncombustible building.
16	Fire-Resistance of Timber Elements (PDF pg 12)	Reports are referenced relating to CLT charring. These reports should be referenced in the alternative solution. Any deviation from CSA O86 should be part of the alternative solution.
17	Comparative Risk Analysis (PDF pg 13)	A comparison is made between the proposed mass timber floor assembly and ULC Design No. G515. The ULC design is characterized as light steel joists with a single layer of ⅝" gypsum board. However, this design includes a 3" slab of concrete to achieve the 2-hour fire-resistance rating. The elements work together to achieve the fire-resistance rating which is not part of the discussion.
18	Comparative Risk Analysis (PDF pg 14)	A discussion is provided on outlet boxes penetrating a gypsum membrane forming part of the fire-resistance rating of an assembly. These outlet boxes would be required to be fire-rated or appropriately firestopped to maintain the fire-resistance rating. Provide additional clarification/commentary.
19	Comparative Risk Analysis (PDF pg 14)	A report is mentioned where the NRC tested a wide range of fire-rated assemblies. Reference the report in the alternative solution.
20	Potential Elevated Fuel Load (PDF pg 14)	A reference is made to an NRC report, *Cross-Laminated Timber Stair/Elevator Shaft*. However, there is no further discussion on this report or its relevance to the M5 building.

Peer Review Example – M5

- GHL reviewed the review comments.
- Initial draft responses formulated.
- Meeting arranged between GHL and PR.
- Discussion.

GHL

Peer Review Example – M5

- GHL responded with revised report.
- Expanded the “Evolving Table”.
- Direct response to each comment.
- A few disagreeable items.

Comment No.	Section	CHM Comment (February 14, 2023)	GHL Response
1	General	The analysis of the building's exposed mass timber compared to the NRC tests does not appear to be complete. It is noted that the exposed mass timber prolongs the decay period, and the proposed exposed mass timber is similar to one of the tests. However, it is not explained how the performance equivalent of the Acceptable Solution (noncombustible construction) is met. For example, how does the prolonged decay period affect the fire safety with respect to the objectives and functional statements?	A new section has been added to address the objective and functional statements directly. In summary, occupant safety including first responders [P02-OS1.2] is addressed by the comparable pre-flashover conditions of the CLT compartments, enhanced fire separations, pressurized corridor, noncombustible exit stairs and enhanced sprinkler reliability. Building structure [P02-OP1.2] is addressed by the fact that the structural elements are fire resistance rated.
2	General	There is very little discussion of a number of the proposed mitigating features and how they improve the performance with respect to the functional statements and objectives (such as the upgraded fire separations between suites and suite/corridor, doorway sprinklers, pressurization of corridors).	Similar to Item 1, we added a new section to address this item.
3	General	GHL to confirm that all other interior finishes, other than the exposed mass timber, will meet the VBBL for a building of noncombustible construction, or is noncombustible such as gypsum board?	Confirmed, but will need HPA and Westbank to agree.
4	General	The maximum areas of exposed mass timber have not been finalized. Provide final numbers.	The maximum areas of exposed mass timber is tentatively determined to be 73% of ceilings and 40% of wall areas.

Comment No.	Section	CHM Comment (February 14, 2023)	GHL Response
7	General	Connection design between steel structural elements (beams/columns) and mass timber can be challenging to meet the required fire-resistance rating. The report should address how the fire resistance rating of such connections will be achieved (e.g., gypsum board bulk heads protecting steel beams).	All connections are proposed to be contained within 2h partition walls or gypsum board bulkheads
8	Objectives and Functional Statements (PDF pg 8)	Final sentence – "...sprinkler system has failed to operate or effectively suppress the fire." Sprinkler systems are designed to control rather than suppress fire. Suggest rewording to "control or suppress".	We reworded per your comment.
9	Summary of Solutions/List Mitigating Features (PDF pg 8)	Some of the features indicated as mitigating features are not mitigating features (e.g., features that improve the level of performance over and above code provisions). Examples are hybrid construction (building is required to be noncombustible), material properties of mass timber, and test data. Suggest moving items 1-7 to a separate list.	There are two lists of mitigating features. The first set has to do with the analysis of the design supported by fire tests. This is considered as a mitigating feature that substantiates the AS. The second set are "trade offs" (e.g., enhanced separations) to further address specific concerns. It is our opinion that the order of the mitigating features should remain as is.
10	Alternative Solution (PDF pg. 5)	It is stated that the analysis compares the proposed hybrid construction with light steel-frame construction. However, floor assemblies would not be light steel-frame construction.	For discussion: it is understood that 2h FRR steel construction is permitted for this building, and represents the lowest level of performance that is permitted by Division B.
11	Compartment Fire Dynamics (PDF pg 5)	It is stated that "massive ventilation" is observed during flashover. Clarify the statement.	We reworded to say "significant ventilation of smoke through opening..."

Peer Review Example – M5

- PR reviewed the revised report and GHL comments.

Comment No.	Section	CHM Comment (February 14, 2023)	GHL Response	CHM Notes – May 2023	GHL Response May 2023
5	General	Since more than 10% of wall and ceiling areas are to be exposed mass timber, Sentence 3.1.13.2 (4) (relating to flame-spread rating of interior finishes) also needs to be addressed in the alternative solution.	Under Article 3.1.5.16, solid lumber partitions not less than 38mm thick are permitted in a building similar to the M5. In other words, exposed mass timber walls as interior partitions are permitted in each M5 residential units are the building is sprinklered and each unit is less than 600m². Compared to a building of noncombustible construction with mass timber interior partition walls, the exposed mass timber wall surfaces that would contribute to room flame spread proposed for the M5 is within that prescribed by the VBBL. Furthermore, maximum 25mm thick wall and ceiling finishes of not more than FSR 150 are permitted under Article 3.1.5.12. Mass timber surfaces generally have a flame spread rating of 35 to 40, as tested by FPInnovations. Therefore, comparing to a building that complies with Division B, with exposed mass timber interior partitions and ceiling finishes of 150 FSR, the proposed M5 compartments can be considered to contribute not more to fire growth.	We agree that this is an important comparison to consider for the building. However, the building does not meet the requirement of Sentence 3.1.13.2.(4) and as such this Sentence needs to be referenced at the start of the report as one of the provisions that this alternative solution is addressing, along with Functional Statements and Objectives. While Sentence 3.1.13.2 (4) is an exception and as such is not directly attributed Functional Statements and Objectives, common practice would be to reference those of Sentence 3.1.13.2 (1) as this relates to flame-spread rating more generally.	In our opinion, it is appropriate to consider Sentence 3.1.5.12.(2), 3.1.5.12.(3) and 3.1.13.2.(4) together to formulate the By-law's provisions for flame spread of walls and ceilings in a residential suite (except washrooms): flame spread rating of floor and ceiling is to be not more than 25, with the exception of 10% of the surfaces are permitted to have a flame spread rating of 150. We will make a reference to all three Sentences.
6	General	As mass timber makes up part of the exterior wall assembly, the wall assembly must meet CAN/ULC-S134, *Standard Method of Fire Test Of Exterior Wall Assemblies*. The path to compliance should be added to the alternative solution.	We added a paragraph to comment on CAN/ULC-S134. In summary, the exterior wall including combustible elements will conform to the provisions of Article 3.1.5.5 or 3.1.5.6. The exterior wall may be similar to EXTW-4.	The report notes that the exterior wall will be designed to meet the requirements. In order to meet the requirements, the wall must be tested, must comply with Appendix D, or an alternative solution will be required. Additional information will be required in the final report for CHM's review, or CHM can leave this as a condition of our review.	We will coordinate with HPA + Westbank to provide a tentative design. The tentative design is to demonstrate that the exterior wall will exhibit substantial ability to meet CAN/ULC-S134, through a comparison with Appendix D-6 assemblies. In other words, the proposed assembly should not differ from those in D-6 so that a straightforward EI/AL can be written to substantiate the performance of the assembly.

Peer Review Example – M5

- Review #3: Most comments were resolved.
- Remaining comments relate to design direction, not technical feasibility.
- Expecting final review letter once design is finalized.

GHL

Peer Review Example – M5 – What We Learned

- Peer review is an iterative process.
- A qualified PR agreed by all parties is key to success.
- Direct line of communication between proponent and PR improves efficiency.
- Proponent should expect to learn something new.

GHL

Liability

- Local Government Act – Section 743
  - Immunity in relation to approval of certified building plans
- Community Charter – Professional Reliance Discount
  - 5% (up to $500)
- Local Building Bylaw / MIA Bylaw
- Process Rigor

Closing Comments

- Special Thanks to ACBOA and NRC
  - Course Offering Soon: *"Objective-Based Codes and Alternative Solutions"*