

Overview of Process to Review and Approve “Alternate” Fire Safety Designs in the USA

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Approach in the US - Overview

- US building regulatory system is state-based
- Most states adopt a 'model' building code
- Most widely adopted model code is the International Building Code (IBC)
- Highly prescriptive but allows 'alternative' solutions



Modifications

- 104.10. Wherever there are practical difficulties involved in carrying out the provisions of this code, the building official shall have the authority to grant modifications for individual cases, upon application of the owner or owner's representative, provided the building official shall first find that special individual reason makes the strict letter of this code impractical and the modification is in compliance with the intent and purpose of this code and that such modification does not lessen health, accessibility, life and fire safety, or structural requirements.



Alternative Approaches

- 104.11. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of the code, and that the material, method or work offered is, for the purpose intended, at least equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety."

Paths to Approval

- There are several paths to approval, depending upon jurisdiction and discipline
 - Approval by code official
 - Alone (suitably qualified)
 - Based on peer review (with concurrence of authority)
 - Approval by third party
 - Designated review body (contracted by government)
 - Designated peer reviewer (identified by jurisdiction, paid by entity seeking alternative design)
 - Approval by review/appeals board

Paths to Approval

- Third party review entity
 - Firms which are contracted by government for purpose of code review, inspections, and approvals (widely used for 'normal' plan review)
- Peer / independent review
 - May be voluntary
 - May be mandated by state or local legislation for alternative design (either review, the process to be used, or both)
 - Massachusetts (780 CMR, 2010)
 - Where alternative fire protection designs, which vary from any prescriptive requirements of this Chapter, are to be utilized, the owner shall engage an independent registered design professional, to review said alternative design. The scope of the review shall include, but not be limited to design assumptions, methodologies, and resulting proposed system designs...

Paths to Approval

- Review / appeals board
 - In some jurisdictions, the local authority does not have the legal authority to approve alternative designs – must go before state commissioner, commission, review or appeals board
 - MA – variations from code requires appeal
 - VT – variation requires state Commissioner approval
http://firesafety.vermont.gov/sites/firesafety/files/pdf/Code%20Info%20Sheets/2012_firecode.pdf

Demonstrating Compliance

- Various approaches and requirements exist for demonstrating compliance / equivalency based on jurisdiction and discipline
 - Documentation requirements in code (minimum)
 - Submittal of research reports from approved sources
 - Submittal of tests by approved agency
 - Registered design professional (minimum)
 - PE, SE, AIA, other requirements as per jurisdiction
 - Mandatory or voluntary review and approval guidelines for alternate designs and peer reviews

Qualifications / Licensing

- States have authority to regulate professions
 - States have boards for licensing of professional engineers (PE) and architects (RA) – professionals must be licensed by each state where the practice
 - Common requirements: examinations administered by the National Council of Examiners for Engineering and Surveying (NCEES) - <http://ncees.org/>
 - Engineering degree from accredited university plus 4 (or more) years of experience
 - Fundamentals of Engineering Exam
 - Professional Engineering Exam
 - States may require certified building officials (CBO)
 - ICC certifies building officials (grants CBO designation)

Qualifications / Licensing (NY)

Education/ Experience Credit	12 Years of credit required for admission to the Principles and Practice examination and for licensure											
	ABET-Accredited			Non-ABET Accredited								
12 Years -												
11 Years -												
10 Years -												
9 Years -												
8 Years -												
7 Years -												
6 Years -	6 years of a combination of education and experience credit required for admission to the Fundamentals of Engineering examination											
5 Years -												
4 Years -												
3 Years -												
2 Years -												
1 Year -												
HIGHEST DEGREE	Bachelor	Bachelor	Associate	Bachelor	Bachelor	Bachelor	Bachelor	Associate	Associate	Bachelor	Associate	None
FIELD OF STUDY	Engineering	Engineering Technology	Engineering Technology	Engineering	Technology	Architecture	Science Related to Engineering	Engineering Science/ Pre-Eng. Equivalent	Technology	Not Directly related to Engineering	Not Directly related to Engineering	No College Study
ACCREDITATION	ABET/EAC	ABET/TAC	ABET	Regional	Regional	Regional	Regional	Regional	Regional	Regional	Regional	N/A

Educational credit based in education

Engineering work experience credit needed



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PE Exam Areas – Fire Protection

- 8-hour PE exam
 - Fire Protection Analysis (20%)
 - Types of analysis (risk analysis, hazard analysis, etc) (7.5%); data and information issues (uncertainty, criteria, test methods, etc) (12.5%)
 - Fire Protection Management (5%)
 - Risk management, ITM
 - Fire Dynamics (12.5%)
 - Active and Passive Fire Protection Systems (50%)
 - Water (15%); Special hazards (10%); Detection (7.5%); Smoke Management (5%); Explosion (2.5%); Passive (10%)
 - Egress & Occupant Analysis (12.5%)
 - Human behavior (3.75%) and egress (8.75%)



Processes

- Requirements for alternative materials & methods
 - Some jurisdictions mandate process and requirements
 - http://www.ci.berkeley.ca.us/uploadedFiles/Online_Service_Center/Planning/Guidelines%20for%20Completing%20Alternative%20Methods%20and%20Materials%20Form%20May102012.pdf
 - Other jurisdictions leave decisions to code official on case-by-case basis

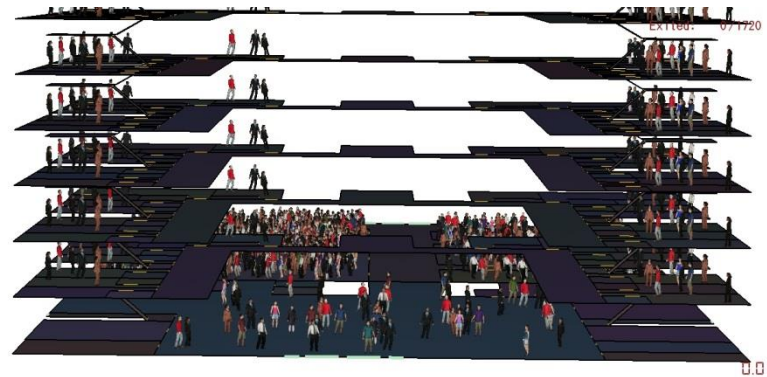
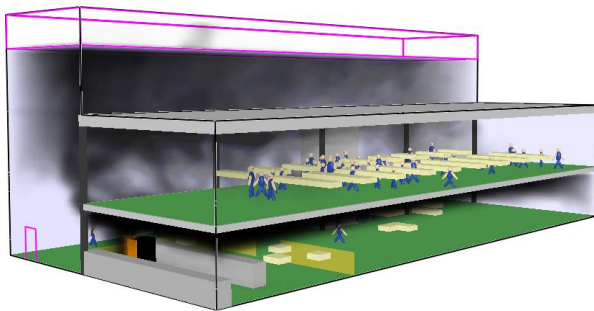
Alternative Materials

- Starting point is use of 'listed' products (UL label) and compliance with approved test standards (ASCE, ASTM, NFPA, UL, ...)
- Some alternate paths are identified in code
 - Flame spread and smoke production of interior finishes
 - IBC requires compliance with ASTM E84, or,
 - Compliance with NFPA 286, room corner test, using stated criteria (IBC 803.1.2, 803.1.2.1)
- Testing and reports by approved agencies are readily accepted.
 - ICC Evaluation Service (ICC-ES)
 - Materials and criteria reports
 - http://www.icc-es.org/reports/pdf_files/ICC-ES/ESR-3043.pdf



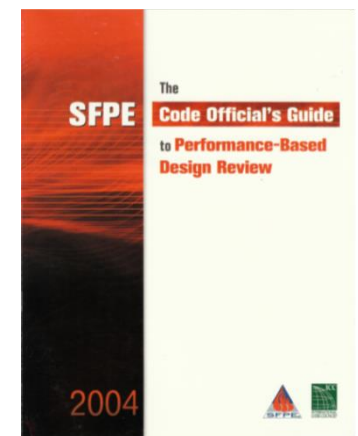
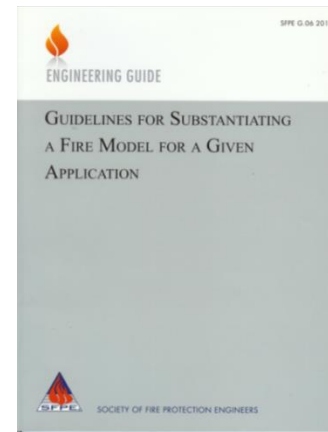
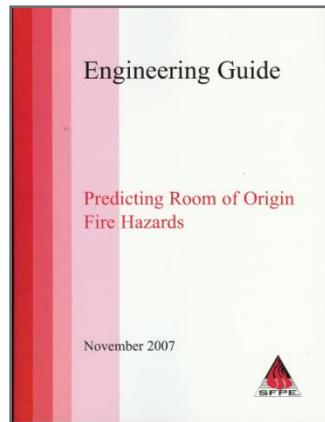
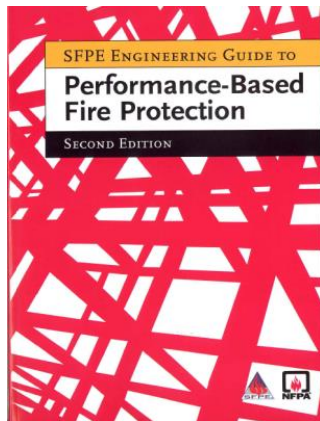
Alternative Methods (Design)

- Engineering analysis and computational modeling, in a performance-based approach, can be accepted as alternative design approach
 - Often used in seismic engineering and fire protection engineering
 - Many of the procedures previously identified apply
 - In addition, numerous guidelines for engineers and code officials



Alternative Fire Design

- Various guidelines
 - SFPE Engineering Guide to Performance-Based Fire Protection Design
 - SFPE Engineering Guidelines for Substantiating a Fire Model for a Given Application
 - ICC/SFPE Code Official's Guide to Performance-Based Design Review



General Approach

- Identify requirements by code / jurisdiction
- Define scope of alternative design
- Develop analysis, following guidelines, using acceptable data, tools and methods
- Submit analysis and documentation, along with request for approval of alternative design
- Code official applies one of methods discussed above

General Approach

- Code official may require
 - Specific testing
 - Copies of computational analysis
 - Third party review of all or parts of analysis and reports
 - Additional analysis to be conducted

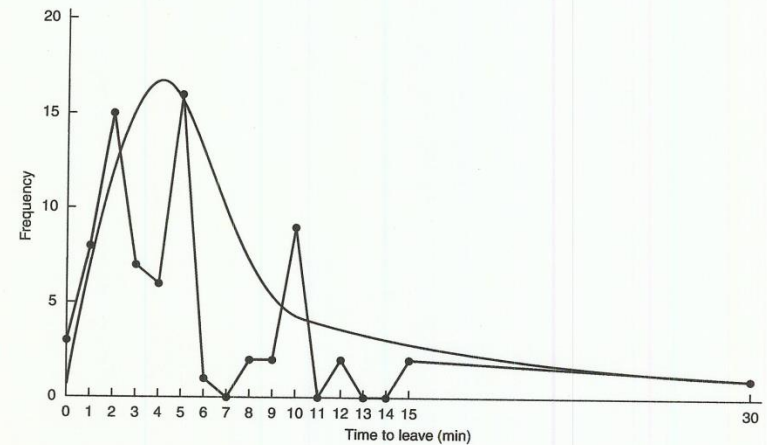
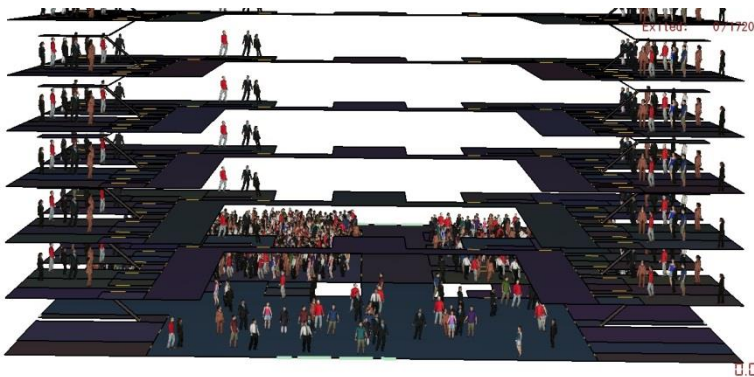


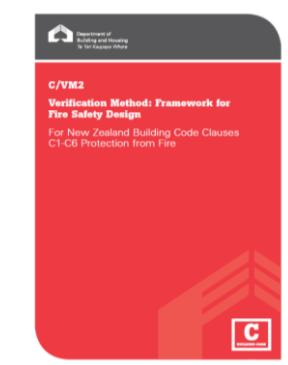
Figure 3-12.2. *Distribution of pre-movement times as reported by the survivors of the Cook County Administration Building fire.*³⁸

Protection

- Code official liability limited
- All legislation requires licensed design professionals
- All contracts require liability insurance for designers and contractors
- For designers, standard of care defined by engineering guidelines, handbooks and related resources
- Liability on owner, limited by contract

Issues

- For fire, guidelines are generic – flexibility means difficulty in assessment and lack of consistency in implementation
- Continuing development in several arenas aimed at better specifying requirements
 - New SFPE committee on fire scenarios and design fires
 - Consideration of specified loads, criteria and verification methods, as in Japan, New Zealand and Sweden



Issues

- Performance may not be known at time of permitting – or for some time to come
 - Potential for unintended consequences as a result of incomplete testing, analysis, experience
 - Leaky buildings in NZ – similar issues were seen in USA, Canada, Sweden and elsewhere
 - Fire designs not fully tested until events
 - Competing objectives – ‘green’ building technology may increase fire risk in some areas
- In the case of performance-based design, it could be held that the designer (engineer) could be negligent if he does not apply an appropriate standard of care
 - If a fire protection engineer assumes occupants will leave when an alarm sounds, and data suggests otherwise, this could be a problem



Issues

- Education and ethics are big issues in performance / alternative designs
 - Need to understand fundamental principles, causes and effects – not just be able to read and comply with code
 - Errors of omission can occur with lack of education and guidance documents
 - Better opportunity to intentionally do less than required as many actors in the process lack knowledge, tools and experience (acts of commission)
 - Helpful to have
 - FSE educational programs
 - FSE CPD courses
 - PE licensing
 - FPE Examination

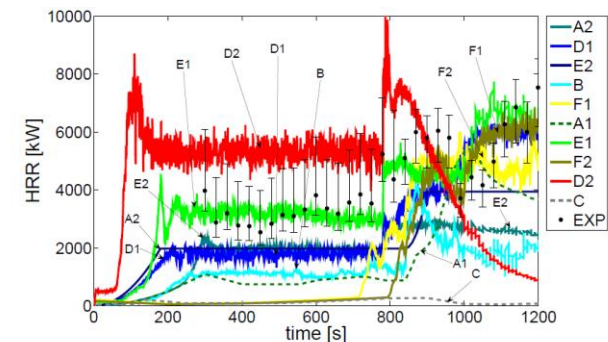


Figure 6: Evolution of the global heat release rate within the compartment. Legend for the different curves: continuous line for CFD simulations; dashed line for zone model simulations; and dotted for the experimental data with error bars.

Summary

- Fire engineering designs within the 'alternate materials and methods' clause
- Wide range of expertise and options to building control – in-house expertise, contract review, peer review
- In USA, engineers must be licensed to practice, and suitable qualifications and experience required to obtain license.
- Wide range of guidance documents to help engineers and enforcement officials
- Insurance, limits on liability, other measures help



Thank You for your Attention!

Questions?

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