Alternative Solutions for the Building Official

Determining Compliance

Randall Kovacs, P.Eng., CP, FEC
Gage-Babcock & Associates, Ltd.

Topics

- Roles/Responsibility
- Elements of an Alternative Solution
- Evaluation Techniques
- Acceptance Criteria
- Peer Review
- Documentation
- Liability Issues
- Site Work

Roles - Proponent

- Sound Code Knowledge
- FPE Tools/Resources – access to expertise
  - Research Papers (NFPA, others)
  - Texts, Online Material
  - Models (CFAST, CFD)

Responsibilities - Proponent

- Demonstrate Compliance
  - Objectives
  - Functional Statements
- Compare Code Compliant vs. Proposed
- "As good as or better"
- Reasonable Mitigation Strategies

Roles – AHJ

- Sound code knowledge
- Permit issuer

Responsibility - AHJ

- Independent, unbiased reviewer
- Is the Alternative Solution "as good as or better"?
- Do not necessarily have to "like" the solution, just assess compliance with O+FS

Elements of an Alternative Solution

- Review basis of Alternative Solution
  - Division A 1.2.1.1.(1) Compliance with this Code
    1) 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).

Elements of an Alternative Solution

- Appendix Notes to Division A.1.2.1.1.:
  - Division B solution satisfies Objectives and Functional Statements (O+FS)
  - "...Division B establishes the quantitative performance targets that Alternative Solutions must meet"
  - Acceptable vs Unacceptable risk:
    - Division B defines what society is willing to accept

Elements of an Alternative Solution

- Clear statement of code reference(s)
- Clear statement of O+FS
- Clear statement of mitigating features including design criteria (e.g. sprinklers, glazing, fans)

Elements of an Alternative Solution

- Justification/Discussion can take many forms
  - Research Papers (CWS)
  - Models (CFAST, FDS)
  - Calculations
- Should compare Compliant Case vs Proposed Solution
- Not a comparison of risk, but of performance

Elements of an Alternative Solution

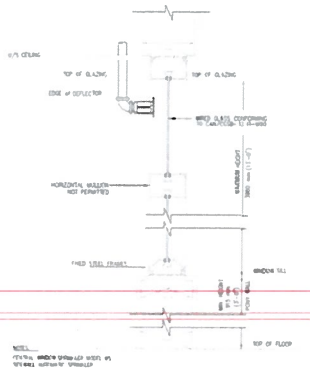
- Complete report with:
  - Maintenance Requirements
    - Short Term
    - Long Term
    - Testing
  - Proponent Qualifications
  - Supporting Documentation

Evaluation Techniques

- Broad Categories
  - Justified by technical reports
  - Justified by modeling/calculations
  - Justified by words

Evaluation Techniques

- Technical Report based:
  - Compare proposed design to criteria in report
    - Examples:
      - Water Curtain Sprinklers
      - Glazing Wetted – Look for no horizontal mullions
      - Pony Walls – Look for methods to keep fire away from base of glazing



Evaluation Criteria

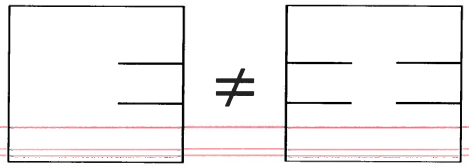
- Reports:
  - Heat Attenuation
    - Does water spray at glazing stop at least as much heat as wired glass?
    - Show by heat transfer calculation or by test data

Evaluation Criteria

- Models
  - Review input parameters carefully
    - Fire size and location adequately justified
    - Multiple runs done for location sensitivity
    - Geometry correct (will be simplified to reduce run time)
    - Is geometry representative of what space really looks like?

Evaluation Criteria

Simplified Geometry Example



Evaluation Criteria

- Models – need sensitivity analysis:
  - Bigger fire size
  - Different (faster) growth rate
  - Multiple occupancies (e.g. Hockey vs Trade Show)
  - Different (credible) fire location
  - Requires multiple runs
  - Different ventilation rates
  - Sprinkler failures

Evaluation Criteria

- Base (Compliant Case) vs Proposed
  - Often difficult to set up a code compliant case, especially for travel distance
  - For smoke studies, can do a run with 4ACH vs other proposed design, but make sure geometry is the same
  - Beware of changing more than one design parameter at a time (e.g. 4ACH, 8g/m^3 combustibles)

Evaluation Criteria

- Word Based
  - Beware of "RISK" comparison
  - Not what Division A says about performance
  - Code (Division B) gives us the tolerable risk, not up to Proponent to say otherwise

Acceptance Criteria

- O+FS
  - Demonstrated as performing as good as or better
  - Should have sound basis for comparison
- Are all elements included?
- Is the solution viable and maintainable in the long term?

Acceptance Criteria

- ASET vs RSET
  - Valid comparison of available vs required time to clear an area, floor or building
  - Must include decision making time delay (1-3 minutes)
  - Based on height of smoke layer (2100-2400mm aff)
  - Requires a timed egress study

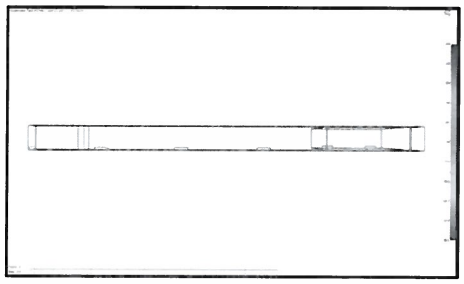
Acceptance Criteria

- Make sure other O+FS are drawn into the discussion, and are justified if they are
- Example
  - Atrium smoke only:
    - O: OS 1.2, OS 1.5, OP 1.2
    - FS: F03, F12
  - But if travel distance as well, add in:
    - O: OS 3.7
    - FS: F10

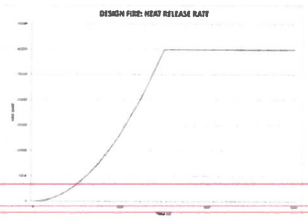
Notes on Models

- Use commercially available models only
  - Validated
  - Provide accurate representation of equations, balances
  - Reliable, repeatable
- No "In-House" models unless validated against real world and repeatable
- NIST CFD, CFAST etc. ok
- Commercially published reports good
  - NFPA
  - SFPE
  - NIST
  - etc.

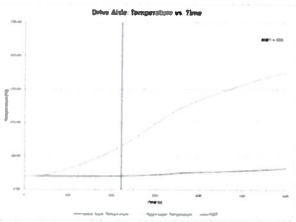
CFAST Elevation Video



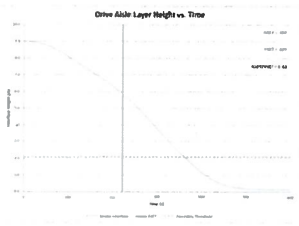
Smoke View Example



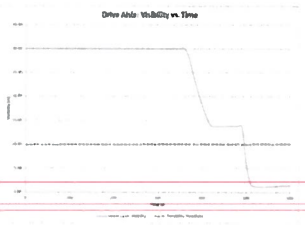
Smoke View Example



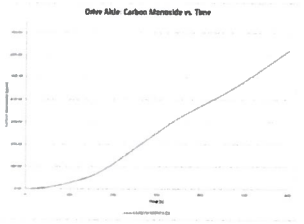
Smoke View Example



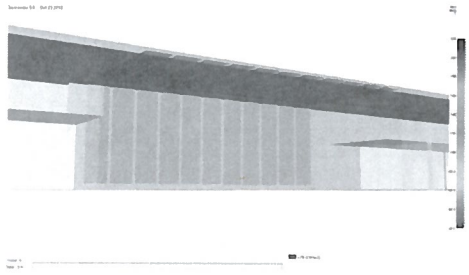
Smoke View Example



Smoke View Example



FDS Simulation



Peer Review

- For complex models, or complex Alternative Solutions
- Viable alternative to AHJ review
- Get sealed recommendation for acceptance from peer reviewer
- Applicant pays

Documentation

- Sealed reports
- Commitment for:
  - Field Reviews
  - Shop Drawing reviews
- Review stamp on sprinkler shop drawings
- Schedule S-B, S-C
- Never Schedule B, C-B

Liability Issues

- AHJ issues the permit
- Alternative Solution is a viable and permitted method of code compliance (Division A)
- Means that as long as the Alternative Solution demonstrates compliance with Division A 1.2.1.1.(1). then no different than Division B
- Then the Alternative solution becomes part of the compliant building permit
- No additional liability

Liability Issues

- Proponent has liability for the Alternative Solution
  - Signs Schedule S-B, S-C
- Applicant has obligation to comply
- AHJ Bylaws and permit wording confirm this
- Occupant has obligation to maintain systems under Fire Code

Site Works

- Proponent obliged to do field reviews during construction (if applicable)
- Should form part of coordinated fire and life safety system testing if appropriate (e.g. fans)
- Caution regarding long term operability and knowledge of systems by building operators
- Do not rely too much on putting information in Fire Safety Plan

Questions/Discussion