Engineering Judgements: The Good, The Bad, The Useful

Today's Presenters

- **Brian Lieburn**, DowDupont
- **Lorraine Ross**, Intech Consulting Inc.

Presentation Overview

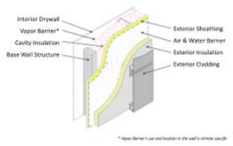
- What is an Engineering Judgement (EJ)?
- How are EJs used for Code Compliance?
- How are EJs Developed?
- What constitutes a credible EJ?
- NFPA 285 testing and EJs
- Group Exercise: Review sample EJs based on NFPA 285
- Interactive Q&A and Discussion

What is an Engineering Judgement (EJ)?

Engineering Judgements (EJs)

- An Engineering Judgement (EJ) is a report, or drawing, issued by a credible organization, which provides an assessment of component substitutions or installation deviations based on a tested assembly.
- Example:
- The code requirement for exterior wall spread of fire is NFPA 285. But there is no practical way to test every combination of components.
- EJs provide a solution for code compliance

Building Envelope



Types of Engineering Judgements (EJs)

- EJs can be “generic” or they may be “specific” to a building or condition
- EJs may or may not require a PE stamp. Depends!
- EJs extend results to a wall assembly not “specifically” tested
- Change to one or more of the tested wall components or their location in the wall
- “Generic” EJs typically provide design documents for manufacturers, architects and specifiers
- “Specific” EJs are typically for architects, general contractors, and Code Officials
- EJs are allowed by code (Section 104.11) when accepted by Code Official

How are EJs used for Code Compliance?

Pertinent IBC Sections

- Section 104.11 Alternate Means and Methods.
- List the code sections that reference engineering analysis (EJs)
- Provide examples – Fire Resistance Directory Listings, etc.

Fire Resistance Requirements

703.3 Methods for Determining Fire Resistance

The application of any of the methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263. The required *fire resistance* of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures:

1. *Fire-resistance* designs documented in approved sources.
2. Prescriptive designs of fire-resistance-rated building elements, components or assemblies as prescribed in Section 721.
3. Calculations in accordance with Section 722.
4. Engineering analysis based on a comparison of building element, component or assemblies designs having *fire-resistance* ratings as determined by the test procedures set forth in ASTM E119 or UL 263.
5. Alternative protection methods as allowed by Section 104.11.
6. *Fire-resistance* designs certified by an approved agency.

EJs Help Code Compliance

- Reasons for EJs
  - Designed systems that occasionally must deviate from a tested and listed system;
  - Field conditions sometimes preclude installation exactly as tested or designed;
  - Mistakes during construction result in installations that do not match the designed systems.
- When these situations arise, a technically sound engineering evaluation demonstrating an adequate level of performance can be the key to gain approval from code officials and keep the project on schedule.
- In many cases, these engineering judgment letters are stamped by a licensed Professional Engineer prior to being submitted to the local building official for acceptance.

Acceptance of EJs for Code Compliance

- Engineering judgments show that the proposed design and use will result in a level of safety and performance that meets the intent of the applicable codes and standards.
- Only the Authority Having Jurisdiction (AHJ) has the authority to accept the EJ for code compliance.

How are EJs Developed?

Features of an Engineering Judgement

- Who does it?
  - Qualifications
- What are the boundaries?
  - How far can one extrapolate or interpolate from the tested assembly?
- How is a substitution / change determined to be credible?
  - Additional testing
  - Experience
- Does the EJ provide technical justification?

Guidance Documents for EJs

- There are documents for several fire tests that provide guidance in determining interpolation or extrapolation from a tested assembly
  - ASTM E119
  - ASTM E814
  - NFPA 285
    - Guidance document is under development

What constitutes a credible EJ?

The question that EJ should answer . . .

Does the variation, change or substitution still provide a wall assembly that exhibits the same or similar fire performance as the NFPA 285 test(s) that were used for the basis of the EJ?

Credible EJs

- Issued only by qualified technical organizations
  - Date, name, signature, PE stamp if required, contact information
- Clearly describe the conditions of the EJ with drawings if necessary
- Stipulate that this is an EJ, NOT a tested or listed assembly
- Reference the base tested assemblies upon which the EJ is issued
- Clearly identify the deviation from the tested assembly

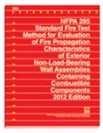
NFPA 285 testing and EJs

IBC NFPA 285 Testing – Material Triggers

- **Foam Plastic Insulation (Ch. 26)**
  - Applies to Type I – IV construction (~1988)
  - Applies to buildings of any height
- **Combustible Exterior Cladding (Ch. 14)**
  - EIFS - (~2000 IBC)
  - MCMs - (~2003 IBC)
  - FRPs - (~2009 IBC – Ch. 26)
  - HPLs - (~2012 IBC)
- **Water-Resistive Barriers (Ch. 14)**
  - Applies to Type I, II, III, IV buildings over 40 ft
  - Applies to combustible WRB's - (2012 IBC)

MULTI-STORY FIRE TEST STANDARD

- Test submitted to NFPA Fire Test Committee and adopted as NFPA 285 in 1998.
- NFPA 285, "*Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-load-bearing Wall Assemblies Containing Combustible Components*"
- NFPA 285 referenced in all editions of IBC
  - 2000 to 2018 Editions of IBC



21

WHAT IS NFPA 285?

- Multi-story fire test standard
- Assess ability of exterior wall to resist:
  - Flame propagation over exterior wall surface
  - Vertical flame propagation within the combustible core or components
  - Vertical flame propagation over the interior surface from one floor to the next
  - Lateral flame propagation to adjacent compartments
- Fire source reproduces ASTM E119 fire exposure conditions (room interior)
- Does not address floor-line perimeter fire barrier systems *per se*.
  - ASTM E2307

22

NFPA 285 Wall Assembly: Air & Water Barrier

COMBUSTIBLE

- **Water Resistive Barriers (WRBs)**
  - **Building Wraps**
  - **Self Adhered Building Wraps**
  - **Self Adhered Membranes**
  - **Fluid Applied Membranes**
- 2012 IBC: Installations over 40' above grade must meet the requirements of NFPA 285 (Type I, II, III, or IV)

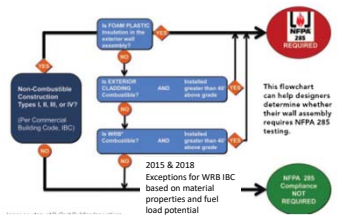
2015 IBC has approved WRB exceptions based on material properties and fuel load potential

NFPA 285 Wall Assembly: Air & Water Barrier

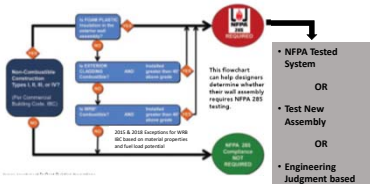
IBC NFPA 285 Test Requirements for WRBs

	Pre-2012	2012	2015
NFPA 285 Test Req's	None	Installations over 40' above grade must meet the requirements of NFPA 285 (Type I, II, III, or IV)	
Exceptions	N/A	None	**1.** WRB is the only combustible wall component and the wall has a non-combustible covering (Table 1405.2) **2.** WRB is the only combustible wall component and: -ASTM E84 Product Test: -flame spread index of 25 or less -smoke-developed index of 450 -ASTM E1354 (Cone Calorimeter)Product Test: -Incident radiant heat flux of 50 kW/m2. -Effective Heat of Combustion of less than 18 MJ/kg -Peak Heat Release Rate less than 150 kW/m2 -Total Heat Release of less than 20 MJ/m2 **3.** Windows and doors, and window/door flashings

IBC & NFPA Test Requirements



Acceptable Compliance Paths



- **NFPA Tested System**

OR

- **Test New Assembly**

OR

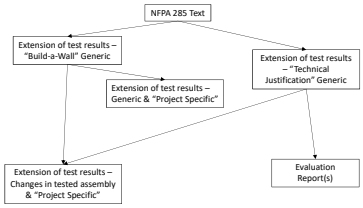
- **Engineering Judgment based on tested NFPA 285 assembly**

Applicability of NFPA 285

- NFPA 285 applies to any exterior wall assembly where required by Code
- NFPA 285 is a test of a complete wall assembly & applies only to the tested construction – similar to ASTM E119
- Appropriate extension of tested configurations is possible but within limits
- Substitutions of one material for another can (maybe) cause different test results
- Addition of combustibles (insulation, WRBs, etc.) can cause different test results
- Changes in configurations (air gaps, attachment systems, etc.) can cause different results

27

Flow of EJs



Example of an Extension of Results Analysis

29

Group Exercise: Review sample EJs based on NFPA 285

Interactive Q&A and Discussion

Presenter Contact Information

Brian Lieburn
wblieburn@dow.com

Lorraine Ross
intech.ross@gmail.com

Thank you for your attention!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Attending
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