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PITFALLS AND CHALLENGES OF NFPA 285 ENGINEERING ANALYSIS

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Daniel A. Martin, PE, CFEI, CVFI – Jensen Hughes

Daniel A. Martin is a Fire Protection Engineer with 9 years of experience at Jensen Hughes related to building code consulting, fire testing, passive fire protection engineering, code development, and fire investigation. Mr. Martin specializes in fire performance and flame spread analysis of building construction materials and assemblies by performing engineering evaluations and as a fire test consultant during qualification testing. Mr. Martin is also a member of numerous NFPA and ASTM Committees and participates in the ICC code development process.

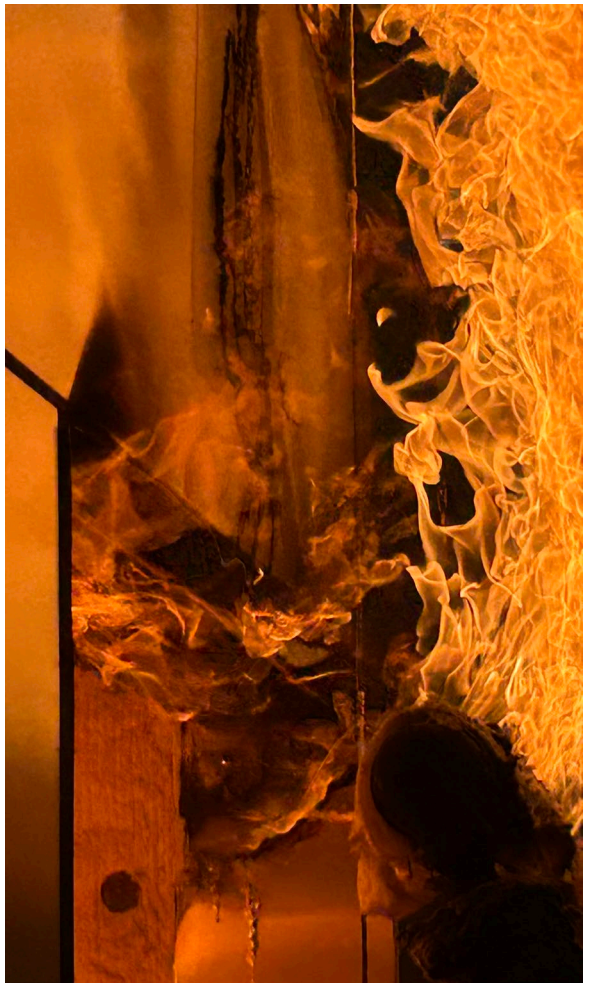
Keith P. Nelson, NCARB, AIA, CDT, BCxP - DuPont

Keith P. Nelson joined DuPont in January 2023 with over 20 years of industry experience leading building enclosure consulting for design and construction projects across the US and internationally. He is a licensed Architect in multiple states and joined DuPont with strong experiences in building science, building enclosure forensics, enclosure commissioning, field performance testing, and is an industry leader in NFPA 285 compliance education. Keith leads and participates in multiple standard development organizations, including ICC 1125, ASHRAE 90.1, ASTM E06, and ASTM E05 and was elected to the ABAA Board of Directors in June 2024. He holds a Bachelor of Science in Architecture and a Bachelor of Science in Environmental Design from Ball State University in Muncie, Indiana.

Abstract

Engineering Analysis is a necessary tool to provide the fire protection and safety of our buildings. The exponential number of wall assembly combinations and detailing of enclosure assemblies in the built environment prevents the opportunity to confirm fire performance through direct testing. This is especially true with the required investment of time, effort, and cost of for larger scale tests such as NFPA 285. Qualified Fire Engineering teams in partnership with third-party labs and the product manufactures offer the opportunity to extend successful test results beyond the tested specimen through a Letter of Engineering Analysis.

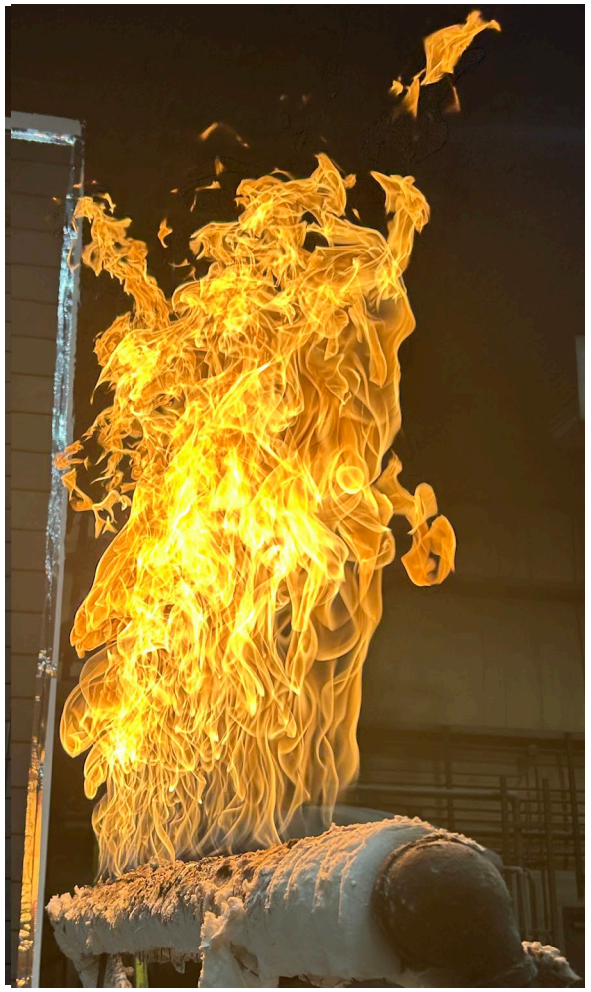
This presentation will discuss the opportunity, challenges and limitation present when considering acceptance of test data extended to support substitution or modification to an assembly.



Learning Objectives

Upon completion of this presentation participants will be able to:

1. Identify appropriate content within an engineering analysis reports pertaining to exterior walls
2. Understand the different types of engineering analysis reports
3. Gain an understanding of the engineering analysis process and considerations when reviewing fire test data for extension
4. Identify the relevant code path that allows for engineering analyses

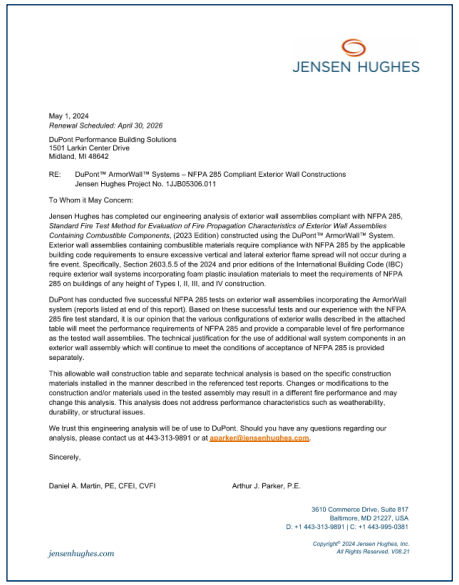


What is Engineering Analysis?

An Engineering Analysis can be a report, drawing, or calculations issued by a credible organization or design professional, 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.



JENSEN HUGHES

May 1, 2024
Renewal Scheduled: April 30, 2026

DuPont Performance Building Solutions
1501 Larkin Center Drive
Midland, MI 48642

RE: DuPont™ ArmorWall™ Systems – NFPA 285 Compliant Exterior Wall Constructions
Jensen Hughes Project No. 1JJB05306.011

To Whom it May Concern:

Jensen Hughes has completed our engineering analysis of exterior wall assemblies compliant with NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*, (2023 Edition) constructed using the DuPont™ ArmorWall™ System. Exterior wall assemblies containing combustible materials require compliance with NFPA 285 by the applicable building code requirements to ensure excessive vertical and lateral exterior flame spread will not occur during a fire event. Specifically, Section 2603.5.5 of the 2024 and prior editions of the International Building Code (IBC) require exterior wall systems incorporating foam plastic insulation materials to meet the requirements of NFPA 285 on buildings of any height of Types I, II, III, and IV construction.

DuPont has conducted five successful NFPA 285 tests on exterior wall assemblies incorporating the ArmorWall system (reports listed at end of this report). Based on these successful tests and our experience with the NFPA 285 fire test standard, it is our opinion that the various configurations of exterior walls described in the attached table will meet the performance requirements of NFPA 285 and provide a comparable level of fire performance as the tested wall assemblies. The technical justification for the use of additional wall system components in an exterior wall assembly which will continue to meet the conditions of acceptance of NFPA 285 is provided separately.

This allowable wall construction table and separate technical analysis is based on the specific construction materials installed in the manner described in the referenced test reports. Changes or modifications to the construction and/or materials used in the tested assembly may result in a different fire performance and may change this analysis. This analysis does not address performance characteristics such as weatherability, durability, or structural issues.

We trust this engineering analysis will be of use to DuPont. Should you have any questions regarding our analysis, please contact us at 443-313-9891 or at aparker@jensenhughes.com.

Sincerely,

Daniel A. Martin, PE, CFEI, CVFI — Arthur J. Parker, P.E.

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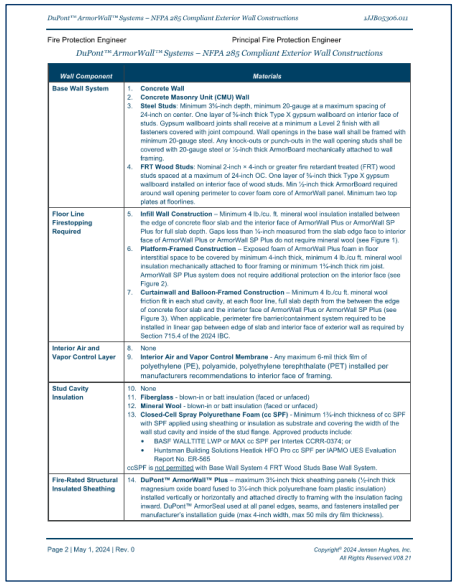
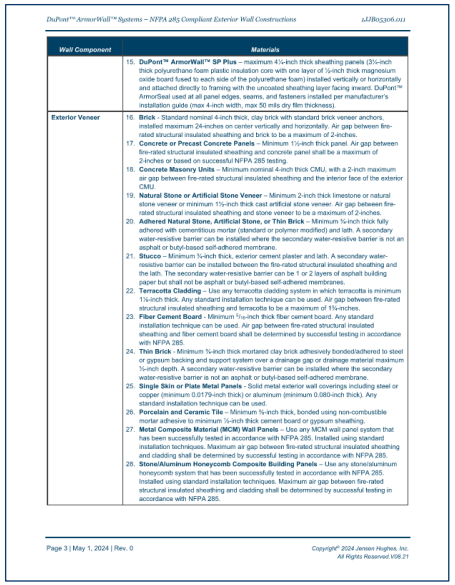


Fire Protection Engineer — Principal Fire Protection Engineer

DuPont™ ArmorWall™ Systems – NFPA 285 Compliant Exterior Wall Constructions

Wall Component	Materials
Base Wall System	1. **Concrete Wall** 2. **Concrete Masonry Unit (CMU) Wall** 3. **Steel Studs**- Minimum 3⅝-inch depth, minimum 20-gauge at a maximum spacing of 24-inch on center. One layer of ½-inch thick Type X gypsum wallboard on interior face of studs. Gypsum wallboard joints shall receive at a minimum a Level 2 finish with all fasteners covered with joint compound. Wall openings in the base wall shall be framed with minimum 20-gauge steel. Any knock-outs or punch-outs in the wall opening studs shall be covered with 20-gauge steel or ½-inch thick ArmorBoard mechanically attached to wall framing. 4. **FRT Wood Studs**: Nominal 2-inch × 4-inch or greater fire retardant treated (FRT) wood studs spaced at a maximum of 24-inch OC. One layer of ½-inch thick Type X gypsum wallboard installed on interior face of wood studs. Min ½-inch thick ArmorBoard required around wall opening perimeter to cover foam core of ArmorWall panel. Minimum two top plates at floorlines.
Floor Line Firestopping Required	5. **Infill Wall Construction** – Minimum 4 lb./cu. ft. mineral wool insulation installed between the edge of concrete floor slab and the interior face of ArmorWall Plus or ArmorWall SP Plus for full slab depth. Gaps less than ¾-inch measured from the slab edge face to interior face of ArmorWall Plus or ArmorWall SP Plus do not require mineral wool (see Figure 1). 6. **Platform-Framed Construction** – Exposed foam of ArmorWall Plus foam in floor interstitial space to be covered by minimum 4-inch thick, minimum 4 lb./cu ft. mineral wool insulation mechanically attached to floor framing or minimum 1½-inch thick rim joist. ArmorWall SP Plus system does not require additional protection on the interior face (see Figure 2). 7. **Curtainwall and Balloon-Framed Construction** – Minimum 4 lb./cu ft. mineral wool friction fit in each stud cavity, at each floor line, full slab depth from the between the edge of concrete floor slab and the interior face of ArmorWall Plus or ArmorWall SP Plus (see Figure 3). When applicable, perimeter fire barrier/containment system required to be installed in linear gap between edge of slab and interior face of exterior wall as required by Section 715.4 of the 2024 IBC.
Interior Air and Vapor Control Layer	8. None 9. **Interior Air and Vapor Control Membrane** - Any maximum 6-mil thick film of polyethylene (PE), polyamide, polyethylene terephthalate (PET) installed per manufacturers recommendations to interior face of framing.
Stud Cavity Insulation	10. None 11. **Fiberglass** - blown-in or batt insulation (faced or unfaced) 12. **Mineral Wool** - blown-in or batt insulation (faced or unfaced) 13. **Closed-Cell Spray Polyurethane Foam (cc SPF)** - Minimum 1½-inch thickness of cc SPF with SPF applied using sheathing or insulation as substrate and covering the width of the wall stud cavity and inside of the stud flange. Approved products include: • BASF WALLTITE LWP or MAX cc SPF per Intertek CCRR-0374; or • Huntsman Building Solutions Heatlok HFO Pro cc SPF per IAPMO UES Evaluation Report No. ER-565 ccSPF is not permitted with Base Wall System 4 FRT Wood Studs Base Wall System.
Fire-Rated Structural Insulated Sheathing	14. **DuPont™ ArmorWall™ Plus** – maximum 3⅛-inch thick sheathing panels (⅝-inch thick magnesium oxide board fused to 2½-inch thick polyurethane foam plastic insulation) installed vertically or horizontally and attached directly to framing with the insulation facing inward. DuPont™ ArmorSeal used at all panel edges, seams, and fasteners installed per manufacturer's installation guide (max 4-inch width, max 50 mils dry film thickness).



Wall Component	Materials
	15. **DuPont™ ArmorWall™ SP Plus** – maximum 4¼-inch thick sheathing panels (3½-inch thick polyurethane foam plastic insulation core with one layer of ½-inch thick magnesium oxide board fused to each side of the polyurethane foam) installed vertically or horizontally and attached directly to framing with the uncoated sheathing layer facing inward. DuPont™ ArmorSeal used at all panel edges, seams, and fasteners installed per manufacturer's installation guide (max 4-inch width, max 50 mils dry film thickness).
Exterior Veneer	16. **Brick** - Standard nominal 4-inch thick, clay brick with standard brick veneer anchors, installed maximum 24-inches on center vertically and horizontally. Air gap between fire-rated structural insulated sheathing and brick to be a maximum of 2-inches. 17. **Concrete or Precast Concrete Panels** – Minimum 1½-inch thick panel. Air gap between fire-rated structural insulated sheathing and concrete panel shall be a maximum of 2-inches or based on successful NFPA 285 testing. 18. **Concrete Masonry Units** – Minimum nominal 4-inch thick CMU, with a 2-inch maximum air gap between fire-rated structural insulated sheathing and the interior face of the exterior CMU. 19. **Natural Stone or Artificial Stone Veneer** – Minimum 2-inch thick limestone or natural stone veneer or minimum 1½-inch thick cast artificial stone veneer. Air gap between fire-rated structural insulated sheathing and stone veneer to be a maximum of 2-inches. 20. **Adhered Natural Stone, Artificial Stone, or Thin Brick** – Minimum ¾-inch thick fully adhered with cementitious mortar (standard or polymer modified) and lath. A secondary water-resistive barrier can be installed where the secondary water-resistive barrier is not an asphalt or butyl-based self-adhered membrane. 21. **Stucco** – Minimum ⅞-inch thick, exterior cement plaster and lath. A secondary water-resistive barrier can be installed between the fire-rated structural insulated sheathing and the lath. The secondary water-resistive barrier can be 1 or 2 layers of asphalt building paper but shall not be asphalt or butyl-based self-adhered membranes. 22. **Terracotta Cladding** – Use any terracotta cladding system in which terracotta is minimum 1⅛-inch thick. Any standard installation technique can be used. Air gap between fire-rated structural insulated sheathing and terracotta to be a maximum of 1⅛-inches. 23. **Fiber Cement Board** - Minimum 5/16-inch thick fiber cement board. Any standard installation technique can be used. Air gap between fire-rated structural insulated sheathing and fiber cement board shall be determined by successful testing in accordance with NFPA 285. 24. **Thin Brick** - Minimum ¾-inch thick mortared clay brick adhesively bonded/adhered to steel or gypsum backing and support system over a drainage gap or drainage material maximum ½-inch depth. A secondary water-resistive barrier can be installed where the secondary water-resistive barrier is not an asphalt or butyl-based self-adhered membrane. 25. **Single Skin or Plate Metal Panels** - Solid metal exterior wall coverings including steel or copper (minimum 0.0179-inch thick) or aluminum (minimum 0.080-inch thick). Any standard installation technique can be used. 26. **Porcelain and Ceramic Tile** – Minimum ¾-inch thick, bonded using non-combustible mortar adhesive to minimum ¼-inch thick cement board or gypsum sheathing. 27. **Metal Composite Material (MCM) Wall Panels** – Use any MCM wall panel system that has been successfully tested in accordance with NFPA 285. Installed using standard installation techniques. Maximum air gap between fire-rated structural insulated sheathing and cladding shall be determined by successful testing in accordance with NFPA 285. 28. **Stone/Aluminum Honeycomb Composite Building Panels** – Use any stone/aluminum honeycomb system that has been successfully tested in accordance with NFPA 285. Installed using standard installation techniques. Maximum air gap between fire-rated structural insulated sheathing and cladding shall be determined by successful testing in accordance with NFPA 285.

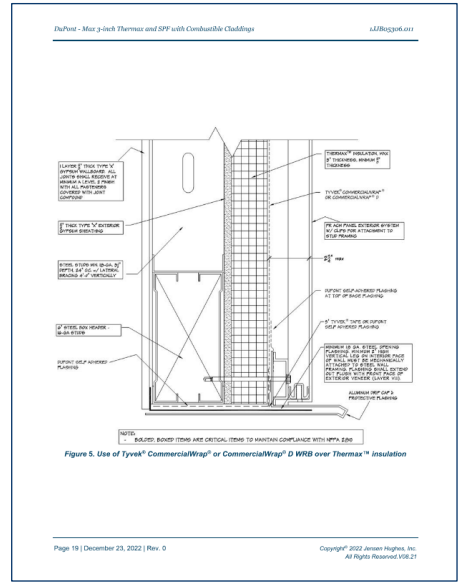
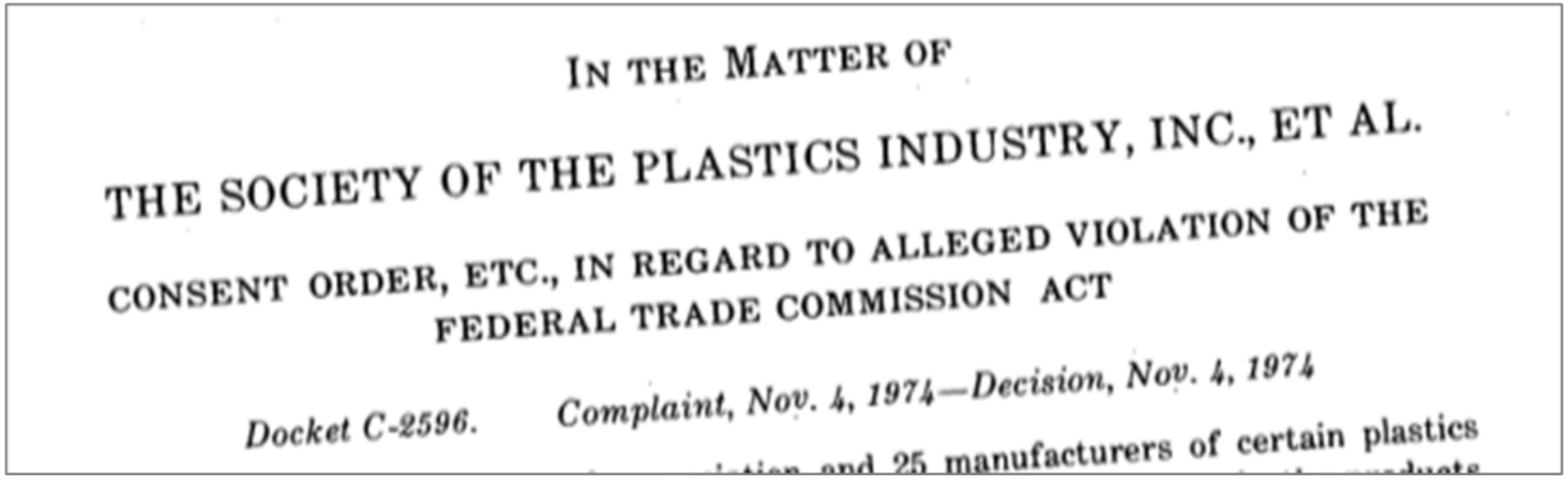


Figure 5. Use of Tyvek® CommercialWrap® or CommercialWrap® D WRB over Thermax™ insulation

Brief History of NFPA 285

1974 Federal Trade Commission Consent Decree

- 25 Manufactures and SPI
- Notification of prior purchasers of their foams
- Sponsoring product research ($5M)
- Resulted in a 1980 Final Report of the Products Research Committee



IN THE MATTER OF

THE SOCIETY OF THE PLASTICS INDUSTRY, INC., ET AL.

CONSENT ORDER, ETC., IN REGARD TO ALLEGED VIOLATION OF THE FEDERAL TRADE COMMISSION ACT

Docket C-2596. *Complaint, Nov. 4, 1974—Decision, Nov. 4, 1974*

and 25 manufacturers of certain plastics

Brief History of NFPA 285

Energy Crisis:
Leads to increased exterior insulation applications

1988:
Uniform Building Code adopts UBC 17-6

1997:
Uniform Building Code adopts UBC 26-9

2000:
IBC begins requiring NFPA 285 testing

1970's → 1980's → 1990's → 2000's → 2010's

Late 70's:
SPI develops full-scale test

Full-scale Fire Test
UBC 17-6 / UBC 26-4

Reduced-scale Fire Test
UBC 26-9 / NFPA 285

2012:
IBC expands NFPA 285 testing to WRB

2015 & 2018
IBC has approved WRB exceptions based on material properties and fuel load potential

What is NFPA 285?

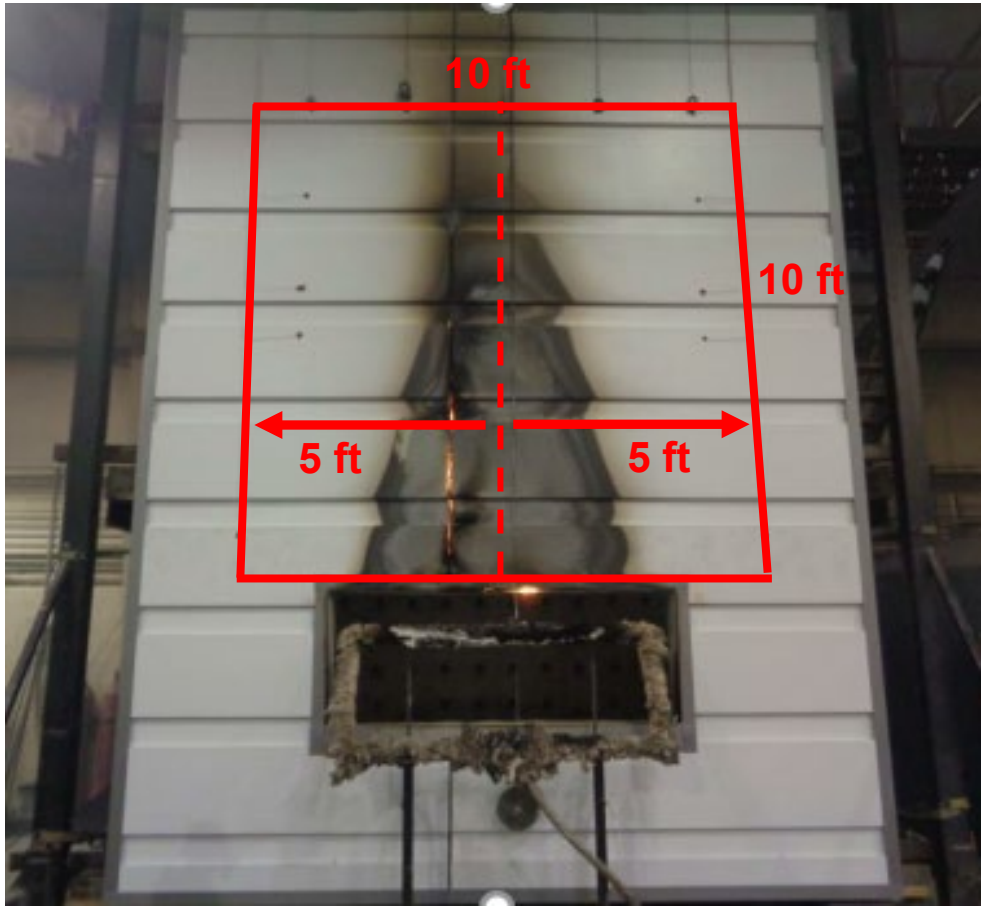
- Multi-story fire test standard
- Assess ability of exterior wall **assembly** to resist:
  - Flame propagation over exterior wall surface
  - Vertical flame propagation within the combustible core or components.
  - Lateral flame propagation to adjacent compartments
- Fire source reproduces ASTM E119 fire exposure conditions (room interior)

NFPA 285 – Test Method Basics and Results

- Test assembly - 18’ tall x 14’ wide
  - Representative wall construction
  - Typically non-combustible construction (Light Gauge Metal Framing)
- Framed window opening on first floor
- Gas fueled burners
- Interior fire exposure with exterior flame plume component

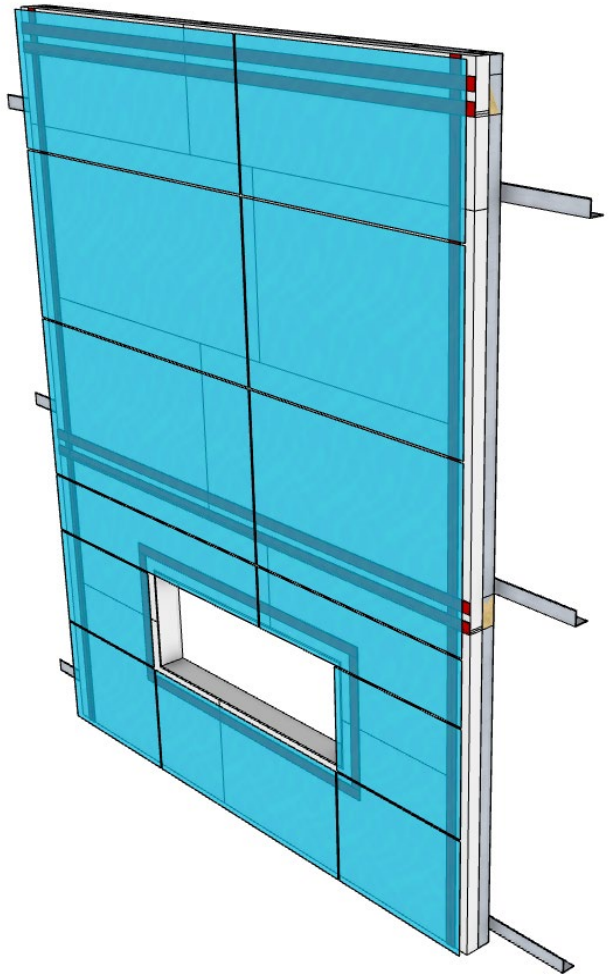
NFPA 285 – Test Method Basics and Results

- 30-minute test
- Pass / fail
- Performance criteria
  - Flame spread 10 ft above window opening header
  - Flame spread 5 ft laterally from assembly centerline
    - Visual
    - Temperature measurements
      - 50 to 80 thermocouples installed on each test assembly at different depths



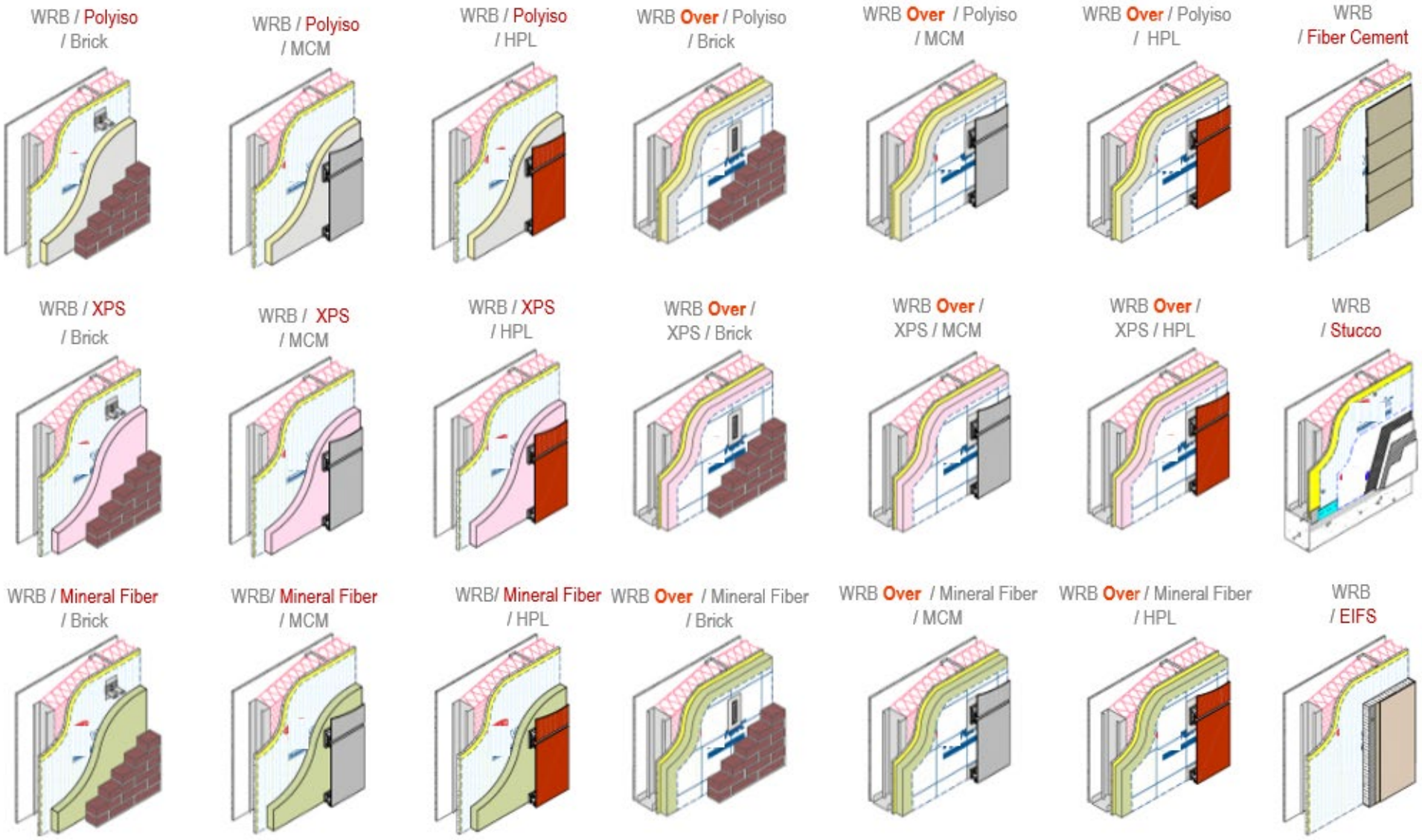
Why Engineering Analysis Reports?

- Test Approval is limited to the materials, assembly, and details successfully tested.
- Large Scale, Expensive, and Time Consuming
- Specificity and Cost Preclude Testing Every Possible Combination
- Manufacturer’s Generally Take on NFPA 285 Test Data Responsibility
- Project Specific Testing is Generally Limited to Large and Complicated projects



Enter the Engineering Analysis

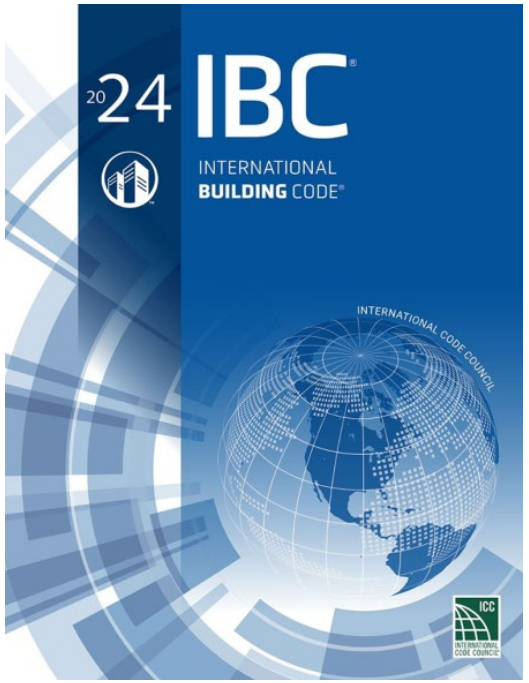
Why Engineering Analysis Reports?



Alternate Materials and Methodology

Section 104.2.3 Alternative materials, design and methods of construction and equipment.

The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*.



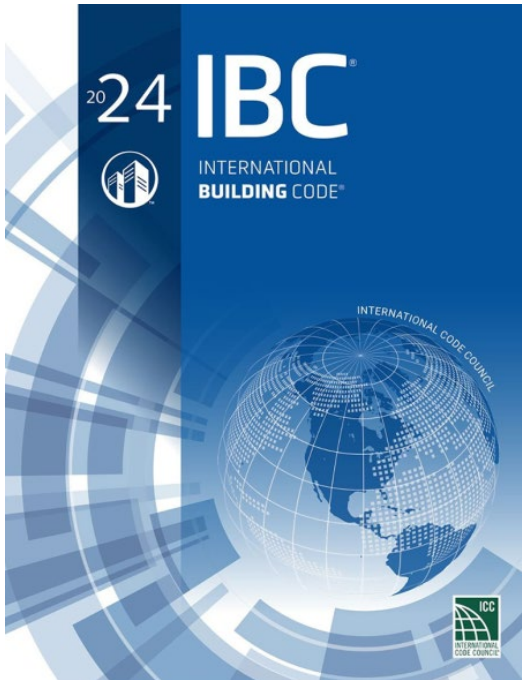
[A] APPROVED. Acceptable to the *building official*.

[A] BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

Alternate Materials and Methodology

104.2.3 in 2024 IBC:

- *Building official* has the final say (104.2.3.1)
- Applications must be proposed in writing for approval (104.2.3.2)
- Alternate must comply with code intent (104.2.3.3)
- Alternate shall not be less than prescribed in the code with respect to (104.2.3.4):
  - Quality.
  - Strength.
  - Effectiveness.
  - Durability.
  - Safety, other than fire safety.
  - Fire safety.



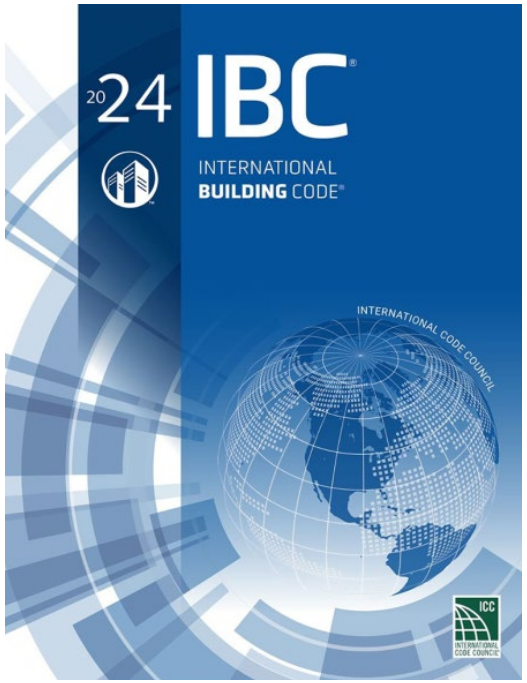
Alternate Materials and Methodology

104.2.3.5 Tests.

Tests conducted to demonstrate equivalency in support of an alternative material, design or method of construction application shall be of a scale that is sufficient to predict performance of the end use configuration. Tests shall be performed by a party acceptable to the *building official*.

104.2.3.5.1 Fire Tests.

Tests conducted to demonstrate equivalent fire safety in support of an alternative material, design or method of construction application shall be of a scale that is sufficient to predict fire safety performance of the end use configuration. Tests shall be performed by a party acceptable to the building official.



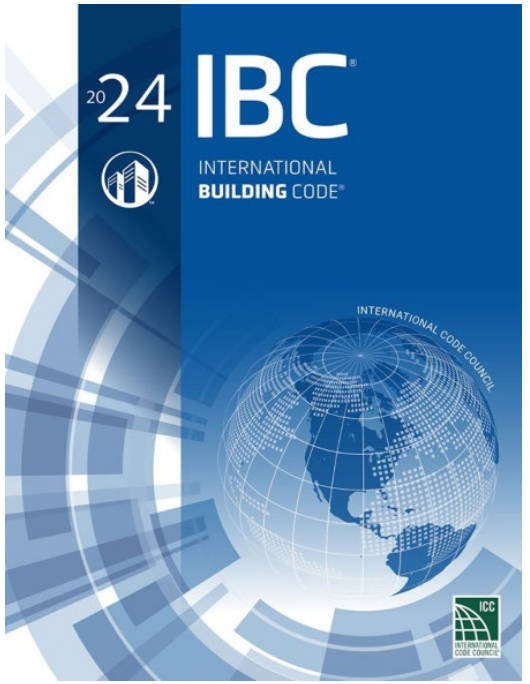
Alternate Materials and Methodology

104.2.3.6 Reports.

Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall comply with sections 104.2.3.6.1 and 104.2.3.6.2.

104.2.3.6.1 Evaluation reports. (“Code Report”)

- Prepared by an *approved agency*
- Evaluation report shall require approval by the *building official*
- Evaluation within scope of building official's recognition of the *approved agency*
- Acceptance criteria shall be provided to the *building official*.

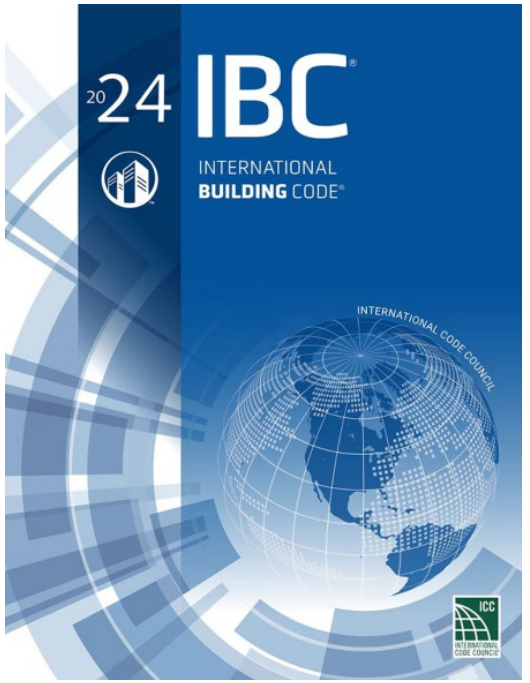


Alternate Materials and Methodology

104.2.3.6.2 Other reports.

- Describe referenced testing or analysis used to justify code equivalence.
- Prepared by a qualified engineer or other acceptable to the *building official*.
- *Building official* may require preparation and stamp of a *registered design professional*.

[A] REGISTERED DESIGN PROFESSIONAL. An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or *jurisdiction* in which the project is to be constructed.

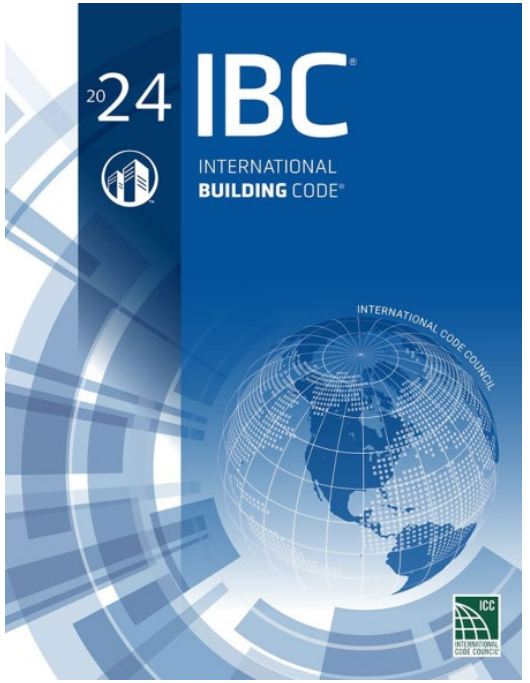


Alternate Materials and Methodology

Added Criteria to Section 104.2.3 in 2024 IBC:

104.2.3.7 Peer review.

The *building official* is authorized to require submittal of a *peer review* report in conjunction with a request to use an alternative material, design or method of construction, prepared by a peer reviewer that is *approved* by the *building official*.



[A] PEER REVIEW. An independent and objective technical review conducted by an approved third party.

NFPA 285 Compliance Methods

Added Criteria to Section 1402.8 in 2024 IBC:

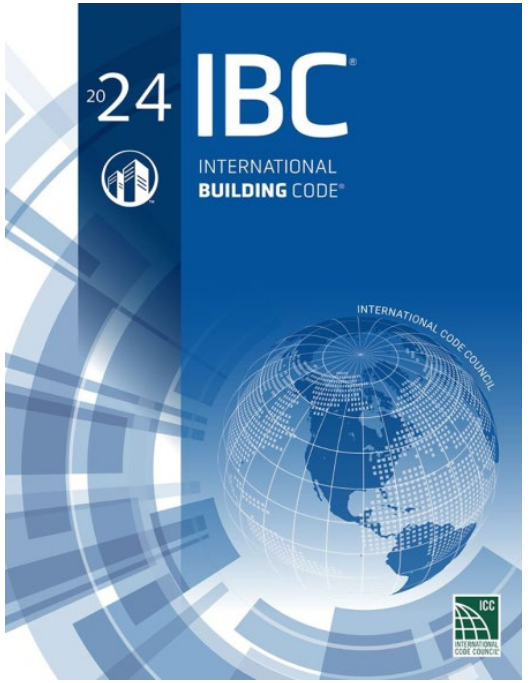
1402.8 Flame Propagation Compliance Methods.

- Assembly as Successfully Tested
- Design Listing (ICC-ES, Intertek, UL Solutions, etc.)
- Approved Analysis (EJ, Evaluation Report, Build-a-Wall Table)

1402.8 Vertical and lateral flame propagation compliance methods. CDP INSIGHTS

When exterior wall assemblies are required in this chapter to be tested for vertical and lateral flame propagation in accordance with and comply with the acceptance criteria of NFPA 285, compliance with the requirements shall be established by any of the following:

1. An *exterior wall assembly* tested in accordance with and meeting the acceptance criteria of NFPA 285.
2. An *exterior wall assembly* design *listed* by an *approved agency* for compliance with NFPA 285.
3. An *approved* analysis based on an assembly or condition tested in accordance with and meeting the acceptance criteria of NFPA 285.



Demonstrating Compliance with NFPA 285

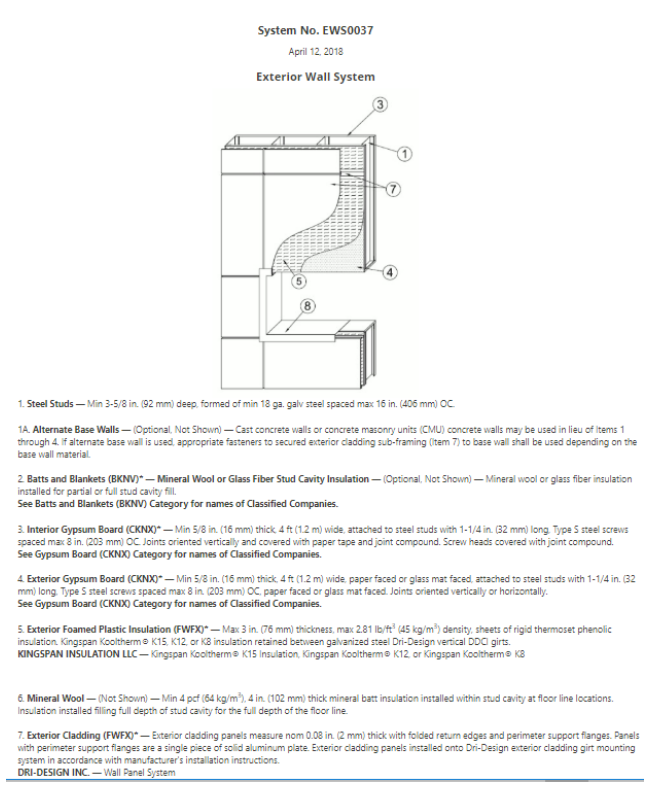
Large-scale assembly testing

- By manufacturers
  - Product use qualification
- Project specific
  - Installation qualification

- Third Party Design Listings
- Evaluation Reports
  - IAPMO, DrJ, PEI (non-Lab)
  - ICC-ES, Intertek, UL, QAI (Labs)
- Engineering Analysis
  - Jensen Hughes, Priest & Associates, etc

Compliance with NFPA 285 – Third Party Design Listings

- Design Listings
- Component-by-component assembly builds
  - UL Online Directory
  - Intertek Directory of Tested Assemblies



System No. EWS0037

April 12, 2018

Exterior Wall System

1. **Steel Studs** — Min 3-5/8 in. (92 mm) deep, formed of min 18 ga. galv steel spaced max 16 in. (406 mm) OC.

1A. **Alternate Base Walls** — (Optional, Not Shown) — Cast concrete walls or concrete masonry units (CMU) concrete walls may be used in lieu of Items 1 through 4. If alternate base wall is used, appropriate fasteners to secured exterior cladding sub-framing (Item 7) to base wall shall be used depending on the base wall material.

2. **Batts and Blankets (BKNV)* — Mineral Wool or Glass Fiber Stud Cavity Insulation** — (Optional, Not Shown) — Mineral wool or glass fiber insulation installed for partial or full stud cavity fill.
See Batts and Blankets (BKNV) Category for names of Classified Companies.

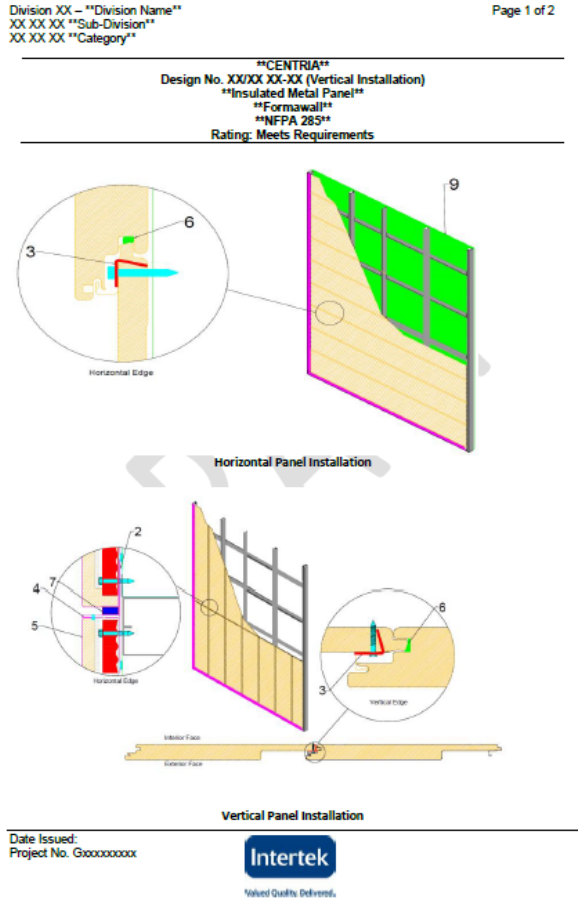
3. **Interior Gypsum Board (CKNX)*** — Min 5/8 in. (16 mm) thick, 4 ft (1.2 m) wide, attached to steel studs with 1-1/4 in. (32 mm) long, Type S steel screws spaced max 8 in. (203 mm) OC. Joints oriented vertically and covered with paper tape and joint compound. Screw heads covered with joint compound.
See Gypsum Board (CKNX) Category for names of Classified Companies.

4. **Exterior Gypsum Board (CKNX)*** — Min 5/8 in. (16 mm) thick, 4 ft (1.2 m) wide, paper faced or glass mat faced, attached to steel studs with 1-1/4 in. (32 mm) long, Type S steel screws spaced max 8 in. (203 mm) OC, paper faced or glass mat faced. Joints oriented vertically or horizontally.
See Gypsum Board (CKNX) Category for names of Classified Companies.

5. **Exterior Foamed Plastic Insulation (FWFX)*** — Max 3 in. (76 mm) thickness, max 2.81 lb/ft^3 (45 kg/m^3) density, sheets of rigid thermoset phenolic insulation. Kingspan Kooltherm® K15, K12, or K8 insulation retained between galvanized steel Dri-Design vertical DDCI girts.
KINGSPAN INSULATION LLC — Kingspan Kooltherm® K15 Insulation, Kingspan Kooltherm® K12, or Kingspan Kooltherm® K8

6. **Mineral Wool** — (Not Shown) — Min 4 pcf (64 kg/m^3), 4 in. (102 mm) thick mineral batt insulation installed within stud cavity at floor line locations. Insulation installed filling full depth of stud cavity for the full depth of the floor line.

7. **Exterior Cladding (FWFX)*** — Exterior cladding panels measure nom 0.08 in. (2 mm) thick with folded return edges and perimeter support flanges. Panels with perimeter support flanges are a single piece of solid aluminum plate. Exterior cladding panels installed onto Dri-Design exterior cladding girt mounting system in accordance with manufacturer's installation instructions.
DRI-DESIGN INC. — Wall Panel System



Division XX – **Division Name**
XX XX XX **Sub-Division**
XX XX XX **Category**

Page 1 of 2

CENTRIA
Design No. XX/XX XX-XX (Vertical Installation)
Insulated Metal Panel
Formawall
NFPA 285
Rating: Meets Requirements

Horizontal Panel Installation

Vertical Panel Installation

Date Issued:
Project No. Gxxxxxxxxx

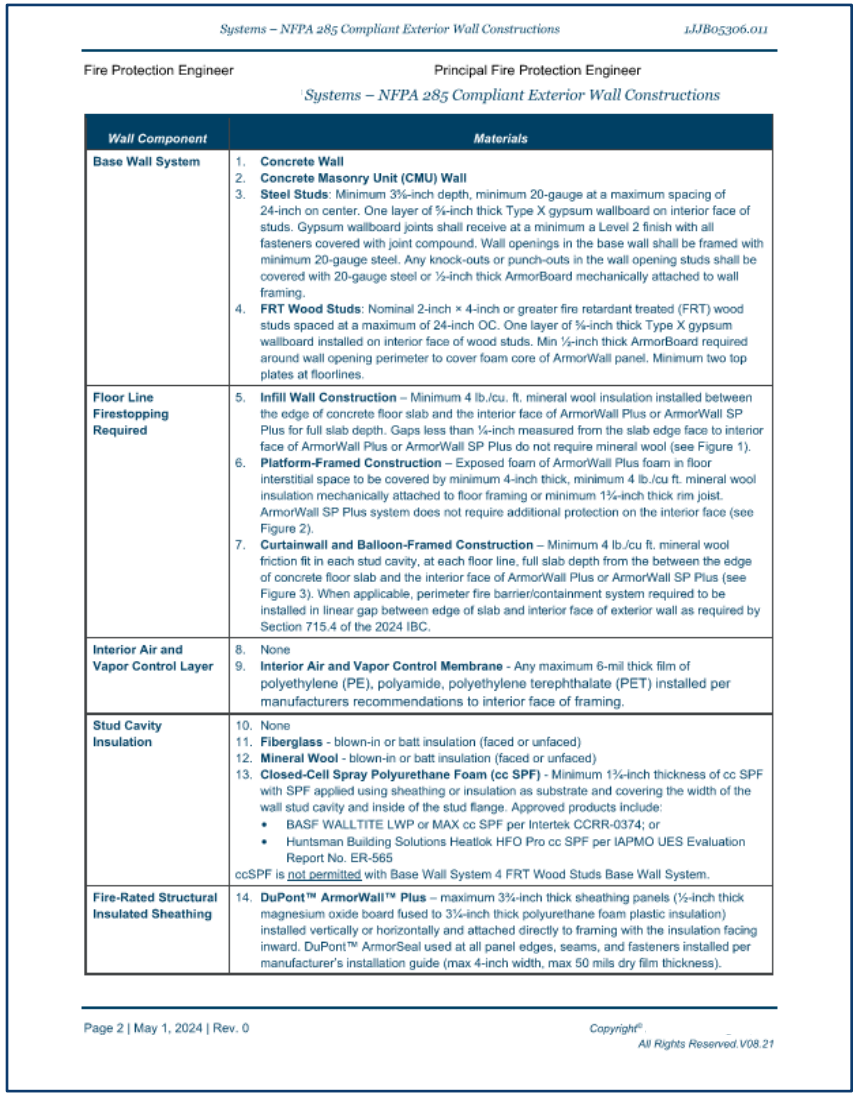
Intertek
Value Quality. Delivered.

Compliance with NFPA 285 – Evaluation Reports

- Wall Construction Tables
- Compliant assemblies by “layers”
- Evaluation Reports

    ICC-ES, IAPMO, DrJ

    UL, Intertek, QAI Labs



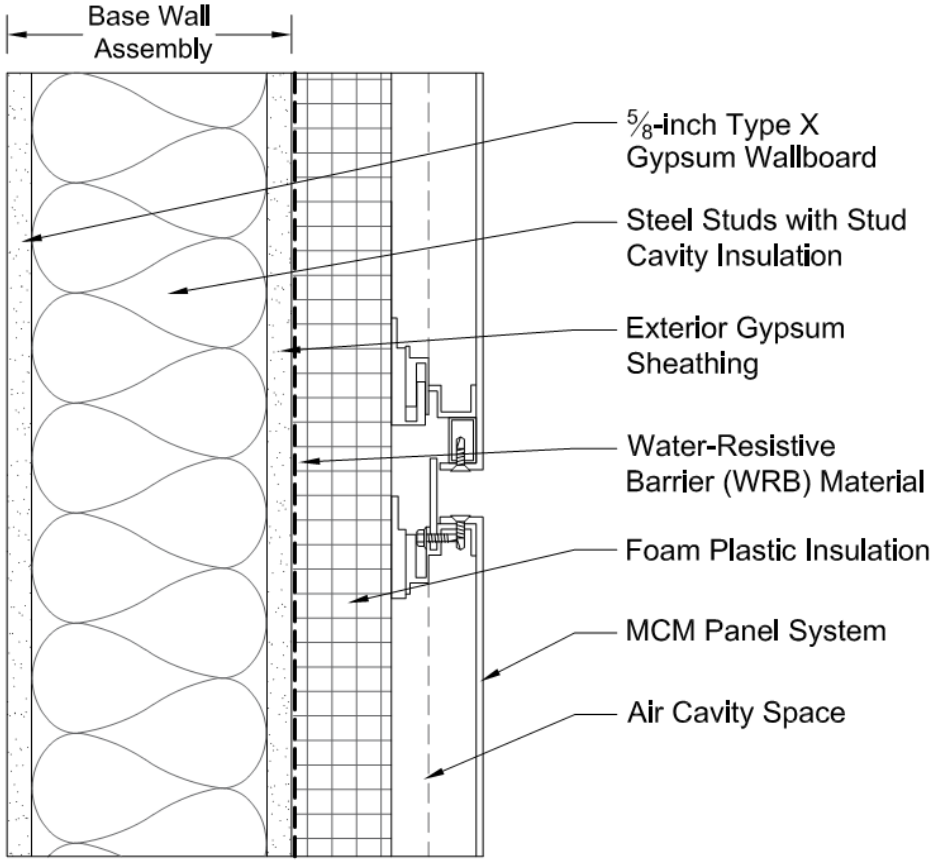
Fire Protection Engineer Principal Fire Protection Engineer

Systems – NFPA 285 Compliant Exterior Wall Constructions

Wall Component	Materials
Base Wall System	1. **Concrete Wall** 2. **Concrete Masonry Unit (CMU) Wall** 3. **Steel Studs**: Minimum 3⅝-inch depth, minimum 20-gauge at a maximum spacing of 24-inch on center. One layer of ⅝-inch thick Type X gypsum wallboard on interior face of studs. Gypsum wallboard joints shall receive at a minimum a Level 2 finish with all fasteners covered with joint compound. Wall openings in the base wall shall be framed with minimum 20-gauge steel. Any knock-outs or punch-outs in the wall opening studs shall be covered with 20-gauge steel or ½-inch thick ArmorBoard mechanically attached to wall framing. 4. **FRT Wood Studs**: Nominal 2-inch × 4-inch or greater fire retardant treated (FRT) wood studs spaced at a maximum of 24-inch OC. One layer of ⅝-inch thick Type X gypsum wallboard installed on interior face of wood studs. Min ½-inch thick ArmorBoard required around wall opening perimeter to cover foam core of ArmorWall panel. Minimum two top plates at floorlines.
Floor Line Firestopping Required	5. **Infill Wall Construction** – Minimum 4 lb./cu. ft. mineral wool insulation installed between the edge of concrete floor slab and the interior face of ArmorWall Plus or ArmorWall SP Plus for full slab depth. Gaps less than ¼-inch measured from the slab edge face to interior face of ArmorWall Plus or ArmorWall SP Plus do not require mineral wool (see Figure 1). 6. **Platform-Framed Construction** – Exposed foam of ArmorWall Plus foam in floor interstitial space to be covered by minimum 4-inch thick, minimum 4 lb./cu ft. mineral wool insulation mechanically attached to floor framing or minimum 1¾-inch thick rim joist. ArmorWall SP Plus system does not require additional protection on the interior face (see Figure 2). 7. **Curtainwall and Balloon-Framed Construction** – Minimum 4 lb./cu ft. mineral wool friction fit in each stud cavity, at each floor line, full slab depth from the between the edge of concrete floor slab and the interior face of ArmorWall Plus or ArmorWall SP Plus (see Figure 3). When applicable, perimeter fire barrier/containment system required to be installed in linear gap between edge of slab and interior face of exterior wall as required by Section 715.4 of the 2024 IBC.
Interior Air and Vapor Control Layer	8. None 9. **Interior Air and Vapor Control Membrane** - Any maximum 6-mil thick film of polyethylene (PE), polyamide, polyethylene terephthalate (PET) installed per manufacturers recommendations to interior face of framing.
Stud Cavity Insulation	10. None 11. **Fiberglass** - blown-in or batt insulation (faced or unfaced) 12. **Mineral Wool** - blown-in or batt insulation (faced or unfaced) 13. **Closed-Cell Spray Polyurethane Foam (cc SPF)** - Minimum 1¾-inch thickness of cc SPF with SPF applied using sheathing or insulation as substrate and covering the width of the wall stud cavity and inside of the stud flange. Approved products include: • BASF WALLTITE LWP or MAX cc SPF per Intertek CCRR-0374; or • Huntsman Building Solutions Heatlok HFO Pro cc SPF per IAPMO UES Evaluation Report No. ER-565 ccSPF is not permitted with Base Wall System 4 FRT Wood Studs Base Wall System.
Fire-Rated Structural Insulated Sheathing	14. **DuPont™ ArmorWall™ Plus** – maximum 3¾-inch thick sheathing panels (½-inch thick magnesium oxide board fused to 3¼-inch thick polyurethane foam plastic insulation) installed vertically or horizontally and attached directly to framing with the insulation facing inward. DuPont™ ArmorSeal used at all panel edges, seams, and fasteners installed per manufacturer's installation guide (max 4-inch width, max 50 mils dry film thickness).

Compliance with NFPA 285 – Engineering Analyses

- A means to bridge the designed assembly to a tested assembly
- Existing or new construction
- Based on engineering data
- Case by case basis, requires AHJ approval
- Not every assembly can be supported



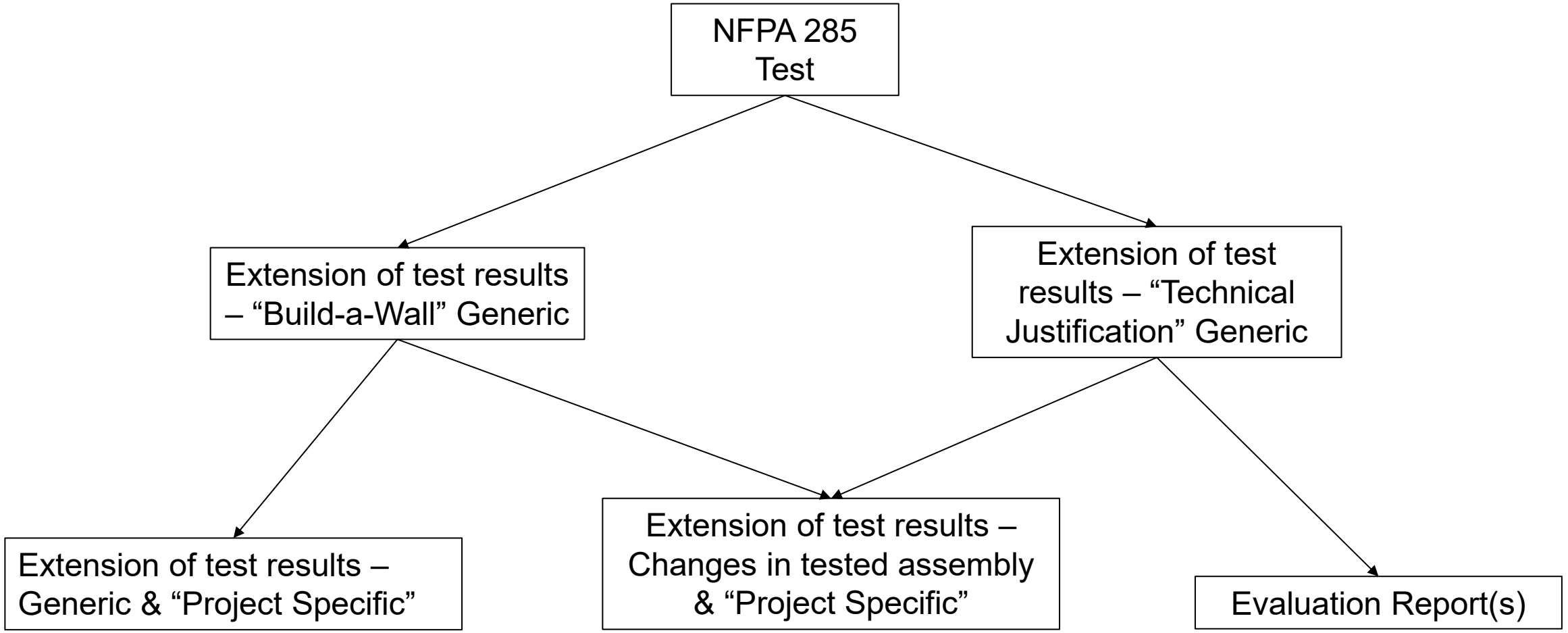
Who provides an Engineering Analysis?

2024 IBC 104.2.3.6.2 "The report shall be prepared by a qualified engineer, specialist, laboratory or specialty organization acceptable to the *building official*. The *building official* is authorized to require design submittals to be prepared by, and bear the stamp of, a *registered design professional*."

> **[A] REGISTERED DESIGN PROFESSIONAL.** An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or *jurisdiction* in which the project is to be constructed.

NFPA 285-2022 B.1.2.1 "The purpose of this annex is to provide guidelines for qualified engineers, design professionals, or individual(s) to follow when performing a design for or making an engineering analysis/judgement on NFPA 285-based wall assemblies.

Engineering Analysis Pathways



Engineering Analysis Process

- Describe project conditions
- Identify technical basis
  - Tested assembly or assemblies
  - Design Listings
  - Other fire test data
- Identify differences between proposed and tested
- Develop technical rationale for deviations
- Demonstrate equivalent level of compliance

- Write report such that you can read it in court
- - “Dear Your Honor”

Content of a Project Specific NFPA 285 Analysis

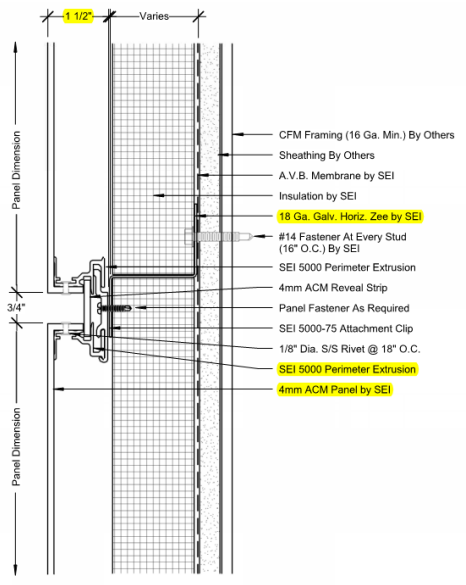
Things to look for:

- Building specific information
  - Address
  - Building Code of Record
  - Type of Construction
  - Building Height
- Identification of combustible materials
- Relevant code sections and NFPA 285 trigger pointers

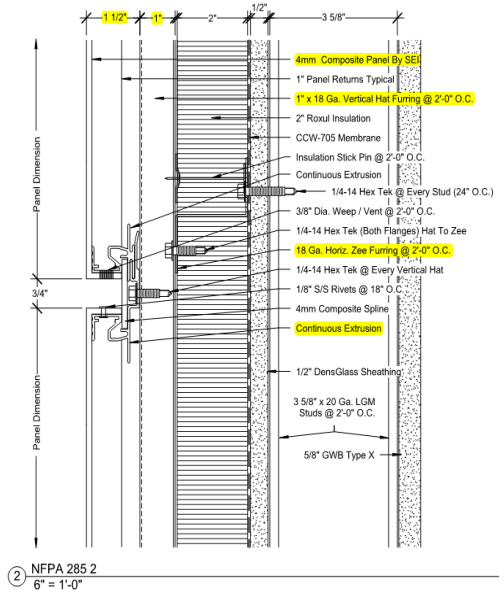
Content of a Project Specific NFPA 285 Analysis

Things to look for:

- Proposed wall construction
  - Description of each component
  - Location within the wall assembly
  - Full wall cross-section



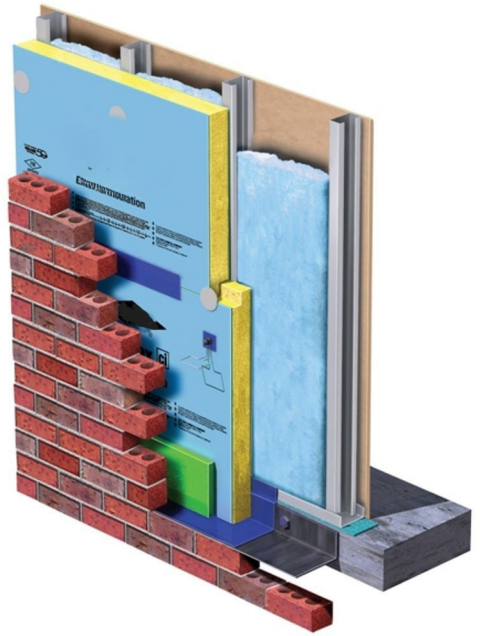
- Tested wall construction
  - Description of each component
  - Location within the wall assembly
  - Full wall cross-section



Content of a Project Specific NFPA 285 Analysis

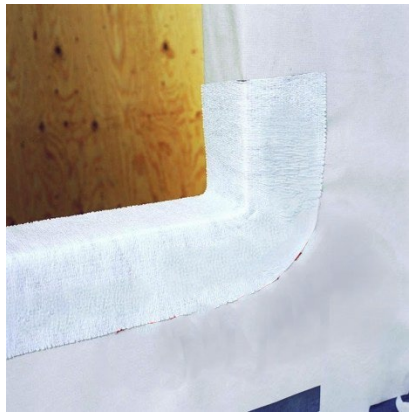
Things to look for:

- Comparative analysis between proposed and tested
  - Technical rationale
  - Additional fire test data
  - Small scale testing data
  - Experience witnessing NFPA 285 tests
  - Individual component substitution impact on fire performance
  - Component substitution impact on assembly fire performance



Possible Wall Assembly Modifications

- Base wall assembly
- Cavity insulation materials
- Exterior gypsum sheathing
- WRB
- Exterior Insulation materials
- Exterior wall covering materials
- Attachment systems



Limitations of Engineering Analysis…

- Not all proposed modifications can be supported by an Engineering Analysis
- NFPA 285 Annex B introduced in 2023 Edition
- Several modifications to a design may not be supported by one test
- Possible negative impact on fire performance:
  - Increasing combustible insulation thickness
  - Increase the air cavity space behind a veneer
  - Changing Spray Polyurethane Foam (SPF) products from a different manufacturer than what was tested
  - Changing to a combustible veneer from a tested non-combustible veneer

Annex B — Guide for Extensions of Results from Assemblies that Meet NFPA 285 Test Requirements

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Examples of Engineering Analysis

“The **[REDACTED]** panels were successfully tested to NFPA 285 requirements with an EPS core with no cavity insulation. It is proposed that the EPS core, which provides an R-value of R-4 per inch will be substituted with a phenolic core, which will increase the value to R-7.12 per inch. This phenolic core will be provided by a separate supplier who has tested the core to ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials. This resulted in a Flame Spread Index of 0 and a Smoke Developed Index of 35 (copy attached).”

No product data provided for EPS or Phenolic cores in letter or test report

No Maximum thickness provided in either material in letter or test report

No NFPA 259 Potential Heat (BTU content) data

ASTM E84 report is lacking clear identification information

ASTM E84 results do not align with similar products (FSI ~25 / SDI ~10).

Examples of Engineering Analysis

"All materials proposed for installation in the wall assemblies on the above referenced project are either non-combustible, or limited combustible materials, having pre-fabricated steel-framed wall assemblies and the **[REDACTED]** panels with the phenolic core. The wall assembly (from exterior to interior) is to be constructed of **[REDACTED]** fiber cement or **[REDACTED]** metal panel siding, **[REDACTED]** peel-and-stick Membrane, **[REDACTED]** panel with phenolic core, and 6-inch, 18 GA steel frame filled with mineral wool insulation."

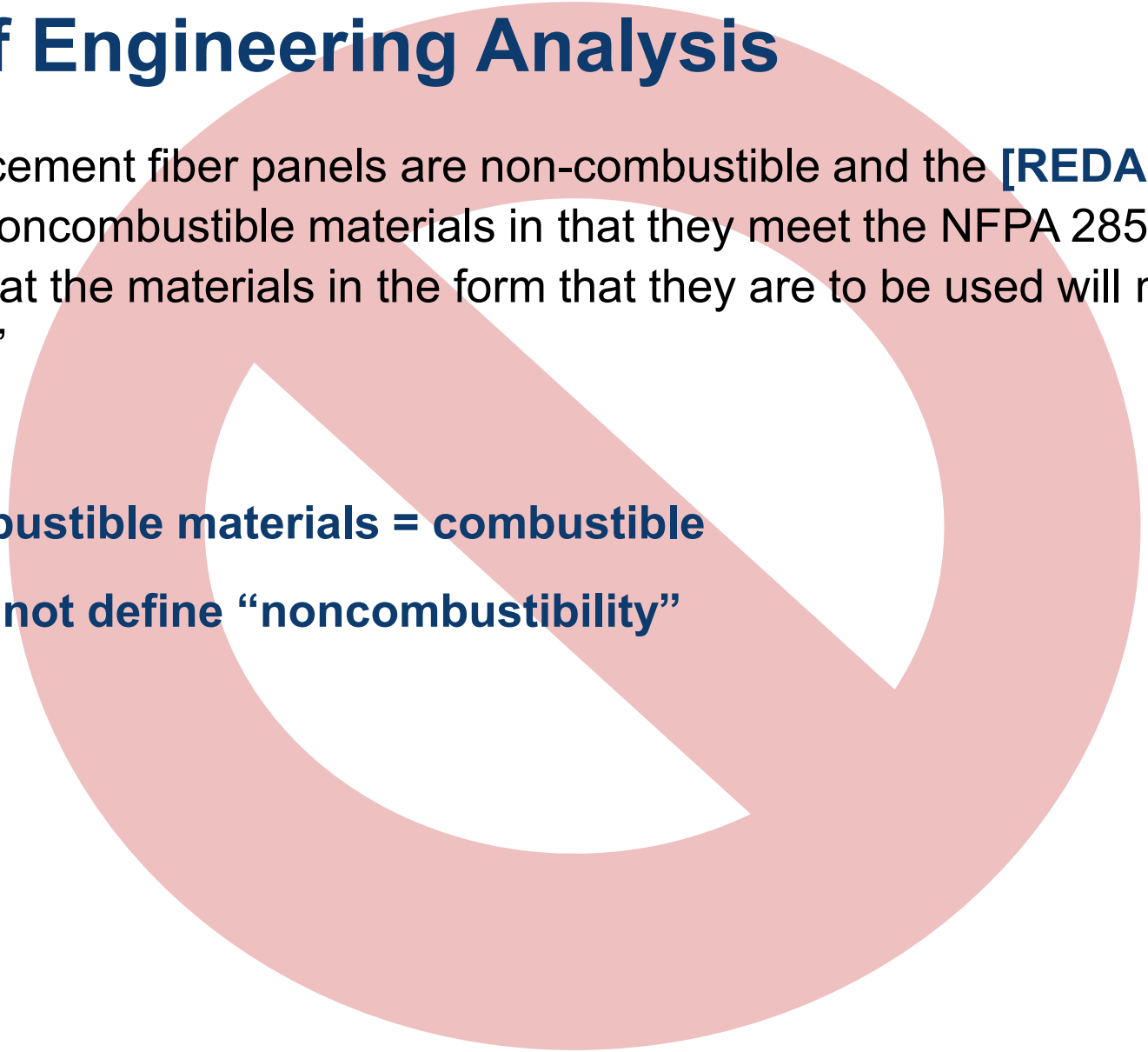
Materials are Combustible - do not meet E136 criteria.

Substantial changes and from referenced NFPA 285 test assembly:

- EPS changed Phenolic Core Panels (with interior spline joint protection)
- Removed two coat, 1/16" thick, plaster render to cover exterior surface
- Removed interior spline joint protection of panels
- Added Combustible WRB
- Added "metal panel siding" and air space over WRB

Examples of Engineering Analysis

“The **[REDACTED]** cement fiber panels are non-combustible and the **[REDACTED]** metal components utilize noncombustible materials in that they meet the NFPA 285 definition of noncombustible in that the materials in the form that they are to be used will not ignite, burn or support combustion.”



Utilize noncombustible materials = combustible

NFPA 285 does not define “noncombustibility”

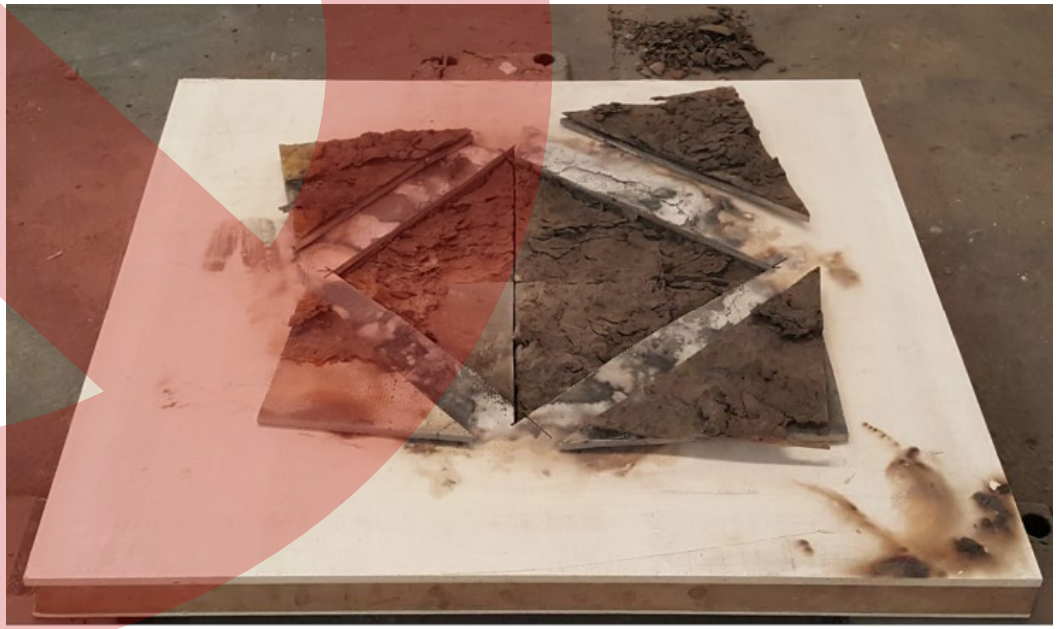
Examples of Engineering Analysis

“The **[REDACTED]** panels have been internally tested and have been shown to be non-combustible. This internal testing utilized a fire exposure on the panel for 2.5-hours and the results were found to have performed better in a fire condition than the EPS core, with the results as shown in the following photo.”

No Reference to Test Standard

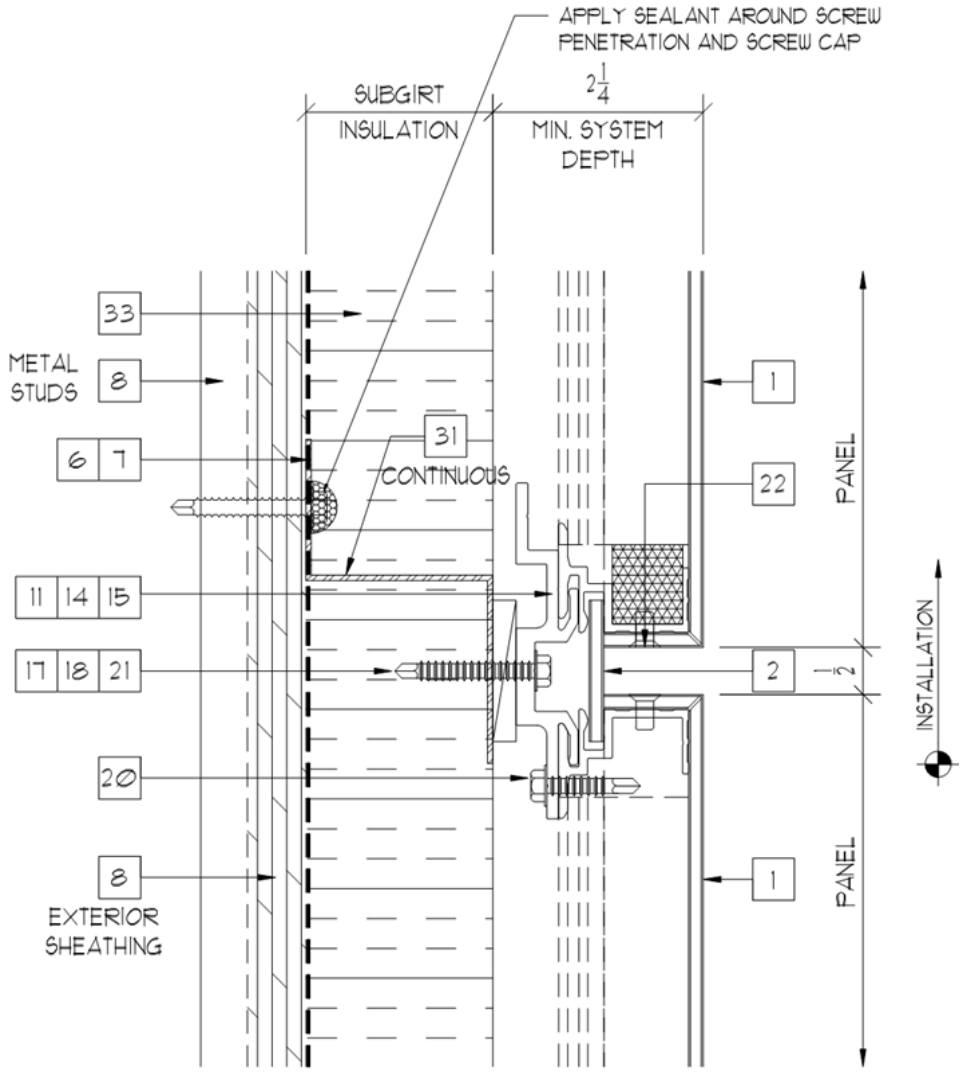
Unknown Exposure Condition

Undefined Criteria



Case Study – Exterior Wall Assembly Evaluation

- Building Details:
  - 42-story High Rise, Type I construction
  - 780 CMR Mass Building Code, 9th Edition
  - Fully sprinklered building
- Wall Construction (interior to exterior)
- ⅝” thick Type X GWB
  - Steel framing
  - ⅝” thick Type X exterior sheathing
  - Aluminum WRB
  - 2” Mineral wool
  - 4mm thick ACM
    - 2¼” air cavity space



Exterior Wall Construction Comparison

Wall Component	Project Wall	Tested Assembly	Comments
Interior GWB	⅝” thick Type X GWB	⅝” thick Type X GWB	Same
Wall Framing	3⅝-inch deep, 18-gauge metal studs spaced 16-inches on center	3⅝-inch deep, 20-gauge metal studs spaced 24-inches on center	Same
Exterior sheathing	⅝” thick Type X exterior sheathing	⅝” thick Type X exterior sheathing	Same
WRB	Carlisle Barritech VP	Tyvek Commercial Wrap WRB	Project WRB has higher flammability properties
Insulation Material	Min 2” of mineral wool insulation	3” of polyiso foam plastic insulation	Project utilizes non-combustible insulation
Exterior cladding	4-mm Alucobond PLUS FR ACM	4-mm Alucobond PLUS FR ACM	Same
Air cavity space	2¼”	2¼”	Same

Exterior Wall Evaluation

- Base Wall assembly construction the same:
  - Same interior GWB - Same ✓
  - Wall Framing – Same ✓
  - Exterior gypsum sheathing – Same ✓
- WRB – Project WRB has higher flammability characteristics ✓
  - Project WRB has higher flammability properties
  - Increases overall wall flammability
  - WRB is covered by 2” of mineral wool insulation – protects WRB
- Insulation Material – Project uses noncombustible insulation ✓
  - Tested assembly included combustible foam plastic insulation
  - Project wall assembly will utilize mineral wool insulation
- Exterior Cladding – Same ✓
- Air cavity space – Same ✓

Take Aways

1. NFPA 285 is a 3D Assembly Test, not a component test.
2. Engineering Analyses are needed due to cost and time required to test
3. Code allows Engineering Analyses
4. Engineering Analyses need to evaluate each component individually and the assembly as a whole
5. Not all Engineering Analyses are created equal
6. Full scale testing may be the only solution

QUESTION & ANSWER PERIOD

Thank you!

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Speaker & Presentation Evaluation

Pitfalls and Challenges