SFRM Fireproofing Inspection & IBC

Bill McHugh, NFCA
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National Fireproofing Contractors Association

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National Fireproofing Contractors Association

Mission

The NFCA promotes the fireproofing industry including contractors, inspection agencies, manufacturers, providing education and advocacy resulting in high quality, passive fire protection for building elements and assemblies for life safety.

National Fireproofing Contractors Association

Vision

The NFCA works to improve the proper use and application of fireproofing products through development of standard practices and educational programs for the industry.

What does NFCA Do?

- NFCA @ ICC Codes…
  - 2021/2024 SFRM/IFRM Proposals…
- NFCA @ ASTM Task Groups - Fireproofing
- NFCA @ NFPA Fire Protection Features
- NFCA @ AISC, AISI, CSI/CSC
- NFCA @ National Codes, Canada – NBCC, NFCC
- NFCA @ American Institute of Steel Construction (AISC)
- Industry Articles
- NFCA @ SFPE/ASCE Meetings
- NFCA Committee ACTIONS
- NFCA International Efforts
  - Middle East
  - Mexico
  - India
  - More…

CSI NATIONAL CONFERENCE 2024

2024 INTERNATIONAL CODE COUNCIL CONFERENCE EXPO+HEARINGS

ASTM INTERNATIONAL

AMERICAN INSTITUTE OF STEEL CONSTRUCTION AISC FOUNDED 1921

NFPA

What Does NFCA Provide?

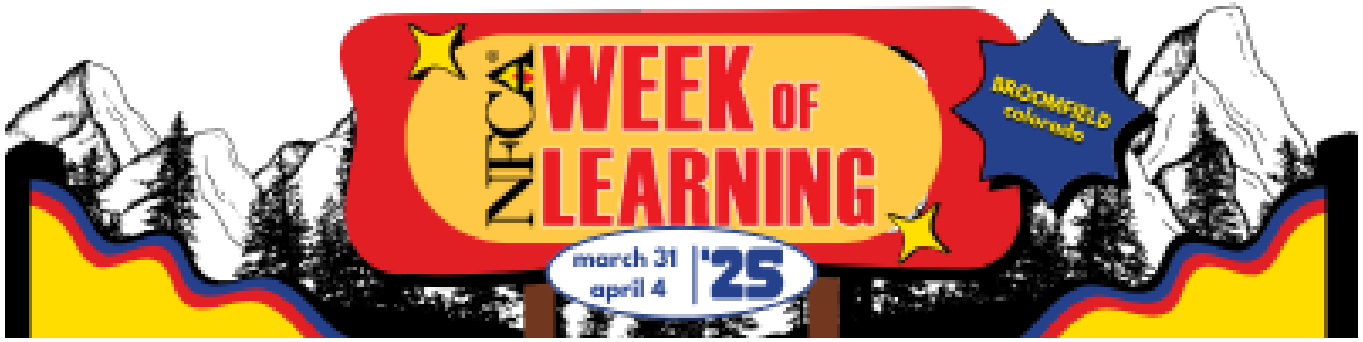
National Fireproofing Contractors Association

- **Fireproofing Education & Exams**
  - World-Class SFRM & IFRM Fireproofing Instruction
- **NFCA Contractor Accreditation Program for IFRM & SFRM**
  - Educated fireproofing Companies
- **NEW UL Qualified Fireproofing Contractor Program**
- **Week of Learning - Educational Conference**
  - Network with top Fireproofing Contractors, Manufacturers, Associates
  - A forum for suppliers and contractors to learn from one another
- **NFCA 100-400 Standards** for quality and life safety
- **Technical expertise, Standards and Code Development**
- **NFCA Website** to find Fireproofing Leaders – NFCA-online.org

NFCA Educational Events

- ***NFCA's Week of Learning***

  March 31 – April 4
- ***Monday, Tuesday, Weds., Fireproofing Education & Exams***
- **Weds. MORNING @ RP & Education, Exhibits**
- **Thursday & Friday Education**
- **Amazing Speakers**
- **Committee Action**



National Fireproofing Contractors Association

2027 Code Development Process (CDP) IBC, NFPA
2025/2030 CDP – NBCC, NFCC

Bill McHugh, Technical Director, NFCA
Rich Walke, Consultant to the NFCA

NFCA FREE Webinar Series

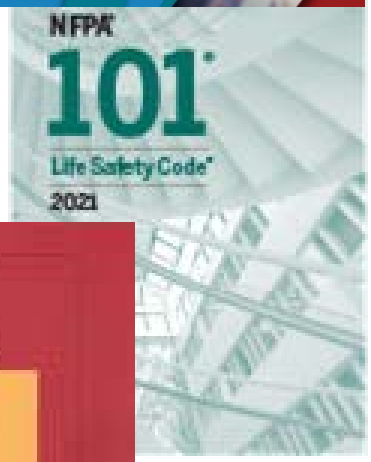
Learn – Network – Grow

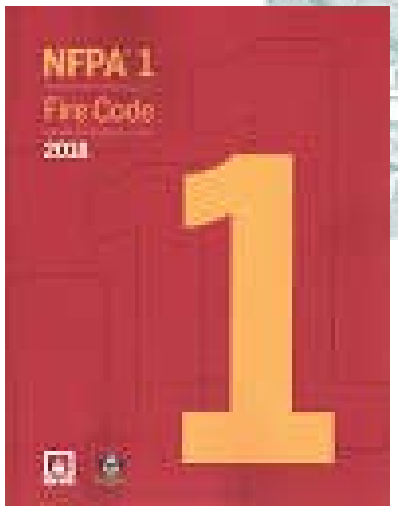
NFCA @ 2027 IBC CDP

- **Table 601 - 20’ Rule; Clarifications**
- **Occupiable Roofs**
- **Special Inspection**
- **Parking Garage Fire-Resistance**
- **Attachments**
- **Restrained/Unrestrained – FS2**

NFCA @ ICC, NFPA, Canada, etc. CDP

- **NBCC – National Building Code of Canada**
  - Fireproofing Special Inspection
  - Fire-resistance Rated Roofs
  - Installation in accordance with Manufacturers Instructions and Listings
- **NFCC – National Fire Code of Canada**
  - Maintain Protection
- NFPA 1 – PEI Adopted …
- NFPA 101 – Newfoundland/Labrador
- **Educate About Existing Buildings**





NFCA's Standards Work

- **Standards Development & Other Relationships**
  - **NFCA @ ASTM**
    - **SFRM – IFRM Inspection**
    - Boards/Wraps Inspection Standards
    - ASTM E119 – Fire Tests –
  - **NFCA @ UL/ULC**
    - UL STP 263 Fire Tests –
    - **ULC STP ULC-S101 GUIDE INFO SUBMISSIONS**
    - Others
  - **NFCA @ AISC, AISI**

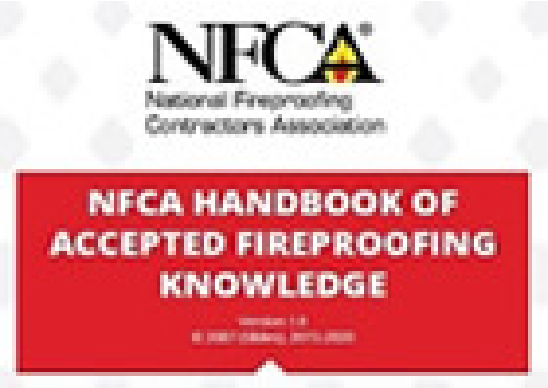
ASTM INTERNATIONAL
Helping our world work better

American Iron and Steel Institute

AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISC
FOUNDED 1921

NFCA Handbook of Accepted Fireproofing Knowledge (HAFK)

National Fireproofing Contractors Association



- Study Resource for NFCA Fireproofing Exams
- Fireproofing in ‘One Place’
- **NFCA Members = $500 Discount**
- **FREE HAFK PDF for AHJ’s & Specifiers with Design Firms, Independent Specifiers**
- **SAFETY HANDBOOK INCLUDED**
- More New Chapters coming… www.nfca-online.org

NFCA Contractor Accreditation Program

- **NFCA LIVE & VIRTUAL EDUCATION / EXAMS**
  - **Contractor DRI Designated Responsible Individual**
  - **Prove Inspection Agency Competence**
  - **Focus on Fire-Resistance & Fireproofing**
- **NFCA Contractor Accreditation Program**

IFRM Accredited Contractor

NFCA®

National Fireproofing Contractors Association

SFRM Accredited Contractor

NFCA®

National Fireproofing Contractors Association

Contractor Qualifications – NFCA Contractor Accreditation Program (CAP)

- Commitment to Fireproofing Installation
- NFCA Accreditation Seal - Registered mark

IFRM Accredited Contractor

NFCA®

National Fireproofing Contractors Association

SFRM Accredited Contractor

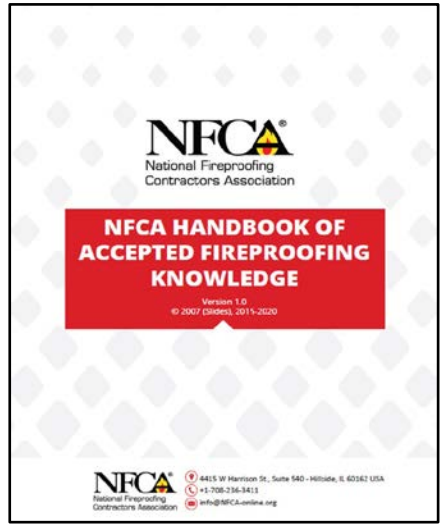
NFCA®

National Fireproofing Contractors Association

IFRM and SFRM Accredited Contractor

NFCA®

National Fireproofing Contractors Association



Contractor Qualifications – UL QFCP

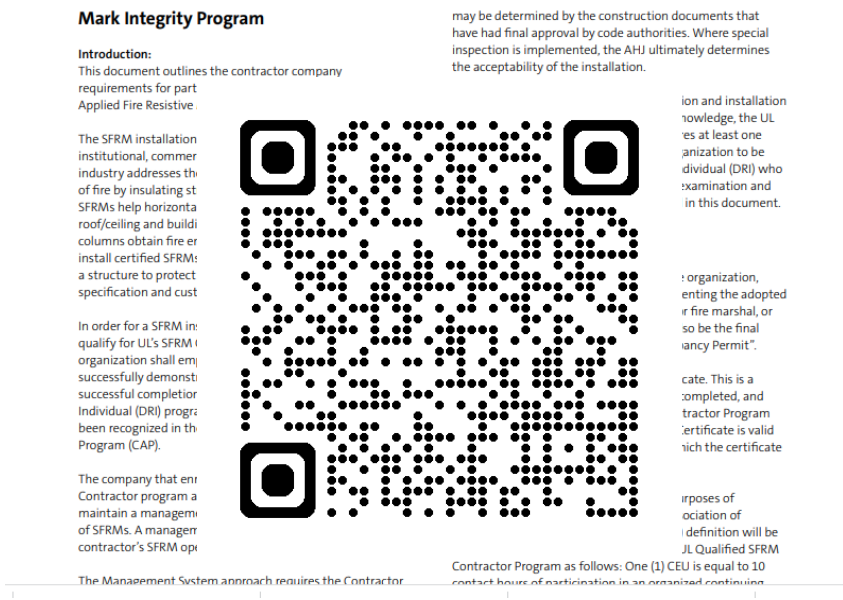
- UL Qualified SFRM Fireproofing Contractors
  - NFCA Education
    - NFCA HAFK, DRI
    - UL Program Guide, Product iQ
  - NFCA SFRM Fireproofing Exam
  - Management System
  - UL Audits –
    - Office
    - Field

CERTIFIED
MANAGEMENT SYSTEM
QUALIFIED FIRESTOP CONTRACTOR

UL Qualified Fireproofing Contractor Program

- **NFCA DRI REQUIRED**
- **Management System (MS)**
- **Audited**
  - **Contractor's Office**
  - **Jobsite**
- **Several Contractors in Process….**

UL Qualified Spray-Applied Fire Resistive Material (SFRM) Contractor Program requirements



Mark Integrity Program

Introduction:
This document outlines the contractor company requirements for part
Applied Fire Resistive

The SFRM installation
institutional, commer
industry addresses th
of fire by insulating st
SFRMs help horizonta
roof/ceiling and buildi
columns obtain fire er
install certified SFRMs
a structure to protect
specification and cust

In order for a SFRM in
qualify for UL's SFRM
organization shall em
successfully demonst
successful completio
Individual (DRI) progra
been recognized in th
Program (CAP).

The company that en
Contractor program a
maintain a managem
of SFRMs. A manager
contractor's SFRM op

The Management System approach requires the Contractor

may be determined by the construction documents that have had final approval by code authorities. Where special inspection is implemented, the AHJ ultimately determines the acceptability of the installation.

ion and installation
owledge, the UL
es at least one
anization to be
dividual (DRI) who
xamination and
in this document.

organization,
enting the adopted
r fire marshal, or
so be the final
ancy Permit".

cate. This is a
completed, and
tractor Program
ertificate is valid
hich the certificate

rposes of
ociation of
definition will be
JL Qualified SFRM

Contractor Program as follows: One (1) CEU is equal to 10 contact hours of participation in an organized continuing

NFCA Educational Events

National Fireproofing Contractors Association

- **NFCA/FCIA PasFiPro Canada Symposium**
  - **Members**
  - **Code Officials**
- **NFCA/FCIA PasFiPro Dubai, Doha**
- **NFCA @ Mexico LATAM/PCI**

Lots Done, Much Travel in 2024….

- **NFCA Speaks, Builds Relationships**
  - Webinars
  - FSBI - Fire Safe Build India
  - CSI – Construction Specifications Institute
  - NFPA Expo
  - ICC Expo
  - Dubai, UAE & Doha, Qatar & Riyadh, Saudi Arabia

Fireproofing Inspection & IBC

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National Fireproofing Contractors Association

Firestopping, Compartmentation & Structural Fire-Resistance for Safety

- **NIST NCSTAR 1A, report for WTC towers I & II**
- **World Trade Center 7** - Recommendation C

- ***'the need for redundancy in fire protection systems that are critical to life structural integrity';***

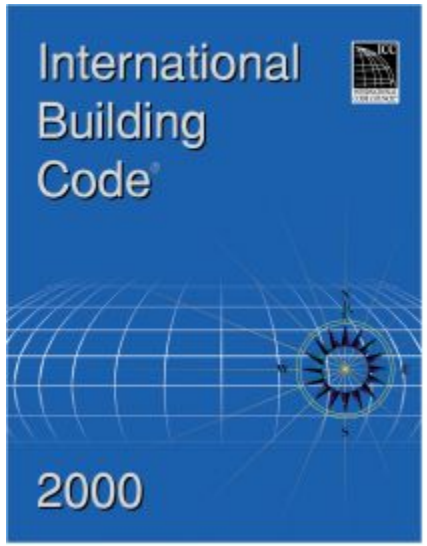
- *'...and the active sprinkler system each provide redundancy for maintaining structural integrity in a building fire, should one of the systems fail to perform it's intended function.'*

- ***'the ability of the structure and local floor systems to withstand a maximum credible fire scenario, without collapse, recognizing that sprinklers could be compromised, not operational, or non existent.'***

National Fireproofing Contractors Association

Fireproofing Special Inspection

IBC Ch. 17



Fireproofing Special Inspection

- **Industry Terminology**
- **Fire Testing (Short)**
- **IBC & Inspection - Code & Standards Requirements**
- **SFRM Section**
  - Specific Inspection and Testing Procedures
  - Reporting Results
- **IFRM Section**
  - Specific Inspection and Testing Procedures
  - Reporting Results

Code Requirements

- Chapter 7 – Fire and Smoke Protection Features
  - 703.2 – Fire-resistance ratings shall be determined in accordance with Section 703.2.1 or 703.2.2 without the use of automatic sprinklers or any other fire suppression system being incorporated, or in accordance with Section 703.2.3
    - 703.2.1 **Tested assemblies** – Fire-resistance ratings shall be determined in accordance with ASTM E119 or UL 263
      - 703.2.1.1 – Nonsymmetrical walls shall be tested from both faces

Code Requirements Cont.

- 703.2.2 **Analytical methods** – Methods for determining fire resistance shall be based on fire exposure and acceptance criteria of ASTM E119 or UL 263

Code Requirements Cont.

- 703.2.2 Cont. – Required fire resistance permitted to be established based on any of the following:
  - Designs documented from **approved sources**
  - Prescriptive requirements from **Section 721**
  - Calculations in accordance with **Section 722**
  - Engineering analysis based on **ASTM E119 or UL 263**
  - Fire-resistance designs certified by an **approved agency**

Code Requirements Cont.

[A] 104.11 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. An alternative material, design or method of construction shall be **approved where the *building official* finds that the proposed alternative meets all of the following**:

1. The alternative material, design or method of construction is satisfactory and complies with the intent of the provisions of this code,

2. The material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code as it pertains to the following:

2.1. Quality.

2.2. Strength.

2.3. Effectiveness.

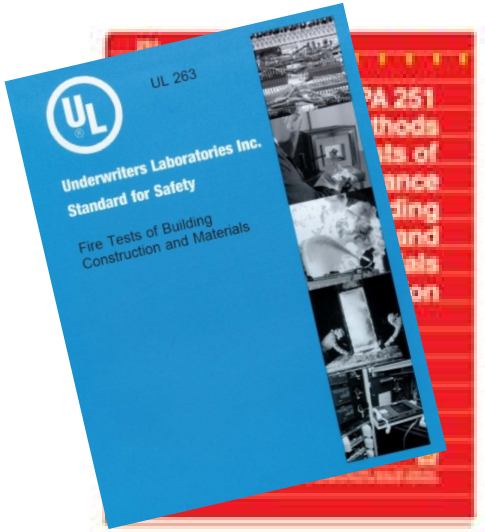
2.4. ~~*Fire resistance*~~……*Fire Safety* in 2024

2.5. Durability.

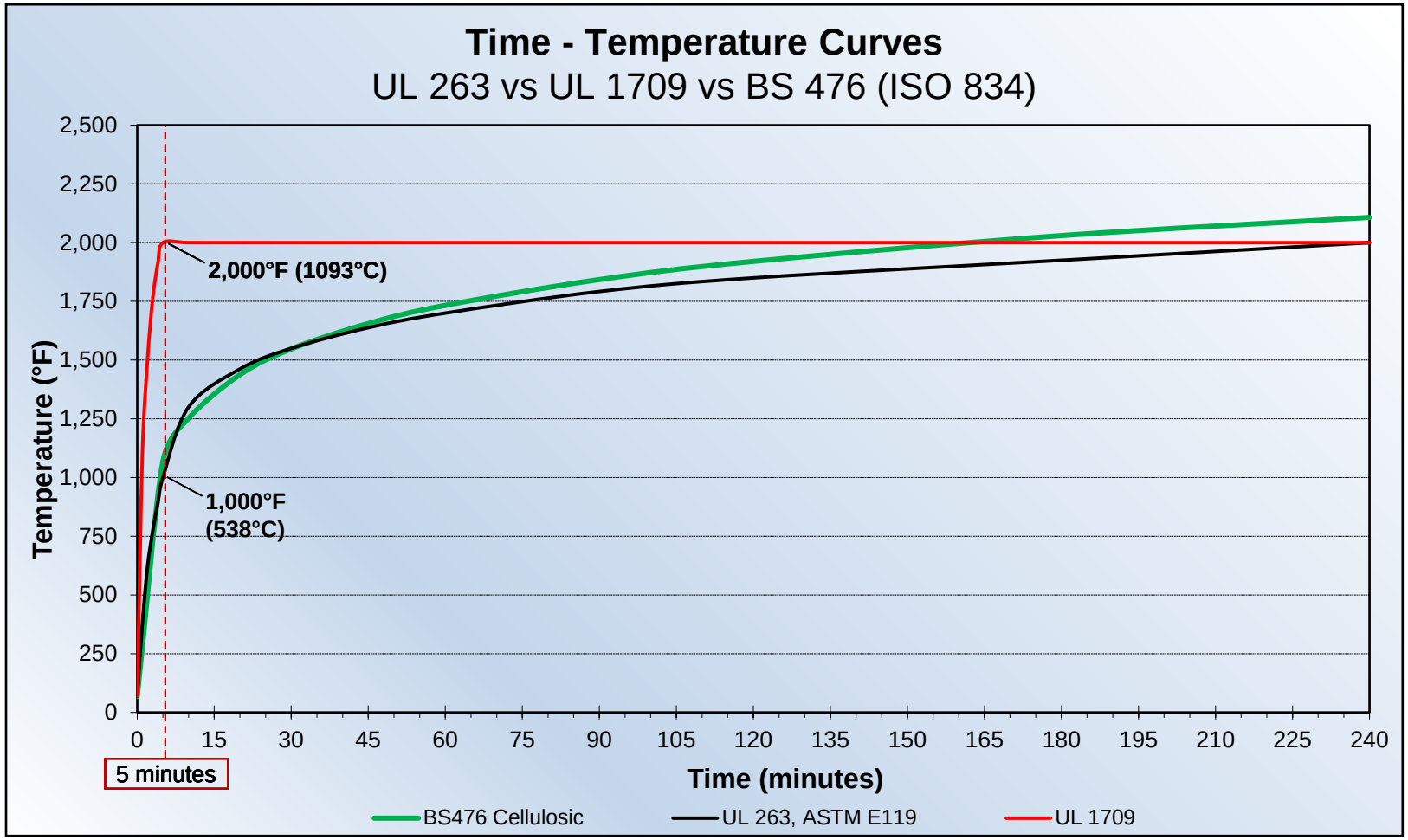
2.6. Safety.

Standards to Establish Ratings

- US
  - ASTM E119
  - UL 263
- Canada
  - ULC-S101
- Euro – Another Webinar…



Time – Fire Test Temperature Curve



UL 263 / ASTM E119
Cellulosic
- Office buildings
- Hospitals
- Schools

UL 1709 / ASTM E1529
Hydrocarbon
- Oil refineries
- Petrochemical plants
- Li Batteries???

BS 476 / ISO 834
Cellulosic
- Office buildings
- Hospitals
- Schools

UL Image

Columns

- Sample size – Minimum 9 ft
- Tested unloaded
- CONDITIONS OF ACCEPTANCE
  - 1000ºF / 1200ºF

    Support load if tested load bearing

Beams

- Sample size – Minimum 12 ft
- Load applied – Per design

UL Image

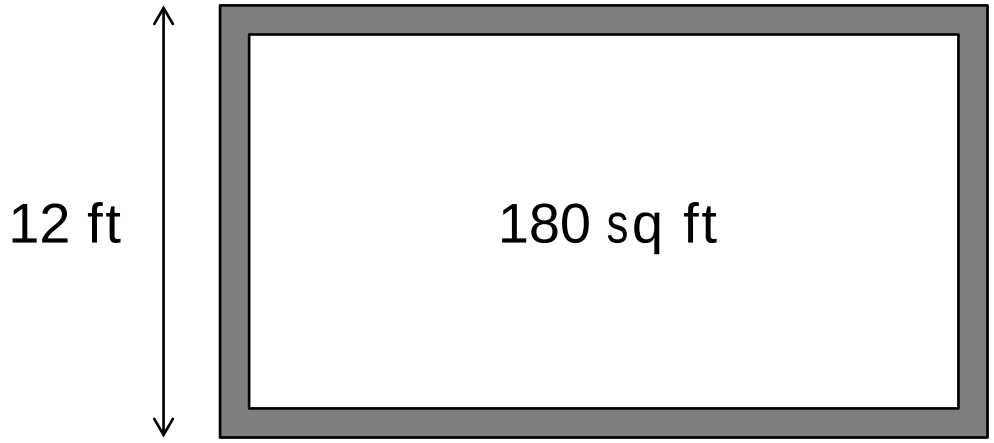
UL Image

Conditions of Acceptance – Beams

- Support load
- 1100ºF / 1300ºF

Floor/Ceiling or Roof/Ceilings

- Sample size – 180 sq ft / 12 ft
- Load applied – Per design



UL Image

UL Image

Conditions of Acceptance
Floor/Ceilings or Roof/Ceilings

- Support load
- Flame passage
- 250ºF / 325ºF
- Support temperatures

Why Special Inspection?

UL Image

- **Critical Structural protection**
- **Protection for Fire and Life Safety**
- **Code Required…**
- ***ICC Adhoc Comm., Terrorism Resistant Buildings***

NEW Definitions and Terminology
IFRM = ONE DEFINED TERM

Great Northern Insulation Photo

INTUMESCENT FIRE-RESISTIVE RESISTANT MATERIALS. ~~Thin film l~~ Liquid mixture applied to substrates by brush, roller, spray or trowel which expands into a protective ~~foamed~~ layer to provide fire- resistive ~~resistant~~ protection of the substrates when exposed to flame or intense heat.

~~**MASTIC FIRE-RESISTANT COATINGS.** Liquid mixture applied to a substrate by brush, roller, spray or trowel that provides fire-resistant protection of a substrate when exposed to flame or intense heat.~~

[IBC 202 - 2018, 2021 2024 ~~2021~~]

NEW Definitions and Terminology

The Raymond Group Photo

SPRAYED FIRE-RESISTIVE ~~RESISTANT~~ MATERIALS. Cementitious or fibrous materials that are sprayed to provide fire-resistive ~~resistant~~ protection of the substrates.

[IBC 202 - 2018, 2021 2024 ~~2021~~]

NEW Definitions and Terminology

HIGH-RISE BUILDING. A building with an occupiable floor or occupiable roof located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access.

[IBC 202 2021, 2024]

NFCA's 2020/2021 Disappointments – Group A

- **G135-21 – OCCUPIABLE ROOFS**
- Table 601, Footnotes b and c
  - **b.** Where a roof is an occupiable space, the fire-resistance rating of the roof assembly shall be equal to or greater than the floor below.
  - ~~b~~c. Except in Group F-1, H, M and S-1 occupancies and where the roof is an occupiable space, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
- **G135-21 – DISAPPROVED**
- Committee felt the language in Footnote c was confusing
- On to 2027….

Definitions and Terminology

SPECIAL INSPECTION. Inspection of construction requiring the expertise of an *approved special inspector* in order to ensure compliance with this code and the approved *construction documents*.

Continuous special inspection. *Special inspection* by the *special inspector* who is present continuously when and where the work to be inspected is being performed.

Periodic special inspection. *Special inspection* by the *special inspector* who is intermittently present where the work to be inspected has been or is being performed.
[IBC 202 - 2018, 2021]

Definitions and Terminology - APPROVALS

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been *approved* by the *building official*.

APPROVED. Acceptable to the *building official* or authority having jurisdiction.

[IBC 2021, 202]

Definitions and Terminology - APPROVALS

SPECIAL INSPECTOR. A qualified person employed or retained by an *approved* agency and *approved* by the *building official* as having the competence necessary to inspect a particular type of construction requiring *special inspection.*

[IBC 2021, 202]

Ch. 17 Special Inspection

1703.1 Approved agency. An approved agency shall provide all information as necessary for the *building official* to determine that the agency meets the applicable requirements specified in Sections 1703.1.1 through 1703.1.3.

1703.1.1 Independence. An *approved agency* shall be objective, competent and independent from the contractor responsible for the work being inspected. The agency shall disclose to the *building official* and the *registered design professional in responsible charge* possible conflicts of interest so that objectivity can be confirmed.

1703.1.2 Equipment. An *approved agency* shall have adequate equipment to perform required tests. The equipment shall be periodically calibrated.

1703.1.3 Personnel. An *approved agency* shall employ experienced personnel educated in conducting, supervising and evaluating tests and *special inspections*

Ch. 17 – Special Inspections

1704.2.1 Special inspector qualifications. Prior to the start of construction, the ***approved agencies*** shall provide written documentation to the *building official* **demonstrating his or her competence and relevant experience or training of the *special inspectors*** who will perform the *special inspections* and tests during construction**.** Experience or training shall be considered relevant when the documented experience or training is **related in complexity to the same type of *special inspection* or testing activities for projects of similar complexity and material qualities**. These qualifications are in addition to qualifications specified in other sections of this code. Continued…..

[IBC 2015, 1704.2.1]

Ch. 17 Special Inspection

1704.2.1 Special inspector qualifications. …..

…. The *registered design professional in responsible charge* and engineers of record involved in the design of the project are permitted to act as the *approved agency* and their personnel are permitted to act as the special inspector for the work designed by them, provided they qualify as special inspectors.

[IBC 2021, 1704.2.1]

Special Inspection Agency Approval
IAS AC 291

- Special Inspection Agency Accreditation
  - Company Management System Manual
    - (ISO 9000 ‘lite’)
  - Audit
  - Ongoing Audits
  - Individual Competencies
- Inspection Firm shall have at least one staff..
  - PASS ICC Fireproofing Inspector Exam or
  - ICC Fire Inspector I

https://www.iasonline.org/resources/accreditation-criteria-for-special-inspection-agencies-ac291/

Ch. 17 Special Inspection

1704.2.4 Report requirement. *Approved agencies* shall keep records of *special inspections* and tests. The *approved agency* shall submit reports of *special inspections* and tests to the *building official* and to the *registered design professional in responsible charge*. Reports shall indicate that work inspected or tested was or was not completed in conformance to *approved construction documents*. **Discrepancies shall be brought to the immediate attention of the contractor for correction.** If they are not corrected, the discrepancies shall be brought to the attention of the *building official* and to the *registered design professional in responsible charge* prior to the completion of that phase of the work. A final report documenting required *special inspections* and tests, and correction of any discrepancies noted in the inspections or tests, shall be submitted at a point in time agreed upon prior to the start of work by the owner or the owner's authorized agent to the *building official*. **[IBC 2021, 1704.2.4]**

Ch. 17 Special Inspection

1705.1.1 Special cases. *Special inspections* and tests shall be required for proposed work that is, in the opinion of the building official, unusual in its nature, such as, but not limited to, the following examples:

1. Construction materials and systems that are alternatives to materials and systems prescribed by this code.

2. Unusual design applications of materials described in this code.

3. Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in this code or in standards referenced by this code.

[IBC 2021, 1705.1.1]

Means Boards & Wraps, even though not referenced…..

Ch. 17 Special Inspection

1705.15 Sprayed fire-resistant materials. *Special inspections* and tests of sprayed fire-resistant materials applied to floor, roof and wall assemblies and structural members shall be performed in accordance with Sections 1705.14.1 through 1705.14.6. *Special inspections* shall be **based on the fire-resistance design** as designated in the *approved construction documents*. The tests set forth in this section shall be based on samplings from specific floor, roof and wall assemblies and structural members. *Special inspections* and tests shall be performed during construction with an additional inspection after the rough installation of electrical, automatic sprinkler, mechanical and plumbing systems and suspension systems for ceilings, where applicable.

[IBC 2021, 1705.15]

Ch. 17 Special Inspection

NEW SENTENCE…..

1705.15 Sprayed fire-resistive materials……

The sample size shall not exceed 110% of that specified by the reference standards in section 1705.15.4.1 through 1705.14.4.9

[IBC 2021, 1705.15]

NEWS

Safer Buildings Are Goal of New Code Changes Based on Recommendations from NIST World Trade Center Investigation

October 01, 2008

GAITHERSBURG, Md.—Future buildings—especially tall structures—should be increasingly resistant to fire, more easily evacuated in emergencies, and safer overall thanks to 23 major and far-reaching building and fire code changes approved recently by the International Code Council (ICC) based on recommendations from the Commerce Department's National Institute of Standards and Technology (NIST). The recommendations were part of NIST's investigation of the collapses of New York City's World Trade Center (WTC) towers on Sept. 11, 2001. The changes, adopted at the ICC hearings held Sept. 15-21, 2008, in Minneapolis, Minn., will be incorporated into the 2009 edition of the ICC's I-Codes (specifically the International Building Code, or IBC, and the International Fire Code, or IFC), a state-of-the-art model code used as the basis for building and fire regulations promulgated and

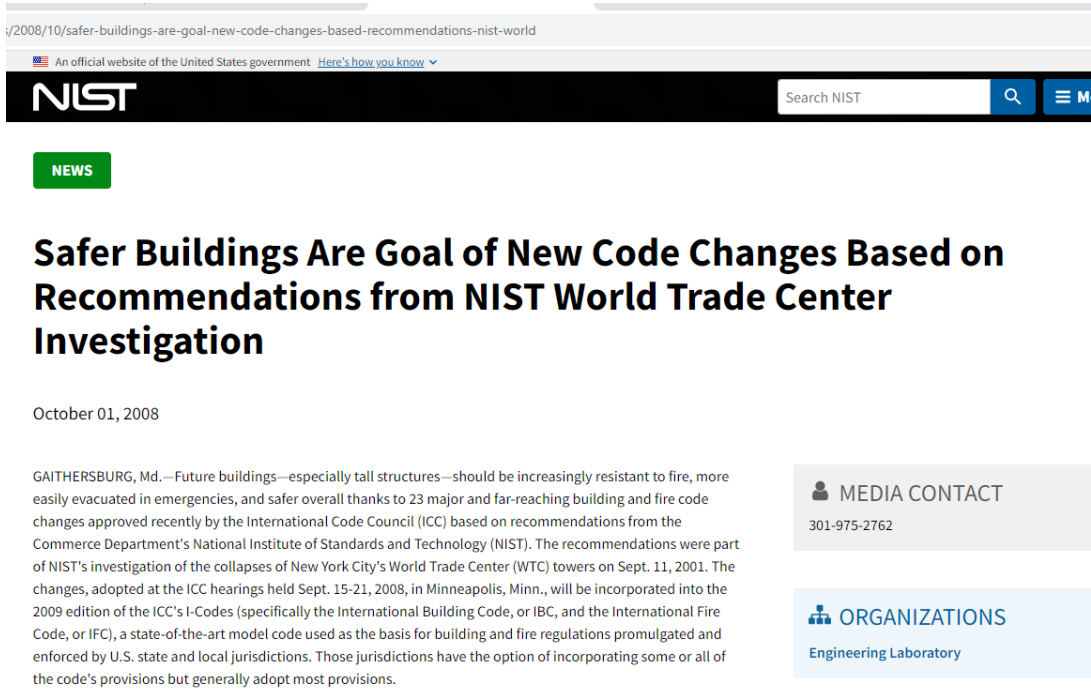
MEDIA CONTACT

301-975-2762

ORGANIZATIONS

ICC TRB -

- **Fireproofing –**
  - **Increased Bond Strength – 75’-120’; >420’**
  - **Primer Bond Strength too**
  - **Special Inspection**
  - **Maintaining Protection**
  - **Increased fire-resistance, >420’**
- **Stairwells, Egress & Corridor Length**
  - **Strength, Width**
  - **Separation**
  - **Number – w/Trade Off for Emergency Evac Elevators**
  - **PL Markings – Egress >75’**
  - **Fire Service Elevator**
- **Communications in Stairwells**
- **Two Sprinkler Risers >420’**
- **Much more…**



/2008/10/safer-buildings-are-goal-new-code-changes-based-recommendations-nist-world

An official website of the United States government Here's how you know

NIST Search NIST

NEWS

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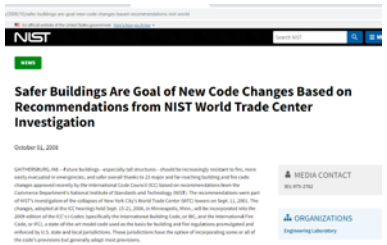
MEDIA CONTACT
301-975-2762

ORGANIZATIONS
Engineering Laboratory

Ch. 17 Special Inspection

1705.14.1 Physical and visual tests. The *special inspections* and tests shall include the following to demonstrate compliance with the listing and the *fire-resistance rating*:


NIST

Safer Buildings Are Goal of New Code Changes Based on Recommendations from NIST World Trade Center Investigation

1. Condition of substrates.
2. Thickness of application.
3. Density in pounds per cubic foot (kg/m_3).
4. Bond strength adhesion/cohesion.
5. Condition of finished application.

[IBC 2018, 2021, 1705.15.1]

Preparation….

1705.15.2 Structural member surface conditions. The surfaces shall be prepared in accordance with the *approved* fire-resistance design **and** the written instructions of *approved* manufacturers.

The prepared surface of structural members to be sprayed shall be inspected by the special inspector before the application of the sprayed fire resistive material.

- **[IBC 2018, 2021 1705.15.2]**

Application Conditions

1705.15.3 Application. The substrate shall have a minimum ambient temperature before and after application as specified in the written instructions of *approved* manufacturers. The area for application shall be ventilated during and after application as required by the written instructions of *approved* manufacturers.

[IBC 2018, 2021, 1705.15.3]

Bond Strength

1705.15.6 Bond strength. The cohesive/adhesive bond strength of the cured sprayed fire-resistive material applied to floor, roof and wall assemblies and structural members shall be **not less than 150 pounds per square foot (psf) (7.18 kN/m2).** The cohesive/adhesive bond strength shall be determined in accordance with the field test specified in **ASTM E736** by testing in-place samples of the sprayed fire-resistive material selected in accordance with Sections 1705.15.6.1 through 1705.15.6.3.

…1,000 PSF for >420'….in Chapter 4, High Rise Buildings

…for '27 code, 1,000 PSF listed in this section too…NFCA!

[IBC 2018, 2021, 1705.15.6]

Bond Strength…IBC

1705.15.6.1 Floor, roof and wall assemblies.

The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistive materials shall be selected from each floor, roof and wall assembly at the rate of not less than **one sample for every 2,500 square feet (232 m2)** of the sprayed area, or portion thereof, in each *story*.

1705.15.6.2 Structural members.

The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistant materials shall be selected from beams, girders, trusses, columns and other structural members at the rate of **not less than one sample for each type of structural member for each 2,500 square feet** (232 m2) of floor area or portion thereof in each *story*.

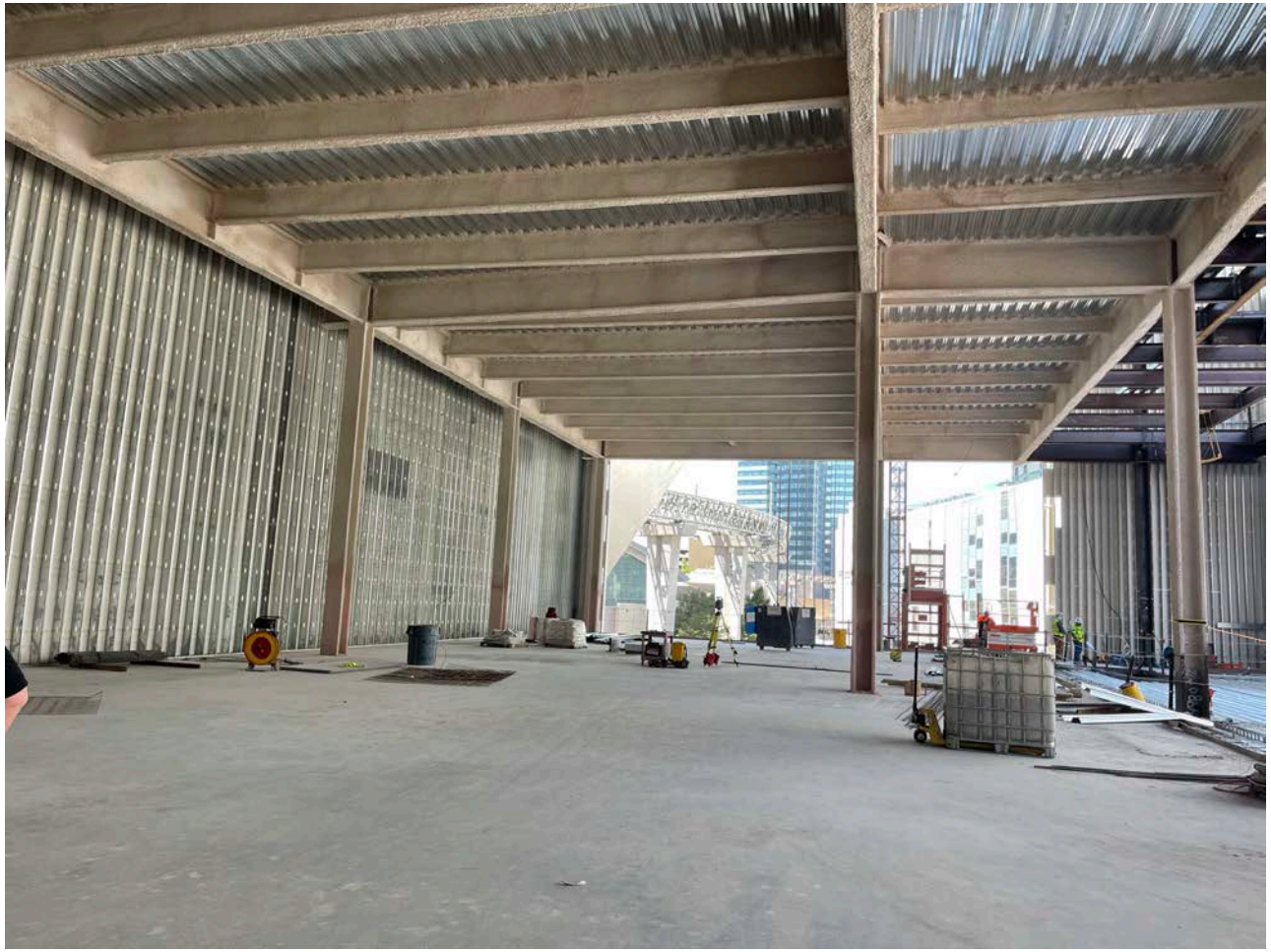
[IBC 2018, 2021, 1705.15.6.1 & 6.2]

Primers, Paints, Encapsulants…

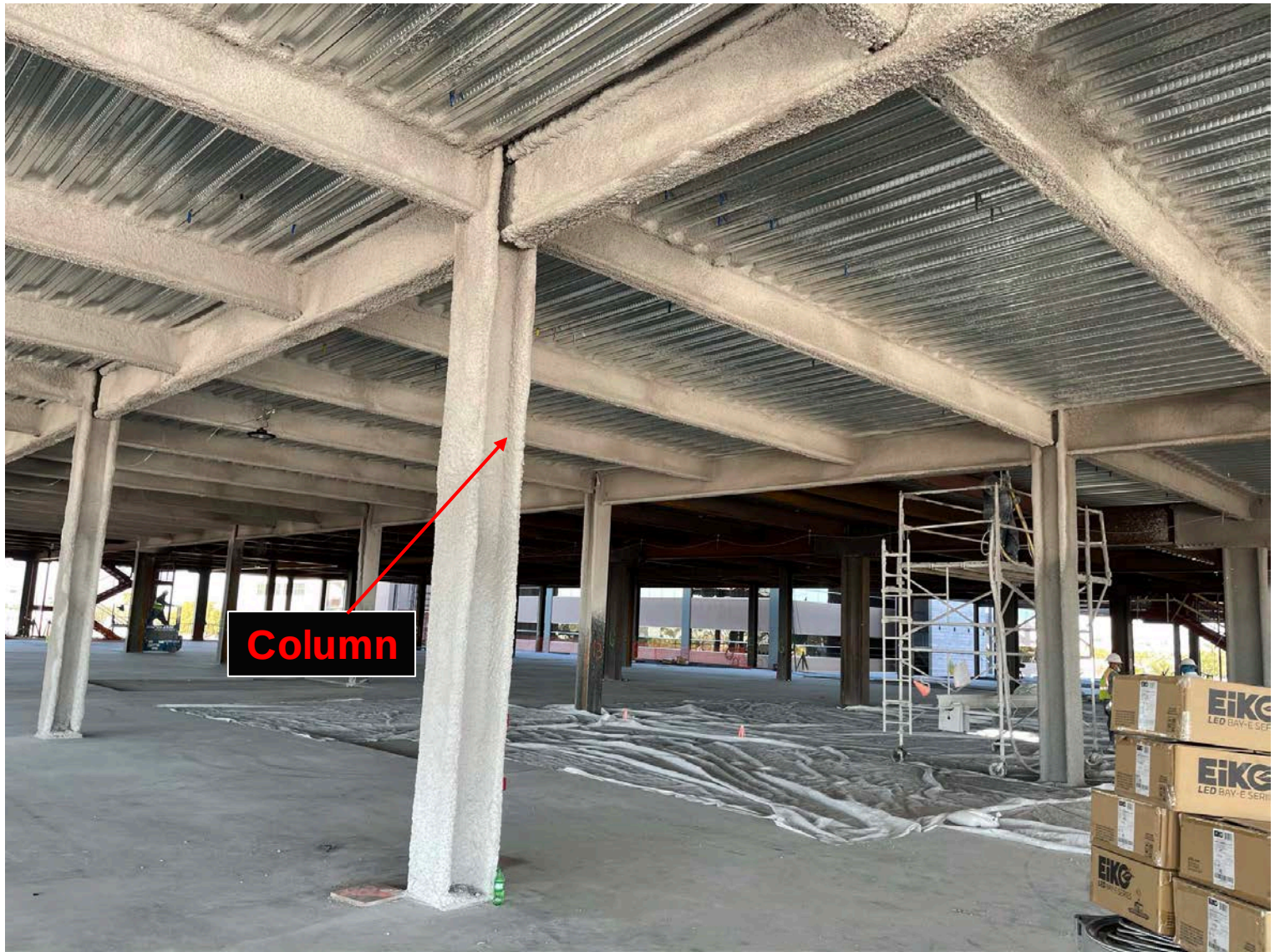
1705.15.6.3 Primer, paint and encapsulant bond tests. Bond tests to qualify a primer, paint or encapsulant shall be conducted where the sprayed fire-resistive material is applied to a primed, painted or encapsulated surface for which acceptable bond strength performance between these coatings and the fire-resistive material has not been determined. **A bonding agent *approved* by the SFRM manufacturer shall be applied to a primed, painted or encapsulated surface where the bond strengths are found to be less than required values.**

[IBC 2018, 2021, 1705.15.6.3]

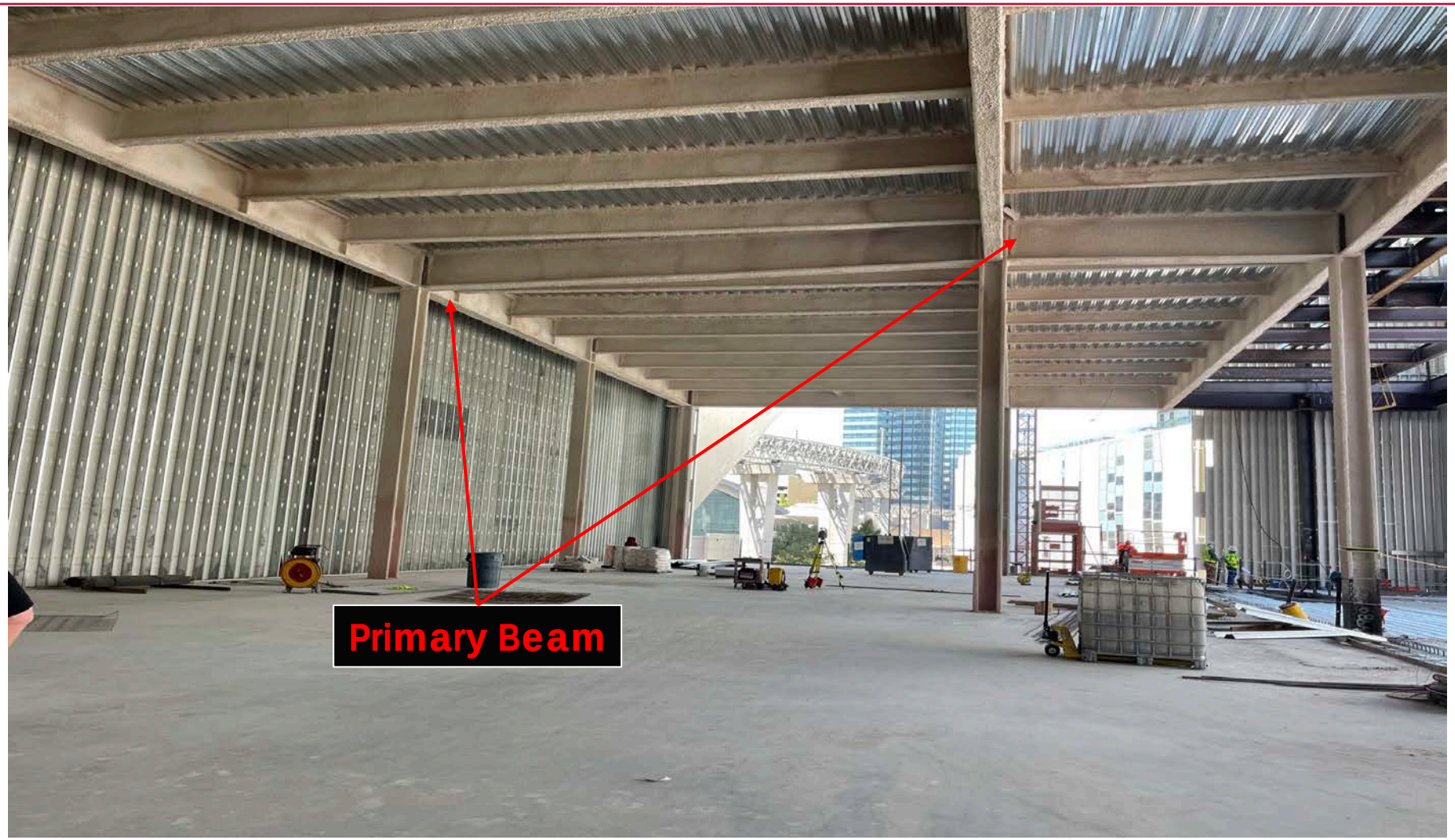
Typical Bay of Sprayed Fireproofing



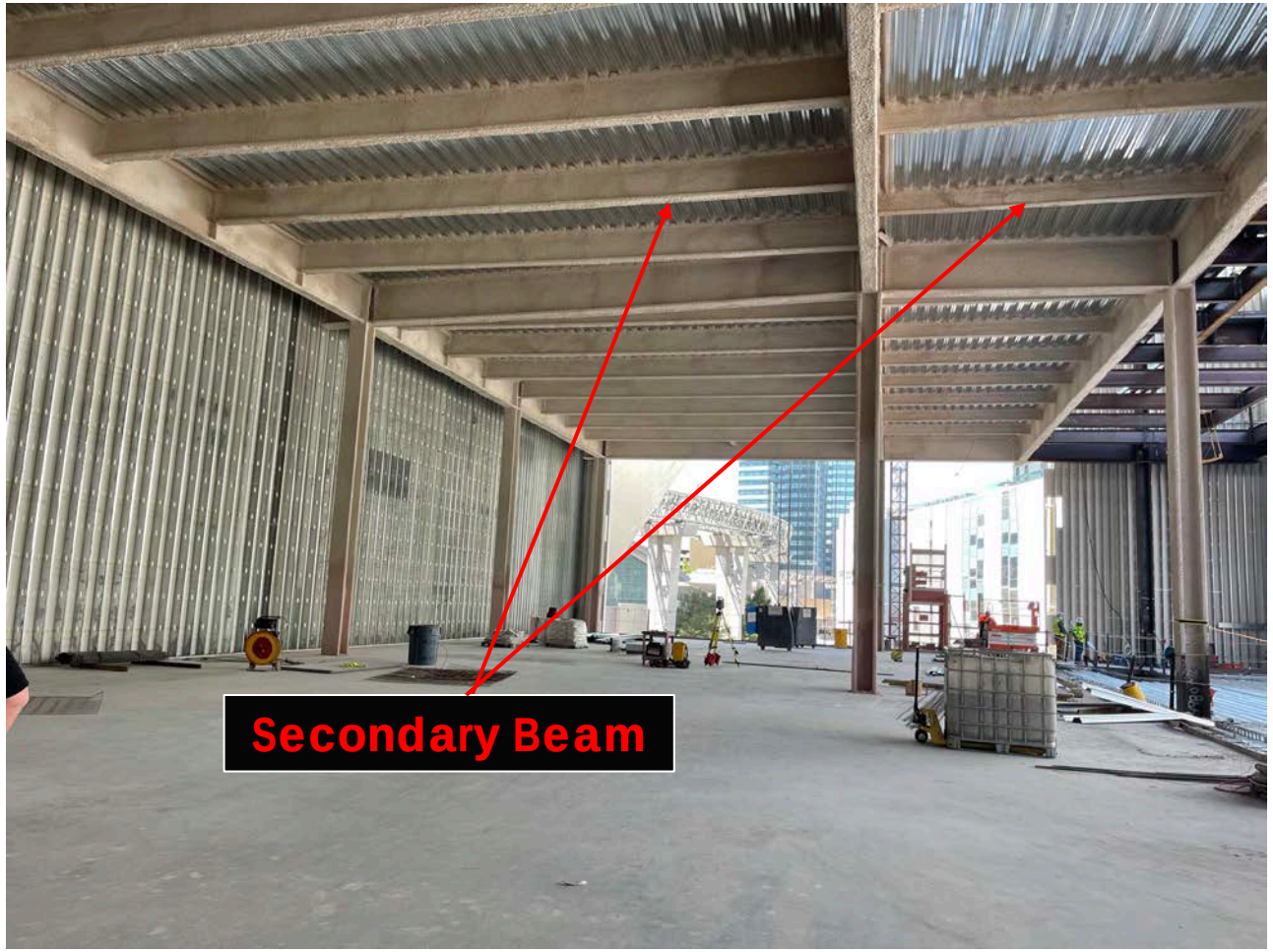
Column



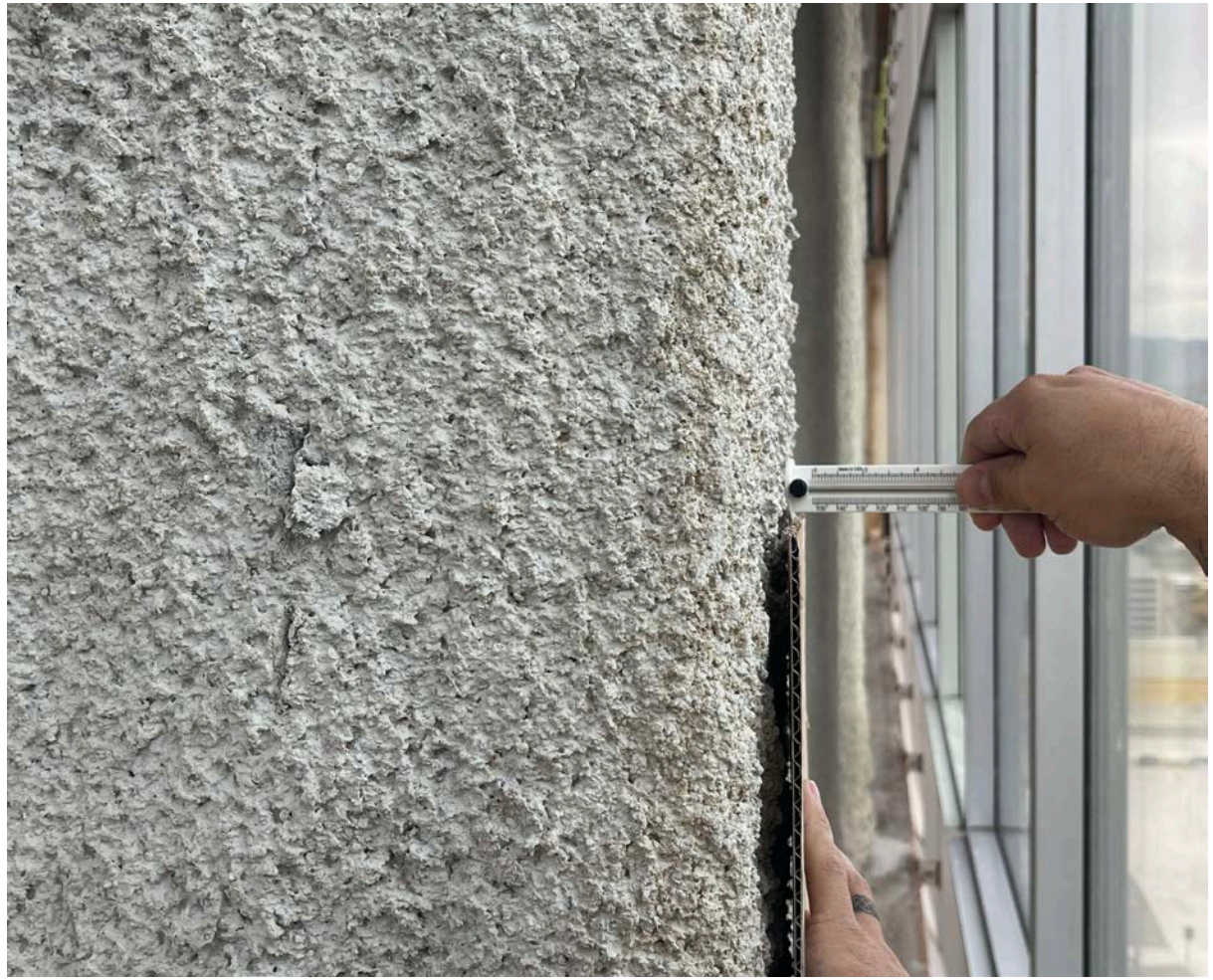
Primary Floor Beam or Joist



Secondary Beam or Joist



Measuring Thickness



Thicknesses

1705.15.4 Thickness. Not more than 10 percent of the thickness measurements of the sprayed fire-resistive materials applied to floor, roof and wall assemblies and structural members shall be less than the thickness required by the *approved* fire-resistance design, and none shall be less than the minimum allowable thickness required by Section 1705.15.4.1.

[IBC 2018, 2021, 1705.15.4]

Thicknesses

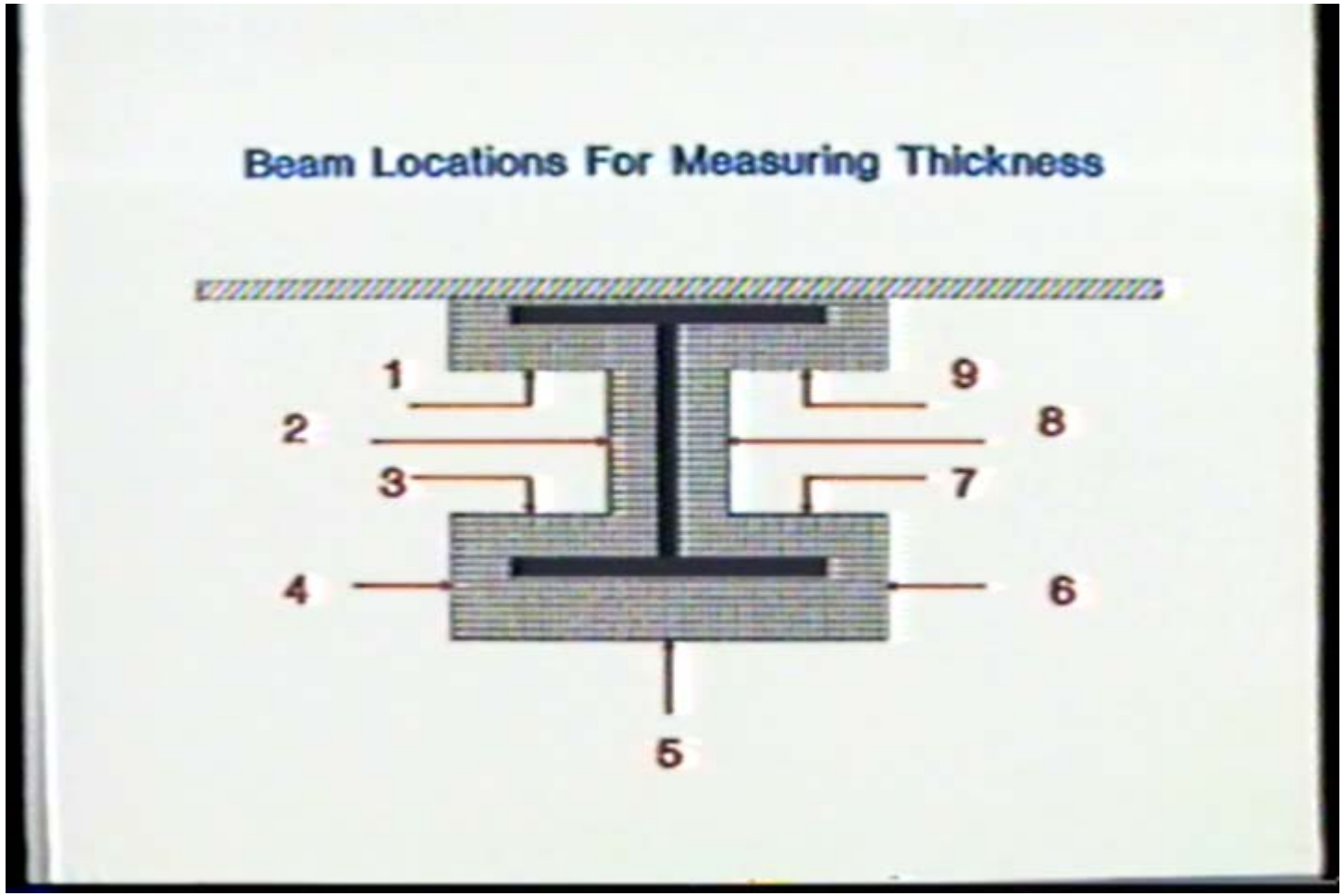
1705.15.4.1 Minimum allowable thickness.

For design thicknesses 1 inch (25 mm) or greater, the minimum allowable individual thickness shall be the design thickness minus 1/4 inch (6.4 mm). For design thicknesses less than 1 inch (25 mm), the minimum allowable individual thickness shall be the design thickness minus 25 percent.

Thickness shall be determined in accordance with ASTM E605. Samples of the sprayed fire-resistive materials shall be selected in accordance with Sections 1705.15.4.2 and 1705.15.4.3.

[IBC 2018, 2021, 1705.15.4.1]

Beam Measurement Locations



Recording Results and Averaging Beam Data

- Full design thickness shall be measured at locations 1, 2, 3, 5, 7, 8, 9.
- ½ of full thickness or a minimum of ¼ inch measured at locations 4 and 6 Flange Tips.
- Repeat the above measurements at a location on the beam 12 inches from the first measurement set.
- Calculate full thickness by averaging locations 1, 2, 3, 5, 7, 8, 9.
- Do not include locations 4 and 6 in average of full thickness.

Thicknesses

1705.15.4.2 Floor, roof and wall assemblies.

The thickness of the sprayed fire-resistive material applied to floor, roof and wall assemblies shall be determined in accordance with ASTM E605, making not less than four measurements for each 1,000 square feet (93 m2) of the sprayed area, or portion thereof, in each story.

[IBC 2018, 2021, 1705.15.4.2]

Thicknesses

1705.15.4.3 Cellular decks.

Thickness measurements shall be selected from a square area, 12 inches by 12 inches (305 mm by 305 mm) in size.

Not fewer than four measurements shall be made, located symmetrically within the square area.

[IBC 2018, 2021, 1705.15.4.3]

Thicknesses

1705.15.4.4 Fluted decks.

Thickness measurements shall be selected from a square area, 12 inches by 12 inches (305 mm by 305 mm) in size. Not fewer than four measurements shall be made, located symmetrically within the square area, including one each of the following: valley, crest and sides. The average of the measurements shall be reported.

[IBC 2018, 2021, 1705.15.4.4]

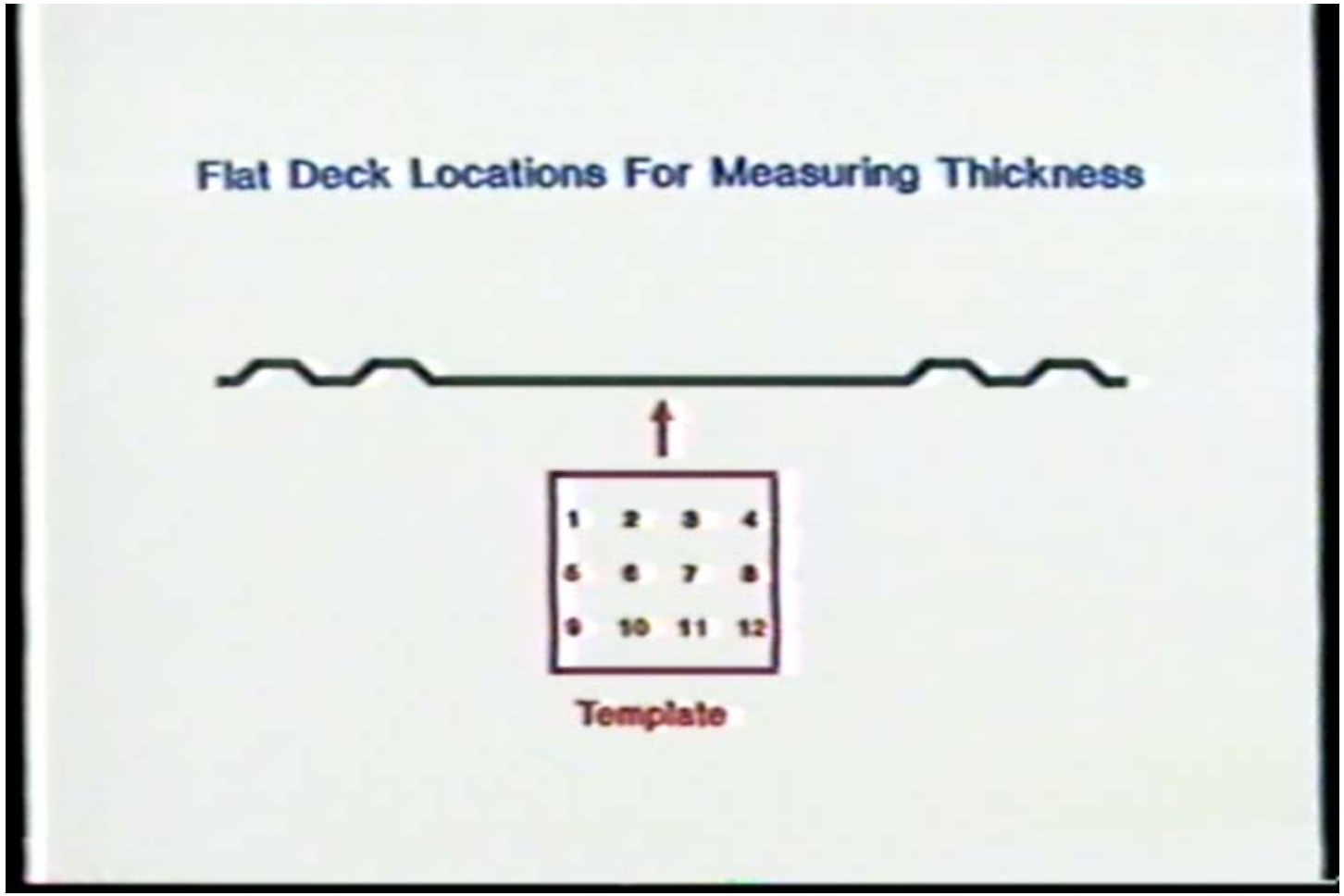
Thicknesses

1705.15.4.5 Structural members. The thickness of the sprayed fire-resistive material applied to structural members shall be determined in accordance with ASTM E605.

Thickness testing shall be performed on not less than 25 percent of the structural members on each floor.

[IBC 2018, 2021, 1705.15.4.5]

12” x 12” Drilled Plate to Locate Thickness Locations on Flat Deck



Using Marking Plate to Define Measurement Area on Flat Deck

Thickness Measurement on Bottom of Deck Flute

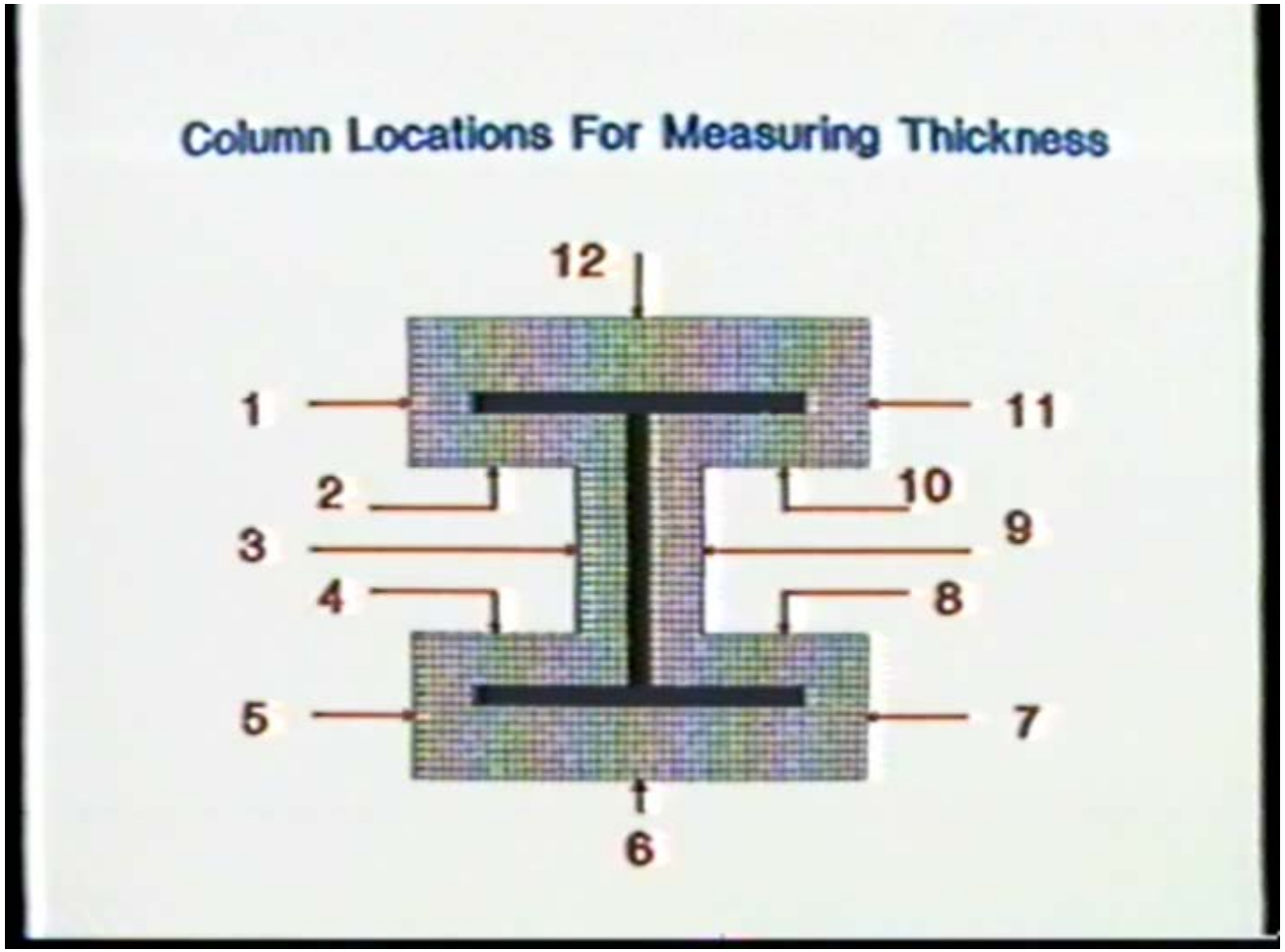
Thickness Measurement on Flat of Deck

Thickness Measurement on Side of Deck Flute

Measurement Locations

- Two sets of thickness measurements are required on each beam, joist and column.
- When finished making the first set of thickness measurements, move 12 inches away on the same structural element and make a second complete set of measurements.
- A 12” template made of cardboard or wood is helpful.

Locations for Measuring Columns



Recording Results and Averaging Column Data

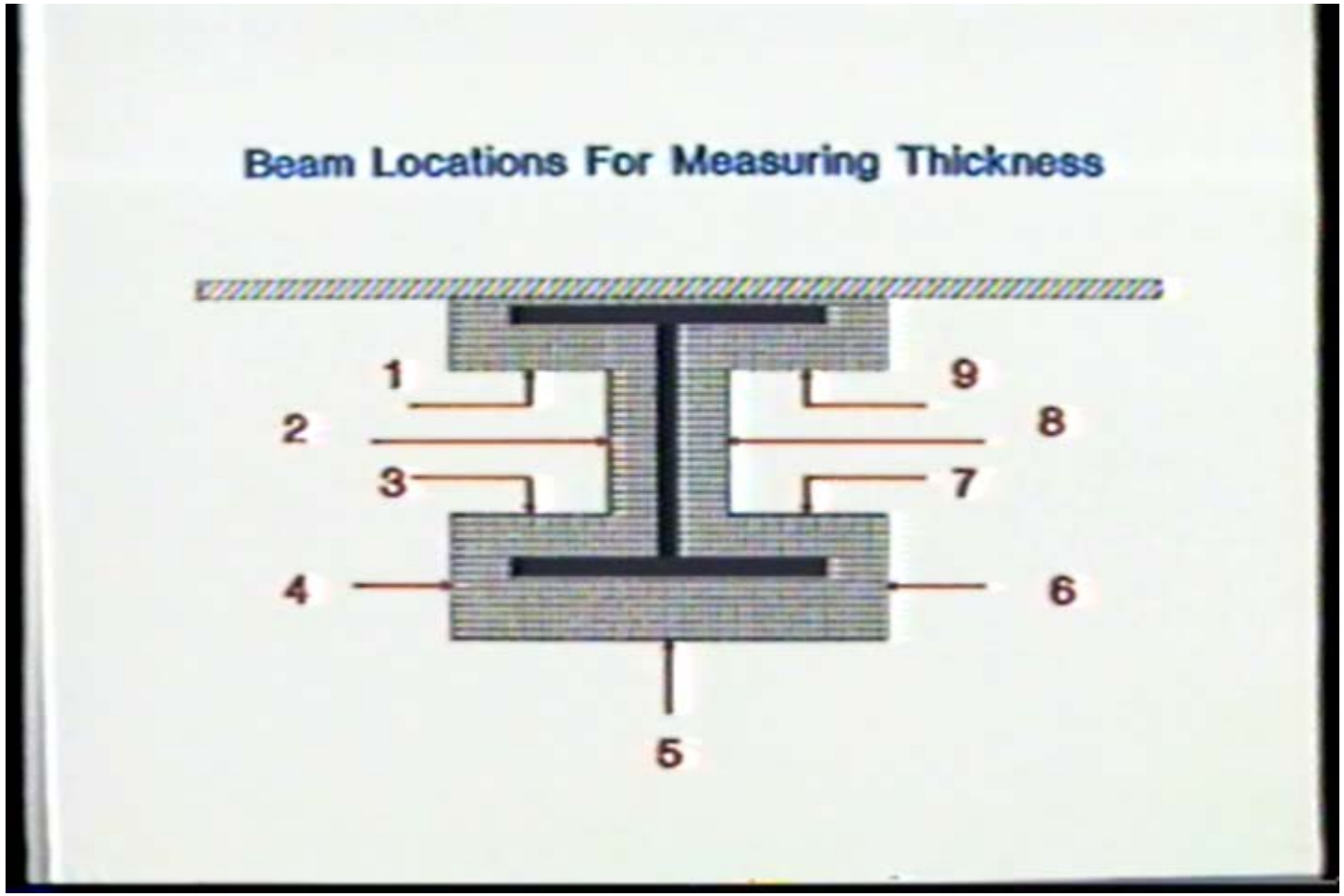
- Full design thickness shall be measured at locations 2, 3, 4, 6, 8, 9, 10, 12.
- One half of full thickness or a minimum of ¼ inch measured at locations 1, 5, 7, 11.
- Repeat the above measurements at a location on the column 12 inches from the first measurement set.
- Calculate full thickness by averaging locations 2, 3, 4, 6, 8, 9, 10, 12.
- Do not include locations 1, 5, 7, 11 in average of full thickness.

Thicknesses

1705.15.4.6 Beams and girders. At beams and girders thickness measurements shall be made at nine locations around the beam or girder at each end of a 12-inch (305 mm) length.

[IBC 2018, 2021, 1705.15.4.6]

Beams, Girders



Column Thickness Measurements Separated by 12 Inches

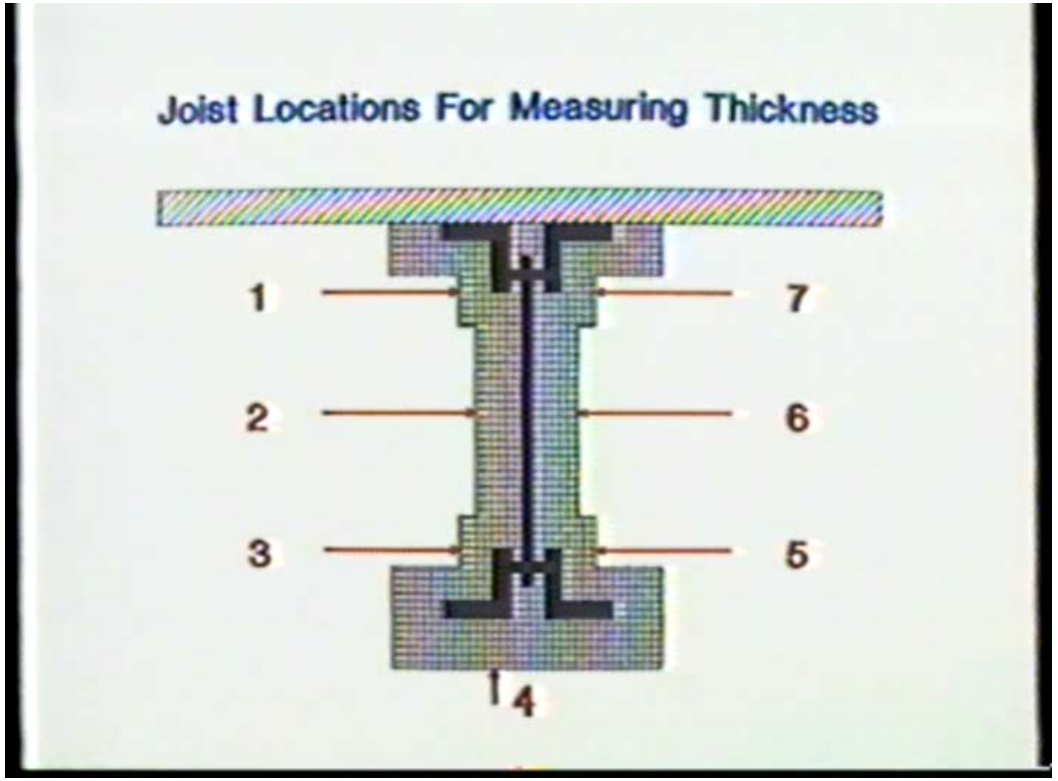
Thicknesses

1705.15.4.7 Joists and trusses.

At joists and trusses, thickness measurements shall be made at seven locations around the joist or truss at each end of a 12-inch (305 mm) length.

[IBC 2018, 2021, 1705.15.4.7]

Locations for Measuring Joists



Recording Results and Averaging Joist Data

- Full design thickness shall be measured at locations 1, 2, 3, 4, 5, 6, 7.
- Repeat the above measurements at a location on the joist 12 inches from the first measurement set.
- Calculate full thickness by averaging locations 1, 2, 3, 4, 5, 6, 7.

Thicknesses

1705.15.4.8 Wide-flanged columns. At wide flanged columns, thickness measurements shall be made at 12 locations around the column at each end of a 12-inch (305 mm) length.

[IBC 2018, 2021, 1705.15.4.8]

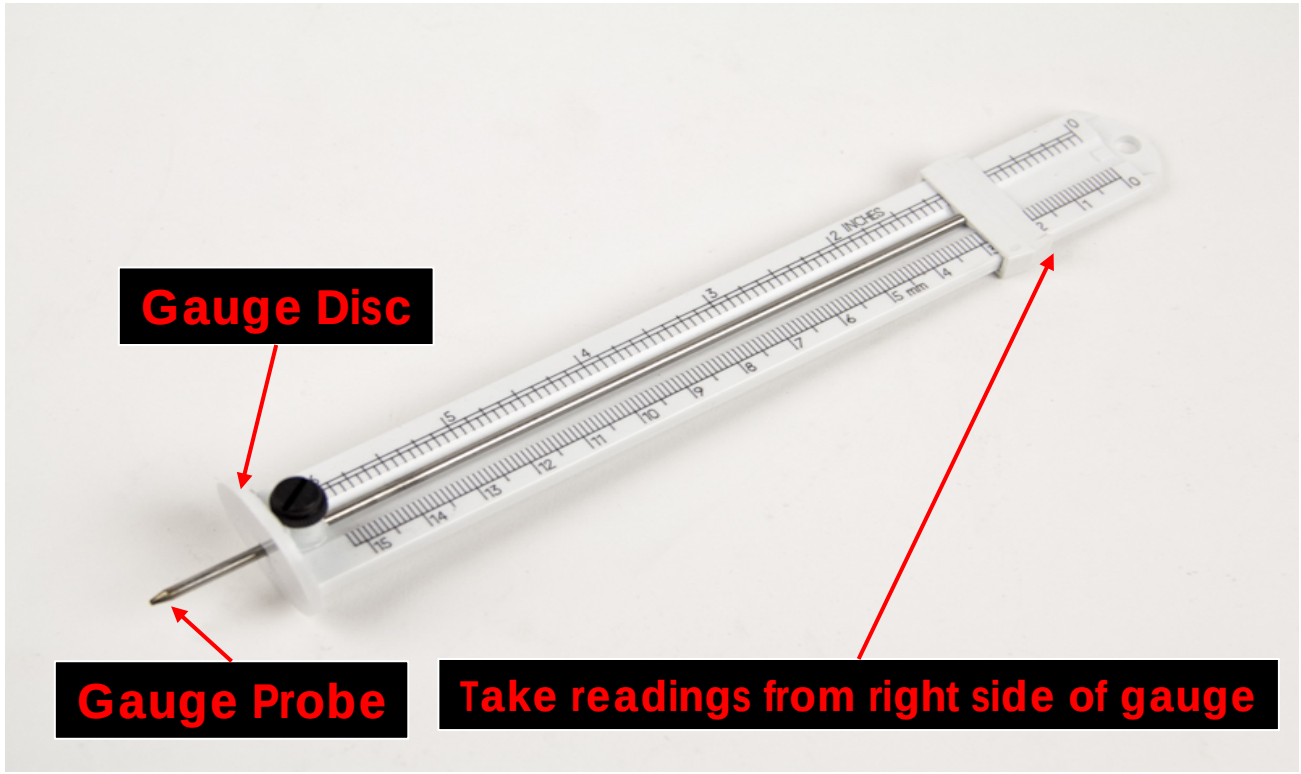
Thicknesses

1705.15.4.9 Hollow structural section and pipe columns.

At hollow structural section and pipe columns, thickness measurements shall be made at not fewer than four locations around the column at each end of a 12-inch (305 mm) length.

[IBC 2018, 2021, 1705.15.4.9]

SFRM Thickness Inspection Notes



- Ensure the gauge disc is flush with the fireproofing. Do not compress the fireproofing with the gauge.
- Confirm gauge probe is inserted fully and that the probe tip meets the steel substrate.
- Insert gauge as perpendicular as possible to SFRM to ensure accurate thickness reading is obtained.
- If gauge probe becomes bent or damaged, discard it.
- Use a 12” template made of cardboard or wood.

Density Selection and Testing

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Density

1705.15.5 Density. The density of the sprayed fire resistive material shall be not less than the density specified in the *approved* fire-resistance design. Density of the sprayed fire-resistive material shall be determined in accordance with ASTM E605. The test samples for determining the density of the sprayed fire-resistive materials shall be selected as follows:

1. From **each floor, roof and wall assembly** at the rate of not less than one sample for every 2,500 square feet (232 m2) or portion thereof of the sprayed area in each story.

2. **From beams, girders, trusses and columns** at the rate of not less than one sample for each type of structural member for each 2,500 square feet (232m2) of floor area or portion thereof in each *story*.

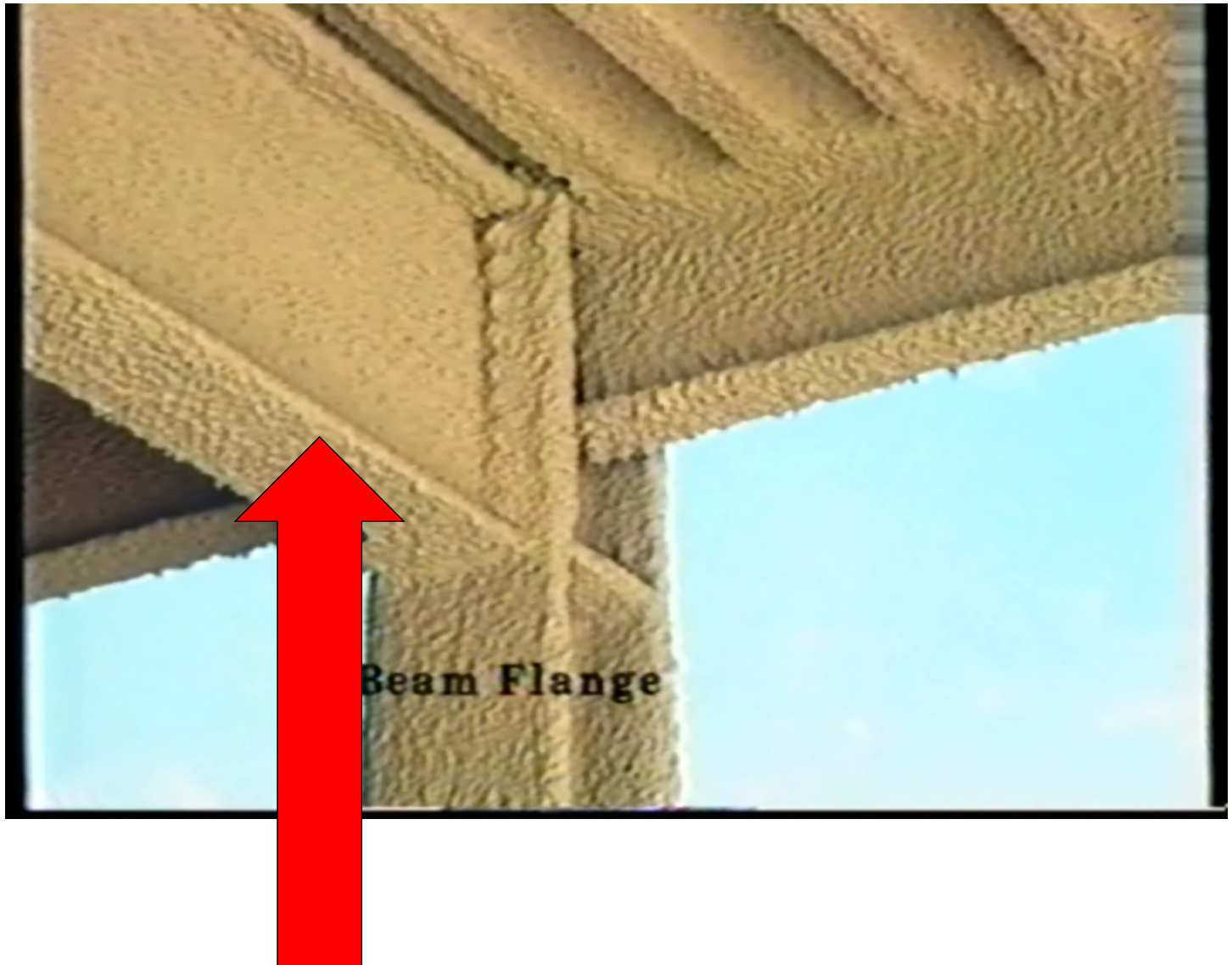
[IBC 2018, 2021, 1705.15.5]

Secure Density Sample from Column Web

Secure Density Sample from Column Flange

Secure Density Sample from Beam Web

Secure Density Sample from Beam Flange



Deck Density Sample Selection

- A deck density sample shall be selected from the flat portion of the deck profile.

Marking Column for Location of Density Sample

Removing Sample for Density Measurement

Density Measurement Sample Selection

- One density measurement on each protected element every 2,500 SF of area for each floor, roof and wall assembly, structural member in each story

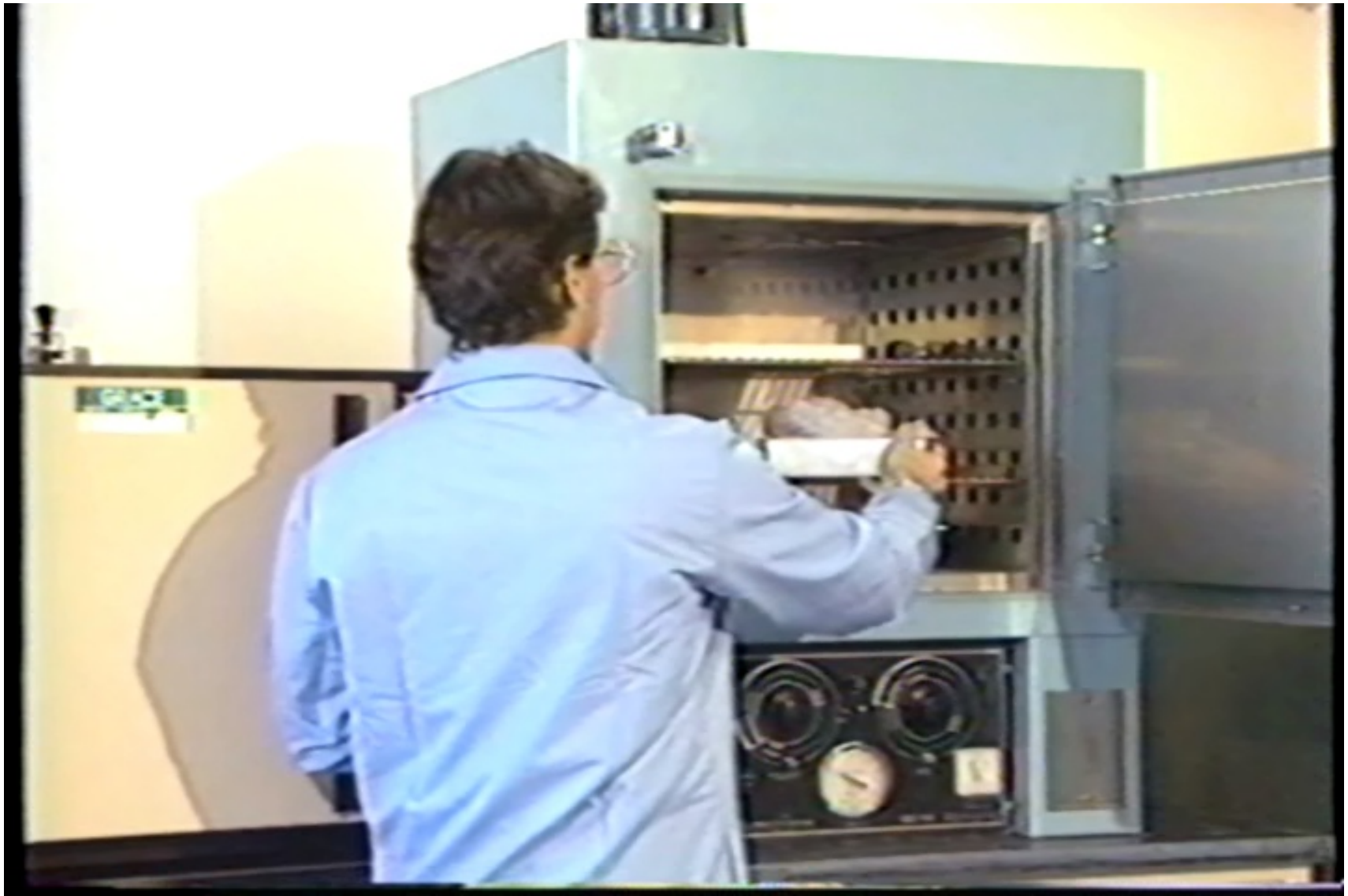
- Protected Element Tested
  - Deck flat portion
  - Beam lower flange or web
  - Column either flange or web

Volume Displacement Method

- Most accurate procedure
- Measures irregular size sample secured from protected element

Place Density Sample in Oven To Dry

Temperature Must not Exceed 109ºF +/- 10ºF (43ºC +/- 6ºC) or Manufacturer's Requirements



Cutting Density Sample from Large Piece

Weighing Density Sample

Pour Beads to Fill Container #1

Smooth Beads to Level Top of Container

Place Beads into Another Empty Container #2

Remove Beads from Tray

Place Container #1 into Empty Tray

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Pour Small Amount of Beads from Container #2 into Container #1

Place Density Sample Into Container #1

Pour Remaining Beads Around Sample to Top of Container #1

Excess Beads in Container #2 and Tray Equal Volume of Sample

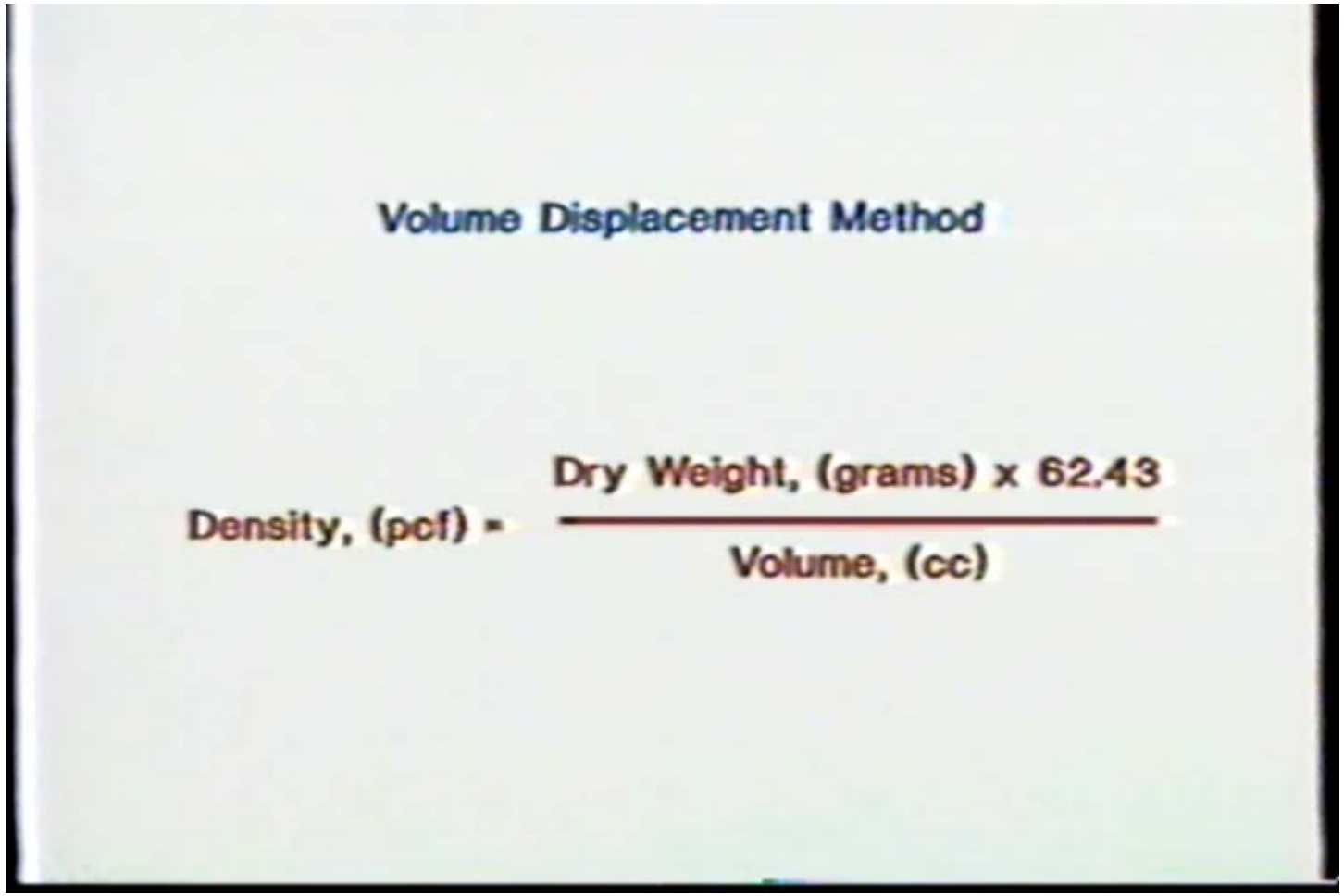
Pour Beads in Tray Back into Volume Container #2

Pour Beads into Graduated Cylinder to Determine Volume

Measure Sample Volume Directly from Graduated Cylinder

Record Sample Volume and Oven Dry Weight

Calculate Density in PCF Using Recorded Data and Equation



Dry Density Notes

- Encourage the use of the Volumetric Determination (Bead Displacement Method) – Most accurate!
- Ensure that the sample is dry but DO NOT overcook.
- Minimum 8 cubic inches ~ ex. 3”x3”x1” – Must fit into test cylinder with at least ¼” space between sample and cylinder sides. If sample is too large, carefully trim and reweigh.

Determining Bond Strength on Medium Density SFRM

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Bond Strength

1705.15.6 Bond strength. The cohesive/adhesive bond strength of the cured sprayed fire-resistive material applied to floor, roof and wall assemblies and structural members shall be **not less than 150 pounds per square foot (psf) (7.18 kN/m2).** The cohesive/adhesive bond strength shall be determined in accordance with the field test specified in **ASTM E736** by testing in-place samples of the sprayed fire-resistive material selected in accordance with Sections 1705.15.6.1 through 1705.15.6.3.

[IBC 2018, 2021, 1705.15.6]

Bond Strength…

1705.15.6.1 Floor, roof and wall assemblies.

The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistive materials shall be selected from each floor, roof and wall assembly at the rate of not less than **one sample for every 2,500 square feet (232 m2)** of the sprayed area, or portion thereof, in each *story*.

1705.15.6.2 Structural members.

The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistant materials shall be selected from beams, girders, trusses, columns and other structural members at the rate of **not less than one sample for each type of structural member for each 2,500 square feet** (232 m2) of floor area or portion thereof in each *story*.

[IBC 2018, 2021, 1705.15.6.1 & 6.2]

Primers, Paints, Encapsulants…

1705.15.6.3 Primer, paint and encapsulant bond tests. Bond tests to qualify a primer, paint or encapsulant shall be conducted where the sprayed fire-resistive material is applied to a primed, painted or encapsulated surface for which acceptable bond strength performance between these coatings and the fire-resistive material has not been determined. **A bonding agent *approved* by the SFRM manufacturer shall be applied to a primed, painted or encapsulated surface where the bond strengths are found to be less than required values.**

[IBC 2018, 2021, 1705.15.6.3]

Bond Strength Testing

Measuring Medium Density SFRM Thickness

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Moving Measuring Slide to SFRM Surface

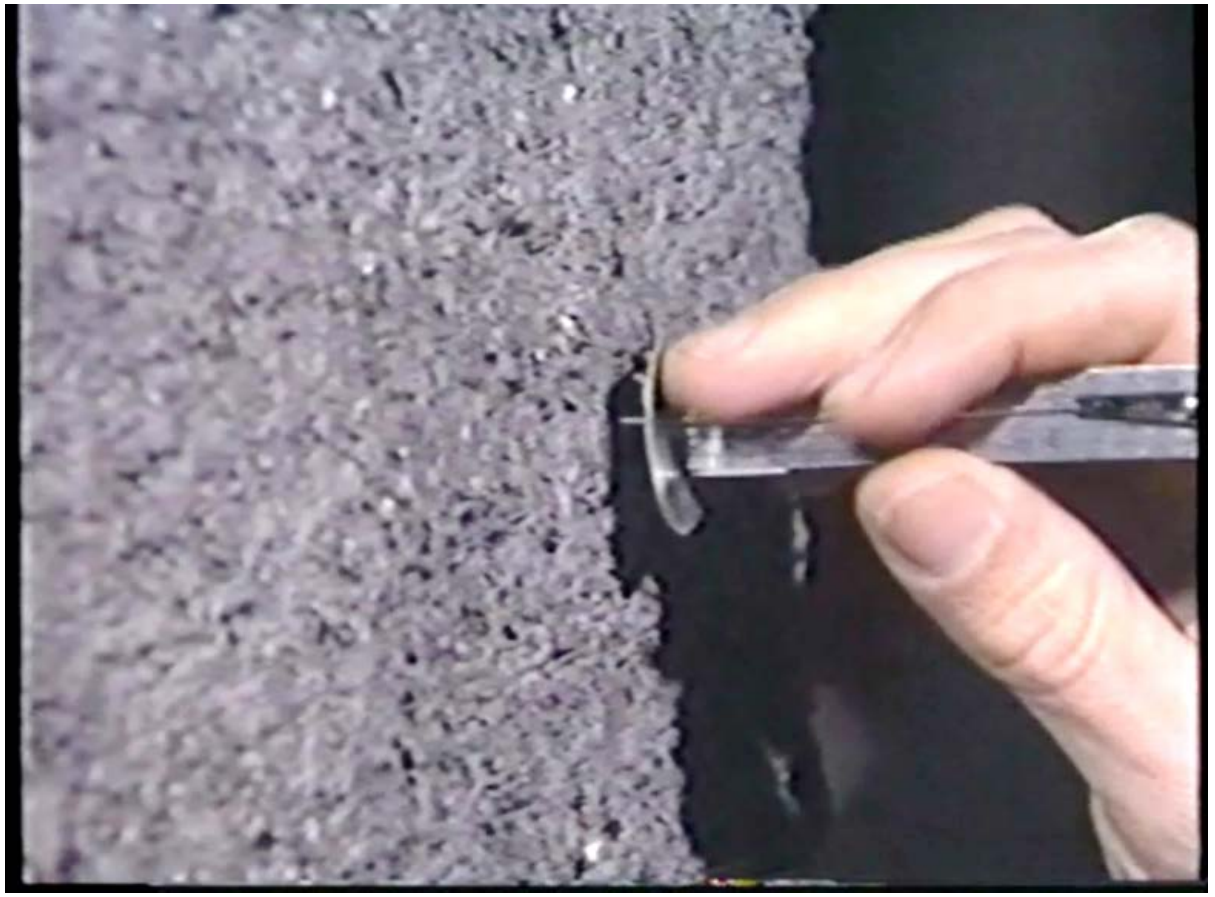
Measuring Slide Contacting but Not Compressing SFRM

Taking Thickness Measurement

Measuring Thickness on Flange of Column

Drill Hole Into High Density SFRM to Steel

Inserting Measuring Probe into Drilled Hole



Repair Immediately

Measuring High Density SFRM Thickness

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Bond Strength - Medium Density SFRM

Bond Strength Testing Occurs on Any Sprayed Flat Surface

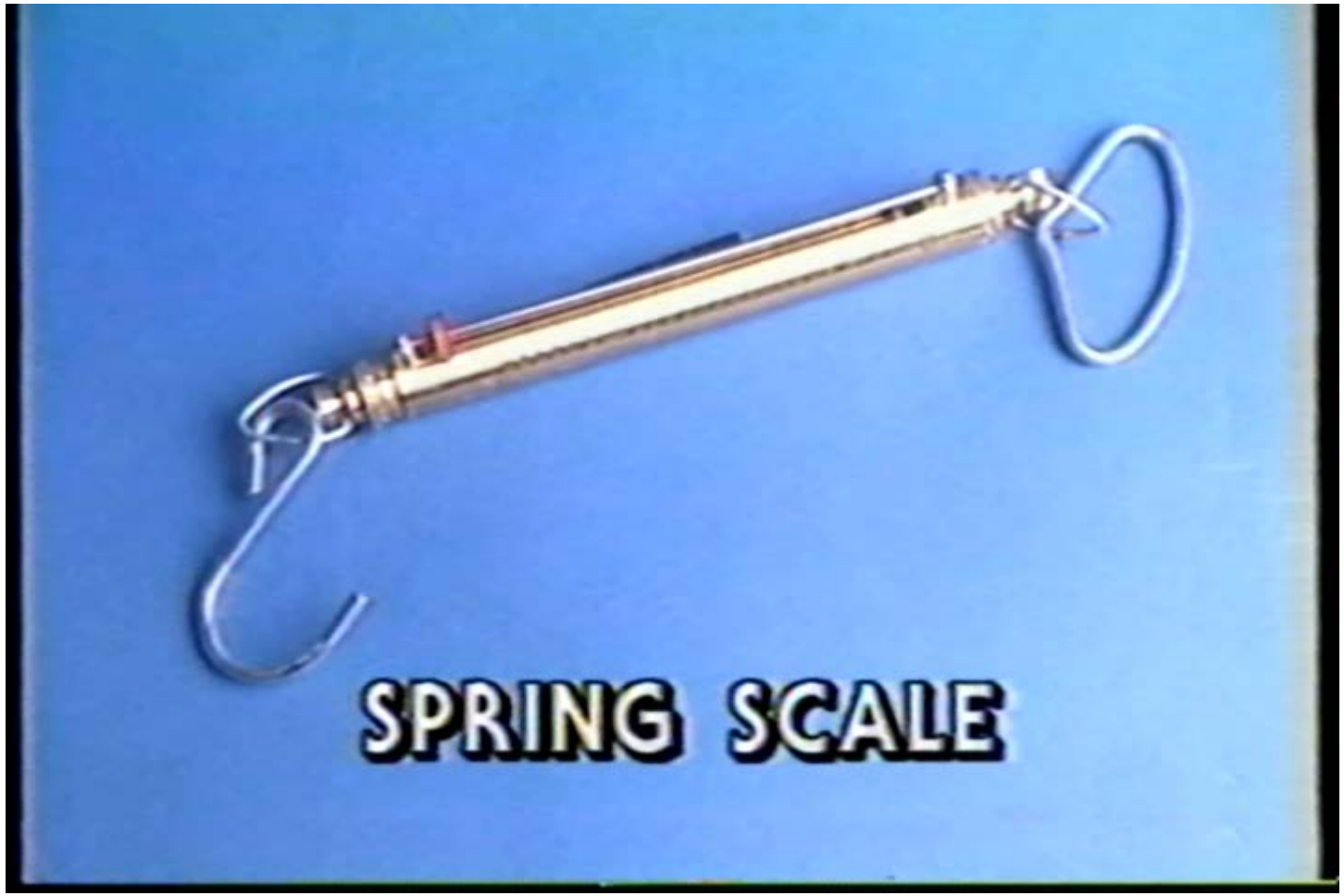
Materials Required to Conduct Test

Rubber Gloves to Protect Hands from Adhesive

Standard ‘Jar Cap’ 2-3/4in. ID Diameter

Screw Eyes (No. 12 x 1 in.)

50 Pound Capacity Spring Scale



Awl Starts Hole in Cap Lid Center for ‘Eye’ Hole

Creating Load Cap & Conducting Bond Strength Test

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Drive Awl into Center Cap Creates Starter Hole for Screw Eye

Install Eye Screw into Hole

Select Location for Bond Test

Pour Part A and Part B of Urethane Adhesive into Inside of Cap

Mix Urethane Adhesive to Initiate Chemical Reaction

Place Cap onto Surface of SFRM Test Location

Press Cap into SFRM until Bonding Occurs and Allow to Cure for 15 min.

Cut Urethane Adhesive from Edge of Cap

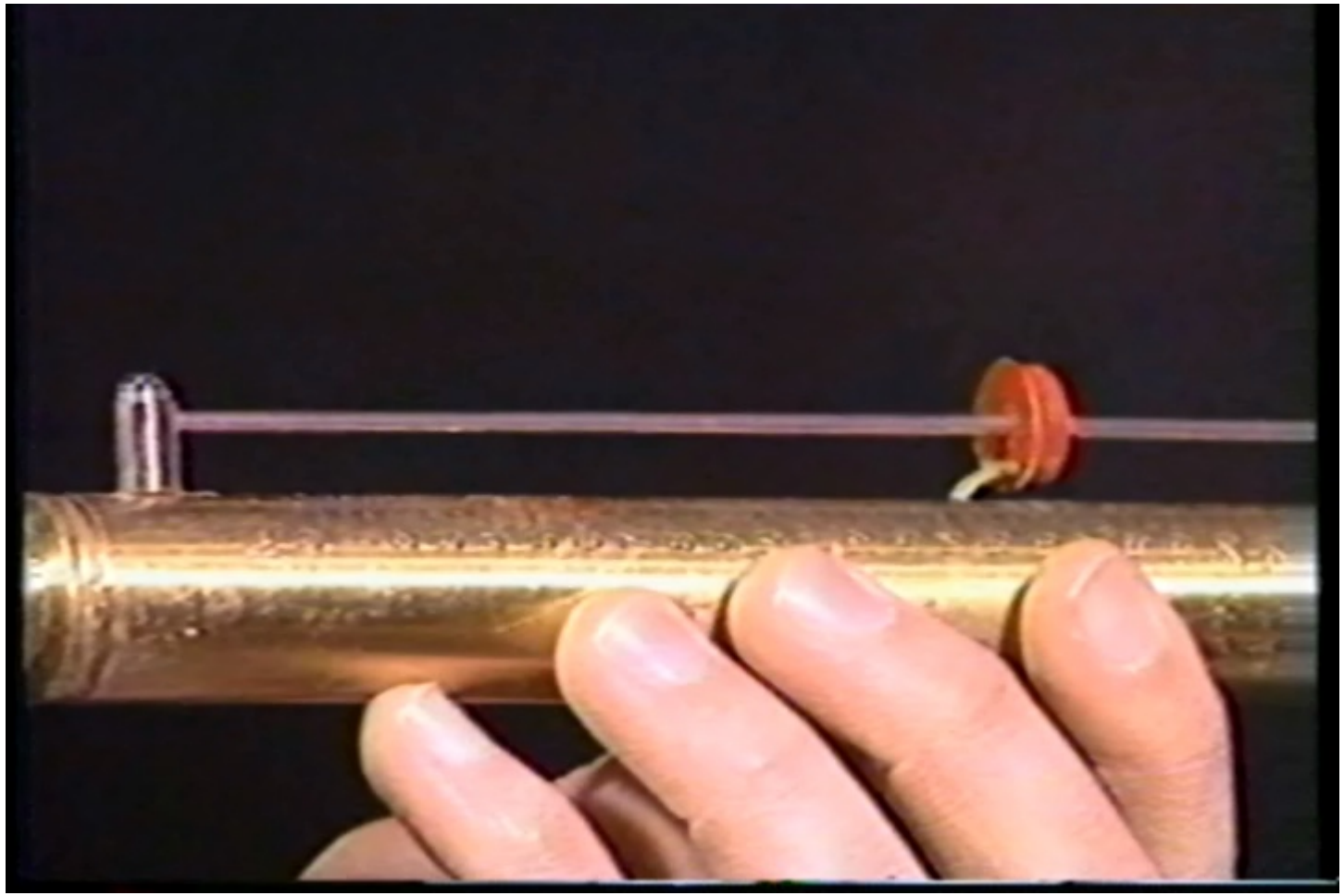
Attach Spring Scale to Eye Screw

Adding Fixed Weights May be Used In Place of Spring Scale (horizontal applications)

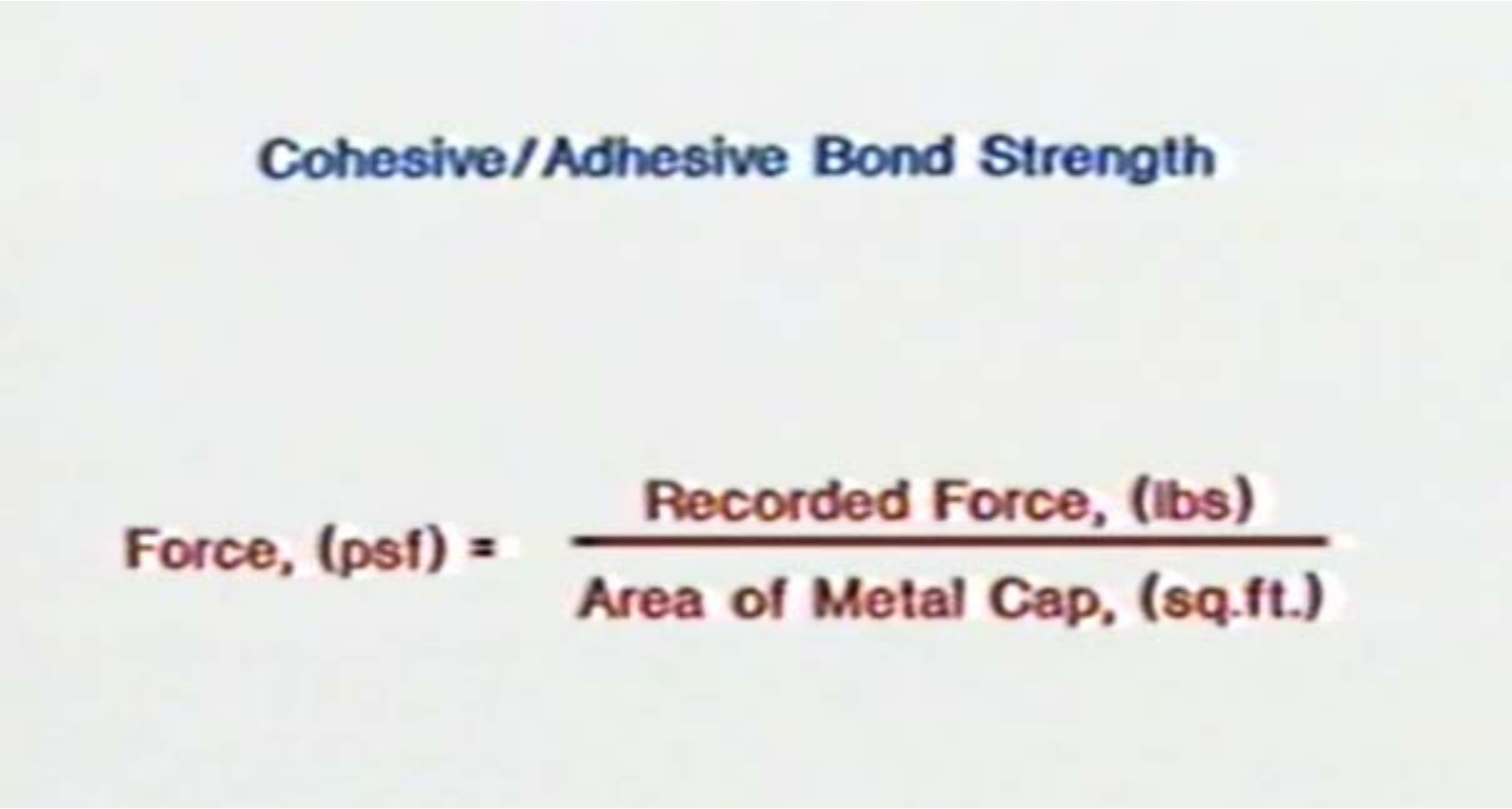
Pull Spring Scale - Consistent Slow Speed

Continue to Apply Tension Force until Failure Occurs or Scale Capacity is Reached

Record Maximum Load from Spring Scale, lbs.



Calculate, Record Bond Strength - Formula



Bond Strength Determination aka Pull Tests

- SFRM must be cured. Consult SFRM manufacturer for recommendations. Testing uncured material will most likely cause premature failure.
- Do not alter (flatten) surface of SFRM.
- Choose test area that is safe, accessible, and *ergonomically comfortable.*
- Pull scale slowly and you must be perpendicular to the floor (maintain 90° angle). If you do not maintain a 90° angle, you will create shear which will cause an invalid failure.
- Two types of failures: adhesive and cohesive. Adhesive failure is where cap/substrate/surface of SFRM is removed, and Cohesive is where the material separates from itself.
- Pull scale to a predetermined value. If you need to test to 150psf, gather all involved parties and have all agree to a value which meets or exceeds the 150psf requirement. Pulling the scale to failure is dangerous! For example: Using a 3” cap, to achieve 150psf, you would need to pull to about 8lbs. (163psf). To safely exceed this, see if all will agree to 10lbs (204psf) or 15lbs (306psf).
- Caps: Many sizes of caps are commercially available. It is recommended to use the smallest sized cap for the material being tested. Consult material manufacturer for recommendations.
- Adhesives: Commercially available foam adhesives work great for low and medium density fireproofing.
- When filling cap with adhesive, do not overfill. Prior to test, remove excess foam from SFRM using utility knife *taking care* to not cut into the SFRM.
- Use two wood screws or two nails and a rubber band to hold cap in place while adhesive cures. Remove screws/nails and rubber band before test.

Determining Bond Strength
High Bond Strength SFRM

Materials Required to Conduct Test

- Wooden disk - 1-3/8 inch in diameter and 1 inch long with a ¼ inch eyebolt screwed ¾ inch into the center of the diameter disk.
- Two component epoxy adhesive with a minimum 4,000 psi strength.
  - Generally known as a two-ton epoxy.
- 1,000 pound capacity portable load cell that allows “S” hook to attach to the wooden disk eyebolt.

Materials Required to Conduct Test

- Drill
- 1-3/8 inch diam. Forstner bit - drills a flat bottom hole.
- Level to position the load cell and drill bit parallel to the load direction of pull on a structural element test.

Sample Preparation

- SFRM shall be applied to substrate in a thickness not less that ¾ inch. This procedure shall not be used for thickness application less that ¾ inch thick.
- Allow material to set, cure and dry as required by standards. Material containing cement shall be cured for a minimum of 28 days before being tested.
- Using the Forstner bit, drill a hole perpendicular to the structural element being tested to a depth from the surface of ½ inch and no less than ¼ inch deep.

Sample Preparation

- Remove loose dust or any loose material from inside the drilled hole.

Test Procedure

- Mix the epoxy and apply coating inside the hole bottom and sides. Press wooden disk inside hole and allow epoxy to set and sure.
- Attach the “S” hook to the eyebolt in wooden disk and load cell apparatus. Position load cell so the load is applied parallel to the wooden disk. (If the load is not parallel to test sample, a shear failure may occur which is not a true bond strength test).
- Apply load at a rate of 50 lbs/min.
- Record the peak low from the load cell in lbs.

Test Procedure

- Calculate bond strength using formula:
  - Cohesive bond strength = F / A where:
  - F= recorded peak load in lbs.
  - A = area of wooden disk in ft^3.

WEEK OF LEARNING

NFCA®
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Fireproofing Special Inspection

IBC Ch. 17

Fireproofing Inspection & IBC

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