



PASSIVE FIRE PROTECTION SYMPOSIUM

4-6 JUNE 2024 • INTERCONTINENTAL DUBAI MARINA

FCIA 

NFCA® 



FCIA 2024 DUBAI MEMBER MEETING & SYMPOSIUM

Inspection

Presented by:

Bill McHugh

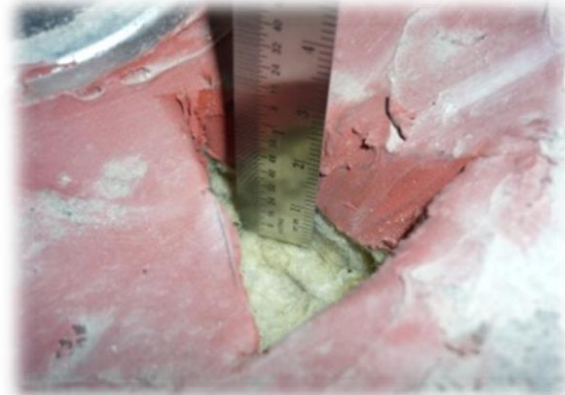
Abhishek Chhabra

FCIA & NFCA



Firestop & Inspection

- ASTM E2174 / ASTM E2393 – “*Inspection Process*”



Firestop Inspection in Codes

ASTM E2174 – ASTM E2393

- NFPA 1 - Ch. 12
- NFPA 101 / 5000 – Chapter 8 – Annex
- 2012 – 2018 International Building Code
- IBC Ch. 17 - Special Inspections
 - Buildings 75' & higher above Fire Department Access
 - Risk Category Types III, IV, Chapter 16, Table 1604.5
 - **IBC 2021 Residential \geq 250 Occupants**
- Abu Dhabi International Building Code

FCIA & KOFFEL
2002-2023



Firestop Systems Inspection Introduction

ASTM E2174 – ASTM E2393

- “Standard Practice for On-Site Inspection of Installed Fire Stops – Penetrations - Joints”
 - Standard Inspection Procedure
 - Special Inspection Agency Companies & Other Firms
 - **Hired by & Report to Building Owner, Architect, Owners Rep, AHJ...other than GC**
 - *Drawings, LISTINGS & Manufacturers Instructions*
 - **Destructive (2%) or Observation (10%)**
 - **Final Report**

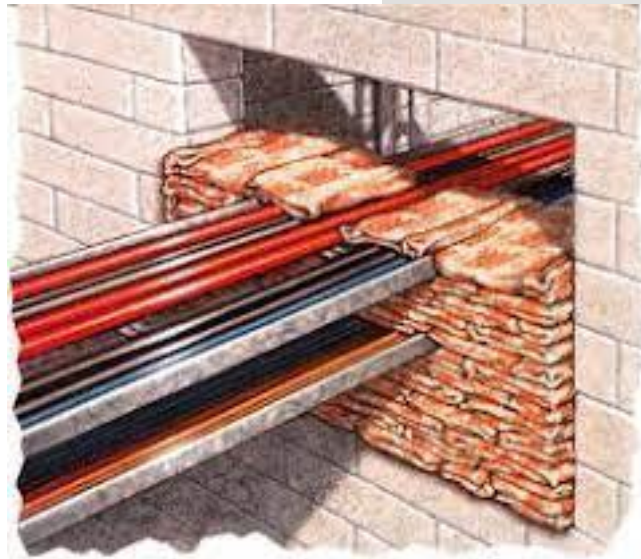
I – Inspection – VERIFY VS. LISTINGS....

2% Destructive or 10% Observation



I – Inspection – Procedures

- **Bags, Bricks, Foam**
 - **Wall/floor Type/Thickness**
 - **Penetrating Item(s)**
 - **Hole Size**



3M, KBS, Hilti Image

I – Inspection – Procedures

- MCT - Open Path
- Hole size, Pen(s)
- Wall/floor Type/Thickness



STI Image



Hilti Image

I – Inspection – Procedures

- **Firestop Mortar**
 - Hole size
 - Penetrating item(s)
 - Wall/floor Type/Thickness



Hilti Image

I – Inspection – Procedures

- **Firestop Composite Sheet**

- Fasteners
- Sealants/Wrap Strips
- Spacing
- Hole Size
- Tray Type, Size
- Penetrating Item(s)
- Wall/floor Type/Thickness



STI Image

I – Inspection – Procedures

- **Mineral Wool & Firestop Spray – Mineral Wool**
 - **Compression, Orientation, Thickness, Product**
 - **Spray Thickness, Overlap**
 - **Gap Size**
 - **Wall/floor Type/Thickness**



Hilti, STI Images



I – Inspection – Procedures

- **Mineral Wool & Firestop Tapes**
 - Density, Compression, Orientation, Product Type
 - Overlap, Adhesion
 - Wall/floor Type/Thickness



3M Image

I – Inspection – Procedures

- **Wrap Strips – Devices**
 - **Elastomer Count/Size**
- **Composite Sheet**
- **Kits**
 - **Fasteners**
 - **Attachments**
 - **Bands**
- **Bags**
- **Bricks**
- **Foam**



Hilti Image



STI Image

I – Inspection – Procedures

- **Wrap Strips – Devices**
 - **Elastomer Count/Size**
- **Composite Sheet**
- **Kits**
 - **Fasteners**
 - **Attachments**
 - **Bands**
- **Bags**
- **Bricks**
- **Foam**



Hilti Image



STI Image

I – Inspection – Procedures

- Firestop Sealants / Firestop Sprays
- Multiple Locations
- Forming Materials
 - Density
 - Compression
 - Fiber Orientation
 - Depth
 - **Tightly Packed**
 - **Wall/Floor Type, Thickness**
 - **Hole Size, Shape**
 - **Penetrating Item (s), covering, spacing**



Affinity Image

I – Inspection – Procedures

- Multiple Locations
- Sealants
 - Identify
 - Depth
 - Measure at 'Bond Line'
 - <2" – 2 locations 4 points
 - SHRINKAGE?

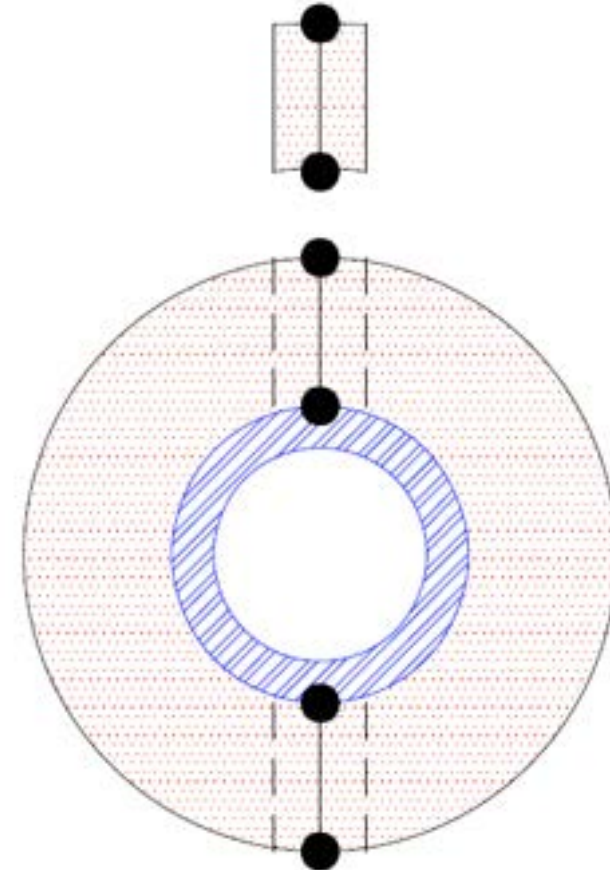


Figure 4

I – Inspection – Procedures

- Multiple Locations
- Sealants
 - Identify
 - Depth
 - Measure at 'Bond Line'
 - <6" >2" – 3 Locations, 6 points
 - SHRINKAGE?

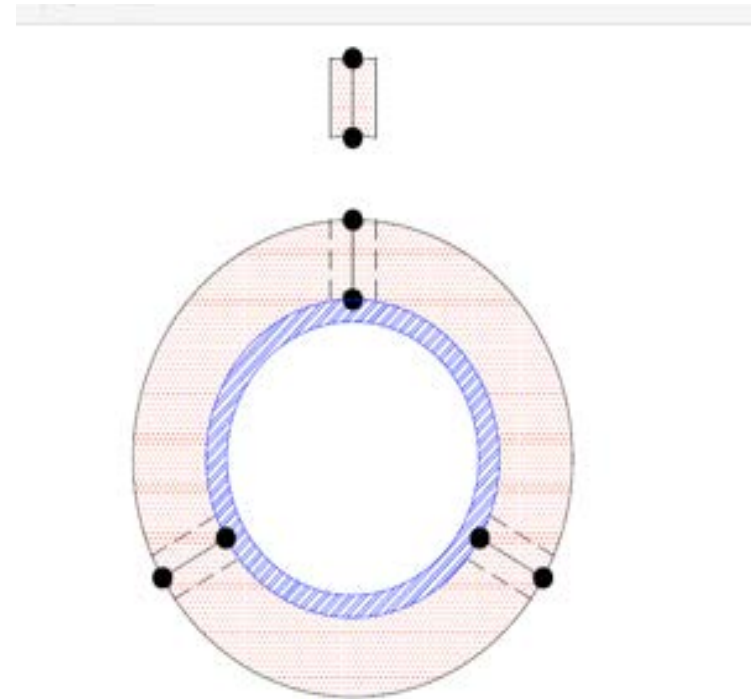


Figure 3

I – Inspection – Procedures

- Multiple Locations
- Sealants
 - Identify
 - Depth
 - Measure at 'Bond Line'
 - >6" – 4 Locations, 8 points
 - SHRINKAGE?

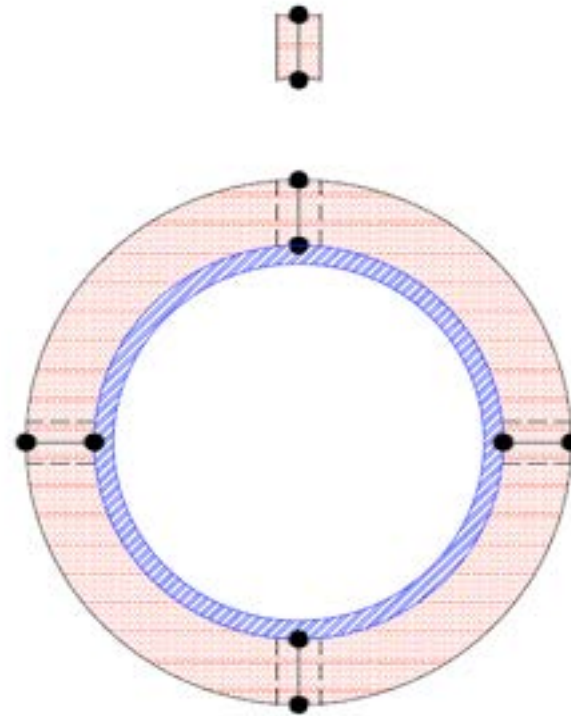
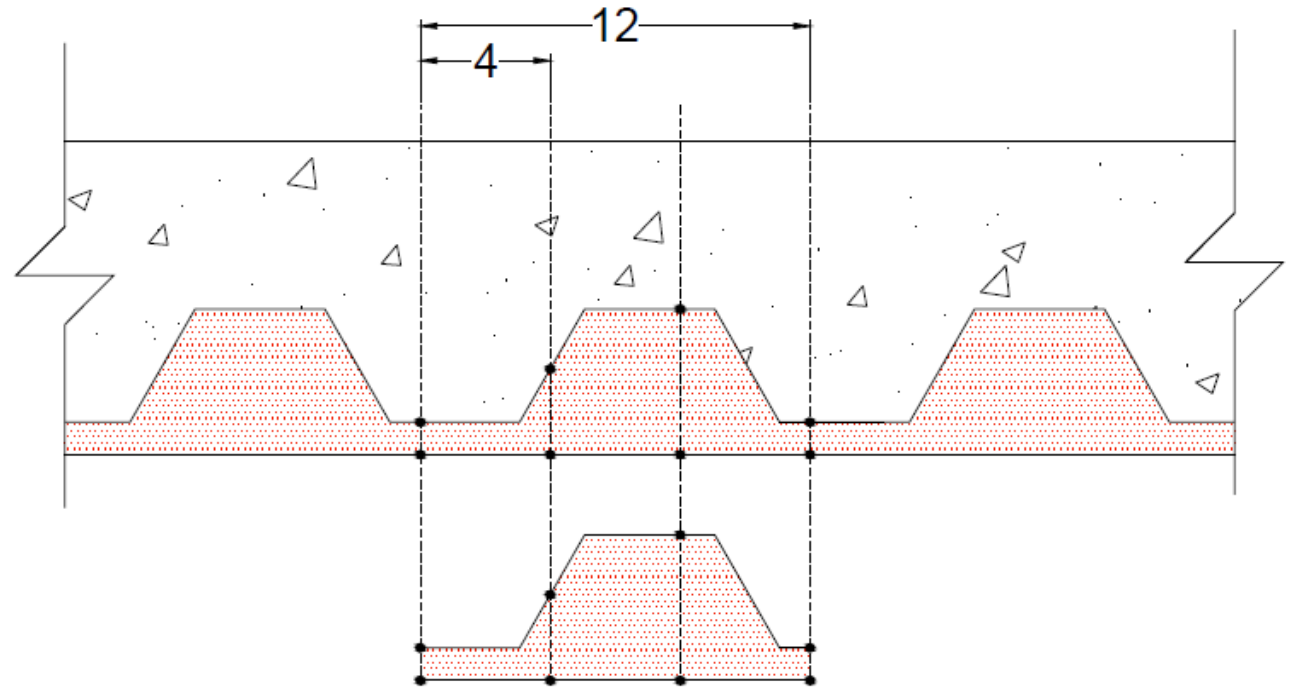


Figure 2

I – Inspection – Procedures

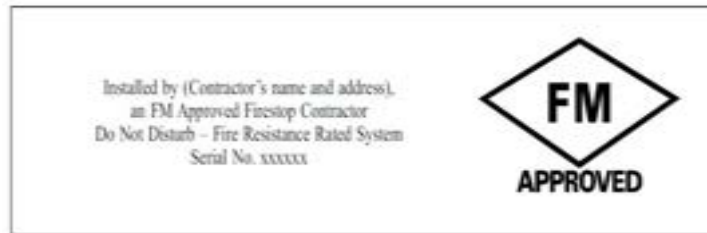
- Multiple Locations – JOINTS – HW, FF, FW, WW, Perimeter
- Sealants/Sprays
 - Identify
 - Depth
 - Measure at 'Bond Line'
 - **1/500 LF @ 8 Locations**
 - SHRINKAGE?



IFC Image

Firestop Special Inspection ASTM E2174 – ASTM E2393

- **Inspection Documents**
 - Identify System, Materials
- **Identification Systems (Labels)**
 - Firestop Contractor Installed
 - Speeds System Evaluation



Firestop Identification system - LABELS

- **“Firestop System #XX – Do Not Remove or Tamper”**

- Tested and listed system number.
- Date of Installation.
- Installing Contractor Company name, contact information.
- Installing Individual Identifier

OR

- Bar Code
- Location Identifier in the Cloud
- 6” over, under, besides...



Adler Firestop Photo

Firestop Inspection Process

ASTM E2174 – ASTM E2393

- **Variances / Deviation Notification**

- **ASTM E2174 & ASTM E2393**

- FS Contractor is notified of any deficiencies within **one day**

- **IBC 1704.2.4**

- Work is in conformance to the documents
- Otherwise it is **immediately** brought to the attention of the FS Contractor
- If not corrected, AHJ and AA will be informed to take action



Affinity Firestop Photo

- **COMMUNICATION AGREEMENT**

Execution – Special Inspections

- **What's Acceptable?**
- **Firestopping *installation* in accordance with**
 - **Manufacturers Instructions**
 - PDS
 - SDS
 - MII
 - Sell Sheets
 - **Listings**

LISTINGS....



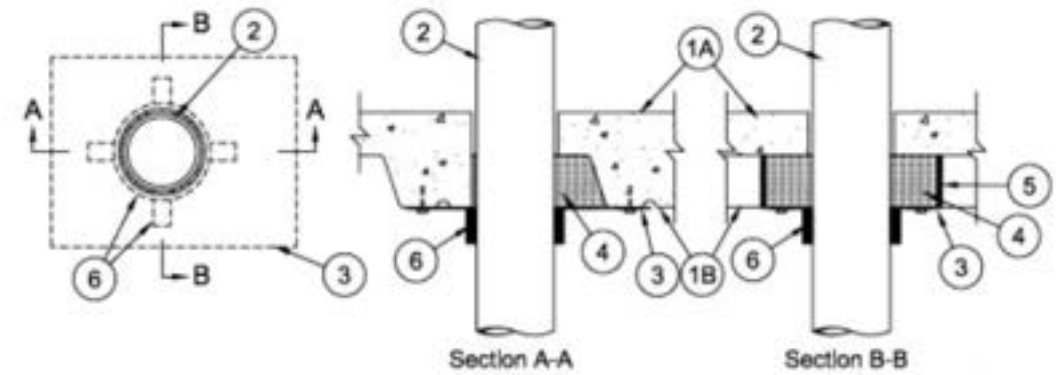
[General Information for Through-penetration Firestop Systems](#)

System No. F-A-2025

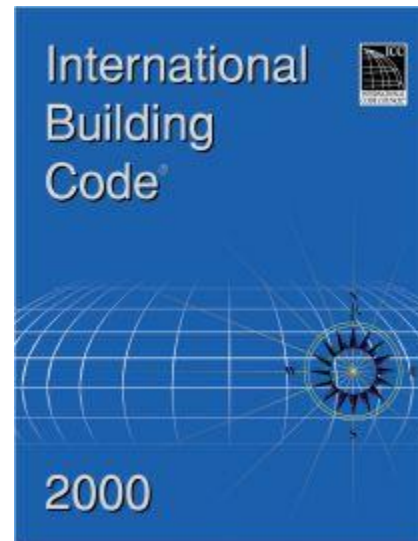
January 15, 2015

F Rating — 2 Hr

T Rating — 2 Hr



Fireproofing Special Inspection IBC Ch. 17

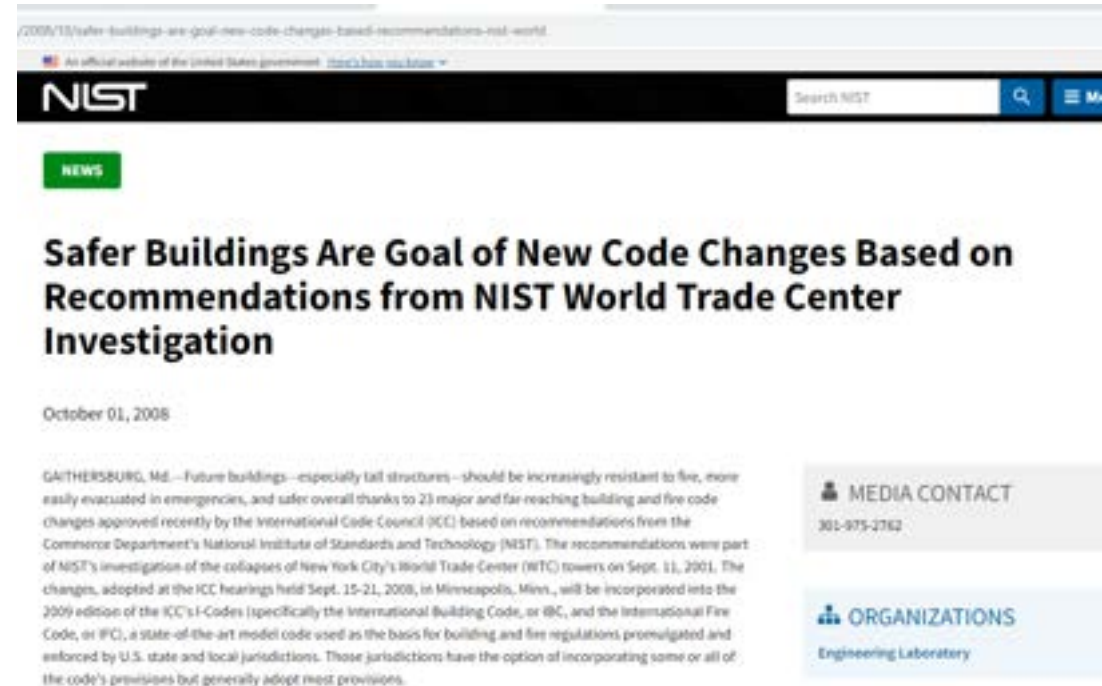


Firestopping, Compartmentation & Structural Fire-Resistance for Safety

- 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.'*

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...**



The image is a screenshot of a news article from the National Institute of Standards and Technology (NIST) website. The article is titled "Safer Buildings Are Goal of New Code Changes Based on Recommendations from NIST World Trade Center Investigation" and is dated October 01, 2008. The article text discusses recommendations for future buildings, particularly tall structures, to be more resistant to fire and easier to evacuate. It mentions that these recommendations were based on the NIST investigation of the World Trade Center towers' collapse on September 11, 2001. The article also notes that the changes were adopted at ICC hearings in September 2008 and will be incorporated into the 2009 edition of the ICC's I-Codes. On the right side of the screenshot, there are two call-to-action boxes: "MEDIA CONTACT" with the phone number 301-975-2762, and "ORGANIZATIONS" with a link to the Engineering Laboratory.

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

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 enforced by U.S. state and local jurisdictions. Those jurisdictions have the option of incorporating some or all of the code's provisions but generally adopt most provisions.

MEDIA CONTACT
301-975-2762

ORGANIZATIONS
Engineering Laboratory

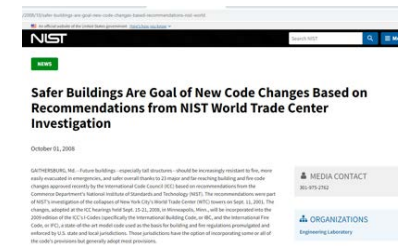
Fireproofing Special Inspection

- **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

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*:

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.



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

[IBC 2018, 2021, 1705.15.6]

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]

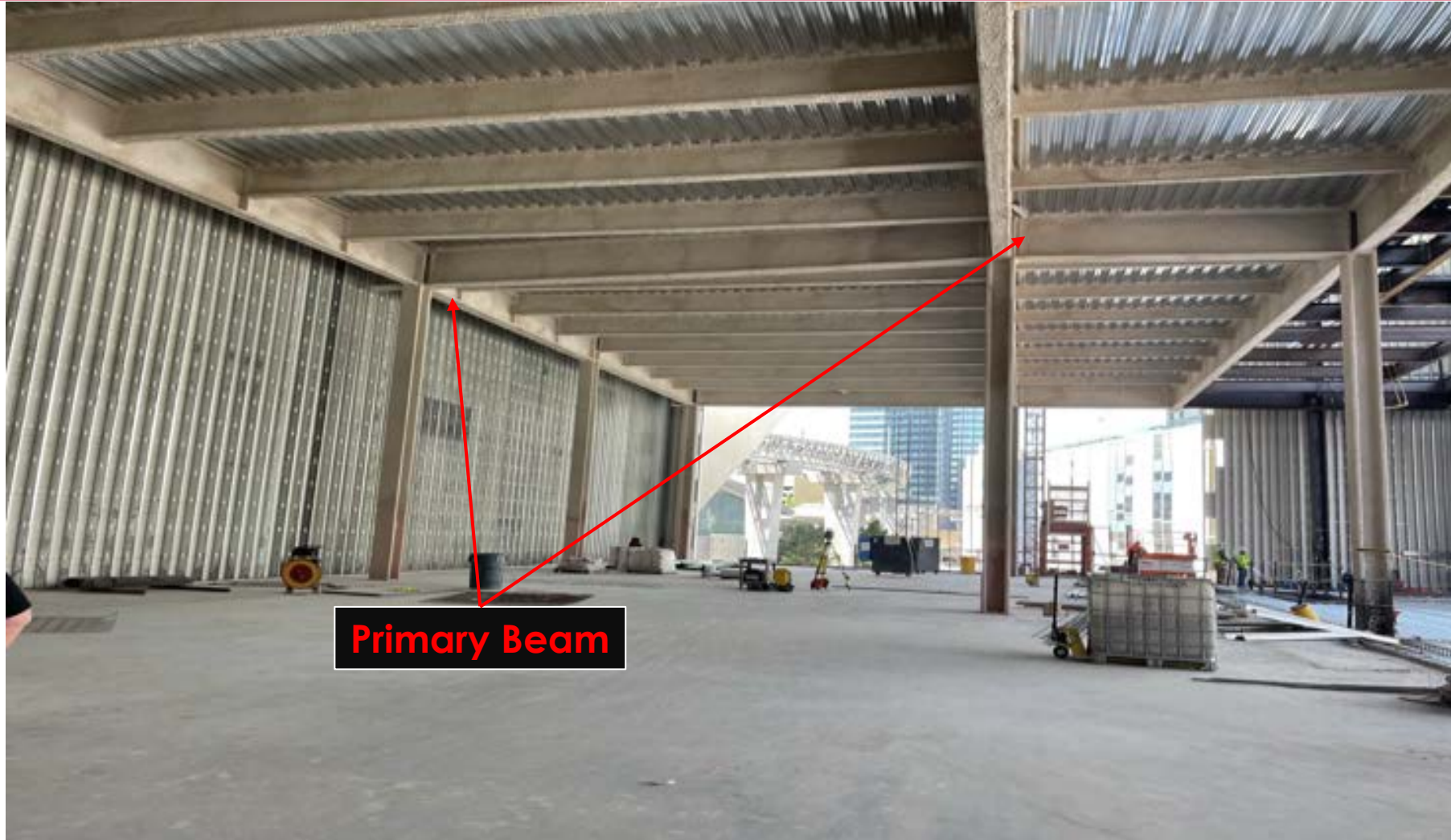
Typical Bay of Sprayed Fireproofing



Column



Primary Floor Beam or Joist



Primary Beam

Secondary Beam or Joist



Secondary Beam

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]

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]

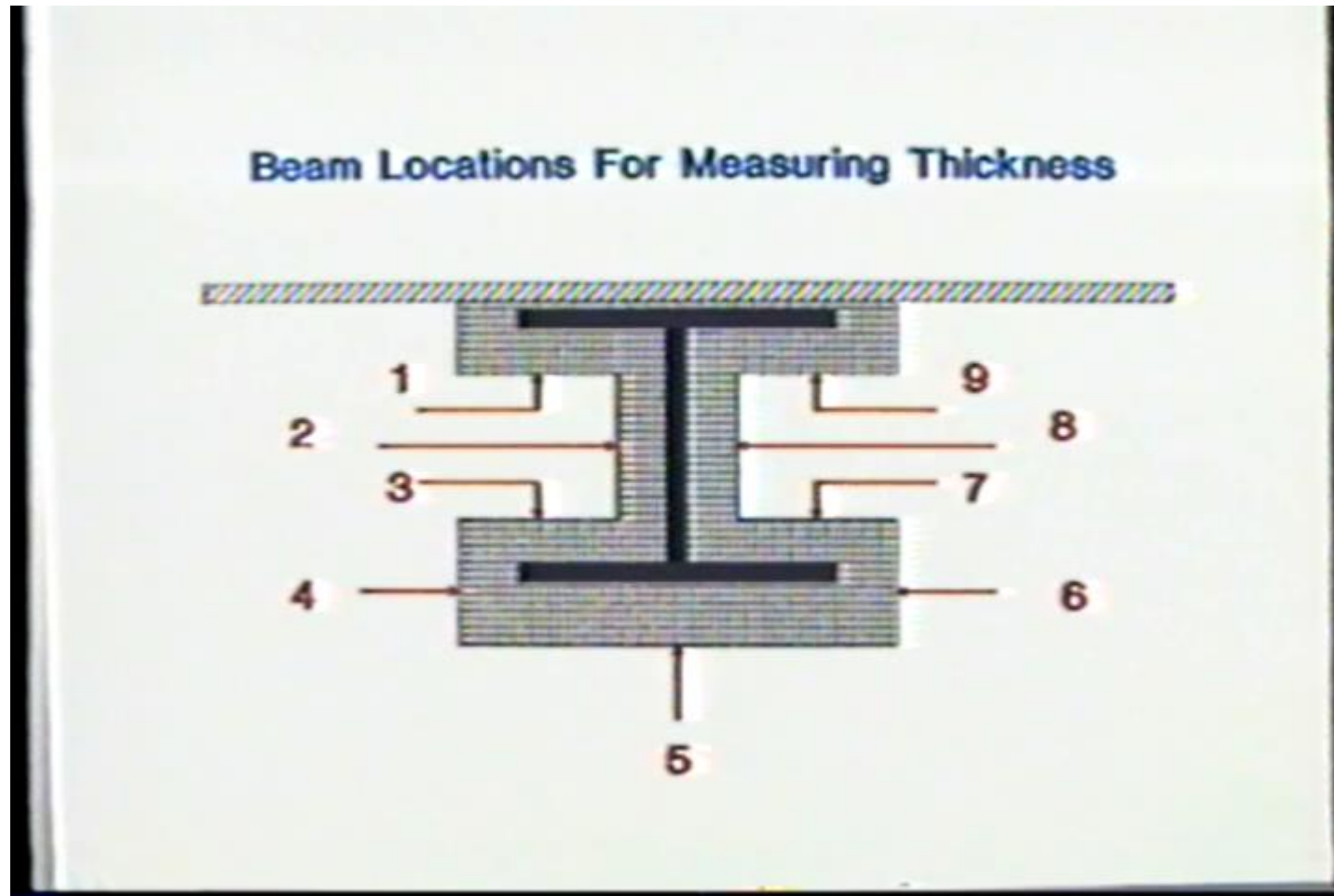
Thicknesses

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]

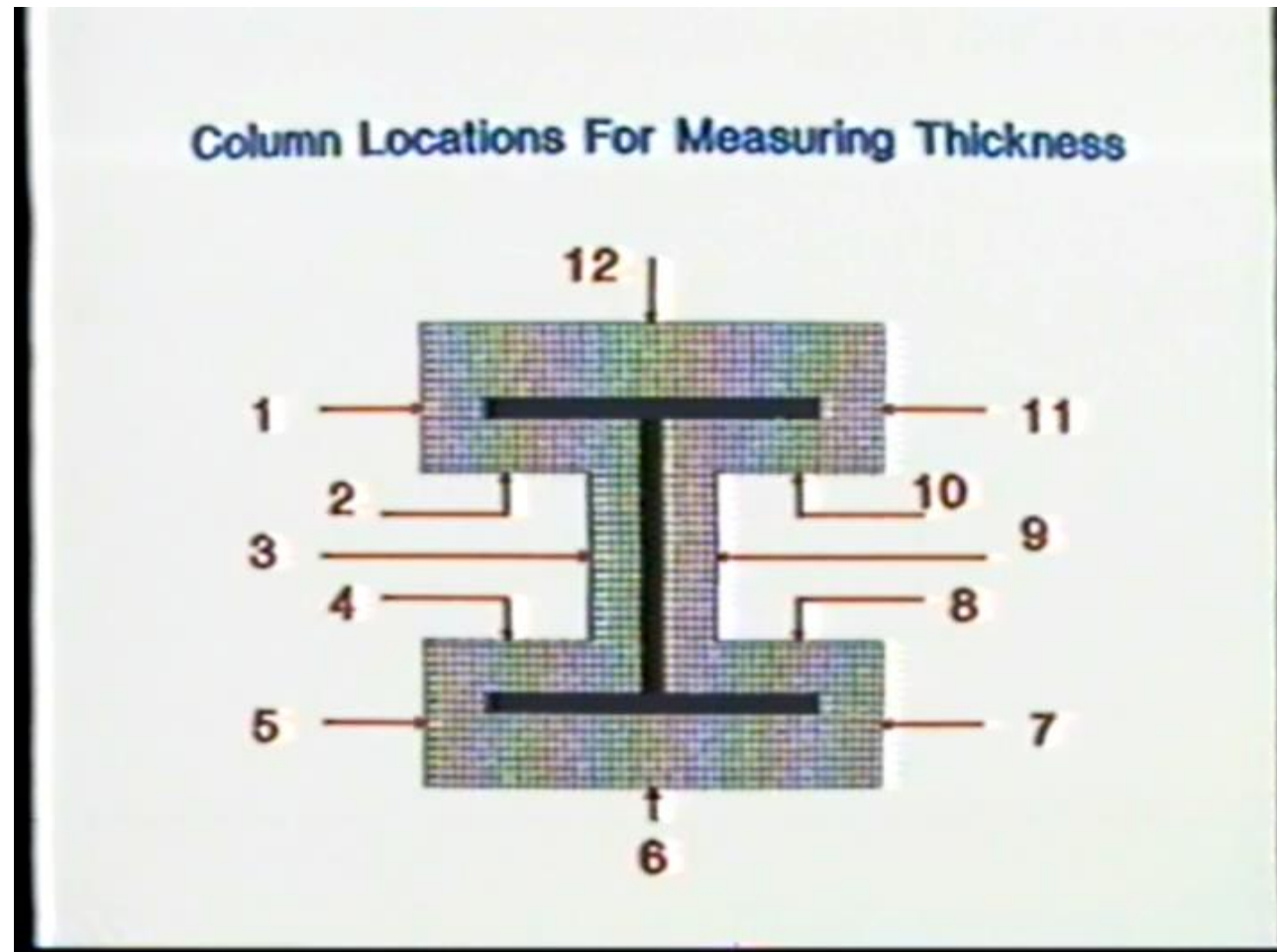
Beam Measurement Locations



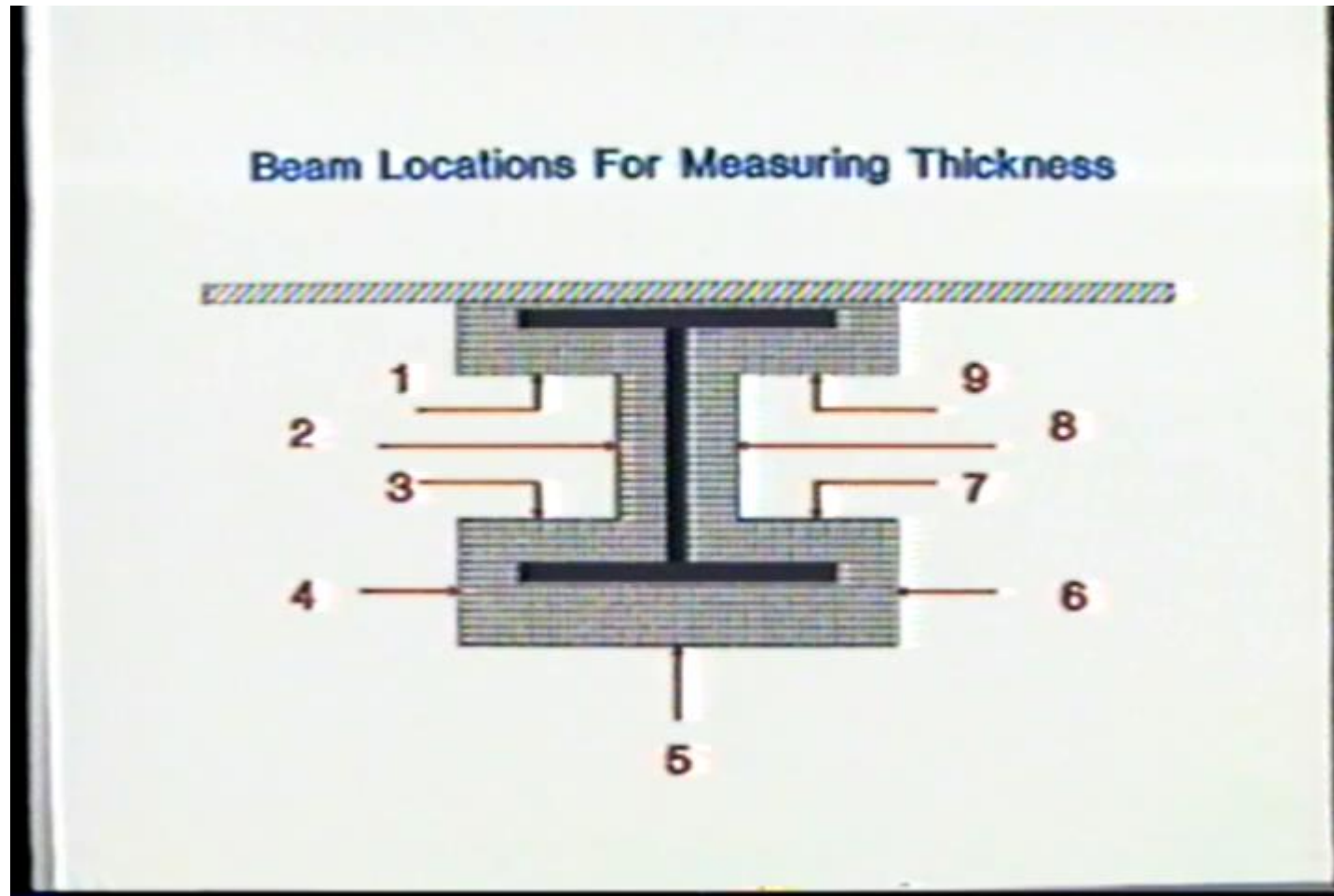
Recording Results and Averaging Beam Data

- Full design thickness shall be measured at locations 1, 2, 3, 5, 7, 8, 9.
- $\frac{1}{2}$ of full thickness or a minimum of $\frac{1}{4}$ 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.**

Locations for Measuring Columns



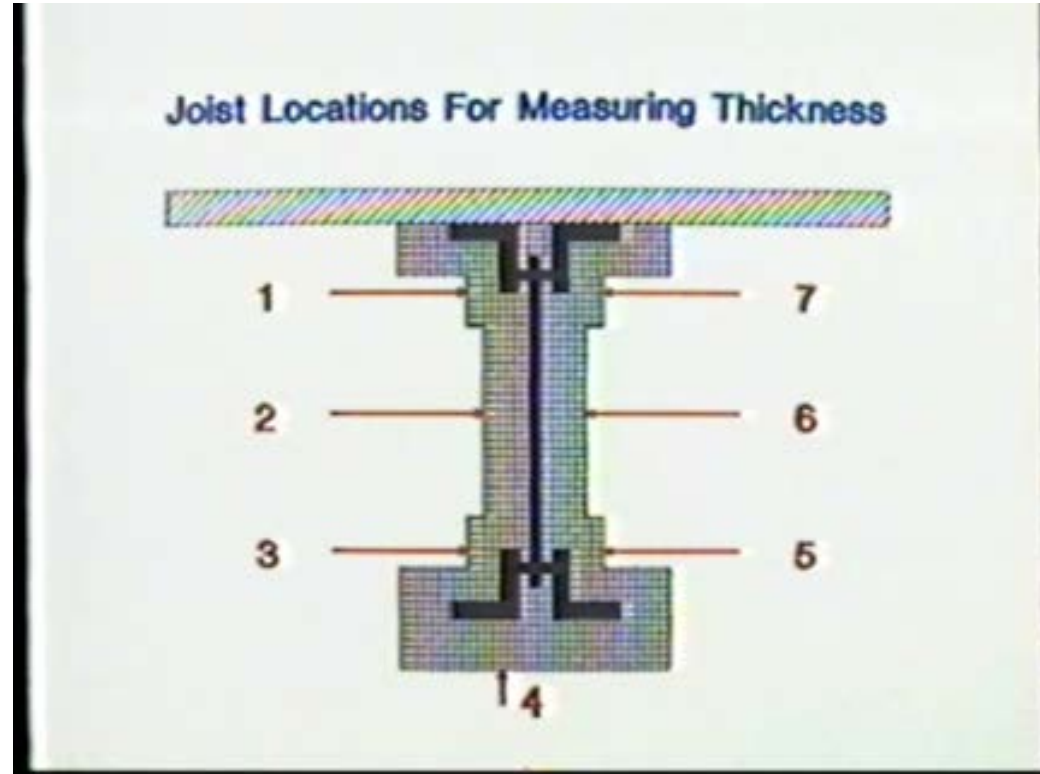
Beams, Girders



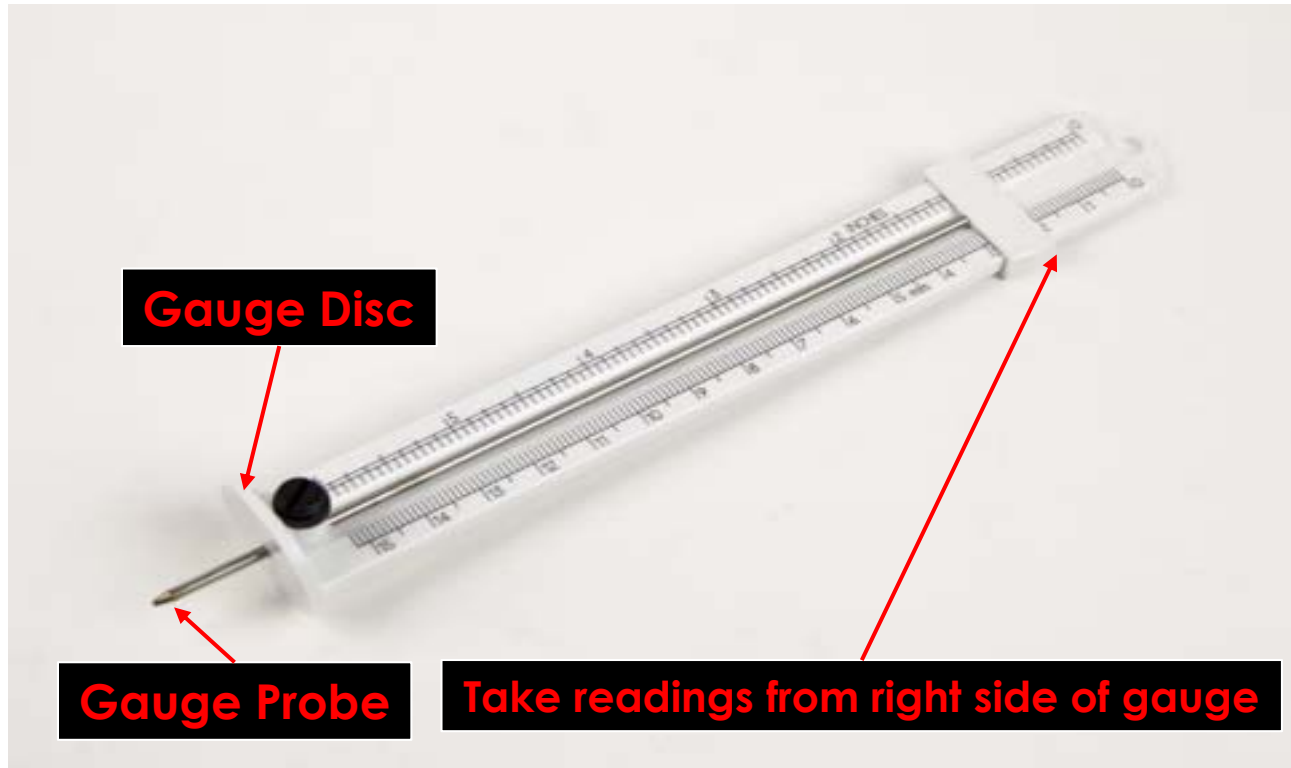
Column Thickness Measurements Separated by 12 Inches



Locations for Measuring Joists



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

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]

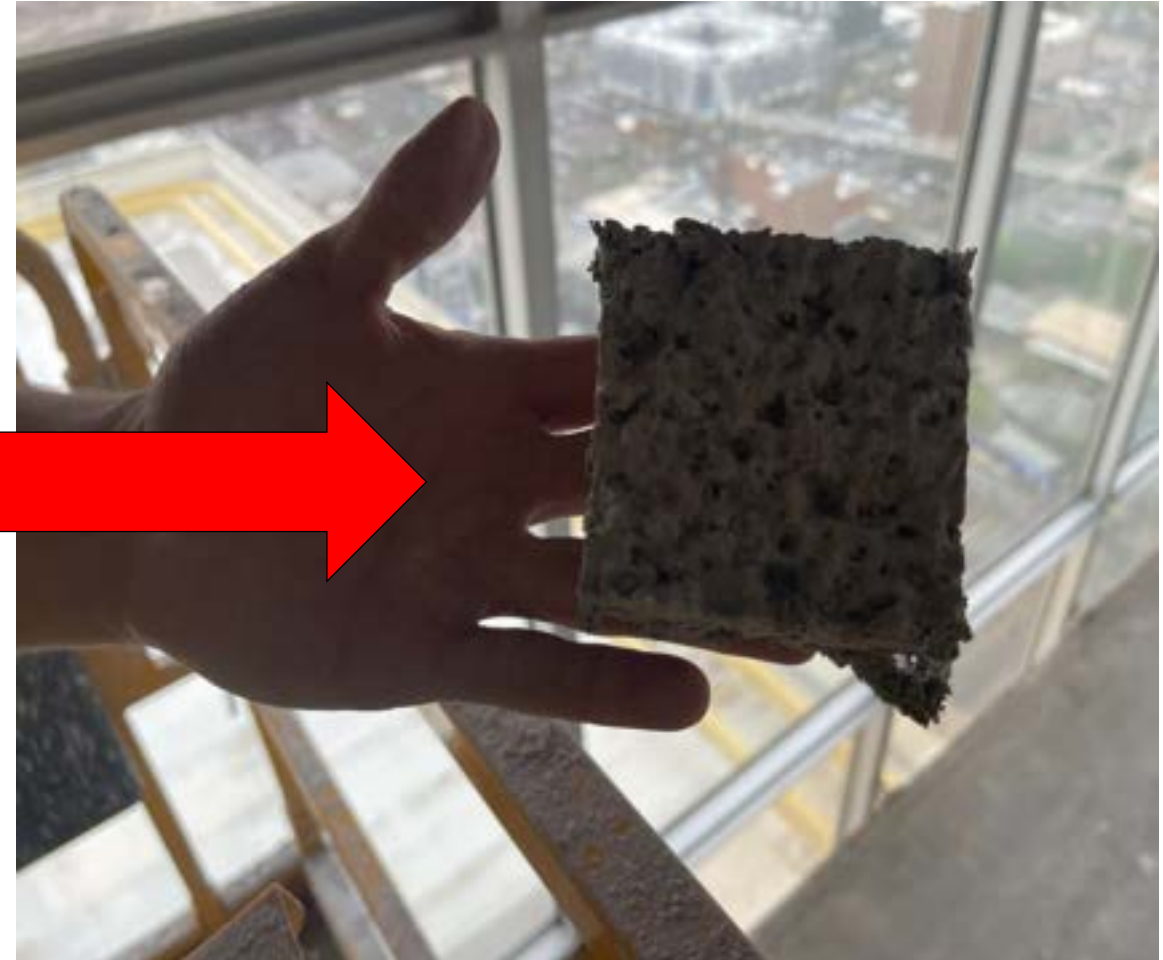
Secure Density Sample from Column Web



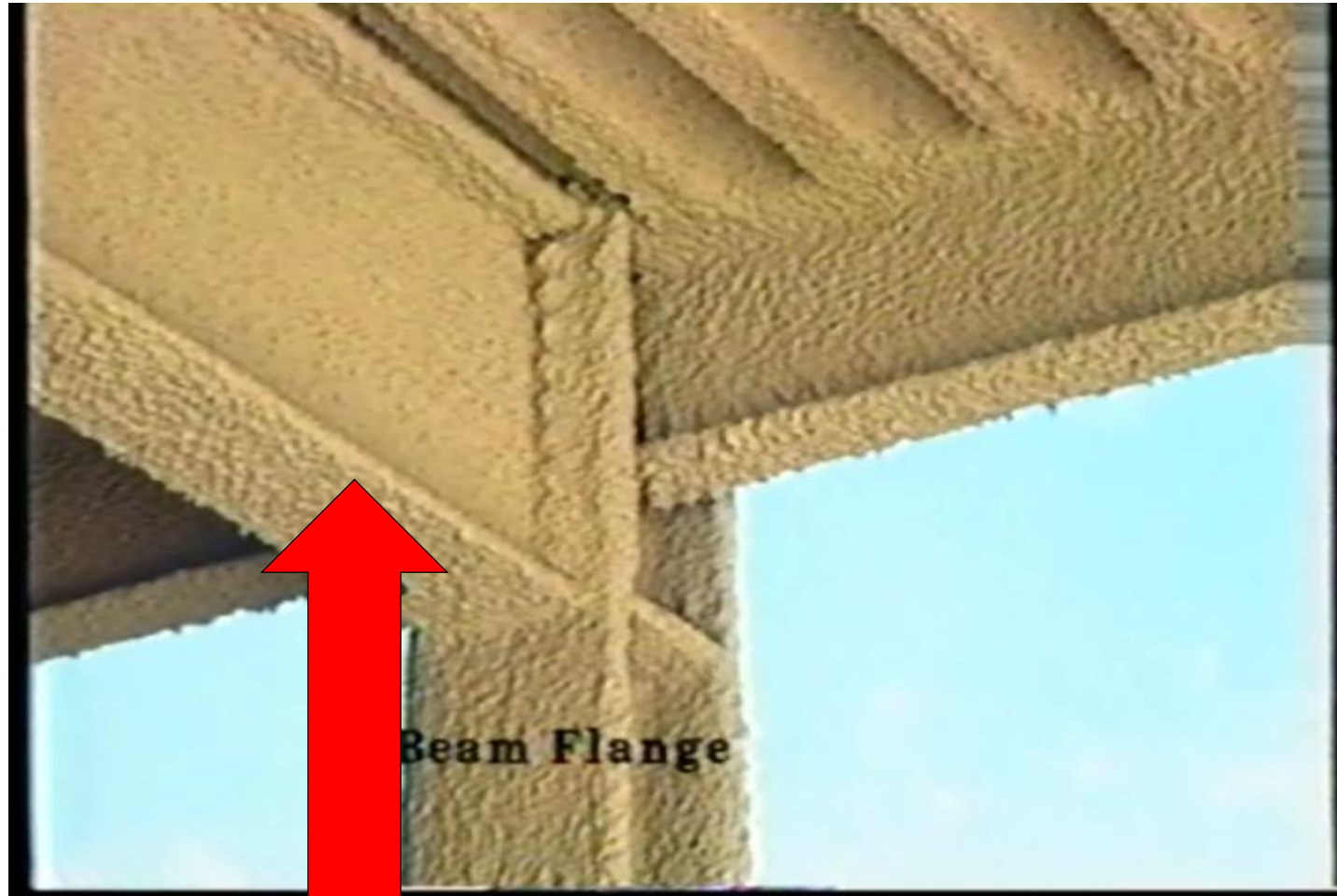
Secure Density Sample from Column Flange



Secure Density Sample from Beam Web



Secure Density Sample from Beam Flange



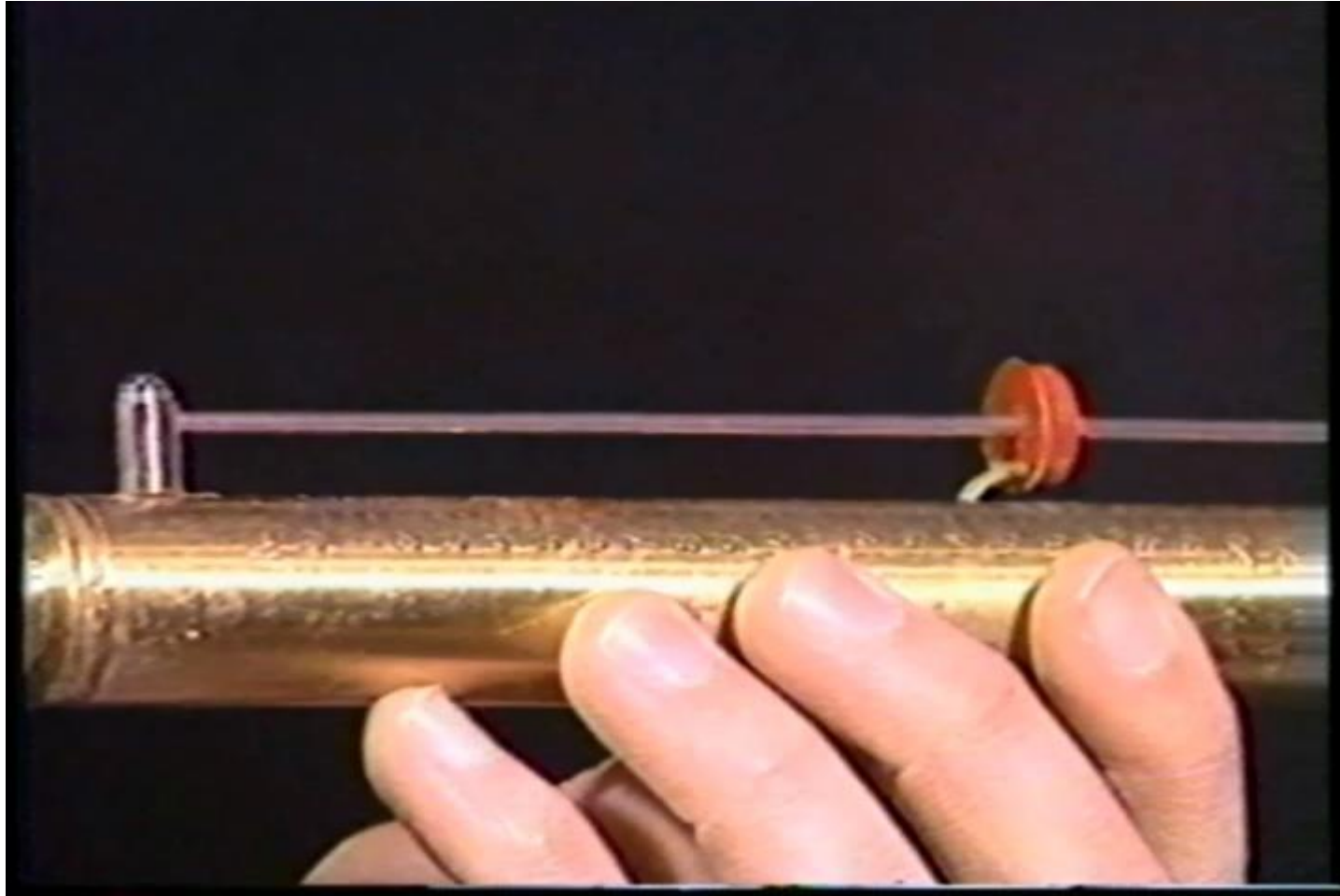
Volume Displacement Method

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

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

Cohesive/Adhesive Bond Strength

$$\text{Force, (psf)} = \frac{\text{Recorded Force, (lbs)}}{\text{Area of Metal Cap, (sq.ft.)}}$$

IFRM Special Inspection



Intumescent Fire-Resistive Materials (IFRM) Special Inspection

1705.16 Intumescent Fire-Resistive Materials ~~Mastic and intumescent fire-resistant coatings.~~

Special inspections and tests for ~~mastic and intumescent fire-resistive materials~~ applied to structural elements and decks shall be performed in accordance with **AWCI 12-B**.

Special inspections and tests shall be based on the fire-resistance design as designated in the *approved construction documents*. *Special inspections* and tests shall be performed during construction. Additional visual inspection shall be performed after the rough installation and, where applicable, prior to the concealment of electrical, automatic sprinkler, mechanical and plumbing systems.

[IBC 2018, 2021, 1705.16]

IFRM Special Inspection - AWC1 12-B

5.3 Inspection Firm. The testing of TFIFRM shall be conducted by an **accredited independent inspector and/or testing laboratory and/or agency acceptable** to the owner or his representative and the TFIFRM

5.3.1 Qualifications. Personnel testing TFIFRM shall **be familiar** with the application and use of these products, shall be thoroughly trained in the test methods and shall be **experienced** in conducting field testing procedures.

5.3.2 Testing Experience. Personnel responsible for the execution of field inspection procedures and test reports shall have a **minimum of three years** of testing experience.

NFCA NOTE:

ACCEPTABLE TO THE AHJ IS ALL THAT'S REQUIRED CURRENTLY IN IBC....

[AWC1 12-B, Third Edition]

Application Conditions

- Minimum ambient and substrate temperature shall be maintained prior to, during and a minimum of 72 hours after application, except as otherwise indicated in the SFRM manufacturer's application instructions for the following products.
 - Water Based Materials 50°F/10°C
 - Solvent Based Materials 40°F/4.44°C
 - Epoxy Based Materials 50°F/10°C
- **NFCA NOTES:**
 - Ambient temperature 5°F/-15°C above dew point & rising.
 - Relative humidity not to exceed 75%.
 - Verify with Manufacturers Installation Instructions

IFRM Inspection Procedures

- Thickness measurement is the only inspection conducted on an intumescent product after application.
- All thickness measurements shall be made before application of any topcoat.

Measurement Locations

- Measurement locations for beams, W-shape columns, and trusses shall **follow the same locations as for measuring SFRM application.**
- Tube and pipe column thickness measurement shall be made at a minimum of four locations around the column at each end of 12 inch length.

IFRM Inspection Procedures

- Many IFRM's shrink as they dry due to solvent or water evaporation.
- Thickness measurements shall be taken only after the IFRM has stabilized.
- Consult manufacturer's recommendations.
- Some manufacturers specify a minimum Shore "D" hardness as a means of determining dryness.
- Many IFRM's become harder as they dry or cure.

IFRM Inspection Procedures

- Electronic thickness measuring meter - ferrous metals.
- Calibrate device in accordance with manufacturer's recommendations.
- Place probe on coating and record thickness.

Thickness Measurements

- Thickness determination shall be the mean of three separate thickness readings within the area of $\frac{1}{2}$ inch diameter circle.
- Small surface irregularities may cause readings to differ even in small areas.
- When moving the probe within the $\frac{1}{2}$ inch diameter, discard any unusually high or low readings that cannot be repeated consistently.

Visual Inspection

- Visual inspection of structural elements shall take place upon complete drying or curing before top coat is applied.
- IFRM's shall not exhibit deep or wide cracks, voids, blisters, bubbles, delamination or any exposure of the substrate.
- Minor surface irregularities are acceptable.

Measurement Locations

- Measurement locations for beams, W-shape columns, and trusses shall **follow the same locations as for measuring SFRM application.**
- Tube and pipe column thickness measurement shall be made at a minimum of four locations around the column at each end of 12 inch length.

Measuring Calibration Shim



Measure Thickness Coating and Record



Thickness Maximum

- Individual thickness determinations that exceed the thickness specified in a fire resistance design criteria by **20 percent** shall be recorded as the thickness in the design plus 20 percent.
- The average dry film thickness on any member **shall not exceed by more than 10 percent the manufacturer's maximum tested thickness** for the particular member shape and orientation.



Thickness Minimum

- **No individual thickness determination shall be less than 80 percent of the thickness specified** in the fire resistance rating design criteria.
- If the member fails to meet the average or individual thickness criteria, corrective action shall be taken and the area re-tested.



PASSIVE FIRE PROTECTION SYMPOSIUM

4-6 JUNE 2024 • INTERCONTINENTAL DUBAI MARINA

FCIA 

NFCA 

