Special Inspection Procedures for SFRM and Intumescent Fireproofing Materials

National Fireproofing Contractors Association

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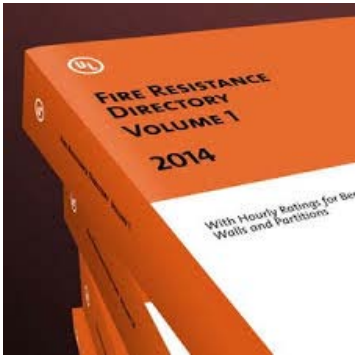
Contact

- Bill McHugh, NFCA Executive Director
  - info@NFCA-online.org
- Join NFCA…..
  - Sandy@NFCA-Online.org

Program Outline

- Industry Terminology
- IBC Code Requirements 2009…
- SFRM Section
  - Specific Inspection and Testing Procedures
  - Reporting Results
- Intumescent Section
  - Specific Inspection and Testing Procedures
  - Reporting Results



Why Special Inspection?

- Critical Structural protection
  - Structural elements lose strength @ Temperatures
  - Field Fabrication
- Protection for Fire and Life Safety
- Code Required…

Definitions and Terminology

- Area, Building – The area included within surrounding *exterior walls (or exterior walls* and *fire walls)* exclusive of vent *shafts* and *courts*. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.

  [IBC 2015, 202]

Definitions and Terminology

- **Story** – That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above. **[IBC 2009, 202]**
- **STORY.** That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above (see "*Basement*," *"Building height,"* "*Grade plane" and* "*Mezzanine*"). A story is measured as the vertical distance from top to top of two successive tiers of beams or finished floor surfaces and, for the topmost story, from the top of the floor finish to the top of the ceiling joists or, where there is not a ceiling, to the top of the roof rafters. **[IBC 2015, 202]**

Definitions and Terminology

- **Special Inspection** – Inspection as herein required of materials, installation, fabrication, erection or placement of components, and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.

  [IBC 2009, 202]

- **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*. **[IBC 2015, 202]**

  Continuous special inspection. Special inspection by the *special inspector* who is present 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

Definitions and Terminology

- **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 2015, 202]**

Definitions and Terminology

- Sprayed Fire-Resistive Materials (SFRM) – Materials that are spray applied to provide fire-resistant protection to the structural elements. **[IBC 2009, 2015, 202]**

Definitions and Terminology

- **Intumescent Materials** - Intumescent coatings are either thin film or mastic materials that intumesce and form an insulating char when exposed to fire thus providing fire protection to structural elements. **[IBC 2009, 202]**

- **INTUMESCENT FIRE-RESISTANT COATINGS.** Thin film liquid mixture applied to substrates by brush, roller, spray or trowel which expands into a protective foamed layer to provide fire-resistant protection of the substrates when exposed to flame or intense heat. **[IBC 2015, 202]**

Definitions and Terminology

- **PRIMARY STRUCTURAL FRAME.** The primary structural frame shall include all of the following structural members:

  1. The columns.
  2. Structural members having direct connections to the columns, including girders, beams, trusses and spandrels.
  3. Members of the floor construction and roof construction having direct connections to the columns.
  4. Bracing members that are essential to the vertical stability of the primary structural frame under gravity loading shall be considered part of the primary structural frame whether or not the bracing member carries gravity *loads.*

Definitions and Terminology

- Primary beams frame directly into columns.
- Secondary beams frame directly into primary beams.
- Half-Flange Thickness – Thickness of SFRM or intumescent applied only to the flange edge profile of beam or column.

Definitions and Terminology

- **SECONDARY MEMBERS.** The following structural members shall be considered secondary members and not part of the *primary structural frame*:

  1. Structural members not having direct connections to the columns.
  2. Members of the floor construction and roof construction not having direct connections to the columns.
  3. Bracing members other than those that are part of the *primary structural frame*.

International Building Code (IBC) SFRM & IFRM Special Inspection

- IBC 2009 – 2015 Chapter 17
- Requires special inspection of SFRM and IFRM applications.
  - IBC 2009 - Section 110.3.9 requires special inspection and refers to Section 1704.
  - IBC 2009 - 1704.12 and 1704.13 cover special inspections of SFRM and intumescent.

IBC SFRM & IFRM
Special Inspection

SECTION 104 –
DUTIES AND POWERS OF BUILDING OFFICIAL

[A] 104.1 General. The *building official* is hereby authorized and directed to enforce the provisions of this code. The *building official* shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code. **[IBC 2015, 104.1]**

IBC SFRM & IFRM
Special Inspection

[A] 104.4 Inspections. The *building official* shall make all of the required inspections, or the *building official* shall have the authority to accept reports of inspection by *approved agencies* or individuals. Reports of such inspections shall be in writing and be certified by a responsible officer of such *approved agency* or by the responsible individual. The *building official* is authorized to engage such expert opinion as deemed necessary to report upon unusual technical issues that arise, subject to the approval of the appointing authority.
[IBC 2015, 104.4]

IBC SFRM & IFRM
Special Inspection

110.3 Required inspections. The *building official*, upon notification, shall make the inspections set forth in Sections 110.3.1 through 110.3.10.

110.3.8 Other inspections. In addition to the inspections specified in Sections 110.3.1 through 110.3.7, the *building official* is authorized to make or require other inspections of any construction work to ascertain compliance with the provisions of this code and other laws that are enforced by the department of building safety.

110.3.9 Special inspections. For *special inspections*, see Chapter 17. **[IBC 2015, 110.3, 110.3.8 110.3.9]**

IBC SFRM & IFRM
Special Inspection

110.4 Inspection agencies. The *building official* is authorized to accept reports of *approved* inspection agencies, provided such agencies satisfy the requirements as to qualifications and reliability. **[IBC 2015 110.4]**

110.6 Approval required. Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the *building official*….More. **[IBC 2015 110.6]**

IBC SFRM & IFRM
Special Inspection

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*.

[IBC 2015, 202.2 Definitions]

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

[IBC 2015, 202.2 Definitions]

IBC SFRM & IFRM
Special Inspection

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 2015, 202.2 Definitions]

IBC SFRM & IFRM
Special Inspection

SECTION 1703 APPROVALS

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.
[IBC 2015, 1703.1]

IBC SFRM & IFRM
Special Inspection

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 also disclose possible conflicts of interest so that objectivity can be confirmed.

[IBC 2015, 1703.1.2]

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

[IBC 2015, 1703.1.2]

IBC SFRM & IFRM
Special Inspection

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

[IBC 2015, 1703.1.3]

IBC SFRM & IFRM
Special Inspection

1704.2 Special inspections. Where application is made to the *building official* for construction as specified in Section 105, **the owner or the owners authorized agent, other than the contractor,** shall employ one or more approved agencies to provide *special inspections* and tests during construction on the types of work specified in Section 1705 and identify the *approved agencies* to the *building official*. **These *special inspections* and tests are in addition to the inspections identified in Section 110. [IBC 2015 1704.2]**

I – Inspection – Code Requirements

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]

I – Inspection – Code Requirements

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 2015, 1704.2.1]

Special Inspection Agency Approvals Firm and Individual Qualifications 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

Special Inspection Agency Approvals Firm and Individual Qualifications IAS AC 291

- **Specify IAS AC 291 –**
  - Quantified Qualifications
  - Helps AHJ with “Approved Agency”
  - Not in ASTM Standards, IBC Code
- **Specify Individual Competency**
  - ICC Spray Applied Fireproofing Special Inspector Exam
  - NFCA CAP Program Education & Exams
  - ICC Fire Inspector I

IBC SFRM & IFRM
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 2015, 1705.1.1]

IBC SFRM & IFRM
Special Inspection - Reports

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 2015, 1704.2.4 – emphasis added]

SFRM IBC 1705.14 Special Inspection

1705.14 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 after the rough installation of electrical, automatic sprinkler, mechanical and plumbing systems and suspension systems for ceilings, where applicable. **[IBC 2015, 1704.14]**

IBC SFRM & IFRM
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.

[IBC 2015, 1704.14.1]

SFRM Required Inspections

- **1705.14.2 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 resistant material. **[IBC 2015 1705.14.2]**

- **Sec. 1704.12.2 - 2009** – Structural Member Surface Conditions
  - Surfaces prepared in accordance with the approved design and approved manufacturer's instructions.
  - Prepared surface to be inspected before application of SFRM or intumescent.

Prepared Surface Conditions

- Surfaces to receive SFRM shall be free of primers/paint (other than those tested and found acceptable), oils, grease, loose mill scale, dirt or foreign substances that may impair proper adhesion.
- Steel decks shall be free of rolling compounds, rust or other foreign substances that may impair adhesion.
- When primed steel is present, the UL Fire Resistance Directory must be followed for coating materials.

Application Conditions

- Minimum ambient and substrate temperature of 40ºF shall be maintained prior to, during and a minimum of 24 hours after application, except as otherwise indicated in the SFRM manufacturer's application instructions.
- Proper ventilation must be maintained after application at the rate of four complete air exchanges per hour. **[IBC 2009]**

Application Conditions

- **1705.14.3 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 2015 1704.14.3]

Thickness Measurement (con't.)

- For design thickness less than 1 inch, the individual minimum shall be the design thickness minus 25%.
- Thickness samples selected according to Sections 1704.12.4.2 and 1704.12.4.3.

  [IBC 2009, 1704.12.4]

Thickness Measurement Sample Selection

- Thickness Measurement in Accordance with ASTM E 605.

- 1704.12.4.2 Floor, Roof and Wall Assemblies.
  - Four measurements taken for each 1,000 SF on each floor or part thereof.
- 1704.12.4.3 Structural Framing Members
  - Thickness testing on not less than 25% of structural members on each floor.

[IBC 2009, 1704.12.4.2 & .3]

SFRM IBC 1705.14xx Special Inspection

- **1705.14.4 Thickness.** No more than 10 percent of the thickness measurements of the sprayed fire-resistant materials applied to floor, roof and wall assemblies and structural members shall be less than the thickness required by the *approved* fire-resistance design**, but in no case less than the minimum allowable thickness required by Section 1705.14.4.1**. **[IBC 2015 1705.14.4]**

SFRM IBC 1705.14xx Special Inspection

- **1705.14.4.1 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 E 605.** Samples of the sprayed fire-resistant materials shall be selected in accordance with Sections 1705.14.4.2 and 1705.14.4.3. **[IBC 2015 1705.14.4.1]**

SFRM IBC 1705.14xx Special Inspection

1705.14.4.2 Floor, roof and wall assemblies. The thickness of the sprayed fire-resistant material applied to floor, roof and wall assemblies shall be determined in accordance with **ASTM E 605**, 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 2015 1705.14.4.2]

8.1.4.1 *Flat Decks*—In the preselected area, lay out a 300 mm [12 in.] square. Take four random symmetrical measurements within that square and report as an average. (See Note 1.)

[ASTM E 605-93-15]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.3 Cellular decks. Thickness measurements shall be selected from a square area, 12 inches by 12 inches (305 mm by 305 mm) in size. A minimum of four measurements shall be made, located symmetrically within the square area.

[IBC 2015 1705.14.4.3]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.4 Fluted decks. Thickness measurements shall be selected from a square area, 12 inches by 12 inches (305 mm by 305 mm) in size. A minimum of 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 2015 1705.14.4.4]

8.1.4.2 *Fluted Decks*—In the preselected area, lay out a 300 mm [12 in.] square. Take four random symmetrical measurements within that square, one each of the following: valley, crest, and sides, and report as an average. (See Note 1.)

[ASTM E 605-93-15]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.5 Structural members. The thickness of the sprayed fire-resistant material applied to structural members shall be **determined in accordance with ASTM E 605.** Thickness testing shall be performed on not less than 25 percent of the structural members on each floor.

[IBC 2015 1705.14.4.5]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.6 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 2015 1705.14.4.6]

8.1.5.1 *Beams*—For each preselected beam, lay out one 300 mm [12 in.] length and take nine thickness measurements (see Fig. 2) at each end of the 300 mm length (see Fig. 3). (See Notes 1 and 2.)

[ASTM E 605-93-15]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.7 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 2015 1705.14.4.7]

8.1.5.2 *Joists (Trusses)*—For each preselected joist (truss), lay out one 300 mm [12 in.] length and take seven thickness measurements (see Fig. 4) at each end of the 300 mm length (see Fig. 5). (See Notes 1 and 2.)

[ASTM E 605-93-15]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.8 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 2015 1705.14.4.8]

8.1.5.3 *Columns*—For each preselected column, lay out one 300 mm [12 in.] length and take twelve thickness measurements (see Fig. 6) at each end of the 300 mm length (see Fig. 7). (See Notes 1 and 2.)

[ASTM E 605-93-15]

SFRM IBC 1705.14xx Special Inspection

1705.14.4.9 Hollow structural section and pipe columns. At hollow structural section and pipe columns, thickness measurements shall be made at a minimum of four locations around the column at each end of a 12-inch (305 mm) length.

[IBC 2015 1705.14.4.x]

ASTM E 605
Thickness Measurement Criteria

8.1.5.4 *Beams, Joists (Trusses), and Columns*—Average, separately, the 18 thickness measurements for the beams, the 14 thickness measurements for the joists (trusses), and the 24 thickness measurements for the columns. (A sample data sheet is shown in Fig. 8.) (See Notes 1 and 2.)

[ASTM E 605-93-15]

ASTM E 605
Thickness Measurement Criteria

NOTE 1—Specific fire resistance rating criteria for beams, trusses, and columns may allow for a reduced thickness on flange tips. These thicknesses are to be averaged apart from other sections of the structural member. Also, some fire rating assemblies have different thickness requirements for crests and valleys of floor decks and should be averaged apart.

NOTE 2—Medium and high density SFRM may be too hard to test for thickness by standard procedure. It is recommended to check thicknesses immediately after application, and before curing. The applicator shall adjust the thickness of the freshly applied SFRM to yield thickness after cure, in accordance with the SFRM manufacturer's recommendations. If the product is cured and too hard to insert the thickness gage, drill small diameter holes into the product just large enough to accommodate the thickness gage pin. The thickness gage is then inserted into these holes and thickness is determined by the standard procedure. These holes are to be closed off immediately following the test using the same SFRM.

[ASTM E 605-93-15]

Thickness Deficiencies

8.1.6 ***Thickness Deficiency*—An** item (deck, column, beam, or joist) is deficient if:

8.1.6.1 An individual measured thickness is more than 6 mm [1⁄4 in.] less, or more than 25 % less, than the required fire resistance design thickness. (See Note 3.)

8.1.6.2 The calculated average thickness of the SFRM is less than that required by the design.

[ASTM E 605-93-15]

Thickness Deficiencies

NOTE 3—The applicable building code governs. Consult the applicable building code for exact requirements and tolerances.

NOTE 4—A thickness to density correction formula is contained in certain fire resistance rating criteria or is available from some SFRM manufacturers. Consult the rating criteria and the SFRM manufacturer for specific information before citing for deficiency.

NOTE 5—If an item is deficient, then only that specific item fails. The remaining items in the bay, and like items in other areas of the building, shall not be deemed to have failed solely because the tested item has failed. (See 8.1.7.)

[ASTM E 605-93-15]

Thickness Measurement Criteria

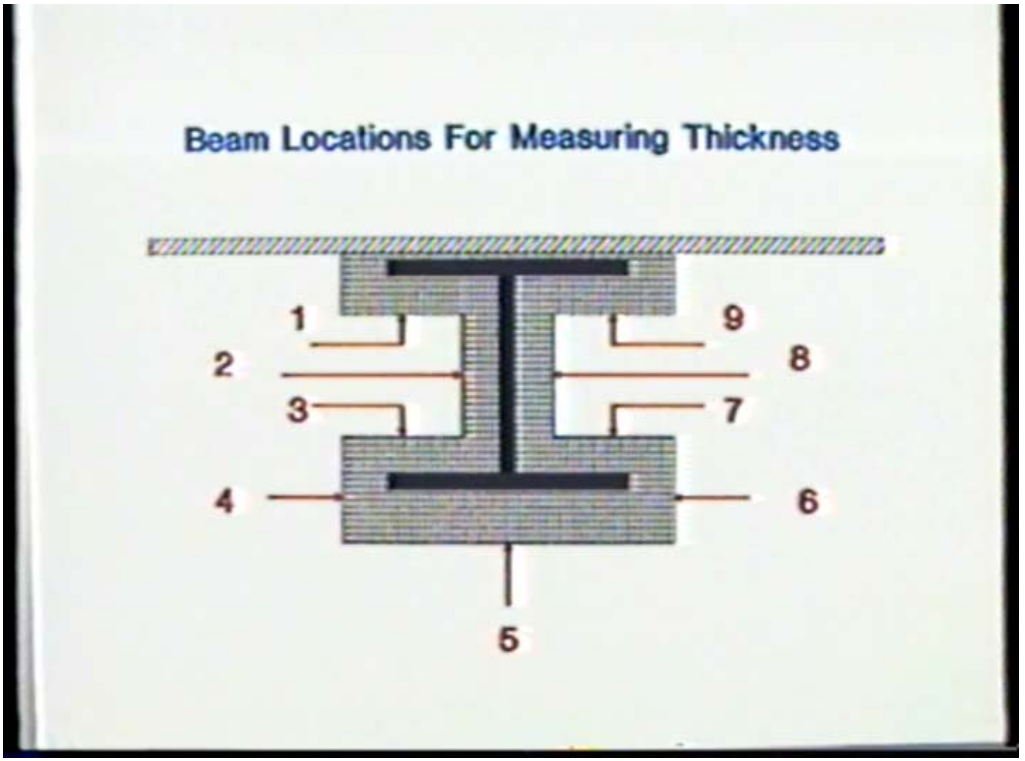
- Thickness – 2009 Sec. 1704.12.4 –
- No more than 10% of average thickness of SFRM shall be less than the thickness required by approved design and none less than stated below.
  - Individual measured thickness exceeding specified thickness by ¼ inch or more recorded as design thickness plus ¼ inch.
  - For design thickness of 1 inch or greater, the minimum individual thickness shall be design thickness minus ¼ inch.

[IBC 2009, 1704.12.4]

Thickness Measurement Locations and Recording Results

- Locations for measuring beams, columns, joists and under deck surfaces.
- Recording results and issues relating to averaging measurement results.

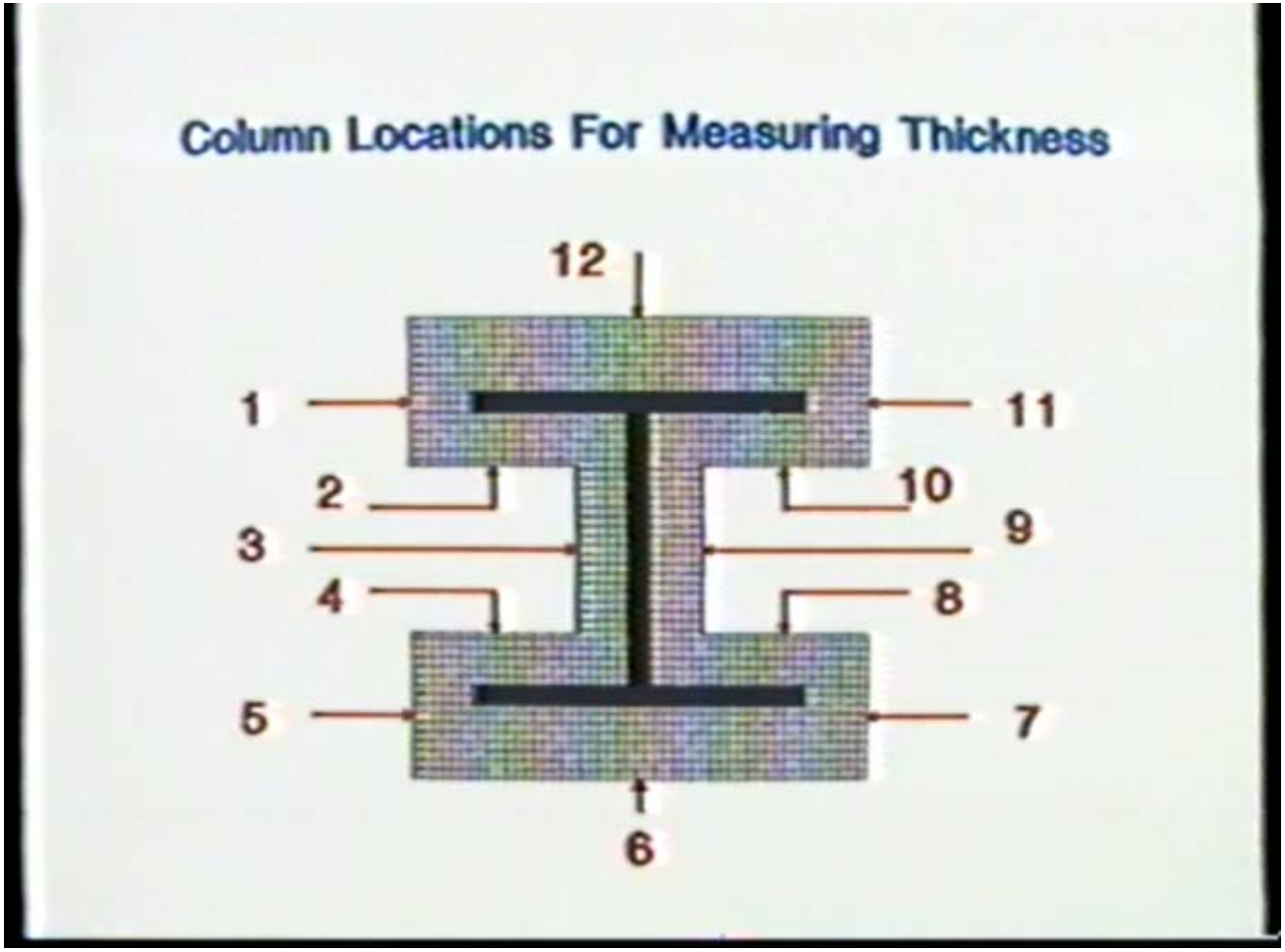
Locations for Measuring Beams



Recording Results and Averaging Beam Data

- Full design thickness shall be measured at locations 1, 2, 3, 5, 7, 8, 9.
- One half of full thickness or a minimum of ¼ inch measured at locations 4 and 6.
- 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.

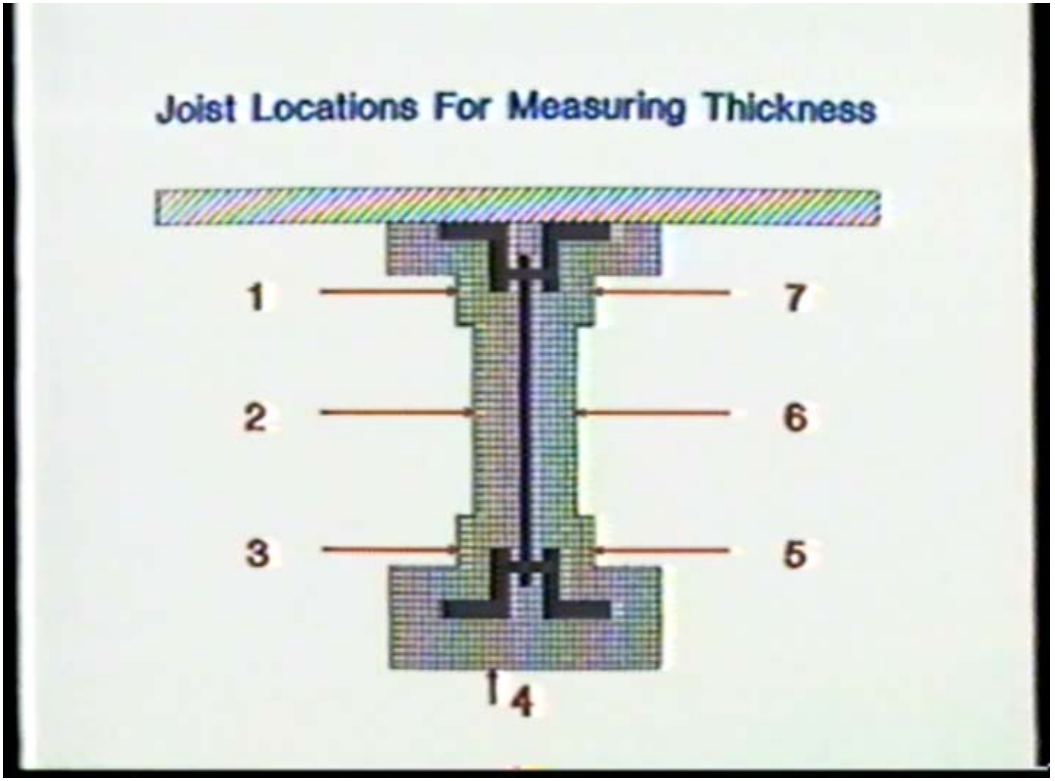
Locations for Measuring Columns



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.

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.

Protected Elements to be Measured

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Density Measurement Criteria

1705.13.5 Density. The density of the sprayed fire-resistant material shall not be less than the density specified in the *approved* fire-resistance design. Density of the sprayed fire-resistant material shall be determined **in accordance with ASTM E 605**. The test samples for determining the density of the sprayed fire-resistant 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 (232 m2) of floor area or portion thereof in each *story*.

[IBC 2015, 1705.13.5]

Density Measurement Criteria

- 1704.12.5 Density
  - Average density shall not be less than density specified in design.
  - Density determined in accordance with ASTM E 605.

    8.2 *Density*:

    8.2.1 Conduct one density test at random on each of the following protected elements, per floor or per every 930 m2 [10 000 ft2], whichever provides the greatest number of tests: the flat portion of the deck; a beam, either the bottom of the beam lower flange or the beam web; and a column, either the column web or the outside of one of the column flanges.

    8.2.1.1 When density falls between the minimum average and minimum individual values of the fire resistance design, a similar, randomly selected element in the same area shall be tested. If the average density of the two elements is then met, the area passes. If the average is not met, then those elements in that area must be corrected.

    [ASTM E 605-93-15]

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

Bond Strength Criteria Required in IBC

- 1704.12.6 Bond Strength
  - Cohesive/adhesive bond strength not less than 150 pounds per SF.
  - Bond strength test is in accordance with ASTM E 736.
  - Selection of samples in accordance with Sections 1704.12.6.1 and 1704.12.6.2 and 1704.12.6.3

Bond Strength Selection of Samples

- **1704.12.6.1-09 / 1705.13.6.1-15**
  Floor, Roof and Wall Assemblies
  - In- place samples selected from floor, roof and wall assembly at rate of one sample every 2,500 SF of sprayed area in **each story.**
- **1704.12.6.2-09 / 1705.13.6.2-15**
  Structural Framing Members
  - In- place samples selected from beams, girders, joists, trusses and columns (and other structural members) at rate of not less than one sample for each type for each 2,500 SF of floor area or portion thereof in each story.

[IBC 2015, 1705.13.6.x]

Bond Strength - Primers

1705.13.6.3 Primer, paint and encapsulant bond tests. Bond tests to qualify a primer, paint or encapsulant shall be conducted when the sprayed fire-resistant material is applied to a primed, painted or encapsulated surface for which acceptable bond-strength performance between these coatings and the fire-resistant 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 2015, 1705.13.6.3]

Consult Structural Drawings or Specification for Correct Thickness, Density and Bond Strength Values

The Details in Pictures…

- Definitions
- Procedures

Typical Bay of Sprayed Fireproofing

Bottom of Structural Floor Deck

Floor Column

Primary Floor Beam or Joist

Secondary Beam or Joist

Field Inspections of Sprayed Fireproofing

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Measuring Thickness

Removing Sample for Density Measurement

Bond Strength Testing

Thickness Measurement Locations

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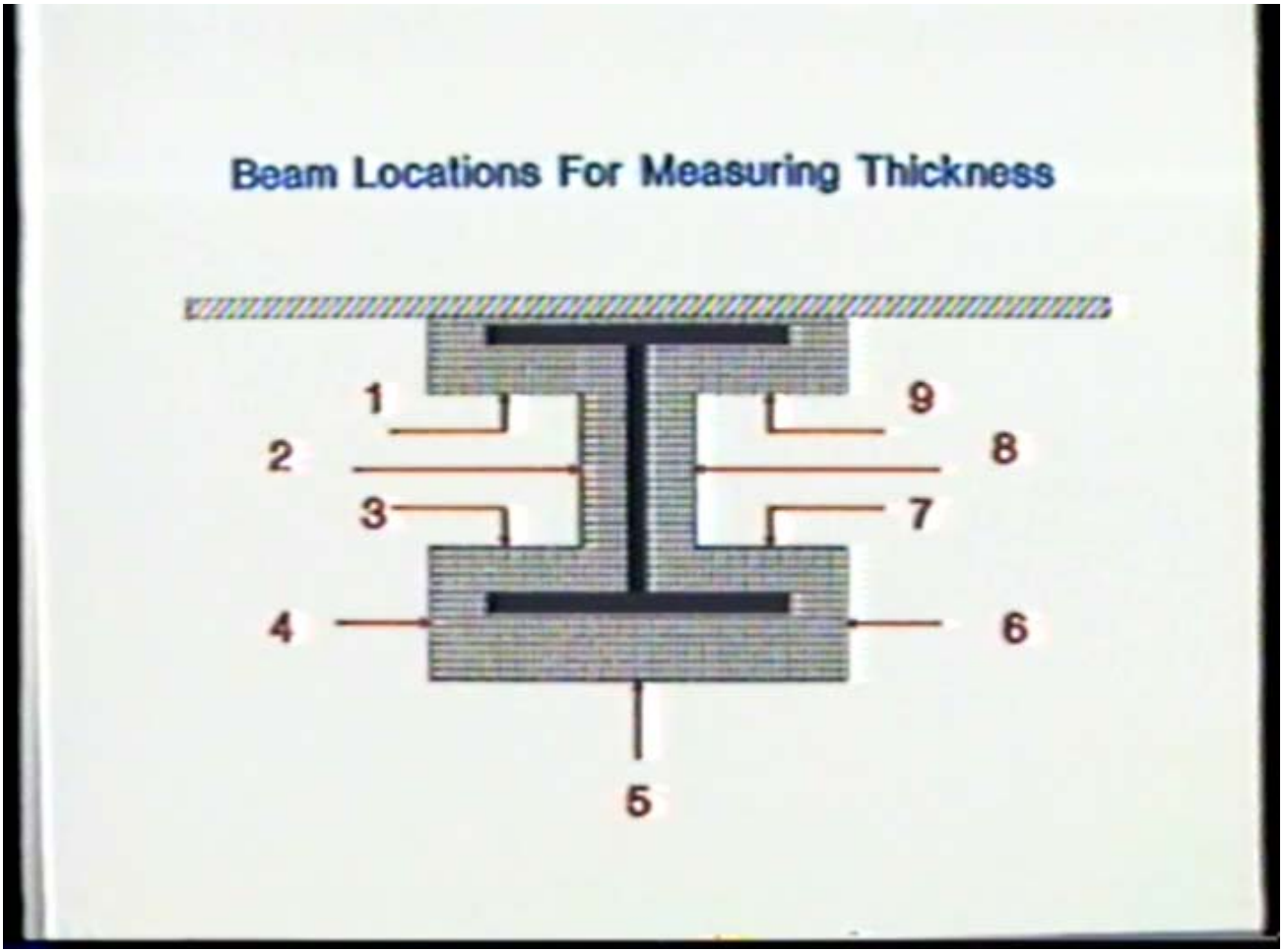
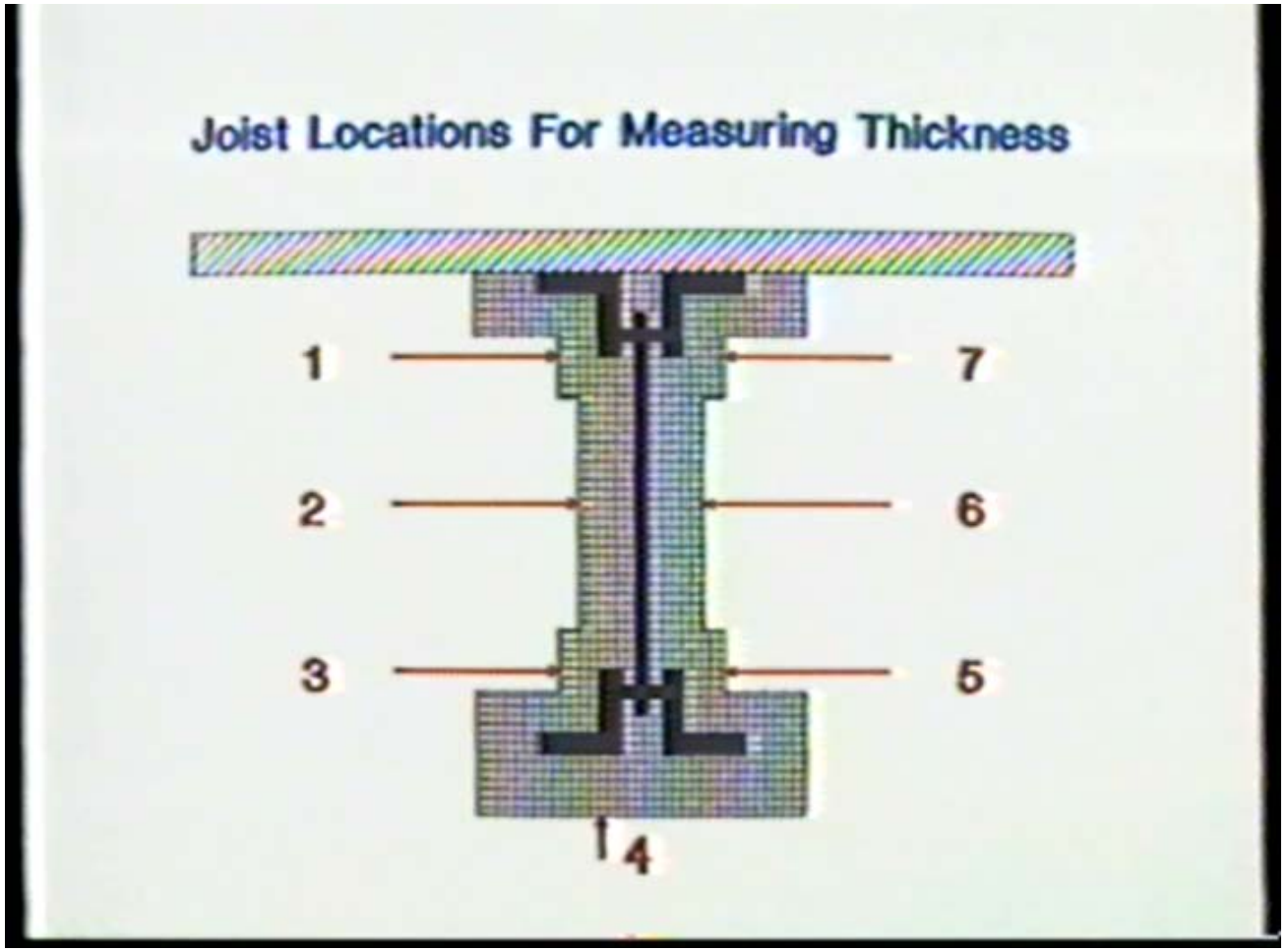
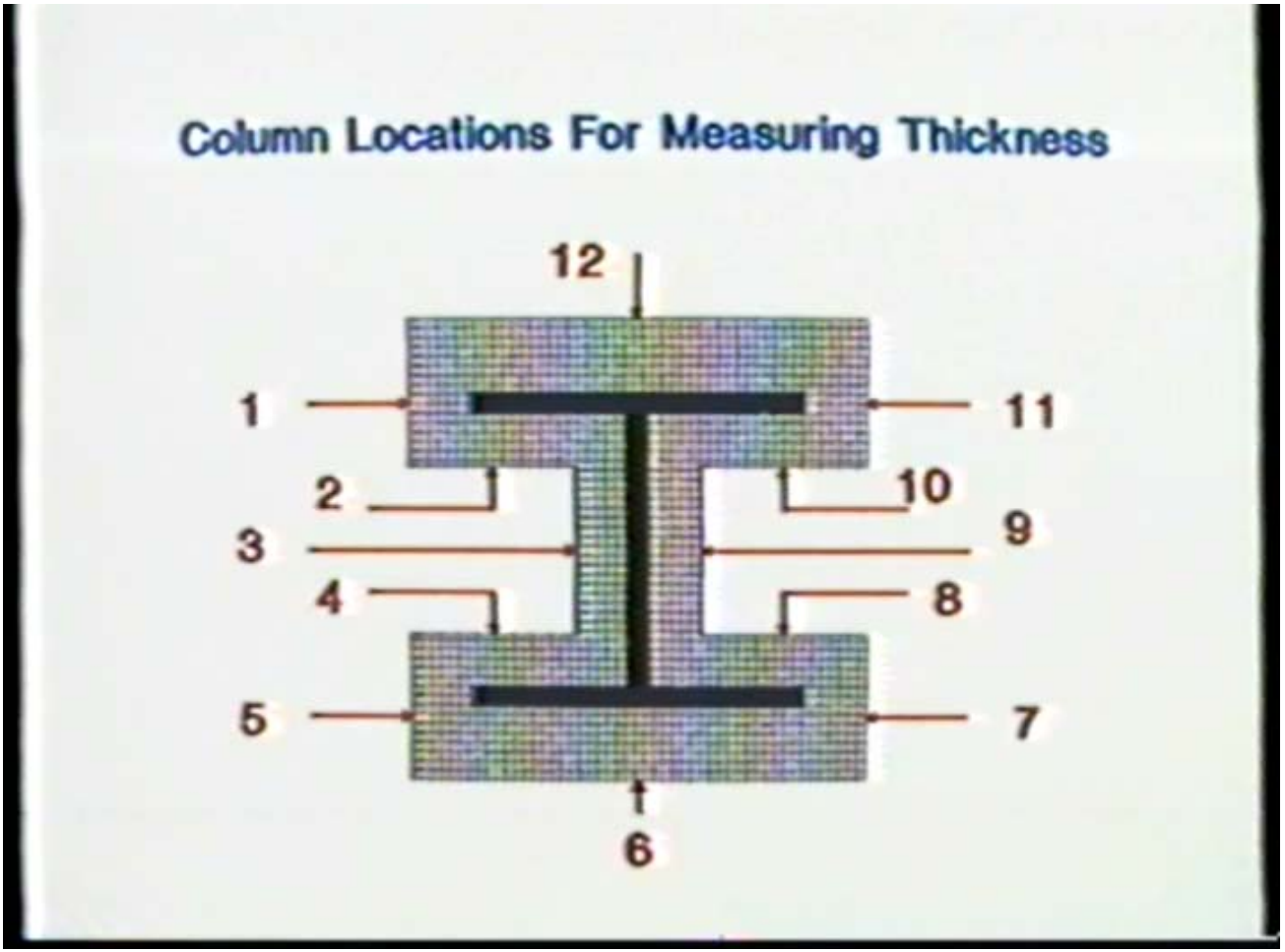
Measurement Locations

- 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.


Beam Locations For Measuring Thickness
1
2
3
4
5
6
7
8
9


Joist Locations For Measuring Thickness
1
2
3
4
5
6
7


Column Locations For Measuring Thickness
12
1
11
2
10
3
9
4
8
5
7
6

Column Thickness Measurements Separated by 12 Inches

Medium Density SFRM Thickness Measuring Procedure

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Inserting Thickness Device Probe through SFRM to Steel

Moving Measuring Slide to SFRM Surface

Measuring Slide Contacting but Not Compressing SFRM

Taking Thickness Measurement

Measuring Thickness on Flange of Column

High Density SFRM Thickness Measuring Procedure

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Drill Hole Into High Density SFRM to Steel

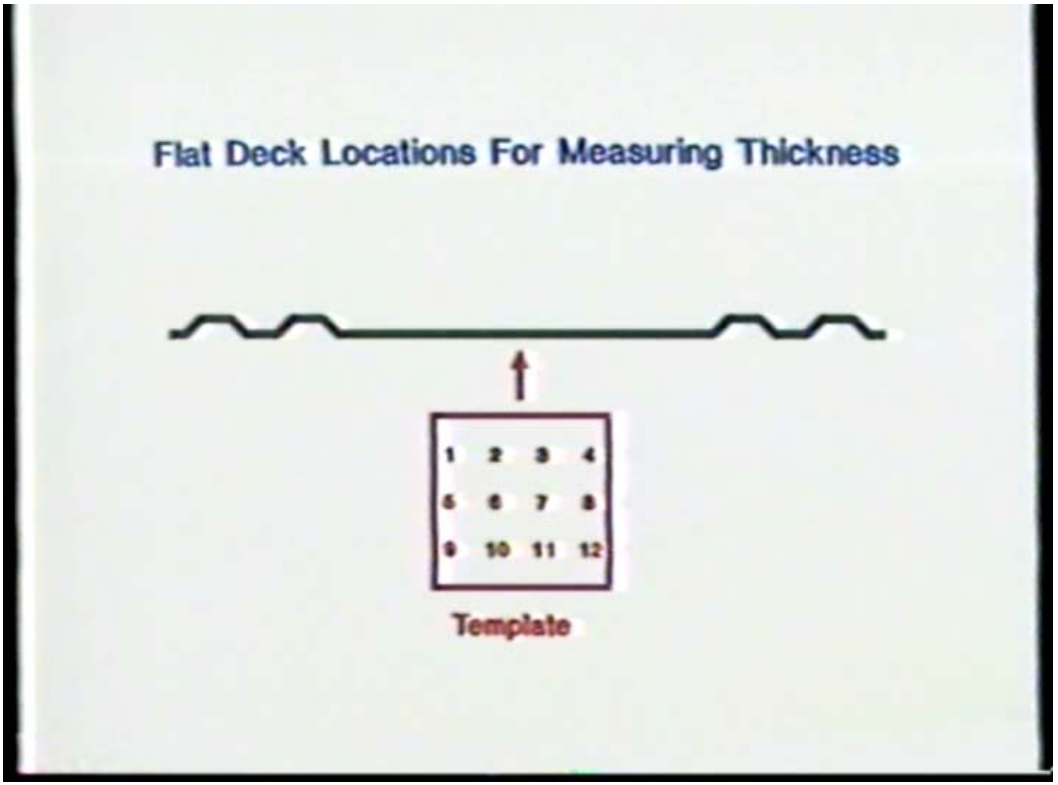
Inserting Measuring Probe into Drilled Hole

Repair Immediately

Deck Thickness Measurement Locations and Procedure

National Fireproofing Contractors Association

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

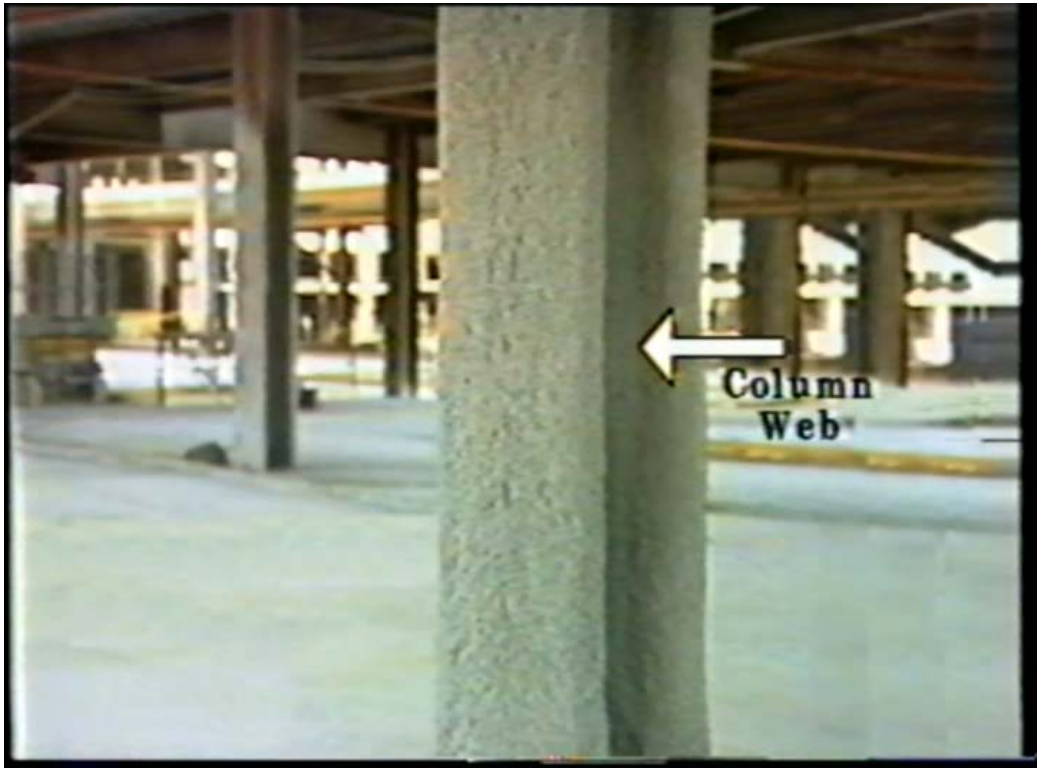
Thickness Measurement on Flat of Deck

Thickness Measurement on Side of Deck Flute

Density Selection and Testing

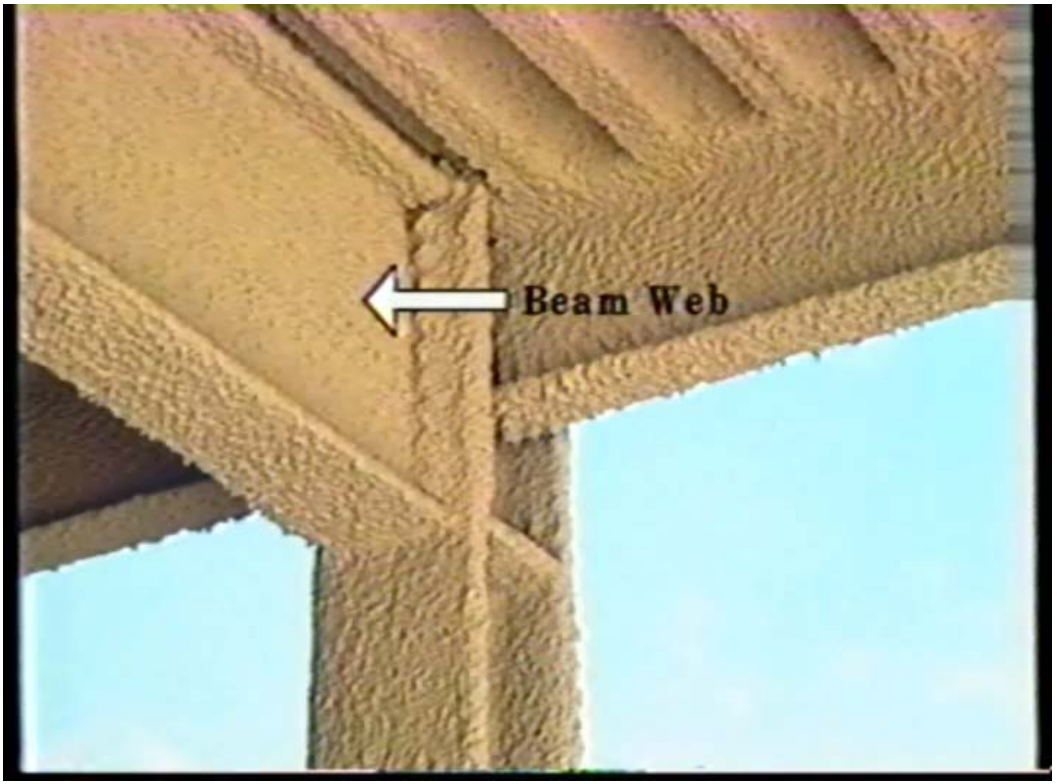
National Fireproofing Contractors Association

Secure Density Sample from Column Web

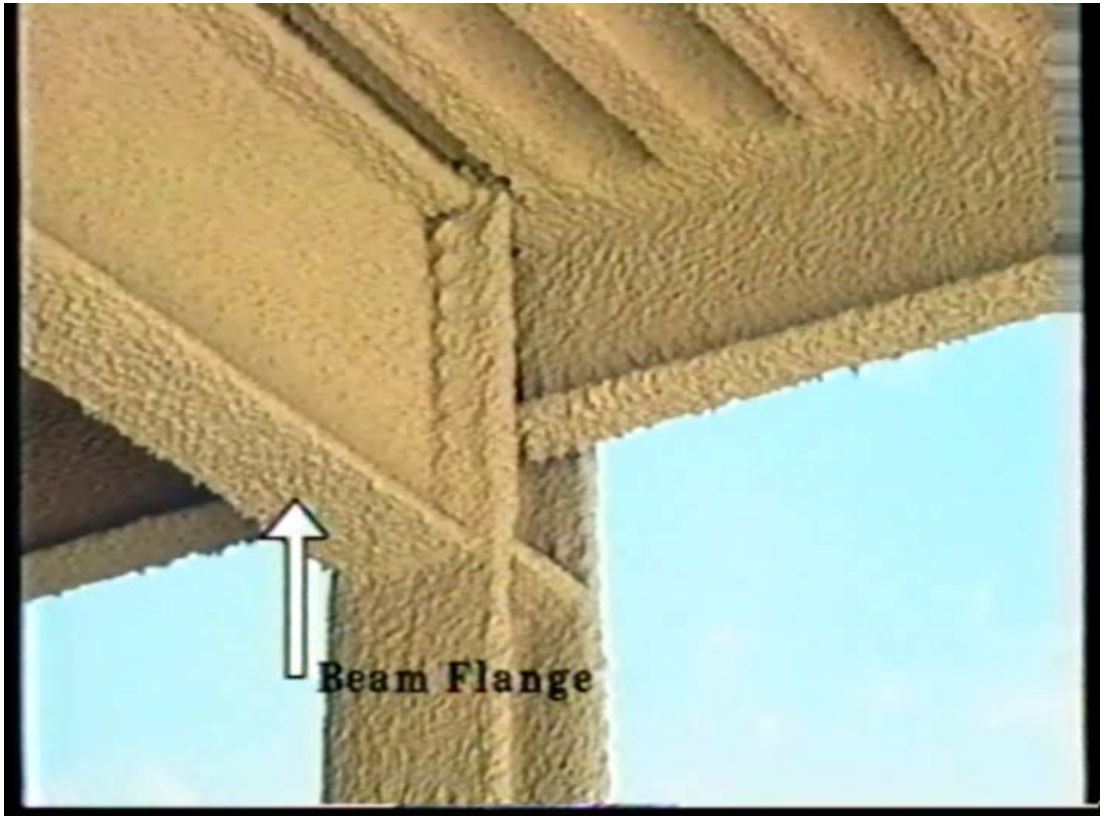


Secure Density Sample from Column Flange

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 Density Sample

Volume Displacement Method

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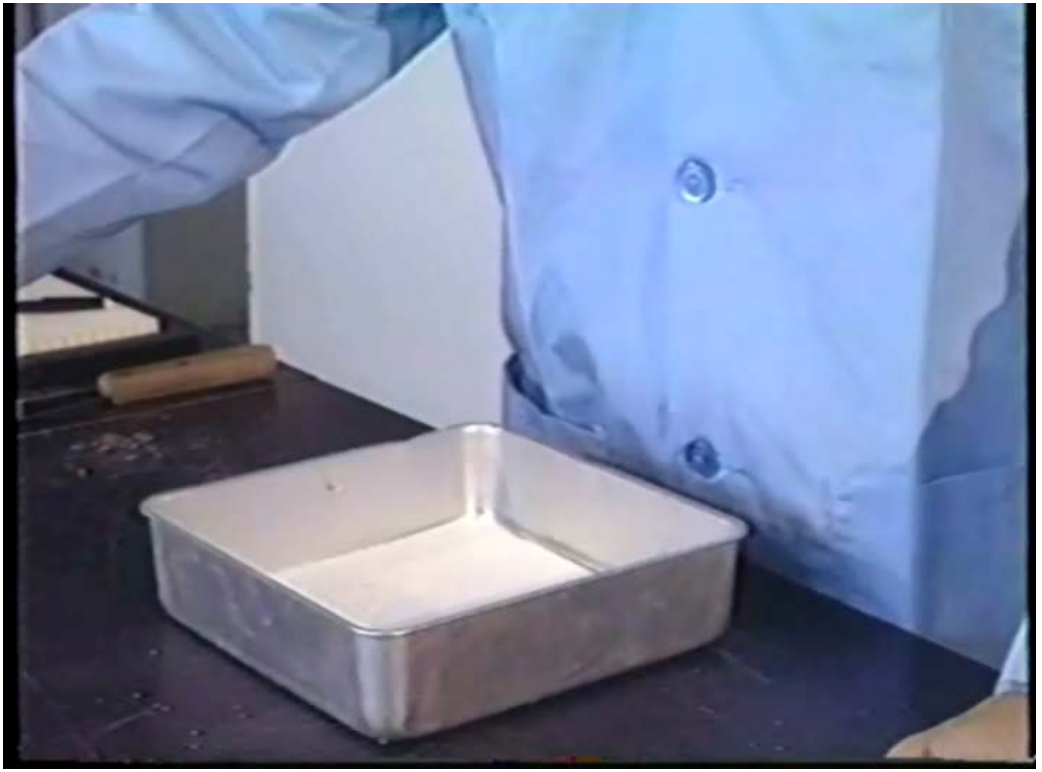
Pour Small Amount of Beads from Container #2 into Container #1

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



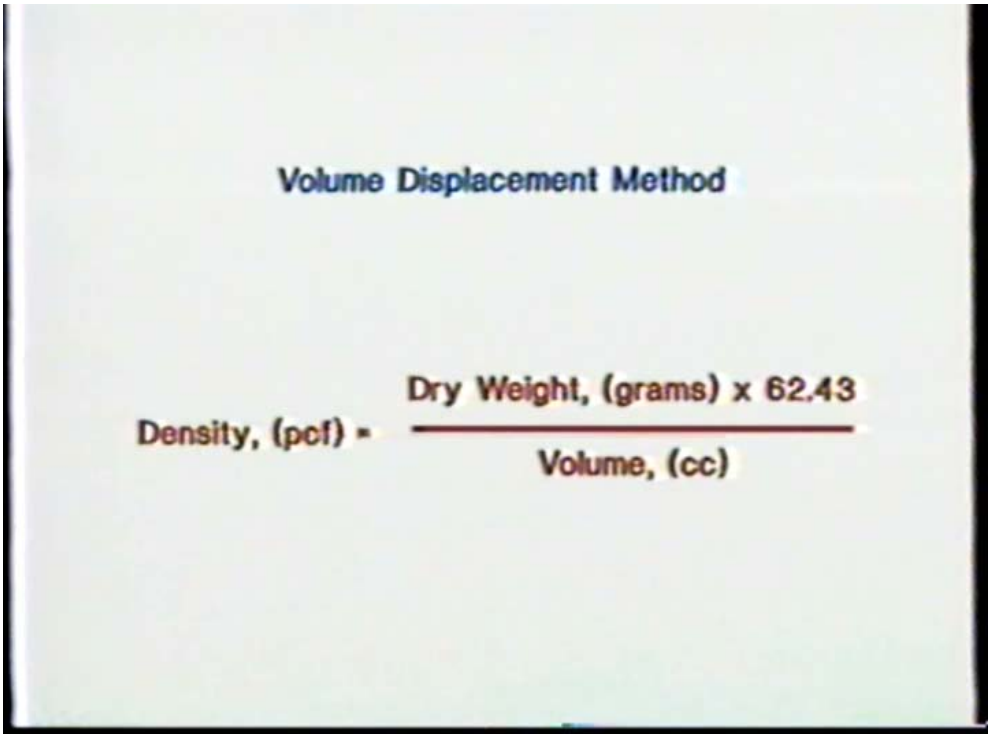
Pour Beads in Tray Back into Volume Container #2

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



Determining Bond Strength on Medium Density SFRM

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Bond Strength Testing May Occur 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.)

100 Pound Capacity Spring Scale

Awl to Start Hole in Center of Cap Lid for Screw Eye

Creating Load Cap & Conducting Bond Strength Test

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Drive Awl into Center of Cap to Create 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.

Carefully Cut Urethane Adhesive from Edge of Cap

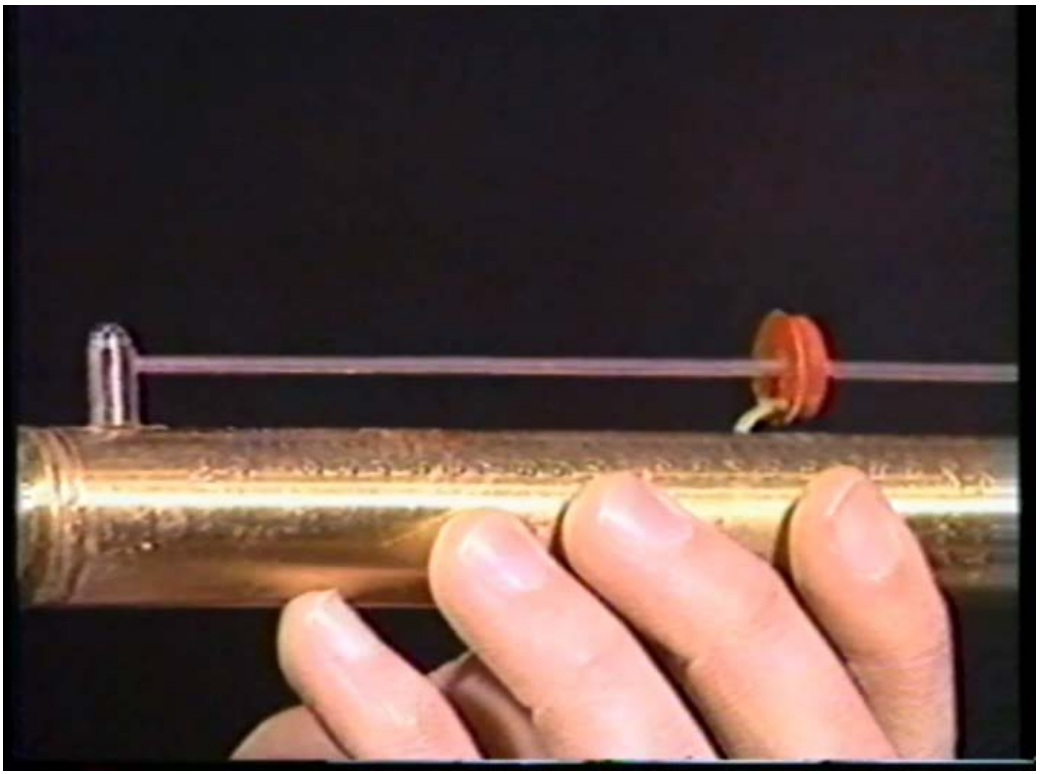
Attach Spring Scale to Eye Screw

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

Pull Spring Scale at a Consistent Slow Speed

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

Record Maximum Load from the Spring Scale in lbs.



Calculate and Record Bond Strength Using the Formula Below

Determining Bond Strength on High Bond Strength SFRM

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Materials Required to Conduct Test

- Wooden disk that measures 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 a “S” hook to attach to the wooden disk eyebolt.

Materials Required to Conduct Test

- Drill
- 1-3/8 inch diameter Fostner bit that 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 Fostner 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 a coating inside the hole bottom and sides. Press the wooden disk inside the hole and allow the epoxy to set and sure.
- Attach the “S” hook to the eyebolt in the wooden disk and the load cell apparatus. Position the load cell so the load is applied parallel to the wooden disk. (If the load is not parallel to the test sample, a shear failure may occur which is not a true test of the bond strength).
- Apply load at a rate of 50 lbs/min.
- Record the peak low from the load cell in lbs.

Test Procedure

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

Intumescent Inspection Procedures

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National Fireproofing Contractors Association

Intumescent Special Inspection

- IBC 2009 Code Section 1704.13
- IBC 2015 Code Section 1705.14
- Testing and inspection in accordance with AWCI Technical Manual 12-B.

1705.14 Mastic and intumescent fire-resistant coatings. *Special inspections* for mastic and intumescent fire-resistant coatings applied to structural elements and decks shall be in accordance with AWCI 12-B. ***Special inspections* shall be based on the fire-resistance design as designated in the *approved construction documents*.**

Intumescent Special Inspection
AWCI 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….

[AWCI 12-B, Third Edition]

Prepared Surface Conditions

- All steel must be primed with a compatible primer in accordance with manufacturer's recommendations or fire test information.
- All substrates must be free of any dust, grease, mill scale, surface contaminants (including water) release agents, paint, primer or other foreign matter prior to application of compatible primer and intumescent coating, as recommended by manufacturer.

NFCA Adds….

- Minor surface irregularities are inherent with intumescent coatings and shall be deemed acceptable.
- Surface finish must be agreed upon by all parties involved before application begins and be in compliance with the project specifications.

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
  - Solvent Based Materials 40°F
  - Epoxy Based Materials 50°F
- NFCA NOTEs:
  - Ambient temperature 5°F above dew point & rising.
  - Relative humidity not to exceed 75%.
  - Verify with Manufacturers Installation Instructions

IFRM Intumescent Inspection Procedures

- Coating 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 a 12 inch length.

Frequency of Measurements

- Thickness measurements made on random basis of structural elements
- Measurements made in at least one bay per floor, or for each 10,000sf of floor area, whichever provides the greatest number of tests
- Number of test not to exceed one per 10,000sf
- One test each on a column, primary beam, secondary beam, and truss

Intumescent Inspection Procedures

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

Intumescent Inspection Procedures

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

Calibration of Device

- Use manufacturer's calibration shim for the thickness range expected to be measured.
- Measure coating thickness on calibration shim.
- Adjust thickness meter to thickness on calibration shim.

Calibration Shim

Measuring Calibration Shim

Adjust Meter to Calibration Reading and Re-measure

Measure Thickness Coating and Record

Thickness Measurements

- Thickness determination shall be the mean of three separate thickness readings within the area of ½ inch diameter circle.
- Small surface irregularities may cause readings to differ even in small areas.
- When moving the probe within the ½ inch diameter, discard any unusually high or low readings that cannot be repeated consistently.

Thickness Measurements (con't.)

- Make readings at least 1 inch away from any edge or corner of the substrate.

Thickness Measurement Averaging

- A single average thickness shall be calculated from each series of individual thickness determinations on the member tested.
- The calculated average thickness shall be equal to or greater than the thickness specified for the member.
- Reduced thickness on flanges specified in the design shall be averaged separately and not be included in the average thickness for the member.

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.

Visual Inspection

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

Summary of Inspection Program

- Reviewed IBC 2009 – 2015 Code requirements
  - Spray Fire Resistive Materials (SFRM) Special Inspection
- Reviewed SFRM thickness measurement requirements for structural members.
- Reviewed SFRM volume displacement and calculated density procedure.
- Reviewed SFRM bond strength procedure.
- Reviewed Intumescent Fire Resistive Materials (IFRM) thickness measuring procedures.

Fire Resistance Maintenance

- **Maintenance**
  - **Code Required**
  - **How??**

- **How to keep Track – Barrier Management Initiatives**

  Paper

  Software

  Labeling

  Apps

National Fire Protection Association - NFPA 101-2012

- **SECTION 4.5.8 Maintenance, Inspection, and Testing.**
- **4.5.8.1** **Whenever or wherever any device**, equipment, system, condition, arrangement, level of protection, fire-resistive construction, or any other feature **is required for compliance** with the provisions of this Code, **such device**, equipment, system, condition, arrangement, level of protection, fire-resistive construction, or other feature ***shall thereafter be continuously maintained*** in accordance with applicable NFPA requirements or requirements developed as part of a performance-based design, or as directed by the AHJ. [101:4.6.12.1]

National Fire Protection Association - NFPA 101-2012

- **4.5.8.2 No existing life safety feature *shall be removed or reduced*** where such feature is a requirement for new construction. [101:4.6.12.2]
- **4.5.8.3*** **Existing life safety features obvious to the public, if not required by the Code, *shall be either maintained or removed*.** [101:4.6.12.3]
- **4.5.8.4 Any device**, equipment, system, condition, arrangement, level of protection, fire-resistive construction, or any other feature **requiring periodic testing, inspection, or operation** to ensure its maintenance ***shall be tested, inspected, or operated*** as specified elsewhere in this Code or as directed by the AHJ. [101:4.6.12.4]
- **4.5.8.5 Maintenance, inspection, and testing *shall be performed under the supervision of a responsible person who shall ensure*** that testing, inspection, and maintenance ***are made at specified intervals*** in accordance with applicable NFPA standards or as directed by the AHJ. [101:4.6.12.5]

International Fire Code

SECTION 703
FIRE-RESISTANCE-RATED CONSTRUCTION

703.1 Maintenance. The required fire resistance rating of fire-resistance rated construction (including walls, fire stops, shaft enclosures, partitions, smoke barriers, floors, fire resistive coatings and sprayed fire resistant materials applied to structural members and fire resistive joint systems) *shall be maintained*. Such elements shall be *visually inspected by the owner annually and* properly repaired, restored or replaced when damaged, altered, breached or penetrated.

Openings made therein for the passage of pipes, electrical conduit, wires, ducts, air transfer openings, and holes made for any reason *shall be protected with approved methods* capable of resisting the passage of smoke and fire.

"TOTAL FIRE PROTECTION"

- Effective Compartmentation
  - Fire Barriers, Fire Walls/Floors, Smoke Barriers
  - Firestopping, Fire Dampers, Swinging and Rolling Fire Doors, Fire Rated Glazing
- Detection & Alarm Systems
- Sprinkler Suppression Systems
- Education & Egress–
  - Building Owners & Managers, Building Occupants and Firefighters

Next Steps

- Contact the NFCA at the following e-mail address with any questions you may have on this course or to take further Education Classes
  - info@nfca-online.org
- Become a ICC certified inspector by going to this web site and sign up for the certification test.
  - http://www.iccsafe.org/certification

Contact

- Bill McHugh, NFCA Executive Director
  - info@NFCA-online.org
- Join NFCA…..
  - Sandy@NFCA-Online.org