

Structural Fire -Resistance

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INFO@NFCA-online.org –

Thanks Rich Walke for many slides...

NFCA FREE Webinar Series

Learn – Network – Grow

FCIA Webinar Series 2024

Compartmentation & Fire-Resistance

*Thanks Rich Walke for
many slides...*

Presented by:

Bill McHugh, FCIA

FREE STUFF - INFO@FCIA.org

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Firestop Contractors International Association

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FCIA – Firestop Contractors International Association

- UL/ULC, FM 4991 Contractor Programs
- IAS AC 291 Inspection Agency Accreditation Program
- ASTM Firestop Inspection Standards
- Firestop Education Program
 - Contractor, Inspection Agency, AHJ, Others
- **Tools @ FCIA.org** for Specifiers, AHJ's, Building Owners, Facility Directors, Firestop Contractors & Inspection Agencies



FREE RESOURCES

- **Info@FCIA.org** for **FREE** Webinars
- **Info@FCIA.org** **FREE** Life Safety Digest
- **INFO@FCIA.org** **FREE** MOP



FCIA – Firestop Contractors International Association

- Canada – Symposiums, National Presence, NBCC, NFC
- Qatar - Doha FCIA Symposium; Members
- India - Mumbai/Ahmadabad – Fire Safe Build India – IIT-G
- UAE - Dubai – FCIA Symposium; Civil Defence
- Saudi Arabia - Riyadh – BIG5 Show; UL, ICC, T
- Mexico/LATAM - CONAPCI/AMRACI
- Australia/New Zealand – FPA, Etc.



D-DESIGN

Specs, Code, Standards
First....Divisions, plus 1

**M – Maintain Protection
BARRIER MANAGEMENT**

Fire Codes
NFPA 101, 1, IFC, NFCC, Etc

**QUALITY
PROCESS**

I-INSTALLATION

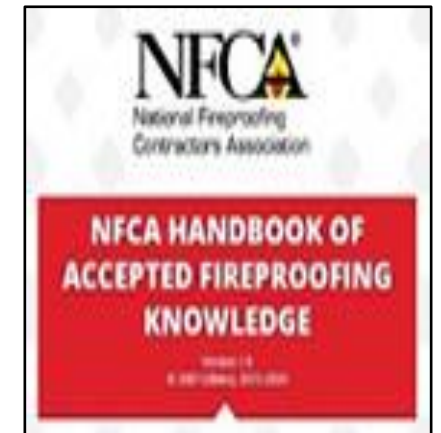
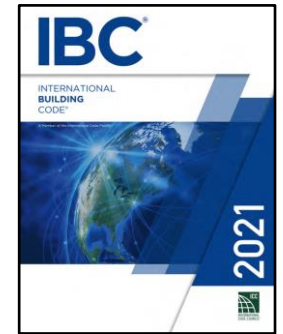
FM4991 /ULQFCP
UL QFPP
MS Programs *AND*
Mfr. Education

I – INSPECTION

IBC Ch. 17 - ASTM
NFPA 80
NFPA 1

What does NFCA Do?

- NFCA Member Conferences, Support
- NFCA Standard Practices
- NFCA Committee ACTIONS
- NFCA @ ICC Codes...
- NFCA @ National Building Code of India ...
- NFCA @ National Codes, Canada
- NFCA @ UL/ULC/ASTM Task Groups - Fireproofing
- NFCA @ NFPA Fire Protection Features
- NFCA @ American Institute of Steel Construction (AISC)
American Iron and Steel Institute (AISI)
- HAFK Fireproofing & Safety Book
- **FREE RESOURCES – INFO@NFCA-online.org**



NFCA & UL Contractor Accreditation Program

- **NFCA LIVE & VIRTUAL EDUCATION/EXAMS**

- **Focus on Fire-Resistance & Fireproofing**

- Contractor Designated Responsible Individual

- Fireproofing Inspectors

- **2024 Spring & 2024 NFCA Week of Learning**

- **VIRTUAL Education & Exams –**

- January 2024...happened!

- Again in '24..

- **LIVE Education & Exams March 11-13**

- **LIVE Conference, Exhibits March 13-15**



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

Mark Integrity Program

Introduction:
This document outlines the contractor company requirements for participation in the UL Qualified Spray-Applied Fire Resistive Material (SFRM) Contractor Program.

The SFRM installation industry serves residential, institutional, commercial and industrial structures. The industry addresses the need to limit the damaging effects of fire by insulating structural building elements from fire. SFRM helps horizontal assemblies including floor/ceiling, roof/ceiling and building elements such as beams and columns obtain fire endurance ratings. SFRM contractors install certified SFRM to establish a protective system for a structure to protect fire and life safety and comply with specification and customer requirements.

In order for a SFRM installation contractor organization to qualify for UL's SFRM Contractor Program, the contractor organization shall employ a knowledgeable individual who successfully demonstrates their competency to UL through successful completion of the Designated Responsible Individual (DRI) program at a contractor company that has been recognized in the NFCA Contractor Accreditation Program (CAP).

The company that enrolls in the UL Qualified SFRM Contractor program also has to establish, implement and maintain a management system focused on the application of SFRM. A management system is used to describe the contractor's SFRM operations.

The Management System approach ensures 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.

Because the SFRM contractor firm's selection and installation of SFRM to requirements relies on staff knowledge, the UL Qualified SFRM Contractor Program requires at least one individual employed by the Contractor organization to be designated as a Designated Responsible Individual (DRI) who has demonstrated his/her knowledge via examination and meets other related requirements defined in this document.

Definitions

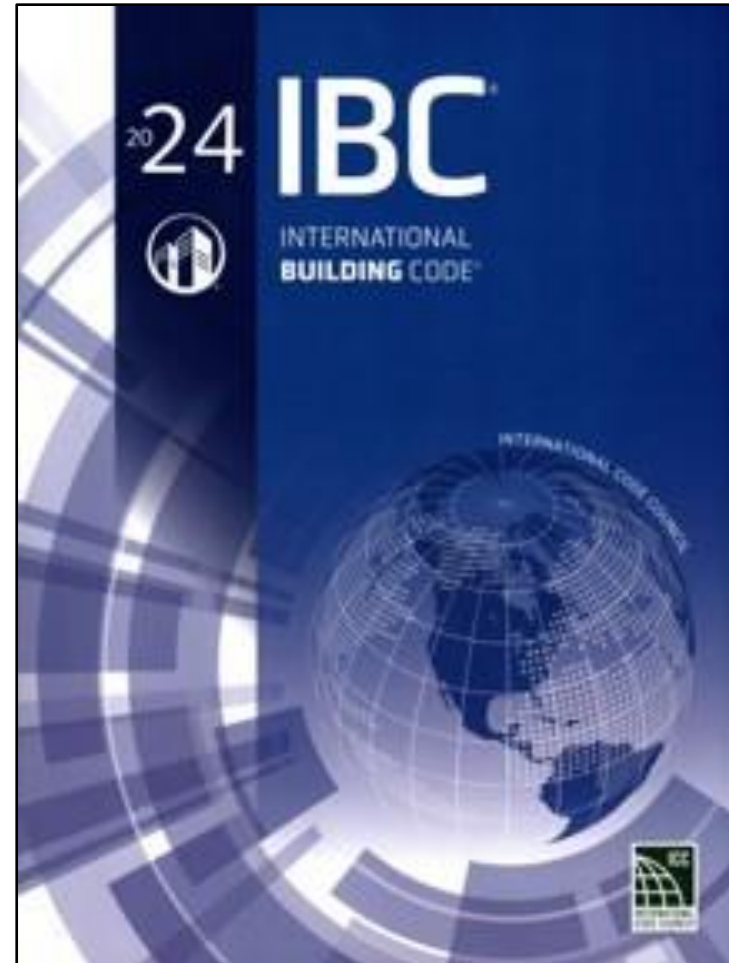
Authority Having Jurisdiction (AHJ) – The organization, office or individual responsible for implementing the adopted code. This is typically the building official or fire marshal, or another governmental agency who may also be the final authority signing the "Certificate of Occupancy Permit".

Certificate – The SFRM Contractor Certificate. This is a document issued after an audit has been completed, and conformance to all UL Qualified SFRM Contractor Program Requirements has been determined. The Certificate is valid until Dec. 31 of the following year from which the certificate was issued.

Continuing Education Unit (CEU) – For purposes of awarding CEU credit, the International Association of Continuing Education and Training (IACET) definition will be used for those individuals involved in the UL Qualified SFRM Contractor Program as follows. One (1) CEU is equal to 10 credit hours of instruction in an approved condition.

Fire-Resistance-Rated Construction

Code Requirements for
Fire-Resistance-Rated
Construction



Fire Resistance – Terms

- **FIRE RESISTANCE.** That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.
 - ***ASTM E119, UL 263, CAN/ULC-S-101, etc.***



Fire Resistance – Code Requirements

- **FIRE RESISTANCE.** That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.
 - ASTM E119, UL 263, CAN/ULC-S101, etc.



Code Requirements Cont.

- 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.

- 703.2.1.3 – Assemblies considered unrestrained unless registered design professional provides evidence satisfactory to AHJ that construction qualifies for restrained classification per ASTM E119 or UL 263.

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.

- **703.2.3 Approved alternate methods** – Required fire resistance permitted to be established by alternate protection methods in accordance with Section 104.11 ('21IBC)... **104.2.3 ('24IBC)**

2024 IBC 104.2.3 Code Requirements Cont.

[A] 104.2.3.3 Compliance with code intent. An alternative material, design or method of construction shall comply with the intent of the provisions of this code.

[A] 104.2.3.4 Equivalency criteria. An alternative material, design or method of construction shall, for the purpose intended, be not less than the equivalent of that prescribed in this code with respect to all of the following, as applicable:

1. Quality.
2. Strength.
3. Effectiveness.
4. Durability.
5. Safety, other than fire safety.
6. *Fire safety. ~~Fire Resistance (from '21)~~*

NOTE: Fire Safety includes Reaction to Fire, Fire-Resistance, Compare to language in Ch. 7 for EACH.

2024 IBC 104.2.3 Code Requirements Cont.

[A] 104.2.3.5 Tests. Tests conducted to demonstrate equivalency in support of an alternative material, design or method of construction application **shall be of a scale that is sufficient to predict performance** of the end use configuration. Tests shall be performed by a party acceptable to the *building official*.

[A] 104.2.3.5.1 Fire Tests. Tests conducted to demonstrate equivalent fire safety in support of an alternative material, design or method of construction application **shall be of a scale that is sufficient to predict fire safety performance of the end use configuration.** Tests shall be performed by a party acceptable to the *building official*.

Fire Resistance – Summary

- Chapters 3, 4, 5, 6 and 10 establish the required ratings
- Chapter 7 establishes how rating is determined
- Rating expressed as an Hourly Time Period
- Ratings range from 1/2 to 4 hours
- **Contain** Fire to Room or Floor of Origin and Maintain **Structural Integrity**



REACTION TO FIRE vs. FIRE RESISTANCE

- **Reaction to Fire** - Surface burning characteristics of building materials.
 - **Spread, contribution to fire**
 - **ASTM E84, UL 723**, *Standard for Test for Surface Burning Characteristics of Building Materials*
- ***Fire Resistance....***



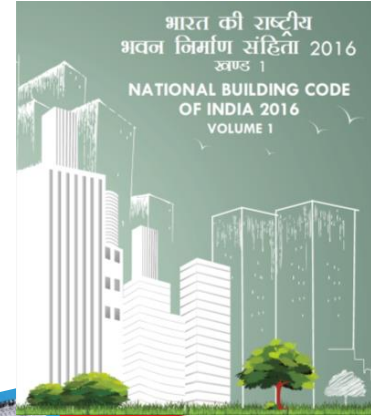
Fire Resistance – Terms & Summary

- Rating expressed as Minutes or Hours Time
- Ratings range from 1/2 to 4 hours
- *Maintain Structural Integrity*
- *Contain Fire to Room or Floor of Origin*



Standard Tests Establish Fire-Resistance

- US/UAE, Other areas
 - ASTM E119
 - NFPA 251 (Withdrawn)
 - UL 263
- Canada
 - ULC-S101
- Euro/India/UK
 - ISO 834
 - BS476/EN 1363



Building Components

- Columns
- Beams
- Floor/Ceilings or Roof/Ceilings
- Walls

Building Components

- **Columns** – *Supporting Construction*,
 - (X, Y, Z)
- **Beams** – *Supporting Construction*
 - (N, O)
- **Floor/Ceilings or Roof/Ceilings** – *Supporting Construction, Compartmentation*
 - (A-M, P, Q, R)
- **Walls** – *Compartmentation, Supporting Construction*
 - (U, V, W)

Time Temperature Curve

Structural, Compartmentation, Breach

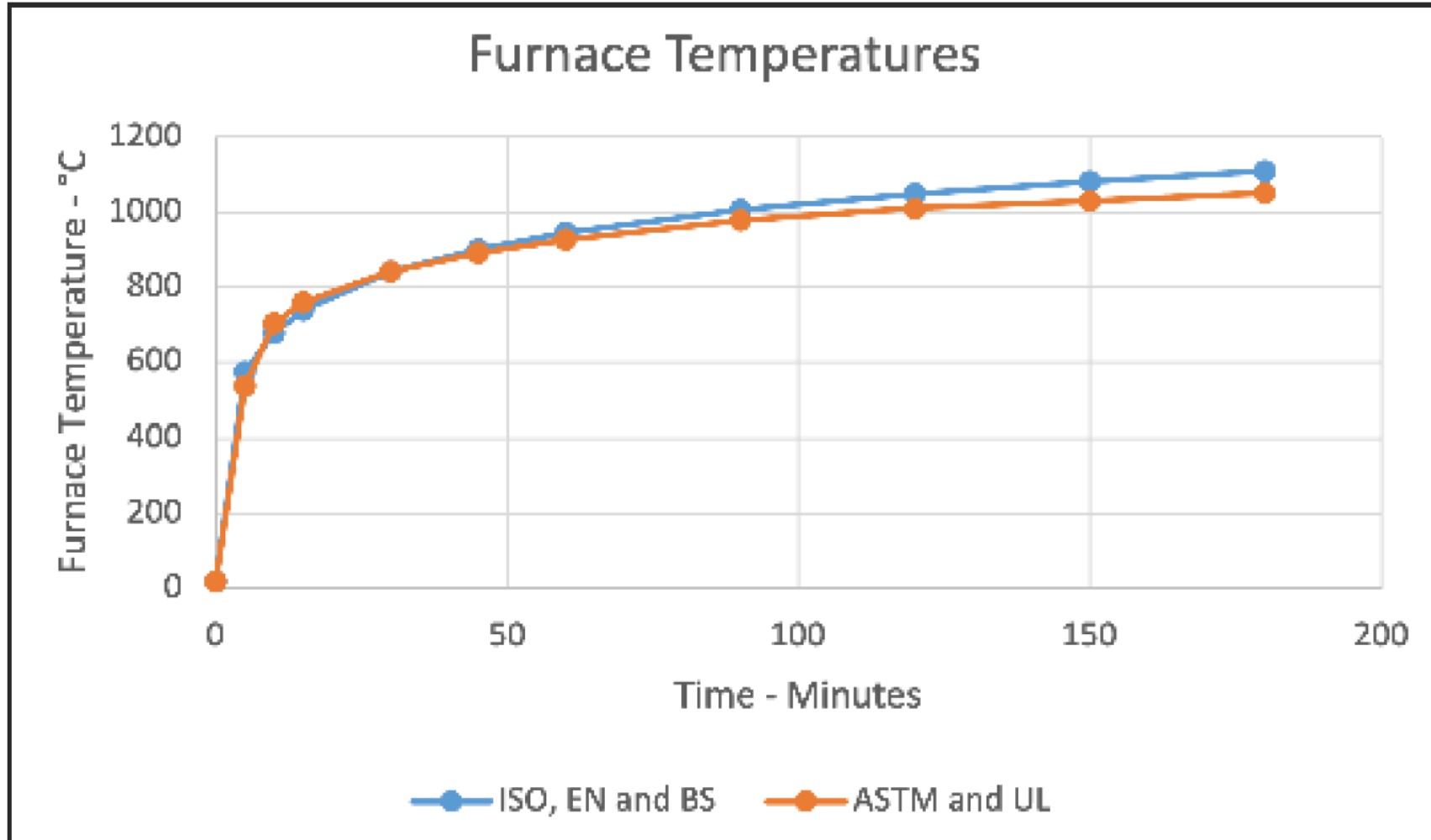
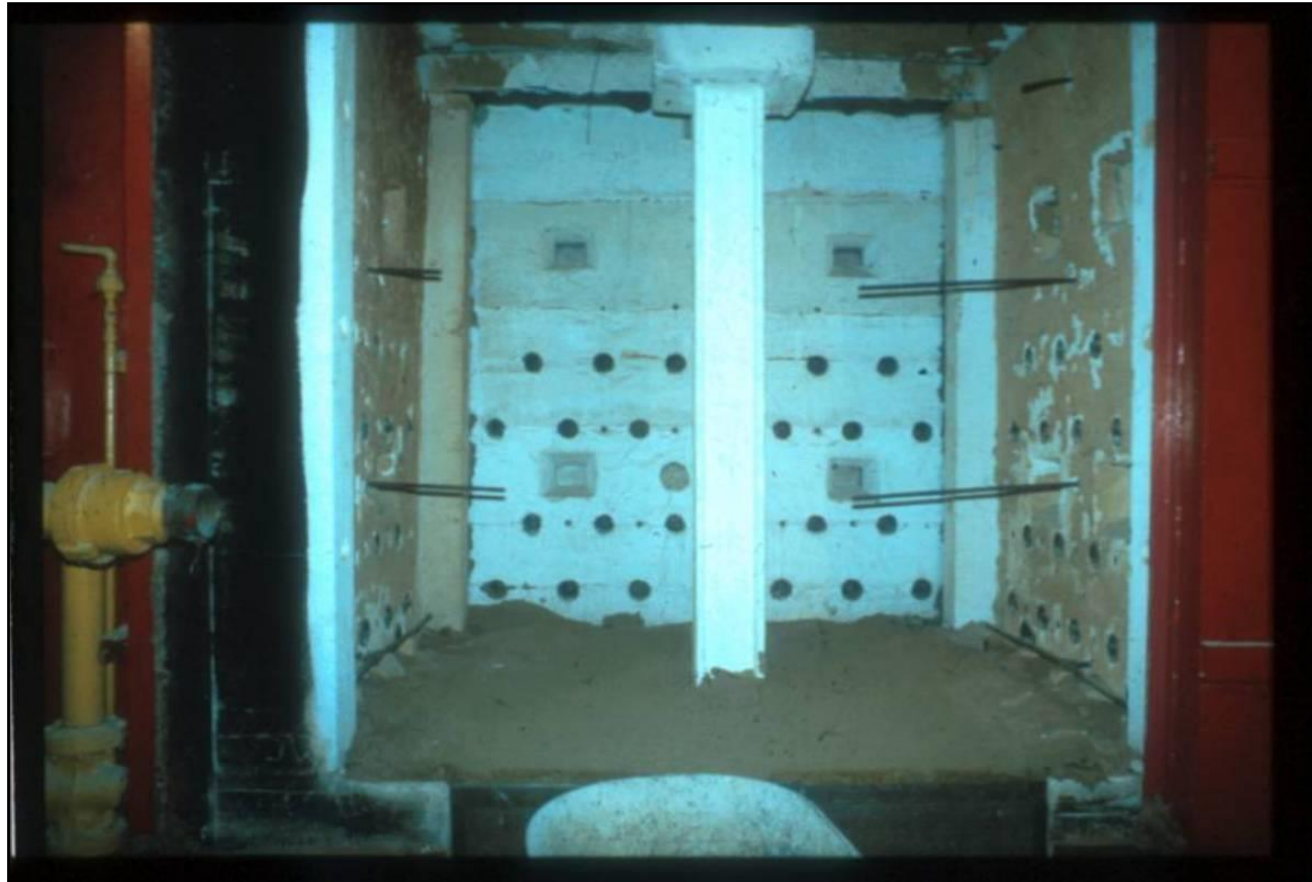


Figure 1 - Comparison of furnace temperatures, the time/temperature curve
Berhing Image

Columns

- **Sample size – Minimum approx. 3m, (9 ft)**
- Most often tested unloaded

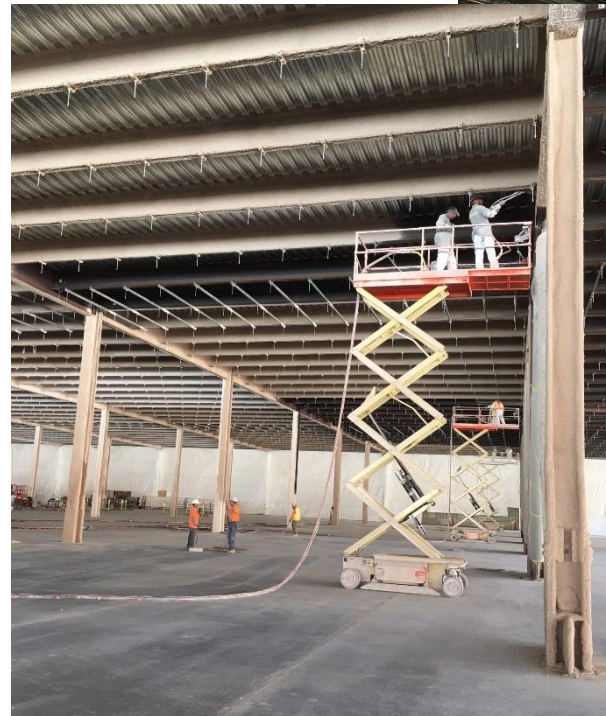


Columns

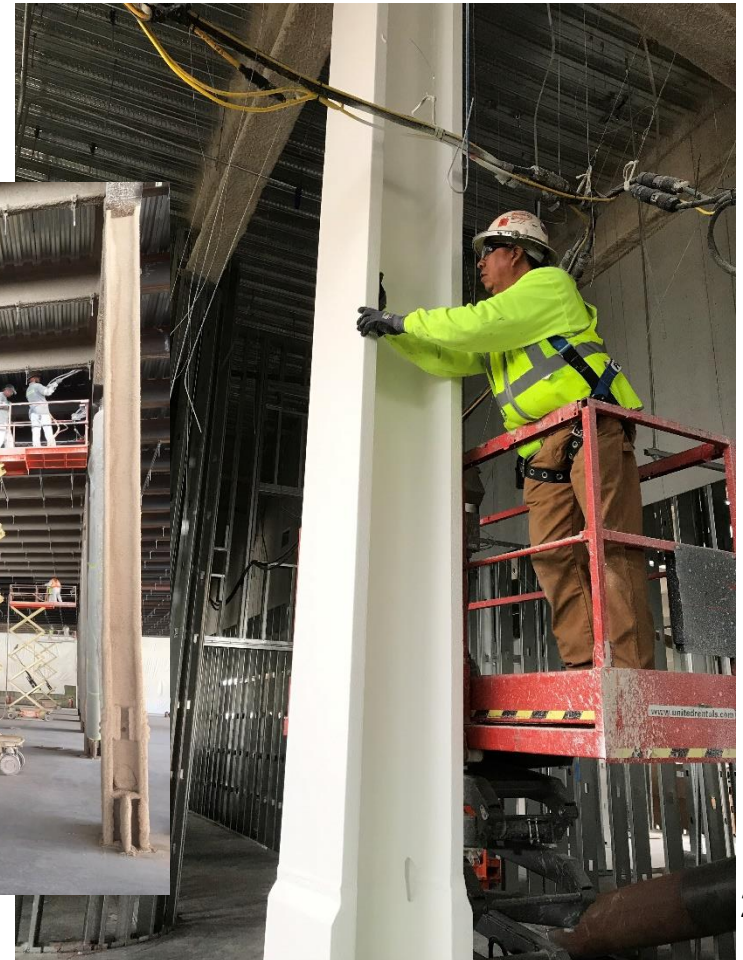
- **Sample size – Minimum approx. 3m, (9 ft)**
- Most often tested unloaded



UL Image



Rolling Plains Images



Conditions of Acceptance – Columns

- **537°C (1000°F)**
648°C (1200°F)

OR

Support load if
tested load bearing



Beams

- Sample size – Minimum approx. 4m (12 ft)
- Load applied – Per design



UL Image



UL Image



UL Image



UL Image



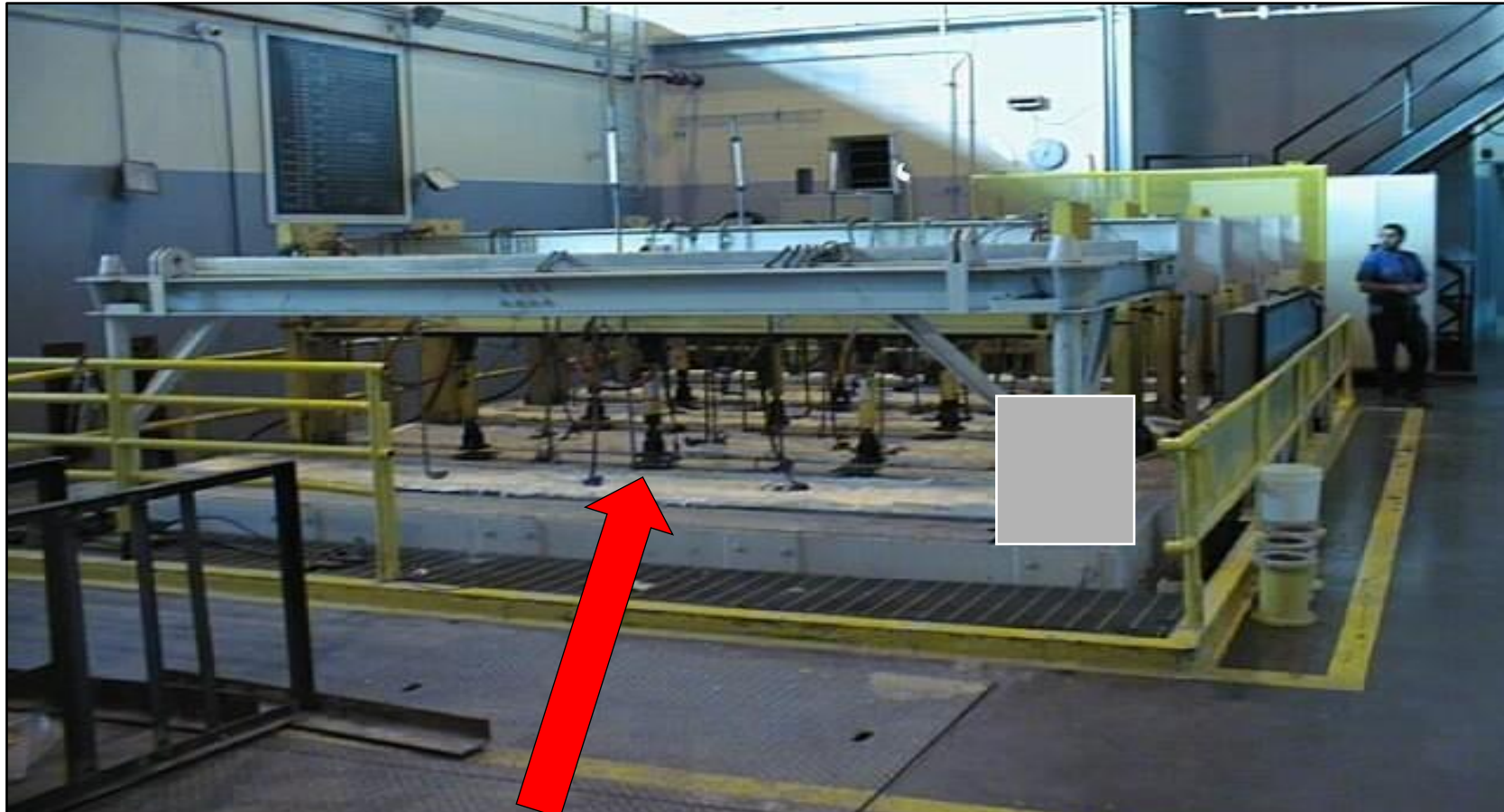
UL Image; Raymond Image



UL Image

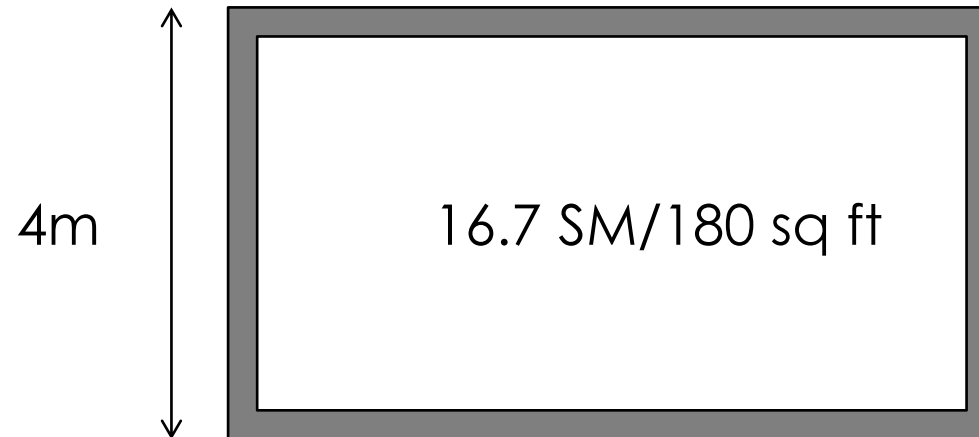
Conditions of Acceptance – Beams

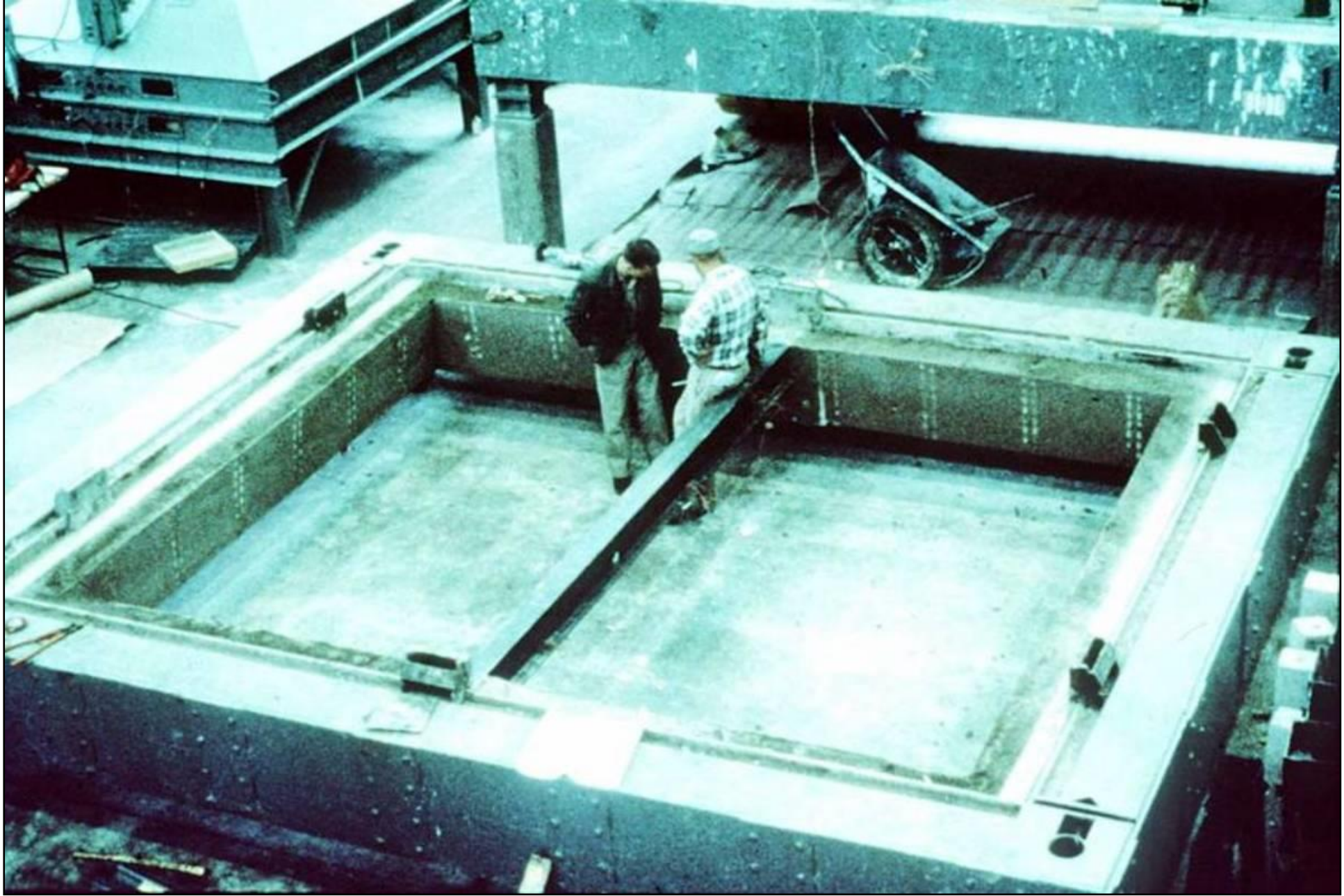
- Support load
- **593°C (1100°F) / 704°C (1300°F)**



Floor/Ceiling or Roof/Ceilings

- Sample size – 16.7sm (180 sq ft) / 4m (12 ft)
- ***Full Scale, Load applied*** – Per design





UL Image



UL Image



UL Image



UL Image



UL Image

Conditions of Acceptance Floor/Ceilings or Roof/Ceilings

- Support load
- Flame passage
- 250°F (121°C) / 325°F (162.7°C)
- Support temperatures



Building Components

- Columns
- Beams
- Floor/Ceilings or Roof/Ceilings
- **Walls**

Building & Fire Codes – Assemblies/Breaches

Similar Fire Test Time-Temperature Curves

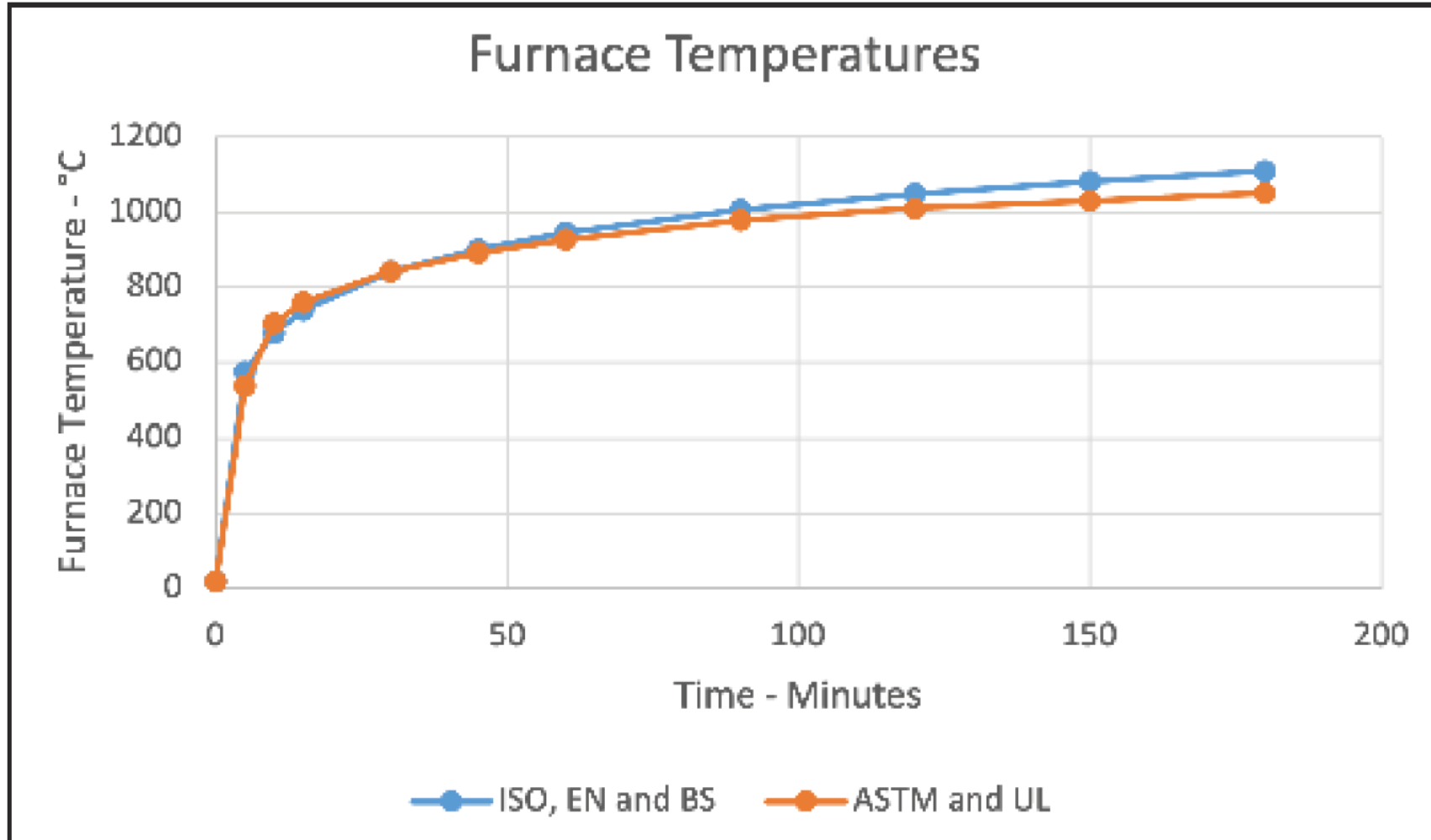


Figure 1 - Comparison of furnace temperatures, the time/temperature curve
Berhning Image

Terminology – Fire-Resistance - Walls

- Fire Smoke *Compartmentation* – **IBC/NFPA**
 - ***Fire Barrier – Fire-Rated, SYSTEMS Repairs***
 - ***Fire Walls – Fire-Rated & Structural, SYSTEMS Repairs***
 - ***Smoke Barriers – Fire-Rated, Smoke, SYSTEMS Repairs***
 - ***Smoke Partitions – NO Fire-Rating, MATERIALS***
 - *Fire Partitions (Not in NFPA)*
 - ***Archaic Assemblies – Ratings Found in Books...***
 - ***Exterior Walls***
 - *Fire Compartment (UK/IN)*
 - ***Fire Separations (CAN)***

Wall Testing Furnace



USG Photo

Walls – U, V, W

- **Tested in accordance with ...'**
 - Standards – ASTM E119, UL 263, CAN/ULC-S101,
 - F Rating – Flame
 - T Rating – Temperature
 - **H Hose Stream Test**
 - **ASTM E119, UL 263, CAN/ULC-S101**
 - BS476, EN 1363, IS 3809
 - **Insulation**
 - **Integrity**



Terminology – Fire-Resistance - Walls

- Fire Smoke *Compartmentation* – **IBC/NFPA**
 - ***Fire Barrier – Fire-Rated, SYSTEMS Repairs***
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 - ***Exterior Walls***
 - *Fire Compartment (UK/IN)*
 - ***Fire Separations (CAN)***

Fire-Resistance Rated Walls & Support....

- **Fire Barrier –**

707.5.1 Supporting construction. The supporting construction for a *fire barrier* shall be protected to afford the required *fire resistance rating* of the *fire barrier* supported....[& follow Table 509.1] [2024 IBC]

- **Smoke Barriers – Min. 1 hour ...**

The supporting construction shall be protected to afford the required *fire-resistance rating* of the wall or floor supported in *buildings* of other than Type IIB, IIIB or VB construction. *Smoke-barrier* walls used to separate *smoke compartments* shall comply with Section 709.4.1

Fire-Resistance Rated Walls & Support....

- ***Fire Partitions - Some Exceptions...***
- **708.4.2 Supporting construction.** The supporting construction for a *fire partition* shall have a *fire-resistance rating* that is equal to or greater than the required *fire-resistance rating* of the supported *fire partition*.
- ***Fire Separations (CAN) –***
 - *3.1.7.5 Rating of Supporting Construction. Loadbearing Wall FRR, Noncombustible Construction*
 - *3.1.8 Fire Separations & Closures*
 - *CA/ULC-S115*

Fire-Resistance Rated Walls & Support....

- ***Horizontal Assemblies*** –
- **704.1.1 Supporting construction.** The *fire-resistance ratings* of supporting structural members and assemblies shall be not less than the ratings required for the fire-resistance-rated assemblies supported by the structural members.
- *Some exceptions...not many.*

Mockup Review BEFORE Construction....



Heckler Photo



C.Zussman, Pepper Photo

C. Zussman Pepper Photo

Firestopping for Continuity

Products become **SYSTEMS** Based on Testing

- ‘Field Erected Construction...Tested to...’
 - Standards – UL 1479, ASTM E814, FM 4990, UL 2079, ASTM E1966, ASTM E2307, ASTM E2837, **CAN/ULC-S115**
 - F Rating – Flame
 - T Rating – Temperature
 - L Rating – Smoke
 - W Rating – Water
 - M Rating – Movement
 - H Hose Stream Test



3M Image

Hose Stream Test



UL Photo

Fire Dampers

“A device, installed in an air distribution system, designed to close automatically upon detection of heat, to interrupt migratory airflow, and to **restrict the passage of flame.**”
(NFPA 80)



Curtain Fire Damper



True Round Fire Damper



Multi-blade Fire Damper

Greenheck Image

Combination Fire/Smoke Dampers

“A device that meets **both the fire damper and smoke damper requirements.**” (NFPA80)



Greenheck Image

Purpose of Combination Fire/Smoke Damper

- Provide the same level of protection as individual fire and smoke dampers
- Fire rating – UL555 certified
- Leakage rating – UL555S certified
 - Always supplied with factory mounted actuator
- Always dynamically rated
- CAN/ULC-S112, 112.1 (Smoke Control)



Greenheck Image

Fire Dampers & Compartmentation



Fire Damper Annular Space?

FCIA Images



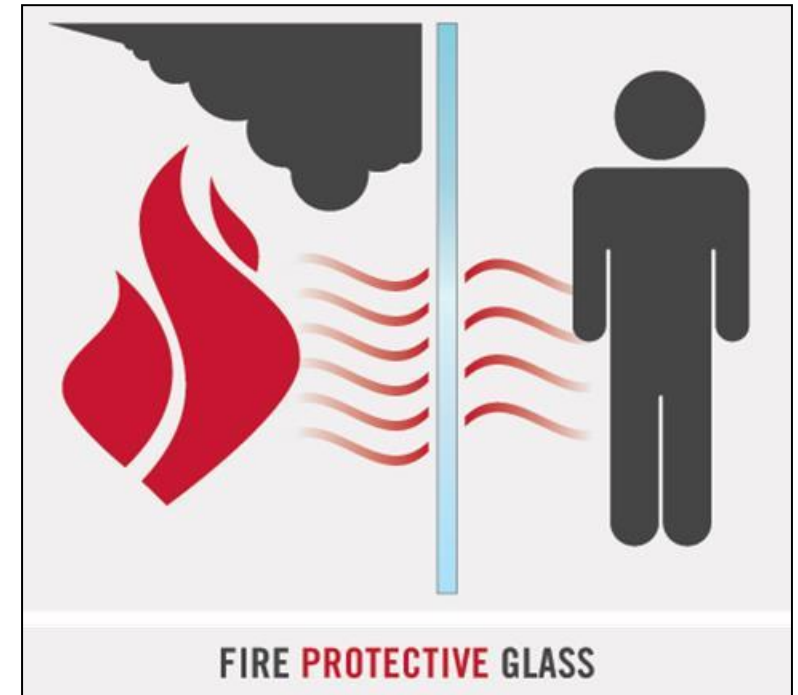
Fire Rated Glazing & Compartmentation



TGP Image

Fire-Protection-Rated Glazing

- Fire-rated, thin glazing
- Traditional fire-rated material (wired glass, proprietary glass, etc.)
 - Traditional wired glass does not meet safety glazing requirements
- Allows significant radiant heat from unexposed side
- May or may not meet hose stream and temperature requirement



TGP Image

Standards

Fire-Protection-Rated Glazing

- When Used in Fire Door Assemblies
 - UL 10B
 - UL 10C
 - NFPA 252
- Fire Window Assemblies
 - UL 9
 - NFPA 257
- ***NBC references NFPA 80, CAN/ULC-S106***

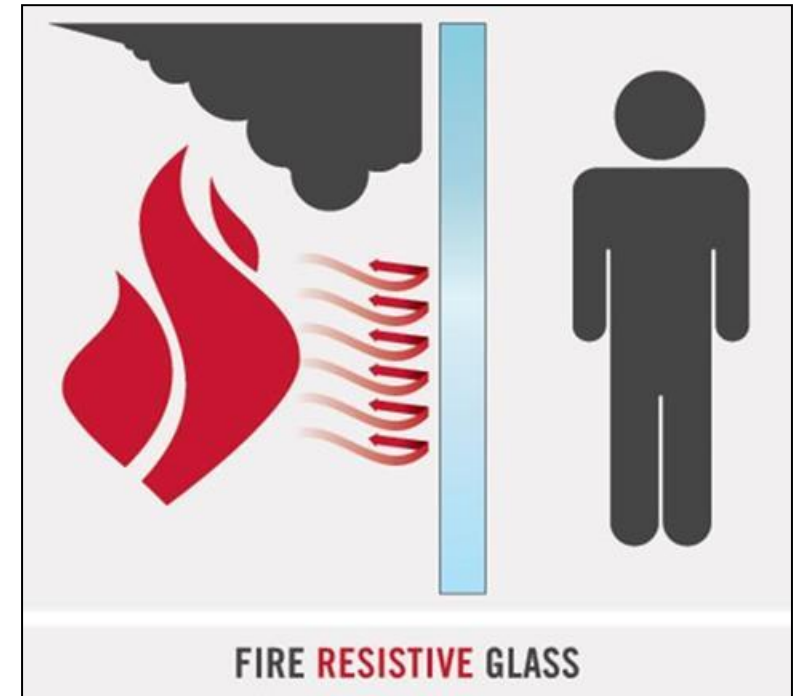
Conditions of Acceptance

Fire-Protection-Rated Glazing

- Flame Passage
- Hose Stream after Full Duration Fire Exposure
 - Limited Openings (Max 5% Fall-Out) Permitted

Fire-Resistance-Rated Glazing

- “Thick” glazing
- Stops fire **AND** radiant heat
- Classified as a “wall” vs. opening
- Meets same requirements as a gypsum or CMU wall
- When use in walls, both glass and frame must block passage of heat
- UL 263 & ASTM E119,
CAN/ULC-S101



TGP Image

Conditions of Acceptance Fire-Resistance-Rated Glazing

- Flame Passage
- 250°F / 325°F Temperature Rise
- Hose Stream on Duplicate Test Sample Exposed to Fire for Reduced Time Frame

Fire Door Assemblies Under Test



Opening Protectives

- Fire Door Assemblies
 - Fire Door Frames
 - Fire Doors
 - Hardware
 - Glazing within Fire Doors
- Fire Window Assemblies
 - Fire Window Frames
 - Glazing



Component Approach Used for Fire Door Assemblies

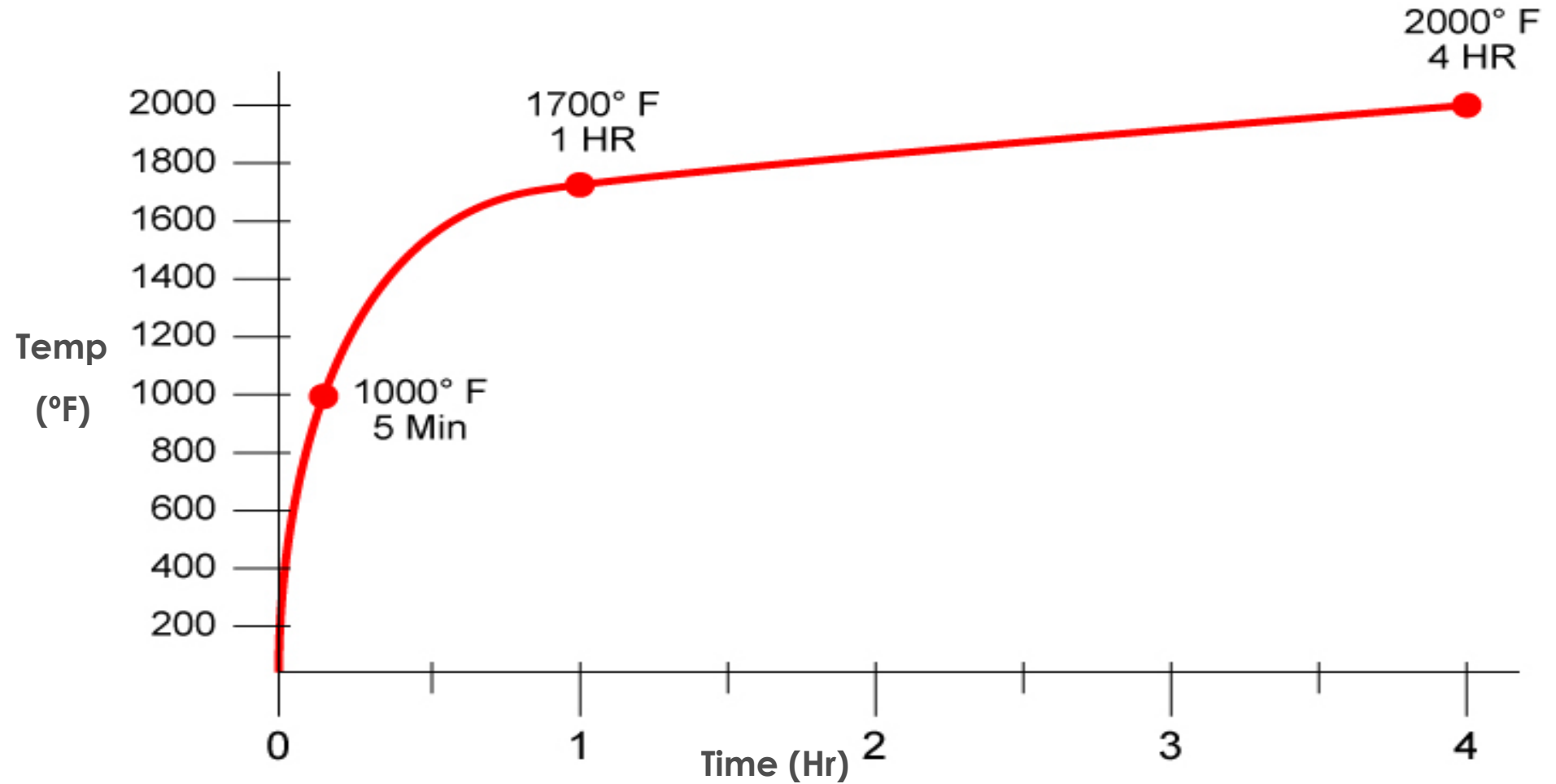
- Both documents prescribe a component approach for fire door and fire window openings
- IBC and NFPA 101 both reference NFPA 80 and 105 for details on the installation of fire and leakage rated door assemblies, respectively
- Approval of the finished opening protective relies on Listing and ratings of individual components with final approval up to the Code Official

Fire Door and Shutter Assemblies – IBC

Section 716

- IBC Referenced Standards
 - Side-hinged or pivoted swinging doors - UL 10C or NFPA 252 (positive pressure)
 - Tin-clad fire door assemblies - UL 10A, UL 14B, and UL 14C
 - Other types of doors - UL 10B or NFPA 252 (neutral pressure)

Time - Temperature Curve



Fire Door / Window Assembly Under Test



Fire Door Assemblies Under Test



Hose Stream Test



Conditions of Acceptance

Fire Door Assemblies

- Flame Passage
- Hose Stream After Full Duration Fire Exposure



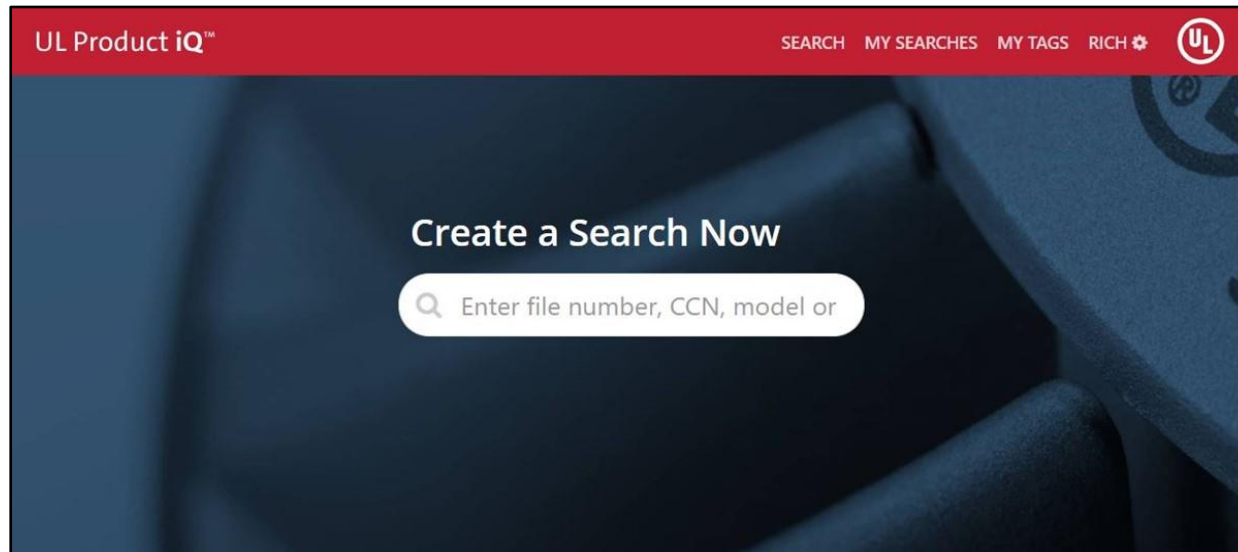
UL



Warrington

Finding Current Listings?....

UL Product iQ



INTERTEK DIRECTORY OF BUILDING PRODUCTS

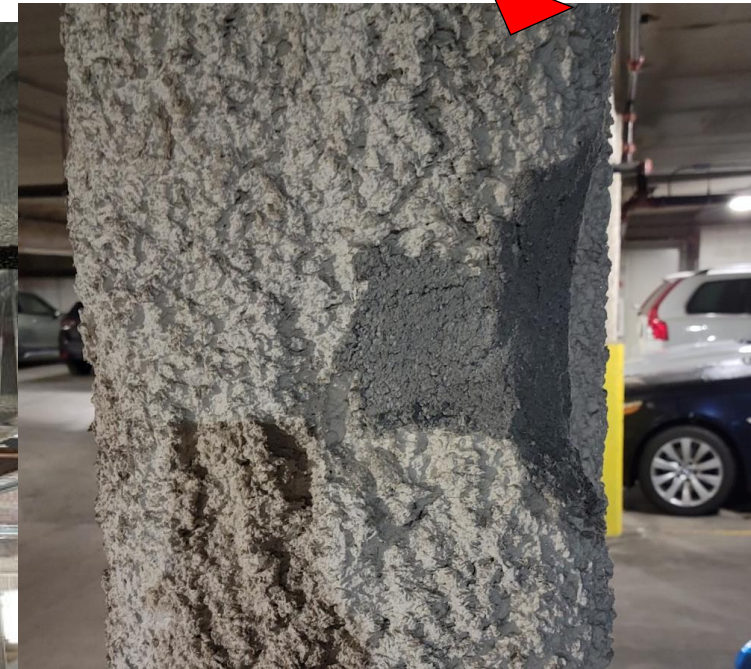
Listed Products, Code Compliance Research Reports (CCRRs), Certificates of Compliance (COCs), Quality Assurance, and Industry Programs

Company	Nothing selected	
Listing Category	Nothing selected	
CSI Code	Nothing selected	
Standard	Nothing selected	
Keywords	<input type="text"/>	Spec ID <input type="text"/>
CCRR #	<input type="text"/>	COC # <input type="text"/>
Trade/Brand Name	<input type="text"/>	Design Document <input type="text"/>

Limit results to listings with code compliance research reports (CCRRs)
 Limit results to listings with certificates of compliance (COCs)

Maintain Protection – Intl. Fire Code

- Structural Fire-Resistance –
 - Annual Accessible Visual Inspection
 - Fireproofing Voids
 - Attachment installation
 - Non Compliant Repairs
 - Adding combustibles



Installation, Inspection, Maintenance Standards

Both the IBC and the NFPA Life Safety Code (**AND NBCC**) reference NFPA 80, Standard for Fire Doors and other Opening Protectives, and NFPA 105, Standard for Smoke Door Assemblies and Other Opening Protectives



National Fire Protection Association

NFPA 1 – 2018

- **12.3.3* Maintenance of Fire-Resistive Construction, Draft-Stop Partitions, and Roof Coverings.**
 - **12.3.3.1 Required fire-resistive construction**, including fire barriers, fire walls, exterior walls due to location on property, fire-resistive requirements based on type of construction, draftstop partitions, and roof coverings, *shall be maintained and shall be properly repaired, restored, or replaced where damaged, altered, breached, penetrated, removed, or improperly installed.*

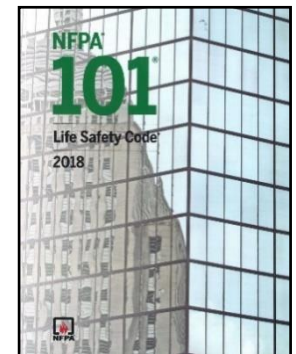


National Fire Protection Association

NFPA 101 – 2018

- **SECTION 4.6.12 Maintenance, Inspection, and Testing.**

- **4.6.12.1** **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.



2018 (& 2021, 2024...) International Fire Code Maintain Protection

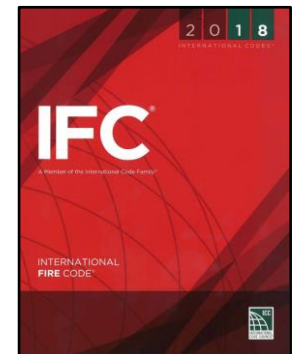
SECTION 701

GENERAL

- **701.6 Owner's responsibility.** The **owner shall maintain an inventory** of all required fire-resistance-rated construction, construction installed to resist the passage of smoke and the construction included in Sections 703 through 707. **Such construction shall be visually inspected by the owner annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated.**

FCIA Initiative – 'Inventory'...

[IFC 2018, 701.6]

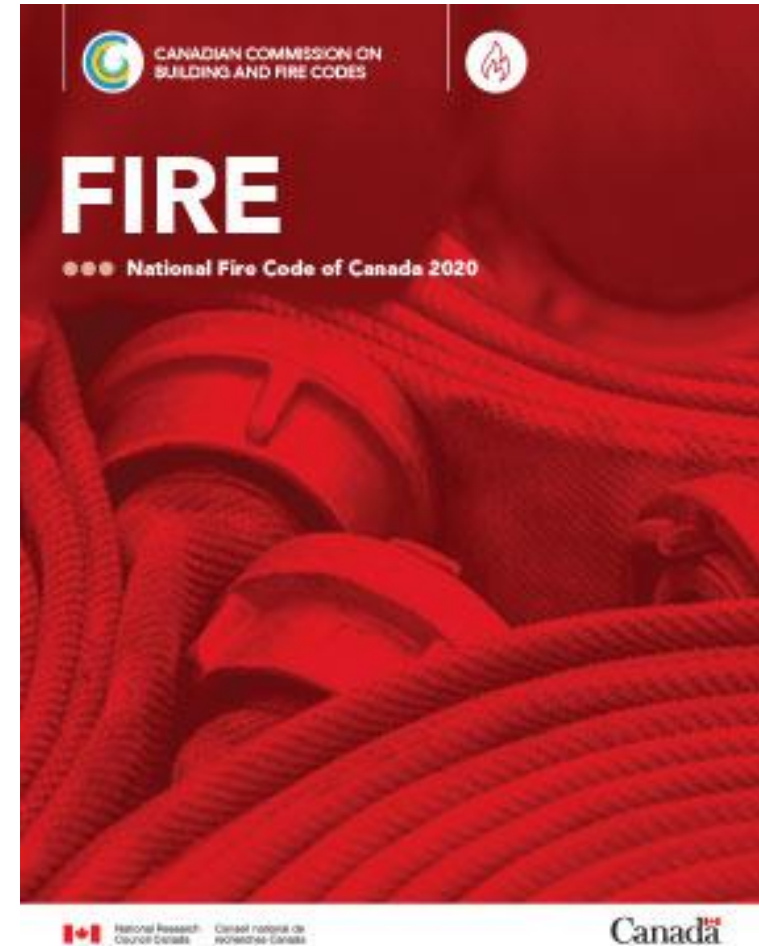


National Fire Code of Canada

National Fire Code of Canada

- ***Division B – Part 2, Building and Occupant Fire Safety***

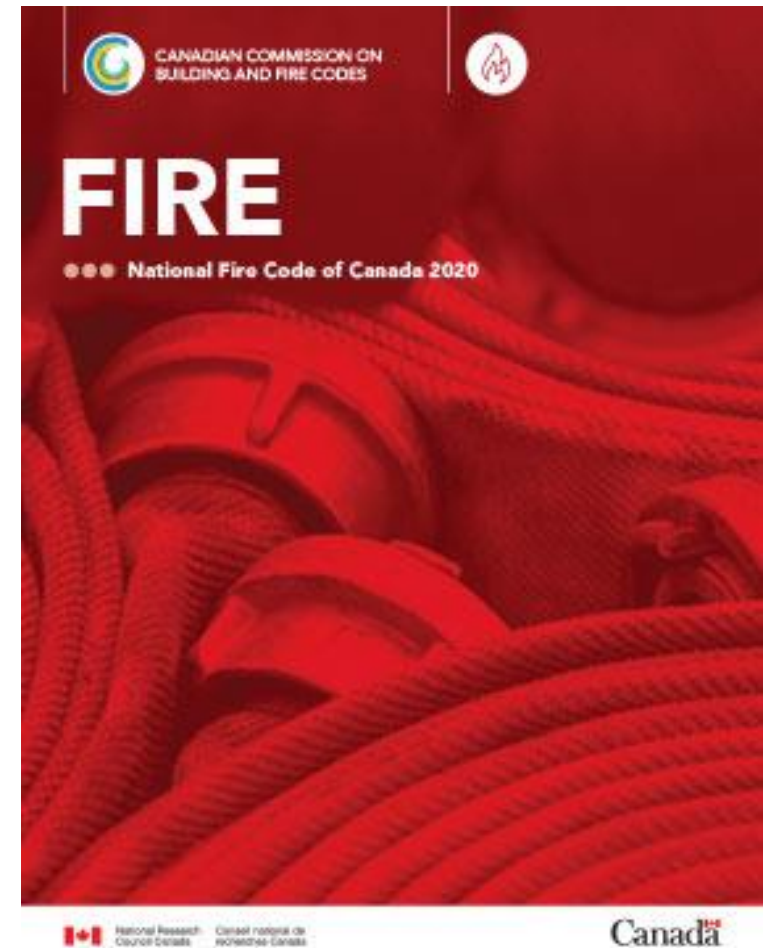
2.2.1.2 – Damage to Fire Separations – Where *fire separations* are damaged so as to **affect their integrity, they shall be repaired** so that the integrity of the *fire separation* is maintained...



National Fire Code of Canada - Fireproofing

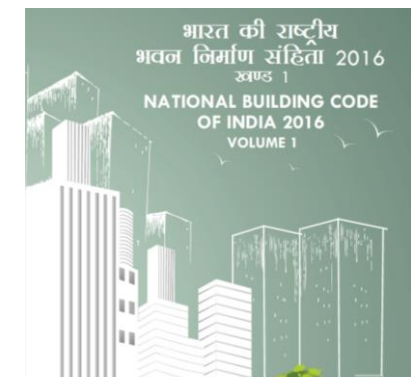
- *Division B – Part 2, Building and Occupant Fire Safety*
2.2.1.2 (2) – Damage to *Fire Separations* & *Fire Protection Materials*

Where materials used to provide fire protection are damaged or removed, they shall be repaired or replaced so that the integrity of the fire protection is maintained.

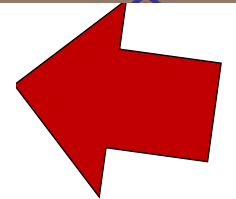
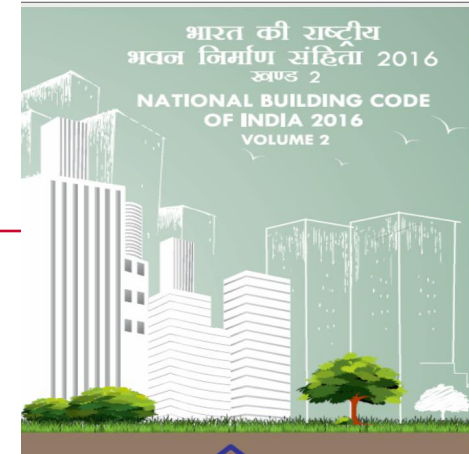


Codes & Maintenance – INDIA

- Ch. 12, Section 9 Asset and Facility Maintenance
- **BUILDING MAINTENANCE – METHODS AND MANAGEMENT**
- **9.1 General** – “Any building (including its services) when built has certain objectives and during its total economic life, it has to be maintained in proper condition to meet those objectives. **Maintenance is a continuous process requiring a close watch and taking immediate remedial action.** It is interwoven with good quality of housekeeping. It is largely governed by the quality of original construction. **The owners, engineers, constructors, occupants and the maintenance agency are all deeply involved in this process and share a responsibility....”**.



Codes & Maintenance

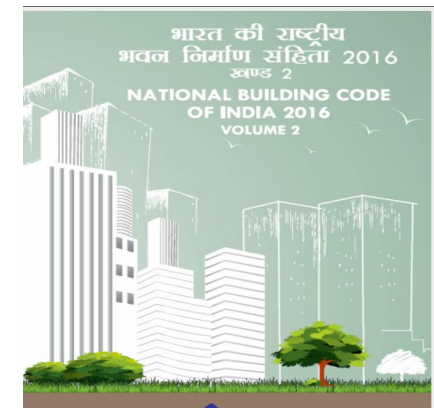


9.1.1 The objective of maintenance is,

- a) to preserve building and services, machinery in good operating condition;
- b) to restore it back to its original standards; and
- c) to improve the facilities depending upon the development that is taking place in building and services engineering.

Codes & Maintenance - India

- q) Records of security measures should be known to authorized personnel only.
- r) Where no records exist, information should be slowly built up as it becomes available during the course of maintenance work.
- s) Use of computers for storing information may be preferred.

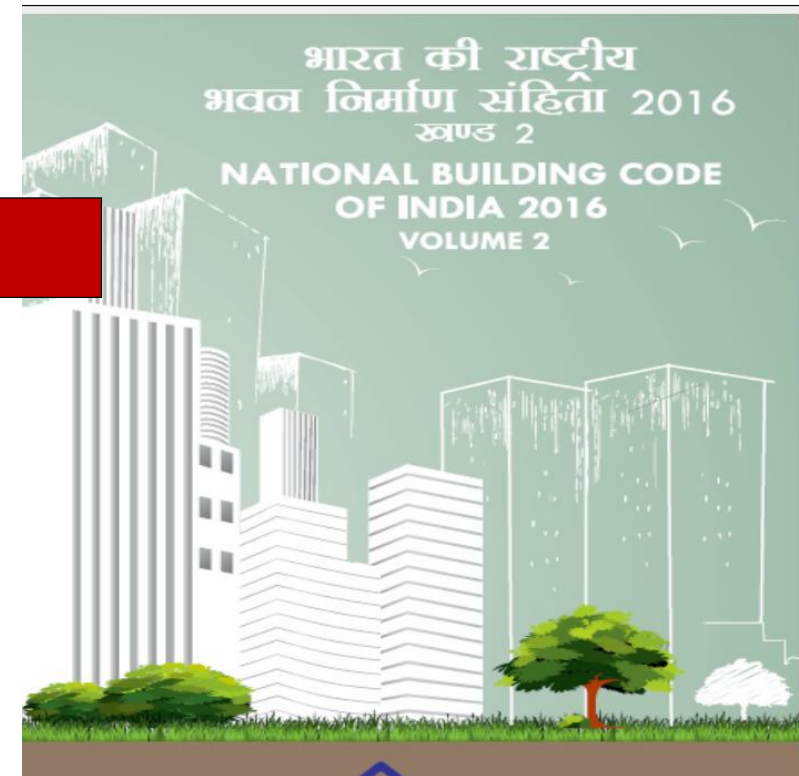
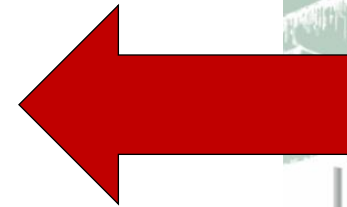
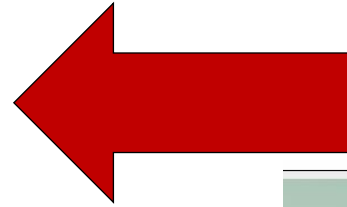


Codes & Maintenance

The records of the facility should include detailed specifications of,

- a) all materials incorporated, for example name of facing brick, mix of concrete, species and grade of timber;
- b) materials with properties that can prove injurious to health and safety;
- c) all plant and machinery, including manufacturers' trade literature, manuals and instructions for installation, operation and maintenance; and
- d) methods of work used during construction, which are unusual or atypical, such as assembly of purpose-made manufactured units.

All specifications and schedules, including those used during construction work, should be verified against



Saudi Arabia Fire Code – “Continuously Maintained”

SECTION 107 MAINTENANCE

107.1 Maintenance of safeguards. Where any device, equipment, system, condition, arrangement, level of protection, or any other feature is required for compliance with the provisions of this code, or otherwise installed, such device, equipment, system, condition, arrangement, level of protection, or other feature shall thereafter be continuously maintained in accordance with this code and applicable referenced standards.



Thanks for Attending!!!



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