

## Fire Inspector Certification Program

### New Jersey Uniform Fire Code Inspector training program

Module 7 Building Construction & Plan Review



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## Welcome

Instructor

- Before we get started
  - Has everyone signed in?
  - Anyone have any questions?

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## Building Construction & Plan Review

In this two part module we will discuss...

- *Brief Overview of UCC*
- *Types of construction;*
- *Height and area limitations;*
- *Fire resistance ratings;*
- *Continuity of fire ratings;*
- *Truss construction concepts;*

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## Building Construction & Plan Review

We will also discuss...

- *Special features*
- *Building Loads*
- *Load carrying design of beams and columns;*
- *Recognizing construction deficiencies*

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Part

1 of 2

For this module

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## The Uniform Construction Code



- *October 1975, the Governor signed into law Public Law 1975 Chapter 217. This is known as the State Uniform Construction Code Act*
- *Purpose was:*
  - *Uniform building standards*
  - *Mini/Max code requirements*
  - *Standardization of building code enforcement*
  - *To encourage innovation & economy in construction*

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### UCC – NJAC 5:23-1 et.seq

- NJAC 5:23-1 General Provisions
- NJAC 5:23-2 Administration and Enforcement; Process
- NJAC 5:23-3 Subcodes (Building, Fire, Electrical, Plumbing)
- NJAC 5:23-3A State-Jurisdiction Subcodes
- NJAC 5:23-4 Enforcing Agencies; Duties; Powers; Procedures
- NJAC 5:23-4A Industrialized/Modular Buildings and Building Components
- NJAC 5:23-4B Manufactured Homes and Manufactured Home Add on Units
- NJAC 5:23-4C Enforcement of Federal Manufactured Home Standards
- NJAC 5:23-4D Recreational Park Trailers
- NJAC 5:23-5 Licensing of Code Enforcement Officials

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### UCC – NJAC 5:23-1 et.seq

- NJAC 5:23-6 Rehabilitation Subcode
- NJAC 5:23-7 Barrier Free Subcode
- NJAC 5:23-8 Asbestos Hazard Abatement Subcode
- NJAC 5:23-9 Code Interpretations
- NJAC 5:23-10 Radon Hazard Subcode
- NJAC 5:23-11 Playground Safety Subcode
- NJAC 5:23-12 Elevator Safety Subcode
- NJAC 5:23-12A Optional Elevator Inspection Program

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### UCC- Codes & regulations

- You may look at the UCC and adopted codes at the following web cite:
- <http://www.state.nj.us/dca/divisions/codes/codreg/>
- <https://codes.iccsafe.org/public/document/details/toc/759>
- <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/free-access>

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Fire Inspector Essentials

- It is an essential element of any fire inspection program that its personnel must fully understand :
  - Basic building construction and features
  - How to identify and recognize deficiencies
  - How buildings can be compromised by fire, loading and other factors.
  - It is only through this understanding that we can enforce the code to maintain safety.

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Type of Building Construction

- Type I Fire Resistive
- Type II Non Combustible
- Type III Ordinary
- Type IV Heavy Timber
- Type V Wood Frame

IFSTA Chapter4 page 116 to 123 explains construction types, uses, materials, fire resistance and building components

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IFSTA Table 4.1

Table 4.1 Fire-Resistance Rating Requirements for Building Elements (Hours)									
Building Element	Type I		Type II		Type III		Type IV	Type V	
	A	B	A	B	A	B	HT	A	B
Primary Structural Frame <sup>a</sup> (see Section 105)	2 <sup>b</sup>	2 <sup>b</sup>	1	0	1	0	HT	1	0
Bearing Walls									
Exterior <sup>c</sup>	3	2	1	0	2	2	2	1	0
Interior	2 <sup>b</sup>	2 <sup>b</sup>	1	0	1	0	1½-T	1	0
Nonbearing Walls and Partitions									
Exterior									
Interior <sup>d</sup>	0	0	0	0	0	0	See Section 602.4.6 <sup>e</sup>	0	0
Floor Construction and associated secondary members <sup>f</sup> (see Section 105)	2	2	1	0	1	0	HT	1	0
Roof Construction and associated secondary members <sup>f</sup> (see Section 105)	1½ <sup>g</sup>	1 <sup>g,1</sup>	1 <sup>g,1</sup>	0 <sup>g</sup>	1½ <sup>g</sup>	0	HT	1½ <sup>g</sup>	0

For SI: 1 foot = 304.8 mm  
HT = Heavy Timber

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Except in Group F-1, H, M, and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. The fire-retarded treated lumber members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections<sup>h</sup> of this code.

e. Not less than the fire-resistance rating based on the separation distance (see Table 4.2).

f. Not less than the fire-resistance rating as referenced in Section 704.5.1.

g. Section numbers refer to sections in the 2015 International Building Code<sup>h</sup>.

h. Courtesy of the International Code Council®, 2015 International Building Code®, Table 601.

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## UCC Type 1 –Fire Resistive

- **Type 1A:** Concrete & steel construction
  - *rating on structural elements 3 hour*
- **Type 1B:** Concrete & steel construction
  - *rating on structural elements 2 hour*



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## UCC Type 2 Non-Combustible

- **Type 2A:** Non-combustible building elements
  - *1 hour rating on structural elements*
- **Type 2B:** Non-combustible building elements
  - *0 hour rating on structural elements*



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## UCC Type 3- Ordinary

- **Type 3A:** Exterior walls are non-combustible, roof and floors are combustible
  - *2 hour rating Exterior*
  - *1 hours rating Interior*
- **Type 3B:** Exterior wall are non-combustible, roofs and floor are combustible
  - *2 hour rating Exterior*
  - *0 hours rating Interior*



Main Street-USA

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## UCC Type 4 – Heavy Timber

- Heavy timber frame structural members
  - Nominal dimensions 4"X6" or greater.



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## UCC Type 5 - Frame

- Type 5A: combustible structural elements
  - 1 hour fire rating
- Type 5B: combustible structural elements
  - 0 hour fire rating
  - Balloon: Open stud cavity foundation to roof
  - Platform: Fire stop every 8 feet by next platform
  - Truss: Light weight composite floor and roof systems



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## CONSTRUCTION EXAMPLES

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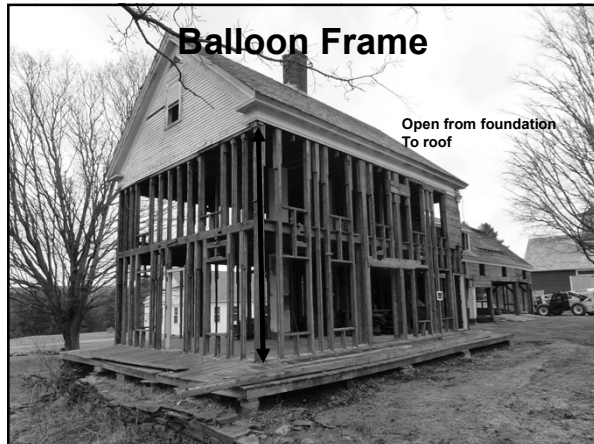
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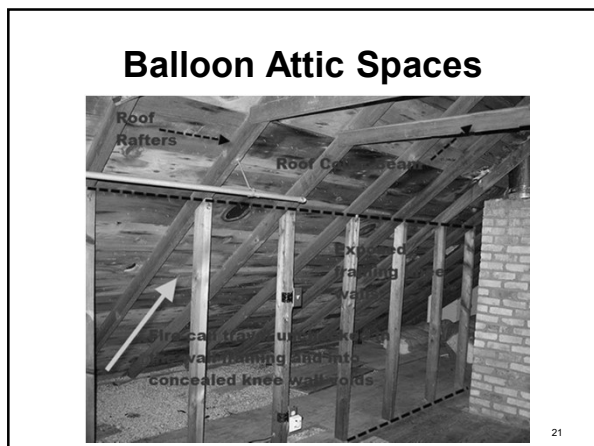
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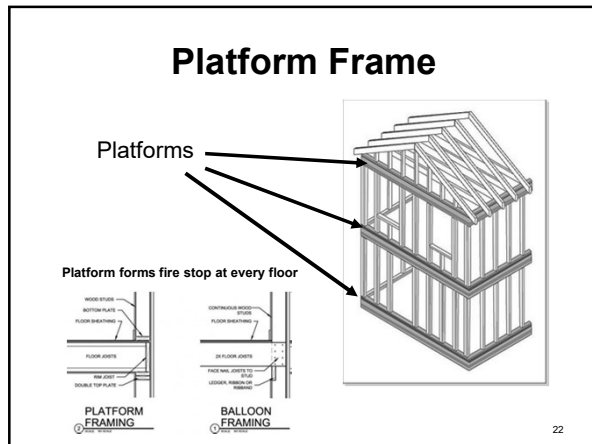
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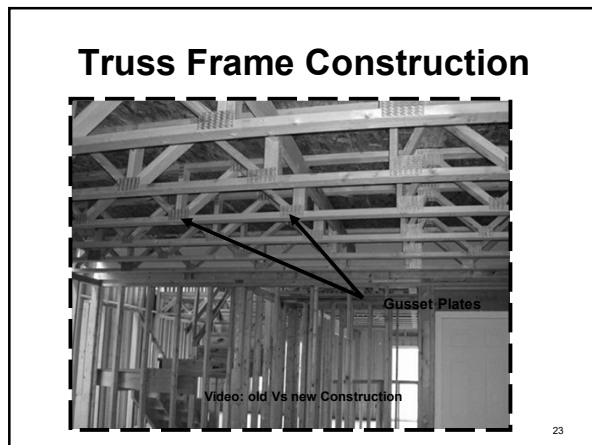
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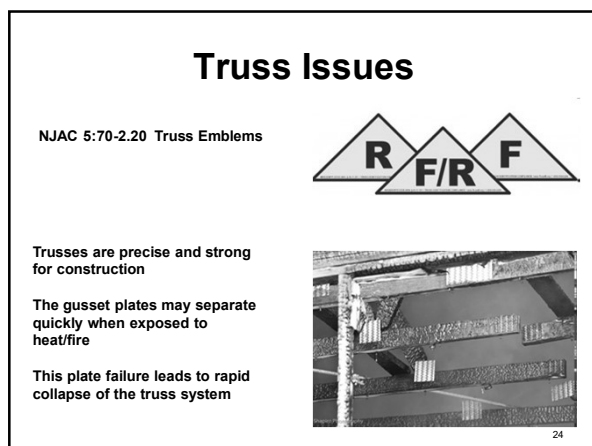
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### Truss Types

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### Building Height and Area

■ The UCC determines the height and area of a building on several factors:

- Use Group
- Type Construction
- Percentage of open space around building
- Presence of automatic sprinkler systems

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### Building Height in feet

TABLE 504.3<sup>3</sup> ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION										
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
		A	B	A	B	A	B	A	B	A	B
A, B, E, F, M, S, U	NS <sup>b</sup>	UL 160	65	55	65	55	65	50	40		
	S	UL 180	85	75	85	75	85	70	60		
	NS <sup>c, d</sup>	UL 160	65	55	65	55	65	50	40		
H-1, H-2, H-3, H-5											
H-4											
I-1 Condition 1, I-3											
I-1 Condition 2, I-2	S	UL 180	85	75	85	75	85	70	60		
	NS <sup>e, f, g</sup>	UL 160	65	55	65	55	65	50	40		
	S	UL 180	85	75	85	75	85	70	60		
I-4	NS <sup>g, h</sup>	UL 160	65	55	65	55	65	50	40		
	S	UL 180	85	75	85	75	85	70	60		
	NS <sup>h</sup>	UL 160	65	55	65	55	65	50	40		
R	S13R	60	60	60	60	60	60	60	60		
	S	UL 180	85	75	85	75	85	70	60		

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## Building Height in Stories

- The UCC table 504.4 governs the height of a building by stories.
- A Residential R-1,R-2,or R-3 is limited to 3 stories in 5B construction and 4 stories in all others with NFPA 13R sprinkler systems.
- This is because NFPA 13R only covers up to 4 story residential structures.

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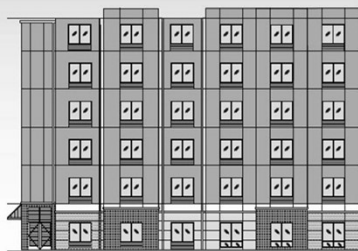
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## Wood Frame -Residential

Five-Story Wood-Frame Structure over Podium Slab



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## Podium Frame Construction




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## FIRE RESISTANCE RATINGS

### IFSTA CHAPTER 5

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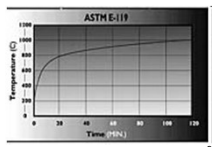
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## Fire Resistance Ratings

- Fire resistance ratings are determined by:
  - ASTM –E119 or UL 263
- Alternate Protection
  - UCC 5:23-3.7
  - Subcode official
  - Documentation , testing, equivalency



Selected and built under UCC

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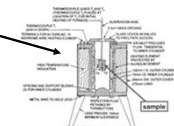
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## Fire Resistance Ratings

- Non Combustible materials
  - ASTM E-136
- Flame Spread
  - ASTM –E-84
  - 0-25 Class I
  - 26-75 Class II
  - 76-200 Class III



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## Fire Resistance Ratings

- Structural Steel Columns and Girders may be protected by encapsulation of membrane protection meeting ASTM E-119



Encapsulation



Membrane Protection

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## Fire Resistant Wall Types

- UCC Chapter 7 addresses fire resistance for types of walls:
  - Fire Walls –706
  - Fire Barriers –707
  - Fire Partitions –708
  - Smoke Barriers –709
  - Smoke Partitions-710
  - Horizontal Assemblies –711
- Let's examine a few!

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## Fire Walls

- Fire resistant rated wall with protected openings that runs from the foundation to or through the roof and will allow the collapse of buildings on either side without collapsing the wall



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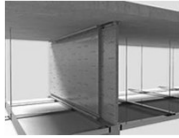
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## Fire Barrier

- A fire resistant rated wall assembly designed to restrict the spread of fire in which continuity is maintained.
- Fire barriers are generally 1 to 2 hours fire rated.
- Must go from floor to slab above including above ceiling space.



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## Fire Partition

- A vertical assembly of material designed to restrict the spread of fire in which openings are protected.
- May be moveable partition



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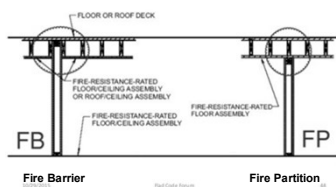
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## Fire Barrier & Fire Partition

Continuity – FB & FP



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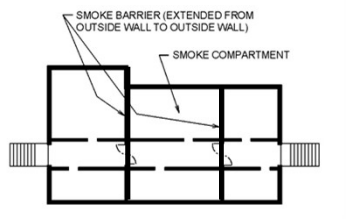
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## Smoke Barriers

- Smoke Barriers are continuous membranes either vertical or horizontal that are designed and constructed to restrict the movement of smoke



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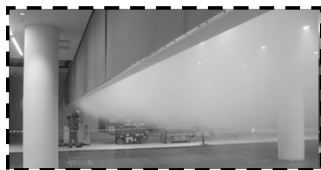
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## Smoke Partitions

- Smoke partitions control the movement of smoke within a compartment. Unless required they are not fire rated.



Video: Hot smoke test

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## Fire Resistance Signage

- Fire resistant walls, barriers and partitions are required to be identified above the ceiling 15 feet from end wall and not exceeding 30 feet



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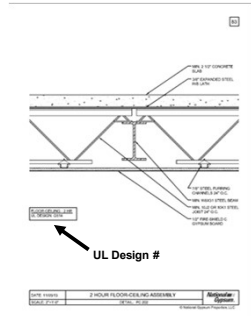
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## Horizontal Fire Assemblies

- Horizontal Floor and Floor Ceiling assemblies may be fire rated or not depending on the type of construction and height of the building



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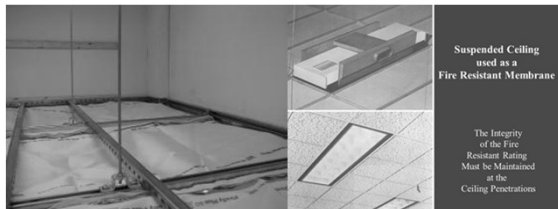
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## fire resistant drop ceiling...



Heavier support track and hangers, tiles are fire resistant rated and clipped fixtures and penetrating Objects are rated

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## FRR Ceiling Fixtures



2= hour fire resistant enclosure

Fixtures must be supported Independently from ceiling

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## General Horizontal Fire Ratings

- Type I A or B – 2 hours
- Type II A- 1 hour, Type B –0 hours
- Type IIIA- 1 hour, Type B –0 hours
- Type IV – Heavy Timber
- Type V A- 1 hour, Type B –0 hours

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## Alternative to Shafts

- Fire rated duct wrap is an alternative method to protect vertical and horizontal shafts for grease ducts and HVAC



Fire Rated Duct Wrap

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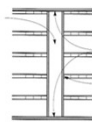
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## Shafts

- Shafts that penetrate floors must be protected by fire rated assemblies
- Generally Shafts are rated at 1 hour to four floors and 2 hours above four floors.
- All openings in shaft walls must be protected by rated closures

Shaft and Vertical Exit Enclosures



§707.2 states that all openings through floor/ceiling or roof/ceiling assemblies will be protected. Shaft enclosures shall be of 1-hour fire resistance. The required rating for shafts is usually determined by the number of floors the enclosure shafts should be of 2-hr rating if extending four stories or more and 1-hr otherwise. Shaft ratings are equal to those of the floor assemblies, but need not be >2hr.

\* Vertical spaces within shaft enclosures should be fire blocked at each floor level.

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### Smoke will find the path of least resistance



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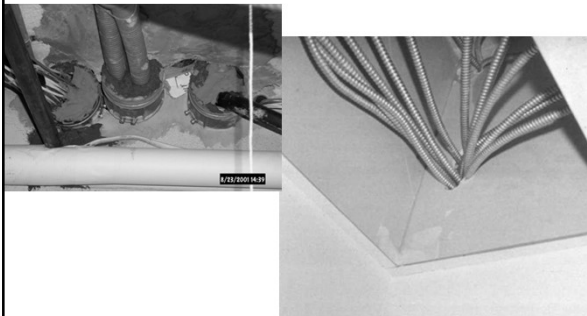
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### Penetrations must be properly fire stopped




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### Fire Stop Standard

- Fire rated walls & ceilings must have all openings protected.
- **ASTM E-814** is the standard applicable to through wall/floor fire penetrations



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### Proper Fire Stops



Must meet  
ASTM E-814  
Fire Test





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### Fire Penetration Seals

■ All penetrating items must have a properly installed fire stopping device that is **UL listed**.

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### Fire Block Foams



Video: Fire stop vs Fire block Foams

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Fire Protective Opening  
Devices

- All Fire rated walls/ ceilings or shafts must have opening protective devices. These include:
  - Fire doors NFPA-80, NFPA – 252, UL 10A UL10B, UL 10C
  - Fire windows NFPA-257, UL-9
  - Fire Shutters NFPA-80
  - Fire Access panels- ASTM-E119 or UL-263
  - Fire /Smoke Dampers UL-555 / 555S

No chocks permitted to hold open

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Fire Doors

- NFPA-80 doors must be:
  - Self closing
  - Positive latching
  - Labeled
  - Double doors require
    - Astragals or brushes
    - Coordinator
  - Listed hardware



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Chart of Door Ratings and UL Labels



UL Label	Rating	Rating	Max. Glass Area
A	3 HR	180 MIN	100 square inches per leaf
B	1 1/2 HR	90 MIN	100 square inches per leaf
C	3/4 HR	45 MIN	1296 square inches per lite
D	1 1/2 HR	90 MIN	Refer to local codes
E	3/4 HR	45 MIN	Refer to local codes
	1/3 HR	20 MIN	1296 square inches per lite
S	SMOKE	SMOKE	

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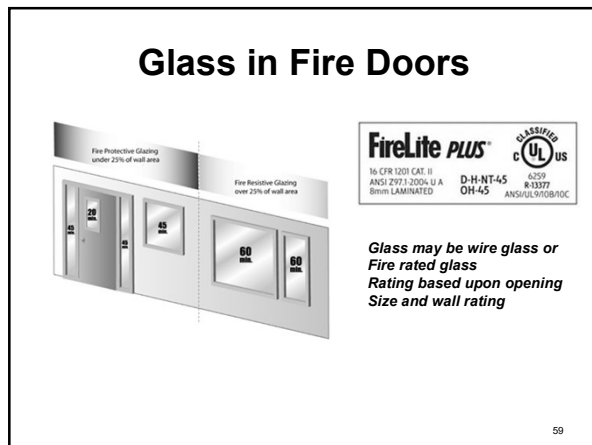
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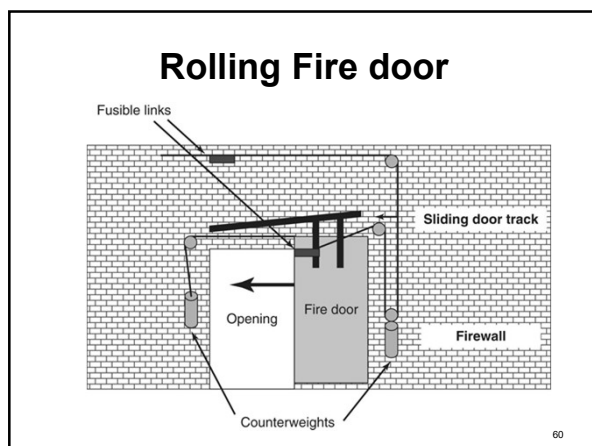
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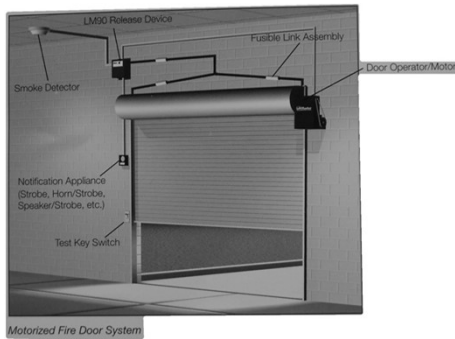
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## New Rolling Fire Doors



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## Fire Shutters



Fire Shutter



Signaling device

Fire Windows and Shutters are tested to UL-9 or NFPA 257 standards

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## Fire / Smoke Dampers



DROP DAMPER



MOTORIZED SMOKE/FIRE DAMPER



DAMPER ACCESS

Fire dampers are listed UL-555 or UL-555S for smoke/fire  
 Static Fire dampers should be inspected every 4 years  
 (6 years in hospitals)  
 Mechanical Fire/Smoke dampers should be tested annually

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## Hurricane Glass



*Code required in 100mph  
Wind zones.  
Glass is labeled in corner  
Not easy to remove*



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## Common Fire Wall Violations

- Unprotected holes or openings in fire walls or fire barriers
- Improper construction without permits
- Missing ceiling tiles if horizontal assemblies
- Chocked doors or other opening protective devices
- Damaged membranes

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## Construction Considerations

- Certain building features are designed to collapse during fires such as ordinary construction floor /roof connections to firewalls.
- The reason is to keep all burning combustible materials inside the fire walls without causing collapse of the wall.
- Thereby limiting the potential for extension of fire

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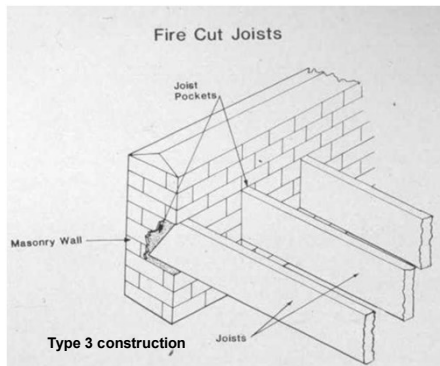
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## Fire Cuts



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## Fire cuts in two side walls worked



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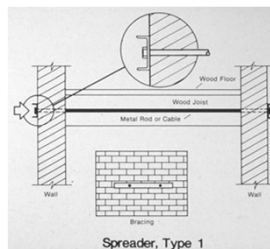
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## Spreaders & Tie Rods

- Spreaders & tie rods may be found in older Type 3 masonry walls.
- These are installed to re-enforce the wall or pull it back to the structure
- Masonry walls if not maintained may erode or move due to water and ice infiltration.



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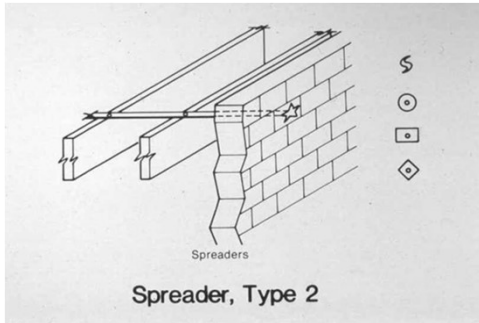
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**Note the different shapes  
of the ends**




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**Spreader**




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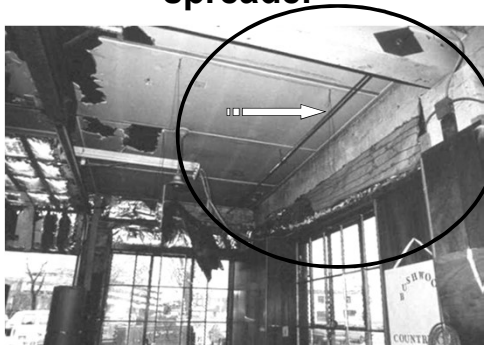
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**Look at upper right for  
spreader**




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**Proper inspection prevents this**




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**Summary**

In this module Part 1 we have discussed

- ☐Types of construction
- ☐Fire Resistance rating
- ☐Types of Protectives
- ☐Opening protectives
- ☐Fire Cuts

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End

Part 1 of 2

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End of Module

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