

# Fire Sprinkler Plan Review

## *The Basics*

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## Certificate

- ❑ West Coast Code Consultants, Inc. is an ICC Preferred Provider (Provider #1129)
- ❑ This course has been approved by ICC to count for Preferred Provider Credit (Course #38473)



All fields are required

CEI ACTIVITY OPTION  
 03 Participation as a student or instructor in an on-site seminar or technical session delivered by an ICC Preferred Provider

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CEI PROVIDER  
 West Coast Code Consultants, Inc.

CEI ACTIVITY NAME  
 2018 IBC, Chapter 7 - Fire Rated Construction



## Course Objectives

*The intent of this course is...*

1. To help ensure that an adequate fire sprinkler submittal has been provided.
2. Know what to verify on the fire sprinkler shop drawings, hydraulic calculations, and seismic bracing calculations.
3. Know what to check in relation to standpipes and fire pumps.



## Seminar Format

- 1) Introduction
- 2) Documentation
- 3) Underground
- 4) **Aboveground**
- 5) Calculations
- 6) Standpipes
- 7) Pumps

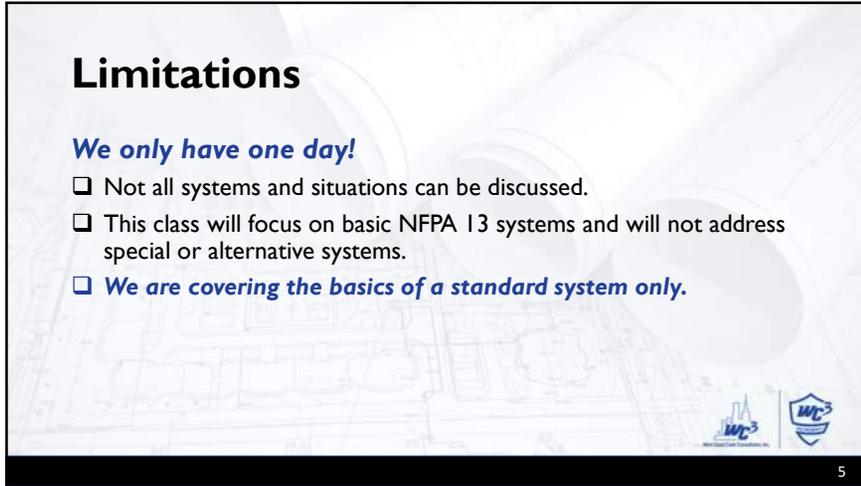
Main focus of today's class




## Limitations

*We only have one day!*

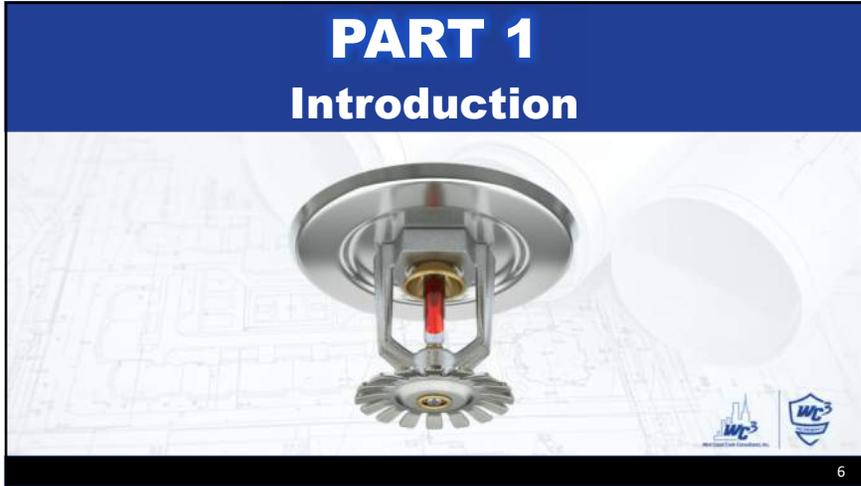
- Not all systems and situations can be discussed.
- This class will focus on basic NFPA 13 systems and will not address special or alternative systems.
- We are covering the basics of a standard system only.*



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# PART 1

## Introduction




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## Introduction

*Welcome!*

- Intro's → Why the heck are we here?!
- Refresher, New to this, Inspector, Designer...
- How can we help each other?

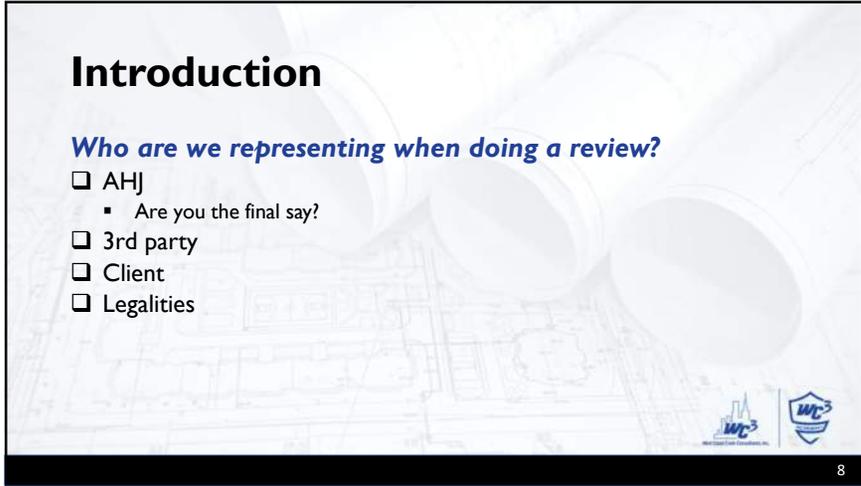


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## Introduction

*Who are we representing when doing a review?*

- AHJ
  - Are you the final say?
- 3rd party
- Client
- Legalities



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# Introduction

**Know your Audience**

- Designers
  - Licensed?
- AHJ
- Builders-Contractors
  - HPS
  - Underground
- Fitters
- Inspectors
- Lawyers!!!! Maybe even a newspaper if all goes sideways.



# Codes vs. Standards

- Code requirements are intended to complement other regulations. Where conflicts arise between code provisions and the referenced standards, the code provisions apply.
- Where a standard provides additional technical detail or guidance beyond that provided in the related code text, the fire code official must use judgment when applying these provisions to prevent conflicts with the code provisions' a conflict arises, it is the fire code official's duty to determine which provisions secure the code's intent



# Whose Code are we using?

- The "Because I said So" code, is not a code.
- Stand on Code
- We always start with the IFC

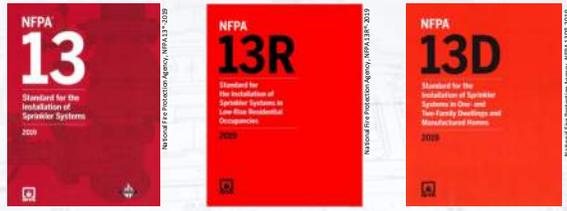
- NFPA 13
- NFPA 13R
- NFPA 13D
- NFPA 14
- NFPA 20
- NFPA 24
- 15, 16, 17, 18, 22, 25, 68, 69, 409, 2001, ...
- And much, much, more



# Design Standard

**NFPA 13, 13R, or 13D?**

- Is the purpose to provide fire control/suppression, or...
- Life safety?




## Design Standard

### NFPA 13 – Design Basis

- ❑ Assumes total coverage of all combustable and concealed spaces
  - Special omissions
  - Limited area systems
- ❑ Water supply
  - System capacity plus “hose stream allowance”
    - For fire suppression forces
  - Amount and duration based on hazard classification




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## Design Standard

### NFPA 13 – Design Basis (cont.)

- ❑ Building codes recognize “sprinklers throughout” as “construction substitute”
- ❑ Entire building, except:
  - Some non-combustible or limited combustable spaces
    - Review “Special Situations”
  - Elevator shafts under specific conditions
    - ASME A17.1 Elevator Safety Code
  - Electrical rooms in specific conditions
    - Electrical equipment only
    - Dry-type electrical
    - Two-hour enclosure
    - No storage permitted



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## Design Standard

### NFPA 13R – Design Basis

- ❑ Developed as a life safety system
  - Permitted only in Residential occupancies up to and including four stories
    - IBC allows increase of 20 feet or one story
  - Intended to prevent flashover in the compartment where the fire starts and enable occupant escape.




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## Design Standard

### NFPA 13R – Design Basis (cont.)

- ❑ Coverage level
  - Anticipates only partial coverage
  - Omits:
    - bathrooms
    - unused attics
    - clothes closets
    - open, attached balconies and porches
- ❑ System capacity but no hose stream allowance
- ❑ Duration: 30 minutes

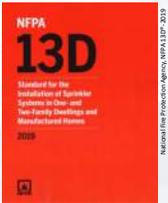



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## Design Standard

### NFPA 13D – Design Basis

- ❑ Level of protection
  - Anticipates only partial coverage
  - Omits
    - bathrooms
    - unused attics
    - clothes closets
    - open, attached balconies and porches
- ❑ System capacity but no hose stream allowance
- ❑ Duration: 10 minutes




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## Design Approach

### NFPA 13 – Two Options

- ❑ Pipe Schedule
  - Uses table or “schedule” for selecting pipe size
  - Must know:
    - Hazard classification
    - Building area
    - Sprinkler spacing
- ❑ Hydraulic Analysis\*
  - Performance-type system where:
    - Area of application and density are specified, and...
    - Pipe size and piping arrangement are calculated for efficiency
  - Uses “Remote Area” principle
  - Water supply accuracy is paramount



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## Plan Review Considerations

### Ponder the following:

- ❑ Is there a way to perform a smarter plan review?
- ❑ What really matters?
- ❑ Why have we been doing it this way for so long?
- ❑ What defines a quality plan review?
- ❑ Does your review ignore the experience level of your inspector(s)?
- ❑ Do your plan review comments add value to the project? If so, how?



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## Plan Review Considerations

### Ponder the following (cont.):

- ❑ Are you enforcing this in the field?
- ❑ More comments **does not = higher quality**
- ❑ What are contractors consistently missing?
- ❑ What’s new in the code that contractors aren’t used to?
- ❑ Obscure notes in random places help no one.
- ❑ Adjust accordingly!
- ❑ The plans aren’t our backstop → **The Code Is!**



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## Plan Review Considerations

**Conditional Approval:**

- Does everything have to be addressed on the plans prior to permit?
- Adding red-lines can expedite the process.
- A “Conditional Approval” list can be included as part of the approved plans and is legally binding.

Issued with Conditions

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## Plan Review Considerations

**Discussion:**

- Our authority to enforce the code is never weakened due to plan review approval.
- Pick up the “crumbs” in the field, the code allows us to do that.

**[A] 105.4 Revocation.** The fire code official is authorized to revoke a permit issued under the provisions of this code where it is found by inspection or otherwise that there has been a false statement or misrepresentation as to the material facts in the application or construction documents on which the permit or approval was based including, but not limited to, any one of the following:

**[A] 105.3.6 Compliance with code.** The issuance or granting of a permit shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of this code or of any other ordinance of the jurisdiction. Permits presuming to give authority to violate or cancel the provisions of this code or other ordinances of the jurisdiction shall not be valid. The issuance of a permit based on construction documents and other data shall not prevent the fire code official from requiring the correction of errors in the construction documents and other data. Any addition to or alteration of approved construction documents shall be approved in advance by the fire code official, as evidenced by the issuance of a new or amended permit.

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## Plan Review Considerations

**Comment Formatting**

- Number your comments
- Reference a plan sheet
- Include a code reference
- Write clearly, use spell check, be specific
- Provide direction

**Bad Example**  
Sprinkler the incinerator room.

**Good Example**  
1. Sheet A1.1: Please provide fire sprinklers in the incinerator room as required by IBC Table 509.1.

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## PART 2 Documentation



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## Plans and Information

- ❑ **NFPA 13:23.1.1:** Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled.
- ❑ **[A] 105.4.2:** Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations as determined by the fire code official.
- ❑ **IFC 901.2:** Construction documents. The fire code official shall have the authority to require construction documents and calculations for all fire protection systems and to require permits be issued for the installation, rehabilitation or modification of any fire protection system. Construction documents for fire protection systems shall be submitted for review and approval prior to system installation.



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## Required Documents

- ❑ Plans- to scale!
- ❑ Calculation sheet
- ❑ Owners Certificate (sometimes)
- ❑ Water Supply
- ❑ Graph Sheet
- ❑ AMMR's (If applicable)
- ❑ Spec (cut) Sheets
- ❑ Seismic Calculations

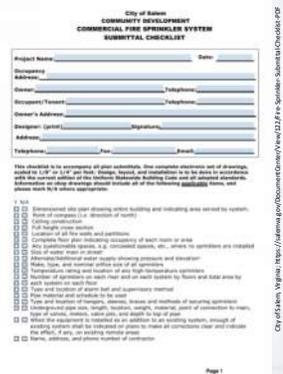



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## Permit Submittals

**General Items:**

- ❑ Some jurisdictions have minimum FSS submittal criteria
- ❑ Typically, we need to ensure that the following are provided:
  - FSS Plans
  - Equipment cut sheets
  - Hydraulic calculations
  - Seismic calculations



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## Permit Submittals

**IFC 907.1: General**

- ❑ **Construction documents** → "...sufficient clarity to indicate the location, nature and extent of the proposed work and show in detail that it will conform to the provisions of this code..."
- ❑ **Shop drawings** → Per **NFPA 13**, submitted for review & approval



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## Permit Submittals

**Separate Permits**

- ❑ **Construction documents** → Building permit plans
  - This is when a general Fire & Life Safety review is performed
  - Fire Sprinklers typically listed as "deferred submittal"
- ❑ **Shop drawings** → Fire sprinkler permit application
  - Not truly a deferred submittal
  - Separate fire department construction permit (IFC 105.6.1)
  - Be careful to consider other systems required by the building permit!
    - Fire pumps, standpipes, water flow monitoring, etc.

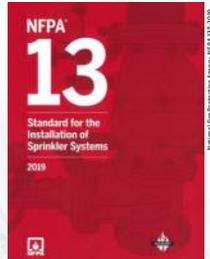


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## Permit Submittals

**Shop Drawing Submittal**

- ❑ We will assume that the building permit has been issued and the FSS submittal consists of the shop drawing review.
- ❑ This review will rely on the requirements of NFPA 13 with occasional reference to the IBC and IFC.




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## Documentation

**Minimum Required (Chapter 27):**

- ❑ Applies to all fire sprinkler submittals, new, additions & alterations
- ❑ Documents:
  - Plans (§27.1)
  - Hydraulic Calcs (§27.2-27.4)
  - Seismic Calcs (§27.1, Item #41)
  - Equipment/Piping Listings (§3.2.3 & Chapter 16)
- ❑ **47 specific items** must be provided on the plans



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## Documentation

Often missing from FSS plans!

- (1) Name of owner and occupant.
- (2) Location, including street address.
- (3) Point of compass.
- (4) Full height cross section or schematic diagram, including structural member information if required for clarity and including ceiling construction and method of protection for nonmetallic piping.
- (5) Ceiling/roof heights and slopes not shown in the full height cross section.
- (6) Location of partitions.
- (7) Location of fire walls.
- (8) Occupancy class of each area or room.
- (9) Location and size of concealed spaces, closets, attics, and bathrooms.
- (10) Any small enclosures in which no sprinklers are to be installed.
- (11) Size of city main in street and whether dead end or circulating; if dead end, direction and distance to nearest circulating main; and city main test results and system elevation relative to test hydrant.
- (12) Other sources of water supply, with pressure or elevation.
- (13) Make, type, model, and nominal K-factor of sprinklers, including sprinkler identification number.
- (14) Temperature rating and location of high-temperature sprinklers.
- (15) Total area protected by each system on each floor.
- (16) Number of sprinklers on each riser per floor.
- (17) Total number of sprinklers on each dry pipe system, preaction system, combined dry pipe-preaction system, or deluge system.
- (18) Approximate capacity in gallons of each dry pipe system.
- (19) Pipe type and schedule of wall thickness.
- (20) Nominal pipe size and cutting lengths of pipe (or center-to-center dimensions). Where typical branch lines prevail, it shall be necessary to size only one typical line.
- (21) Location and size of riser nipples.

National Fire Protection Agency, NFPA13<sup>®</sup>-2019



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## Documentation

Often missing from FSS plans!

- (22) Type of fittings and joints and location of all welds and bends. The contractor shall specify on drawing any sections to be shop welded and the type of fittings or formations to be used.
- (23) Type and locations of hangers, sleeves, braces, and methods of securing sprinklers when applicable.
- (24) All control valves, check valves, drain pipes, and test connections.
- (25) Make, type, model, and size of backflow prevention assembly, and means to forward flow test at system demand.
- (26) Make, type, model, and size of alarm or dry pipe valve.
- (27) Make, type, model, and size of preaction or deluge valve.
- (28) Kind and location of alarm bells.
- (29) Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment.
- (30) Private fire service main sizes, lengths, locations, weights, materials, point of connection to city main; the sizes, types and locations of valves, valve indicators, regulators, meters, and valve pits; and the depth that the top of the pipe is laid below grade.
- (31) Piping provisions for flushing.
- (32) Where the equipment is to be installed as an addition to an existing system, enough of the existing system indicated on the plans to make all conditions clear.
- (33) For hydraulically designed systems, the information on the hydraulic data nameplate.
- (34) A graphic representation of the scale used on all plans.
- (35) Name, address, and phone number(s) of contractor.
- (36) Hydraulic reference points shown on the plan that correspond with comparable reference points on the hydraulic calculation sheets.
- (37) The minimum rate of water application (density or flow or discharge pressure), the design area of water application, in-rack sprinkler demand, and the water required for hose streams both inside and outside.
- (38) The total quantity of water and the pressure required noted at a common reference point for each system.
- (39) Relative elevations of sprinklers, junction points, and supply or reference points.
- (40) If room design method is used, all unprotected wall openings throughout the floor protected.

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## Documentation

Often missing from FSS plans!

- (41) Calculation of loads for sizing and details of sway bracing.
- (42) Zones of influence used in calculations for seismic bracing indicated on plans.
- (43) The setting for pressure-reducing valves.
- (44) Information about listed antifreeze solution used (type and amount).
- (45) Size and location of hydrants showing size and number of outlets and if outlets are to be equipped with independent gate valves. Whether hose houses and equipment are to be provided, and by whom, shall be indicated. Static and residual hydrants that were used in flow tests shall be shown.
- (46) Size, location, and piping arrangement of fire department connections.
- (47) Edition year of NFPA 13 to which the sprinkler system is designed.

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## Documentation



### Licensed/Certified Design Professional?

- Is a registered design professional required for sprinkler design?
- NFPA 13 is silent
- IFC 104.8.2 states, *“The fire code official is authorized to require design submittals to be prepared by, and bear the stamp of, a registered design professional.”*
- The real answer... It depends on each state/AHJ!



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## PART 3 Underground




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## Where to Start?

*As far away as possible!*

- First Sheet
- Scope
- Site Plan
- Underground
- Fire Flow
- Notes
- Specs
- Building Plans\***
- AMMR's



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## Scope

*Should tell you what you are looking at and what is not in the contract.*

**SCOPE OF WORK**

1. THIS TENANT IMPROVEMENT INVOLVES RELOCATION OF EXISTING AND ADDITION OF NEW FIRE SPRINKLER DROPS & UPRIGHTS FOR NEW WALLROOM CONFIGURATIONS AS INDICATED ON THE PLANS.
2. EXISTING BUILDING OCCUPANCY IS LIGHT HAZARD AND IS NOT BEING CHANGED.
3. FIRE HAS NOT BEEN CONTRACTED TO EVALUATE, INSPECT, OR CERTIFY THE EXISTING SYSTEM INSTALLATION. ALL SYSTEM COMPONENTS NOT MODIFIED BY OUR SCOPE OF WORK ARE TO REMAIN AS PREVIOUSLY INSTALLED AND ASSUMED TO BE IN GOOD WORKING ORDER.
4. FIRE HAS NOT BEEN CONTRACTED TO EVALUATE EXISTING SYSTEM HANGERS, RESTRAINTS, OR SEISMIC BRACING TO DETERMINE ADEQUACY AGAINST CURRENT NFPA 13 STANDARDS/REQUIREMENTS.
5. WORK SHALL START AT THE EXISTING BRANCH LINES OR MAINS, EITHER AT EXISTING OUTLETS OR BY USING NEW MECHANICAL TEES, IF NEEDED TO SUPPLY THE REQUIRED SPRINKLER HEADS.

- Don't be afraid to ask for scope clarification.
- Watch out for areas purposely left out of the scope



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## Site Plan

*Not a Site Plan (or scope of work)*



**Items Needed NFPA 13: 23**

- Location of FD access → IFC 912.2.1
- FDC
- Fire Mains-under and over
- Fire Hydrants-IFC 507.5.1.1
- Fire Flow Hydrant Location
  - Address is good



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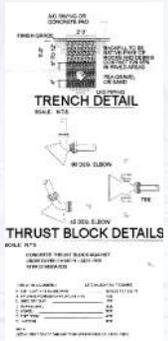
# Underground

- Can be on a separate permit – Local Ordinances
- May consist of several feeds to hydrants and sprinkler systems
- Can go to pumps and tanks
- Will also be reviewed and inspected by Water District\*
- Extends to no more than 10' into a building (except when it doesn't)
- Watch out for Dead End Mains!




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# What's a Restraining Rod? (13:10.6)



- UG Done by Others
- Depth
- Restrains
  - Mega lugs
  - Rods
- Thrust Blocks
  - Soil class
- In Building Riser
  - Length into building




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## IN LIEU OF THRUST BLOCKS RESTRAINED JOINT SYSTEMS MAY BE USED.

**10.6.2<sup>o</sup> Restrained Joint Systems.**  
 Private fire service mains using restrained joint systems shall include one or more of the following:

- Locking mechanical or push-on joints.
- Mechanical joints utilizing setcrew or nut and glands.
- Bolted flange joints.
- Pipe clamps and tie rods.
- Other approved methods or devices.





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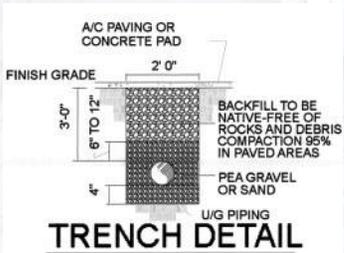
# Thrust Blocks (13:10.6.1)

THRUST BLOCK DESCRIPTION	THRUST BLOCK DESCRIPTION			WEIGHT AT VERTICAL BENDS
	HORIZONTAL BEND	THICKNESS (INCHES)	PIPE SURFACE AREA SQ. FT.	
HORIZONTAL BEND	4" and 6"	6	1.750	17,000
	8"	12	3.500	
	10"	12	4.600	
	12"	14	6.800	
HORIZONTAL TEE	4" and 6"	4	1.750	17,000
	8"	3	1.4	
	10"	6	3.500	
	12"	7	4.600	
VERTICAL BEND	4" and 6"	8	2.8	17,000
	8"	8	2.8	
	10"	10	3.5	
	12"	12	4.6	
HYDRANT BENT	4" and 6"	3	1.05	17,000
	8"	4	1.4	
	10"	6	2.1	
	12"	8.5	2.9	



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### Depth of Cover (13:10.4.2)



- Depends on location (geographic)
- Depends on location- under roads, foundations, etc.
- Never looks like picture



### Common Notes

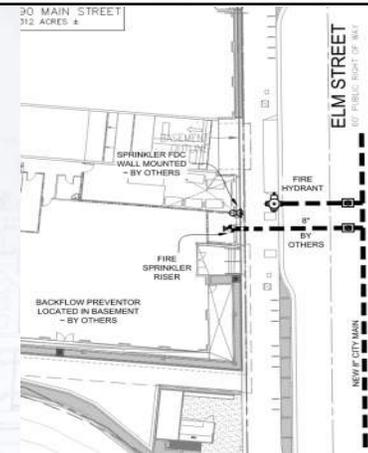
#### UNDERGROUND INSTALLATION NOTES

1. UNDERGROUND TO BE INSTALLED PER NFPA 13, 2016, NFPA 24, 2016 AND THE REQUIREMENTS OF THE LOCAL FIRE DEPARTMENT.
2. ALL PORTIONS OF THE UNDERGROUND MAIN SHALL BE PVC C900.
3. A HYDROSTATIC PRESSURE TEST AT 200 PSI FOR 2 HOURS SHALL BE CONDUCTED BEFORE JOINTS ARE COVERED.
4. THE UNDERGROUND PIPING SHALL BE FLUSHED PRIOR TO SYSTEM TIE IN. FLUSH TO BE WITNESSED BY THE FD.
5. ALL METALLIC PIPE AND FITTINGS SHALL BE EPOXY COATED, POLYETHYLENE ENCASED. ALL BOLTS, NUTS, TIE RODS, ETC. FOR ALL PORTIONS OF THE UNDERGROUND MAINS SHALL BE 316 STAINLESS STEEL.
6. ALL PIPE FITTINGS AND TRANSITIONS TO HAVE APPROVED THRUST BLOCKS MEETING ALL APPLICABLE CODES.
7. PIPE AND FITTINGS TO BE CLASS 200 MINIMUM AND TO BE UL LISTED FOR FIRE SERVICE.
8. MINIMUM PIPE BURY TO BE 36".
9. PIPE TO BE DUCTILE IRON TO 5'-0" OUTSIDE THE BUILDING.
10. SET THE RISER FLANGE AT +0'-6" ABOVE FINISH FLOOR.
11. PROVIDE A 2" ANNULAR CLEARANCE AROUND PIPE AND FLOOR SLAB AT THE SYSTEM RISER.
12. UNDERGROUND TO BE MECHANICAL JOINT AND/OR THRUST BLOCKED.
13. COORDINATE CONDUIT RUN FOR TAMPER SWITCHES AND/OR ALARMS WITH GENERAL CONTRACTOR.
14. PROVIDE WARNING TAPE AND TRACER WIRE.



### Things to look for

- Dead end mains
- Domestic water taps
- FDC
- Location of hydrant to FDC



## Hydrants & FDC's

- ❑ Distance to FDC with or without a Standpipe. (IFC 507.5.1)
- ❑ Obstructed Location (IFC 912)
  - Fire department connections shall be located on the street side of buildings or facing approved fire apparatus access roads, fully visible and recognizable from the street, fire apparatus access road or nearest point of fire department vehicle access or as otherwise approved by the fire code official [IFC 912.2.1].
- ❑ Signage
- ❑ Busy Streets



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## PART 4 Aboveground




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# Fire Flow

- Required within the last 12 months (of sprinkler Sub) NFPA 13:23.2.1.1
- Needs to have who conducted the test
- You may ask for more!
  - Daily and annual changes

TODAY'S DATE: February 15, 2018

ADDRESS OF INSPECTION: 846 32<sup>nd</sup> Street, Oakland  
 SUMMARY TO BE SENT TO: ryan.fetys@victoryrepro.com  
 INSPECTION #: 189928  
 REQUEST: Pressure Data

Connection point is off the 6-inch main (8C37) in 32nd Street, on the south side of 32nd Street, approximately 440 feet east of Market Street.

Address of Hydrant: 648 32nd Street, Oakland  
 Section or Hydrant No: 028352  
 Elevation at connection point = 36 feet  
 Static Pressure = 51 psi  
 Residual Pressure at 100 gpm = 51 psi  
 Pressure Zone: GGA, Central  
 Pipe designation: 8C37

The pressure and flow information stated is available at the street main connection in 32nd Street.

Note: This information is provided as a courtesy and is modeled based on a specific set of distribution system conditions. These conditions are subject to continuous change and may not be conservative enough for your system design. Please use this information as a guideline of the approximate availability of flow, and make allowance for possible reductions in pressure and flow.



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# Fire Flow V Fire Flow

**For Building:**  
*Determines what size and type of building can be built (IFC Appendix B)*

**For Sprinklers:**  
*Determines size of piping to meet sprinkler demand (NFPA 13)*



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## Cut Sheets and Specs

- Make sure they are ALL there
- Verifies listing
- Needed for hydraulic calcs
- Required to be submitted

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## Sprinkler Piping

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## Sprinkler Systems

- Determine the Occupancy → IBC/IFC
- Determine the Use → NFPA 13 Chapter 4
- Identify the Hazard → NFPA 13 Chapter 4
- = Design Standard Used

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## Determine the Occupancy and Use

**IBCI/IFC**

- Occupancy type is determined by use
- Occupancy type and size determines what protection measures are required

**NFPA 13**

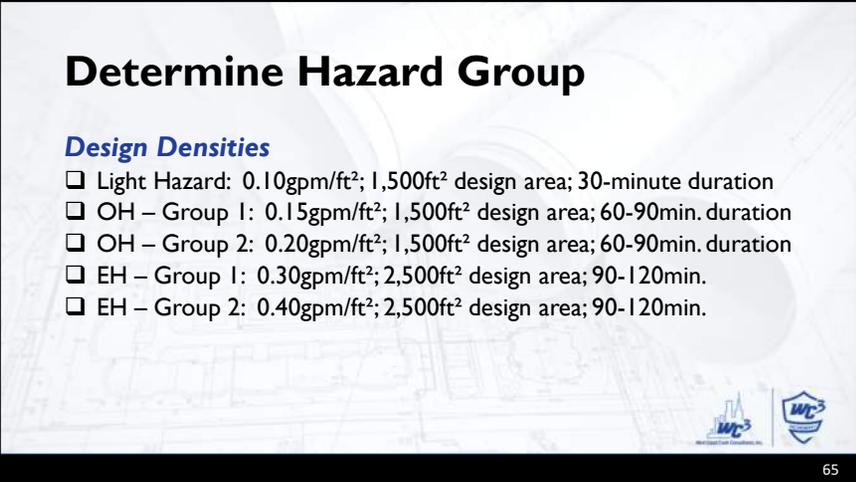
- NFPA 13 occupancy is secondary to hazard
- Size of building dose not determine coverage.

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## Determine Hazard Group

**Design Densities**

- ❑ Light Hazard: 0.10gpm/ft<sup>2</sup>; 1,500ft<sup>2</sup> design area; 30-minute duration
- ❑ OH – Group 1: 0.15gpm/ft<sup>2</sup>; 1,500ft<sup>2</sup> design area; 60-90min. duration
- ❑ OH – Group 2: 0.20gpm/ft<sup>2</sup>; 1,500ft<sup>2</sup> design area; 60-90min. duration
- ❑ EH – Group 1: 0.30gpm/ft<sup>2</sup>; 2,500ft<sup>2</sup> design area; 90-120min.
- ❑ EH – Group 2: 0.40gpm/ft<sup>2</sup>; 2,500ft<sup>2</sup> design area; 90-120min.




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## Determine Hazard Group

**Design Densities**

Table 19.3.3.1.2 Hose Stream Allowance and Water Supply Duration Requirements for Hydraulically Calculated Systems

Occupancy	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
	gpm	L/min	gpm	L/min	
Light hazard	0, 50, or 100	0, 190, or 380	100	380	30
Ordinary hazard	0, 50, or 100	0, 190, or 380	250	950	60-90
Extra hazard	0, 50, or 100	0, 190, or 380	500	1900	90-120

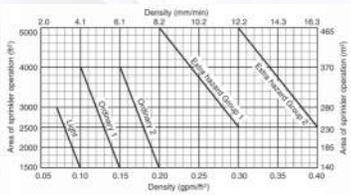
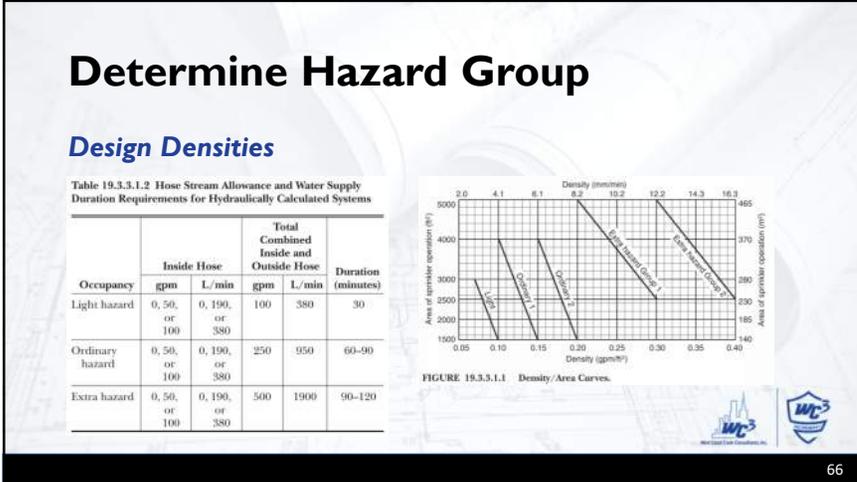


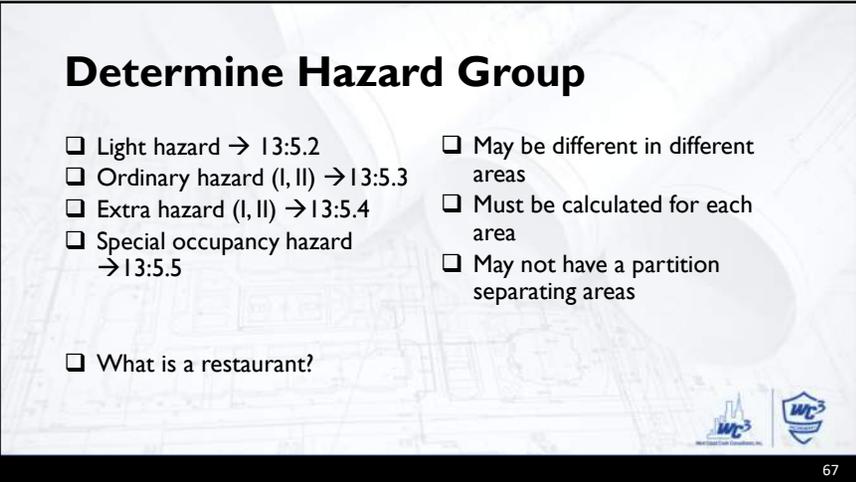
FIGURE 19.3.3.1.1 Density/Area Curves.




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## Determine Hazard Group

- ❑ Light hazard → 13:5.2
- ❑ Ordinary hazard (I, II) → 13:5.3
- ❑ Extra hazard (I, II) → 13:5.4
- ❑ Special occupancy hazard → 13:5.5
- ❑ What is a restaurant?
- ❑ May be different in different areas
- ❑ Must be calculated for each area
- ❑ May not have a partition separating areas



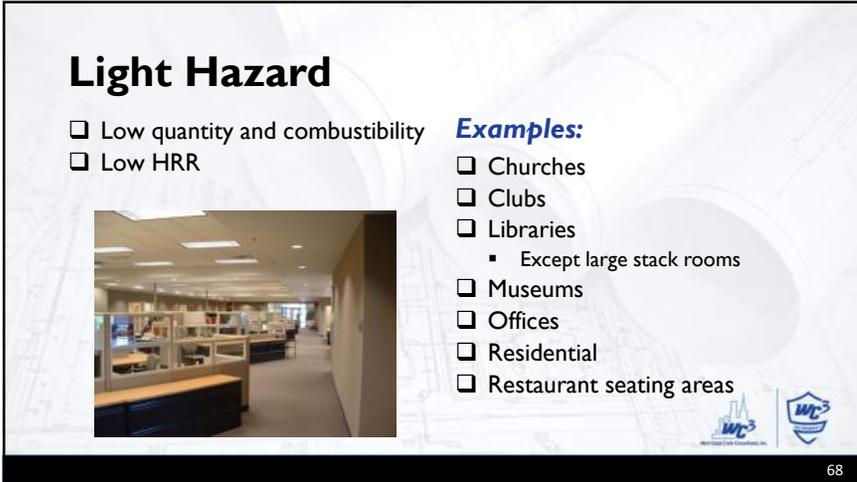

67

## Light Hazard

- ❑ Low quantity and combustibility
- ❑ Low HRR

**Examples:**

- ❑ Churches
- ❑ Clubs
- ❑ Libraries
  - Except large stack rooms
- ❑ Museums
- ❑ Offices
- ❑ Residential
- ❑ Restaurant seating areas


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## Ordinary Hazard, Group 1

**Examples:**

- Automobile parking and showrooms
- Bakeries
- Dairy products
  - Manufacturing and processing
- Electronics plants
- Laundries
- Restaurant service areas

- Low combustibility
- Moderate quantity
  - Stockpiles do not exceed 8 feet
- Moderate HRR




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## Ordinary Hazard, Group 2

- Moderate to high combustibility
- Moderate to high quantity
  - Stockpiles with moderate HRR do not exceed 12 feet
  - Stockpiles with high HRR do not exceed 8 feet





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## Ordinary Hazard, Group 2

- Chemical plants – ordinary
- Distilleries
- Dry cleaners
- Machine shops
- Mercantile
- Pulp and paper mills
- Post offices
- Stages
- Loading docks

- Library stack rooms
  - “Large”
- Agricultural
  - Racetrack stables/kennels
  - Barns
- Wood machining
  - Wood products assembly




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## Extra Hazard, Group 1



**Examples:**

- Die casting
- Metal extruding
- Plywood/particleboard manufacturing
- Printing plants
  - Volatile inks
- Sawmills
- Upholstering with plastic foams

- High combustibility
- High quantity
  - Dust, lint, other materials
- High HRR
  - Little or no flammable or combustible liquids




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## Extra Hazard, Group 2

**Examples:**

- Flammable liquid spraying
- Flow coating
- Open oil quenching
- Plastics processing
- Varnish and paint dipping
- Manufactured home or modular building assemblies
  - Finished enclosure with combustible interiors

- Moderate to substantial flammable or combustible liquids
- Extensive combustible shielding





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DESIGNED TO ORDINARY HAZARD GROUP 1 OCCUPANCY PER NFPA 13.

NFPA 13 RESIDENTIAL WET SPRINKLER SYSTEM DESIGN CRITERIA: LIVING SPACES

- A. C. 15 GPM/SQFT, DESIGN DENSITY.
- B. 4 MOST DEMANDING ADJACENT SPRINKLERS
- C. 100 GPM HOSE STREAM DEMAND
- D. ALL SPRINKLERS SHALL BE RESIDENTIAL, QUICK RESPONSE (TYP)

NFPA 13 LIGHT HAZARD WET SPRINKLER SYSTEM DESIGN CRITERIA: CORRIDOR

- A. C. 15 GPM/SQFT, DESIGN DENSITY.
- B. 225 SQFT/SPRINKLER MAXIMUM COVERAGE
- C. 100 GPM HOSE STREAM DEMAND
- D. ALL SPRINKLERS SHALL BE RESIDENTIAL, QUICK RESPONSE (TYP)

ORDINARY HAZARD GROUP 1 WET SPRINKLER SYSTEM DESIGN CRITERIA: PARKING GARAGES

- A. C. 15 GPM/SQFT, DESIGN DENSITY
- B. 250 GPM HOSE STREAM DEMAND
- C. 130 SQFT/SPRINKLER MAXIMUM COVERAGE
- E. ALL SPRINKLERS SHALL BE QUICK RESPONSE

WATER SUPPLY DATA:  
 STATIC PRESSURE: 65 PSI  
 RESIDUAL PRESSURE: 20 PSI  
 FLOW: 4550 GPM  
 SOURCE: CITY OF REDWOOD CITY PUBLIC WORKS  
 DATE: 10/4/2019

Plan Review of Fire Protection Systems 10

THE INSTALLING CONTRACTOR SHALL REVIEW THE DRAWINGS AND VERIFY FIELD CONDITIONS, WATER FLOW DATA.



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## Storage

- Commodity Classifications: Class I, II, III, or IV → 13:5.6\*
- Plastics: Groups A, B, or C → 13:5.6.3\*
- Owners Certificate → 13:4.3\*
- HazMat → IFC 105.6.21, 13:22

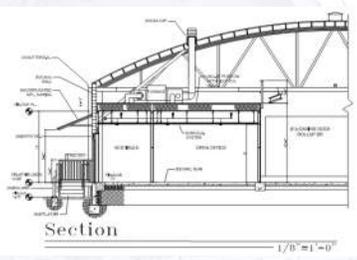
2. DESIGN CRITERIA: FOR ALL SYSTEMS. Class IV Commodity with ESFR K17 Sprinkler Coverage. 40FT max Ceiling Height. 32 FT max storage height. Max Sprinkler spacing = 100 SQ.FT. 10ft. X 10ft. End Head pressure = 52 PSI. (Refer to NFPA 13: Table 16.3.3.1)

3. The Fire Pump Room and all Mechanical Equipment Rooms, Building Service areas, Electrical Equipment Rooms and General Storage Rooms are to be Ordinary Hazard II. 20/1500 gpm/sq.ft. Office area(s) to be Light Hazard .10/1500/GPM/sq.ft.



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## Sectional (13:23.1.3(4))



Section  
1/8" = 1'-0"

- May or may not be helpful
- Helps answer construction type
- High Pile Storage is another class
- Hopefully has scale
- Ask for more detail if needed



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### Start at the Riser

**Good Detail**

**Bad Detail**

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### Type of Systems (13:Chapter 7)

**Common**

- Wet → 13:8.1
- Dry → 13:8.2
- Pre-action → 13:8.3.2
- Anti-Freeze → 13:8.6

Size of System → 13:4.5.1

**Uncommon**

- Double Interlock Pre-action → 13:8.3.2.3
- Deluge → 13:8.3.3
- Foam
- Rate of Rise –On/Off → 13:8.5
- Ma and Pa → 13:8.1.3
- Commercial Kitchen → 13:8.9

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### What to look for → Riser

- Location
  - Varies
  - Rated rooms- not always
  - Size of area
- Transition piece from underground 13:5.1.6.1
- Size of supply
- Back flow preventor\*
  - Matches spec sheet
  - Forward Flow-13:8.16.4.5.1\*
- IFC has more stringent requirements for locations. 901.4.6

**RISER DETAIL**  
1/2"=1'-0"

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### More on the riser

- FDC tie in location → 13: 16.12.5
- Pipe stands → calculated 13: 17.5\*
- Flexible Vics → 13: 18.2.3.1
- Drains! → 13: 16.14
- Notification → IFC 903.4
- Valves → 13:16.9.31.1

**PIPE STAND - STAND ID #101**  
NO. \_\_\_\_\_ SCALE \_\_\_\_\_

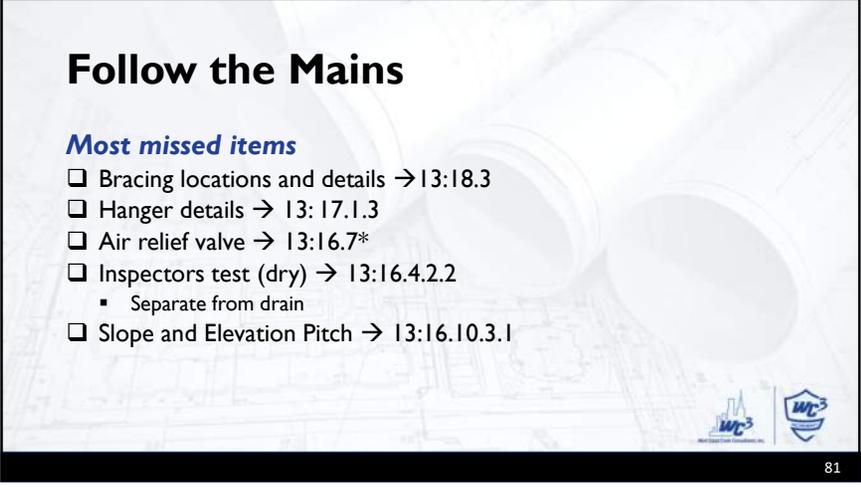
MIN. AND MAX. HEIGHTS BY EXIST. EXCHANGING		MINIMUM PIPE STAND HEIGHTS (UNLESS NOTED)	
HEIGHT	PIPE SIZE	TYPE	HEIGHT
1	1/2"	1	10'
2	3/4"	2	10'
3	1"	3	10'
4	1 1/4"	4	10'
5	1 1/2"	5	10'
6	2"	6	10'
7	2 1/2"	7	10'
8	3"	8	10'
9	3 1/2"	9	10'
10	4"	10	10'
11	4 1/2"	11	10'
12	5"	12	10'
13	5 1/2"	13	10'
14	6"	14	10'
15	6 1/2"	15	10'
16	7"	16	10'
17	7 1/2"	17	10'
18	8"	18	10'
19	8 1/2"	19	10'
20	9"	20	10'
21	9 1/2"	21	10'
22	10"	22	10'
23	10 1/2"	23	10'
24	11"	24	10'
25	11 1/2"	25	10'
26	12"	26	10'
27	12 1/2"	27	10'
28	13"	28	10'
29	13 1/2"	29	10'
30	14"	30	10'
31	14 1/2"	31	10'
32	15"	32	10'
33	15 1/2"	33	10'
34	16"	34	10'
35	16 1/2"	35	10'
36	17"	36	10'
37	17 1/2"	37	10'
38	18"	38	10'
39	18 1/2"	39	10'
40	19"	40	10'
41	19 1/2"	41	10'
42	20"	42	10'
43	20 1/2"	43	10'
44	21"	44	10'
45	21 1/2"	45	10'
46	22"	46	10'
47	22 1/2"	47	10'
48	23"	48	10'
49	23 1/2"	49	10'
50	24"	50	10'
51	24 1/2"	51	10'
52	25"	52	10'
53	25 1/2"	53	10'
54	26"	54	10'
55	26 1/2"	55	10'
56	27"	56	10'
57	27 1/2"	57	10'
58	28"	58	10'
59	28 1/2"	59	10'
60	29"	60	10'
61	29 1/2"	61	10'
62	30"	62	10'
63	30 1/2"	63	10'
64	31"	64	10'
65	31 1/2"	65	10'
66	32"	66	10'
67	32 1/2"	67	10'
68	33"	68	10'
69	33 1/2"	69	10'
70	34"	70	10'
71	34 1/2"	71	10'
72	35"	72	10'
73	35 1/2"	73	10'
74	36"	74	10'
75	36 1/2"	75	10'
76	37"	76	10'
77	37 1/2"	77	10'
78	38"	78	10'
79	38 1/2"	79	10'
80	39"	80	10'
81	39 1/2"	81	10'
82	40"	82	10'
83	40 1/2"	83	10'
84	41"	84	10'
85	41 1/2"	85	10'
86	42"	86	10'
87	42 1/2"	87	10'
88	43"	88	10'
89	43 1/2"	89	10'
90	44"	90	10'
91	44 1/2"	91	10'
92	45"	92	10'
93	45 1/2"	93	10'
94	46"	94	10'
95	46 1/2"	95	10'
96	47"	96	10'
97	47 1/2"	97	10'
98	48"	98	10'
99	48 1/2"	99	10'
100	49"	100	10'

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## Follow the Mains

**Most missed items**

- Bracing locations and details → 13:18.3
- Hanger details → 13:17.1.3
- Air relief valve → 13:16.7\*
- Inspectors test (dry) → 13:16.4.2.2
  - Separate from drain
- Slope and Elevation Pitch → 13:16.10.3.1

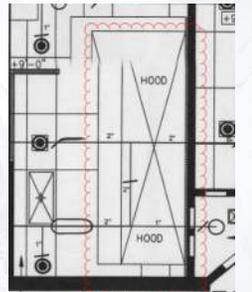
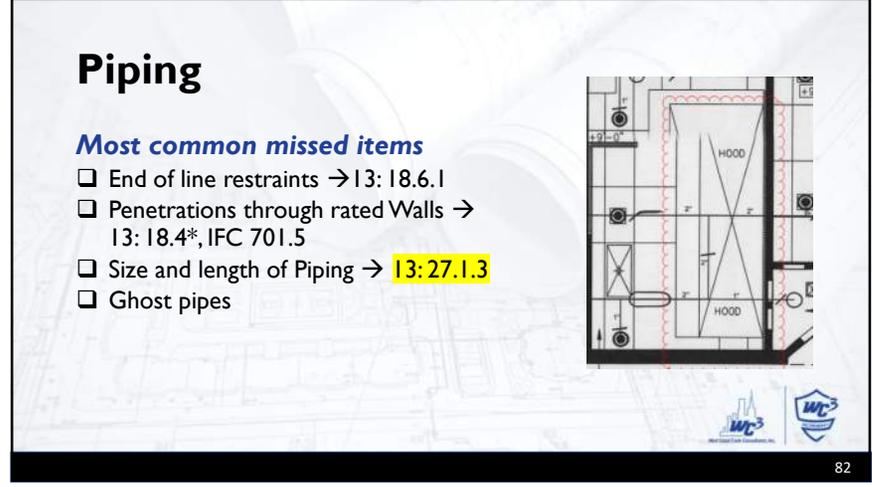



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## Piping

**Most common missed items**

- End of line restraints → 13:18.6.1
- Penetrations through rated Walls → 13:18.4\*, IFC 701.5
- Size and length of Piping → 13:27.1.3
- Ghost pipes


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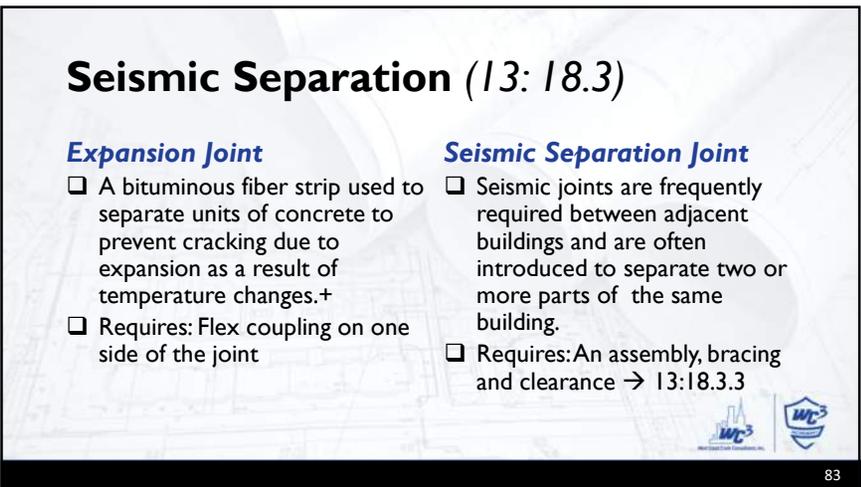
## Seismic Separation (13:18.3)

**Expansion Joint**

- A bituminous fiber strip used to separate units of concrete to prevent cracking due to expansion as a result of temperature changes.+
- Requires: Flex coupling on one side of the joint

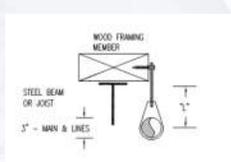
**Seismic Separation Joint**

- Seismic joints are frequently required between adjacent buildings and are often introduced to separate two or more parts of the same building.
- Requires: An assembly, bracing and clearance → 13:18.3.3




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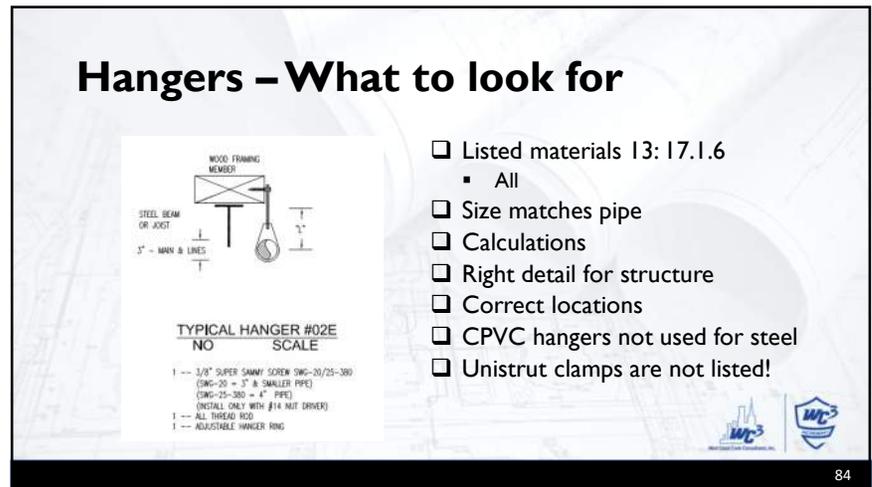
## Hangers – What to look for



**TYPICAL HANGER #02E  
NO SCALE**

- 1 -- 3/8" SUPER SHINY SCREEN (SWG-20/25-300) (SWG-20 = 3" & SMALLER PIPE) (SWG-25-300 = 4" PIPE) (INSTALL ONLY WITH #14 NUT DRIVER)
- 1 -- ALL THREAD ROD
- 1 -- ADJUSTABLE HANGER RING

- Listed materials 13:17.1.6
  - All
- Size matches pipe
- Calculations
- Right detail for structure
- Correct locations
- CPVC hangers not used for steel
- Unistrut clamps are not listed!




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# UNISTRUT CLAMPS

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# Freeze Protection (13:8.16.4)

**8.16.4.1 Protection of Piping Against Freezing.**  
**8.16.4.1.1\*** Where any portion of a system is subject to freezing and the temperatures cannot be reliably maintained at or above 40°F (4°C), the system shall be installed as a dry pipe or preaction system.

**ASK THE AHJ**  
 The design drawings submitted to the authority having jurisdiction for review have a note on them indicating that it is the responsibility of the owner to provide adequate heat. Is that sufficient to meet the requirements of 8.16.4.1.1?  
 No. Authorities having jurisdiction see this mistake on many projects. Such a drawing comment is sufficient for the normally occupied spaces. However, there are many areas of buildings that the architect has not designed as heated spaces. Therefore, the owner will not be able to provide the heat.

Although it is the owner's responsibility to maintain areas above 40°F, it is the designer's responsibility to ensure the piping is in a conditioned area.

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# Freeze Protection

**Options (13:8.16.4)**

- Dry System → 8.2
- Heat Trace → 13:16.4.1.4
- Anti-freeze → 13:8.6\*
- Calculations\* → 13:16.4.1.5
- Condition the space
- Insulation and dry drops → 13:15.3
- Manufacturers specs

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# Bracing!!!! (13:18)

**Good Bracing Detail**

**LATERAL EQ.B.**

**Ok for some applications**

**LATERAL SWAY BRACE**

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### TOLBrace™ Seismic Bracing Calculations

Contributor: J&K FIRE PROTECTION  
 Project Address: Distribution Center  
 3851 San Leandro Street  
 Oakland, Ca. Phone: 415-864-6500  
 Address: 2820 PRODUCTION AVE STE 100  
 RAYMOND, CA. Phone: 415-864-6500

Calculations based on 2019 NFPA Protection 011

Brace Information		TOLCO™ Brace Components	
Maximum Brace Length	7.3' (2.234 m)	TOLCO™ Component	Listed Load
Disconnector Brace	7.3' (2.234 m)	Fig. 1001 (Steel Pipe)	2070 lbs (938 kg)
Type of Brace	100% 10"	Fig. 1002 (No Thread Steel)	2070 lbs (938 kg)
Angle of Brace	90° 30%	See Fastener Information	1740 lbs (790 kg)
Load Ratio of Splices	0.42 (11.1%)	*Always Note: *Always indicate on the TOLCO™ drawings the use of any other manufacturer load limit calculations and the listing of the quantity.	
L/W Value	200	<b>Seismic Brace Assembly Detail</b> 	
Max Horizontal Load	1904 lbs (879 kg)		

Fastener Information	
Disconnector to Connecting Member	NFPA Type F
Fastener	Steel Through-Bolts - Fig. 1001
Dimension	3/4" (19.0 mm)
Maximum Load	579 lbs (264 kg)

Sprinkler System Load Calculation (Fpw = CpWp)					
Dimension	Type	Length	Total Length	Weight Per Unit Length	Total Weight
12" (305 mm)	Steel 10"	30.9 (20.1 m)	30.9 (20.1 m)	67.78 lbs (31.2 kg)	2087 lbs (948 kg)
12" (305 mm)	Steel 10"	103.2 (31.46 m)	134.1 (31.46 m)	145.16 lbs (66.3 kg)	19450 lbs (8870 kg)

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## Mistake #1 – Calculations

- Not using the correct coefficient.
- Should be on USGS report

Sprinkler System Load Calculation (Fpw = CpWp)

Cp = 0.89

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## Where to find the Cp

OSHPD  
 Latitude: 37.704468, -122.206773  
 Longitude: 37.704468, -122.206773

S <sub>s</sub>	C <sub>p</sub>	S <sub>s</sub>	C <sub>p</sub>
0.33 or less	0.35	2.2	1.03
0.4	0.38	2.3	1.07
0.5	0.41	2.4	1.12
0.6	0.42	2.5	1.17
0.7	0.42	2.6	1.21
0.8	0.44	2.7	1.25
0.9	0.48	2.8	1.31
1	0.51	2.9	1.35
1.1	0.54	3	1.4
1.2	0.57	3.1	1.45
1.3	0.61	3.2	1.49
1.4	0.65	3.3	1.54
1.5	0.7	3.4	1.59
1.6	0.75	3.5	1.63
1.7	0.79	3.6	1.68
1.8	0.84	3.7	1.73
1.9	0.89	3.8	1.77
2	0.93	3.9	1.82
2.1	0.98	4	1.87

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## Mistake #2 – Improper attachments

- Wrong size rods → 13: 18.5.
- Through bolts
- Lags
- 6" rule
- Wrong structure type
- Anchors
- Listed equipment

**TOP JOIST SPRINKLER DETAILS (SEISMIC)**

Correct: Sprinkler System Rods on TOP JOIST with Lock Washers to Prevent Rotation in JOIST

Incorrect: Sprinkler System Rods on TOP JOIST with Lags

**EXPOSED STEEL JOIST BRACE ON EPP WALL WITH LOCK WASHERS TO PREVENT ROTATION**

Correct: Sprinkler System Rods on EPP WALL with Lock Washers to Prevent Rotation

Incorrect: Sprinkler System Rods on EPP WALL with Lags

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### Mistake #3

- Location of 4 ways
- Penetrations through walls and floors
- Flexible Vics
- End of mains



### End of line restraints

Not always required

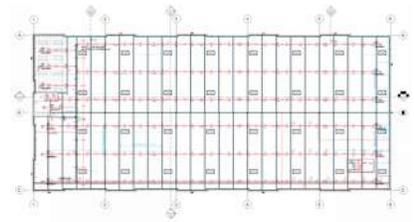


### Questions Thus Far?



### System Layout

Not a design class!



## Sprinklers

- ❑ Must be listed by Underwriters Laboratories (UL) or another agency
  - UL 199 → NFPA 13 – for property protection
  - UL 1626 → NFPA 13R/13D – for life safety
  - Operational range 135 to 600°F in most occupied spaces
  - May be exposed or concealed




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## Sprinkler k-Factors

**Comparing “k”:**

- ❑ Flow:  $Q = k \cdot P^{0.5}$
- ❑ Assume  $P = 30\text{psi}$
- ❑  $k = 2.8 \rightarrow Q = 2.8 \cdot 30^{0.5} = 15.33\text{gpm}$
- ❑  $k = 5.6 \rightarrow Q = 5.6 \cdot 30^{0.5} = 30.67\text{gpm}$
- ❑  $k = 11.2 \rightarrow Q = 11.2 \cdot 30^{0.5} = 61.34\text{gpm}$




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## Sprinkler k-Factors

**“k” Factors:**

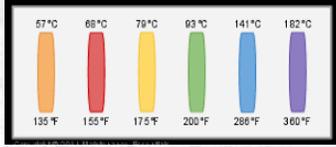
❑ 1.3-1.5	→	1/4-inch
❑ 1.8-2.0	→	5/16-inch
❑ 2.6-2.9	→	3/8-inch
❑ 4.0-4.4	→	7/16-inch
❑ 5.3-5.8	→	1/2-inch
❑ 7.4-8.2	→	17/32-inch
❑ 11.0-11.5	→	5/8-inch
❑ 13.5-14.5	→	3/4-inch
❑ 11.0-11.5	→	5/8-inch Large Drop
❑ 11.0-11.5	→	5/8-inch ESFR
❑ 13.5-14.5	→	3/4-inch ESFR




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## Sprinklers

- ❑ Response Time Index (RTI)
- ❑ Water distribution pattern

57°C	68°C	78°C	93°C	141°C	182°C
135°F	155°F	175°F	200°F	286°F	360°F



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## Types of sprinklers by orientation

**13:3.3.205**

- Concealed
- Flush
- Pendant
- Recessed
- Sidewall
- Upright

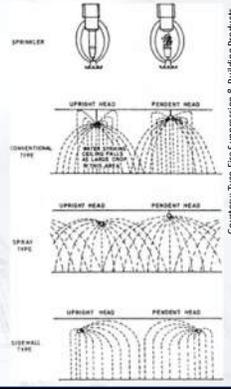



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## Water Distribution Pattern

**Maximum coverage area per sprinkler**

- Paradox: circular discharge and rectangular design criteria.
- Provides overlapping coverage



Courtesy: Tyco Fire Suppression & Building Products



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## Sprinkler Identification Number

- Sprinkler manufacturer's proprietary 5- or 6-character identification for:
  - Manufacturer
  - K-factor
  - Application (use)
  - Response characteristics
- Refer to manufacturer's technical literature for guidance




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## Sprinkler Types (13:3.3.205)

- Control Mode-CMDA
- Early Suppression Fast-Response-ESFR
- Extended Coverage-EC
- Old Style
- Open
- Quick Response-QR(QRES)
- Standard Response-SR
- Standard Spray
- Residential-RES
- Extra Large Orifice-ELO
- Dry




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### Sprinkler Head Legend (13: 27.1.3(12))

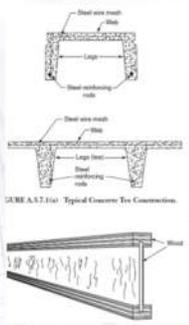
SYMBOL	MANUF.	MODEL	SPR.	#	DISP/CKE	TEMP.	FINISH	ESCUTCHEON	QTY.
○	RELIABLE	SPRINKLER HEAD	RS4475	5.6	1/2"	185	WHITE	WHITE COVER PLATE	22
○	RELIABLE	SPRINKLER HEAD	RS3012	5.6	1/2"	185	WHITE	WHITE COVER PLATE	22
○	RELIABLE	SPRINKLER HEAD	RS4475	5.6	1/2"	200	BRASS	-	204
○	RELIABLE	SPRINKLER HEAD	RS3012	5.6	1/2"	185	WHITE	WHITE RECESSED	4
○	RELIABLE	SPRINKLER HEAD	RS3012	4.9	1/2"	175	WHITE	WHITE RECESSED	1
○	RELIABLE	SPRINKLER HEAD	RS3012	5.6	1/2"	200	CHROME	CHROME	-
○	RELIABLE	SPRINKLER HEAD	RS3012	4.9	1/2"	175	WHITE	WHITE RECESSED	12
○	RELIABLE	SPRINKLER HEAD	RS3012	4.4	1/2"	150	WHITE	WHITE RECESSED	2
○	RELIABLE	SPRINKLER HEAD	RS3012	4.4	1/2"	175	WHITE	WHITE RECESSED	-
○	RELIABLE	SPRINKLER HEAD	RS3012	4.4	1/2"	175	WHITE	WHITE RECESSED	-
○	RELIABLE	SPRINKLER HEAD	RS3012	5.6	1/2"	200	CHROME	CHROME	2
○	RELIABLE	SPRINKLER HEAD	RS3012	5.6	1/2"	200	CHROME	CHROME	-
TOTAL NUMBER OF HEADS: 222									

- Always check specification sheet and compare
- Can be on any sheet
- Every different sprinkler temperature/type should have its own symbol or note



### Obstructions (13: 9.5.5.2\*)

- Obstructed Construction- 13:3.3.41.\* Trusses, beams and other members that impedes heat flow or water distribution.



### Open Web Trusses – Unobstructed

#### Example – Unobstructed Construction – 70% Rule

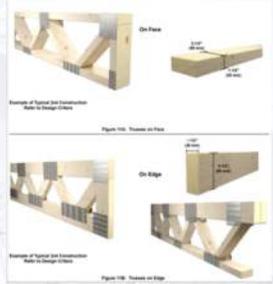
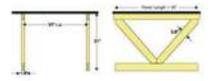
- The truss members in Figure 1 are 2x4's oriented horizontally (4x2):
  - Area of the panel = 24' x 30' = 720 in<sup>2</sup>
  - Chords = 2 x (80" x 1.5") = 90 in<sup>2</sup>
  - Webs = 2 x (25.81" x 1.5") = 77 in<sup>2</sup>
  - Total area = 90 + 77 = 167 in<sup>2</sup>
  - Area of panel divided by obstructed area = 367/720 = 0.233 or 23%
- The panel is 77% open, therefore this configuration would be considered 'Unobstructed Construction.'



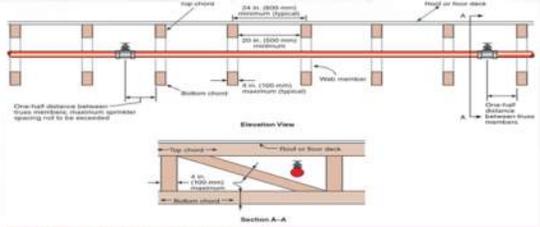
### Open Web Trusses – Obstructed

#### Example – Obstructed Construction

- The truss members in Figure 2 are 2x4's oriented vertically (2x4):
  - Area of the panel = 24' x 30' = 720 in<sup>2</sup>
  - Chords = 2 x (30" x 3.5") = 210 in<sup>2</sup>
  - Webs = 2 x (25.81" x 3.5") = 181 in<sup>2</sup>
  - Total area = 210 + 181 = 391 in<sup>2</sup>
  - Area of panel divided by obstructed area = 391/720 = 0.543 or 54%
- The panel is 46% open, therefore this configuration would be considered 'Obstructed Construction.'



### Very specific placement



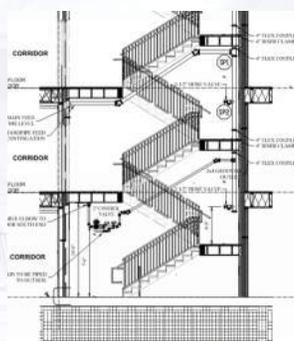
### Other common obstructions

- ❑ Soffits → 10.3.5.1.3
- ❑ Cabinets → HSW 13: 12.1.11.1.5\*
- ❑ Clouds and decorative ceilings → 13:9.2.7
- ❑ HVAC (4') → 13:9.5.5.3.1\*
- ❑ Walls → 13:9.5

*Each sprinkler type has its own development pattern and rules for placement!*

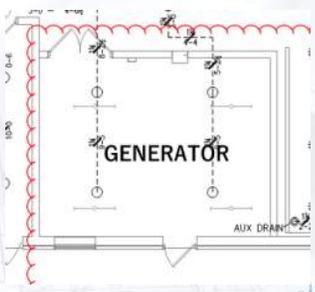
### Common Mistake #1

In noncombustible stair shafts having noncombustible stairs with noncombustible or limited-combustible finishes, sprinklers shall be installed at the top of the shaft and under the first accessible landing above the bottom of the shaft [NFPA 13:9.4.3.2.1].



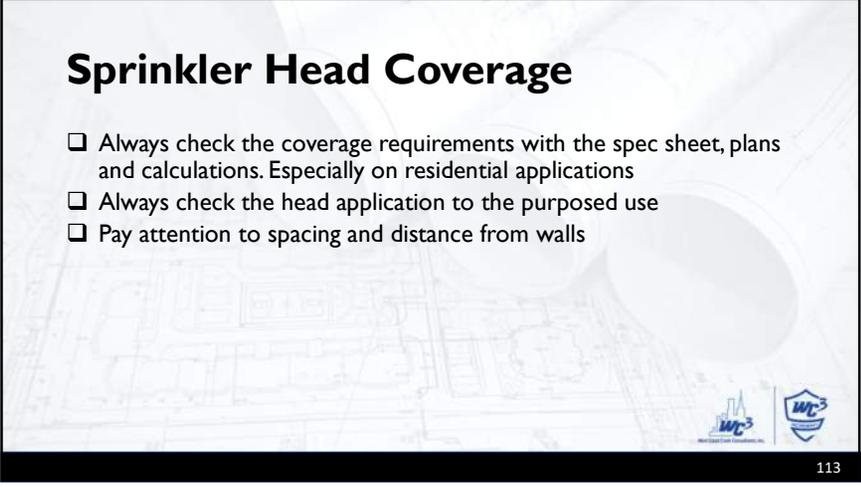
### Common Mistake #2

- ❑ Extra Hazard spaces
- ❑ QR Sprinklers
- ❑ Quick response heads are not to be installed in extra hazard occupancies [NFPA 13: 19.3.3.2.2.2].



## Sprinkler Head Coverage

- ❑ Always check the coverage requirements with the spec sheet, plans and calculations. Especially on residential applications
- ❑ Always check the head application to the purposed use
- ❑ Pay attention to spacing and distance from walls





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## Common Mistake #3

### Spacing





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## Residential Sprinklers

Maximum Coverage Area ft x ft (m x m)	Maximum Spacing ft (m)	WET PIPE SYSTEM Minimum Flow and Residual Pressure <sup>1, 2</sup>		Deflector to Ceiling	Installation Type	Minimum Spacing ft (m)
		Temp. Rating 180°F (71°C), 212°F (100°C)				
		Flow GPM (LPM)	Pressure psi (bar)			
12 x 12 (3.7 x 3.7)	12 (3.7)	13 (48.2)	7.0 (0.48)		Smooth Ceilings 78 to 1-1/8 in.	
16 x 14 (4.9 x 4.3)	14 (4.3)	13 (48.2)	7.0 (0.48)		Smooth Ceilings 78 to 1-1/8 in.	
16 x 16 (4.9 x 4.9)	16 (4.9)	13 (48.2)	7.0 (0.48)		Smooth Ceilings per NFPA 13D or 13, Installed in Ceiling	8 (2.4)
18 x 18 (5.5 x 5.5)	18 (5.5)	17 (64.3)	9.0 (0.62)		78 to 1-1/8 in. below bottom of beam.	
20 x 20 (6.1 x 6.1)	20 (6.1)	20 (75.7)	16.7 (1.18)			

Notes:  
1. For coverage area dimensions less than or between those indicated, use the minimum required flow for the next highest coverage area for which technical design criteria are stated.  
2. Residual pressure is based on minimum flow as (FRP x K) from each application. The associated residual pressures are calculated using the formula in Section 5.4.2. See Hydraulic Design under the Design Criteria section.  
3. For NFPA 13 residential applications, the pressure of 11.3 MPa (1.65 MPa) may be used in accordance with the criteria in this table when the design is for a wet pipe system.

**TABLE A  
WET PIPE SYSTEM  
SERIES LFI RESIDENTIAL 4.9 K-FACTOR PLATE CONCEALED PENDENT SPRINKLER (TY2596)  
NFPA 13D, 13R, AND 13 HYDRAULIC DESIGN CRITERIA**



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## Heads Needing Extra Attention

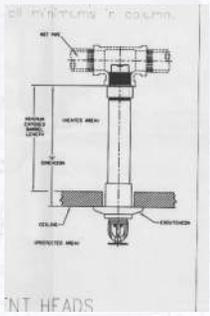
- ❑ CMSA
- ❑ ESRF
- ❑ Extended Coverage
- ❑ Dry
- ❑ HSW
- ❑ Attic

There is no such thing as a standard placement for a sprinkler head.



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## Dry Head Detail



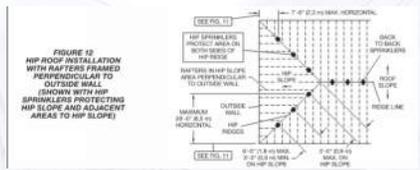
- Can never be on an EII (90)
- Needs to be so many inches from cold area
- Filling
- I3: 15.3



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## Attic Heads

- Have unique protection areas not found in NFPA 13
- Requires special placement of heads
- Obstructions abound
- Always have the designer give a detail on location of heads in attic




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## HSW

- Distance from ceiling dependent on sprinkler head, slope, ceiling type.
- Don't use a rule of thumb
- I3: 10.3

Minimum Flow and Residual Pressure in Wet Pipe Systems <sup>(1)</sup>			
Maximum Coverage Area <sup>(2)</sup> ft. x ft. (m x m)	Flow Rate (GPM)	Pressure and (Bar)	Deflector to Ceiling Distance
18 x 20 (5.5 x 6.1)	30 (1.14)	35.8 (1.85)	
20 x 20 (6.1 x 6.1)	30 (1.14)	35.8 (1.85)	
18 x 22 (5.9 x 6.7)	33 (1.29)	32.4 (2.03)	4 to 6 inches (100 to 150 mm)
18 x 24 (5.9 x 7.3)	38 (1.44)	42.9 (2.96)	
14 x 26 (4.3 x 7.9)	42 (1.60)	32.4 (2.03)	
18 x 20 (5.5 x 6.1)	35 (1.30)	36.4 (2.01)	
18 x 22 (5.9 x 6.7)	38 (1.44)	42.9 (2.96)	
18 x 24 (5.9 x 7.3)	42 (1.60)	52.4 (3.61)	6 to 12 inches (150 to 300 mm)
14 x 26 (4.3 x 7.9)	46 (1.74)	62.9 (4.34)	



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## Concealed Combustible Spaces

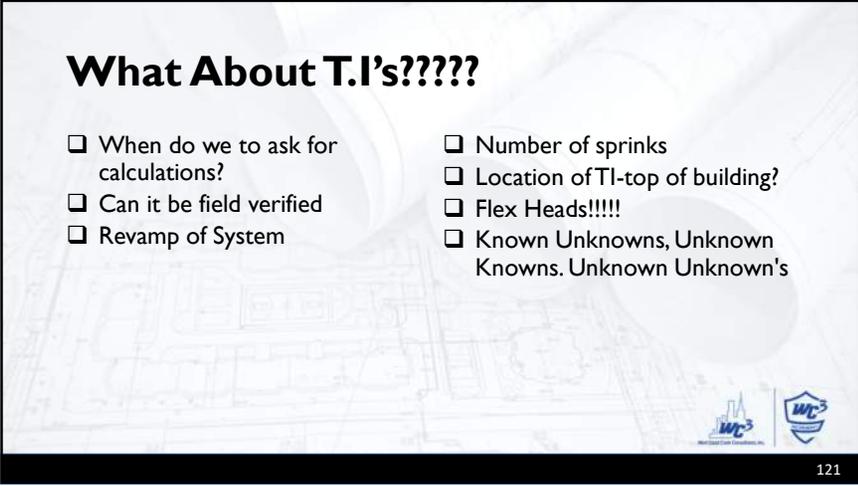
- Different for different occupancies
- Always require special attention
- Does not matter if a space is accessible or not
- I3: 9.2.1\*
- I3: 3.3.1.5.1\*



120

## What About T.I.'s?????

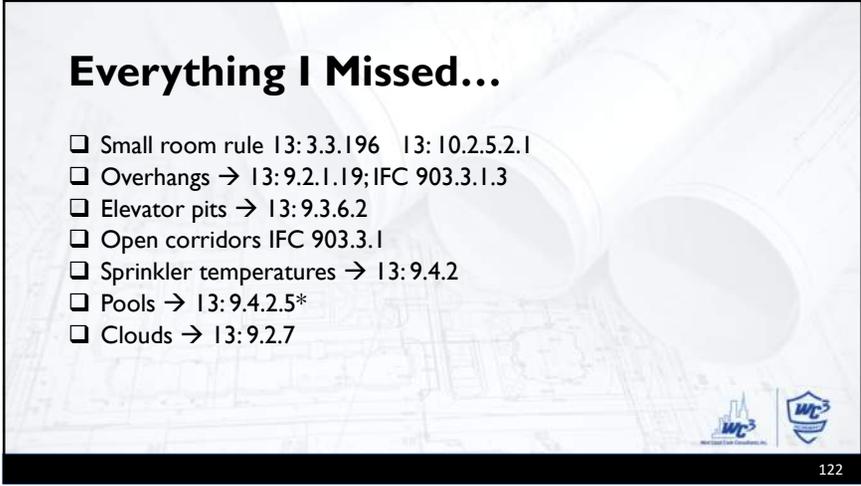
- When do we to ask for calculations?
- Can it be field verified
- Revamp of System
- Number of sprink
- Location of TI-top of building?
- Flex Heads!!!!
- Known Unknowns, Unknown Knowns. Unknown Unknown's




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## Everything I Missed...

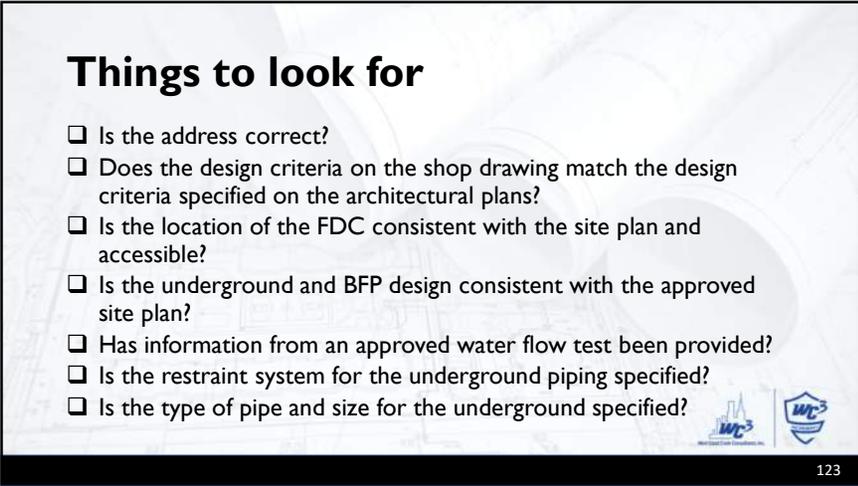
- Small room rule 13: 3.3.196 13: 10.2.5.2.1
- Overhangs → 13: 9.2.1.19; IFC 903.3.1.3
- Elevator pits → 13: 9.3.6.2
- Open corridors IFC 903.3.1
- Sprinkler temperatures → 13: 9.4.2
- Pools → 13: 9.4.2.5\*
- Clouds → 13: 9.2.7




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## Things to look for

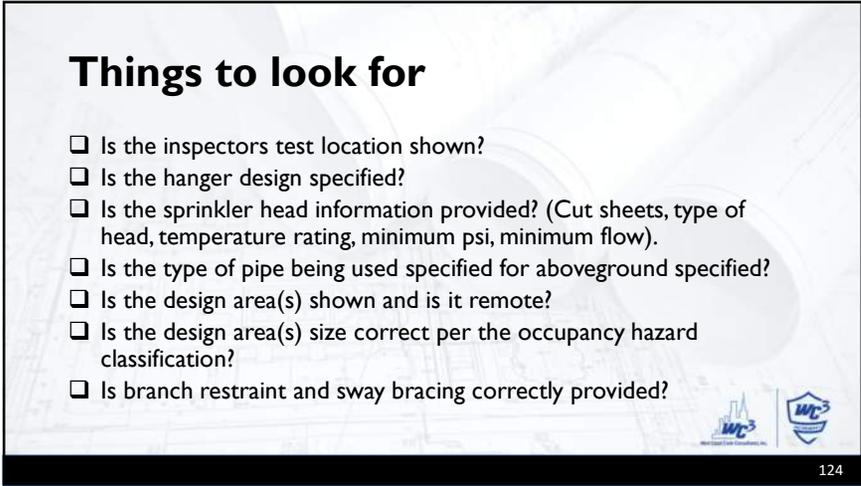
- Is the address correct?
- Does the design criteria on the shop drawing match the design criteria specified on the architectural plans?
- Is the location of the FDC consistent with the site plan and accessible?
- Is the underground and BFP design consistent with the approved site plan?
- Has information from an approved water flow test been provided?
- Is the restraint system for the underground piping specified?
- Is the type of pipe and size for the underground specified?




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## Things to look for

- Is the inspectors test location shown?
- Is the hanger design specified?
- Is the sprinkler head information provided? (Cut sheets, type of head, temperature rating, minimum psi, minimum flow).
- Is the type of pipe being used specified for aboveground specified?
- Is the design area(s) shown and is it remote?
- Is the design area(s) size correct per the occupancy hazard classification?
- Is branch restraint and sway bracing correctly provided?



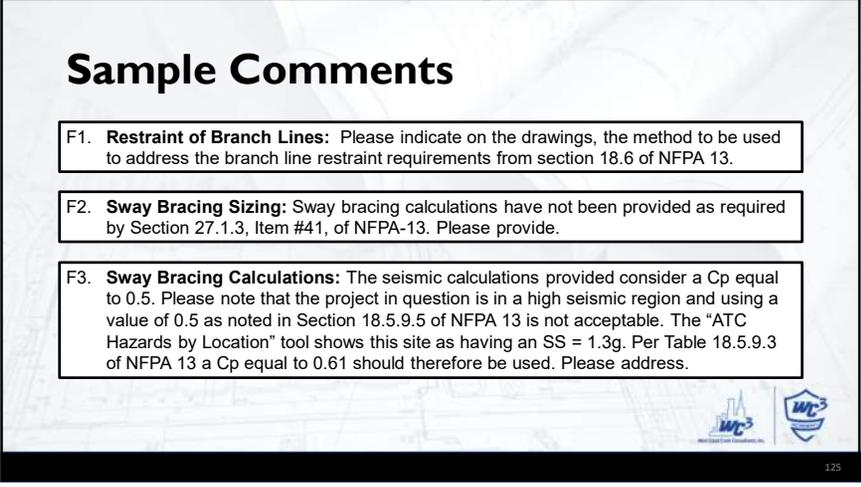

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## Sample Comments

F1. **Restraint of Branch Lines:** Please indicate on the drawings, the method to be used to address the branch line restraint requirements from section 18.6 of NFPA 13.

F2. **Sway Bracing Sizing:** Sway bracing calculations have not been provided as required by Section 27.1.3, Item #41, of NFPA-13. Please provide.

F3. **Sway Bracing Calculations:** The seismic calculations provided consider a  $C_p$  equal to 0.5. Please note that the project in question is in a high seismic region and using a value of 0.5 as noted in Section 18.5.9.5 of NFPA 13 is not acceptable. The "ATC Hazards by Location" tool shows this site as having an  $SS = 1.3g$ . Per Table 18.5.9.3 of NFPA 13 a  $C_p$  equal to 0.61 should therefore be used. Please address.



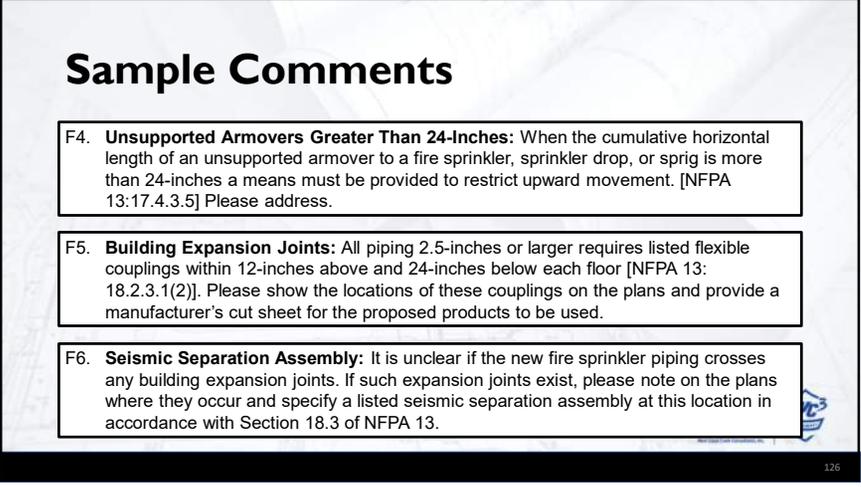
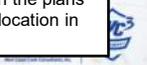

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## Sample Comments

F4. **Unsupported Armoovers Greater Than 24-Inches:** When the cumulative horizontal length of an unsupported armoover to a fire sprinkler, sprinkler drop, or sprig is more than 24-inches a means must be provided to restrict upward movement. [NFPA 13:17.4.3.5] Please address.

F5. **Building Expansion Joints:** All piping 2.5-inches or larger requires listed flexible couplings within 12-inches above and 24-inches below each floor [NFPA 13: 18.2.3.1(2)]. Please show the locations of these couplings on the plans and provide a manufacturer's cut sheet for the proposed products to be used.

F6. **Seismic Separation Assembly:** It is unclear if the new fire sprinkler piping crosses any building expansion joints. If such expansion joints exist, please note on the plans where they occur and specify a listed seismic separation assembly at this location in accordance with Section 18.3 of NFPA 13.

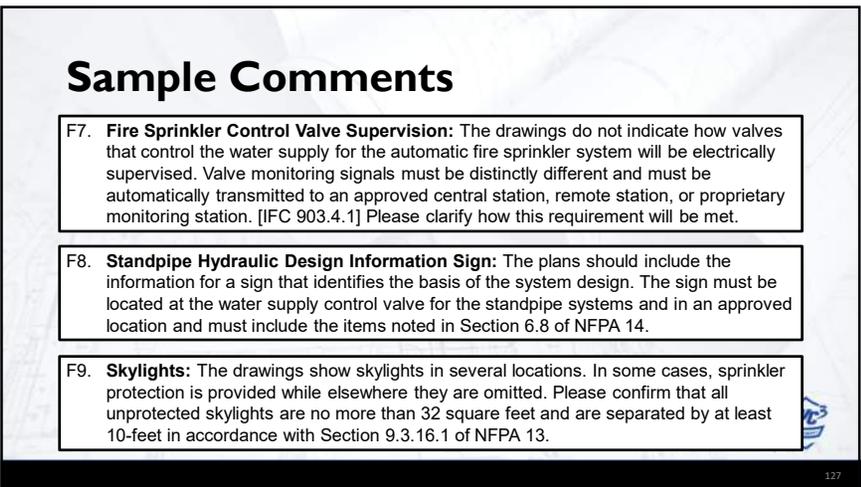
126

## Sample Comments

F7. **Fire Sprinkler Control Valve Supervision:** The drawings do not indicate how valves that control the water supply for the automatic fire sprinkler system will be electrically supervised. Valve monitoring signals must be distinctly different and must be automatically transmitted to an approved central station, remote station, or proprietary monitoring station. [IFC 903.4.1] Please clarify how this requirement will be met.

F8. **Standpipe Hydraulic Design Information Sign:** The plans should include the information for a sign that identifies the basis of the system design. The sign must be located at the water supply control valve for the standpipe systems and in an approved location and must include the items noted in Section 6.8 of NFPA 14.

F9. **Skylights:** The drawings show skylights in several locations. In some cases, sprinkler protection is provided while elsewhere they are omitted. Please confirm that all unprotected skylights are no more than 32 square feet and are separated by at least 10-feet in accordance with Section 9.3.16.1 of NFPA 13.



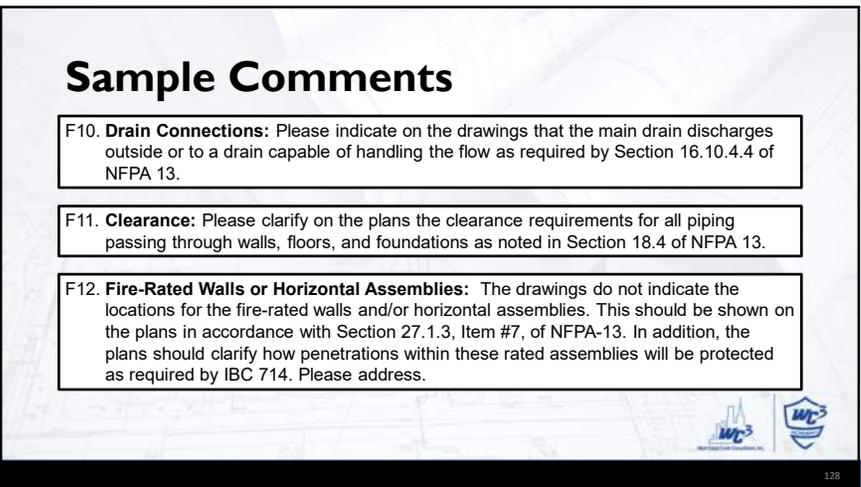

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## Sample Comments

F10. **Drain Connections:** Please indicate on the drawings that the main drain discharges outside or to a drain capable of handling the flow as required by Section 16.10.4.4 of NFPA 13.

F11. **Clearance:** Please clarify on the plans the clearance requirements for all piping passing through walls, floors, and foundations as noted in Section 18.4 of NFPA 13.

F12. **Fire-Rated Walls or Horizontal Assemblies:** The drawings do not indicate the locations for the fire-rated walls and/or horizontal assemblies. This should be shown on the plans in accordance with Section 27.1.3, Item #7, of NFPA-13. In addition, the plans should clarify how penetrations within these rated assemblies will be protected as required by IBC 714. Please address.




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### Sample Comments

**F13. Drawing FP1 - Underground Fire Sprinkler Piping Main:** It is unclear from the drawings if the main supplying the fire sprinkler system is to be installed under the building. This is not allowed by Section 5.1.6.2 of NFPA 13 unless proper clearance is provided. Please clarify how the proper clearance will be provided in accordance with NFPA 24.

**F14. Acceptance of Underground:** Please note on the drawings that a completed "Contractor's Material and Test Certificate for Underground Piping" will be provided to the AHJ, and that the AHJ will be notified before this test takes place in accordance with Section 6.10.1 of NFPA 13.

**F15. Sprinkler System Acceptance:** Please note on the drawings that a completed "Contractor's Material and Test Certificate for Aboveground Piping" will be provided to the AHJ, and that the AHJ will be notified before this test takes place in accordance with Section 28.1 of NFPA 13.

### Sample Comments

**F16. Hydraulic Design Information Sign:** Please clarify on the drawings that a hydraulic design information sign will be provided at the alarm valve as required by Section 28.5 of NFPA 13.

**F17. General Information Sign:** Please note on the drawings that a general information sign is to be provided at each fire sprinkler riser complying with Section 28.6 of NFPA 13.

SPRINKLER SYSTEM GENERAL INFO.

Name: \_\_\_\_\_

Location: \_\_\_\_\_

High Piled Storage  Yes  No  Rack Storage  Yes  No

Maximum Storage Height: \_\_\_\_\_ ft.

Minimum Aisle Width: \_\_\_\_\_ ft.

Commonly Classified: \_\_\_\_\_

Encapsulation  Yes  No  Solid Shoring  Yes  No

Flow Test Data: \_\_\_\_\_

Date: \_\_\_\_\_

Pressure: \_\_\_\_\_ psi

Location: \_\_\_\_\_

Presence of Flammable/Combustible Liquids:  Yes  No

Presence of Hazardous Materials:  Yes  No

Presence of Other Special Storage:  Yes  No

Auxiliary Low Point Drain Locations: \_\_\_\_\_

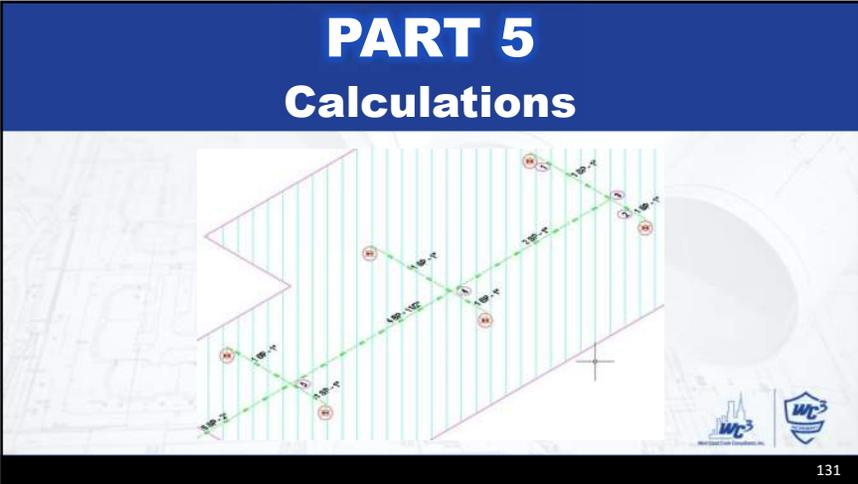
Original Main Drain Test - Static: \_\_\_\_\_ psi

Result: \_\_\_\_\_ psi

Airline or Auxiliary Systems Present:  Yes  No

Location: \_\_\_\_\_

Installing Contractor: \_\_\_\_\_



## Hydraulic Calculations

- Not a calculation class!
- How far you want to do the hydraulic calculations on a plan review is up to you.

NO.	SECTION	IN-FACTOR	PROVISION	DETERMINER
1	100	1.00	100	100
2	100	1.00	100	100
3	100	1.00	100	100
4	100	1.00	100	100
5	100	1.00	100	100
6	100	1.00	100	100
7	100	1.00	100	100
8	100	1.00	100	100
9	100	1.00	100	100
10	100	1.00	100	100
11	100	1.00	100	100
12	100	1.00	100	100
13	100	1.00	100	100
14	100	1.00	100	100
15	100	1.00	100	100
16	100	1.00	100	100
17	100	1.00	100	100
18	100	1.00	100	100
19	100	1.00	100	100
20	100	1.00	100	100
21	100	1.00	100	100
22	100	1.00	100	100
23	100	1.00	100	100
24	100	1.00	100	100
25	100	1.00	100	100
26	100	1.00	100	100
27	100	1.00	100	100
28	100	1.00	100	100
29	100	1.00	100	100
30	100	1.00	100	100
31	100	1.00	100	100
32	100	1.00	100	100
33	100	1.00	100	100
34	100	1.00	100	100
35	100	1.00	100	100
36	100	1.00	100	100
37	100	1.00	100	100
38	100	1.00	100	100
39	100	1.00	100	100
40	100	1.00	100	100
41	100	1.00	100	100
42	100	1.00	100	100
43	100	1.00	100	100
44	100	1.00	100	100
45	100	1.00	100	100
46	100	1.00	100	100
47	100	1.00	100	100
48	100	1.00	100	100
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50	100	1.00	100	100
51	100	1.00	100	100
52	100	1.00	100	100
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64	100	1.00	100	100
65	100	1.00	100	100
66	100	1.00	100	100
67	100	1.00	100	100
68	100	1.00	100	100
69	100	1.00	100	100
70	100	1.00	100	100
71	100	1.00	100	100
72	100	1.00	100	100
73	100	1.00	100	100
74	100	1.00	100	100
75	100	1.00	100	100
76	100	1.00	100	100
77	100	1.00	100	100
78	100	1.00	100	100
79	100	1.00	100	100
80	100	1.00	100	100
81	100	1.00	100	100
82	100	1.00	100	100
83	100	1.00	100	100
84	100	1.00	100	100
85	100	1.00	100	100
86	100	1.00	100	100
87	100	1.00	100	100
88	100	1.00	100	100
89	100	1.00	100	100
90	100	1.00	100	100
91	100	1.00	100	100
92	100	1.00	100	100
93	100	1.00	100	100
94	100	1.00	100	100
95	100	1.00	100	100
96	100	1.00	100	100
97	100	1.00	100	100
98	100	1.00	100	100
99	100	1.00	100	100
100	100	1.00	100	100

### Key Items to Check

- ❑ Compare the given fire flow information to the hydraulic calculation's summary and on the node calculations for the source

WATER SUPPLY DATA						
SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	FLOW @ (GPM)	AVAIL. PRESS. (PSI)	TOTAL @ DEMAND (GPM)	REQ'D PRESS. (PSI)
SOURCE	59.0	53.0	1500.0	48.6	2017.4	49.3
U13 SOURCE	-4.0	-4.0	---	45.0	---	---
			SOURCE	49.3	2017.4	



### Key Items to Check

- ❑ Check to see if the node #'s match both the analysis and the plan
- ❑ Make sure the remote areas are where and what they should be
  - Most demanding
  - Different hazards
  - Most remote

Hydraulic Information	
Remote Area 1	
OCCUPANCY CLASSIFICATION	LIGHT HAZARD
DENSITY (GPM/FT <sup>2</sup> )	0.10 FOR 1000FT <sup>2</sup> ACTUAL 1005FT <sup>2</sup>
QUICK RESPONSE REDUCTION	10'-0" CEILING (40.0%) 600FT <sup>2</sup>
TOTAL HOSE STREAMS	100.00
TOTAL HEADS FLOWING	9
K-FACTOR	5.8
TOTAL WATER REQUIRED	312.04
TOTAL PRESSURE REQUIRED	47.789
BASE OF RISER (GPM)	312.04
BASE OF RISER (PSI)	47.789
SAFETY MARGIN (PSI)	+11.233 (16.6%)



### Common Issues

- ❑ Back flow preventer is different
- ❑ Size of piping on analysis is different from plan (inside diameters)

Segment	Length
AO	1.0830
1011	10'-8"
24	10'-8"
BL	1.5300
24	10'-8"
21	10'-8"



### Common Issues

- ❑ Long runs get shortened
- ❑ Design density is off
- ❑ Slope of ceiling is not considered
- ❑ Concealed combustible areas
  - Filled with insulation-adjusts density
- ❑ Adjoining hazard 15' rule



# Anti-Freeze

- No loop (Closed System)
- Expansion tank
- No 1/32<sup>nd</sup> hole in check valve
- Listed Anti-freeze (13D different)
- Viscosity

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# Loop-Straight

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# Start your Questions!

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# PART 6 Standpipes

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## Standpipes (NFPA 14/IFC)

*Standpipes are required when the following conditions apply [IFC 905.3.1]:*

1. Four or more stories above or below grade
2. Building where floor level of highest story is more than 30' above lowest level of fire department access 3rd floor of this building is a 34' and above the required distance.
3. Building where floor level of lowest story is more than 30' above highest level of fire department access



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## Types of Standpipe Systems

- Automatic-wet standpipe system
- Automatic-dry standpipe system
- Semiautomatic-dry standpipe system
- Manual-dry standpipe system
- Manual-wet system system

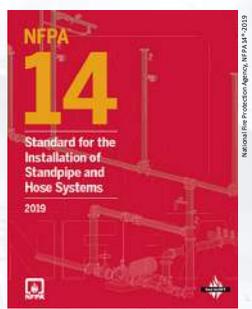


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## Standard

*NFPA 14 – Standard For the Installation of Standpipe and Hose Systems*

- Class I
- Class II
- Class III




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## Class I Standpipe Systems

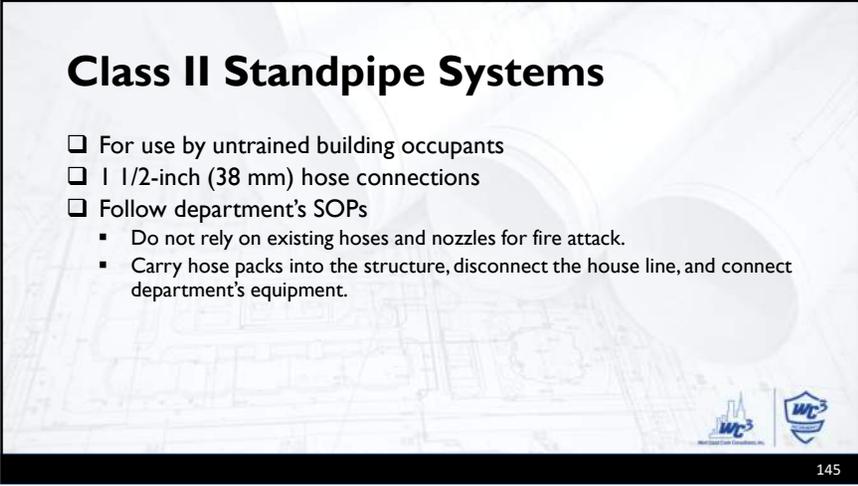
- For use by trained fire fighting personnel
- Can supply effective fire streams during more advanced fire stages
- 2 1/2-inch (65 mm) hose connections or hose stations attached to standpipe riser



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## Class II Standpipe Systems

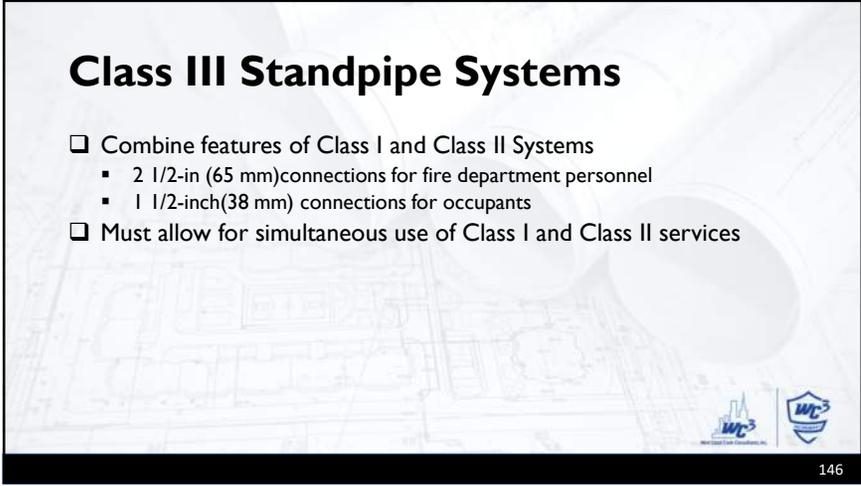
- ❑ For use by untrained building occupants
- ❑ 1 1/2-inch (38 mm) hose connections
- ❑ Follow department's SOPs
  - Do not rely on existing hoses and nozzles for fire attack.
  - Carry hose packs into the structure, disconnect the house line, and connect department's equipment.




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## Class III Standpipe Systems

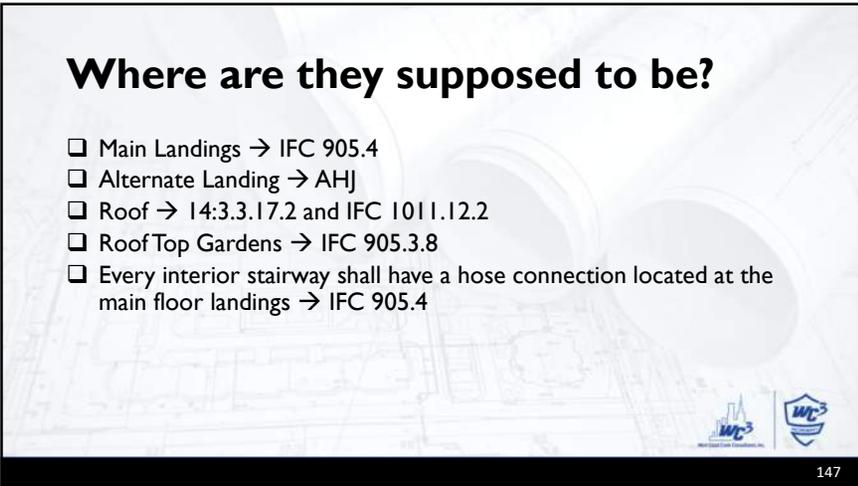
- ❑ Combine features of Class I and Class II Systems
  - 2 1/2-in (65 mm) connections for fire department personnel
  - 1 1/2-inch(38 mm) connections for occupants
- ❑ Must allow for simultaneous use of Class I and Class II services




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## Where are they supposed to be?

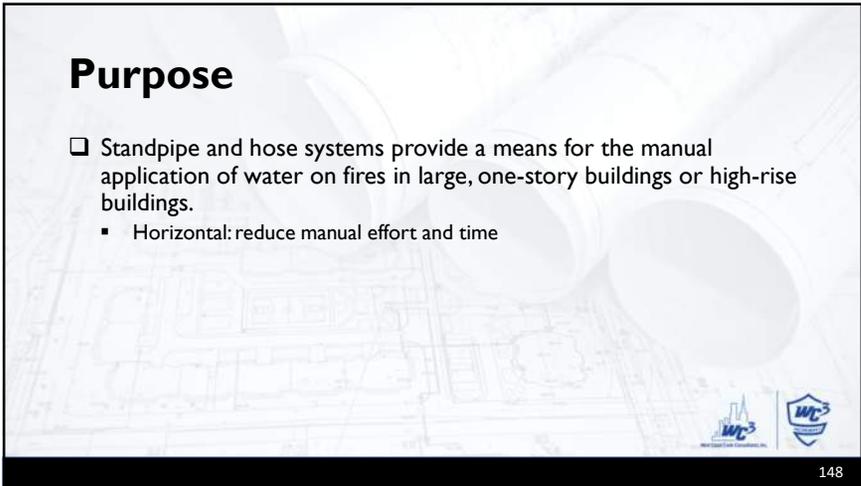
- ❑ Main Landings → IFC 905.4
- ❑ Alternate Landing → AHJ
- ❑ Roof → 14:3.3.17.2 and IFC 1011.12.2
- ❑ Roof Top Gardens → IFC 905.3.8
- ❑ Every interior stairway shall have a hose connection located at the main floor landings → IFC 905.4




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## Purpose

- ❑ Standpipe and hose systems provide a means for the manual application of water on fires in large, one-story buildings or high-rise buildings.
  - Horizontal: reduce manual effort and time




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## Water Supply for Standpipe Systems

**Class I and Class III:**

- ❑ 500 gpm (1 893 L/min) for 30 minutes, with a residual pressure of 100 psi (690 kPa) at the most hydraulically remote 2 1/2-inch (65 mm) outlet
- ❑ 100 psi (690 kPa) for the most remote 1 1/2-inch (38 mm) outlet
- ❑ More than one standpipe riser: 250 gpm (946 L/min) for each additional riser to a maximum of 2,500 gpm (9 463 L/min).



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## Water Supply for Standpipe Systems

- ❑ Class II: 100 gpm (378 L/min) for at least 30 minutes, with a residual pressure of at least 65 psi (448 kPa) at the highest outlet
- ❑ Fog nozzles
- ❑ Sprinkler system supply
- ❑ Water supply



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## Standpipes in High-Rise Buildings

**Size:**

- ❑ Determined by height of building and class of service
- ❑ Class I and Class III: 4 inches (100 mm) for building heights less than 100 feet (30 m); 6 inches (150 mm) for heights over 100 feet (30 m). When a Class I or Class III standpipe exceeds 100 feet (30 m) in height, the top 100 feet (30 m) is allowed to be 4-inch (100 mm) pipe.



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## Standpipes in High-Rise Buildings

**Size (cont.):**

- ❑ Class II: 2 inches (50 mm) for a building height less than 50 feet (15 m); for a building over 50 feet (15 m) in height, the minimum size riser is 2 1/2 inches (65 mm); systems over 275 feet (84 m) should be divided into sections.
- ❑ Combined standpipe and sprinkler systems: 6 inches unless building is completely sprinklered with hydraulically calculated system



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## Standpipes in High-Rise Buildings

### Location

- Travel distances
- Stair enclosures
- Roof (Class I or Class III)

### Zoned buildings

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## Pressure Regulating Devices

### Hose outlet pressure > 100 psi (682.5 kPa)

- Hose handling
- System reliability

### Types

- Restricting orifice
- Vanes in waterway
- Pressure reducing valve

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## Fire Department Connections

- Class I and Class III
  - At least one FDC
  - Zoned buildings: at least one FDC per zone
- Maximum height: 450 feet (137 m) for two-stage pumper
- Connections: female or Storz, equipped with standard caps
- Signage

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## Inspecting and Testing Standpipes

- Plans review
- Initial inspection
  - Hydrostatic test
  - Flow tests
  - Listing of all devices by testing laboratory
  - Hose stations and connections
  - Signage on cabinets/closets and FDC
  - (Continued)

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## Inspecting and Testing Standpipes

***In-service inspections***

- All water supply valves sealed in open position
- Power available to fire pump
- Individual hose valves free of paint, corrosion, and other impediments
- Hose valve threads undamaged and matched to fire department couplings
- Fire department connection caps in place
- (Continued)



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## Inspecting and Testing Standpipes

***In-service inspections (cont.)***

- Pipes free of trash or debris
- Hose valve wheels present and undamaged
- Hose cabinets accessible
- Hose in good condition, properly dry, and properly positioned on rack
- Hose nozzles present and in good working order



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# PART 7 Pumps




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## Fire Pumps are Cool!

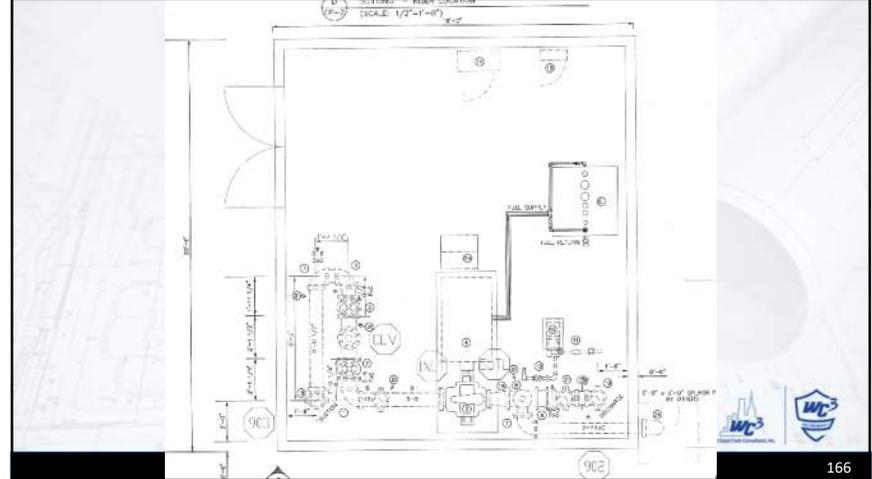
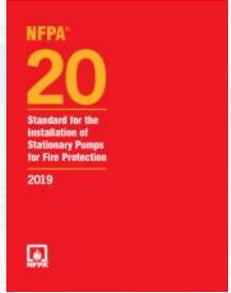
- The main function of a fire pump is to increase the pressure of the water that flows through it.
- Inadequate or nonexistent municipal water supply system
- May or may not be feed from a tank
- Or a pond



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### Things to be attentive to

- Pumps for high rises
- Electric drive
- Diesel drive
- Location of pump room
- Rating of pump room
- Access to that room



### Pump Piping

- Location of valves
- Cooling system
- By-pass
- Test header
- Eccentric fittings
- Footing

