Common Mistakes You SHOULD Find Doing a Fire Sprinkler Plan Review – or at LEAST Think About…

- Richard M. Ray, PE
- Cybor Fire Protection Company
- 5123 Thatcher Road
- Downers Grove, IL 60515
- 630 810 1161
- 630 774 1616 cell
- rmr@cyborfireprotection.com

Who Prepared the Plans?

- Here's what the IL Fire Sprinkler Licensing Act says:
- "*All fire protection system layout documents of fire sprinkler systems, as defined in Section 10 of this Act,* ***shall be prepared by*** *(i) a professional engineer who is licensed under the Professional Engineering Practice Act of 1989, (ii) an architect who is licensed under the Illinois Architecture Practice Act of 1989, or (iii) a holder of a valid NICET level 3 or 4 certification in fire protection technology automatic sprinkler system layout who is either licensed under this Act or employed by an organization licensed under this Act"*.
- So the plan **cannot be** prepared by a non-certified person (PE or NICET III) then "reviewed" by a certified person.

Watch End Head Pressures VS Deflector Distance!

Especially with Residential & Extended Coverage Sprinkler Heads

Max. Coverage area Ft x Ft (m x m)	Max. Spacing Ft (m)	Ordinary Temp. Rating (155°F/68°C)		Intermediate Temp. Rating (175°F/79°C)		Top of Deflector to Ceiling Inch (mm)	Minimum Spacing Ft (m)
		Flow GPM (L/min)	Pressure PSI (bar)	Flow GPM (L/min)	Pressure PSI (bar)		
12 x 12 (3,6 x 3,6)	12 (3,6)	12 (45,4)	7.5 (0,52)	12 (45,4)	7.5 (0,52)	* 4 to 6 (100 to 152); ½ (13) recessed using F2 escutcheon	8 (2,4)
14 x 14 (4,3 x 4,3)	14 (4,3)	14 (53,0)	10.2 (0,71)	14 (53,0)	10.2 (0,71)		
16 x 16 (4,9 x 4,9)	16 (4,9)	16 (60,6)	13.3 (0,92)	16 (60,6)	13.3 (0,92)		
16 x 18 (4,9 x 5,5)	16 (4,9)	18 (68,1)	16.8 (1,16)	18 (68,1)	16.8 (1,16)		
18 x 18 (5,5 x 5,5)	18 (5,5)	19 (72,0)	18.7 (1,29)	19 (72,0)	18.7 (1,29)		
16 x 20 (4,9 x 6,1)	16 (4,9)	23 (87,1)	27.4 (1,89)	23 (87,1)	27.4 (1,89)		
12 x 12 (3,6 x 3,6)	12 (3,6)	14 (53,0)	10.2 (0,71)	14 (53,0)	10.2 (0,71)	* 6 to 12 (152 to 305); ½ (13) recessed using F2 escutcheon	
14 x 14 (4,3 x 4,3)	14 (4,3)	16 (60,6)	13.3 (0,92)	16 (60,6)	13.3 (0,92)		
16 x 16 (4,9 x 4,9)	16 (4,9)	17 (64,4)	15.0 (1,04)	17 (64,4)	15.0 (1,04)		
16 x 18 (4,9 x 5,5)	16 (4,9)	20 (75,7)	20.7 (1,43)	20 (75,7)	20.7 (1,43)		
16 x 20 (4,9 x 6,1)	16 (4,9)	23 (87,1)	27.4 (1,89)	23 (87,1)	27.4 (1,89)		

For Ceiling types refer to NFPA 13, 13R or 13D

HUH? Why Does This Matter??

- Because what will happen if there is a fire & the head is further down from the ceiling……..?

HUH? Why Does This Matter??

- Operation of the sprinkler head will be delayed and by then the fire will have grown in size.
- This is very often overlooked!
- OR – the plans/calcs match but the install is different (“I had to avoid the crown molding”).
- Projects with marginal water supplies!

Head Spacing

- Area of coverage not necessarily based on distance between heads.
- Its based on the greater of: the distance between heads or TWICE the distance to a wall (or obstruction)
- Example:

What's the spacing?

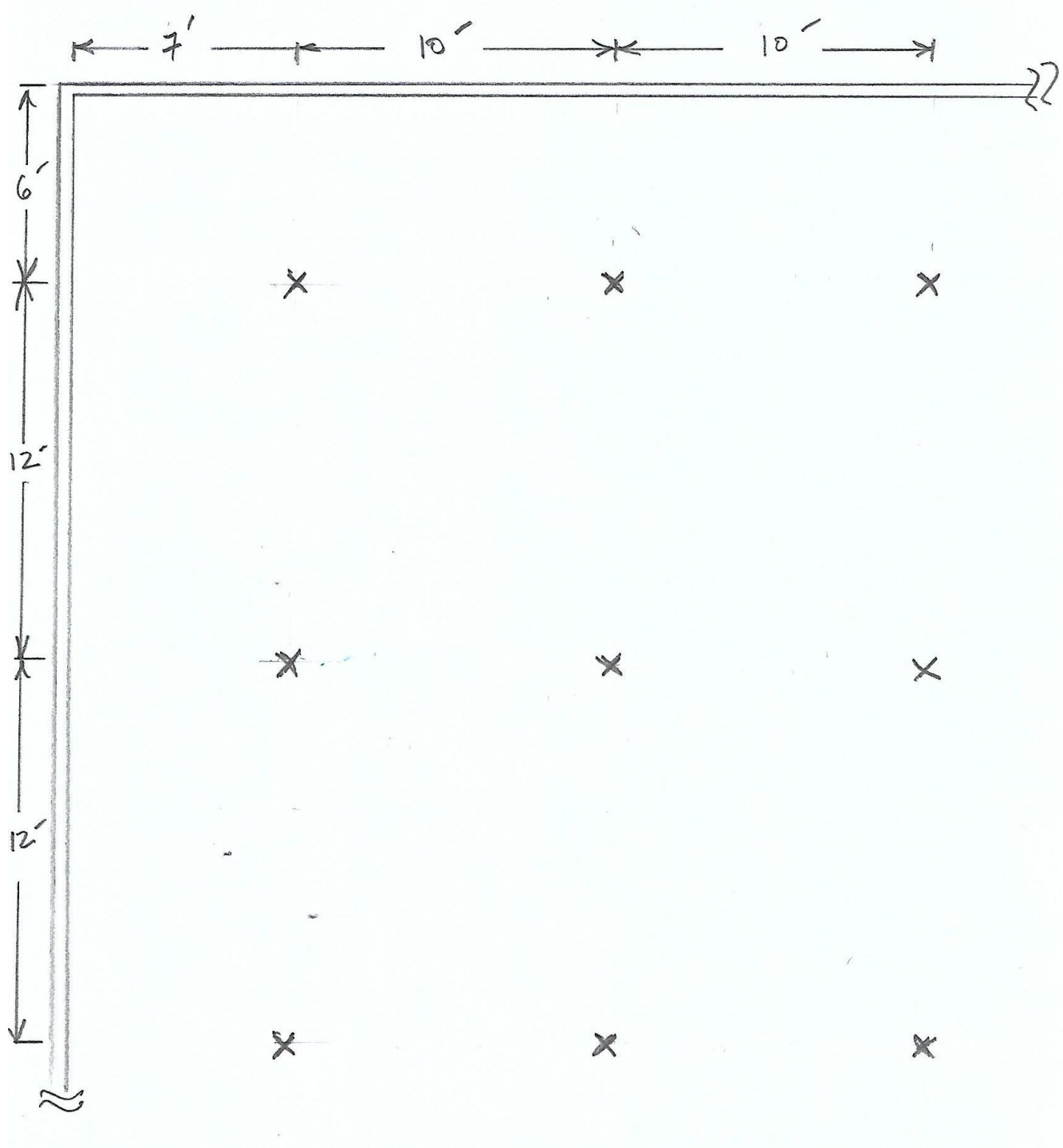
10'x12' = 120sqft?

No!

10' or twice 7' – greater is twice 7' so 14'.

Then 14' x 12' = 168sq ft

(note twice 6' = 12')



Backflow Preventers

- When any type of backflow preventer is installed on a system, a means of “full forward flow testing” it shall be provided.
- How do you do that?
- Light hazard or 13R or D: could use the main drain (probably).
- Fire pump: can use the test header.
- Others: separate riser with 2-1/2” hose valves on it; separate valve with cap for use; etc.
- Some means to move system demand thru the BFP.

Backflow Preventers

- What about when the Plumbing or Public Works Department goes knocking on doors telling people with detector check valves that they need to retrofit their system with a BFP?
- Does the fire department get involved?
- If the answer is “NO”, they need to!
- NFPA 13 says that a hydraulic analysis is REQUIRED to be performed to determine the effect the BFP will have on the water supply to the fire sprinkler (or standpipe) system.
- DDC – usually ok; RPZ – usually NOT ok.
- Can mean pipe sizes need to be changed or pump added (!).

Backflow Preventers

- Keep in mind they must be TEN PIPE DIAMETERS away from the suction of a fire pump.
- This is similar to butterfly valves – which are prohibited on the suction side of a fire pump unless 50’ away (that’s way more than ten pipe diameters).
- The issue is turbulence on the suction side of the pump.

While We're Talking About Fire Pumps…

- NFPA 20 requires ALL fire pumps to be located in a one hour rated room (can be a surprise on a retrofit job).
- Keep in mind that if the length of piping to a pump test header exceeds 15', you typically must increase the pipe size "one size" to account for added friction loss & bad pump test results.
- NFPA 20 allows a calculation to "add the pressure" back into a pump test result – but who knows this years later during annual pump tests?

What About “Cushions”?

- NFPA 13 is pretty weak….no clear direction & probably never will be (they keep trying but its like herding cats).
- 5%? 5psi? 10%? 10psi?
- Recommendation is establish some criteria BASED ON YOUR WATER SUPPLY and implement that! 10psi may not be a big deal in some cities but can be 1/3rd of the available pressure in others (I like 10%).
- Account for seasonal variations (July vs Feb), degradation of supply, etc.
- % to be at SYSTEM DEMAND including HOSE ALLOWANCE

“Big Ass Fans”

- HVLS – High Volume Low Speed
- NFPA 13 says:
- - center between four heads
- - install 3’ below the sprinkler head deflectors
- - interlock with flow switch to IMMEDIATELY shut down fan
- 24’ is maximum fan diameter allowed
- The issue is delaying sprinkler operation & opening heads far away from the fire (first tests at XL Gaps opened 78 sprinklers).

Combination Sprinkler/Standpipe Risers

- We all know that you need to have a control valve to allow the sprinklers on a floor to be taken out of service without affecting the standpipe riser.
- And since there's a control valve there has to be a drain connection.
- And, there's usually a waterflow switch there too.
- And since there's a waterflow switch, there has to be an inspectors test connection.
- But there is also a requirement to install a check valve on the take-off from the standpipe to the sprinklers – usually overlooked.
- Reason: avoids the need to close all the floor control valves if the standpipe is to be drained for some reason. That assumes the check valves hold….

Speaking of Standpipes….

- Older versions of NFPA 14 required that hose valves be located at the floor landing.
- Recent changes to NFPA 14 now require them to be installed at the intermediate floor landings.
- NFPA 14 still allows the AHJ to determine where they are to be located.
- But it’s a good idea to be sure they are shown on the plans where you actually want them – not a simple fix in the field once installed!

Roof Pitch and Hydraulic Calcs

- If the roof pitch exceeds 2/12 (two inches rise for every twelve inches of run), the sprinkler system operating area needs to be increased 30%.
- Why?
- This is often the case in attics with dry pipe systems – and since NFPA 13 already requires that the area of operation be increased by 30% just because it's a dry system (WHY?), if the roof slope exceeds 2/12, you have to increase the area ANOTHER 30%.
- 1500sqftx1.3(dry)x1.3(slope) = 2,535sqft – That's a big deal!

Roof Pitch and Hydraulic Calcs

- There is NO design criteria for storage occupancy protection if the roof slope exceeds 2/12.
- Cannot use ESFR's.
- Cannot use area/density design.
- Cannot use CMSA design.
- What to do??????????????

Dry Pendant Heads in Coolers & Freezers

- What temperature rating is appropriate?
- Does the unit have an automatic defrost cycle feature?
- May need to be a 212F rated head.
- Also may need to be a link head NOT a bulb (Food & Drug Admin).
- HEADS UP: dry pendants with bulbs – the liquid in the bulb can go CLEAR when in a freezer – is the bulb cracked, etc???
- Warm up the head, the color comes back.
- HUH? Manufacturers say “oh well”.

Use of Small Orifice Heads

- Not a very normally occurring issue but often used in attics
- Why?
- Recall the 2/12, dry, 30%, 30% issue.
- LOTS of heads in the MRA – so to minimize the flow, use small orifice heads
- Can ONLY be used to protect light hazard – ok so far.
- IF A DRY SYSTEM (attic!) – pipe HAS to be internally galvanized
- Is this “good” fire protection…..?

Speaking of Galvanized Pipe

- Up until 2002 or so, NFPA 13 gave a designer a “hydraulic advantage” if they used GALVANIZED pipe in a dry pipe system.
- Would allow C factor to be 120 (instead of 100) for a dry system.
- Newer versions of NFPA 13 have REMOVED the “hydraulic advantage”.
- Why?
- Industry is finding out that galvanized pipe “ain’t what it used to be”.
- Galvanizing “flaking off”; MIC grows faster in galvanized pipe if there is a weak spot.

So, think about the last 2 slides

- And we allow SMALL ORIFICE HEADS if you use GALVANIZED pipe on a dry system…….
- ??????
- Might the galvanizing “flakes” plug a “small orifice sprinkler”?
- There will be some changes coming in this arena.

What is THE buzz word today?

- CORROSION!
- Pipe made today just isn’t what it used to be – there is no question about that.
- Systems – even wet systems – 5 years old developing pin hole leaks.
- And NO evidence of MIC.
- So what’s going on?
- What is the best practice?

Corrosion

- Rolled groove thin wall pipe
- ¼” in 10 feet pitching of mains
- Can the residual water in a dry system “make it over the hump” at the groove?
- We find the ends of grooved pipe GONE…..and after only a few years.
- Is it the water? Is it the pipe?
- Should we require only schedule 40 CUT GROOVED pipe on dry systems?
- Should we ONLY allow black pipe (flaking…)?
- Should we DOUBLE the pitch?

HUH? What does this have to do with PLAN REVIEW mistakes?

- Well, since YOU are the person making them sprinkler their building (at least that is the PERCEPTION).
- Do we/you owe them a duty to try to minimize future headaches & system failures?
- What about the anti-corrosion juice?
- HAH! The San Francisco Bay story:

Dry Pipe Systems

- We all know that you need a water flow alarm.
- Typically a pressure switch.
- In fact CANNOT be a vane type water flow switch.
- Why?
- What about monitoring the air pressure? Why would that be a good idea?
- NFPA 13 does NOT require a “high/low air pressure switch”.
- NFPA 72 used to but erroneously removed it!
- Very, very often overlooked

Lets Talk About Hydraulic Calcs

- NFPA 13 allows many ways:
- Area/Density (x gpm per sqft over y sq ft area) – very common.
- Special Application (ESFR's 12 heads at 52psi & CMSA) – becoming more common.
- Residential areas (doesn't have to be 13D or 13R) – calculate the most demanding 4 heads.
- The old "Room Design Method": calculate the "room that creates the greatest demand".
- Often results in smaller pipes!! Hence it is used A LOT.

The Room Design Method

- Here's what is required (and almost ALWAYS overlooked) if the Room Design Method is being utilized:
- "*All rooms SHALL BE enclosed with WALLS having a FIRE RESISTANCE rating equal to the water supply duration*" specified in NFPA 13 based on the occupancy.
- So, for LH -> 30mins; for OH -> 60mins; for EH -> 90mins
- AND: OPENINGS IN THE WALLS HAVE TO BE PROTECTED
- HUH? That means DOORS!
- LH: Non-rated AUTOMATIC or SELF-CLOSING doors (sure!).
- OH & EH: AUTOMATIC or SELF-CLOSING doors WITH THE APPROPRIATE FIRE RESISTANCE RATING

The Room Design Method

- What if it is a LH occupancy (where the room design method is often used) and there are NO DOORS???????
- NO DOORS = UNPROTECTED OPENING
- Then the calcs HAVE TO INCLUDE TWO (MORE) SPRINKLERS in the "*communicating space nearest EACH such unprotected opening*".
- AND the unprotected openings have to have a lintel at least 8" deep.
- AND the unprotected openings cannot exceed 8' in width.
- This method of calculating a system is used very frequently and is often improperly done.

More About Calculations

- We all know that NFPA 13 requires calculations to include “hose allowance”.
- DO NOT CONFUSE THIS WITH STANDPIPE SYSTEMS!
- LH = 100gpm; OH = 250gpm; EH = 500gpm
- If there is NOT a fire hydrant on the lead in from the street to the system riser, then the practice is to “take all the hose out in the street” – that is, deplete the water supply curve by the required hose allowance.

CYBOR FIRE PROTECTION COMPANY

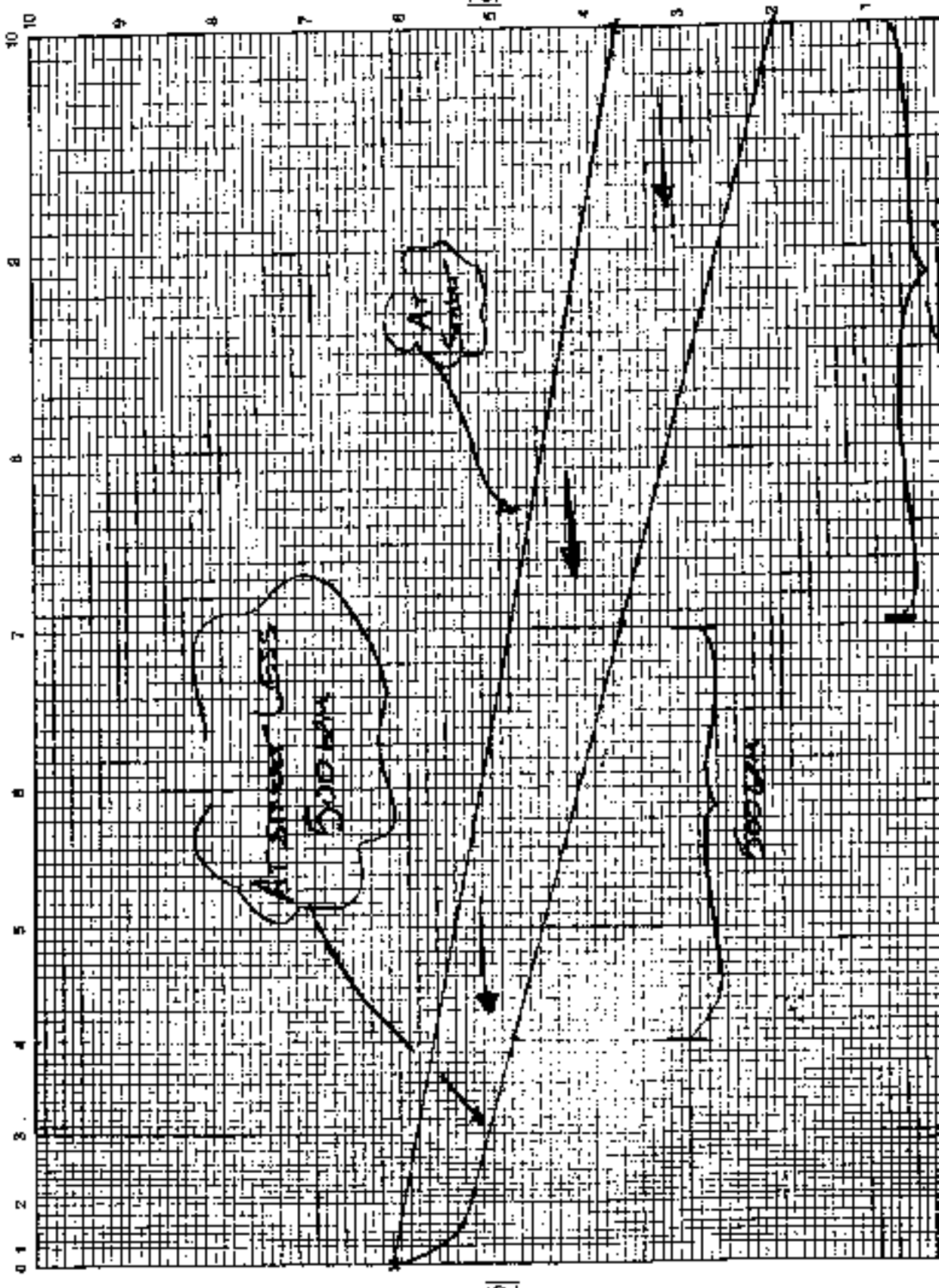
CONTRACT NO. _____ SHEET NO. _____

NAME: _____ SYSTEM NO. _____

ADDRESS: _____ DATE: _____

MULTIPLY SCALE BY 10
PSI

MULTIPLY SCALE BY 170
GPM

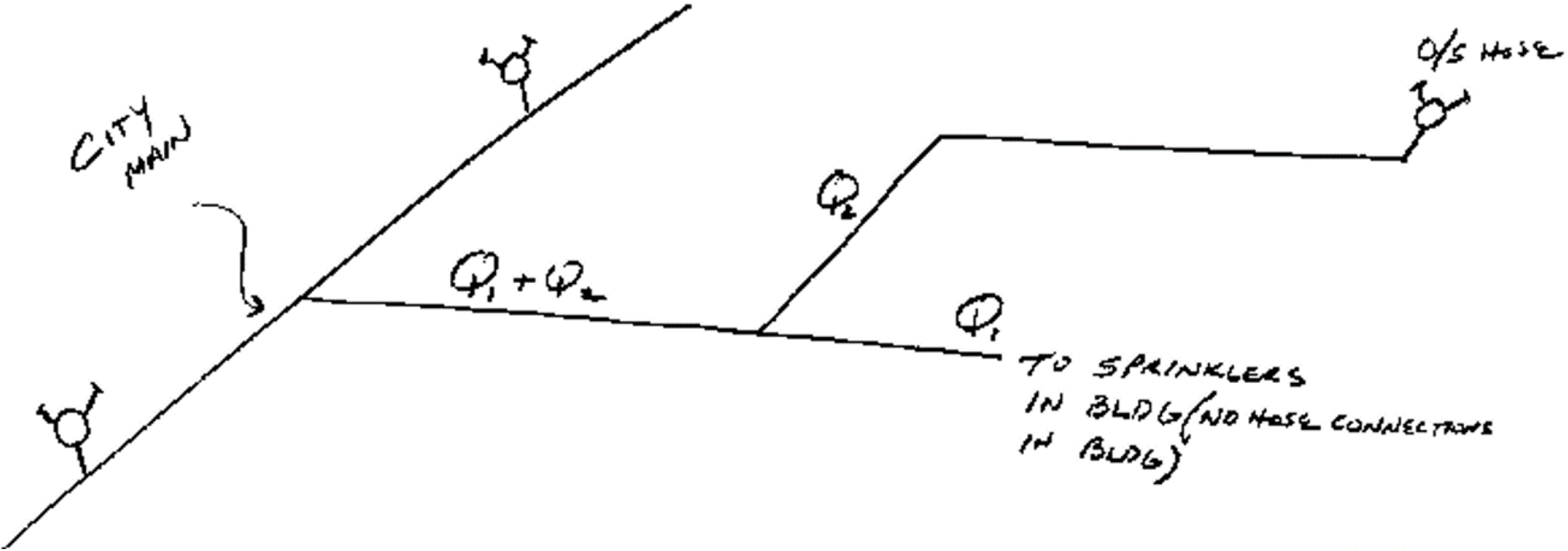


62/37/1750

SAY outside Hose Demand
IS 500 GPM

More About Calculations

- BUT if THERE IS a hydrant on the lead in, then the calculations MUST include the sprinkler (only demand) from the riser to the hydrant, THEN the sprinkler demand PLUS the hose demand from the hydrant to the street.



Room Names

- How often do you see plans that just say “Design to be light hazard” or “All head spacing to be in accordance with NFPA 13”?
- Did you know that NFPA 13 REQUIRES that the use of all rooms be designated ON THE DRAWING?
- There are many rooms often found in OFFICE buildings (LH) that are NOT light hazard occupancies:
- Storage rooms, kitchens, supply rooms, etc.
- Not only is spacing of heads a problem but also you CANNOT USE THE SMALL ROOM RULE unless it’s a light hazard occupancy.

Quick Response Sprinklers

- They have been **required** in NEW INSTALLATIONS in LIGHT HAZARD occupancies since the 1994 edition of NFPA 13.
- If it's a "remodeling" type job (even a LH occupancy), you CAN STILL use standard response sprinklers.
- WHAT YOU CANNOT DO IS MIX SR AND QR "IN THE SAME COMPARTMENT" – see definition of "compartment" in NFPA 13.
- A space enclosed by walls & a ceiling – if openings in walls, need a minimum 8" lintel and the opening cannot exceed 8' in width; a single opening up to 36" wide WITHOUT a lintel is allowed as long as there are NO OTHER openings.

Quick Response Sprinklers

- So what do you do about concealed sprinklers? Does the contractor know if they are QR or SR?
- And just because the head has a glass bulb OR a skinny bulb does NOT mean it is a QR sprinkler!
- The listing of the sprinkler head is what determines its thermal sensitivity.
- WATCH OUT FOR THIS ONE!

Here's Another One to Watch Out For

- Another remodeling type job.
- Sprinklers are being relocated & added to accommodate a new wall and/or ceiling layout.
- One head for one head, typically not a big deal.
- But, let's consider a LH occupancy where the original layout was about a 12'x12' pattern. Now walls, lights, etc cause the need for a 15'x15' layout.
- Are the pipe sizes/calcs still ok (assume the supply hasn't changed).
- 12x12=144 x 0.1 = 14.4gpm & 7psi EHP
- 15x15=225 x 0.1 = 22.5gpm & 16psi EHP
- Do you need to see calcs?? Was there a 9psi cushion originally?

Here's Another One to Watch Out For

- The same remodeling job.
- Typical branchlines with 1" outlets.
- Can you REALLY supply two heads from a single 1" outlet??
- Fitters will do this just because the old rule for pipe scheduled systems was "two heads off of one inch".
- Consider the last slide with 15'x15' spacing (LH):
- 15x15=225 x 0.1 = 22.5gpm. PER HEAD.
- So now two heads thru a 1" outlet – can the system piping (and water supply) support 45gpm (2 heads @ 22.5gpm) thru a 1" outlet??
- This happens ALL THE TIME!

CPVC Pipe

- Note that CPVC is typically limited to use in residential and light hazard occupancies.
- It CAN also be used in a room classified as an ordinary hazard occupancy (incidental to an allowed occupancy) UP TO A MAXIMUM OF 400sqft room.
- Storage rooms, mechanical rooms, etc.
- BUT IT CANNOT BE EXPOSED IN THESE AREAS.

NFPA 13D

- For systems in single family homes:
- If the water supply is a combination supply pipe (serving the sprinklers PLUS the domestic water), then an allowance of 5gpm must be added in the calcs at the point the two demands meet.
- Also, there MUST be a shut off valve installed that allows the domestic water (only) to be shut off – without affecting the sprinklers.
- New State of IL requires ONLY combination water services.

NFPA 13R

- If the water supply is a combination supply pipe (serving the sprinklers PLUS the domestic water), then an allowance must be added in the calculations at the point the two demands meet.
- The allowance is based on “fixture count” – found in appendix of NFPA 13R
- Also, there MUST be a shut off valve installed that allows the domestic water (only) to be shut off – without affecting the sprinklers.
- New State of IL requires ONLY combination water services.

Fire Department Connections

- NFPA 13 requires that the FDC be connected to the system in certain manners.
- This is usually simple when there is just one system in the building (“system” means “control valve”).
- In these cases, the FDC can pretty much be connected to any point in the system (useful when the FDC is to be somewhere OTHER than where the riser is).
- Limitations on pipe sizes of course (cannot connect it to a 1” branch line) – “piping never smaller than the system riser”.

Fire Department Connections

- But what about when there is MORE than one system?
- (Same pipe size restrictions).
- NFPA 13 requires that the FDC be connected in such a manner that the FDC can service ALL OTHER SYSTEMS if any ONE SYSTEM control valve is SHUT.
- So….YOU CAN’T TAKE THE FDC OFF THE END OF A SYSTEM!

QUESTIONS?????????

- Richard M. Ray, PE
- Cybor Fire Protection Company
- 5123 Thatcher Road
- Downers Grove, IL 60515
- 630 810 1161
- 630 774 1616 cell
- rmr@cyborfireprotection.com