MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

NFPA 13

(Standard for Installation of Sprinkler System/2013)

(Chapter 23)

COMPLETE GUIDE ON

PLANS

&

CALCULATIONS

- **Basics of Hydraulics**
- **Hydraulic Calculation- PRILIMINARY CONCEPTS**
- **Hydraulic Calculation –EXAMPLE CALCULATION (MANUAL+ SOFTWARE)**
- **Hydraulic Calculation Considerations for Storage Sprinklers**
  - **CMDA/CMSA/ESFR Sprinklers**
  - **In Rack Sprinklers**
- **Plan Review Checklists**

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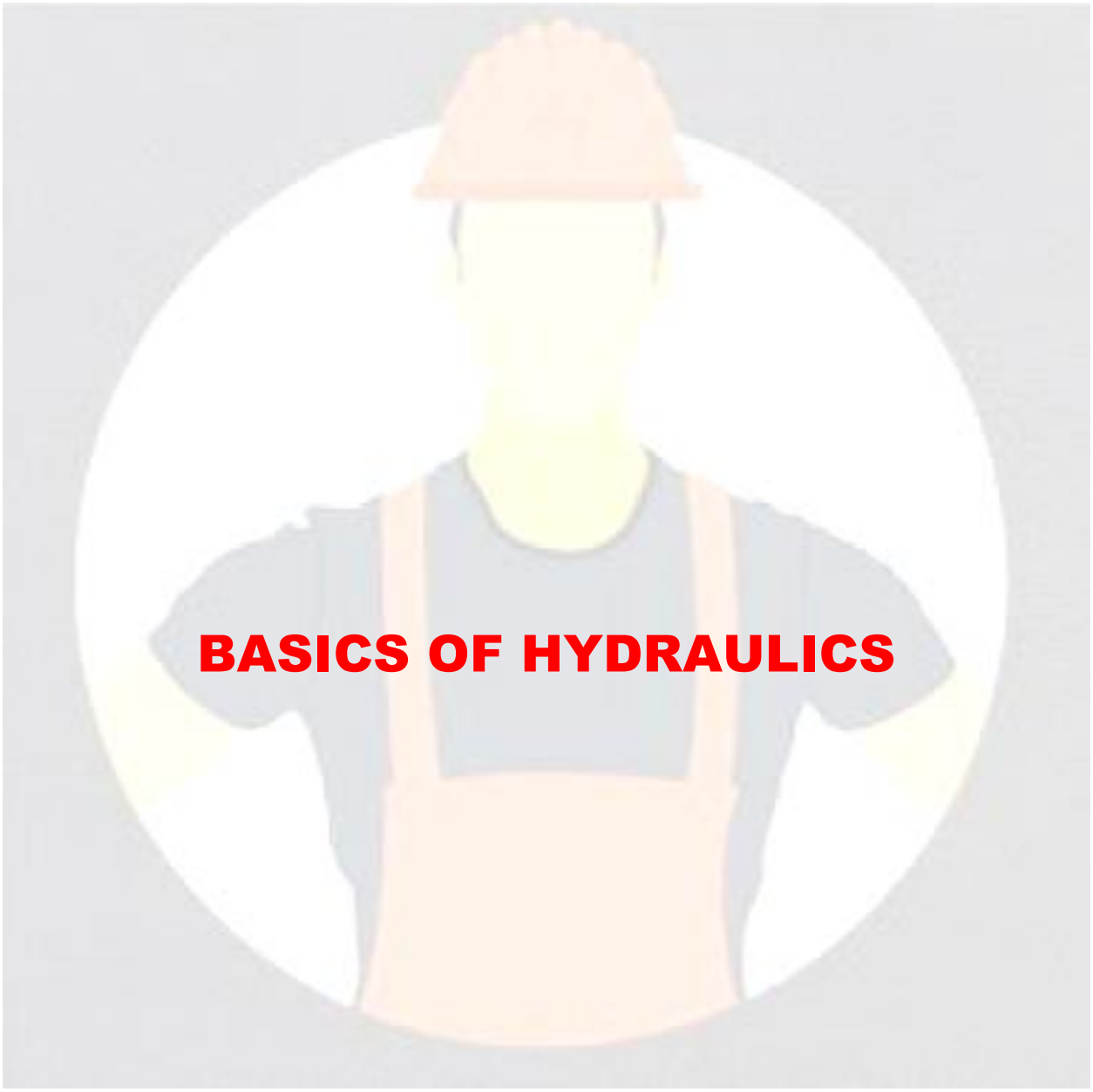
MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

CONTENT

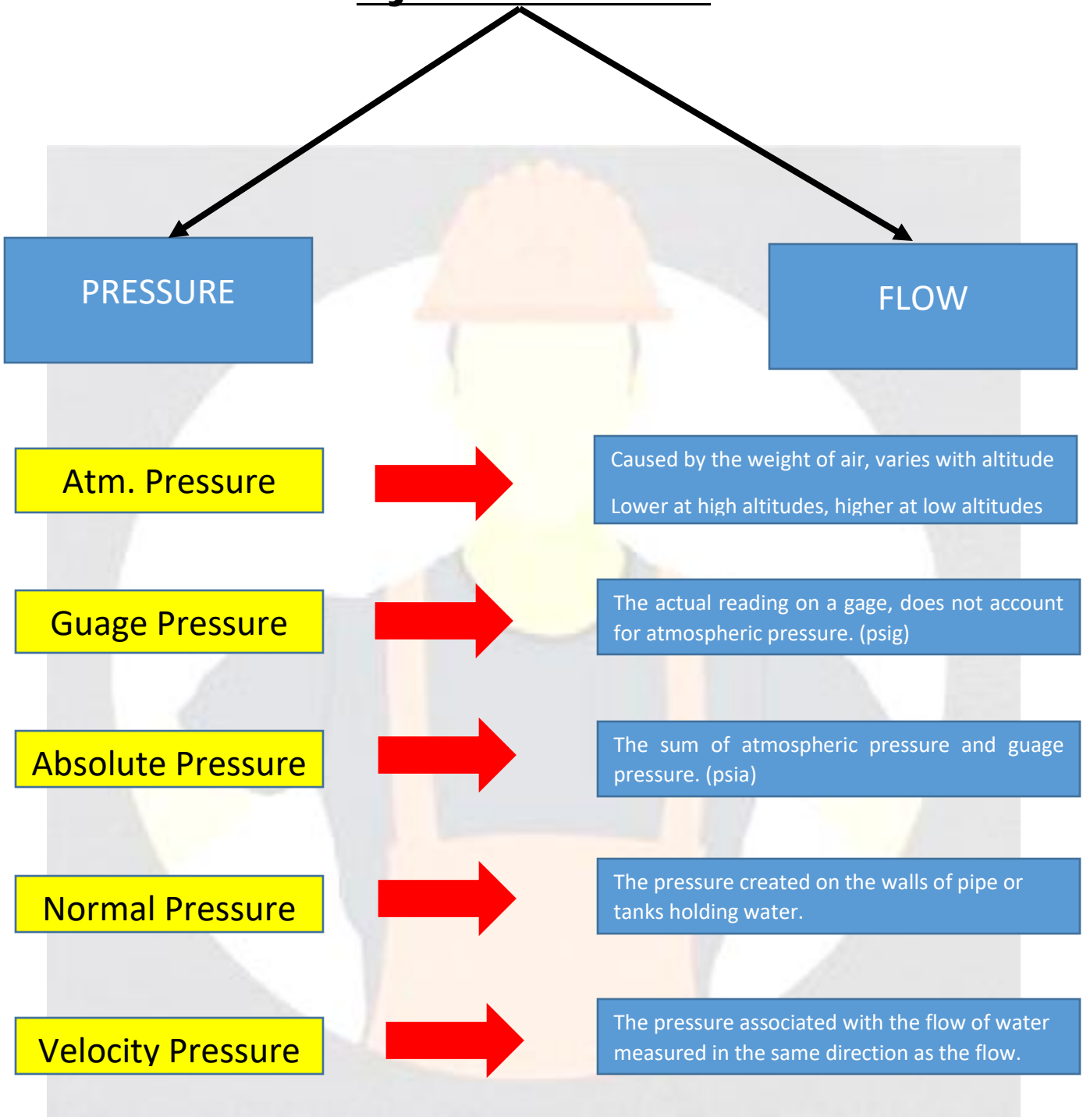
MECHSOFT ENGINEERING DESIGN AND CONSULTANCY



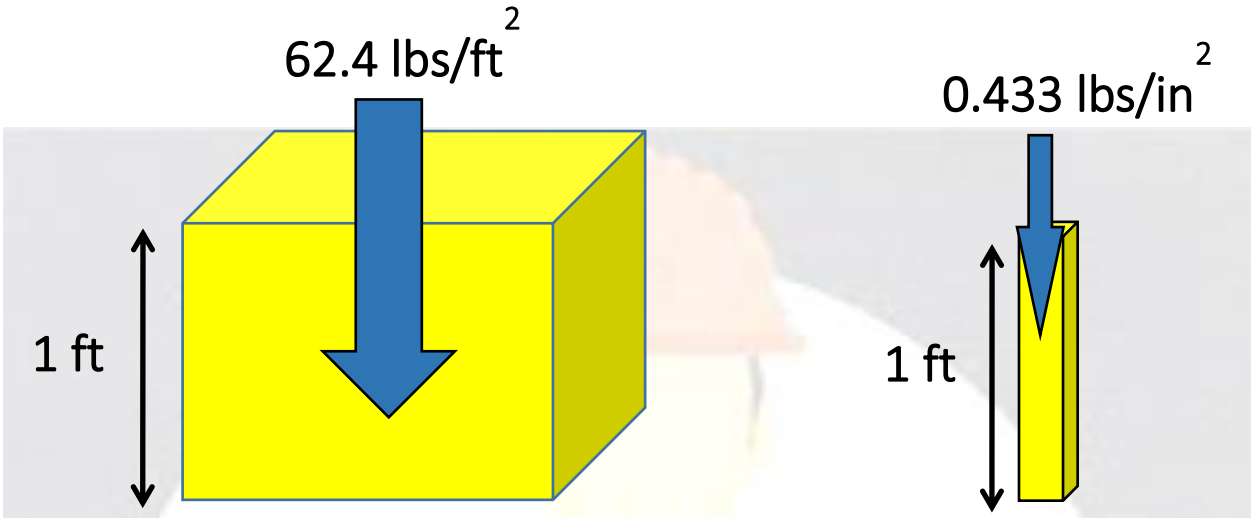
BASICS OF HYDRAULICS

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Hydraulics Focus

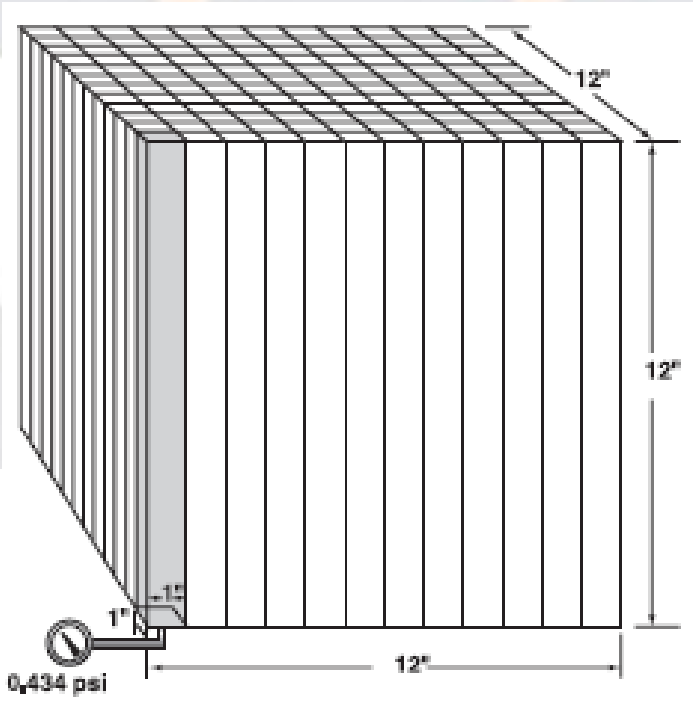


Elevation Pressure :



A cubic foot of water results in a static pressure at its base of 62.4 lbs/ft^2

Converted to square inches a column of water 1-foot high exerts a pressure of 0.433 lbs/in^2



MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Example : 01

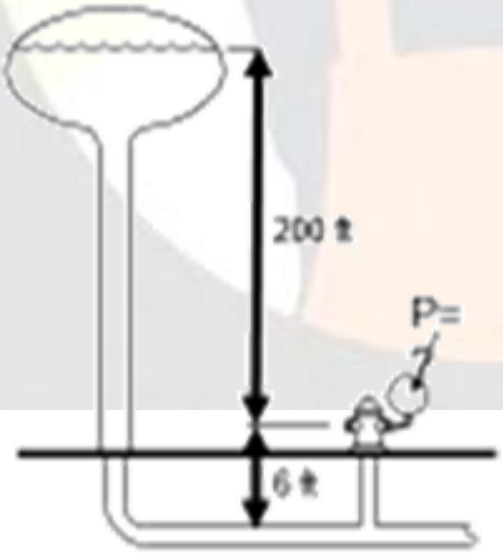
Pressure (psi) = 0.433 X Elevation (ft)

What is the pressure difference?

Example : 02

What is the pressure at the hydrant?

Pressure (psi) = 0.433 x Elevation (ft)



$$P = 0.433 \times 200\,ft$$

$$P = 90.93 psi$$

$$P \approx 91 psi$$

Calculating Velocity Pressures

Pn = Pt – Pv

Where:

Pn = normal pressure (psi)

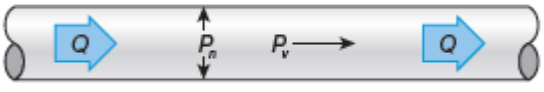
Pt = total pressure (psi)

Pv = velocity pressure (psi)

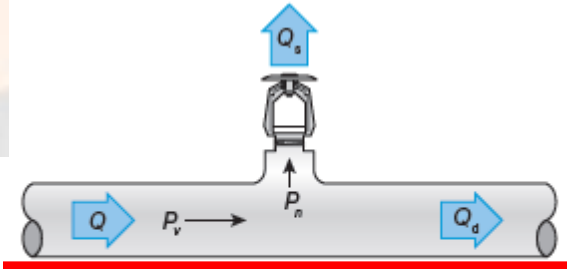
Velocity pressure can be found as follows,

$$P_v = \frac{0.001123Q^2}{d_i^4}$$

- *When velocities are high in a closed system the pressure needs to be accounted for in the calculations.*
- *It can reduce the flows and pressures needed in a system 5-10 percent.*
- *In most sprinkler systems velocities are low and their pressures create a minor effect, therefore velocity pressures can be ignored.*
- *It should be used at points where large flows take a 90-degree turn in the piping.*

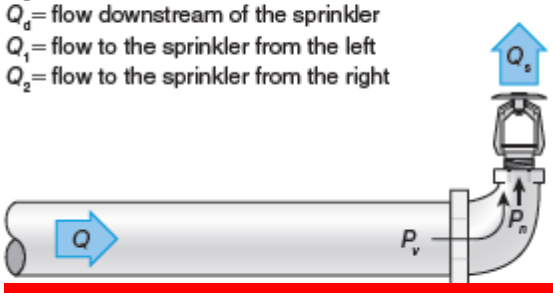


(a) Velocity and normal pressures

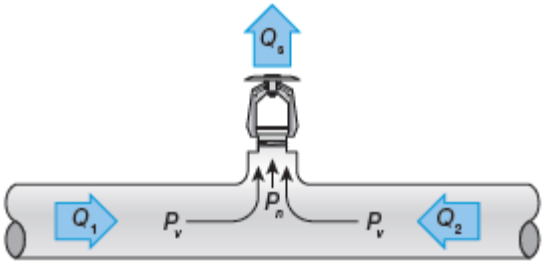


(b) Normal pressure is responsible for flow from sprinklers where additional flow is downstream of operating sprinkler

P_n = normal pressure
P_v = velocity pressure
Q = flow in the piping
Q_s = flow from the sprinkler
Q_d = flow downstream of the sprinkler
Q_1 = flow to the sprinkler from the left
Q_2 = flow to the sprinkler from the right



(c) Both normal and velocity pressure are responsible for flow from sprinklers at the end of a line



(d) Both normal and velocity pressure are responsible for flow from sprinklers where flow enters the sprinkler from both directions in gridded piping

FLOW :

$$Q = A \times V$$

Q = Flow in ft^3/sec

A = Cross sectional area of pipe in ft^2

V = Water velocity in ft/sec

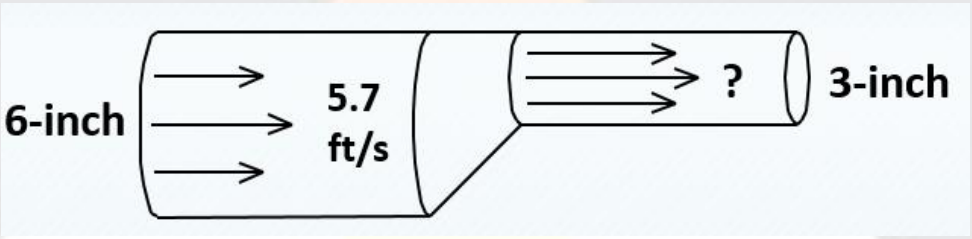
Q is a constant for any given closed system.

$$Q = A_1 \times V_1 = A_2 \times V_2$$

$$A_1 \times V_1 = A_2 \times V_2$$

Example : 03

If water is flowing at 5.7 ft/sec in 6-inch pipe, how fast is it flowing when the pipe size is reduced to 3-inch?



Solution :

$$V2 = \frac{A1 \text{ X } V1}{A2}$$

$$A_1 = \pi r^2 = \pi (3 \text{ in})^2 = 28.3 \text{ in}^2$$

$$A_2 = \pi r^2 = \pi (1.5 \text{ in})^2 = 7.1 \text{ in}^2$$

$$V_2 = \frac{(28.3 \text{in}^2)(5.7 \text{ft/sec})}{7.1 \text{in}^2} = 22.7 \text{ft/sec}$$

V2 = 22.7 ft/sec

Flow from an Outlet :

$$Q = 29.83 \times d_i^{\,2} \times \sqrt{P_v} \times C_D$$

Q is the flow (gpm)

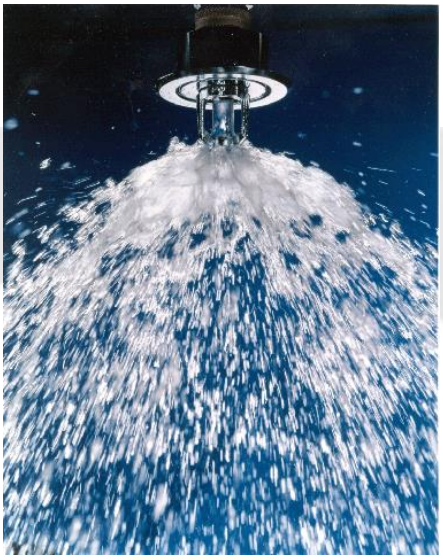
d_i is the diameter of opening (inches)

P_v is the measured velocity pressure (psi)

CD is the discharge coefficient of the device

Note : This is used when testing water supplies to determine the amount of flow

Flow from a Sprinkler :



$$Q = k \times \sqrt{P}$$

Where:

Q is flow (gpm)

k is k-factor determined in the sprinkler listing (gpm/psi½)

P is the pressure (psi)

- The diameter of the opening and discharge coefficient are incorporated into the empirical determination of k-factor.

Example : 04

A sprinkler is being installed with a k-factor of 5.6. If the pressure at the sprinkler is 20 psi, how much water will exit the sprinkler?

Solution :

$$Q = k\sqrt{P}$$

$$Q = 5.6\sqrt{20\,\text{psi}}$$

$$Q = 25.0\,\text{gpm}$$

Example : 05

What is the pressure for a sprinkler that has a k-factor of 17.6 and the expected flow is 83 gpm?

Solution :

$$P = \left(\frac{Q}{k}\right)^2$$

$$P = \left(\frac{83\,\text{gpm}}{17.6}\right)^2$$

$$P = (4.716)^2 = 22.2\,\text{psi}$$

Example : 06

What is the K-factor for an outlet that is flowing 65 gpm at 30 psi?

Solution :

$$k = \frac{Q}{\sqrt{P}}$$

$$k = \frac{65\,gpm}{\sqrt{30\,psi}}$$

$$k = \frac{65}{5.48} = 11.86$$

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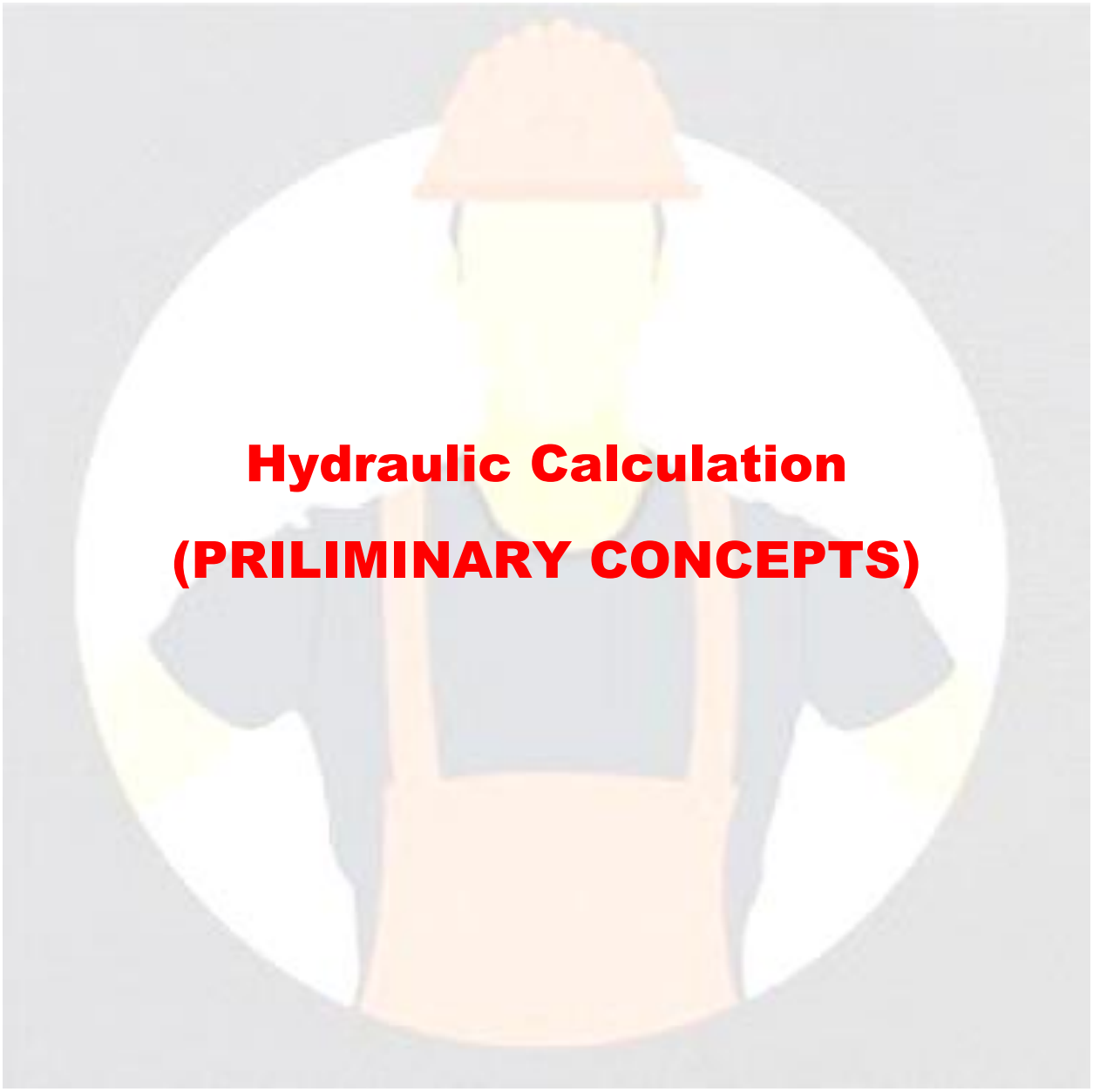

Hydraulic Calculation

(PRILIMINARY CONCEPTS)

Purpose of Hydraulic Calculations

Performed to tell you,

- *What pipe size will be best?*
- *Will the water supply provide the flow and pressure necessary to control/suppress a fire?*

Hydraulic Calcualtion Formulae :

Hazen-Williams formula

- Fire sprinkler systems
- Water-spray systems

Darcy-Weisbach formula

(The Darcy-Weisbach equation more accurately accounts for the effects of turbulence, temperature, and viscosity)

- Anti-freeze systems
- Water mist systems
- Foam-water systems

Fanning formula

Hazen-Williams formula

$$P_L = \frac{4.52Q^{1.85}}{C^{1.85}d_i^{4.87}}$$

Where:

PL = friction loss (psi/ft)

Q = flow (gpm)

C = roughness coefficient (based on pipe material)

d_i = interior pipe diameter (inches)

Roughness Coefficient :

Table 23.4.4.7.1 Hazen–Williams *C* Values

Pipe or Tube	*C* Value*
Unlined cast or ductile iron	100
Black steel (dry systems including preaction)	100
Black steel (wet systems including deluge)	120
Galvanized steel (dry systems including preaction)	100
Galvanized steel (wet systems including deluge)	120
Plastic (listed) all	150
Cement-lined cast- or ductile iron	140
Copper tube or stainless steel	150
Asbestos cement	140
Concrete	140

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Inside Diameters (di) :

Table A.6.3.2 Steel Pipe Dimensions

Nominal Pipe Size		Outside Diameter		Schedule 5				Schedule 10[a]				Schedule 30				Schedule 40			
				Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
½[b]	15	0.840	21.3	—	—	—	—	0.674	17.0	0.083	2.1	—	—	—	—	0.622	15.8	0.109	2.8
¾[b]	20	1.050	26.7	—	—	—	—	0.884	22.4	0.083	2.1	—	—	—	—	0.824	21.0	0.113	2.9
1	25	1.315	33.4	1.185	30.1	0.065	1.7	1.097	27.9	0.109	2.8	—	—	—	—	1.049	26.6	0.133	3.4
1¼	32	1.660	42.2	1.530	38.9	0.065	1.7	1.442	36.6	0.109	2.8	—	—	—	—	1.380	35.1	0.140	3.6
1½	40	1.900	48.3	1.770	45.0	0.065	1.7	1.682	42.7	0.109	2.8	—	—	—	—	1.610	40.9	0.145	3.7
2	50	2.375	60.3	2.245	57.0	0.065	1.7	2.157	54.8	0.109	2.8	—	—	—	—	2.067	52.5	0.154	3.9
2½	65	2.875	73.0	2.709	68.8	0.083	2.1	2.635	66.9	0.120	3.0	—	—	—	—	2.469	62.7	0.203	5.2
3	80	3.500	88.9	3.334	84.7	0.083	2.1	3.260	82.8	0.120	3.0	—	—	—	—	3.068	77.9	0.216	5.5
3½	90	4.000	101.6	3.834	97.4	0.083	2.1	3.760	95.5	0.120	3.0	—	—	—	—	3.548	90.1	0.226	5.7
4	100	4.500	114.3	4.334	110.1	0.083	2.1	4.260	108.2	0.120	3.0	—	—	—	—	4.026	102.3	0.237	6.0
5	125	5.563	141.3	—	—	—	—	5.295	134.5	0.134	3.4	—	—	—	—	5.047	128.2	0.258	6.6
6	150	6.625	168.3	6.407	162.7	0.109	2.8	6.357	161.5	0.134[c]	3.4	—	—	—	—	6.065	154.1	0.280	7.1
8	200	8.625	219.1	—	—	—	—	8.249	209.5	0.188[c]	4.8	8.071	205.0	0.277[d]	7.0	7.981	—	0.322	—
10	250	10.750	273.1	—	—	—	—	10.370	263.4	0.188[c]	4.8	10.140	257.6	0.307[d]	7.8	10.020	—	0.365	—
12	300	12.750	—	—	—	—	—	—	—	—	—	12.090	—	0.330[c]	—	11.938	—	0.406	—

Table A.6.3.5 Copper Tube Dimensions

Nominal Tube Size		Outside Diameter		Type K				Type L				Type M			
				Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
¾	20	0.875	22.2	0.745	18.9	0.065	1.7	0.785	19.9	0.045	1.1	0.811	20.6	0.032	0.8
1	25	1.125	28.6	0.995	25.3	0.065	1.7	1.025	26.0	0.050	1.3	1.055	26.8	0.035	0.9
1¼	32	1.375	34.9	1.245	31.6	0.065	1.7	1.265	32.1	0.055	1.4	1.291	32.8	0.042	1.1
1½	40	1.625	41.3	1.481	37.6	0.072	1.8	1.505	38.2	0.060	1.5	1.527	38.8	0.049	1.2
2	50	2.125	54.0	1.959	49.8	0.083	2.1	1.985	50.4	0.070	1.8	2.009	51.0	0.058	1.5
2½	65	2.625	66.7	2.435	61.8	0.095	2.4	2.465	62.6	0.080	2.0	2.495	63.4	0.065	1.7
3	80	3.125	79.4	2.907	73.8	0.109	2.8	2.945	74.8	0.090	2.3	2.981	75.7	0.072	1.8
3½	90	3.625	92.1	3.385	86.0	0.120	3.0	3.425	87.0	0.100	2.5	3.459	87.9	0.083	2.1
4	100	4.125	104.8	3.857	98.0	0.134	3.4	3.905	99.2	0.110	2.8	3.935	99.9	0.095	2.4
5	125	5.125	130.2	4.805	122.0	0.160	4.1	4.875	123.8	0.125	3.2	4.907	124.6	0.109	2.8
6	150	6.125	155.6	5.741	145.8	0.192	4.9	5.845	148.5	0.140	3.6	5.881	149.4	0.122	3.1
8	200	8.125	206.4	7.583	192.6	0.271	6.9	7.725	196.2	0.200	5.1	7.785	197.7	0.170	4.3
10	250	10.130	257.3	9.449	240.0	0.338	8.6	9.625	244.5	0.250	6.4	9.701	246.4	0.212	5.4

Example : 07

If a pressure gage is reading 40 psi at one end of a 32-foot section of 2-inch schedule 40 pipe (C = 120) flowing at 110 gpm, what will a gage at the other end read?

Solution :

$$P_L = \frac{4.52Q^{1.85}}{C^{1.85}d_i^{4.87}} = \frac{4.52(110gpm)^{1.85}}{(120)^{1.85}(2.067in)^{4.87}}$$

P_L= 0.112 psi/ft

PL = 0.112 psi/ft

Friction Loss = 0.112 psi/ft x 32 ft = 3.6 psi

Guage Pressure = 40 psi – 3.6 psi ≅ 36 psi

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Equivalent Length Chart :

Table 23.4.3.1.1 Equivalent Schedule 40 Steel Pipe Length Chart

	Fittings and Valves Expressed in Equivalent Feet (Meters) of Pipe														
	½ in.	¾ in.	1 in.	1¼ in.	1½ in.	2 in.	2½ in	3 in.	½ in.	4 in.	5 in.	6 in.	8 in.	10 in.	12 in.
Fittings and Valves	(15 mm)	(20 mm)	(25 mm)	(32 mm)	(40 mm)	(50 mm)	(65 mm	(80 mm)	mm)	(100 mm)	(125 mm)	(150 mm)	(200 mm)	(250 mm)	(300 mm)
45° elbow	—	1 (0.3)	1 (0.3)	1 (0.3)	2 (0.6)	2 (0.6)	3 (0.9)	3 (0.9)	3 (0.9)	4 (1.2)	5 (1.5)	7 (2.1)	9 (2.7)	11 (3.4)	13 (4)
90° standard elbow	1 (0.3)	2 (0.6)	2 (0.6)	3 (0.9)	4 (1.2)	5 (1.5)	6 (1.8)	7 (2.1)	8 (2.4)	10 (3)	12 (3.7)	14 (4.3)	18 (5.5)	22 (6.7)	27 (8.2)
90° long-turn elbow	0.5 (0.2)	1 (0.3)	2 (0.6)	2 (0.6)	2 (0.6)	3 (0.9)	4 (1.2)	5 (1.5)	5 (1.5)	6 (1.8)	8 (2.4)	9 (2.7)	13 (4)	16 (4.9)	18 (5.5)
Tee or cross (flow turned 90°)	3 (0.9)	4 (1.2)	5 (1.5)	6 (1.8)	8 (2.4)	10 (3)	12 (3.7)	15 (4.6)	17 (5.2)	20 (6.1)	25 (7.6)	30 (9.1)	35 (10.7)	50 (15.2)	60 (18.3)
Butterfly valve	—	—	—	—	—	6 (1.8)	7 (2.1)	10 (3)	—	12 (3.7)	9 (2.7)	10 (3)	12 (3.7)	19 (5.8)	21 (6.4)
Gate valve	—	—	—	—	—	1 (0.3)	1 (0.3)	1 (0.3)	1 (0.3)	2 (0.6)	2 (0.6)	3 (0.9)	4 (1.2)	5 (1.5)	6 (1.8)
Swing check*	—	—	5 (1.5)	7 (2.1)	9 (2.7)	11 (3.4)	14 (4.3)	16 (4.9)	19 (5.8)	22 (6.7)	27 (8.2)	32 (9.3)	45 (13.7)	55 (16.8)	65 (20)

Adjusting Equivalent Lengths

NFPA 13 table is based on schedule 40 steel pipe for a wet system

All others need to be adjusted for:

- Change in pipe material
  - C-factor other than 120
- Change in interior diameter
  - Other than those for schedule 40 steel

Adjusting for C-Factor for above conditions :

Table 23.4.3.2.1 *C* Value Multiplier

Value of *C*	100	130	140	150
Multiplying factor	0.713	1.16	1.33	1.51

- Begin with the equivalent length value from the table
- Multiply the length by the factor above for the appropriate C-factor

Adjusting for Inside Diameter :

$$\text{Factor} = \left(\frac{\text{Actual inside diameter}}{\text{Schedule 40 Steel Pipe inside diameter}} \right)^{4.87}$$

- Begin with the equivalent length value from the table
- Multiply the length by the factor above calculated for the inside diameter of the pipe being used

Example : 08

What is the equivalent pipe length of Type K copper tube which used for a 3-inch standard turn 90-degree elbow?

Solution:

See Eq. Pipe length From table – 23.4.3.1.1

3” elbow 90 degree elbow = 7 ft.

As the type of pipe is different than steel we need to adjust for,

- Type K Copper
- Interior diameter

Adjustment for material (C-factor)

See table no 23.4.3.2.1 ,23.4.4.7.1 C factor & C factor multiplier for Copper Pipe

Copper Pipe has C Factor of 150 with multiplier of 1.51

Adjustment for inside Diameter :

See table no A. 6.3.5,

- 3-inch copper has an inside diameter of 2.907-inch

$$\text{Factor} = \left(\frac{\text{Actual i.d.}}{\text{Schedule 40 Steel Pipe i.d.}} \right)^{4.87} = \left(\frac{2.907}{3.068} \right)^{4.87} = 0.77$$

Apply the factors:

- Equivalent pipe length from table 23.4.3.1.1 = 7 ft
- Adjustment for C-factor = 1.51
- Adjustment for diameter = 0.77

Hence,The equivalent length for a 3-inch Type K Copper standard turn elbow is:

7 ft x 1.51 x 0.77 = 8.14 ft

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Hydraulic Calculation

STEP BY STEP PROCEDURE

MANUAL + ELITE SOFTWARE

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The Layout Process

1. Define the Hazard
2. Analyze the Structure
3. Analyze the Water Supply
4. Select the Type of System
5. Select the Sprinkler Type(s) and Locate Them
6. Arrange the Piping
7. Arrange Hangers and Bracing (where needed)
8. Include System Attachments

9. Hydraulic Calculations

9.1 Identify hazard category

9.2 Determine sprinkler spacing

9.3 Determine piping arrangement

9.4 Calculate amount of water needed per sprinkler

9.5 Calculate number and location of open sprinklers in the hydraulically most demanding area

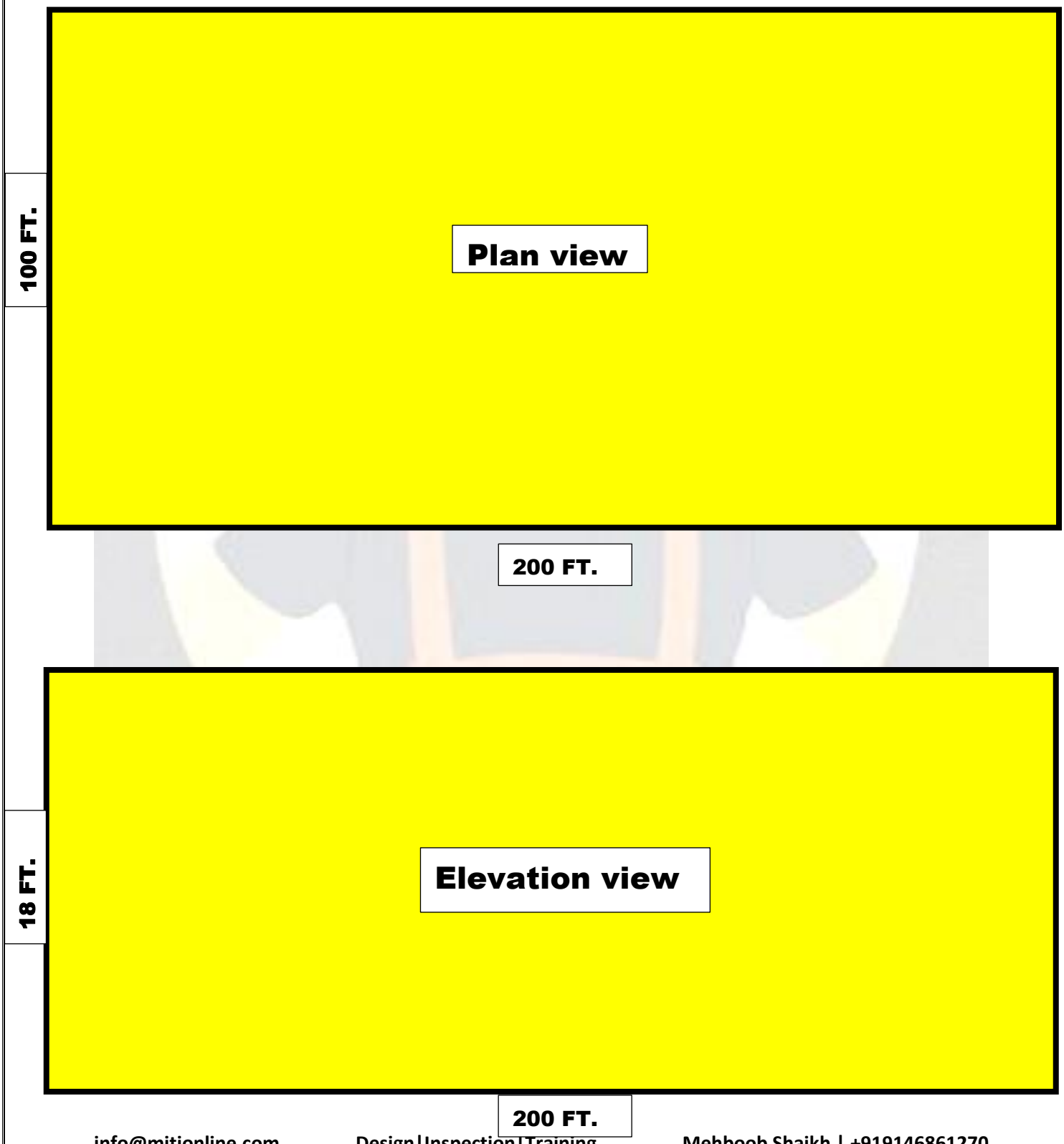
9.6 Start at most remote sprinkler and work towards the water supply calculating flows and pressures

9.7 Compare demand with supply

10. Notes and Details for Plans
11. As-Built Drawings

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Example Project : A Electronic Storage Warehouse



Step:1 : Define Hazard

In accordance with NFPA 13,2013- chapter Chapter 5 & Appendix A 5.3.1

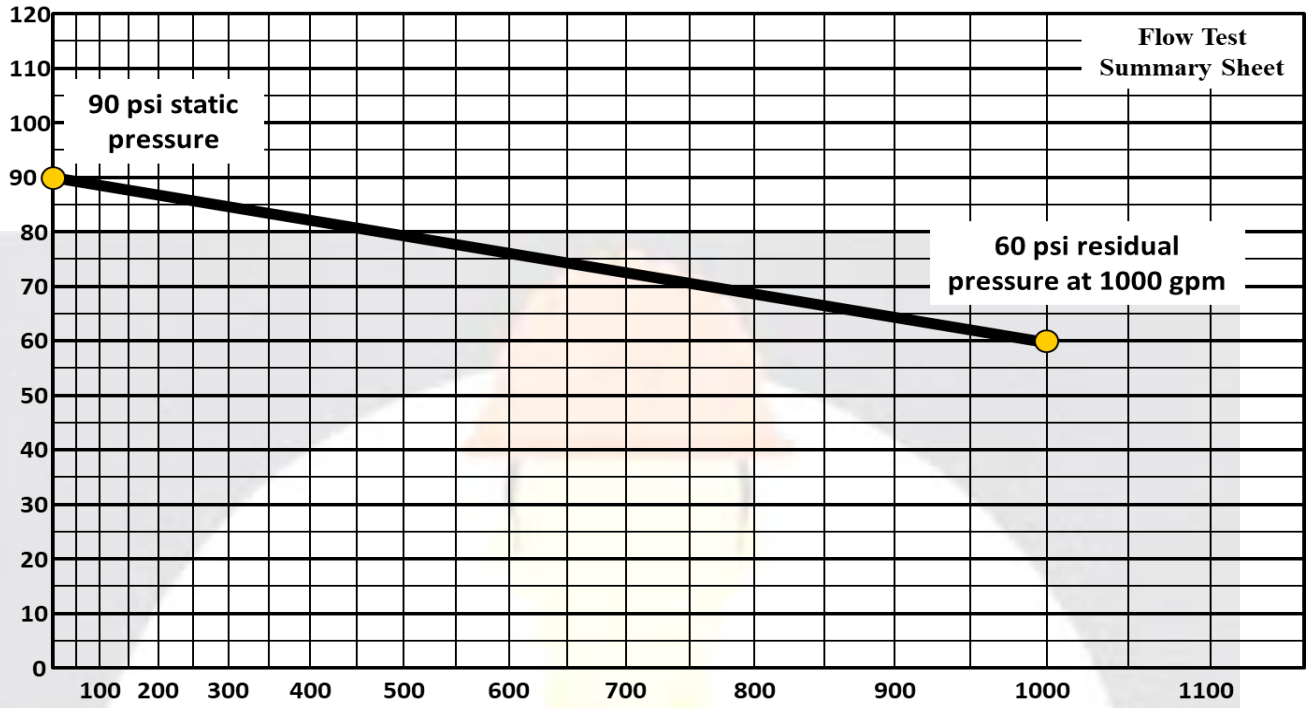
Electronic factory is classified as Ordinary Hazard Group -1 Occupancy

Step:2 : Analyzed Structure

Assuming Completed

Step:3 : Analyze water Supply

Based on the Fire Flow test Conducted on Public water mains in accordance with NFPA 291



Step:4 : Select the Type of System

Wet Pipe System

Step:5 : Type of Sprinkler

Standard Spray *Quick response* upright sprinkler with K factor of 5.6

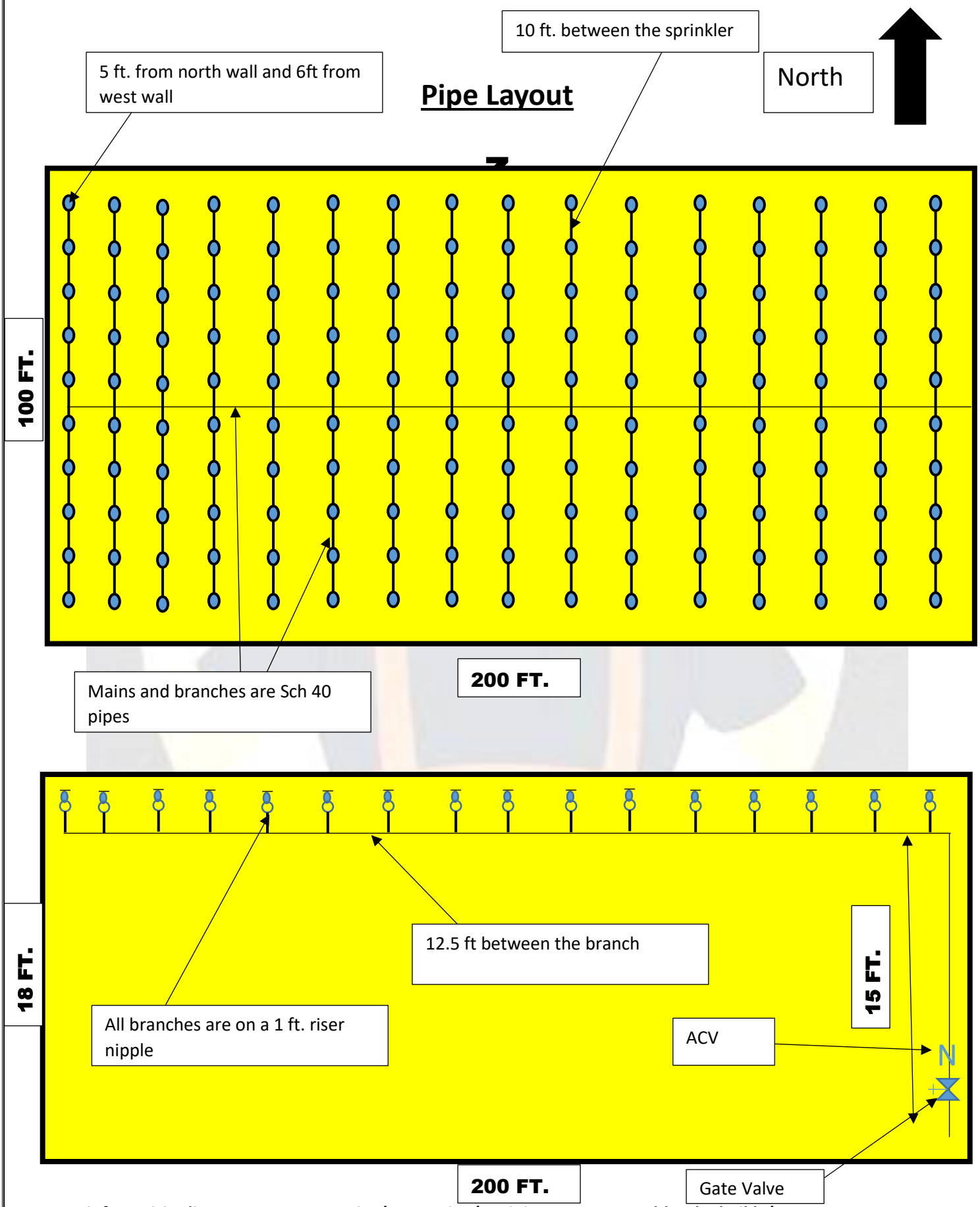
Step:6,7 & 8 : Arrangement of Piping with attachments

Sprinkler are 10 ft. apart on the branch lines and 12.5 between branch lines.

Piping arragment is as shown below,

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Pipe Layout

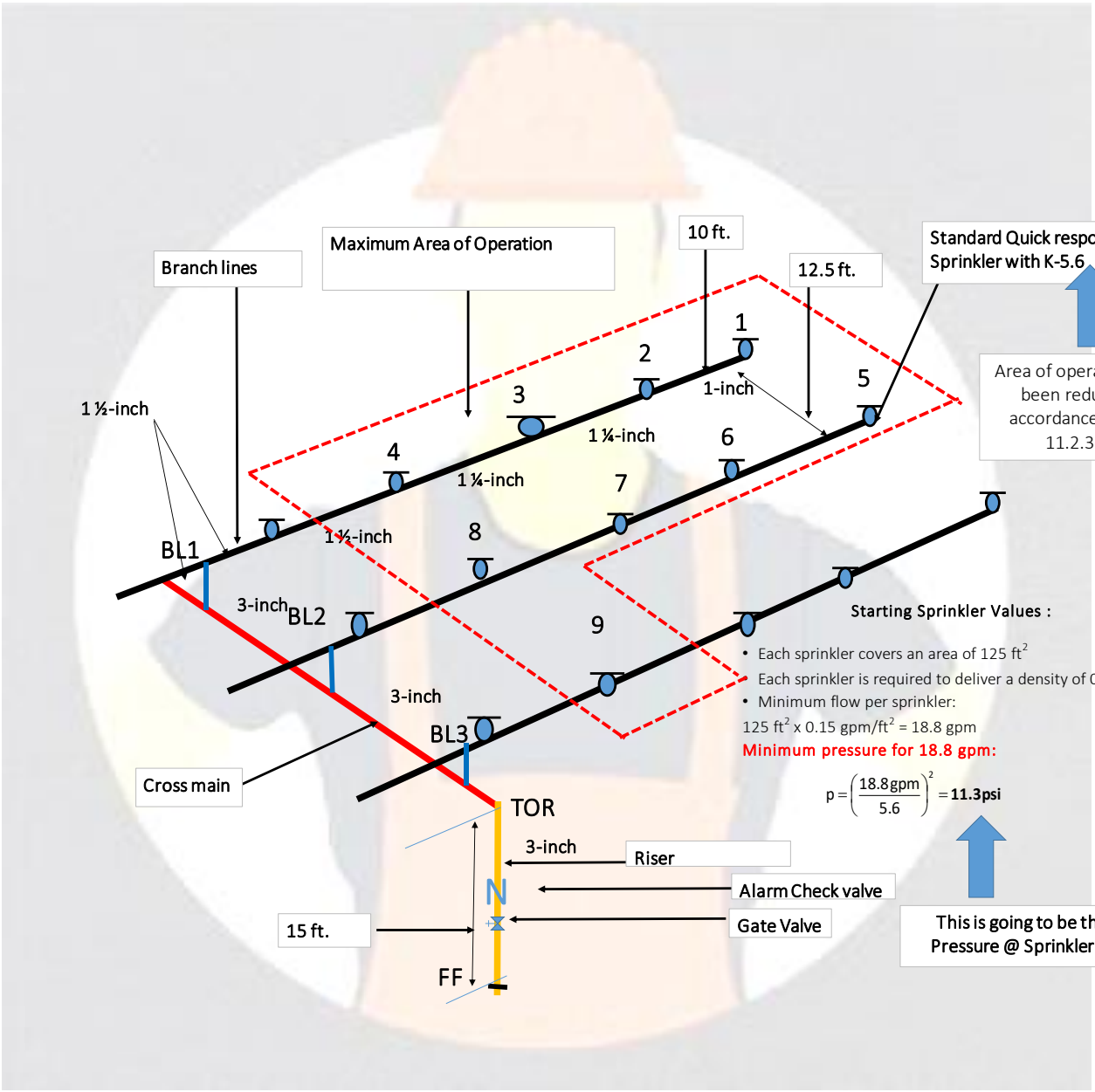


info@mitionline.com Design|Inspection|Training Mehboob Shaikh | +919146861270

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Step: 9 : Hydraulic Calculation

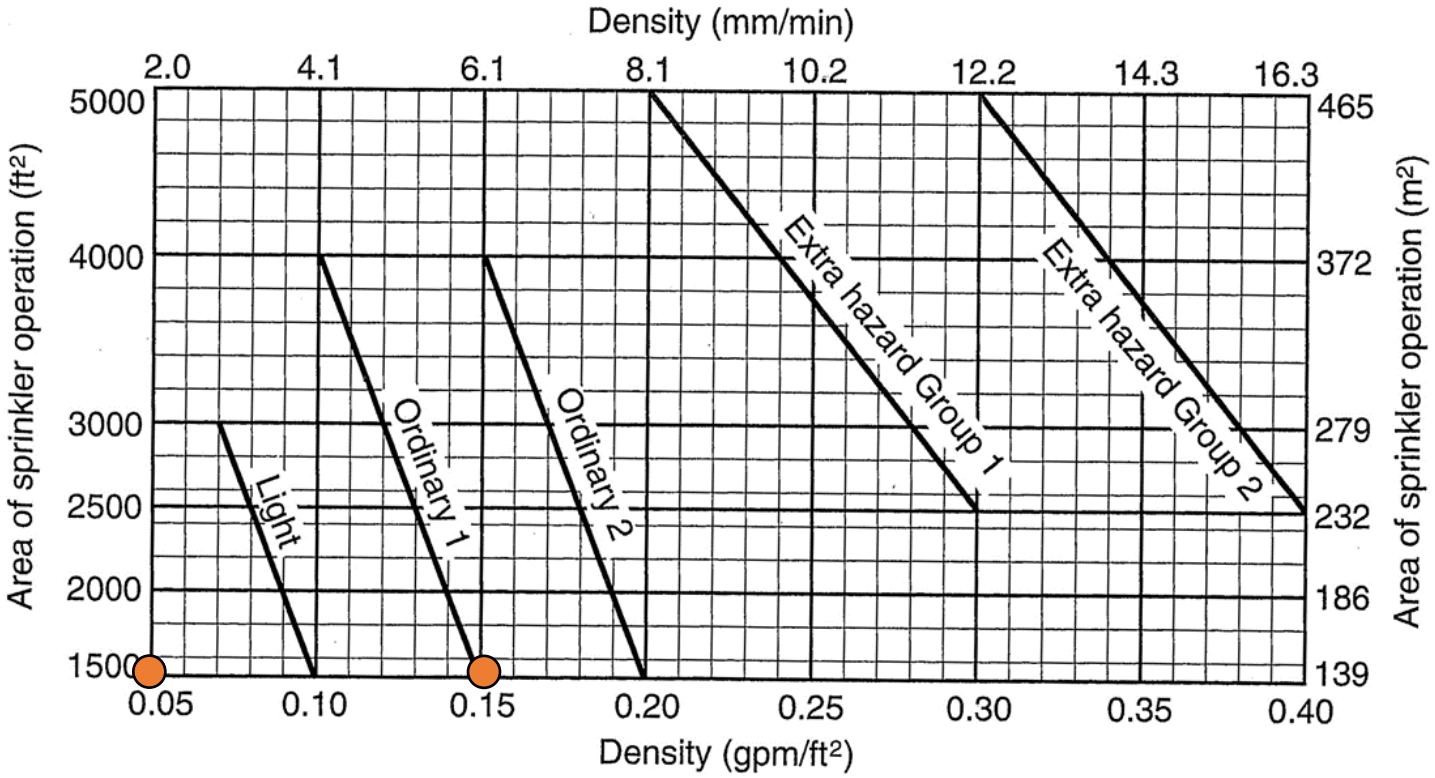
Isometric View



MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Select a Design approach

Using Density/Area Curve (NFPA 13, Chapter 11, Fig;11.2.3.1.1)



As per above figure,

Area of operation = 1500 Sq. Ft.

Density = 0.15 gpm/sq ft.

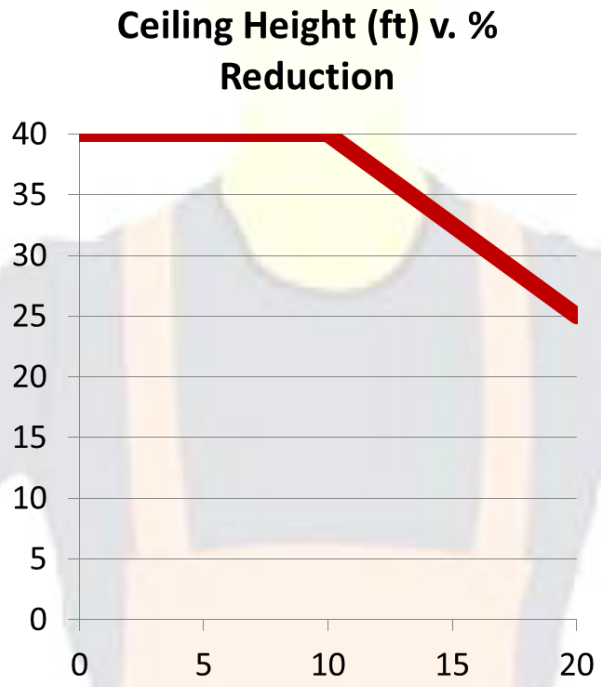
Check for Area Adjustment :

Quick response sprinklers (in light hazard or ordinary hazard with wet pipe system, reduce design area based on maximum ceiling height, where it is less than 20 ft) ----NFPA 13,2013,11.2.3.2.3 excerpt,

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

"Area of Operation shall be permitted to be reduced withtout revising the density as indicated in the below figure when <u>all of the following conditions are satified.</u>

1. Wet Pipe System
2. Light Hazard or Ordinary hazard Occupancy
3. 20 ft. Maximum ceiling height
4. There are no Protected ceiling pockets as allowed by 8.6.7 and 8.8.7 exceeding 32 sq. ft.



$$y = \frac{-3x}{2} + 55$$

$$y = \frac{-3(18)}{2} + 55$$

$$y = \frac{-54}{2} + 55 = 28\%$$

Design area = 1500 Sq ft.

Applying the 28% reduction in area

100% - 28% = 72%

Therefore, 1500 Sq ft. X 0.72 = 1080 Sq. Ft.

New Area of Operation = 1080 Sq .ft.

Density remains same = 0.15 gpm/Sq.ft.

Spacing between the Sprinkler (S) = 10 ft.

Spacing between the branch (L) = 12.5 ft.

Area of Coverage = S x L

Area of Coverage = 10 x 12.5

Area of Coverage = 125 Sq. ft.

No. of Sprinklers in the design area = $\frac{Design\ Area}{Area\ of\ Coverage}$

No. of Sprinklers in the design area = $\frac{1080}{125}$

No. of Sprinklers in the design are = 9 Sprinklers

No. of Sprinkler Along the branch Line = $1.2\sqrt{Area\ of\ operation} \div 10$

No. of Sprinkler Along the branch Line = $1.2\ \sqrt{1080} \div 10$

No. of Sprinkler Along the branch Line = 3.94 Say 4 Sprinklers

Check if Area Increase is required ….?

30% for dry pipe (NFPA 13,2013-11.2.3.2.5)

30% for double interlock (NFPA 13,2013-11.2.3.2.5)

30% for Pitched Ceiling (NFPA 13,2013-11.2.3.2.4)

Starting Sprinkler Values :

- Each sprinkler covers an area of 125 ft^2
- Each sprinkler is required to deliver a density of 0.15 gpm/ft^2
- Minimum flow per sprinkler:

  125 ft^2 x 0.15 gpm/ft^2 = 18.8 gpm
- Minimum pressure for 18.8 gpm:

$$p = \left(\frac{18.8\,gpm}{5.6}\right)^2 = \mathbf{11.3psi}$$

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Check :

- What is minimum required pressure by code ? (7 psi)
- What is minimum pressure required by manufacturer? (specs)
- Is minimum calculated pressure greater than minimums?

11.3 > 7 Psi or Specs ? (Yes)

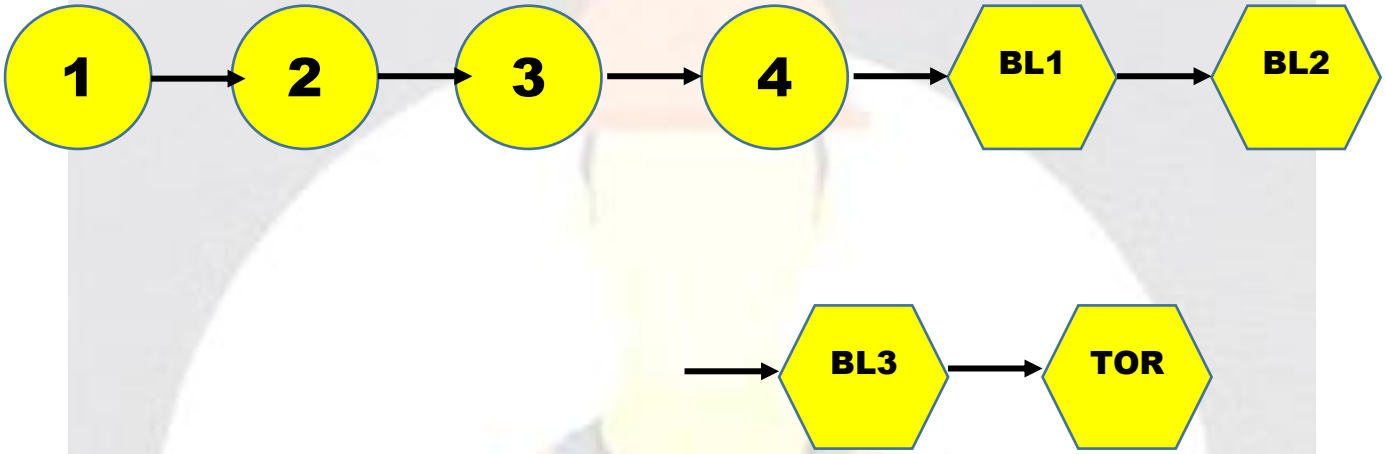
Data Summary :

Water Supply Information	
Static Pressure	90 psi @ 0 gpm
Residual Pressure	60 psi @ 1000 gpm
Hazard Classification	OH - 1
System Type	Wet
Ceiling Height	18 feet
Density/Area	0.15 gpm/ft^2 / 1500 ft^2
Adjusted to	0.15 gpm/ft^2 / 1080 ft^2
Sprinkler Type	Quick Response – Standard Spray
K – Factor	K =5.6
Area Per Sprinkler	125 ft^2
Minimum Sprinkler Flow	18.8 gpm
Minimum Pressure	11.3 psi

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

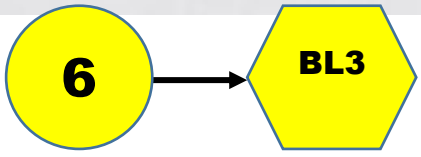
Calculation Paths :

Main Path :



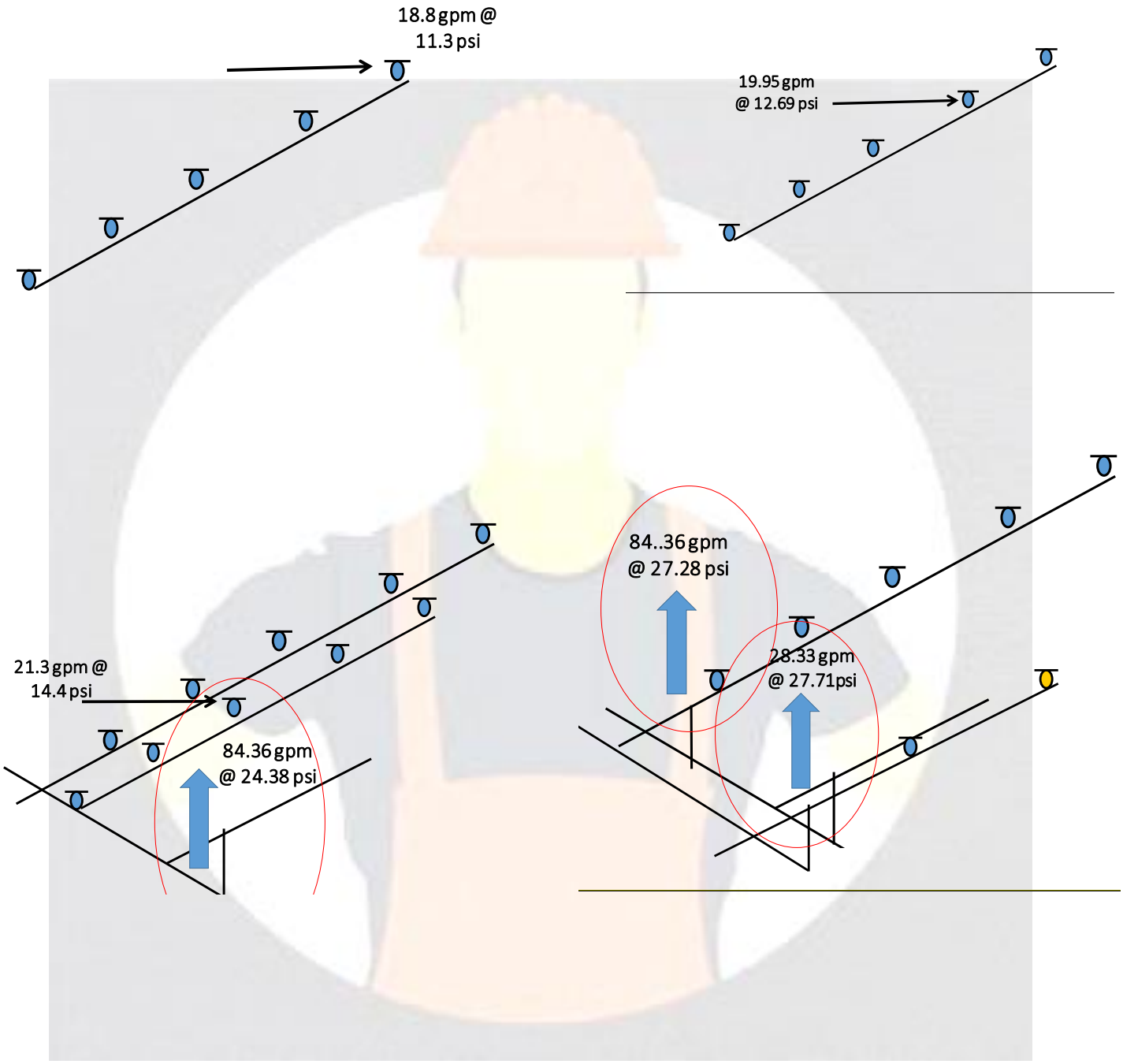
Auxillary Paths-1 :

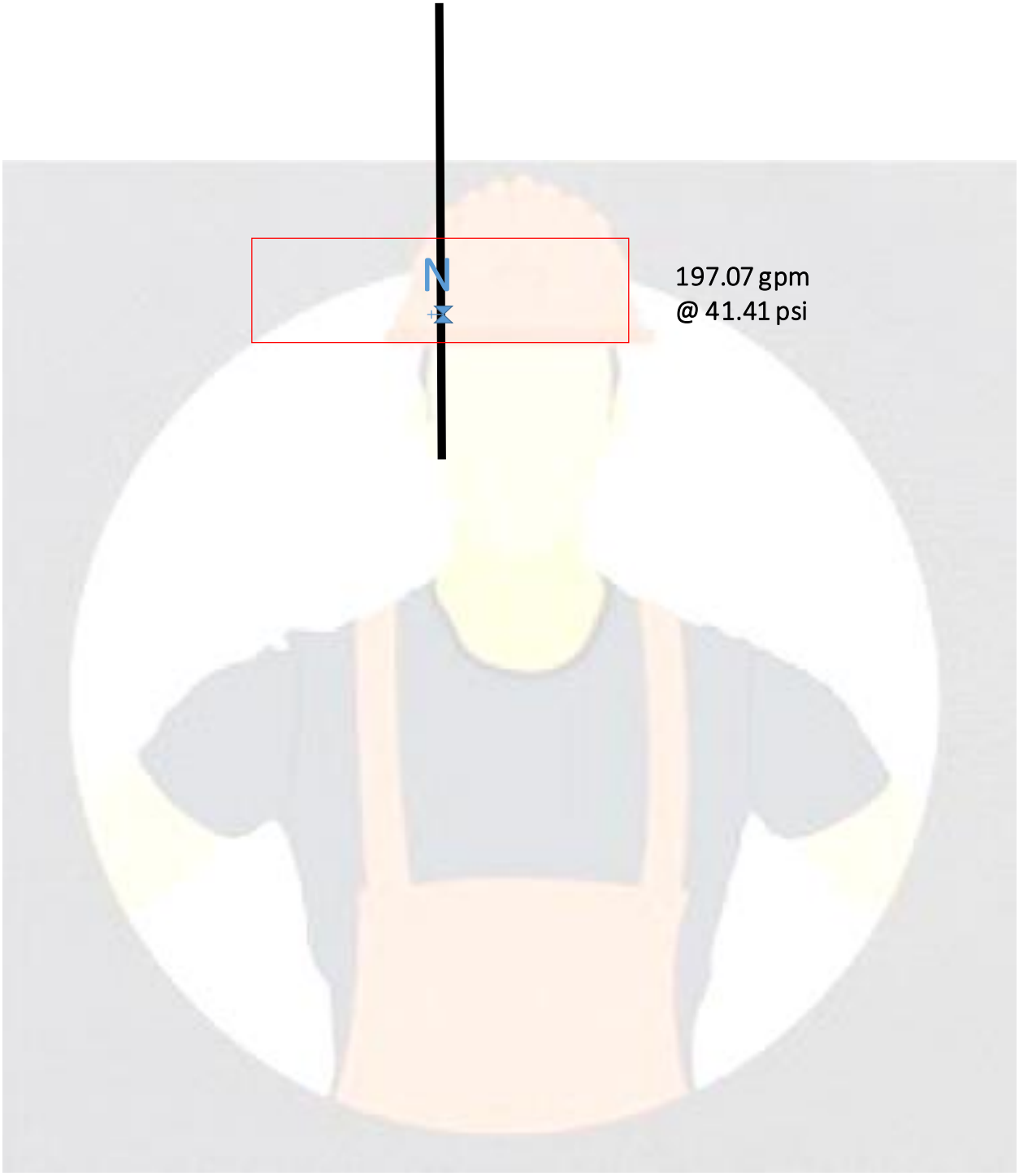
Auxillary Paths-2 :



MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Branch wise Calculation :



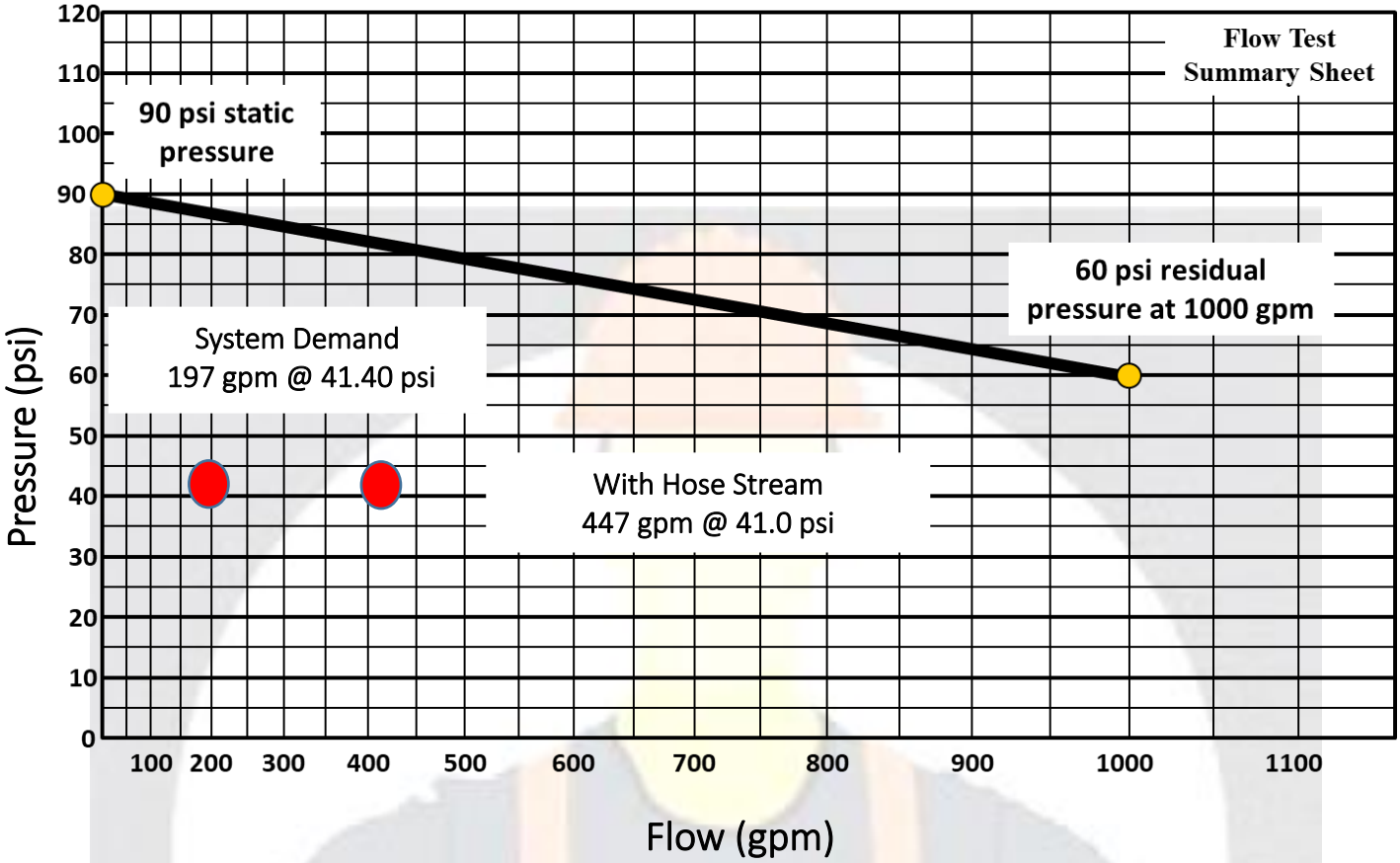

N
197.07 gpm
@ 41.41 psi

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

SPRINKLER HYDRAULIC CALCULATION(Manual Worksheet)

Reference : NFPA 13,2013, Chapter 23, 23.3 & 23.4

Node-1 / Node-2	Elev-1 / Elev-2	K-Factor	Flow added this step(q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings-Quantity and Length	L- ft / F-ft / T- ft	C Factor / Pf per foot (psi)(4.52*Q^1.85*/C^1.85/d^4.87)	Total(Pt) / Elev(Pe) / Frict(Pf)	Remarks (Density Verification)	Notes
1	17	5.6	**18.800**	1.00	1E	10.00	120.000	**11.300**	0.15	Q1 = 18.8 gpm & P1 = 11.3
						2.00	0.116			
2	17		18.800	1.05		12.00		1.393		
2	17	5.6	**19.951**	1.25	1T	10.00	120.000	**12.693**	0.16	Q2 =19.95 gpm & P2 = 12.69
						6.00	0.116			
3	17		38.751	1.38		16.00		1.862		
3	17	5.6	**21.364**	1.25	1T	10.00	120.000	**14.554**	0.17	Q3 =21.3 gpm & P3 = 14.54
						6.00	0.262			
4	17		60.115	1.38		16.00		4.195		
4	17	5.6	**24.248**	1.50	2T	19.00	120.000	**18.749**	0.19	Q4 =24.248 gpm & P4 = 18.74
						16.00	0.232	0.433		
BL1	16		84.363	1.61		35.00		8.107		
BL1	16	16.15	**84.363**	3.00	0	12.50	120.000	**27.289**	0.67	QBL1 =84.363 gpm & PBL1 = 27.289, balaning flow @ BL1 & BL2 | Keq @ BL1 & BL2 = 84.363/(27.289)^(0.5) = 16.15
						-	0.007	0.000		
BL2	16		84.363	3.26		12.50		0.093		
BL2	16		**84.363**	3.00	0	12.50	120.000	**27.382**	0.67	
						-	0.027	0.000		
BL3	16		168.726	3.26		12.50		0.336		
BL3	16	5.38	**28.337**	3.00	1ACV	182.80	120.000	**27.718**	0.23	Keq @ BL3 = 5.38 (Keq = 18.8/12.2^0.5)
					1E	18.00	0.036	6.495		
FF	16		197.063	3.26	1GV	200.80		7.196		
								41.409		



Min. Density Vertification :

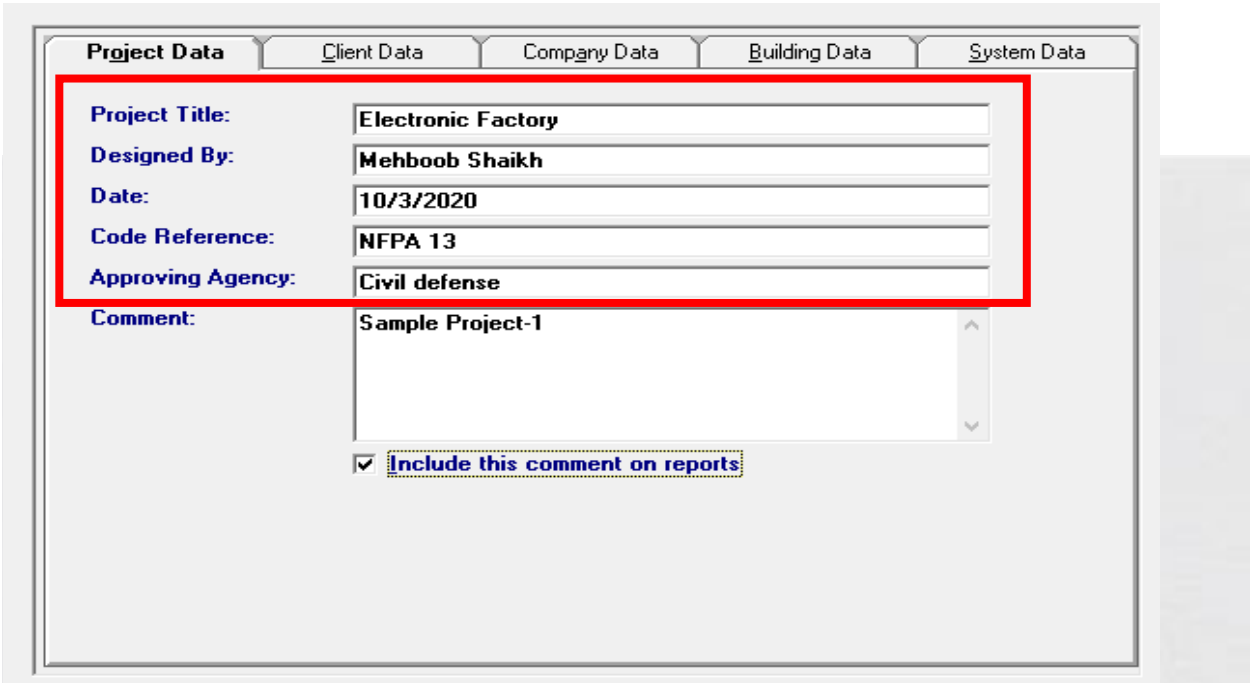
The value in the hydraulic calculations should be higher than the minimum density times area due to pressure losses in the system

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

ELITE SOFTWARE CALCULATION

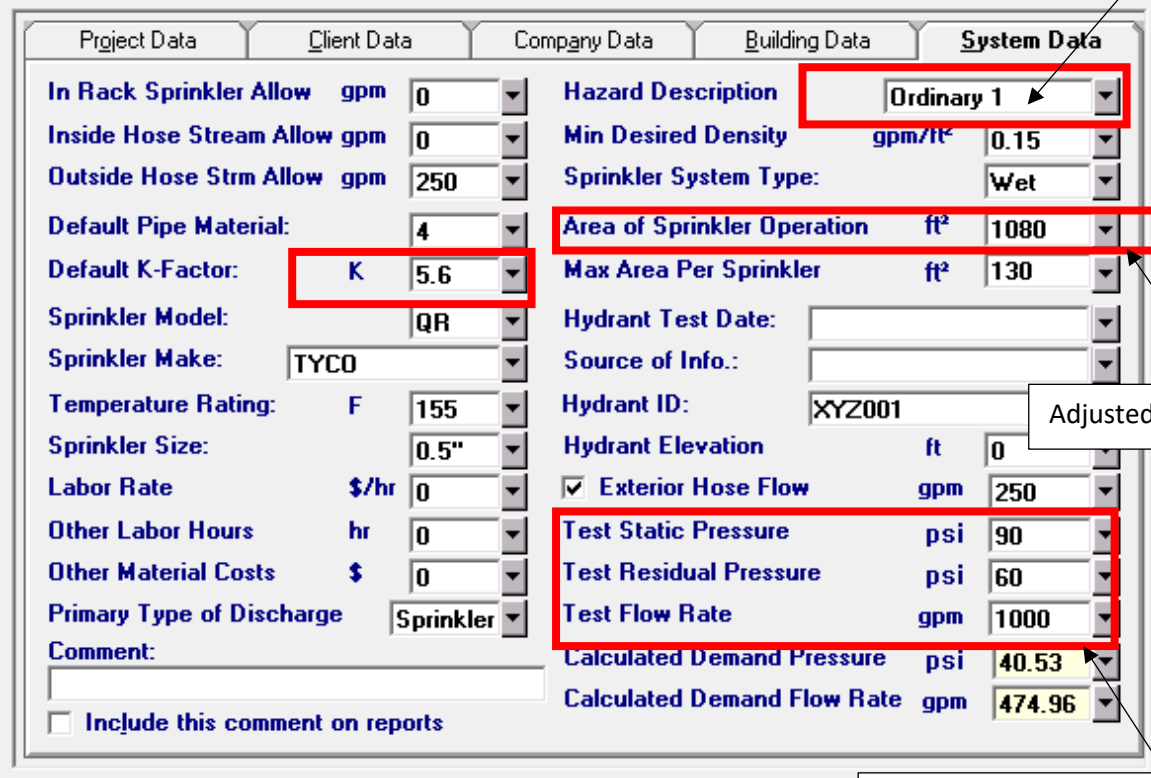
MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Step :1 - General Project Data(client,Company & building data) :



Step-2 : System data:

Select Hazard, NFPA 13, Ch.05



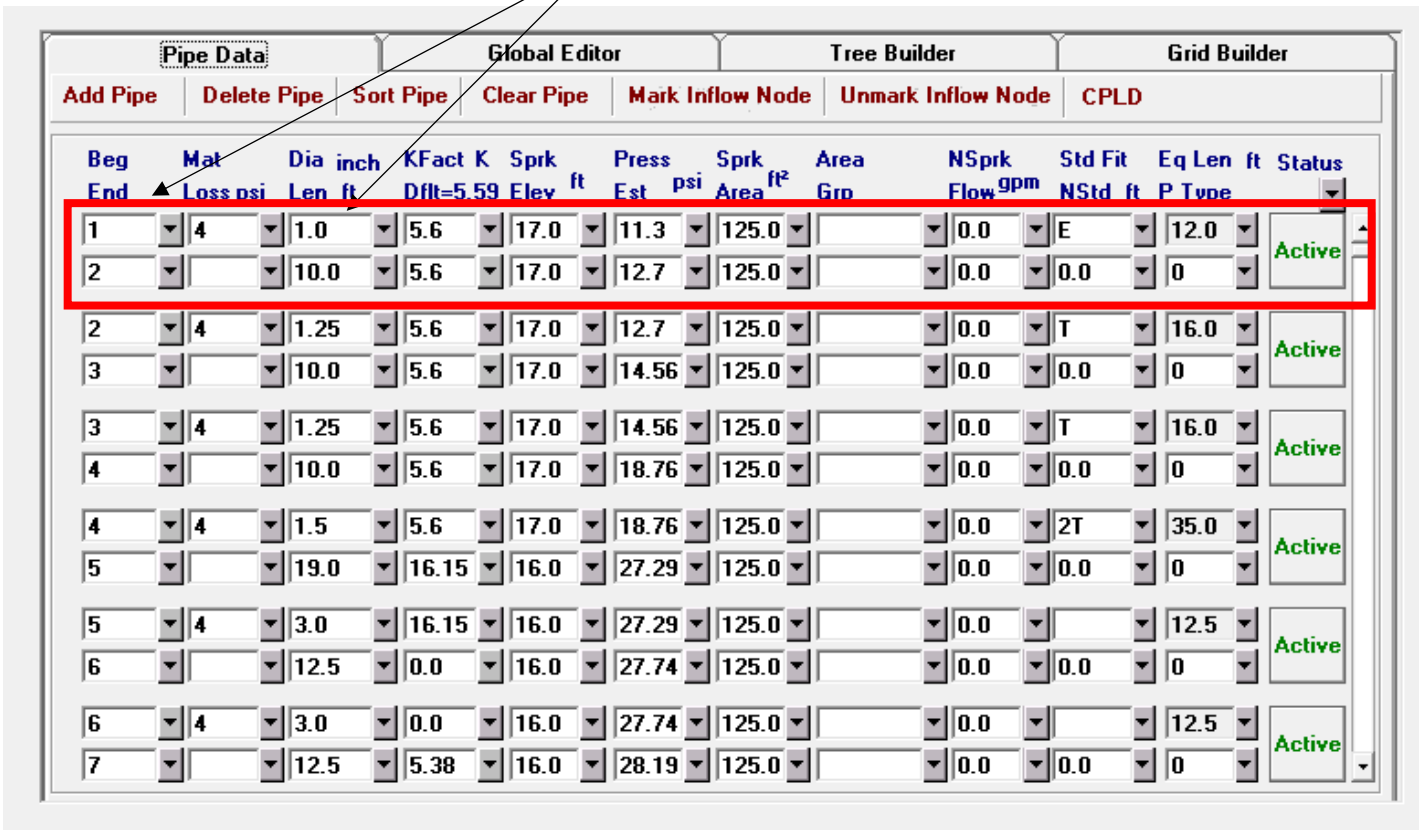
Adjusted area of operation

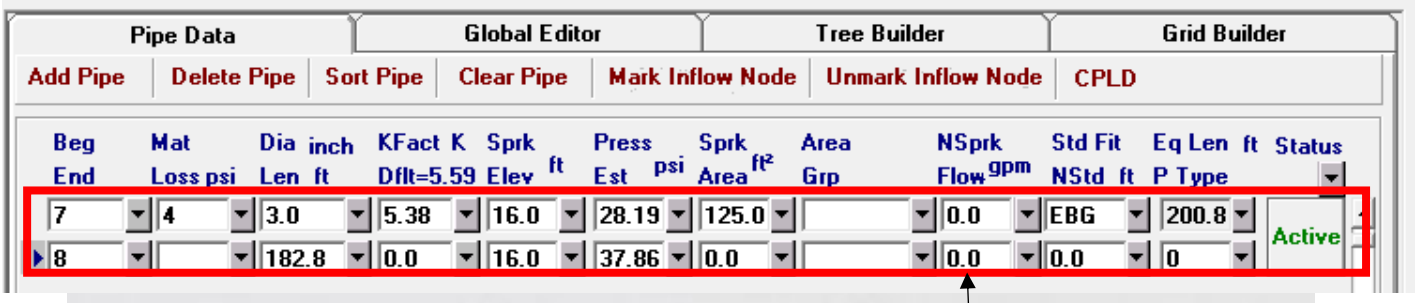
City water mains flow test result as per NFPA 291

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Step -3 : Pipe Data

Nodes, Pipe Length & Dia. Along with details of fittings



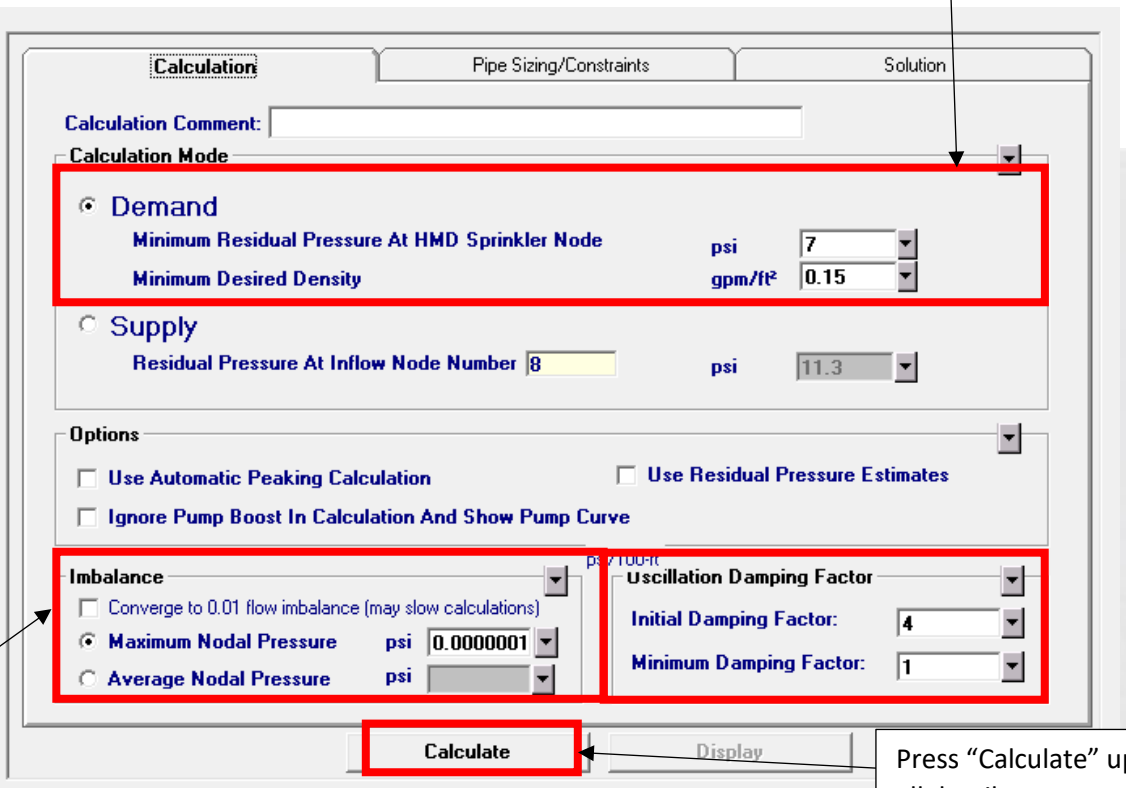


Final Node will be the inflow node

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Step-4 : Calculation

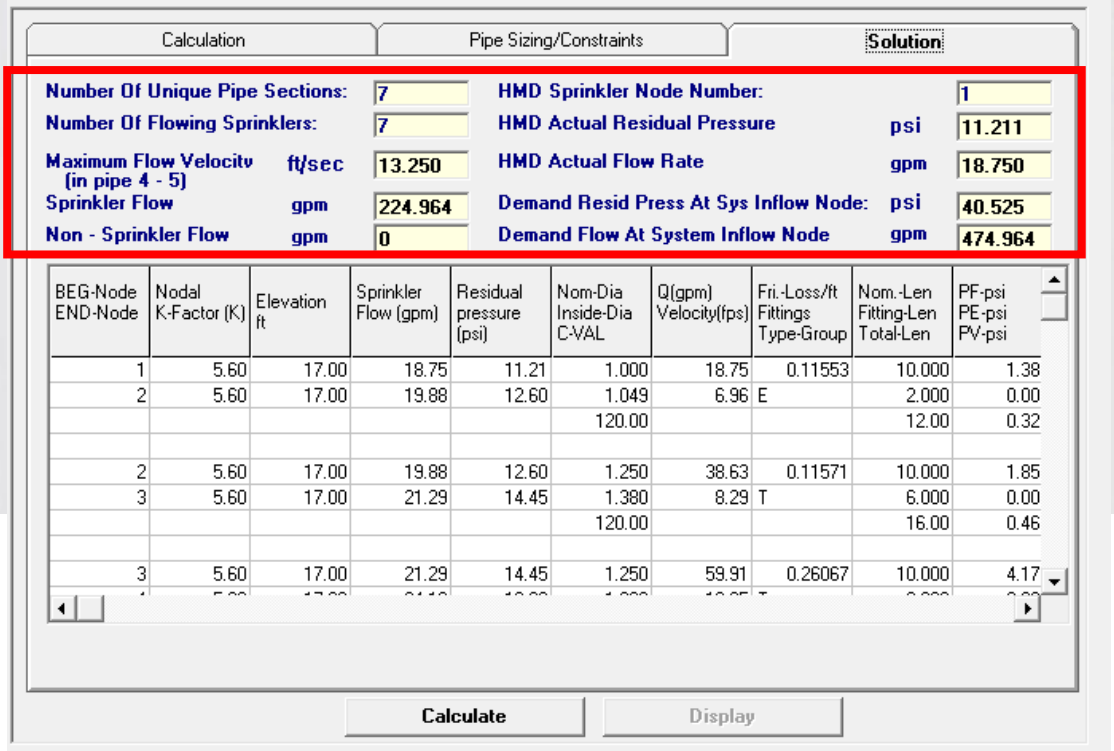
Select Calculation Mode



Smaller imbalance will take more time and result will be more accurate

Press “Calculate” upon filling all details

Step-5 : Solution

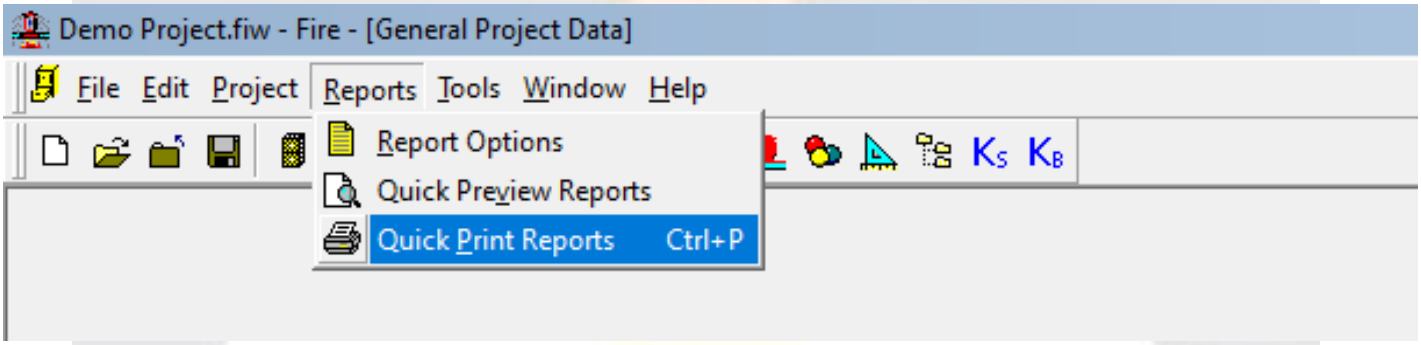


BEG-Node END-Node	Nodal K-Factor (K)	Elevation ft	Sprinkler Flow (gpm)	Residual pressure (psi)	Nom-Dia Inside-Dia C-VAL	Q(gpm) Velocity(fps)	Fri.-Loss/ft Fittings Type-Group	Nom.-Len Fitting-Len Total-Len	PF-psi PE-psi PV-psi
1	5.60	17.00	18.75	11.21	1.000	18.75	0.11553	10.000	1.38
2	5.60	17.00	19.88	12.60	1.049	6.96	E	2.000	0.00
					120.00			12.00	0.32
2	5.60	17.00	19.88	12.60	1.250	38.63	0.11571	10.000	1.85
3	5.60	17.00	21.29	14.45	1.380	8.29	T	6.000	0.00
					120.00			16.00	0.46
3	5.60	17.00	21.29	14.45	1.250	59.91	0.26067	10.000	4.17

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Report :

Print Report



ELECTRONIC STORAGE WAREHOUSE
Fire Sprinkler Reports

for

ABC Brothers

Mumbai
Maharastra-400083

Prepared By:

Mehboob Shaikh
ABC Pvt. Ltd
Mumbai
Maharastara 400083
+919146861270
10/6/2020

Fire Sprinkler Output Summary

Hydraulically Most Demanding Sprinkler Node

HMD Sprinkler Node Number:	1	
HMD Actual Residual Pressure:	11.21	psi
HMD Actual GPM:	18.75	gpm

Sprinkler Summary

Sprinkler System Type:	Wet	
Specified Area Of Application:	1080.00	ft²
Minimum Desired Density:	0.150	gpm/ft²
Application Average Density:	0.208	gpm/ft²
Application Average Area Per Sprinkler:	154.29	ft²
Sprinkler Flow:	224.96	gpm
Average Sprinkler Flow:	32.14	gpm

Flow Velocity And Imbalance Summary

Maximum Flow Velocity (In Pipe 4 - 5)	13.25	ft/sec
Maximum Velocity Pressure (In Pipe 4 - 5)	1.18	psi
Allowable Maximum Nodal Pressure Imbalance:	0.0000	psi
Actual Maximum Nodal Pressure Imbalance:	0.0000	psi
Actual Average Nodal Pressure Imbalance:	0.0000	psi
Actual Maximum Nodal Flow Imbalance:	0.0000	gpm
Actual Average Nodal Flow Imbalance:	0.0000	gpm

Overall Network Summary

Number Of Unique Pipe Sections:	7	
Number Of Flowing Sprinklers:	7	
Pipe System Water Volume:	83.81	gal
Sprinkler Flow:	224.96	gpm
Non-Sprinkler Flow:	0.00	gpm
Demand Flow Excluding Exterior Hose Flow:	224.96	gpm
Exterior Hose Flow:	250.00	gpm
Minimum Required Residual Pressure At System Inflow Node:	40.53	psi
Demand Flow At System Inflow Node:	474.96	gpm

Fire Sprinkler Output Data

Overall Sprinkler Output Data

Flowing Sprinkler Node No.	Area Group Code	Sprinkler KFactor (K)	Sprinkler Elevation (feet)	Residual Pressure (psi)	Flowing Area (ft^2)	Flowing Density (gpm/ft^2)	Sprinkler Discharge (gpm)
1		5.60	17.00	11.21	125.00	0.150	18.75
Sub Totals For Non-Group					125.00	0.150	18.75
2		5.60	17.00	12.60	125.00	0.159	19.88
Sub Totals For Non-Group					125.00	0.159	19.88
3		5.60	17.00	14.45	125.00	0.170	21.29
Sub Totals For Non-Group					125.00	0.170	21.29
4		5.60	17.00	18.62	125.00	0.193	24.16
Sub Totals For Non-Group					125.00	0.193	24.16
5		16.15	16.00	27.11	125.00	0.673	84.09
Sub Totals For Non-Group					125.00	0.673	84.09
6		5.38	16.00	27.56	125.00	0.226	28.24
Sub Totals For Non-Group					125.00	0.226	28.24
7		5.38	16.00	28.16	125.00	0.228	28.55
Sub Totals For Non-Group					125.00	0.228	28.55
Totals For All Groups					875.00	0.257	224.96

Fire Sprinkler Output Data

Overall Pipe Output Data

Beg. End. Node	Nodal KFactor (K)	Elevation (feet)	Spk/Hose Discharge (gpm)	Residual Pressure (psi)	Nom. Dia. Inside Dia. C-Value	q (gpm) Q (gpm) Velocity (fps)	F. L./ft (psi/ft) Fittings Type-Grp	Pipe-Len. Fit-Len. Tot-Len. (ft)	PF-(psi) PE-(psi) PT-(psi)
1	5.60	17.00	18.75	11.21	1.00	18.75	0.11553	10.00	1.386
2	5.60	17.00	19.88	12.60	1.049	18.75	E	2.00	0.000
	SCHED 40 WET STEEL				120	6.96	0	12.00	1.386
2	5.60	17.00	19.88	12.60	1.25	19.88	0.11571	10.00	1.851
3	5.60	17.00	21.29	14.45	1.380	38.63	T	6.00	0.000
	SCHED 40 WET STEEL				120	8.29	0	16.00	1.851
3	5.60	17.00	21.29	14.45	1.25	21.29	0.26067	10.00	4.171
4	5.60	17.00	24.16	18.62	1.380	59.91	T	6.00	0.000
	SCHED 40 WET STEEL				120	12.85	0	16.00	4.171
4	5.60	17.00	24.16	18.62	1.50	24.16	0.23031	19.00	8.061
5	16.15	16.00	84.09	27.11	1.610	84.08	2T	16.00	0.433
	SCHED 40 WET STEEL				120	13.25	0	35.00	8.494
5	16.15	16.00	84.09	27.11	3.00	84.09	0.03594	12.50	0.449
6	5.38	16.00	28.24	27.56	3.068	168.17	-----	0.00	0.000
	SCHED 40 WET STEEL				120	7.30	0	12.50	0.449
6	5.38	16.00	28.24	27.56	3.00	28.24	0.04790	12.50	0.599
7	5.38	16.00	28.55	28.16	3.068	196.41	-----	0.00	0.000
	SCHED 40 WET STEEL				120	8.52	0	12.50	0.599
7	5.38	16.00	28.55	28.16	3.00	0.00	0.06157	182.80	12.364
8	0.00	16.00	0.00	40.53	3.068	224.96	EBG	18.00	0.000
	SCHED 40 WET STEEL				120	9.76	0	200.80	12.364

Fire Sprinkler Output Data

Overall Node Groupings Output Data

Pipe Segment Beg. Node	Pipe Segment End. Node	Pipe Type Group	Pipe Flow Rate (gpm)	Sprinkler Flow At Beg. Node (gpm)	Non-Sprinkler Flow Out (+) (gpm)	Non-Sprinkler Flow In (-) (gpm)	Beg. Node Residual Pressure (psi)	Imbalance Flow At Beg. Node (gpm)
1	2	0	-18.75	18.75	0.00	0.00	11.21	
2	1	0	18.75	19.88	0.00	0.00	12.60	0.00000
2	3	0	-38.63					
3	2	0	38.63	21.29	0.00	0.00	14.45	0.00000
3	4	0	-59.91					
4	3	0	59.91	24.16	0.00	0.00	18.62	0.00000
4	5	0	-84.08					
5	4	0	84.08	84.09	0.00	0.00	27.11	0.00000
5	6	0	-168.17					
6	5	0	168.17	28.24	0.00	0.00	27.56	0.00000
6	7	0	-196.41					
7	6	0	196.41	28.55	0.00	0.00	28.16	0.00000
7	8	0	-224.96					
8	7	0	224.96	0.00	0.00	-224.96	40.53	

Fire Sprinkler Input Data

Pipe Input Data

Beg. Node	End. Node	Pipe Description	Nominal Diameter (inch)	Type Group	Fitting Data	Nominal Length (feet)	Fitting Length (feet)	Total Length (feet)	CFactor (gpm/inch-psi)
1	2	SCHED 40 WET STEEL	1.000	0	E	10.00	2.00	12.00	120
2	3	SCHED 40 WET STEEL	1.250	0	T	10.00	6.00	16.00	120
3	4	SCHED 40 WET STEEL	1.250	0	T	10.00	6.00	16.00	120
4	5	SCHED 40 WET STEEL	1.500	0	2T	19.00	16.00	35.00	120
5	6	SCHED 40 WET STEEL	3.000	0		12.50	0.00	12.50	120
6	7	SCHED 40 WET STEEL	3.000	0		12.50	0.00	12.50	120
7	8	SCHED 40 WET STEEL	3.000	0	EBG	182.80	18.00	200.80	120

Fire Sprinkler Input Data

Node Input Data

Node No.	Node Description Branch Description	Area Group Branch Dia. (in)	Sprinkler KFactor (K) Branch Len. (ft)	Pressure Estimate (psi) Branch Stnd Fittings	Node Elev (ft) Branch Non-Stnd Fittings (ft)	Non-Sprinkler Flow (gpm) Branch Sprk KFactor (K)
1	Sprinkler ----	---- 0.000	5.60 0.0	11.21 ----	17.00 0.0	0.00 0.00
2	Sprinkler ----	---- 0.000	5.60 0.0	12.60 ----	17.00 0.0	0.00 0.00
3	Sprinkler ----	---- 0.000	5.60 0.0	14.45 ----	17.00 0.0	0.00 0.00
4	Sprinkler ----	---- 0.000	5.60 0.0	18.62 ----	17.00 0.0	0.00 0.00
5	Sprinkler ----	---- 0.000	16.15 0.0	27.11 ----	16.00 0.0	0.00 0.00
6	Sprinkler ----	---- 0.000	5.38 0.0	27.56 ----	16.00 0.0	0.00 0.00
7	Sprinkler ----	---- 0.000	5.38 0.0	28.16 ----	16.00 0.0	0.00 0.00
8	No Discharge ----	---- 0.000	N/A 0.0	40.53 ----	16.00 0.0	0.00 0.00

General Project Data Report

General Data

Project Title:	Electronic Storage Warehouse	Project File Name:	Demo Project..fiw
Designed By:	Mehboob Shaikh	Date:	10/6/2020
Code Reference:	NFPA 13,2013	Approving Agency:	Civil Defense
Client Name:	ABC Brothers	Phone:	+919146861270
Address:	Mumbai	City, State Zip Code:	Maharastra-400083
Company Name:	ABC Pvt. Ltd	Representative:	Mr. George
Company Address:	Mumbai	City And State:	Maharastara 400083
Phone:	+919146861270		
Building Name:	Ms. Electronic Store	Building Owner:	Mr. George
Contact at Building:	Mr. David	Phone at Building:	+919146861270
Address Of Building:	Mumbai	City, State Zip Code:	Maharastra-400083

Project Data

Description Of Hazard:	Ordinary 1	Sprinkler System Type:	Wet
Design Area Of Water Application:	1080 ft²	Maximum Area Per Sprinkler:	130 ft²
Default Sprinkler K-Factor:	5.60 K	Default Pipe Material:	SCHED 40 WET STEEL
Inside Hose Stream Allowance:	0.00 gpm	Outside Hose Stream Allowance:	250.00 gpm
In Rack Sprinkler Allowance:	0.00 gpm		
Sprinkler Specifications			
Make:	TYCO	Model:	QR
Size:	0.5"	Temperature Rating:	155 F

Water Supply Test Data

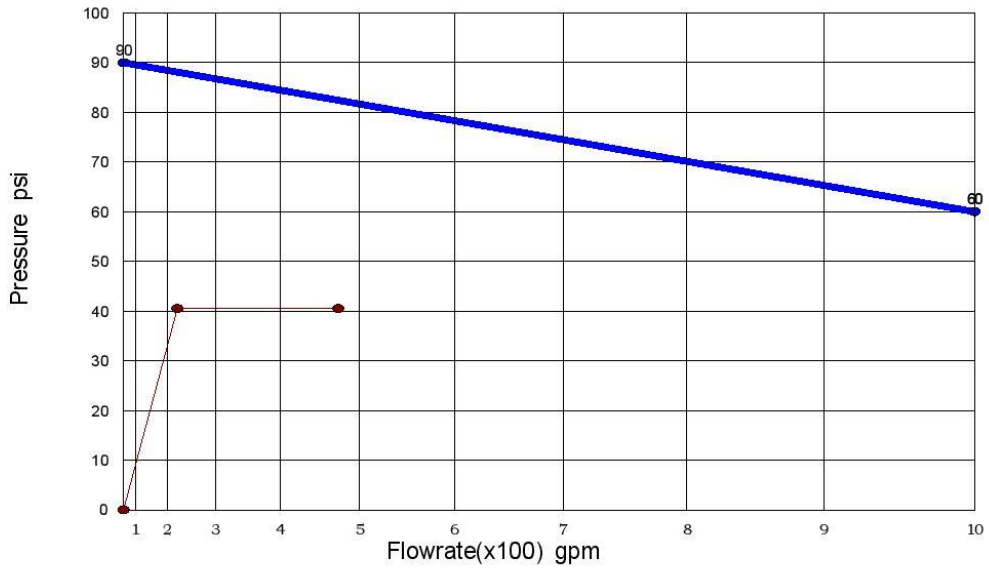
Source Of Information:			
Test Hydrant ID:	XYZ001	Date Of Test:	
Hydrant Elevation:	0 ft	Static Pressure:	90.00 psi
Test Flow Rate:	1000.00 gpm	Test Residual Pressure:	60.00 psi
Calculated System Flow Rate:	474.96 gpm	Calculated Inflow Residual Pressure:	40.53 psi
Available Residual Pressure At System Flow:	82.43 psi		

Calculation Project Data

Calculation Mode:	Demand		
HMD Minimum Residual Pressure:	7.00 psi	Minimum Desired Flow Density:	0.15 gpm/ft²
Maximum Water Velocity:	10.00 ft/s	Maximum Frictional Loss / 100 feet:	0.00 psi
Number Of Active Nodes:	8		
Number Of Active Pipes:	7	Number Of Inactive Pipes:	1
Number Of Active Sprinklers:	7	Number Of Inactive Sprinklers:	0

Fire Sprinkler Output Data

Hydraulic Supply/Demand Graph

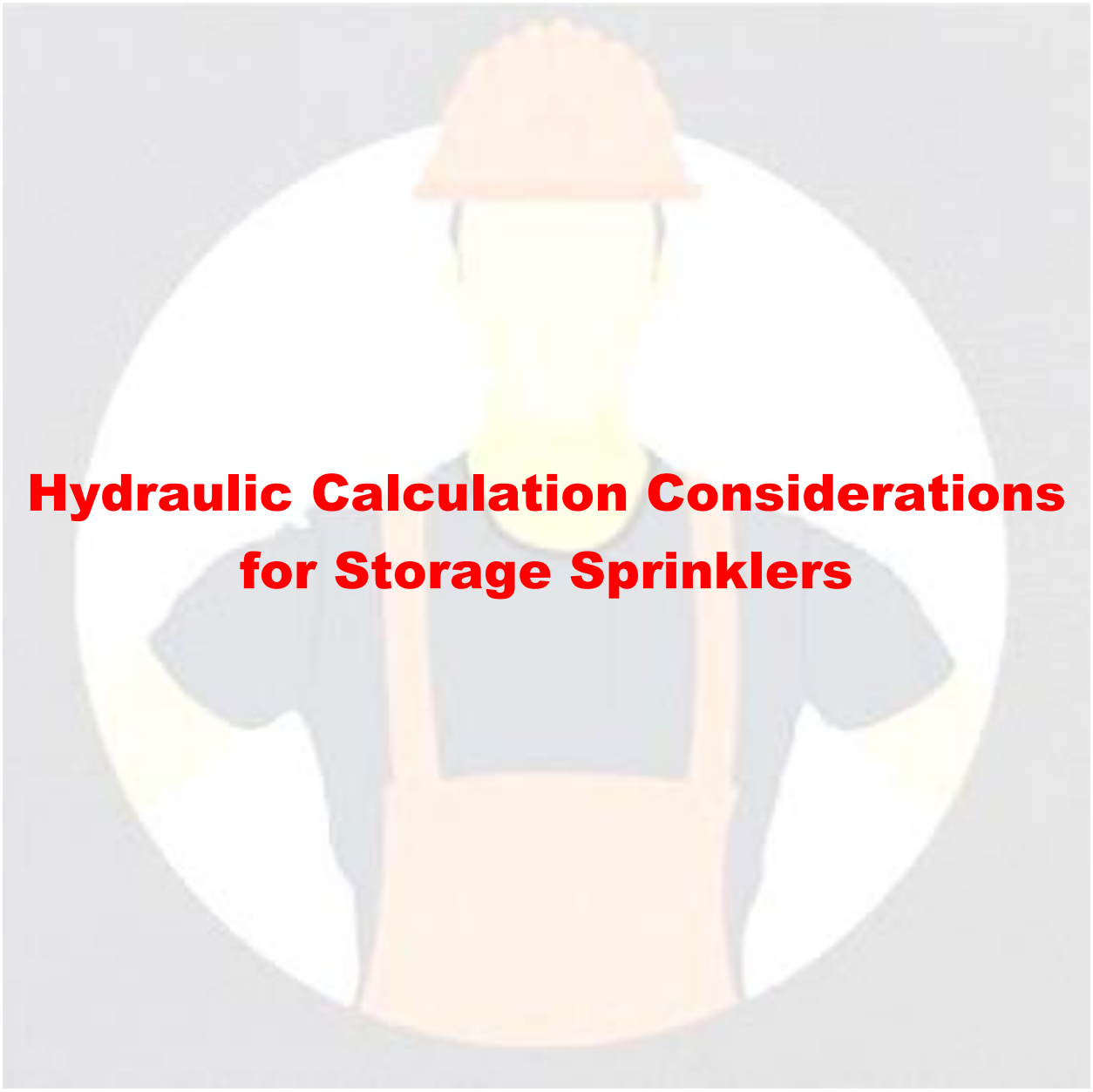


Supply Curve Data

Static Pressure: 90 psi
Test Residual Pressure: 60 psi
Test Flow Rate: 1000 gpm

Demand Curve Data

Calculated Residual Pressure: 40.53 psi
Calculated Flow Rate: 474.96 gpm
Exterior Hose Flow: 250.00 gpm
Excess Available Residual Pressure At Calculated Flow: 41.91 psi
Pressure Required For First Sprinkler Downstream From Inflow Node To Flow: 0.00 psi



Hydraulic Calculation Considerations for Storage Sprinklers

Control Mode Density Area Sprinklers :

Follow Density Area Method for calculations of flow and number of sprinklers.

Control Mode Specific Application/Large Drop Sprinklers :

23.4.4.2.1 For CMSA sprinklers, the design area shall be a rectangular area having a dimension parallel to the branch lines at least 1.2 times the square root of the area protected by

Cl. Reference is from NFPA 13, 2019

the number of sprinklers to be included in the design area. The design area protected by the number of sprinklers to be used by the 1.2 rule shall be based on the maximum allowable area per sprinkler.

CMSA sprinklers do not follow the density/area method of calculation and the discharge criteria in the storage chapters do not specify how many sprinklers to include on the branch line.

So, how to calculate the number of sprinklers on the branch line.

Table 14.3.1 CMSA Sprinkler Design Criteria for Palletized and Solid-Piled Storage of Class I Through Class IV Commodities (Encapsulated and Nonencapsulated)

Configuration	Commodity Class	Maximum Storage Height		Maximum Ceiling/Roof Height		K-Factor/ Orientation	Type of System	Number of Design Sprinklers	Minimum Operating Pressure	
		ft	m	ft	m				psi	bar
Palletized	Class I or II					11.2 (160) Upright	Wet	15	25	1.7
							Dry	25	25	1.7

Table 8.11.2.2.1 Protection Areas and Maximum Spacing for CMSA Sprinklers

Construction Type	Protection Area		Maximum Spacing	
	ft^2	m^2	ft	m
Noncombustible unobstructed	130	12.1	12	3.7
Noncombustible obstructed	130	12.1	12	3.7
Combustible unobstructed	130	12.1	12	3.7
Combustible obstructed	100	9.3	10	3.1
Rack storage combustible obstructed	100	9.3	10	3.1
Rack storage unobstructed and noncombustible obstructed	100	9.3	12	3.7

Example : 9

Type of Facilty : Storage Warehouse

Type of Ceiling Sprinkler : CMSA, K 11.2

Type of Commodity : Class 1, pallatized

Type of System : Wet

No. of Sprinkler in the design Area = 15 (from Table 14.3.1)

Protection area per sprinker = 100 SF

Max. Spacing = 10 ft.

Dimension of rectangle parallel to branch line = 1.2 x Sq. rt (Design Area)

Therefore,

Design area = Allowable area per sprinkler x no. of sprinkler in the design area

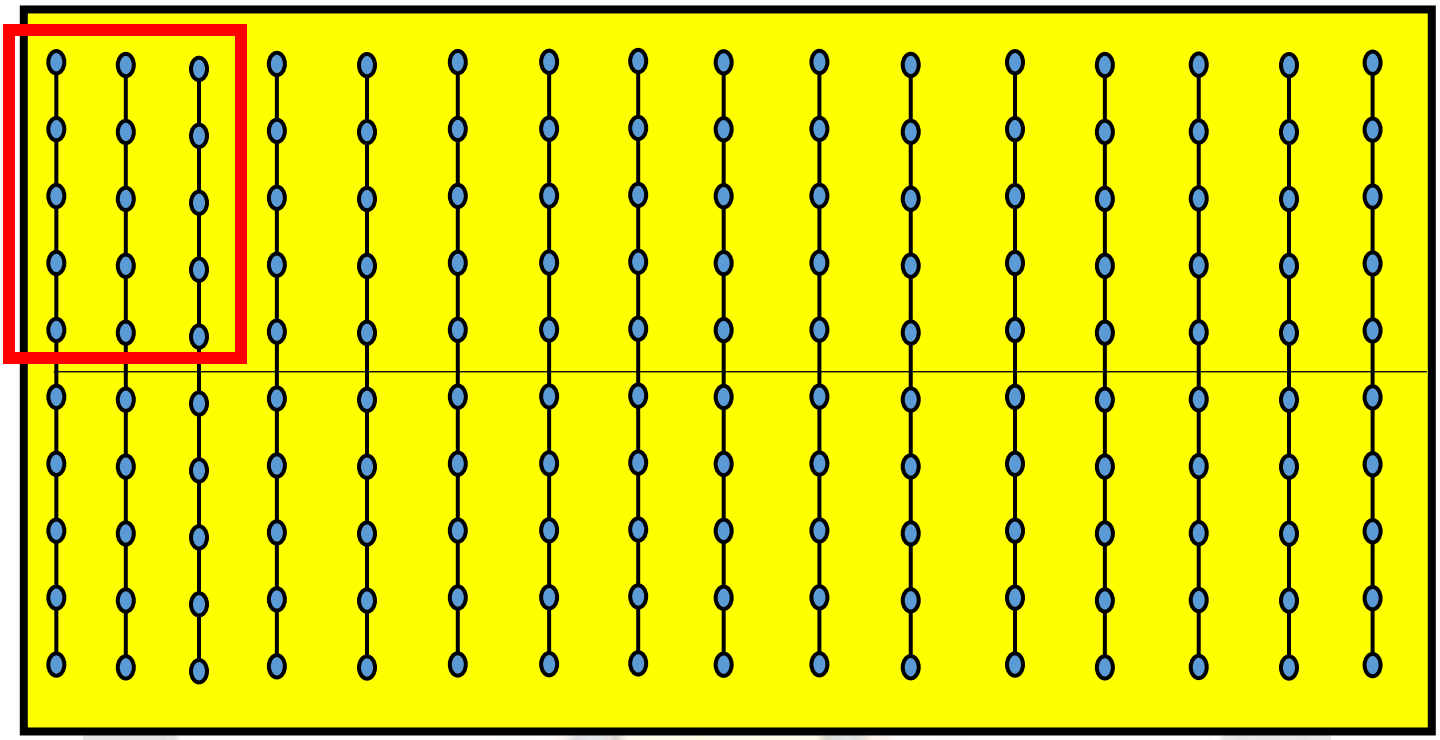
Design Area = 100 x 15

Design Area = 1500 SF

Dimension of rectangle parallel to branch line = 1.2 x Sq. rt (1500)

Dimension of rectangle parallel to branch line = 46.4 say 50

With the spacing of 10 ft between the sprinklers, 5 sprinkles will come in one branch line and such 3 branch lines will be considered for 15 number of sprinklers as shown below.



Early Suppression Fast Response Sprinklers :

23.4.4.3 ESFR Sprinkler Method. For ESFR sprinklers, the design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branch lines, unless other specific numbers of design sprinklers are required in other sections of this standard.

Table 8.12.2.2.1 Protection Areas and Maximum Spacing of ESFR Sprinklers

	Ceiling/Roof Heights Up to 30 ft (9.1 m)				Ceiling/Roof Heights Over 30 ft (9.1 m)			
	Protection Area		Spacing		Protection Area		Spacing	
Construction Type	ft^2	m^2	ft	m	ft^2	m^2	ft	m
Noncombustible unobstructed	100	9.3	12	3.7	100	9.3	10	3.1
Noncombustible obstructed	100	9.3	12	3.7	100	9.3	10	3.1
Combustible unobstructed	100	9.3	12	3.7	100	9.3	10	3.1
Combustible obstructed	N/A		N/A		N/A		N/A	

TABLE 23.8 Early Suppression Fast-Response (ESFR) Sprinklers for Protection of Rubber Tires

Piling Method	Pile Height	Maximum Building Height		Nominal K-factor	Orientation	Number of Sprinklers	Minimum Operating Pressure[a]	
		ft	m				psi	bar
Rubber tire storage, on-side or on-tread, in palletized portable racks, open portable racks, or fixed racks without solid shelves	Up to 25 ft (7.6 m)	30	9.1	14.0 (200)	Upright/pendent	12[a]	50	3.4
				16.8 (240)	Upright/pendent	12[a]	35	2.4
				22.4 (320)	Pendent	12[a]	25	1.7
				25.2 (360)	Pendent	12[a]	15	1.0
Rubber tire storage, on-side, in palletized portable racks, open portable racks, or fixed racks without solid shelves	Up to 25 ft (7.6 m)	35	11	14.0 (200)	Upright/pendent	12[a]	75	5.2
				16.8 (240)	Pendent	12[a]	52	3.6
				22.4 (320)	Pendent	12[a]	35	2.4
				25.2 (360)	Pendent	12[a]	25	1.7
On-tread, on-side, and laced tires in open portable steel racks or palletized portable racks	Up to 25 ft (7.6 m)	30	9.1	14.0 (200)	Pendent	20[b,c]	75	5.2
				16.8 (240)	Pendent	20[b,c]	52	3.6
Rubber tire storage, on-side, in palletized portable racks	Up to 25 ft (7.6 m)	40	12	16.8 (240)	Pendent	12	52	3.6
Rubber tire storage, on-tread, or laced in open portable steel racks	Up to 25 ft (7.6 m)	40	12	25.2 (360)	Pendent	12	40	2.8
On-tread, on-side, and laced tires in open portable steel racks or palletized portable racks	Up to 30 ft (9.1 m)	40	12	25.2 (360)	Pendent	12	75	5.2

In Rack Sprinklers :

How Many In rack Sprinklers will open in case of fire ?

Depends on,

– Number of levels of in-racks

– Type of sprinklers at the ceiling (CMSA/ESFR)

A) For Commodity Class 1 to 4 & Storage Height upto 25 ft.
If Spray or CMSA Sprinklers at the ceiling

In Accordance with Cl. 16.1.6.5,

(1) Six sprinklers where only one level of in-rack sprinklers is installed to protect Class I, Class II, or Class III commodity
(2) Eight sprinklers where only one level of in-rack sprinklers is installed to protect Class IV commodity
(3) Ten sprinklers (five on each of the top two levels) where more than one level of in-rack sprinklers is installed to protect Class I, Class II, or Class III commodity
(4) Fourteen sprinklers (seven on each of the top two levels) when more than one level of in-rack sprinklers is installed to protect Class IV commodity

No. of In rack Spr Level	Type of Commodity	No. of Sprinklers	Notes
1	Class 1,2 or 3	6	
1	Class 4	8	
2	Class 1,2 or 3	10	5 on each level
2	Class 4	14	7 on each level

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Example : 10

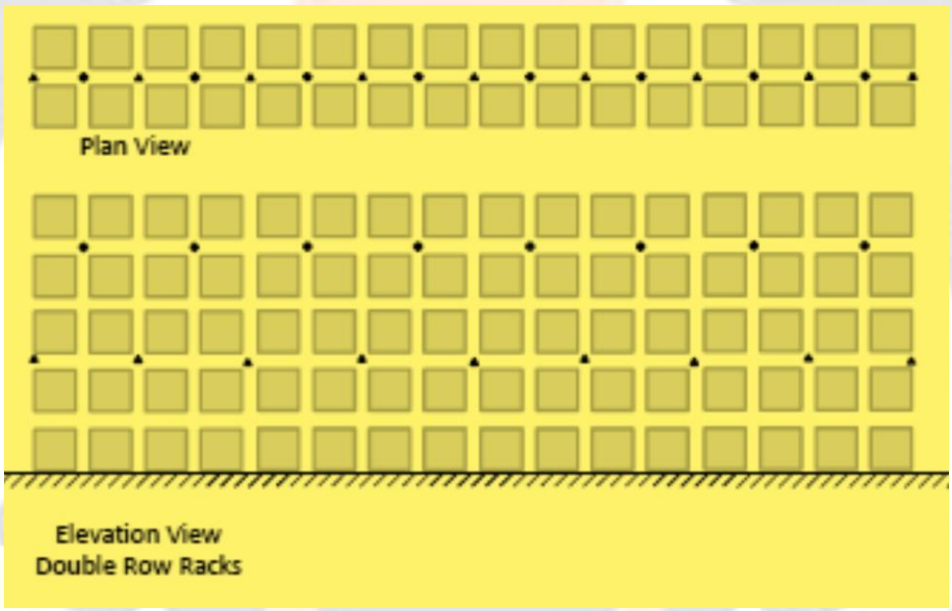
Type of Facilty : Storage Warehouse

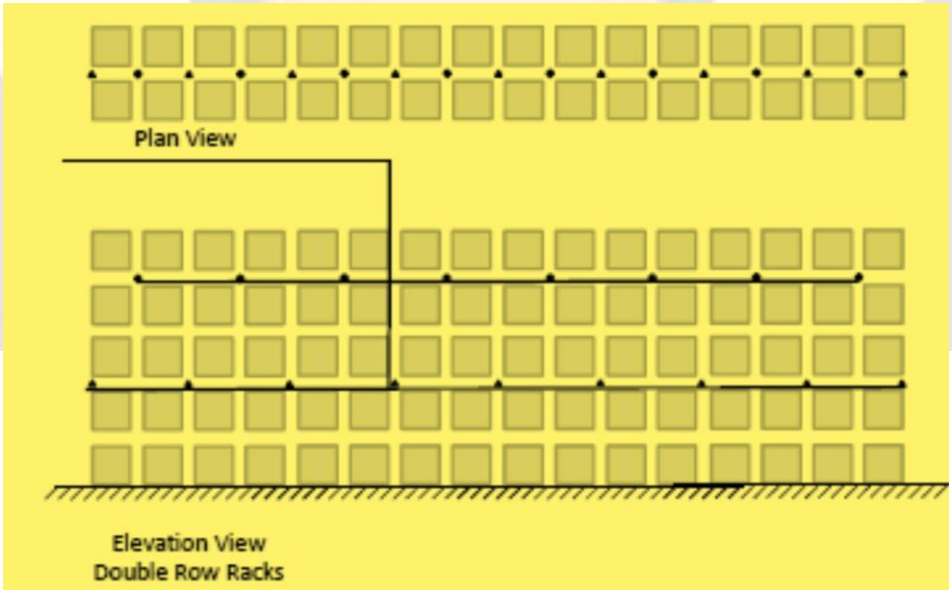
Type of Ceiling Sprinkler : CMSA, K 11.2

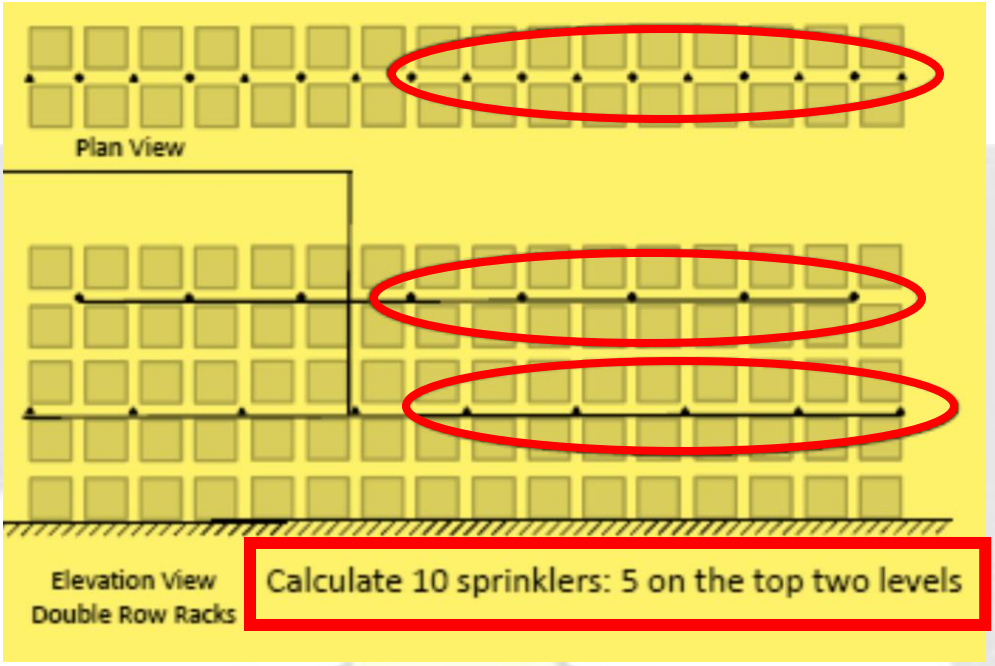
Type of Commodity : Class 3

No. of Rack Sprinklers Level – 02

Type of System : Wet







B) For Commodity Class 1 to 4 & Storage Height over 25 ft.
If Spray or CMSA Sprinklers at the ceiling

In Accordance with Cl. 16.1.6.5,

(1) Six sprinklers where only one level of in-rack sprinklers is installed to protect Class I, Class II, or Class III commodity
(2) Eight sprinklers where only one level of in-rack sprinklers is installed to protect Class IV commodity
(3) Ten sprinklers (five on each of the top two levels) where more than one level of in-rack sprinklers is installed to protect Class I, Class II, or Class III commodity
(4) Fourteen sprinklers (seven on each of the top two levels) when more than one level of in-rack sprinklers is installed to protect Class IV commodity

No. of In rack Spr Level	Type of Commodity	No. of Sprinklers	Notes
1	Class 1,2 or 3	6	
1	Class 4	8	
2	Class 1,2 or 3	10	5 on each level
2	Class 4	14	7 on each level

C) For Group A Plastics

Storage of any height (upto and over 25 ft)

In accordance, 17.1.5.6

(1) Eight sprinklers where only one level of in-rack sprinklers is installed
(2) Fourteen sprinklers (seven on each of the top two levels) when more than one level of in-rack sprinklers is installed

No. of In rack Spr Level	Type of Commodity	No. of Sprinklers	Notes
1	Group A Plastic	8	
More than 1	Group A Plastic	14	7 on each level

D) For Group A Plastics

In accordance, 18.5.3

18.5.3 Water demand for sprinklers installed in racks shall be based on simultaneous operation of the most hydraulically remote 12 sprinklers where only one level is installed in racks.

No. of In rack Spr Level	Type of Commodity	No. of Sprinklers	Notes
1	Rubber Tire	12	
More than 1	Rubber Tire	14	7 on each level

Min. Flow and Pressure Requirement for Rack Sprinkler :

What is the min. Operating Sprinkler at rack Sprinklers ?

For Class 1 to 4 Commodity for storage upto 25 ft. (Cl. 16.2.1.4.4)

Depends on,

– Type of sprinklers at the ceiling (CMSA/ESFR)

If spray sprinklers or CMSA sprinklers at the ceiling

Min. Operating Pressure = 15 psi

Hence for k = 5.6 , Q = 21.7 GPM

for k = 8.0 , Q = 31 GPM

for k = 11.2 , Q = 43.2 GPM

For Class 1 to 4 Commodity for storage Over 25 ft. (Cl.table 16.3.1.1)

If spray sprinklers or CMSA sprinklers at the ceiling

Min. Q = 30 GPM

Hence for k = 5.6 , P = 28.7 psi

for k = 8.0 , P = 14.1 psi

for k = 11.2 , P = 7.2 psi

Group A Plastics Spray Sprinklers at Ceiling :

For storage up to 25 ft, depends on the in-rack configuration selected from the Figures:

– Figure 17.2.1.2.1(b) & (f): 15 psi
– Figure 17.2.1.2.1(c), (d) and (e):

• 15 psi when sprinklers are at every other flue intersection
• 15 psi for k-8 and 30 psi for k-5.6 when sprinklers are at every flue

For storage over 25 ft:
– 30 gpm regardless of situation

Group A Plastics ESFR Sprinklers at Ceiling

• Must use k-8.0 or K- 11.2 quick response, ordinary temprature sprinkler
• 60 gpm (17.3.3.4.1)
• 56.3 psi

Rubber Tire Storage

• 18.5.4
– 30 psi
– 30.7 gpm for k-5.6 sprinkler
– 43.8 gpm for k-8.0 sprinkler
– 61.3 gpm for k-11.2 sprinkler

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Hydraulic Calculations Steps for In Rack Sprinklers :

Step : 01 - Calculate number and location of open sprinklers in the hydraulically most remote area.

Step : 02 - Start at most remote sprinkler and work towards the water supply calculating flows and pressures

Step : 03 - Adding pressure increases due to friction loss

Step : 04 - Add flows from other open sprinklers encountered on the way

Step : 05 – Adjust the Elevation changes

Example- 11 :

Type of Facility : Storage Warehouse

Type of Rack- 5 tier double row rack

Type of Ceiling Sprinkler : CMSA, K 8.0

Type of In Rack Sprinkler : Rack, K 5.6

Width of Aisle : 8 ft.

Type of Commodity : Class 3,Encapsulated

No. of Rack Sprinklers Level – 02

Type of System : Wet

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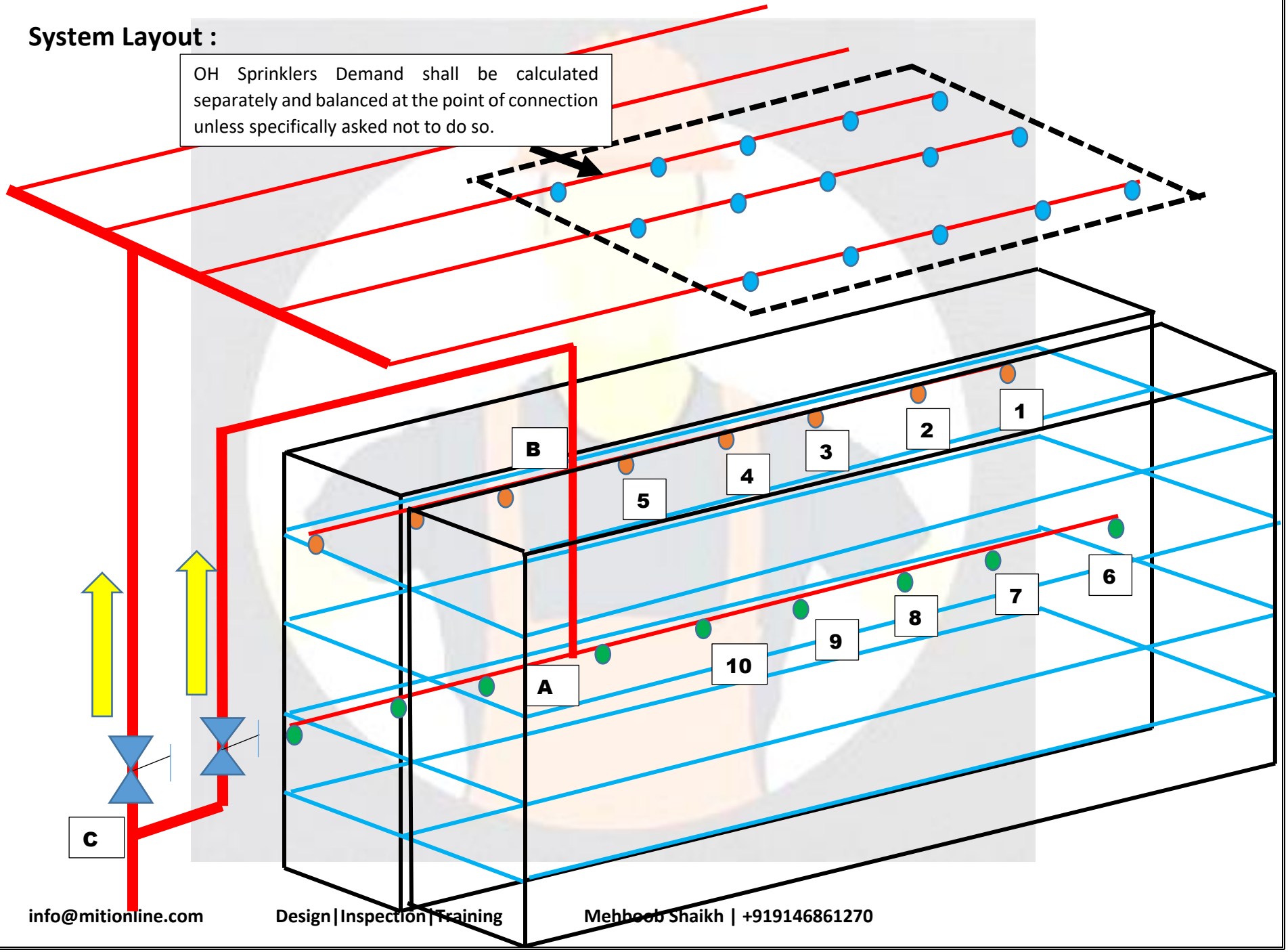
System Layout :

OH Sprinklers Demand shall be calculated separately and balanced at the point of connection unless specifically asked not to do so.



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Hydraulic Calculations Sheet- Manual

IN RACK SPRINKLER SYSTEM HYDRAULIC CALCULATION									
Reference : NFPA 13- 2013, Chapter 23 (PLANS AND CALCULATIONS)									
Node-1	Elev-1	K- Factor	Flow added this step(q)	Nominal ID	Fittings- Quantity and Length	L- ft	C Factor	Total(Pt)	Notes
Node-2	Elev-2		Total Flow (Q)	Actual ID		F-ft T- ft	Pf per foot (psi) 4.52*Q^1.85*/C^1.85/d^4.87	Elev(Pe) Frict(Pf)	
1	20	5.6	**21.700**	1.25	1T	10.00 6.00	120.000 0.040	**15.000**	Q1 = 21.70 gpm & P1 = 15 psi
2	20		21.700	1.38		16.00		0.637	
2	20	5.6	**22.144**	1.25	1T	10.00 6.00	120.000 0.146	**15.637**	
3	20		43.844	1.38		16.00		2.339	
3	20	5.6	**23.743**	1.25	1T	10.00 6.00	120.000 0.326	**17.976**	
4	20		67.587	1.38		16.00		5.210	
4	20	5.6	**26.965**	2.00	1T	10.00 10.00	120.000 0.084	**23.186**	
5	20		94.552	2.07		20.00		1.682	
5	20	5.6	**27.926**	2.50	1T	10.00 12.00	120.000 0.057	**24.868**	Flow at Node B
B	20		122.478	2.47		22.00		1.263	
6	10	5.6	**21.689**	1.25	1T	10.00 6.00	120.000 0.040	**15.000**	
7	10		21.689	1.38		16.00		0.636	
7	10	5.6	**21.689**	1.25	1T	10.00 6.00	120.000 0.143	**15.000**	
8	10		43.377	1.38		16.00		2.294	
8	10	5.6	**23.288**	1.25	1T	10.00 6.00	120.000 0.317	**17.294**	
9	10		66.665	1.38		16.00		5.079	
9	10	5.6	**26.488**	1.25	1T	10.00 6.00	120.000 0.589	**22.372**	
10	10		93.153	1.38		16.00		9.431	
10	10	5.6	**31.581**	2.00	1T	10.00 10.00	120.000 0.140	**31.804**	Flow at Node B
A	10		124.734	2.07		20.00		2.809	
A	10	0	**0.000**	2.50	1T	10.00 12.00	120.000 0.211	**34.612** -4.330	
B	20		247.213	2.47		22.00		4.633	Total Flow at Node A+ Node B
B	20	0	**0.000**	2.50	1T, 3E, 1CV	150.00 31.00	120.000 0.211	**34.915** 2.165	
C	15		247.213	2.47		181.00		38.113	Total Flow at C
								75.193	

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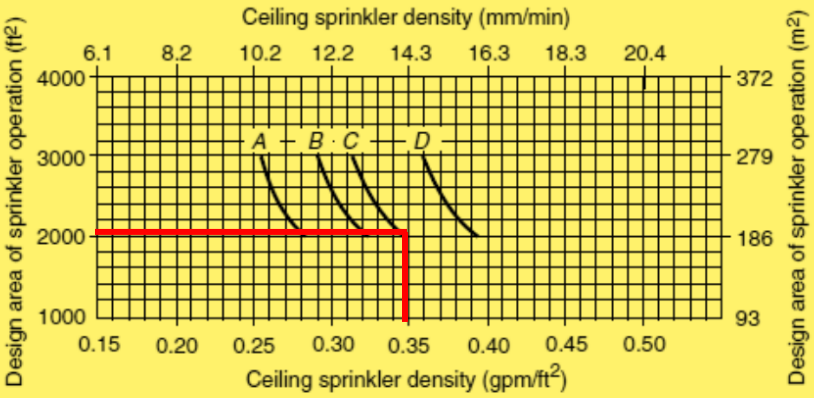
Calculation for Over Head Sprinklers :

In accordance with table 16.2.1.3.2

Table 16.2.1.3.2 *Continued*

Height	Commodity Class	Encapsulated	Aisles* ft	Aisles* m	Sprinklers Mandatory In-Rack	Ceiling Sprinkler Water Demand: With In-Rack Sprinklers: Figure	With In-Rack Sprinklers: Curves	With In-Rack Sprinklers: Apply Figure 16.2.1.3.4.1	Without In-Rack Sprinklers: Figure	Without In-Rack Sprinklers: Curves	Without In-Rack Sprinklers: Apply Figure 16.2.1.3.4.1
Over 22 ft (6.7 m) up to and including 25 ft (7.6 m)	I	No	4	1.2	No	16.2.1.3.2(a)	C and D	No	16.2.1.3.2(a)	F and H	Yes
			8	2.4			A and B			E and G	
		Yes	4	1.2	1 level	16.2.1.3.2(e)	C and D		—	—	—
			8	2.4			A and B				
	II	No	4	1.2	No	16.2.1.3.2(b)	C and D		16.2.1.3.2(b)	G and H	Yes
			8	2.4			A and B			E and F	
		Yes	4	1.2	1 level	16.2.1.3.2(e)	C and D		—	—	—
			8	2.4			A and B				
		No	4	1.2	No	16.2.1.3.2(c)	C and D		16.2.1.3.2(c)	G and H	Yes
	III	Yes	4	1.2	1 level	16.2.1.3.2(f)	C and D		—	—	—
			8	2.4			A and B				



Curve	Legend
A	8 ft (2.44 m) aisles with high-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers
B	8 ft (2.44 m) aisles with ordinary-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers
C	4 ft (1.22 m) aisles with high-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers
D	4 ft (1.22 m) aisles with ordinary-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers

FIGURE 16.2.1.3.2(f) Single- or Double-Row Racks — 20 ft (6.1 m) High Rack Storage — Sprinkler System Design Curves — Class III Encapsulated Commodities — Conventional Pallets.

– Figure 16.2.1.3.2(f); Curve “C”
– 0.345 gpm per sq ft over 2000 sq ft

In accordance with Cl. 16.2.1.3.4.4

16.2.1.3.4.4 For storage height over 20 ft (6.1 m) up to and including 25 ft (7.6 m) protected with ceiling sprinklers and with more than the minimum required level of in-rack sprinklers, but not in every tier, densities obtained from design curves shall be permitted to be reduced 20 percent, as indi-

Reduce by 20% due to extra level of in-rack sprinklers (see 16.2.1.3.4.4) Here, required level of in rack sprinklers are ONE however, in actual we have TWO

Hence, Final density will become, 0.276 GPM @ 2000 SF

After calculation, Let's say, ceiling sprinkler demand at Point "C" is:

– 665 gpm at 84 psi

Lets Put Demands Together

- Ceiling
  - 665 GPM @ 84 PSI

- In Rack
  - 247 at 75 PSI

• Can't add flows unless the pressure is the same
• Adjusting the lower pressure situation to the higher pressure is called "Balancing the Flows

Steps to Balance the Flows :

- Calculate the two demands separately from the most remote point to the node where they connect
- Get the k-factor for the lower pressure situation
- Apply the k-factor to the higher pressure to get the new flow:
- Add the two flows together

Step 01 :

- Calculate the two demands separately from the most remote point to the node where they connect

a. In-Racks: 247 gpm at 75 psi

b. Ceiling: 665 gpm at 84 psi

Step 02 :

- Get the k-factor for the lower pressure situation

In Racks are the lower situation in this case,

$$K = \frac{Q}{Sq.rt\ P}$$

$$K = \frac{247}{Sq.rt\ 75}$$

$$K = 28.52$$

Step 03 :

Apply the K-factor to the higher pressure,

Q = K X Sq. rt (P)

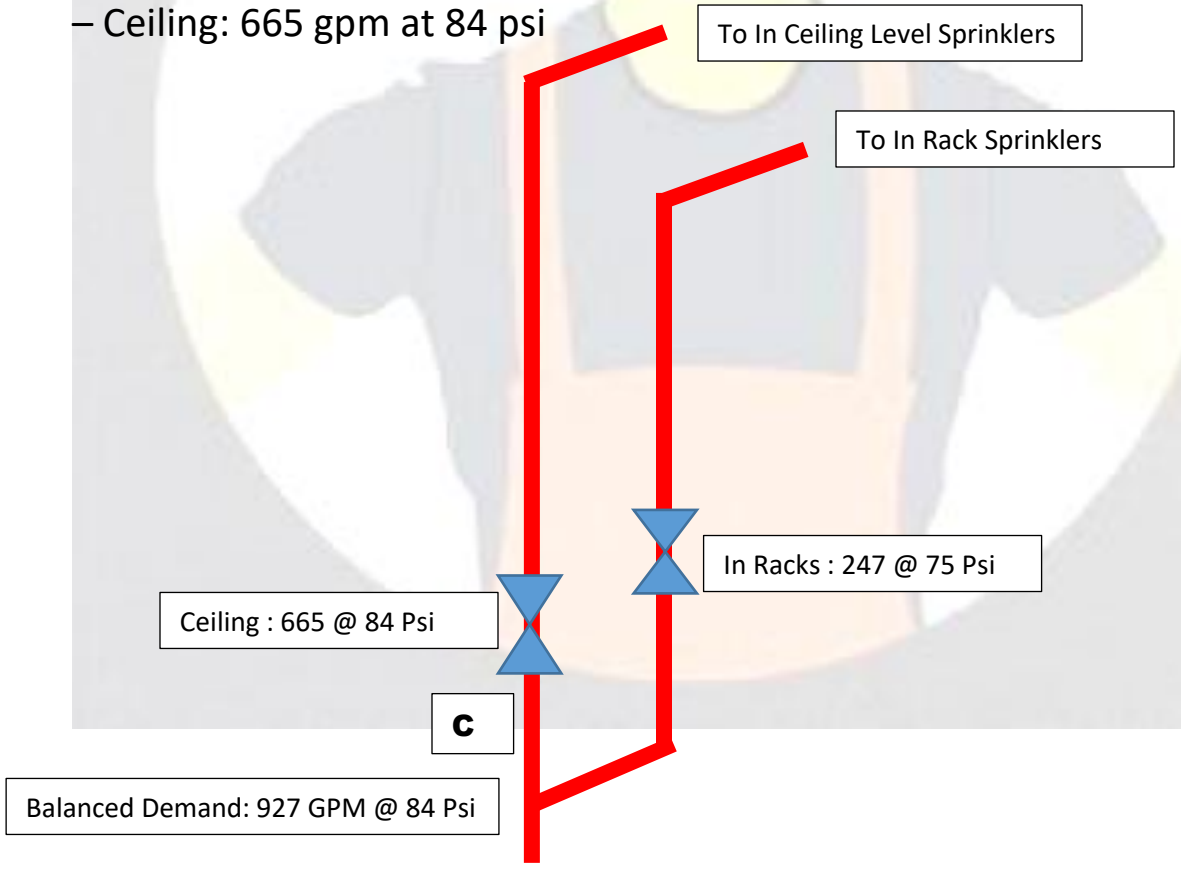
Q = 28.52 x Sq. rt. (84)

Q = 261.4 GPM

Step 04:

Add the flows together

– In-Racks: 262 gpm at 84 psi
– Ceiling: 665 gpm at 84 psi



Therefore, Total Combined demand = 927 GPM @ 84 psi

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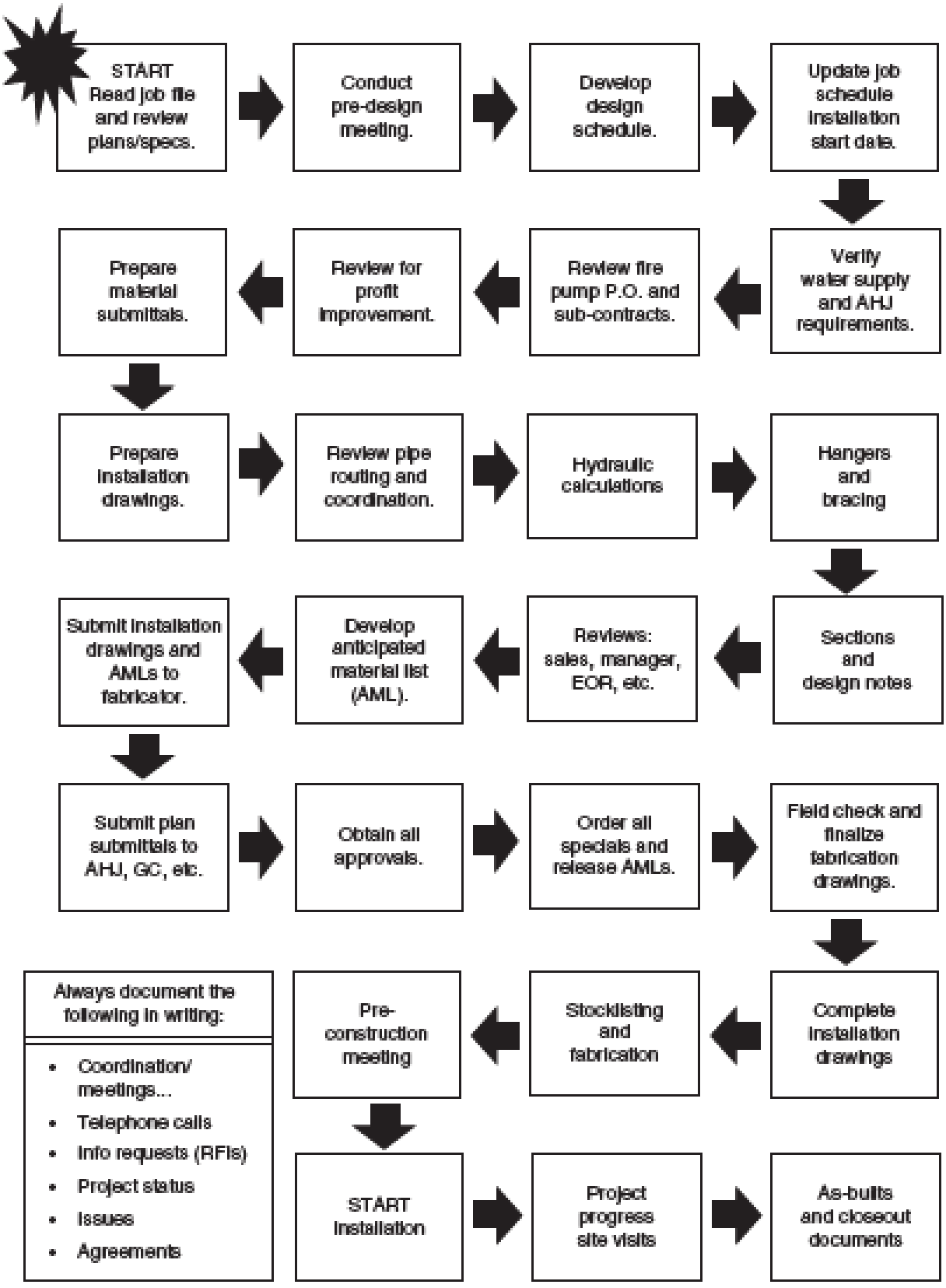
PLAN REVIEW CHECKLISTS

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

PROJECT WORKFLOW DOCUMENTS



MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

SPRINKLER SYSTEM PLAN REVIEW CHECKLIST

STEP 1: GENERAL PROJECT INFORMATION

Permit no.: _____ Project/occupancy name: _____

Project address:
_____

Owner's name:
_____

Sprinkler contractor name:
_____

Contractor address:
_____

Point of contact (name):
_____

Contractor phone: _____ e-mai _____

Date of review by AHJ: _____

Date comments sent to contractor:_____

Name of AHJ plans examiner:

_____

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• Code and edition governed by project: _____

•Edition of NFPA 13 used for design: _____

• Type of system being installed: Wet___ Dry ___ Preaction ___ Deluge_____

• Is this a new system or a change to an existing system? _ New system _ Change to existing system

• Owner certificate included: Yes____ No _____

•Building description:

Square footage of the project: _____

Use of building: _____ Building height: _____

Total area of building: _____ Area per floor: _____

Total number for floors above grade: _____ below grade: _____

What is the construction type?

- Fire resistive
- Noncombustible
- Ordinary
- Heavy timber
- Wood frame
- Mixed

• What is the fire sprinkler occupancy hazard classification?

- Light hazard _
- Ordinary hazard Group I
- Ordinary hazard Group II
- Extra hazard Group I
- Extra hazard Group II
- Storage
- Special occupancy

•Are there special occupancy requirements for the system?

_ Yes _ No

(Flammable/combustible liquids, aircraft hangars, oxidizers, etc.)

• Is there storage over 12 ft (3.7 m)? _ Yes _ No

• If this is a storage occupancy, what is the commodity classification?

- Class I
- Class II
- Class III
- Class IV
- Group A
- Group B
- Group C

STEP 2: GENERAL PLANS INFORMATION

The following has been shown on plans correctly:

YES	NO	
–	_ _	Name of owner or occupant
–	_ _	Location, including street address
–	_ _	Point of compass
–	_ _	Full height cross section
–	_ _	Ceiling/roof heights and slopes not shown in the full height cross section
–	_ _	Location of partitions
–	_ _	Location of fire walls
–	_ _	Occupancy class of each area or room
–	_ _	Location and size of concealed spaces, closets, attics, and bathrooms
–	_ _	Small enclosures in which no sprinklers are to be installed
–	_ _	Scale the plans were drawn to

STEP 3: WATER SUPPLY

The following water supply information is clearly indicated on plans:

_____Capacity is verified at _____ gpm (L/min) for a duration of _____ hours for a total capacity of _____ gal (L)

Type of water supply:

_____ Public _____Stored water (tanks) ____Raw water source

YES NO
_ _ Location and elevation of static and residual hydrants in relationship to the riser location
_ _ Date and time of flow test (must be within one year of design)
_ _ Static, residual, and flow from test
_ _ Name of person who conducted or source of water supply information

Private Fire Service Mains

The following information is clearly indicated on plans:

- Size, length, and location of main
- Material listed for use
- Point of connection to city main
- Size, type, and location of valves
- Size, type, and location of valve indicators
- Size, type, and location of regulators
- Size, type, and location of meters
- Size, type, and location of valve pits
  Depth of top of pipe laid below grade
- Size and location of all thrust blocks
- Size and location of hydrants (showing size and number of outlets and whether outlets to be equipped with independent gate valves)
- Whether hose houses and equipment are to be provided and by whom

Fire Pump

- Electric
- Diesel
- Steam
- N/A

Rated Capacity: _____

_ The pump layout complies with NFPA 20.

Water Tank

- Steel
- Wood
- Concrete

- Fiberglass
- NA

Water tanks comply with the requirements of NFPA 22.

STEP 4: SPRINKLER SYSTEM TYPE AND COVERAGE

• Type of sprinkler system

- Wet
- Dry
- Preaction
- Deluge

• Classification of occupancy:

- Light hazard
- Ordinary: Group 1 _ Group 2 _
- Extra hazard: Group 1 _ Group 2 _

• Classification of commodity: (Chapter 4)

- Class I
- Group A plastic
- Class II
- Group B plastic
- Class III
- Group C plastic
- Class IV
- Mixed commodity

Plastic pallet storage?

Reinforced _
Unreinforced _

• Are sprinklers omitted in any areas? _ Yes _ No
• If yes, are omissions allowed per NFPA 13? _ Yes _ No _ N/A

• What is the area of coverage?

- Total
- Partial
- Special hazard
- Other

All wet piping is in areas that can be maintained above 4°C (40°F)

STEP 5: SPRINKLER SYSTEM COMPONENTS

The following sprinkler component information is clearly indicated on plans specifications:

- Product data is included in the shop drawing submittal
- Make, type, model, nominal K-factor of sprinklers, and sprinkler identification number
- Temperature rating and location of high-temperature sprinklers]
- Pipe type and schedule of wall thickness
- Nominal pipe size and cutting lengths of pipe (or center-to-center dimensions)
- Location and size of riser nipples
- Type of fittings and joints and location of all welds and bends
- Specifications of any sections to be shop welded and type of fittings or formations to be used
- Type and location of hangers, sleeves, braces, and methods of securing sprinklers when applicable
- All control valves and check valves
- Make, type, model, and size of wet pipe, dry pipe, preaction, or deluge valves
- Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment
- Calculation of loads for sizing and details of sway bracing
- Setting for pressure-reducing valves
- Manufacturer, size, type of backflow preventers
- Type and amount of antifreeze solution used
- A pressure gauge on the system and the supply

STEP 6: DESIGN

The following design information is clearly indicated on plans or specifications:

- Total area protected by each system on each floor
- Number of sprinklers on each riser per floor
- Sprinkler spacing and location verified
- Spray patterns free of obstruction
- Total number of sprinklers on each dry pipe, preaction, combined dry pipe-preaction, or deluge system
- Approximate capacity [in gal (L)] of each dry pipe system
- Pitch of pipe for dry pipe, preaction, combined dry pipe-preaction, or deluge system
- Size and capacity for air compressor (where provided) for dry pipe, preaction, combined dry pipe-preaction, or deluge system
- Details of air supply connections for other types of air supply
- Piping provisions for flushing
- Size, location, and arrangement of all auxiliary drain connections.

- Where equipment is to be installed as an addition to an existing system, enough detail of the existing system indicated to
- make all conditions clear
- Hydraulic data nameplate (for hydraulically designed systems)
- Size, location, thread type, and piping arrangement of fire department connections
- Size, location, and arrangement of inspector's test connection.
- Location of main drain connection

STEP 7: HYDRAULIC DESIGN SPECIFICATIONS

The following information has been clearly indicated on plans / specifications / hydraulic calculations:

- **Type of system:**
- Hydraulically calculated
- Pipe schedule

- **Proper hydraulic calculations forms used?**

- **Design area and water application rate**:
- Density/area method
- Special design areas
- Room design method
- Special design approaches

- **Density/area method**
- Area of operation and density noted?
- Area of operation reduced for:
- Quick-response sprinklers
- High-temperature sprinklers
- Area of operation increased for: Sloped ceilings
- Dry pipe/double-interlock preaction systems _
- Multiple adjustments needed?

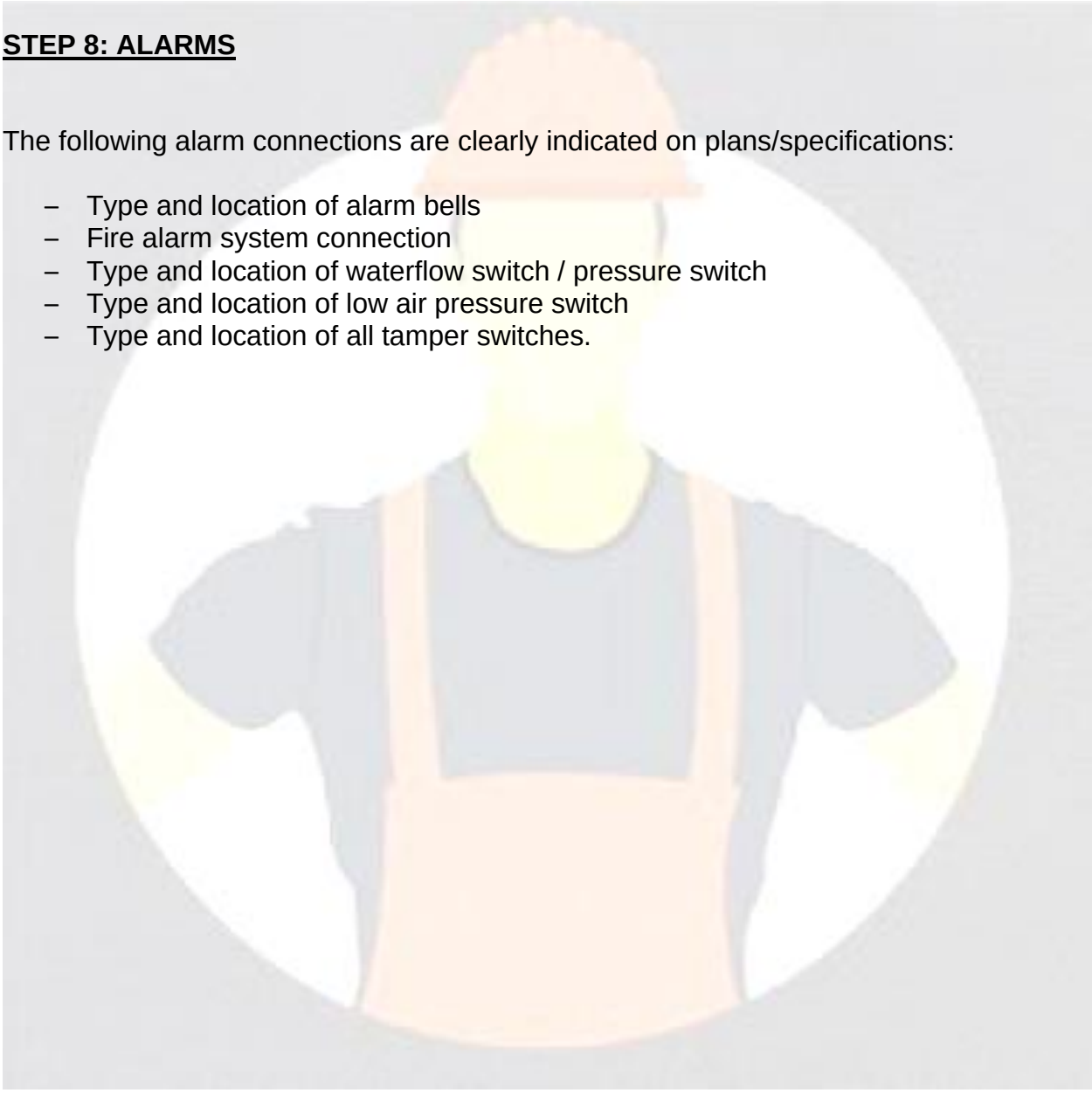
- Area per sprinkler
- Water supply sufficient?
- Allowance for in-rack sprinklers provided (where required)
- Limitations (dimension, flow, and pressure) for listed special sprinklers specified
- Most demanding area calculated
- Hydraulic reference points shown on the plan that correspond with comparable reference points on the hydraulic calculation sheets
- Pipe sizes and lengths shown on the plan correspond with the sizes and lengths shown on the hydraulic calculations sheets
- Total quantity of water and pressure required noted at a common reference point for each system

- Relative elevations of sprinklers, junction points, and supply or reference points
- All unprotected wall openings throughout the floor protected for room design method where permitted
- Pressure loss for backflow preventer, meter or other devices included in hydraulic calculations.

STEP 8: ALARMS

The following alarm connections are clearly indicated on plans/specifications:

- Type and location of alarm bells
- Fire alarm system connection
- Type and location of waterflow switch / pressure switch
- Type and location of low air pressure switch
- Type and location of all tamper switches.



MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

PLAN REVIEW CHECKLISTS

GENERAL SHOP DRAWINGS/ WORKING PLANS

Description	Yes	No	NA
Name of owner and occupant.			
Location, including street address.			
Point of compass.			
Full-height cross section, or schematic diagram, including structural member information if required for clarity and including ceiling construction and method of protection for metallic piping			
Location of partitions.			
Location of fire walls.			
Occupancy class of each area or room.			
Location and size of concealed spaces, closets, attics, and bathrooms.			
Any small enclosures in which no sprinklers are to be installed.			
Size of city main in street and whether dead end or circulating if dead end, direction and distance the nearest circulating main; and city main test results and system elevation relative to test hydrant.			
Other sources of water supply, with pressure or elevation.			
Make, type, model, and nominal K-factor of sprinklers.			
Temperature rating and location of high-temperature sprinklers.			
Total area protected by each system on each floor.			
Number of sprinklers on each riser per floor.			
Total number of sprinklers on each dry-pipe system, preaction system, combined dry- pipe preaction system, or deluge system.			
Approximate capacity in gallons of each dry-pipe system.			
Pipe type and schedule of wall thickness.			
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.			
Location and size of riser nipples.			

Type of fitting, joints and location of all welds and bends. The contractor shall specify on drawing any sections to be shop welded, the type of fitting or formations to be used.			
Type and locations of hangers, sleeves, braces, and methods of securing sprinklers when applicable.			
All control valves, check valves, drain pipes, and test connections.			
Make, type, model, and size of alarm or dry-pipe valve			
Make, type, model, and size of preaction or deluge valve.			
Kind and location of alarm bells			
Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment.			
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.			
Piping provisions for flushing			
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.			
For hydraulically designed systems, the information on the hydraulic data nameplate			
A graphic representation of the scale used on all plans			
Name and address of contractor			
Hydraulic reference points shown on the plan that correspond with comparable reference points on the hydraulic calculation sheets			
The minimum rate of water application (density), the design area of water application, in-rack sprinkler demand, and the water required for hose streams both inside and outside			
The total quantity of water and the pressure required noted at a common reference point for each system			
Relative elevations of sprinklers, junction points, and supply or reference points			
If room design method is used, all unprotected wall openings throughout the floor protected			
Calculation of loads for sizing and details of sway bracing			
The setting for pressure-reducing valves.			
Information about backflow preventors (manufacturer, size, type).			
Information about antifreeze solution used (type and amount).			

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.			
Size, location, and piping arrangement of fire department connections.			
Manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any sprinklers, devices, piping, or fittings.			
Water supply capacity information.			
a. Location and elevation of static and residual test gauge with relation to the riser reference point.			
b. Flow location			
c. Static pressure, psi (bar).			
d. Residual pressure, psi (bar).			
e. Flow, gpm (1/min).			
f. Date.			
g. Time.			
h. Test conducted by or information supplied by.			
i. Other sources of water supply, with pressure or elevation.			

INDIVIDUAL PLANS

Plot or Site Plan

Description	Yes	No	NA
Areas sprinkled clearly outlined or structure noted as totally sprinkled.			
North Arrow present and indicating correct direction (plan and/or true-north).			
Location(s) of city mains indicated as well as size and type of pipe.			
Elevation of finished floor indicated.			
Vicinity map indicating neighboring streets.			

Public and private fire hydrants indicated. Static and residual hydrants noted.			
Flow test data on drawing indicating. Static, Residual, Flow, Date, Time, Witnesses			
Drawing scale clearly indicated per NFPA requirements			
Actual street address for project given, not cross streets			
Details of fire hydrants, taps, valves, pits clearly indicated and appropriate for city			
Bill of materials list provided.			
Plans prepared by or checked and stamped by a licensed professional engineer as required by the Fire Department/Civil Defense or project architect/engineer			

Fire Sprinkler Plan General Items and Information

Description	Yes	No	NA
Typical general notes and disclaimers on drawings.			
Pipe types and schedules consistent with the specifications and estimate guideline.			
Pipe types and schedules consistent with hydraulic calculations.			
Materials submitted foreign or domestic per specification and estimate guideline.			
Trapeze hangers detailed, locations clearly indicated, and all parts listed.			
Typical drop and/or sprig lengths indicated and quantities shown.			
System Type (wet, dry, pre-action. etc.) clearly indicated.			
Boundaries between systems and system types clearly indicated			
Final plot is readable. No cluttered text and piping is clearly distinct from architectural background items.			
Job name and number is in title block.			
Scale indicated and graphic on drawing.			
Cross section shown and building type and construction indicated.			
Riser or connection detail shown.			
Ceiling heights and room numbers shown.			

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Fire Sprinkler Head Types. Spacing, and Location

Description	Yes	No	NA
No sprinklers farther than one half the maximum allowable spacing			
Clear spray around columns, over walls and partitions as well as under ducts, soffits or other obstructions			
No heads less than 6 feet apart or per listing (ESFR, Large Droplet).			
Spacing between lines not over 12' or 12'-6" for 25' bays in warehouses or storage areas classified as High Piled.			
Deflector distances from deck or obstructions per code and/or sprinkler listing. Distances to joists or beams measured to close edge not centerline			
Head spacing does not exceed code and/or manufacturer listing			
Areas of sprinkler coverage per code and/or manufacturer listing			
Spacing and orifice sizes (K factors) match hydraulic calculations.			
Sufficient heads included in remote area (check flow and area of coverage).			

Branch Lines and Riser Nipples

Description	Yes	No	NA
Typical lines noted and/or numbered as typical			
Lines clearly indicated as to system by number and color code			
Sizes, fittings, lengths, pipe types and schedules match hydraulic calculations.			
All hangers cut.			
Hanger spacing and location per code, specification, listing requirements			
Appropriate hangers and fasteners for structure used.			
Pipe lengths beyond last hanger meet code			
Changes in elevation up, down, or sloped indicated			
Joining method (threaded, grooved, press fit) clearly indicated.			

Correct size, type, and location of welded outlets listed			
Branch line locations dimensioned to structure not to architectural walls			
Center line to Top of Sprinkler and FF (finished floor) clearly indicated			
Pipe lengths noted on drawing are final actual cut lengths.			
All riser nipples have size, length, and direction (up or down) indicated			
Riser nipple sizes and lengths match hydraulic calculations			
Hydraulic nodes at top and bottom of riser nipples			
Riser nipples numbered, listed with lines, and/or noted as typical			

Mains

Description	Yes	No	NA
All main piping tagged, numbered and matches stock list.			
Main piping size and schedule matches hydraulic calculations.			
All main piping cut, appropriate takeouts used.			
Welded outlet dimensions add up to main length.			
Mains dimensioned to structural walls and/or columns.			
Main elevation noted centerline to Top of Sprinkler and/or finished floor.			
Main hangers spaced per code and specification.			
Where trapeze hangers are used, standard hangers used at intermediate structural beams or trusses.			
Typical pieces noted and listed as typical.			
Pipe end treatments indicated (G/G, T/G, T/T, etc.).			
Size and location of reducing couplings indicated.			
Main piping color coded where helpful or necessary.			
Seismic bracing provided and properly located where required by code.			
Correct size, type, and location of welded outlets, fittings, or flanges listed.			

MECHSOFT ENGINEERING DESIGN AND CONSULTANCY

Riser and Connection Details

Description	Yes	No	NA
Type of control valve indicated (OS&Y, butterfly, etc.).			
Alarm valve, if used, noted including indication with or without retard chamber and/or water motor gong.			
All riser pipes sized and cut lengths noted			
Additional check valves and type indicated (wafer, swing, grooved, etc.).			
Outlet provided (or tee) for Fire Department Connection			
Flow switch indicated, including type			
Tamper switch indicated, if required. Type appropriate for control valve. Indication if electronically monitored. Signs required as necessary for ceiling areas.			
Additional pipe and fittings included for main drain, bell line and bell drain.			
Fire Department Connection, if on riser, shown			

Fire Department Connection

Description	Yes	No	NA
Size of FDC indicated and per code, both inlets and outlets.			
Number of inlets sufficient to satisfy code. (approx. 250 gpm per 2½ inlet).			
The type of fire department threads noted			
Finish noted (brass, polished, etc.)			
Wall plate included with appropriate lettering (and finish).			
Break caps or matching plugs with chains provided (with correct finish).			
FDC located at correct and/or acceptable height above grade. Not less than 36 inches from grade.			

Minimum of 4 feet of pipe from check to inside of wall in areas subject to freezing.			
Check valve below main control and FDC if dry system			

QUICK REFERENCE SHEET FOR REVIEWING SPRINKLER PLANS

(Also known as "Twenty Questions")

QN	Description	Yes	NO	NA
1	Is the information sufficient to review plans?			
2	Is the hazard and/or commodity classification proper for the occupancy?			
3	Is the protection area per sprinkler within requirements for the appropriate hazard classification?			
4	Are distances between the branch lines and between sprinklers on the branch lines within the maximum allowable? Are end sprinklers and end branch lines within the allowable distance from the walls?			
5	Are sprinklers positioned within allowable deflector distances to ceilings? Are the clearances to obstructions proper?			
6	Are sprinklers to proper temperature rating for maximum expected ceiling temperatures and proximity to unit heaters, skylights, etc.?			
7	Has an inspector's test connection been provided at the end of each sprinkler system?			
8	Has a fire department connection been provided and properly located?			
9	Are sufficient pipe hangers properly located?			
10	Are a sufficient number of systems provided to meet the maximum system size requirements?			
11	If a dry system, does the total system volume require a quick-opening device? Does the total system volume fall within specified limits or will a 60 second water delivery time need to be proven?			
12	Is a system drain of adequate size provided?			
13	Does the water supply data appear reasonably recent? Do the plans indicate when and where the last flow test was made and who performed it?			
14	If a hydraulically designed system, do the design density and area meet the proper curve?			
15	If hydraulically designed does the system demand point fall below the supply curve on the Flow Test Summary Sheet?			

16	Are the pipe joining techniques and C-factor proper for the type of pipe and system?			
17	Does the K-factor of the sprinklers shown on the drawings match that used in the hydraulic calculation?			
18	Does the choice of hydraulically most remote area appear proper?			
19	Are all sprinklers, valves, pumps, hangers, cut and roll grooved couplings and plain-end fittings listed for fire protection service? Does piping meet acceptable materials specifications?			
20	Is complete sprinkler protection provided?