FPST 2483 Lab #10 Hands-on Hardy Cross Name:__________

PART A
OBJECTIVES:
At the completion of this laboratory session the student will be able to:

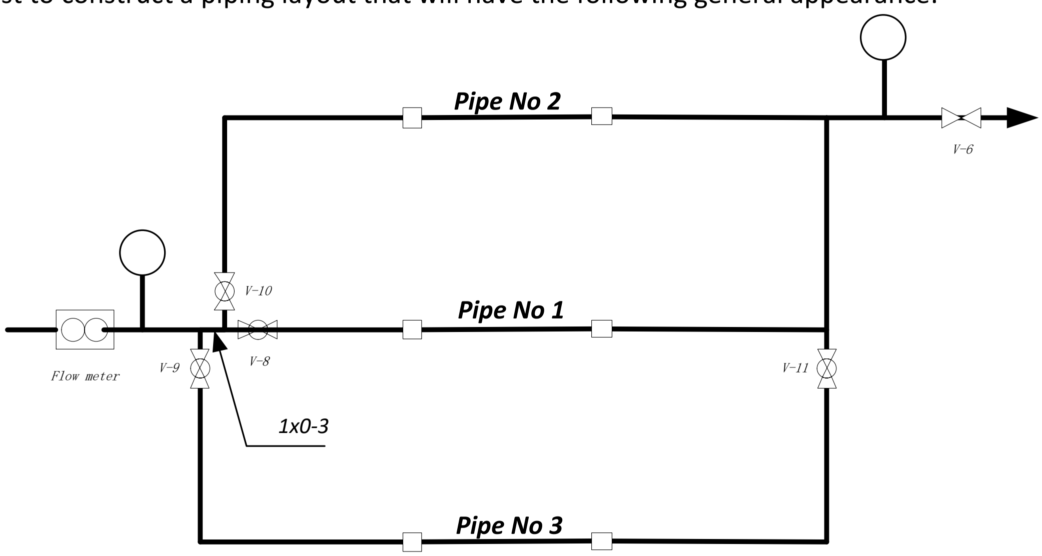
1. Use empirical methods to demonstrate the hydraulic advantages of looped and gridded piping systems and verify the acceptability of methods used to calculate friction loss across loops and grids: and
2. Understand the friction loss reduction due to network system
3. Practice Hardy-Cross method with problems of multiple loops. All problems are supposed to be solved with Hardy-Cross Method using attached spreadsheets.

Part A. Experimental work on multiple loops
Part B. Prepare initial flow data for Hardy-Cross
Part C. Solving one-loop with Hand-calculations
Part D. Solving 2-loops & 3-loops with Hand-calculations

OBJECTIVE:

PROCEDURE: Watch the lab activity at OSU and then participate in the lab at SWJTU.

Students are first to construct a piping layout that will have the following general appearance:



All pipe lengths and diameters are to be established. Pressure gauges are to be installed at Points A and B. ***Please measure and record the dimensions on the diagram before you start the tests.*** With the set up as indicated, the following procedures are to be initiated.

1. Close and open the appropriate valves so that all of the flow is directed through pipe No. 1. Adjust the flow to approximately 50 gpm and record the flow and pressures at points A and B.
2. Open No 2 and close off pipe no. 1, then open no 3 and close no 2., measure the pressures at points A and B respectively.
3. Open all lines so that the flow is through all three pipes. Adjust the flow to 50 gpm as before and measure the pressures at points A and B.
4. Repeat the flow at another 2 levels (70 gpm, 30 gpm) for 3-lines flow

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5. Open 2 pipes alternatively (1&2, 2&3, 1&3) by shut-off one pipe. ***Caution, all pipes cannot be shut-off at the same time, which buildup the pressure and damage the gauge.***
6. Perform calculations to determine how close the calculated values of friction loss are to the measured values. Us the C-factor in your calculations and compensate for the fittings using the equivalent lengths from NFPA 13 that are shown on the following page. Only the flow turns will be considered (included in the pipe length).
7. Submit a lab report as detailed in Lab#1 in the Canvas dropbox.

(NFPA13. Version 2010) Table 22.4.3.1.1   Equivalent Schedule 40 Steel Pipe Length Chart

Table 22.4.3.1.1 Equivalent Schedule 40 Steel Pipe Length Chart															
	Fittings and Valves Expressed in Equivalent Feet (Meters) of Pipe														
Fittings and Valves	½ in. (15 mm)	¾ in. (20 mm)	1 in. (25 mm)	1¼ in. (32 mm)	1½ in. (40 mm)	2 in. (50 mm)	2½ in. (65 mm)	3 in. (80 mm)	3½ in. (90 mm)	4 in. (100 mm)	5 in. (125 mm)	6 in. (150 mm)	8 in. (200 mm)	10 in. (250 mm)	12 in. (300 mm)
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)
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)

Data recording table (hint: Lines 1-3 use hazen Williams, 4-9 use simple loops, 10-12 use hardy cross):

No	Target Flow (gpm)	Real flow (gpm)	Pipes	Inlet pressure (psi)	Outlet pressure (psi)	Pressure difference (psi)	Your calculation (psi)
1	50		1				
2	50		2				
3	50		3				
4	50		1/2				
5	50		1/3				
6	50		2/3				
7	70		1/2				
8	70		1/3				
9	70		2/3				
10	45		1/2/3				
11	55		1/2/3				
12	65		1/2/3				