FPST 2483 Lab 05 Name:_____

OBJECTIVE:

At the completion of this laboratory, the student will be able to use computer assistance for determining the pressures lost to friction using both the Hazen-Williams Formula and the Darcy-Weisbach technique.

PROCEDURE:

Students are to use the computer to solve the problems in Part A and Part B on the following pages. The set of fire protection programs is entitled "***FPST Hydraulics***". This program can be found in a zip file on D2L. In order to run this program you will need JAVA. Additionally, this computer program may be found in CEAT computer labs. This listing includes a group of programs with the following titles:

HAZEN / DARCY / LOOP / HARDY

This set of laboratory exercises will require the use of the Hazen program for Hazen-Williams applications and the Darcy program when Darcy-Weisbach is needed. Once the program is loaded, simply choose the proper menu selection and follow the instructions.

PART A

Use the computer program for BOTH the Hazen-Williams method and for the Darcy-Weisbach Method to calculate friction loss for Problems 1 and 2 below. Draw a general conclusion relative to the comparative results and include this conclusion with your submittal.

NOTES: Consider the kinematic viscosity of water to be $1.217 \times 10^{-5} ft^2/sec$ (60° F)

Consider the absolute roughness of pipe, e, to be:

0.00085 ft. for C = 100;

0.00015 ft. for C = 120;

0.000008 ft. for C = 140;

0.000005 ft. for C = 150

1. Determine the pressure that will be lost to friction in the following situations. **In these problems you must use actual internal pipe diameters**. Actual diameters may be found in the Appendix to your text.

a. 45 gpm through 1 1/4-inch schedule 40 steel pipe 15 ft. long, C = 120.
b. 45 gpm through 1 1/4-inch Type L copper tubing 15 ft. long, C = 150.
c. 45 gpm through 1 1/4-inch CPVC piping 15 ft. long, C = 150.
d. 650 gpm through 120 feet of 4-inch schedule 40 steel pipe, C = 120.
e. 650 gpm through 120 feet of 4-inch schedule 10 steel pipe, C = 120.
f. 3500 gpm through 3000 feet of 12-inch enamel lined ductile iron pipe, C = 140.
g. 1250 gpm through 1200 feet of 6-inch unlined cast iron pipe, C = 100.
h. 2000 gpm through 2800 feet of 12-inch Blue Brute, C = 150.
i. 2250 gpm through 5280 feet of 8-inch CL 200 PVC plastic piping, C = 150.

Problem #	Hazen-Williams (psi)	Darcy-Weisbach (psi)	D-W (feet of head)
A	2.3013	1.904	4.3973
B			
C			
D			
E			
F			
G			
H			
I			

2. Determine the friction loss for 500 gpm flowing through 500 feet of pipe with C of 100 for following sizes: 4, 6, 8, and 12-inch. Nominal pipe diameters may be used.

Pipe size (inches)	Hazen-Williams (psi)	Darcy-Weisbach (psi)	D-W (feet of head)
4			
6			
8			
10			
12			

3. Conclusion: The Darcy-Weisbach equation tends to give _____ (lower or higher) friction loss values than the Hazen-Williams equation.

PART B

4. Use nominal pipe diameters and the Darcy-Weisbach equation to establish the friction loss in psi in the following situations:

a. Water (60F) flowing at 400 gpm through 1000 feet of 6-inch unlined cast-iron pipe.
b. Water (70F) flowing at 1500 gpm through 600 feet of 6-inch unlined cast-iron pipe.
c. Water (70F) flowing at 1725 gpm through one-half mile of 6-inch asphaltic lined cast-iron pipe.
d. Water (70F) flowing at 300 gpm through 150 feet of 4-inch commercial steel pipe.
e. Water (70F) flowing at 100 gpm through 15 feet of 2-inch copper tubing (use the e value for drawn tubing).

Problem #	Answer (psi)
A	
B	
C	
D	
E	

5. Use nominal pipe diameters and the Darcy-Weisbach equation to establish the friction loss in psi in the following situations:

a. Water (60F) flowing at 40 gpm through 12 feet of 1-inch commercial steel pipe.
b. Water (70F) flowing at 1125 gpm through 150 feet of 6-inch commercial steel pipe.
c. Water (70F) flowing at 650 gpm through 380 feet of 4-inch unlined cast-iron pipe.
d. Water (70F) flowing at 26 gpm through 70 feet of ¾ -inch copper tubing in a residential sprinkler systems. (use the e value for drawn tubing).
e. Water (50F) flowing at 2,000 gpm through 10,000 feet of 12-inch cement lined cast-iron pipe.

Problem #	Answer (psi)
A	
B	
C	
D	
E	

6. What minimum diameter of unlined cast-iron pipe could be used to transport a medium lubricating oil (110F) 750 feet at a rate of 500 gpm with a resultant friction loss not exceeding 20 psi? (Hint: you must use trial and error).

7. Use nominal pipe diameters and the Hazen-Williams formula with the following C-factors and recalculate the friction loss for the situations described in 5.7.

a. Water (60F) flowing at 400 gpm through 1000 feet of 6-inch unlined cast-iron pipe. (C=100)
b. Water (70F) flowing at 1500 gpm through 600 feet of 6-inch unlined cast-iron pipe. (C=100)
c. Water (70F) flowing at 1725 gpm through one-half mile of 6-inch cement lined cast-iron pipe. (C=140)
d. Water (70F) flowing at 300 gpm through 150 feet of 4-inch commercial steel pipe. (C=120)
e. Water (70F) flowing at 100 gpm through 15 feet of 2-inch copper tubing (use the e value for drawn tubing). (C=150)

Problem #	Answer (psi)
A	
B	
C	
D	
E	

8. Use nominal pipe diameters and the Hazen-Williams formula with the following C-factors and recalculate the friction loss for the situations described in Exercise 5.8.

a. Water (60F) flowing at 40 gpm through 12 feet of 1-inch commercial steel pipe. (C=120)
b. Water (70F) flowing at 1125 gpm through 150 feet of 6-inch commercial steel pipe. (C=120)
c. Water (70F) flowing at 650 gpm through 380 feet of 4-inch unlined cast-iron pipe. (C=100)
d. Water (70F) flowing at 26 gpm through 70 feet of ¾ -inch copper tubing in a residential sprinkler systems. (use the e value for drawn tubing). (C=150)
e. Water (50F) flowing at 2,000 gpm through 10,000 feet of 12-inch asphaltic lined cast-iron pipe. (C=140)

Problem #	Answer (psi)
A	
B	
C	
D	
E	

9. If a beginning pressure of 80 psi is available at Point A when 1000 gpm are flowing, what minimum size of enamel-lined cast-iron pipe must be used to deliver water at 1000 gpm to Point B which is 1,000 feet away from Point A and have a pressure of 55 psi remaining at Point B?

10. If 6 psi is lost to friction in a section of pipe 800 feet long while 700 gpm of water are flowing, what is the C-factor of the pipe if the pipe diameter is 8.23 inches?

11. It is desired to have 100 psi available at the top of a standpipe 140 feet high while 500 gpm of water are flowing. If the pressure available at ground level is 140 psi with 500 gpm flowing, what minimum size of Schedule 40 steel pipe with a C of 120 will be needed?