Continuing Education Course #050
Water Flow in Pipes
The Hazen-Williams Formula

1. Given:
Quantity of flow = 5,000 gallons per minute
Roughness Coefficient = 120
Pipe diameter=24 Inches
What is the pressure drop in Pounds/Square Inch/Foot?

- a. 0.00198
- b. 0.00065
- c. 0.00086
- d. 0.60374

2. Using the same given information in the previous question, what is the Velocity of flow in Feet/Sec?

- a. 3.55
- b. 1.08
- c. 2.50
- d. 18.93

3. A fire flow test is conducted at the dead-end of a 1000-foot long, 8-inch diameter water main with roughness coefficient = 100. With the hydrant flowing at 774 gallons per minute, what is the expected pressure drop over the length of the pipe?

- a. 6.0 Pounds/Square Inch
- b. 7.0 Pounds/Square Inch
- c. 8.0 Pounds/Square Inch
- d. 9.0 Pounds/Square Inch

4. Continuing the previous question, what would be the quantity of flow if the flow had been allowed to increase until the total pressure drop was 20.0 pounds/square inch?

- a. 774 gallons/minute
- b. 1268 gallons/minute
- c. 1457 gallons/minute
- d. 52,873 gallons/minute

5. A 12-inch diameter water main flowing at 5.0 feet per second has a quantity of flow of:

- a. 763 gallons/minute
- b. 734 gallons/minute
- c. 1763 gallons/minute
- d. Need more information to calculate

6. A 12-inch diameter water main flowing at 5.0 feet per second looses 0.01 feet of head for every foot of length. What is the roughness coefficient of the pipe?

- a. 108
- b. 109
- c. 110
- d. Need more information to calculate

7. A public swimming pool has a 6-inch diameter 200-foot long PVC drain pipe with roughness coefficient = 130, that connects the bottom of the pool to a submerged outlet in an adjacent lake. The surface of the pool is 15-feet above the surface of the lake and the depth of the pool is 8-feet. What is the quantity of flow in gallons/minute when the pool draining begins?
- a. 667
- b. 716
- c. 1006
- d. 1267

8. Continuing the previous question, what is the quantity of flow in gallons/minute just before the pool draining ends?
- a. 667
- b. 716
- c. 1006
- d. 1267

9. What is the hydraulic radius in feet of a 48-inch diameter pipe flowing full?
- a. 0.5
- b. 1.0
- c. 1.5
- d. Need more information to calculate

10. A quantity of flow of 1.0 cubic feet/second is equal to _____ gallons/minute.
- a. 0.028
- b. 448.8
- c. 1699.0
- d. Need more information to calculate

11. A quantity of flow of 1.0 cubic feet/second is equal to _____ liters/minute.
- a. 0.028
- b. 448.8
- c. 1699.0
- d. Need more information to calculate

12. A factory draws 3000-liters/minute of water by gravity flow from a mountain reservoir located 80-meters above the point of connection to the factory. The pipe that connects the reservoir to the factory is a 2.2 kilometer long, 20-centimeter diameter cast iron pipe with roughness coefficient = 100. What is the total head loss for the pipeline in meters.
- a. 45.9
- b. 60.1
- c. 80.0
- d. Need more information to calculate

13. Continuing the previous question, what is the pressure in meters of head at the point of connection?
- a. 16.5
- b. 34.1

○ c. 65.7
○ d. Need more information to calculate

14. An old 6-inch cast iron water main with roughness coefficient = 70 is to be replaced with a new pipe with a roughness coefficient = 140. What size pipe will give double the quantity of flow of the old pipe? (Hint: assume a value for S and use the same value for both pipes)
○ a. 5-inch
○ b. 6-inch
○ c. 8-inch
○ d. Need more information to calculate

15. An inefficient and poorly run small water utility company wants out of the business so it donates all of its assets to a regional public utility. Because the small utility did not keep accurate underground records, fire-flow tests were performed to recreate the records and estimate pipe sizes. In one such case, a dead-end main 660-feet in length was tested and found to deliver 319 gallons/minute with a total head loss of 16 pounds/square inch. All pipes in the system were believed to be Asbestos-Cement with an assumed C = 140. What size pipe is it?
○ a. 4-inch
○ b. 6-inch
○ c. 8-inch
○ d. 10-inch

16. A county ordinance dictates that commercial/industrial uses be protected by fire flows of at least 3500 gallons/minute and that velocities in water mains may not exceed 10 feet/second in achieving those results. Based on this criteria alone, what is the minimum nominal pipe size for a single pipe that could be used to serve such a use?
○ a. 8-inch
○ b. 10-inch
○ c. 12-inch
○ d. 16-inch

17. Continuing the previous question, the same ordinance required that the 3500 gallons/minute must be achieved with no more than a 15 pounds/square inch pressure drop from the feeder main. Based on this criteria alone, what is the maximum length of dead end 16-inch with C=110, that could be used to serve such a use?
○ a. 2011-feet
○ b. 3056-feet
○ c. 4000-feet
○ d. 5556-feet

18. Continuing the previous question, what is the maximum length of dead end 12-inch with C=110, that could be used to serve such a use?
○ a. 984-feet
○ b. 1020-feet
○ c. 1153-feet
○ d. 2287-feet

19. The County's North District and South District water distribution systems have grown over the years until they finally become interconnected by a 16-inch (C=120) main that was installed as a part of a new subdivision that sits between the two systems. the 16-inch main is 2,000 feet long and connects to much larger feeder mains in both districts. The operating pressure in the North District system is 6 pounds/square inch higher than in the South District system. Based on this pressure differential how many million gallons per day will transfer from the North District to the South District?
○ a. 0.081
○ b. 0.202

- ○ c. 4.871
- ○ d. 292.2

20. What is the hydraulic equivalent of the combined flow from the following two pipes, both pipes feeding the same point and both operating at 10 pounds/square inch of total head loss over their length:

1. A 4-inch pipe, 1000 feet long with roughness coefficient = 100
2. A 3-inch pipe, 800 feet long with roughness coefficient = 140

- ○ a. A single 4-inch pipe, 668 feet long with roughness coefficient = 140
- ○ b. A single 5-inch pipe, 1000 feet long with roughness coefficient = 97
- ○ c. A single 6-inch pipe, 1000 feet long with roughness coefficient = 60
- ○ d. All of the above are approximate equivalents
- ○ e. None of the above