BENHA UNIVERSITY MECH. ENG. DEPT.

SHOUBRA FAC. OF ENG. 2nd YEAR, FLUID MECHANICS

SHEET [1] 2015

**Flow Through Pipes**

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1. Choose the most appropriate statement for each of the following statement.
2. For fully turbulent pipe flow the friction coefficient f is function of
3. Re only. 2) ε/D only 3) both of Re and ε/D.
4. For laminar flow through pipes the friction coefficient is function of
5. Re only. 2) ε/D only 3) both of Re and ε/D.
6. For Turbulent flow through pipes the friction coefficient is function of
7. Re only. 2) ε/D only 3) both of Re and ε/D.

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1. A main pipe divides into two parallel smooth pipes which again forms one pipe.

The data is as follows:

*First parallel pipe*: Length = 1000 m, diameter = 0.8 m

*Second parallel pipe*: Length = 1000 m, diameter = 0.6 m

Assume that coefficient of friction for each parallel pipe = 0.02 as a **first assumption**

If the total flow rate in the main is 2 m3/s, find the flow rate in each parallel pipe.

1. A pipe line includes 3 pipes in parallel. The total flow rate through the line is 0.02m3/s. The following table includes the pipes information. Assume wholly turbulent, find the flow rate through each pipe, n = 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Pipe | Length:L (m) | Diameter:d (m) | Minor Loss Coef.: (Σk) | Roughness: ε (mm) |
| 1 | 100 | 0.02 | 10 | 0.2 |
| 2 | 120 | 0.025 | 7 | 0.3 |
| 3 | 150 | 0.03 | 6 | 0.1 |

1. A pipe line of 600 mm diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. If *f* = 0.04 and head at inlet is 3 m calculate the increase in discharge.

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1. The pipe system shown in figure has one loop contains three pipes. Determine the flow in each pipe. The R values are as shown in the figure. Take n = 2.

If the head at supply point is 100 m, Evaluate the head at the demand points.

50 m3/s

20 m3/s

R= 0.02 s2/m5

R= 0.04 s2/m5

R= 0.03 s2/m5

1. Use Hardy Cross method to find the discharge in each pipe and the head at B and C. Given below are the characteristics of three pipes where HA = 30 m, error in discharge must be less than 0.005 m3/s. Assume fully turbulent flow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Pipe | ε/D | L (m) | D (cm) | ∑K |
| 1 | 0.001 | 50 | 20 | 2 |
| 2 | 0.001 | 30 | 20 | 4 |
| 3 | 0.001 | 40 | 20 | 3 |

0.15 m3/s

0.4 m3/s

1. Determine the pipe sizes and the pump shaft power in the shown network by using Hazen William’s relation. The slope of the energy line equal 0.002. The pipe material is welded steel (CHW = 130) and the combined efficiency of the motor and pump is 75%.

100m

1000m

1000m

1200m

1400m

500m

800m

A

B

C

D

E

F

H

G

(1)

(2)

800m

(3)

(4)

(5)

(6)

(7)

0.03m3/s

0.02m3/s

0.025m3/s

0.02m3/s

0.02m3/s

0.02m3/s

0.02m3/s

ε = 0.0002 m (all pipes)

ν= 1.31 x 10-6m2/s

El=110m

Hazen William’s Relation for diameter calculation 