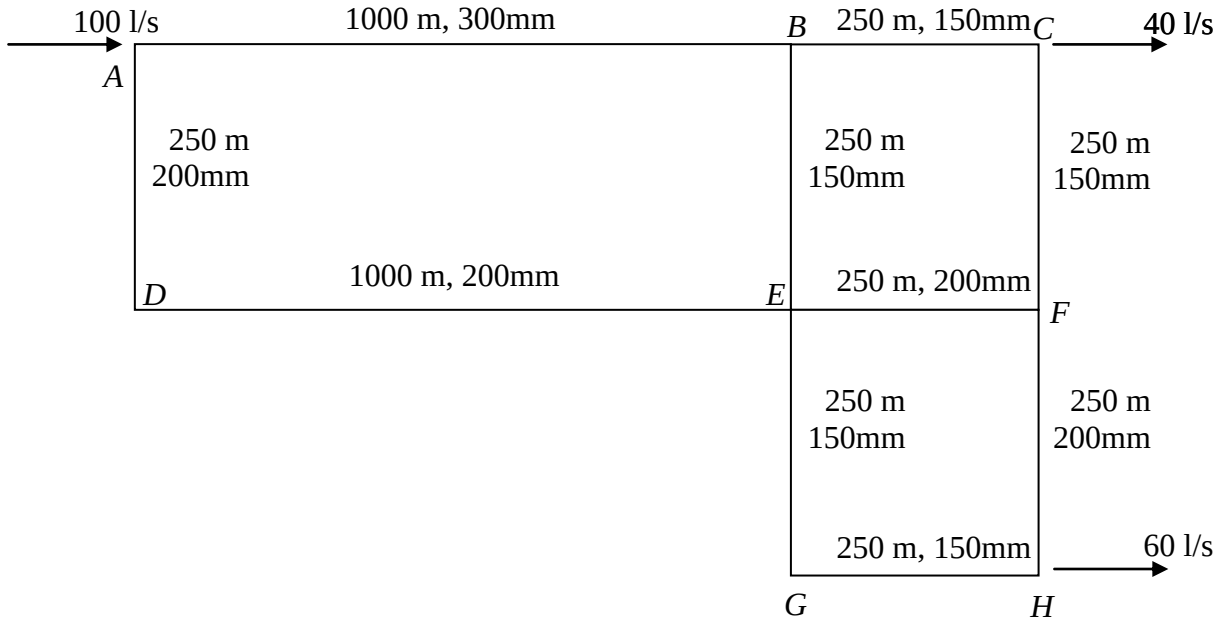
**Problem 1**

Use the Hardy- Cross method of pipe networks analysis to estimate the quantities of flow (L/s) in each of the pipes of the network given below (use C=100 for all pipes and perform at least two trials). Also calculate the water pressure at point 'H' if the pressure at point (A) is 500 kPa. Ground elevations at (A) and (H) are 100m and 95m, respectively.



Problem 3 tutorial 3

Given: Q= 200 L/s $H_L$ < 10m/1000m = s C=130

Find: D

Solution

a) From the nomograph of Hezen-Williams for given Q , S

(s: slope of the energy grade line $H_f/L$ )

Q , s → $D_{100}$=390 mm

| |
|---|
| Nomograph is based on C=100 |
| Can be corrected for other values of C: $S_c= S_{100} (100/c)^{1.85}$ |
| $D_c= D_{100} (100/c)^{0.38}$ |
| $Q_c= Q_{100} (c/100)$ |
| Note: nomograph gives value of S/1000 |

$D_{130}= 390 (100/130)^{0.38} = 353$ mm

b) Hezen-William's equ.

$$H_f = \frac{10.7\ L}{C^{1.85} d^{4.87}} Q^{1.85}$$

$S= h_f/L = 10/1000$

$$10 = \frac{10.7\ (1000)}{(130)^{1.85} d^{4.87}} (0.2)^{1.85}$$

D= 0.357 m = 357 mm

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Problem 6 tutorial 3

Solution a) The old pipe:

D=350 mm C=60 L=700 m

$$h_L = \frac{P_1}{\gamma} = \frac{35}{1.43} = 24.5 \text{ m}$$

$$h_L = \frac{10.7\ L}{C^{1.85} d^{4.87}} Q^{1.85}$$

$$Q^{1.85} = \frac{(24.5)\ (60)^{1.85} (0.35)^{4.87}}{10.7\ (700)} = 0.03836$$

$Q = 0.172\ m^3/s$

b) The new pipe

D=330 mm C=150 L=700 m

$h_L$= 24.5 m

$$Q^{1.85} = \frac{(24.5)\,(150)^{1.85}(0.33)^{4.87}}{10.7\,(700)} = 0.1569$$

Q = 0.368 $m^3/s$

Problem 1 tutorial 4

Solution

$Q_{actual} = Q_{assumed} + \Delta Q$

$$\Delta Q = \frac{-\sum h_i}{1.85\sum(h_i/Q_{io})}$$

$H_L/L = S = 0.00213\,(Q^{1.85}/d^{4.87})$

| Pipe | Q (L/s) | D (mm) | L (m) | S =$h_L$/L | $h_L$ | $h_L$/Q | Modified Q |
|---|---|---|---|---|---|---|---|
| | assumed | given | given | nomomgraph | S * L | | $Q_{assumed} + \Delta Q$ |
| | | | | | | | |
| | | | | | $\sum h_L$ | $\sum (h_L/Q)$ | |
| $\Delta Q = \frac{-\sum h_i}{1.85\sum(h_i/Q)}$ | | | | | | | |

Loop I

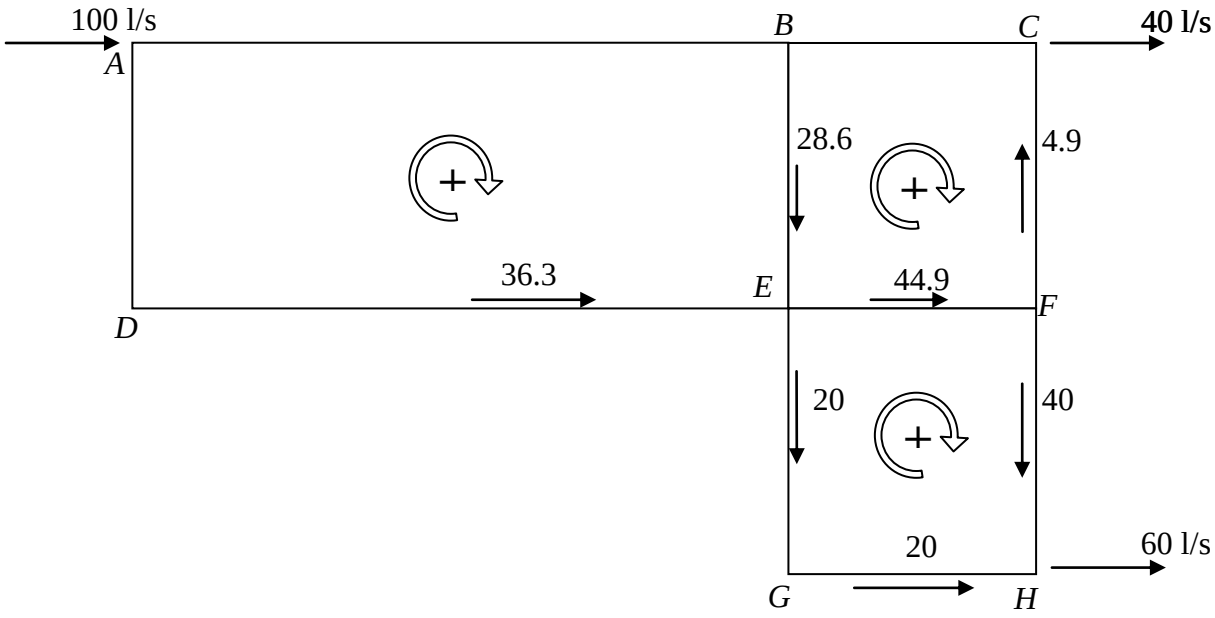
| Pipe | Q (L/s) | D (mm) | L (m) | S =$h_L$/L | $h_L$ | $h_L$/Q | Modified Q |
|---|---|---|---|---|---|---|---|
| AB | 60 | 300 | 1000 | 0.00375 | 3.75 | 0.0625 | 63.7 |
| BE | 30 | 150 | 250 | 0.032 | 8 | 0.267 | 33.7 |
| DE | -40 | 200 | 1000 | 0.0135 | - 13.5 | 0.337 | - 36.3 |
| AD | -40 | 200 | 250 | 0.0135 | - 3.375 | 0.08125 | - 36.3 |
| | | | | $\sum$ | -5.125 | 0.7477 | |

$$\Delta Q = \frac{-(-5.125)}{1.85(0.7477)} = 3.7$$

Loop II

| Pipe | Q (L/s) | D (mm) | L (m) | S =$h_L$/L | $h_L$ | $h_L$/Q | Modified Q |
|---|---|---|---|---|---|---|---|
| BC | 30 | 150 | 250 | 0.032 | 8 | 0.267 | 35.1 |
| CF | - 10 | 150 | 250 | 0.004 | - 1 | 0.1 | - 4.9 |
| FE | - 50 | 200 | 250 | 0.019 | -4.75 | 0.095 | -44.9 |
| EB | - 33.7 | 150 | 250 | 0.035 | - 8.75 | 0.23 | - 28.6 |
| | | | | $\sum$ | -6.5 | 0.692 | |

$$\Delta Q = \frac{-(-6.5)}{1.85(0.692)} = 5.1$$




Loop III

| Pipe | Q (L/s) | D (mm) | L (m) | S =$h_L$/L | $h_L$ | $h_L$/Q | Modified Q |
|---|---|---|---|---|---|---|---|
| EF | 44.9 | 200 | 250 | | | | |
| EG | - 20 | 150 | 250 | | | | |
| GH | - 20 | 150 | 250 | | | | |
| FH | 40 | 150 | 200 | | | | |
| | | | | $\sum$ | | | |