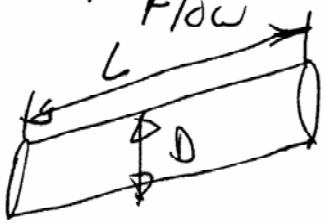
Pipelines / Closed Conduit Flow / Pressure Flow

Hazen-Williams Formula



$$h_L = \frac{L\,Q^{1.85}}{17{,}076\,(C)^{1.85}(D)^{4.87}}$$

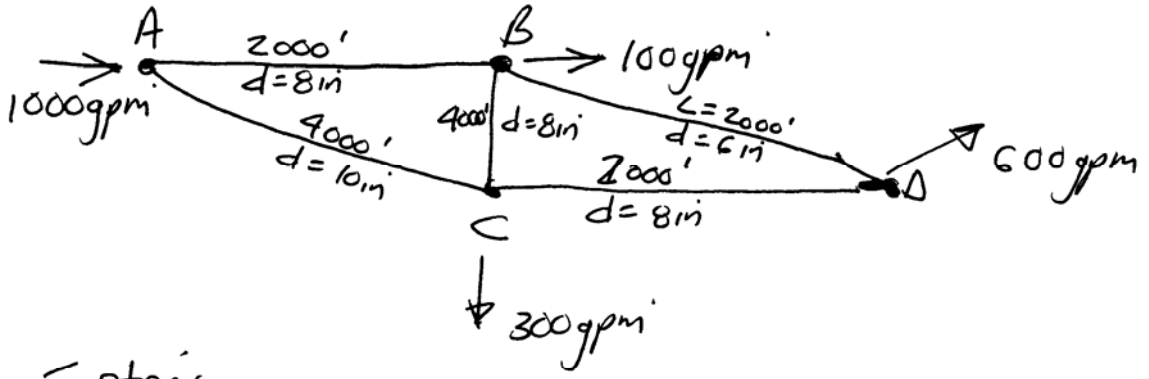
where: h_L = headloss in feet (friction)
L = pipe length (ft)
C = roughness (Table 11.1, p. 349, Lindley)
D = pipe diameter (feet)
Q = flow (gpm)

Ex: $L = 100$ ft
$D = 2$ ft
$Q = 1000$ gpm
$C = 130$ new DIP, ductile iron (Table 11.1 p. 349)

$$h_L = \frac{100\,(1000)^{1.85}}{17{,}076\,(130)^{1.85}\,(2)^{4.87}} = \frac{35{,}481{,}338}{17{,}076\,(8143)\,(1)}$$

$$h_L = 0.25 \text{ ft}$$

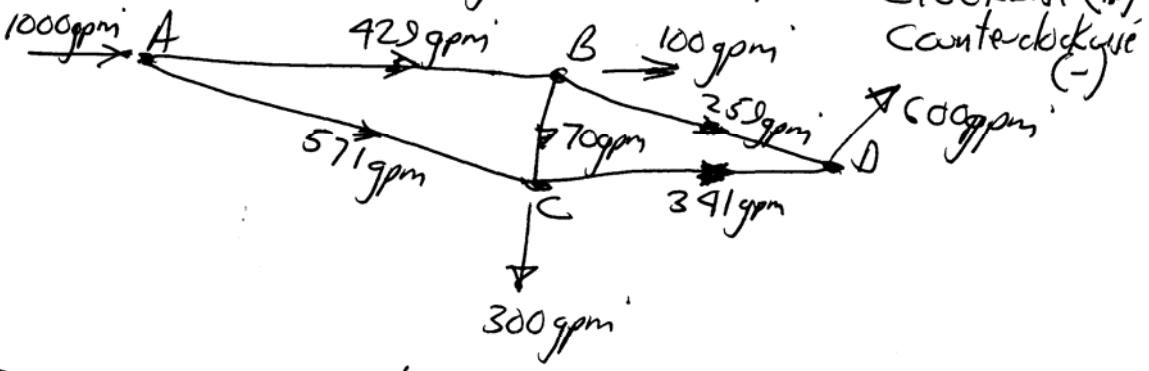
Hardy-Cross Method



5 steps

① Number each of the various loops

② Assume a flow direction and assume a flow through each pipe. clockwise (+) counterclockwise (-)



③ Calculate the head losses for each pipe

$$h_2 = \frac{L\,Q^{1.85}}{17{,}076\,(C)^{1.85}\,(D)^{4.87}}$$

$$h_{AB} = \frac{(2000)(429)^{1.85}}{17,076\,(130)^{1.85}\left(\frac{8}{12}\right)^{4.87}} \quad 3/4 \quad = \frac{2000\,(79,138)}{(17,076)(8193)(0.139)}$$

$$h_{AB} = +7.63 \text{ ft}$$

$$h_{BC} = \frac{(4000)(.70)^{1.85}}{17,076\,(130)^{1.85}\left(\frac{8}{12}\right)^{4.87}} = +0.54 \text{ ft}$$

$$h_{AC} = \frac{4000\,(571)^{1.85}}{17076\,(130)^{1.85}\left(\frac{10}{12}\right)^{4.87}} = -8.8 \text{ ft}$$

④ Sum head losses in all pipes in each loop

$$\Sigma h_L = h_{AB} + h_{BC} - h_{AC} < 1 \text{ ft}$$

$$7.63 + 0.54 - 8.8 = -0.63 \text{ ft} < 1 \text{ ft ok}$$

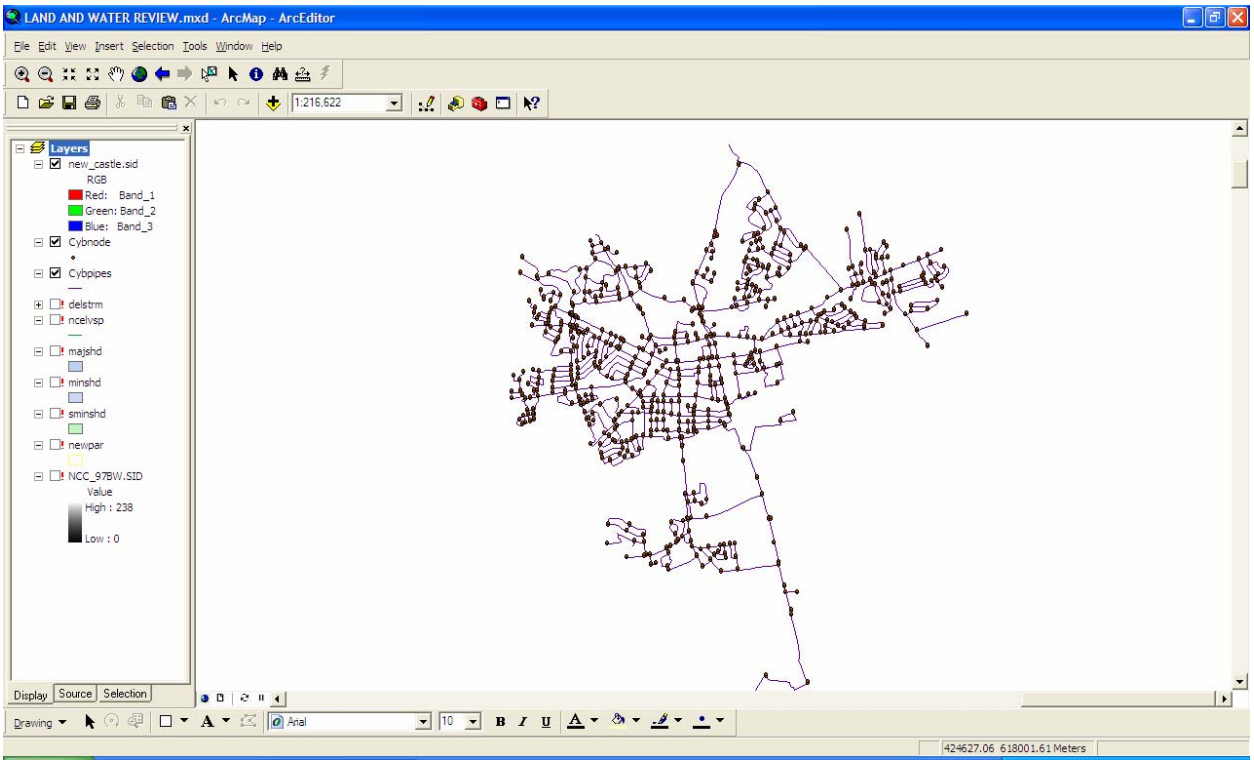
⑤ If Σh_L not less than one, use correction factor.

$$Q = \frac{-\Sigma H_L}{\Sigma \frac{1.85(h)}{Q} \text{ each loop}}$$

=

$$= \frac{-0.63}{\frac{1.85(7.63)}{4.29} + \frac{1.85(0.54)}{70} + \frac{1.85(-8.8)}{571}}$$

$Q = 39$, so add 39 gpm to each flow in pipe


LAND AND WATER REVIEW.mxd - ArcMap - ArcEditor
File Edit View Insert Selection Tools Window Help
1:216,622
Layers
new_castle.sid
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
Cybnode
Cybpipes
delstrm
ncelvsp
majshd
minshd
sminshd
newpar
NCC_97BW.SID
Value
High : 238
Low : 0
Display Source Selection
Drawing
Arial
10
424627.06 618001.61 Meters