CHAPTER FOUR: EMPIRICAL EQUATION

The most widely used is the HAZEN WILLIAMS equation:
$$Q = 0.2785Cd^{2.63}S^{0.54}$$
$$Q = 0.849CAR^{0.63}S^{0.45}$$

Q=m^3/s =discharge

C=Hazen Williams roughness coefficient

D=diameter (m)

S= Slope of the energy line=h_f/L

R=A/P= Hydraulic Radius

$$H_f = \left(\frac{10.7L}{C^{1.852}D^{4.87}}\right)Q^{1.852} = rQ^{1.852}$$

Pipe in series $h_f = r_e Q_T{}^{1.852}$

Pipe in parallel $h_f = Q_T{}^{1.852}$

EXAMPLE

a) Two parallel pipes each 150m long, one 200mm diameter and the other 150mm diameter, each with C=120 and Q_T=0.14m^3/s, determine the head loss in meter of water.

b) Two pipe in series one 30m long with a 300mm diameter and the second 100m long with a 250mm diameter each having a C=110, Q_T=0.14m^3/s, determine the head loss in meter of water.

SOLUTION: Pipe in parallel

(a) $$H_f = \left(\frac{10.7L}{C^{1.852}D^{4.87}}\right)Q^{1.852} = rQ^{1.852}$$

but r_1=579.4, r_2=2341.9

$$\left(\frac{1}{r_e}\right)^{0.54} = \left(\frac{1}{579.4}\right)^{0.54} + \left(\frac{1}{2351.9}\right)^{0.54} = 0.0473$$

$$r_e = \left(\frac{1}{0.0473}\right)^{1.852} = 284.54$$

$$h_f = r_e Q_T^{!.852} = 7.49m$$

$$r_e = \left(\frac{1}{\sum\left(\frac{1}{r}\right)^{1/n}}\right)^n$$

NOTE: $n = 1.852$

$$h_f = r_e Q_T^{1.852}$$

(b) Pipe in series

$$r_e = r_1 + r_2 = 18.8961 + 153.05 = 171.95$$

$$h_f = r_e Q_T^{1.852} = 4.5m$$

TAKE HOME ASSIGNMENT

(1) The dimensions of the figure shown below are shown in this table,

Pipe	L(m)	D(m)	C	r
1	75	0.05	110	2.91×10^5
2	100	0.07	110	5.39×10^4
3	150	0.1	100	2.37×10^4

Find the total discharge in reservoir B.

(2) Water flows in the parallel pipe system shown below for which the following data are available.

Pipe	Diameter (m)	Length (m)	f'
AaB	0.1	300	0.024
AbB	0.15	250	0.022
AcB	0.2	500	0.02

The supply pipe to point A is 0.3m diameter and the mean velocity of water in it is 3m/s. If the elevation of point A is 100m and elevation of point B is 30m above datum, calculate the pressure at point B if that at point A is 200KN/m^2. What is the discharge in each pipe, neglect all minor losses.