2. Piping → friction loss (Darcy + Moody)
→ Hazen williams

$$H_L = \frac{\Delta P}{\rho g} = \frac{f \frac{L}{D}\frac{V^2}{2g}}{\frac{A}{g}}$$

$$= \frac{f L V^2}{2 D g^2 \rho}$$

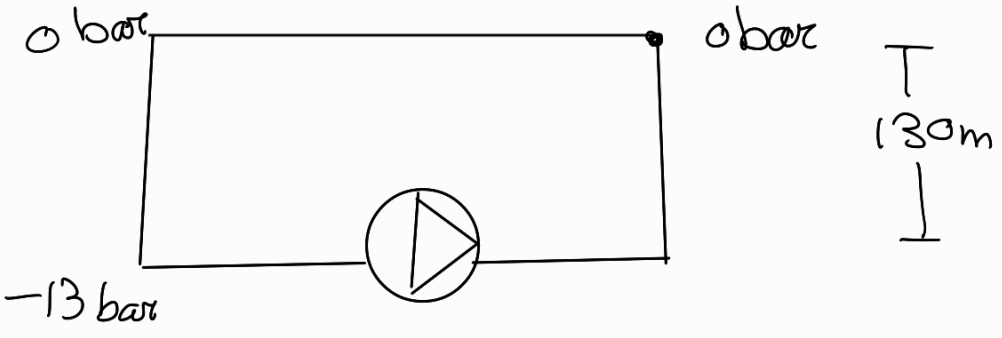
V max = 1.2 m/s → $\dot{m} c_p \Delta T$

$Q = V_{max} A$

D from A and Take larger Standard

Pump Selection

I need to know Head (elevation head)

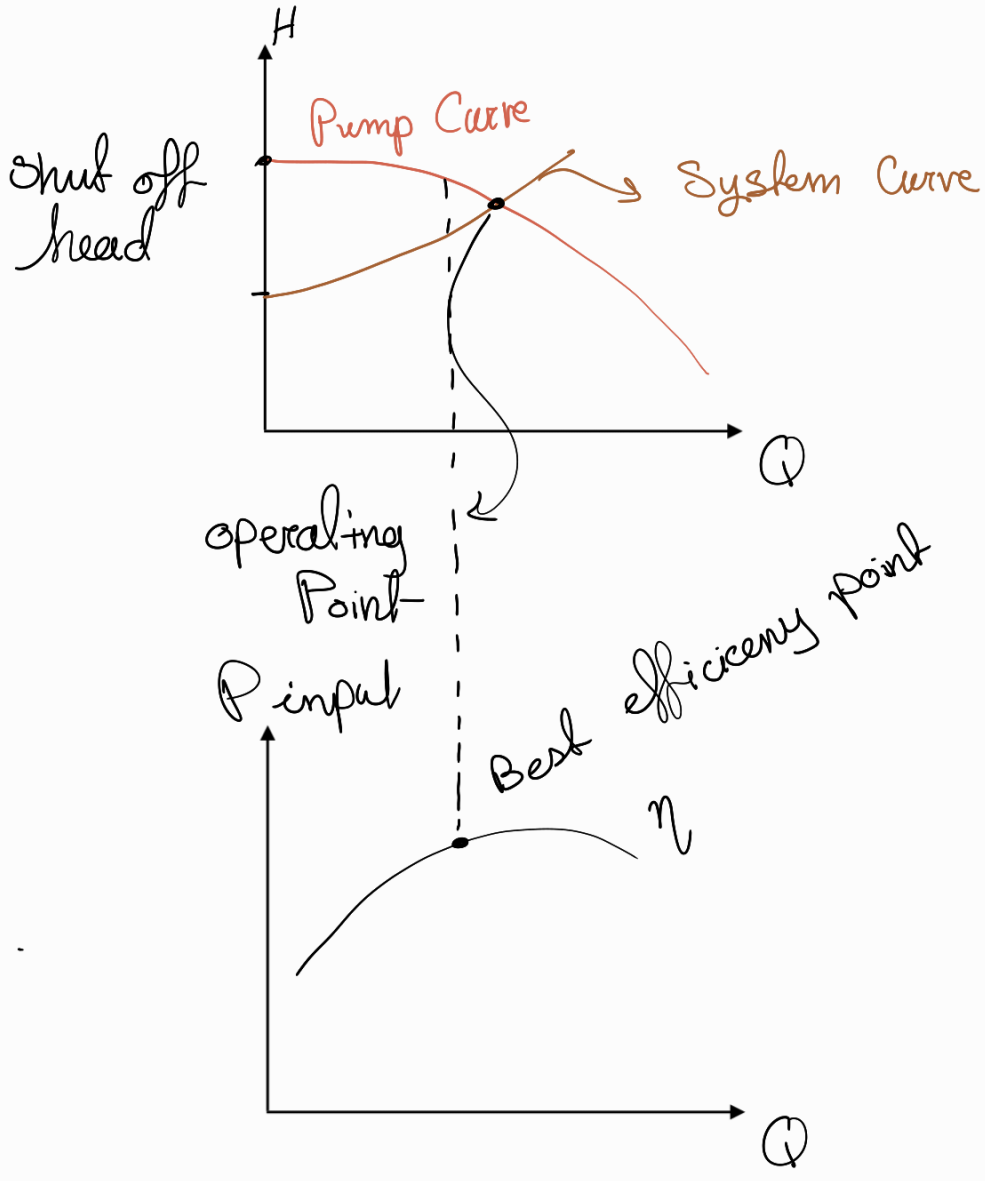


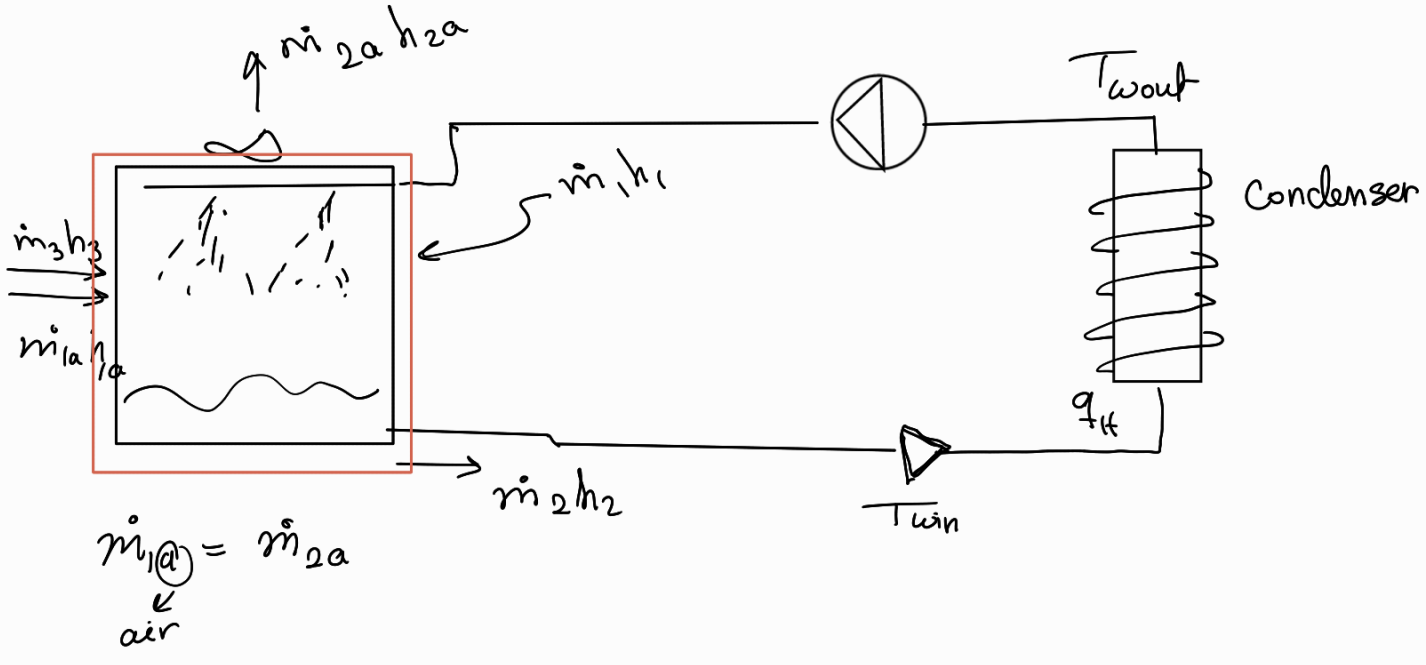
$$H_p + \frac{P_1}{\gamma_w} + \frac{V_1^2}{2g} + Z_1 = Z_2 + \frac{V_2^2}{2g} + \frac{P_2}{\gamma_w} + h_L + h_m + h_T + \text{friction loss duct heat coil}$$

$h_L = f\frac{L}{D}\frac{V^2}{2g}$ or Hazen williams

$h_m = K\frac{V^2}{2g}$ valve, elbow

So $H_p = h_L + h_m + \underbrace{h_c}_{\text{shut off}}$ constant





$$\dot{m}_w = \dot{m}_a (\omega_2 - \omega_1)$$

Energy Saving

$$\dot{m}_{1a} h_1 + \dot{m}_1 h_1 + \dot{m}_3 h_3 = \dot{m}_{2a} h_{2a} + \dot{m}_2 h_2$$