4.1.35.

$H_p = 50 - 45000\,Q^2$ How much is Hand Q?

$H_S = 20 + 20000\,Q^2$

$Q_r = 0{,}015\ m^3/s$ Throttle or Bypass

$P_{input} = 9.4 + 240\,Q - 50000\,Q^2$

Draw the sketches! How large is the hydraulic loss in the two cases? How large is the specific energy consumption f in the two cases?

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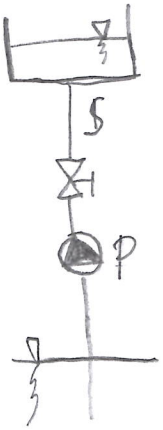
① $H_S = H_p \Rightarrow 50 - 45000\,Q^2 = 20 + 20000\,Q^2$

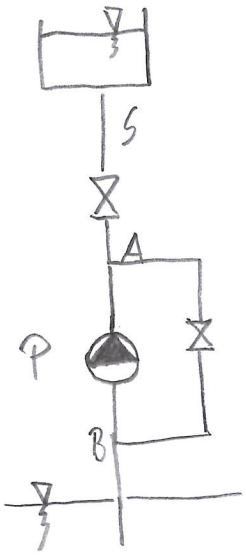
$$Q = \sqrt{\frac{50-20}{20000+45000}} = 0{,}0271\ \frac{m^3}{s}$$

②

a) Throttle



b) By-Pass



③

$Q_R = 0{,}015\ m^3/s$ $H_p(Q_R) = 59{,}375\ m$; $H_S(Q_R) = 24{,}5\ m$

$\Delta H = H_f = H_p - H_S = 35{,}375\ m$

$P'_{f,thr} = Q_R \rho g H'_f = 0{,}015 \cdot 1000 \cdot 9{,}81 \cdot 35{,}375 = 5{,}2\ kW$

b) By-Pass

$$H_p(Q_{p\,BP}) = 70 - 45000\, Q_{p,BP}^2 = H_{BP} = H_s(Q_k) = 24{,}5\ m$$

$$Q_{p,BP} = \sqrt{\frac{70-24{,}5}{45000}} = 0{,}0318\ m^3/s$$

$$Q_{BP} = Q_{p,BP} - Q_k = 0{,}0318 - 0{,}015 = 0{,}0168\ m^3/s$$

$$P'_{BP} = Q_{BP}\, \varrho \cdot g\, H_{BP} = 4\ kW$$

$$P_{input}(Q_k) = 9{,}4 + 240 \cdot 0{,}015 - 50000\, 0{,}015^2 = 12{,}8\ kW$$

a)
$$f = \frac{P_{in}(Q_k)}{Q_k} = \frac{12{,}8\ kW}{0{,}015\ m^3/s} = 855\ \frac{kJ}{m^3}$$

b) $P_{in}(Q_{p,BP}) = 15{,}4\ kW \qquad (Q = 0{,}0318)$

$$f = \frac{P_{in}(Q_{p,BP})}{Q_k} = \frac{15{,}4}{0{,}015} = 1028\ \frac{kJ}{m^3}$$