CIVIL ENGINEERING FACULTY HYDRAULICS DIVISION
HYDROLOGY

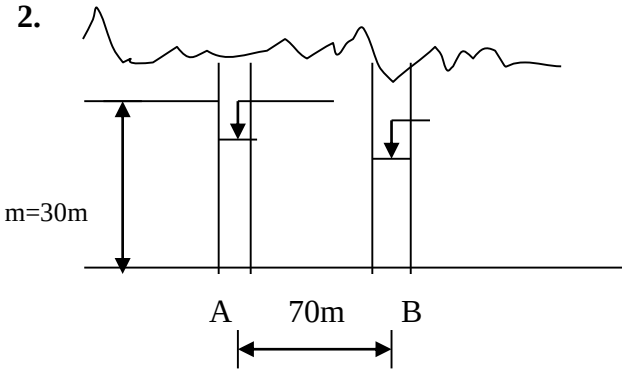
Examples –5 Groundwater Flow

1. L= 25cm A= 80cm^2 Q= 0,16cm^3/s H= 10mm

V= K I Q/A = K I

K= $\frac{QL}{AH}=\frac{0,16*25}{80*1}=0,05cm/s$

2.



a) $I=\frac{\Delta H}{\Delta L}=\frac{75-74,4}{70}=0,0086$

Flow direction; A ⇒ B

b) $V_g=\frac{L}{T}=\frac{70*100}{3,67*3600}=0,53cm/s$

$V_f = V_g\, p = 0,53*0,13 = 0,069$ cm/s

c)

K= $\frac{V_f}{I}=\frac{0,069}{0,0086}=8,02cm/s$

d) Conduction Coefficient; T=mK = 30*100*8,02 = 24060 cm^2/s

e) Specific Permeability Coefficient $k=\frac{\mu}{\gamma}K=\frac{134*10^{-6}}{10^3}*8,02*10^{-2}$

k= 134*8,02*10^{-11}
k= 1,07*10^{-8} m^2

K⇒ related to the fluid and soil properties

k⇒ related to only soil properties

3. a) $Q = \dfrac{2{,}72mk(S_1 - S_2)}{\log(r_2/r_1)}$

$$k = \frac{Q*\log(r_2/r_1)}{2{,}72*m(S_1 - S_2)} = \frac{0{,}03*\log(50/20)}{2{,}72*40*(3{,}2-1{,}9)} = 8{,}43*10^{-5}\, m/s$$

Conduction Capacity T = m*k = 40*8,43*10^{-5} = 3,37*$10^{-3}$$m^2$/s

b) $k = \dfrac{Q*\log(r_2/r_0)}{2{,}72*m(S_0 - r_2)}$

k (S_0-S_1) 2,72m = Q log(r_2-r_0)

$$S_0 = \frac{Q\log(r_2/r_0)}{k*2{,}72*m} + S_2 = \frac{0{,}03\log(50/0{,}4)}{8{,}43*10^{-5}*2{,}72*40} = 6{,}85m$$

4. Q = 0.07 m^3/s, m=8m, r_1 = 55 m, r_2 = 115 m, h_1 = 12.6 m, h_2 = 14 m

The discharge for a confined aquifer is defined as;

$$Q = 2\pi mK\frac{\left(h_2 - h_1\right)}{\ln\dfrac{r_2}{r_1}} \Rightarrow K = \frac{0.07}{2\pi*8}.\frac{\ln(115/55)}{(14-12.6)} = 7.34*10^{-4}\, m/s. = 0.073 \text{ cm/s.}$$