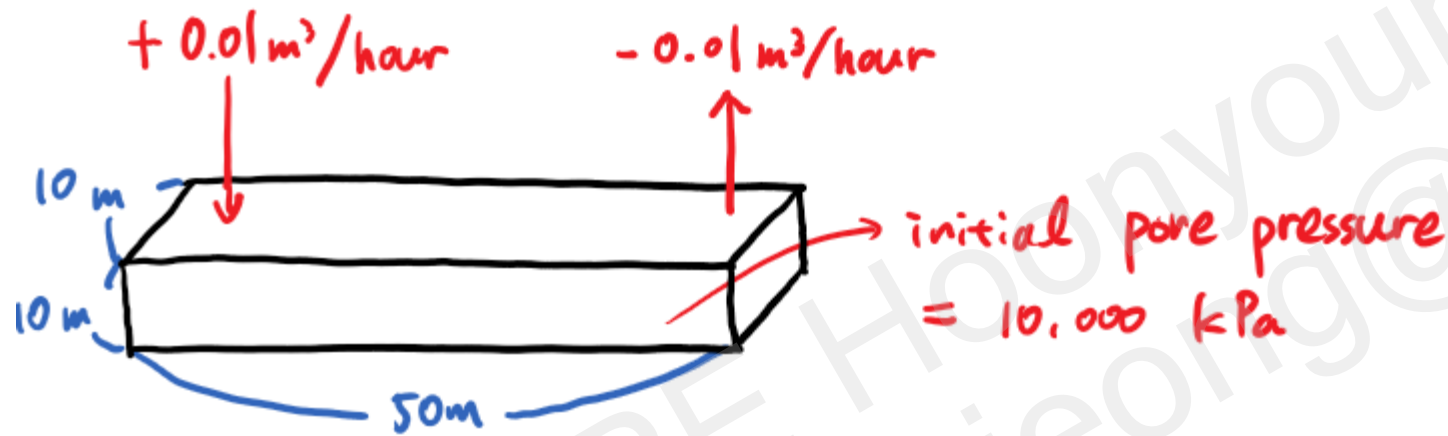




Example of Numerical Solution of 1D Single Phase Flow Equation

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Example



Rock : $k = 200 \text{ md}$, $\phi = 0.2$, $C_r = 1e - 6(1/\text{kPa})$

slightly compressible

Fluid : $\mu = 1 \text{ cp}$,

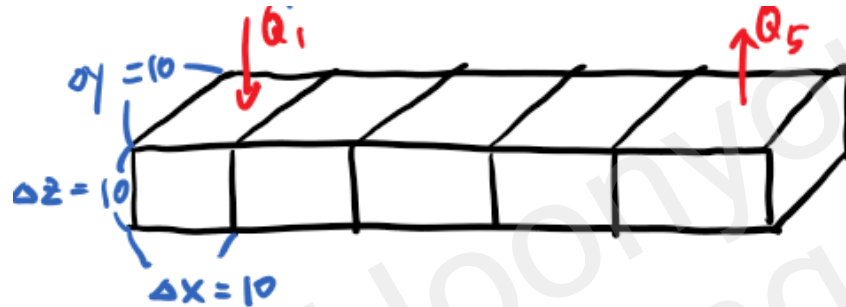
$C_f = 1e - 6(1/\text{kPa})$

slightly compressible

Calculate the pressure numerically for locations and time.

Discretization

$$\Delta x = \Delta y = \Delta z = 10m, \quad \Delta t = 1 \text{ second}$$



| | | | | | | | | | |
|---------------------|---|-----------|---|-----------|---|-----------|---|---------------------|------------------|
| $i = 1$ | | $i = 2$ | | $i = 3$ | | $i = 4$ | | $i = 5$ | |
| P_1^0 | = | P_2^0 | = | P_3^0 | = | P_4^0 | = | P_5^0 | = 10,000kPa |
| $Q_1 = +0.01m^3/hr$ | | $Q_2 = 0$ | | $Q_3 = 0$ | | $Q_4 = 0$ | | $Q_5 = -0.01m^3/hr$ | |
| k_1 | = | k_2 | = | k_3 | = | k_4 | = | k_5 | = 200md |
| ϕ_1 | = | ϕ_2 | = | ϕ_3 | = | ϕ_4 | = | ϕ_5 | = 0.2 |
| $C_{r,1}$ | = | $C_{r,2}$ | = | $C_{r,3}$ | = | $C_{r,4}$ | = | $C_{r,5}$ | = $1e-6$ (1/kPa) |
| μ_1 | = | μ_2 | = | μ_3 | = | μ_4 | = | μ_5 | = 1cp |
| $C_{f,1}$ | = | $C_{f,2}$ | = | $C_{f,3}$ | = | $C_{f,4}$ | = | $C_{f,5}$ | = $1e-6$ (1/kPa) |