4. WELL HYDRAULICS

SPECIFIC YIELD (S_Y)

The specific yield of an unconfined aquifer is the ratio of volume of water which will flow under saturated condition due to gravity effect to the total volume of aquifer (v).

$$S_y = \frac{V_{wy}}{V}$$

where, V_{wy} = Volume of water yielded under gravity effect

and V = Total volume of water.

SPECIFIC RETENTION

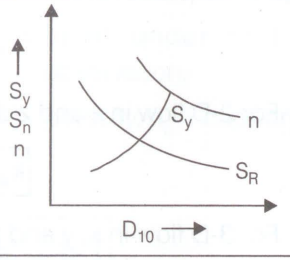
The specific retention of an unconfined aquifer is the ratio of volume of water retained against gravity effect to the total volume of aquifer (v).

$$S_R = \frac{V_{WR}}{V}$$ where, V_{WR} = Volume of water retained under gravity effect.

Remember

$$S_y + S_R = n$$

where, n = Porosity



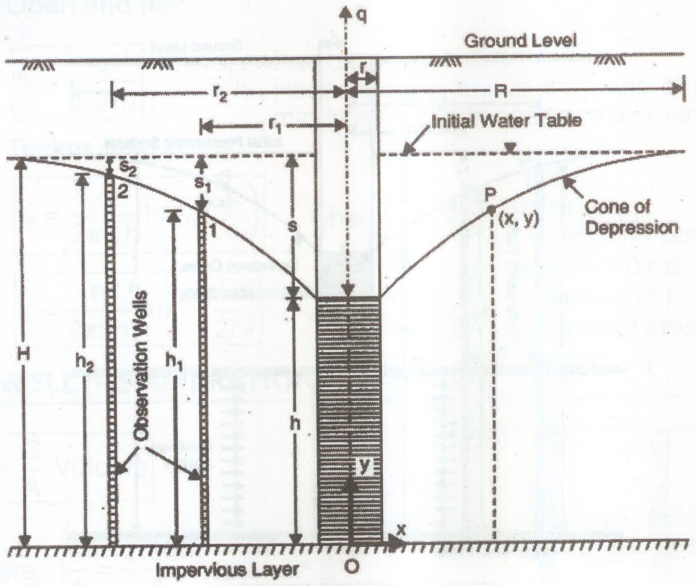
COEFFICIENT OF TRANSMISSIBILITY

$$T = kH$$

where, H = Thickness

k = Coefficient of permeability

UNCONFINED AQUIFER



(a) Theims Theory

$$q = \frac{k\pi}{2.303}\frac{(h_2^2 - h_1^2)}{\log_{10}(r_2/r_1)}$$

$$h_1 + s_1 = h_2 + s_2$$

$$\text{drawdown} = (h_2 - h_1) = s_1 - s_2$$

where, q = Rate of flow in m^3/s

h_1 = Height of water table of 1st observation well

h_2 = Height of water table of 2nd observation well

s_1 = Drawdown of 1st test well

s_2 = Drawdown of 2nd test well.

r_1 and r_2 are radius of Ist and 2nd observation wells respectively.

(b) Dupits Theory

$$q = \frac{k\pi}{2.303}\frac{(H^2 - h^2)}{\log_{10}(R/r)}$$

$$R = 3000.S\sqrt{k}$$ and

$$S = H - h$$

Where, S = Drawdown in the well

k = Permeability coefficient in m/s.

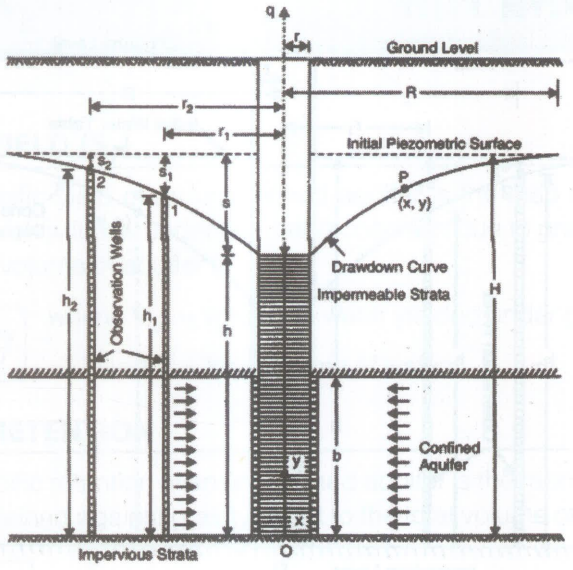
R = Radius of influence in 'm'

$$150\,m \le R \le 300\,m$$

r = Radius of test well in 'm'.

Results of dupits theory are not accurate because 'R' is based on empirical relation.

CONFINED AQUIFER



(a) Theims theory $$q = \frac{2\pi bK(h_2 - h_1)}{2.303 \log_{10}\left(\frac{r_2}{r_1}\right)}$$ where, b = width

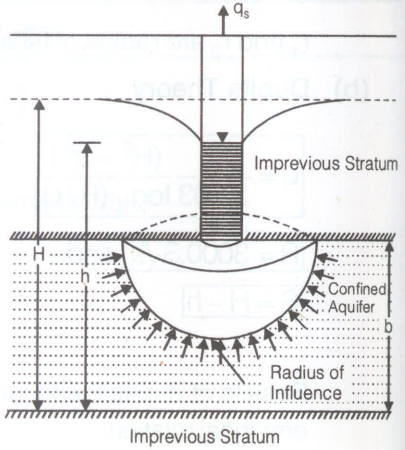
(b) Dupits theory $$q = \frac{2\pi bK(H - h)}{2.303 \log_{10}\left(\frac{R}{r}\right)}$$

SPHERICAL FLOW THROUGH WELL

$$q_s = K.2\pi r.s$$

where, r = Radius of well
S = Drawdown
q_s = Rate of flow through spherical well in m^3/s

$$q_s = \frac{1}{30}.q_{\text{radial flow}}$$



PUMPING-IN-TEST

(a) Open end test

$$K = \frac{q}{5.5rh}$$ where, r = Radius of pipe
h = Head of water above the base of pipe, it may include gravity head and pressure head.

(b) Tacker test

$$K = \frac{q}{2\pi Lh}\log_{10}\left(\frac{L}{r}\right)$$ ... when $L > 10r$

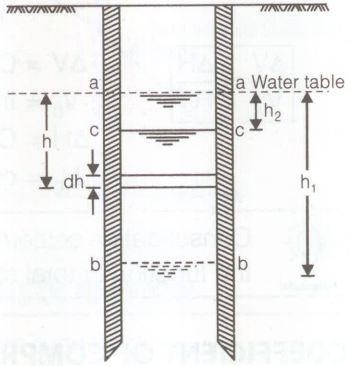
$$k = \frac{q}{2\pi Lh}\sin^{-1}\left(\frac{L}{2r}\right)$$ ... when $L < 10r$

where,
L = Length of perforated section of pipe
r = Radius of pipe
h = Head of which water is added.

OPEN WELL (RECUPERATION TEST)

$$q = \frac{C}{A}.\text{Volume}$$

where, $$\frac{C}{A} = \frac{2.303}{T}\log_{10}\left(\frac{h_1}{h_2}\right)$$



Volume = A.H
A = Area of well
$\frac{C}{A}$ = Specific yield or specific capacity of an open well.
T = Time in 'sec'
h_1 = Position of water table of t = 0
h_2 = Position of water table of t = T

VALUES OF PERMEABILITY

	SOIL	K(cm/sec)	Degree of Permeability
1.	Coarse gravel	>1	High
2.	Fine gravel-Fine sand	1 to 10^{-2}	Medium
3.	Silt-Sand admixtures, loose silts, rock flour and loess	10^{-2} to 10^{-4}	Low
4.	Dense silt, clay silt admixtures, non-homogenous clays	10^{-4} to 10^{-6}	Very low
5.	Homogenous clays	$<10^{-6}$	Impervious

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