"Dhaka Wasa-2017"

Q.1 The Unconfined compression of the soil is 180 kPa. Determine the undrained cohesion.

Ans:

Given that, $q_u = 180$ kPa.

$c_u = ?$

$\therefore c = \frac{q_u}{2} = \frac{180}{2} = 90$ kPa.

Q.2 Sieve Analysis were performed for a coarse sand & it has been found 20% sample retained on each #4, #8, #30, #40, #50, #100 & #200 sieve. Find the F.M. of sand.

Soln:

Sieve No.	percentage of Retained	percentage of cumulative retained
#4	20	20 ✓
#8	20	40 ✓
#30	20	60 ✓
#40	20	80 ✓
#50	20	100 ✓
#100	20	120 ✓
#200	20	140

$\therefore FM = \frac{20+40+60+80+100+120}{100} = \frac{340}{100} = 3.4$ (Ans)

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Q.3 What is the theoretical relationship between speed, density and volume for a highway.

Ans:

Under uninterrupted flow conditions, speed, density and flow are related by the following equation:

$$q = k * v$$

where, q = Flow (vehicles/hour)

k = Density (vehicles/mile, vehicles/km)

v = speed (miles/hour, km/hour)

Q.4 Define BOD & COD. Why COD > BOD?

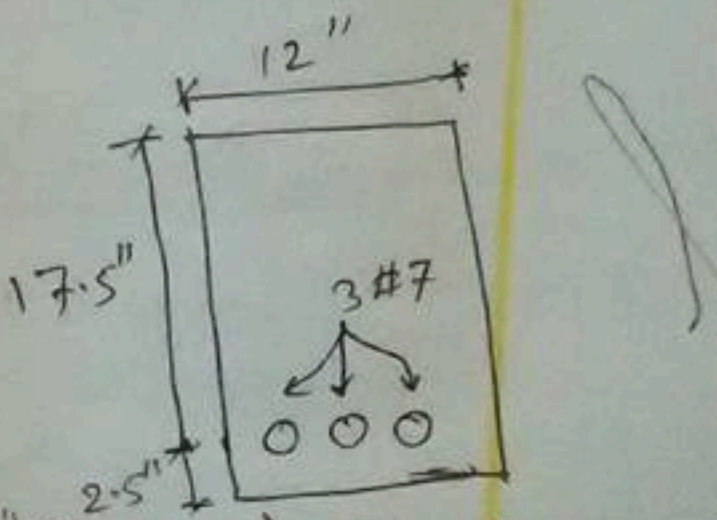
Ans: Try yourself.

Q.5 ~~Given that~~

Singly Reinforced Beam.

2.5 A rectangular Beam has a width of 12" and effective depth 17.5". It is reinforced with 3 #7 bars. If ~~$f_y = 60$ ksi, & $f_c' = 4$ k~~ $f_s = 24$ ksi. & $f_c' = 1.2$ ksi, $n=9$ find the allowable working moment capacity.

Soln.



given that, $f_s = 24$ ksi

$f_c' = 1.2$ ksi

$A_s = 3 * 0.6 = 1.8 in^2$.

$n = 9$

[N.B: if "n" not given then, $n = \frac{E_s}{E_c}$, E_s = Modulus of Elasticity of steel.

$E_c = 57000\sqrt{f_c'}$]

$$n = \frac{f_s}{f_c} = \frac{24}{1.2} = 20$$

$$k = \frac{n}{n+n} = \frac{9}{9+20} = 0.31$$

$$j = 1 - \frac{k}{3}$$

$$= 1 - \frac{0.32}{3}$$

$$= 0.90.$$

Here,

$$k = \sqrt{(pn)^2 + 2pn} - pn$$

& $p = \frac{A_s}{bd}$

$\therefore p = \frac{1.8}{12 \times 17.5} = 8.57 \times 10^{-3}$

$\therefore k = 0.32$

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Now, $\rho_b = \frac{n}{2n(n+n)} = \frac{9}{2*20(9+20)}$ | $n = \frac{f_s}{f_c} = \frac{24}{1.2} = 20$

$= 7.76 \times 10^{-3}$

$\therefore \rho > \rho_b$; Hence, Compression failure occurs.

$\therefore M = \frac{1}{2} f_c jk bd^2$

$= \frac{1}{2} * 1.2 * 0.9 * 0.32 * 12 * 17.5^2$

$= 635.04$ kip-inch. (Ans).

[N.B.: if $\rho < \rho_b$; then tension failure occurs, then, $M = A_s f_s jd$.
& $\rho = \rho_b$; Balanced reinforced
then, $M = A_s f_s jd + \frac{1}{2} f_c jk bd^2$]

[If it is said to do "Design" that means Moment given; but, b, d & A_s value will be calculated.
Then, Procedure: $K = \frac{n}{n+n}$, $j = 1 - K/3$, $n = \frac{f_s}{f_c}$.
$\rho_b = \frac{n}{2n(n+n)}$, $R = \frac{1}{2} f_c jk$. $M = Rbd^2$, $A_s = \rho_b bd$
OR, $A_s = \frac{M}{f_s jd}$]

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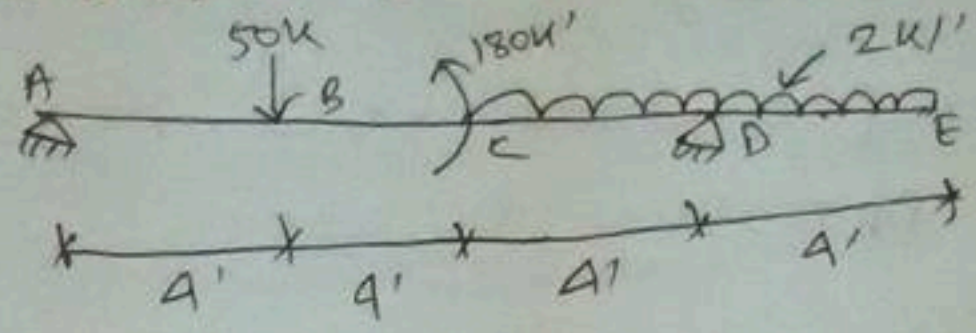
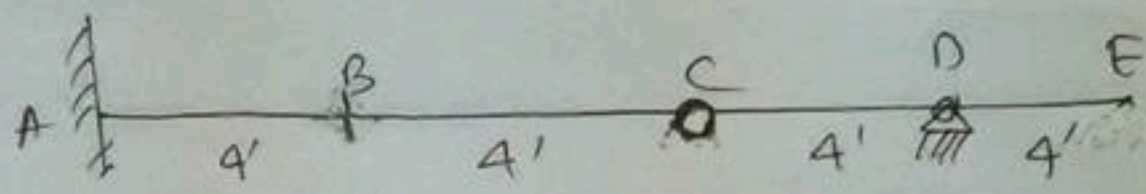
Q.6 Draw SFD & BMD of the following beam:

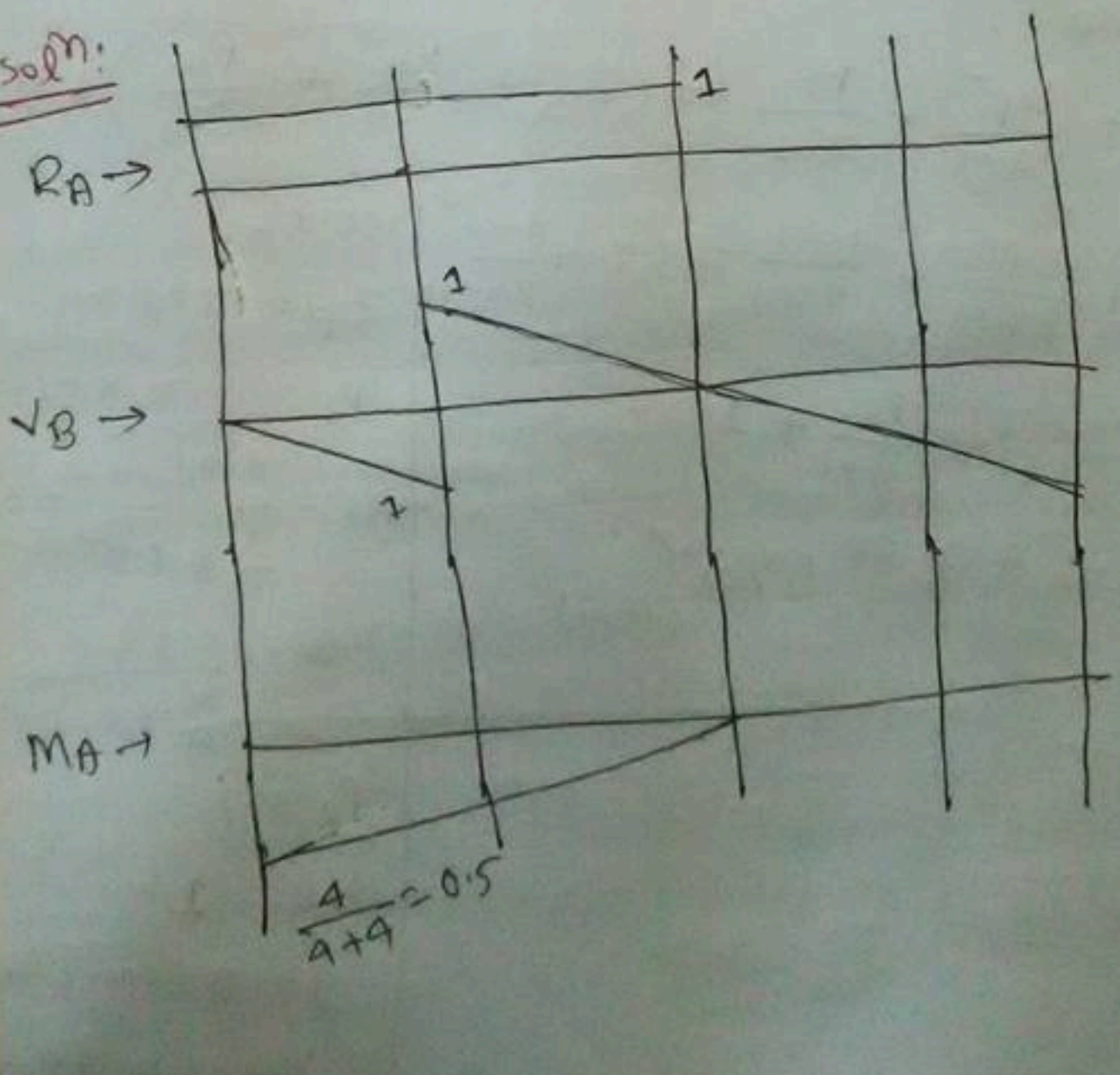


Soln: Try yourself.

Q.7 Draw IL Diagram for R_A, V_B & M_A



Soln:



Q.8 A pipe is laying at head of 525 m at one end, P and at head of 580 m at other end, Q. $D_P = 50$ cm, $D_Q = 75$ cm. Discharg from P to Q is $0.02\ m^3/sec$. If pressure at point P is $1000\ kN/m^2$, Determine the pressure at point Q. Assume head loss = 1 m. ~~Also consider Pressure is~~

Soln:

We know,

$$z_P + \frac{v_P^2}{2g} + \frac{P_P}{\gamma_w} = (z_Q + \frac{v_Q^2}{2g} + \frac{P_Q}{\gamma_w}) + H.L$$

$$\Rightarrow 525 + \frac{0.1^2}{2*9.81} + \frac{1000}{9.81} = 580 + \frac{0.05^2}{2*9.81} + \frac{P_Q}{9.81} + 1$$

$$\Rightarrow P_Q = 450.64\ kN/m^2 \quad (Ans).$$

Here,

$z_P = 525$ m.

$P_P = 1000\ kN/m^2$.

$v_P = \frac{0.02}{\frac{\pi}{4} * 0.5^2} = 0.1\ m/s$

$v_Q = \frac{0.02}{\frac{\pi}{4} * 0.75^2} = 0.05\ m/s$

$P_Q = ?$

$H.L = 1$ m

$g = 9.81\ m/s^2$

$\gamma_w = 9.81\ kN/m^3$.

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Q.9 Calculate volume of road embankment by trapezoidal rule:

Interval (Feet)	100	200	300	400	500
Area (ft^2)	10	25	30	50	60

Soln.

Here, common interval, $d = 100'$

$$\therefore \text{Volume} = \left(\frac{10+60}{2} + 25+30+50\right) * 100$$

$$= 14000\ ft^3$$

$$= 1301.31\ m^3 \text{ (Ans).}$$

Q.10 A pipe diameter of 50cm is flowing a flow the value of $n = 0.016$, $S = 0.001$. Determine the discharge.

Soln:

We know, $Q = \frac{1}{n} A R^{2/3} S^{1/2}$

$$= \frac{1}{0.016} * 0.196 * (0.125)^{2/3} * (0.001)^{1/2}$$

$$= 0.097\ m^3/sec. \text{ (Ans).}$$

Here,
$n = 0.016$
$S = 0.001$.
$Q = ?$.
$A = \frac{\pi}{4} \times 0.5^2 = 0.196\ m^2$
$R = \frac{\pi/4\, d^2}{2\pi d} = \frac{d}{4}$
$= 0.125\ m$

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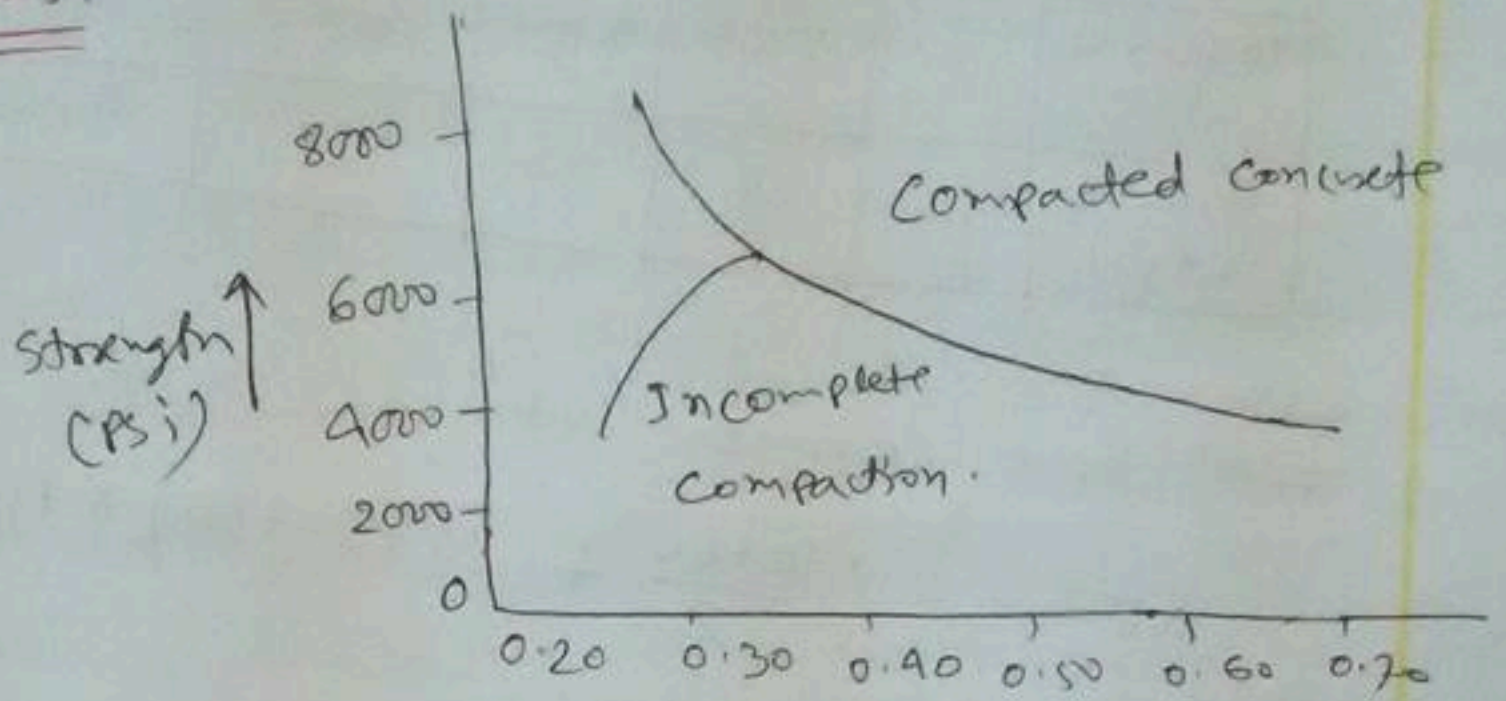
Q.11 ~~E_c~~ Draw the graph between Compressive Strength of concrete and water cement ratio.

Ans:



Q.12 Axle load of 27K and 36 KIPS are repeated 30 and 15 times respectively on pavement of 24 hrs. What will be the Equivalent single Axle Load in a year?.

Soln: ~~365 day = 365 × 24 = 8760 hr.~~

Sl. No.	Axle Load(K)	No. of Load Repition (ni)	EALF (Fi)	Fini
1.	27	30 × 365 = 10,950	$(\frac{27}{18})^9 = 5.06$	55407
2.	36	15 × 365 = 5475	$(\frac{36}{18})^9 = 16$	87616
			Total =	143023 (Ans)

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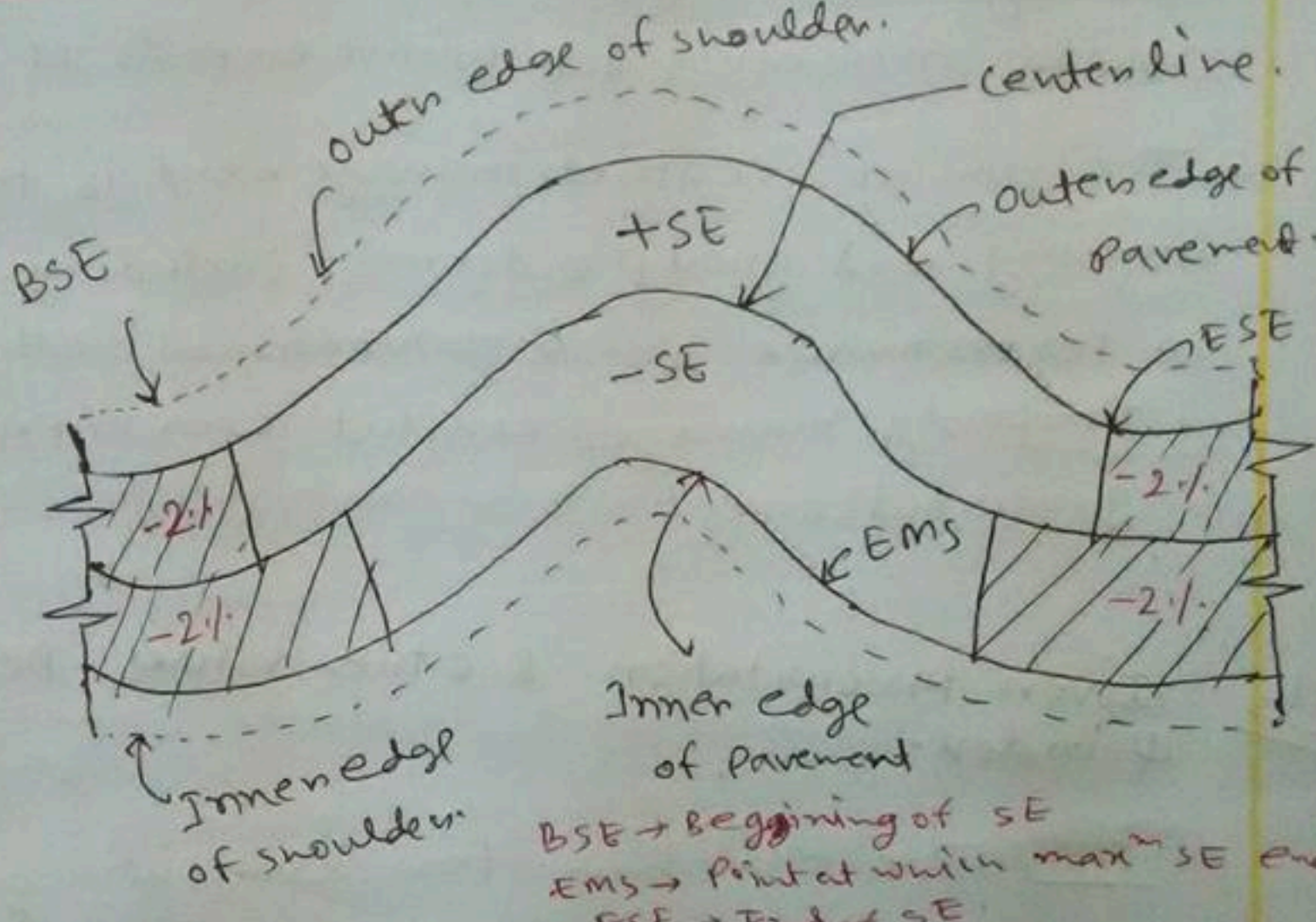
Q.13 Draw Diagram for attaining superelevation Pavement rotating about centerline.

Ans:

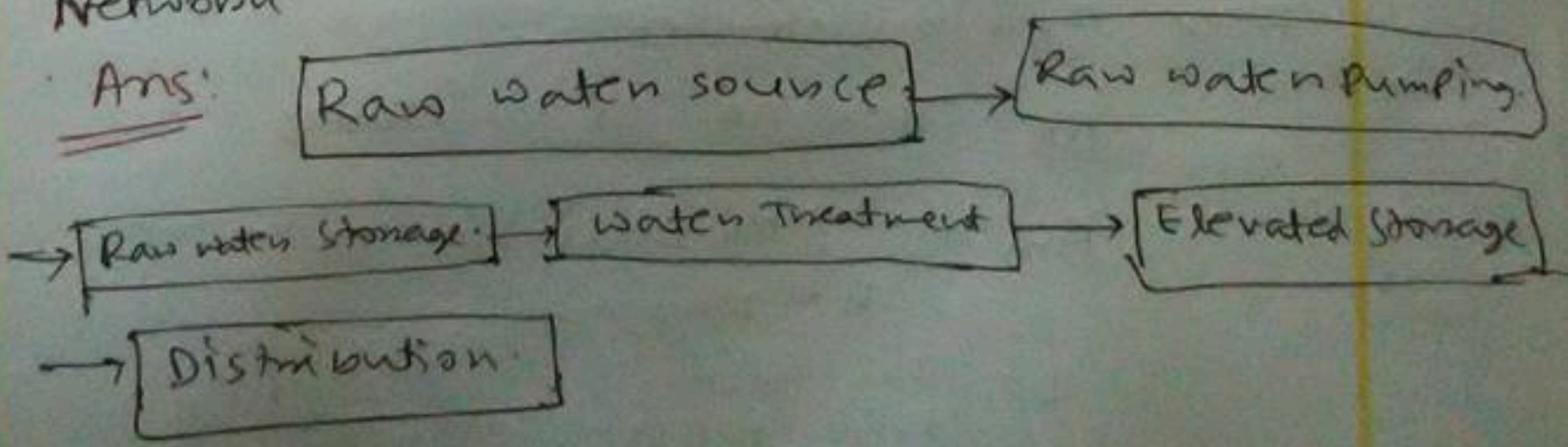


BSE → Beginning of SE
EMS → Point at which max^m SE ends.
ESE → End of SE

Fig: Plan of Typical Super elevation Transition.

Q.19 Sketch the flow diagram of water supply Network.

Ans:



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Q.15 Characteristics of Conflict Management system.

Ans: Conflict management is the process of limiting the negative aspects of conflict while increasing the positive aspects of conflict.

→ The aim of conflict management is to enhance learning and group outcomes, including effectiveness or performance in organizational setting.
→ Properly managed conflict can improve group outcomes.

Q.16 Given precipitation & other values. Determine Φ index.

Ans: The equation for computing Phi-Index:

$$P_d = \sum_{m=1}^{m} (R_m - \phi \Delta t)$$

Here, P_d = runoff depth.
m = Total no. of ordinates.
R_m = "m" th ordinate in the total rainfall hyetograph.
ϕ = Phi-index.
Δt = time step for each a_i.

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~~Another equation,~~

Here, $\eta = \frac{\Sigma Q_i \times \Delta t}{A}$

Q_i = direct runoff ordinate at i^{th} time step

A = watershed Area.

Another Equation:

$$\phi\text{-index} = \frac{(P-R)}{t_e}$$

where, P = total storm precipitation (cm)

R = total surface Runoff (cm)

t_e = elapsed time period (in hours)

$$\& \text{ W-index} = \frac{P-R-I_a}{t_e}$$

Here, I_a = Initial losses.

- The w-index is more accurate than the ϕ-index because it subtracts initial losses.

Example of ϕ index

A 12-hour storm rainfall with the following depths in cm occured over a basin: 2.0, 2.5, 7.6, 3.8, 10.6, 5.0, 7.0, 10.0, 6.4, 3.8, 1.4 and 1.4. The surface runoff resulting from the above storm is equivalent to 25.5cm of depth over the basin. Determine the average infiltration index (ϕ- index) for the basin.

Ans:

Total rainfall in 12 hours = (2.0 + 2.5 + ... + 1.9)

= 61.5 cm.

Total run off in 12 hours = 25.5 cm.

(P-R)

∴ infiltration in 12 hours = (61.5 - 25.5) cm

= 36 cm

(P-R)

∴ Avg. infiltration = $\frac{36}{12}$ = 3.0 cm/hr.

↳ te

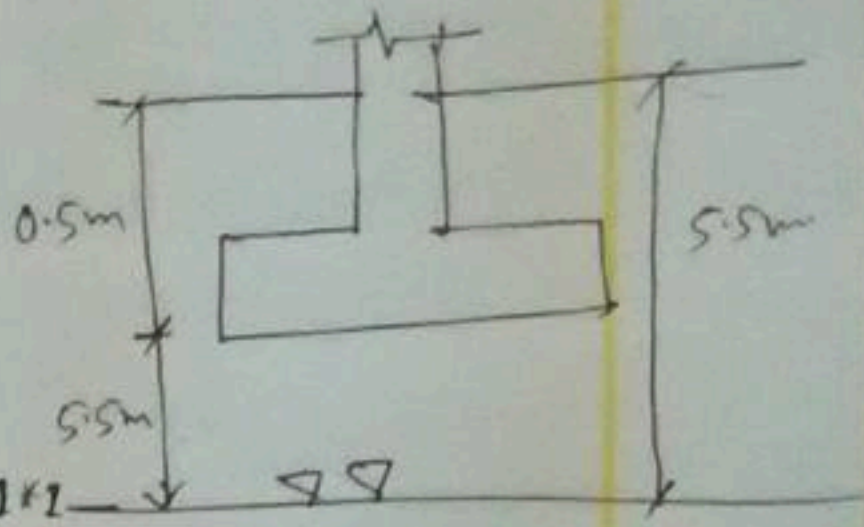
∴ Avg. rate of infiltration during the central 8 hours:

$8\phi + 2.0 + 2.5 + 1.4 + 1.9 = 36$

$\Rightarrow \phi = 3.6$ cm/hr. (Ans).

"D-Wasa-2017"

Q.17 If, $q_u = 50 kPa$, $N_c = 9$, $\gamma = 18 kN/m^3$, $N_q = 2$, $N_\gamma = 1$, $B = 1m$, Calculate Ultimate Bearing capacity.



Solution:

we know,

$$q_u = cN_c + qN_q + \frac{1}{2}\gamma B N_\gamma$$

$$= 25 * 9 + \quad * 9 + \frac{1}{2} * 18 * 1 * 1$$

$$=$$

Here,

$$q = \frac{q_u}{2} = \frac{50}{2} = 25 kPa$$

$N_c = 9$

$q = \gamma D_f = \gamma * 18 * 0.5$

ov 6

confused

Q.18 A problem about the calculation of field capacity. (can't memorize).

(11) Find the field capacity of soil for the given data.

Solution:

water applied = 600 m^3.

∴ water retained

= (600 × 0.90) m^3 × 9.81 KN/m^3

= 5297.4 KN.

Again, dry weight of irrigated land = Area × Depth × γ_d of soil = (800 × 2) × 1400

= 2240000 kg

= $\frac{2240000 \times 9.81}{1000}$ KN

= 21974.4 KN

NOW,

21974.4 KN soil retains 5297.4 KN water

∴ 100 KN " " $\frac{5297.4}{21974.4} \times 100$

= 24.11 % water

Given,

i) Depth of root zone = 2 m.

γ_w = 9.81 KN/m^3.

ii) Existing water content = 7%

iii) γ_d of soil = 1400 kg/m^3

iv) Total water volume = 600 m^3.

v) water lost = 10%.

∴ water retained = (100 − 10)%.

= 90%.

vi) Area of irrigated land = 800 m^2.

Field capacity = ?

We know,

Field capacity = (%) Existing water content + (%) retained water content

= (7 + 24.11)% = 31.11%.

[Am]