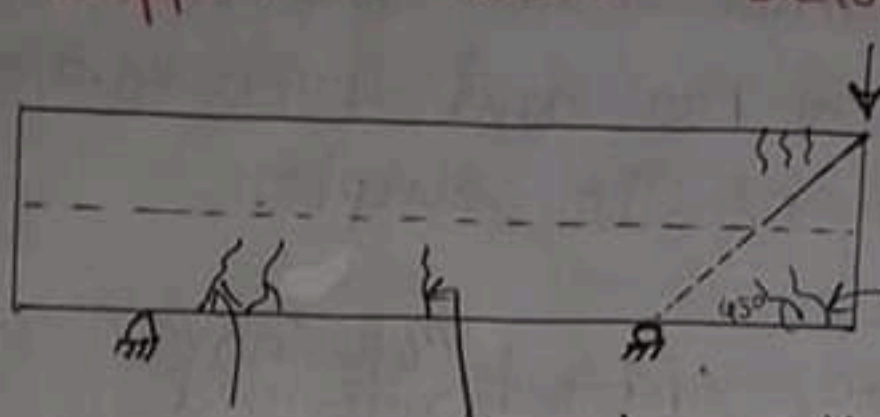
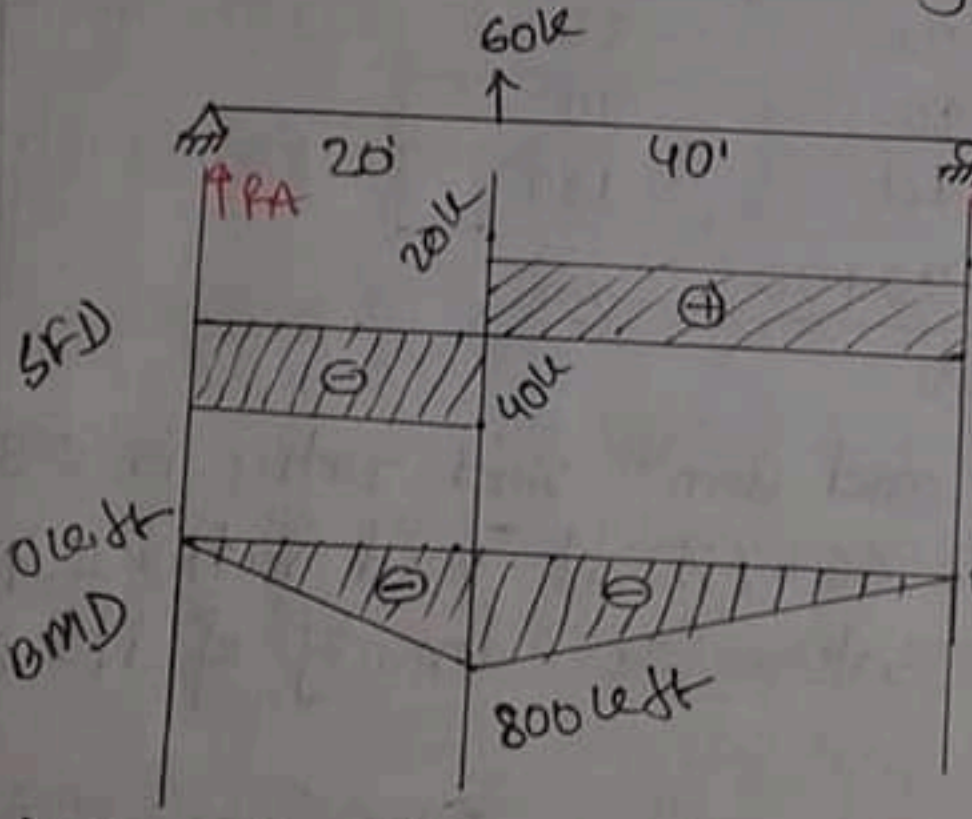
Coal power plant - 2018, BUET

1. Draw qualitative shear and flexural crack in a simply supported beam below.



2. Draw the SFD and BMD of the following beam.



$\Sigma M_A = 0$

$60 \times 20 + R_B \times 60 = 0$

$\Rightarrow R_B = -20k$

$\Sigma f_y = 0$

$R_A + R_B + 60 = 0$

$\Rightarrow R_A - 20 + 60 = 0$

$\Rightarrow R_A = -40k$

3. Determine the axial compression when $f_c' = 4$ ksi $f_y = 60$ ksi of the following column.

Solution:

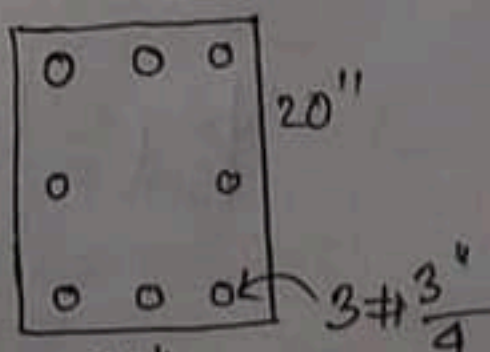
$A_g = 20 \times 20 = 400\ in^2$

$A_s = 8 * \frac{\pi}{4} * (\frac{3}{4})^2 = 3.53 in^2$

$P_c = \alpha [.85 f_c' (A_g - A_s) + A_s f_y]$

$= 0.8 [.85 * 4 (400 - 3.53) + 3.53 * 60]$

$= 1247.83$ kips



4. For a sand sample 20% retained on #110 #130, #140 and #150 sives and rest 20% retains on #100 and #200 sieve equally. Find the FM of the sample.

Sieve	% retained	Cumulative % retained
#116	20	20
#130	20	40
#140	20	60
#150	20	80
#100	10	90
#200	10	100

$$\therefore FM = \frac{20+40+80+90}{100} = 2.3$$

5. Difference of max^m and min^m void ratio is 0.3. If relative density is 66.67% at void ratio 0.4 what will be its saturated density of its loosest state?

Solution:

$$D_r = \frac{e_{max} - e}{e_{max} - e_{min}}$$

$$\Rightarrow .6667 = \frac{e_{max} - .4}{0.3}$$

$e_{max} - e_{min} = 0.3$

$R = 66.67\%$

$e = 0.4$

$\Rightarrow \boxed{e_{max} = 0.6}$

Let, $G_s = 2.65$

$\gamma = 9.81$ kN/m^3

$$\gamma_{sat} = \frac{(G_s + e_{max})\gamma_w}{1 + e_{max}}$$

$$= \frac{(2.65 + .6) \times 9.81}{1 + .6}$$

$$= \boxed{19.92 \text{ kN/m}^3}$$

6. A clay stratum 5m thick has the initial void ratio of 1.5 and the effective overburden pressure of 120 kN/m². What is the increased pressure when void ratio reduces to 1.447. Volume of coefficient of volume compression is 2×10^{-4} m²/kN Also calculate the final settlement.

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Solution:

$$m_v = \frac{a_v}{1+e_{av}}$$

$$\Rightarrow m_v = \frac{\Delta e/\Delta p}{1+e_{av}}$$

$$\Rightarrow 2\times10^{-4} = \frac{(1.5-1.44)}{\Delta p\,(1+1.47)} \Rightarrow \boxed{\Delta p = 121.45\ kN/m^2}$$

$$e_{av} = \frac{1.5+1.44}{2} = 1.47$$

$\therefore m_v = 2\times10^{-4}$ m²/kN

$H = 5m$

Settlement, $S = m_v \Delta p H$

$= 2\times10^{-4} * 121.45 * 5 = \boxed{0.12m}$

7. Two close wheels imprint 20.5 kN load each on road. The applied pressure is 0.7 MPa. If the two wheel is replaced by a single wheel of same propesity, then find the effective imperted diameter of soil (considering circular imperted effect) by single wheel.

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Solution:

$$\text{Tyre pressure} = \frac{\text{Load}}{\text{Area}}$$

$$\Rightarrow P = \frac{F}{A}$$

$$\Rightarrow 0.7\times10^{3} = \frac{20.5\times2}{\frac{\pi}{4}d^2} \Rightarrow \boxed{d = 0.27m}$$

$P = 0.7$ MPa

$= 0.7\times10^{3}$ kPa

$F = 20.5$ kN

8) CBR values found of 10 km length as follows
3·8, 2·8, 3·2, 4·3, 2·8, 4·7, 4·3, 3·9, 4·1 and 4·5.
Find average CBR, standard deviation, CBR of 50% and 90% reliability.

Solution:

$$\text{Average CBR} = \bar{x} = \frac{3.8+2.8+3.2+4.3+2.8+4.7+4.3+3.9+4.1+4.5}{10}$$

$$= 3.84$$

$$\text{Standard deviation} \Rightarrow \sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}} = 0.607$$

$\therefore$ design CBR (50%) $= 3.84 - 0 * 0.607$ [For 50 reliability $z=0$]
$= \boxed{3.84\%}$

design CBR (90%) $= 3.84 - 1.282 * 0.607$ [for 90% " $z=1.282$]
$= \boxed{3.06\%}$

9) One millions gallons Litres of water (1 mgd) passes through a sedimentation tank. If the size of tank is 20' x 50' x 10'. Then calculate detension time in hours.

Solution:

$T = \frac{V}{Q}$

$= \frac{283.38}{3.78 \times 10^3}$

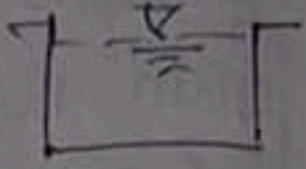
$= 0.074$ day

$= \boxed{1.799 \text{ hrs}}$

$Q = 1$ mgd
$= 106$ gallon/day
$= 3.78 \times 10^6$ litre/day
$= 3.78 \times 10^3$ m³/day

$V = \frac{20 \times 50 \times 10}{(3.28)^3} = 283.38 \text{ m}^3$

10 Calculate the total pressure and effective pressure of a swimming pool having of water level from ground.



Total stress. $\sigma = \gamma_w H = 9.81 * 5 = 49.05$ kN/m²

pore water pressure = $\gamma_w H$

$\sigma_0 = 9.81 * 5 = 49.05$ kN/m²

effective pressure = $\sigma - \sigma_0 = 49.05 - 49.05 = 0$

11. Rainfall intensity is 2.4m/yr. Run-off co-efficient 0.7. Find the max^m catchment area for the daily water demand of 15 lpcd of 7 people.

Solution:

$Q = CIA$

$\Rightarrow 38325 \times 10^{-3} = 0.7 * 2.4 * A$

$\Rightarrow \boxed{A = 22.81\ m^2}$

$Q = 15 * 7$ lpd

$= 15 * 7 * 365$ l/yr

$= 38325 \times 10^{-3}$ m³/yr

$C = 0.7$

$I = 2.4$ m/yr

2. # Calculate the minimum capacity of a storage tank required for a family of 8 persons, to be supplied with 10 lpcd of rain water. The years rainfall intensity is 2.5m and the rainfall distribution is such that at least 35% of the rainwater must be stored for uninterrupted water supply throughout the year. Also calculate minimum catchment area. run off coefficient is 0.7. OR

Solution:

As 35% uninterrupted water supply needed throughout the year

∴ Available supply = 35%

Now, Capacity = $.35 \times 29.2$
$= 10.22 \ m^3/year$

$q = 10 \times 8 \ l/day$
$= 80 \times 365 \times 10^{-3} \ m^3/year$
$= 29.2 \ m^3/year$

$I = 2.5$ year

$C = 0.7$

Again, $q = CAI$

$\Rightarrow 10.22 = 0.7 * 2.5 * A$

$\Rightarrow \boxed{A = 5.84 \ m^2}$