⇒ HIGH & LOW GRAVITY DAM

Maxm Value of major principal stress is at toe when the reservoir is full. This is the maxm at any section.

ie $\sigma_T = \gamma_w \cdot H (G_c - C H)$

⇒ for No failure of dam in comp.

$$\sigma_T \leq f$$

$$-\gamma_w \cdot H \cdot (G_c - C H) \leq f$$

$$H \leq \frac{f}{\gamma_w \cdot (G_c - C H)}$$

$$\boxed{H \leq \frac{f}{\gamma_w \cdot (G_c - C H)}}$$

for H_{min} $C = 0$; $f = 3000\ KN/m^2$; $G_c = 2.4$.

$$H_{min} \leq \frac{3000}{10(2.4H)}$$

$$H_{min} \leq 88.23m \Rightarrow \underline{H \simeq 90m}$$

if $\boxed{H > 90m}$ — High Gravity dam

if $\boxed{H < 90m}$ — Low Gravity dam

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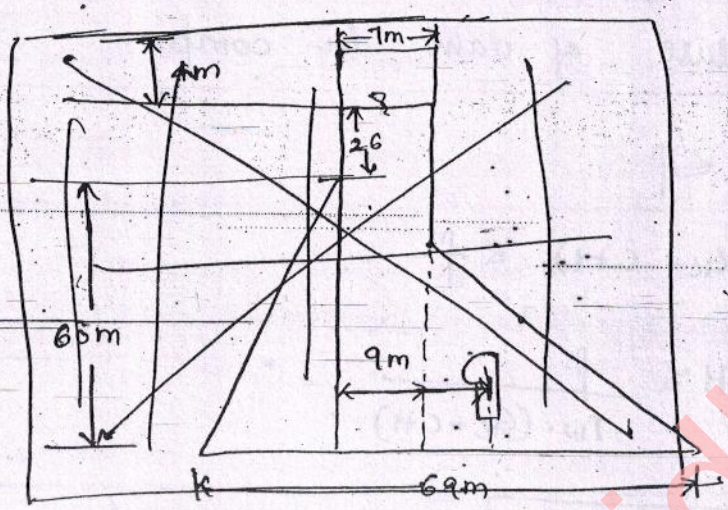
Q. for the given profile of the gravity dam investigate the safety against overturning and sliding, if coefficient of friction = 0.75. Density of concrete $\gamma_c = 2.4\ T/m^3$

Also check for safety against Tension & comp^n.

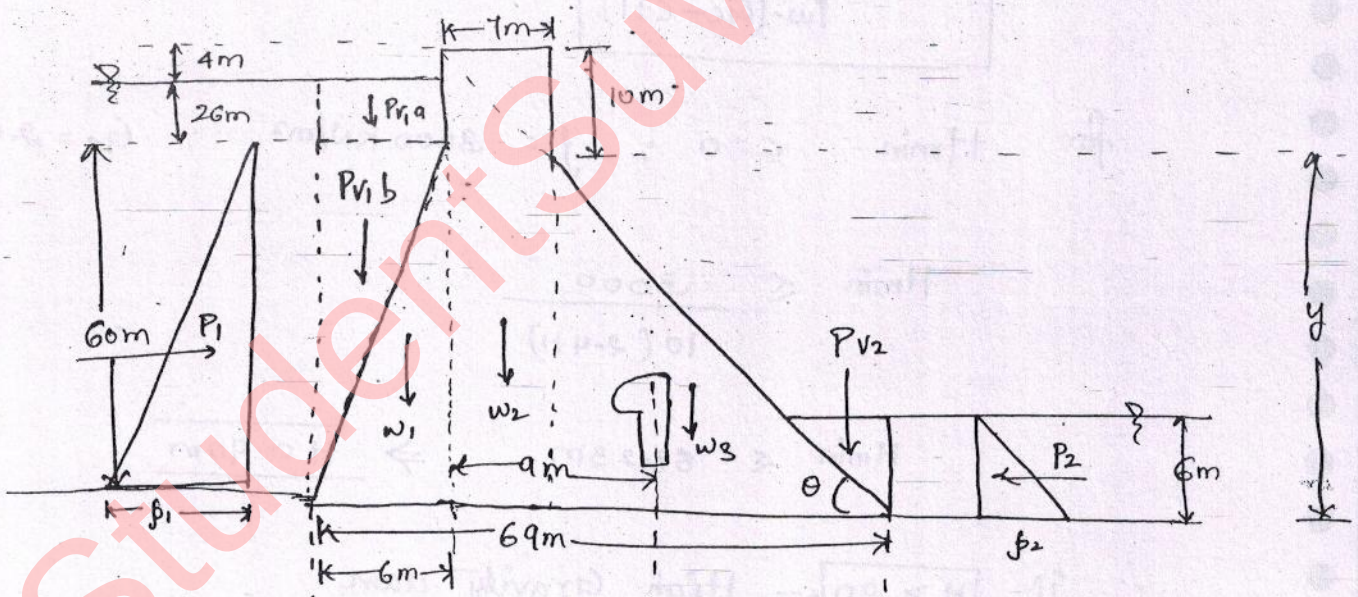
shear strength of the material at base (q) = 14 kg/cm^2.

Sol^n

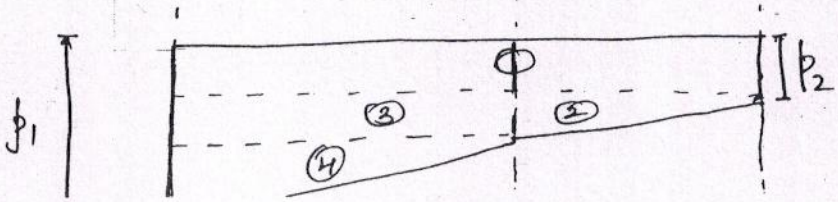


$\tan\theta = \frac{a_0}{63} = \frac{b}{x}$

$x = 11.2$



$\tan\theta = \frac{60+26+4}{69-6} = \frac{y}{69-6-7} \Rightarrow y = 80m \Rightarrow \underline{y = 80m}$



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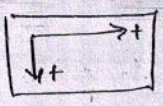
⇒ Here ⓒ not given. so assume $C = T$ as reservoir is full.



F_x (KN)	F_y (KN)	$\bar{x}$ of A_o (m)	M_o (KN-m)	M_R (KN-m)
	$W_1 = 2.4 \times \frac{1}{2} \times 6 \times 60 \times 10$ $= 4320.$	$\bar{x}_1 = 65$	2.81×10^5	
	$W_2 = 24 \times 7 \times 90$ $= 15120$	$\bar{x}_2 = 59.5$	8.99×10^5	
	$W_3 =$ ~~53760~~ 53760	$\bar{x}_3 = 37.3$	20×10^6	
	$P_{V_1 a} = 10 \times 6 \times 26$ $= 1560$	$\bar{x}_{1a} = 69 - 6 + 3$ $= 66$	1×10^5	
$P_1 = 10 \times \frac{1}{2} \times 86^2$ $= 36980$		$\bar{y}_1 = \frac{86}{3} = 28.66$	10×10^5	10×10^5
	$P_{V_1 b} = 10 \times \frac{1}{2} \times 6 \times 60$ $= 1800$	$\bar{x}_{1b} = 69 - 6 + \frac{2}{3} \times 6$ $= 67$	1.2×10^5	
$P_2 = -\frac{1}{2} \times 6 \times 6 \times 10$ $= -180$		$\bar{y}_2 = \frac{6}{3} = 2$	$360.$	
	$P_{V_2} = \frac{1}{2} \times 10 \times 6 \times 4.2$ $= 126$	$\bar{x}_2 = \frac{4.2}{3} = 1.4$	176.4	
	$P_{U_1} = -64 \times 10 \times 6$ $= -4140$	$\bar{x}_1 = 54.5$		1.42×10^5
	$P_{U_2} = -\frac{1}{2}\left(\frac{1}{3}(p_1 - p_2) \times 54\right)$ $= -\frac{1}{6} \times (10(86-6) \times 54)$ $= -7200$	$\bar{x}_2 = 54 \times \frac{2}{3}$ $= 36$		$P_{U_2} = 2.6 \times 10^5$

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$P_{U3} = -\frac{\gamma}{3}(\beta_1 - \beta_2)(6+9)$

$= -\frac{1}{3} \times 10 (26-6)(15)$

$= -4000$

$\bar{x}_3 = \left(\frac{6+9}{2}\right) + (69-6-9)$

$= 61.5$

$P_{U_2 x_2}$

$= 2.46 \times 10^5$

$P_{U4} = -4000$

$\bar{x}_4 = 64$

$P_{U_3 x_3}$

$= 2.56 \times 10^5$

$\Sigma f_x = 36800 \text{ KN}$

$\Sigma f_y = 57346 \text{ KN}$.

$\Sigma M_R = 1.904 \times 10^6 \text{ KN-m}$

$\Sigma M_O = 3.4 \times 10^6 \text{ KN-m}$.

$\Sigma M = \Sigma M_O - \Sigma M_R$

$= (3.4 - 1.904) 10^6$

$= 1.44 \times 10^6 \geq 0$

∴ dam is safe in overturning.

(ii) Check for sliding

$f + q(b \times 1) \geq \Sigma f_x$

$\Rightarrow \mu \Sigma f_y + qB = 0.75 \times 57346 + 1400 \times 69 \times 1$

$= 139609.5 \text{ KN}$.

$\therefore f + qB > \Sigma f_x$

$\Rightarrow$ Safe in sliding.

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(iii)

$$\bar{x} = \frac{\Sigma M}{\Sigma fy} = \frac{1.44 \times 10^6}{57346} = 25.1\,m.$$

$$e = \frac{B}{2} - \bar{x} = \frac{69}{2} - \bar{x} = \underline{9.38\,m}.$$

$$\sigma_{VT} = \frac{\Sigma fv}{B}\left(1 + \frac{6e}{B}\right).$$

$$= \frac{57346}{69}\left(1 + \frac{6 \times 9.38}{69}\right).$$

$$= \underline{1509\ KN/m^2}.$$

$$\sigma_{VH} = \frac{57346}{69}\left(1 - \frac{6 \times 9.38}{69}\right).$$

$$= \underline{153.2\ KN/m^2}.$$

⇒ on heel its (+ve) so its safe in tension.

Note: if (-ve) its not safe.

$$\sigma_T = \sigma_{VT} \sec^2\alpha - \beta_2 \tan^2\alpha$$

$$= 1509\left\{1 + \left(\frac{63}{90}\right)^2\right\} - 10 \times 6 \times \left(\frac{63}{90}\right)^2$$

$$\sigma_T = 2219\ KN/m^2 < \underline{3000\ KN/m^2}$$

Hence safe in compn.

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