- رالسم مدني صنرب الماز راشرالس وصل رالي اول
- مفرر اخيار ٣

Port & Coastal Engineering

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Question (1)

a- $H_{av} = \dfrac{0.5(480)+1(1220)+2(850)+3(300)+4(150)}{3000}$

$= \dfrac{240+1220+1700+900+600}{3000}$

$= \boxed{1.55\,m}$

$H_{1/3} = \dfrac{4(150)+3(300)+2(550)}{1000}$

$= \boxed{2.6\,m}$

$H_{1/10} = \dfrac{4(150)+3(150)}{300} = \boxed{3.5\,m}$

b- Assuming Rayleigh distribution.

$H_{1/3} = 1.6\,\bar{H} = \boxed{2.48\,m}$

$H_{1/10} = 1.27\,H_{1/3} = \boxed{3.14\,m}$

$H_{max} = 0.707\,H_{1/3}\sqrt{\ln N} = \boxed{4.45\,m}$

For Comparison: $H_{1/3}$ = Rayleigh dist. is less by 4 % than the calculated value, which is considered acceptable.

$H_{1/10}$ = Also Rayliegh dist. is less by 10.3 %. not acceptable

H_{max} = is less by about 20 % → not acceptable

c- Wave height for exceedence probability 0.134:

$P(H/\bar{H}) = 0.134 \longrightarrow H/\bar{H} = 1.6$

$\therefore \boxed{H = 2.48\,m}$

Question (2)

d - given : $W = 50$ Km — $Hy_3 = 2.0m$ $U = 12$ m/sec.

$\theta = 180$

$F_e = 50$ km

1st trial

$F_e = F = 50$ km , $\frac{W}{F} = 1$

$Fe/F = 0.72$

$\therefore F = 70$ km

2nd trial

$W/F = 50/70 = 0.72$

$Fe/F = 0.62$

$\boxed{F = 80.65 \text{ km}}$

b - $T = 8$ sec , $H_o = 3.0m$ and $\alpha_o = 2.9^\circ$

$d/L_o = 5/100 \rightarrow K_s = 1.02$, tak $= 0.531$, $d/L = 0.0942$

$\alpha = \sin^{-1}[\sin 2.9^\circ * 0.531] = 15^\circ$

$K_r = \sqrt{\frac{\cos\alpha_o}{\cos\alpha}} = 0.952$ $\therefore H_{tip} = 3 * 0.95 * 1.02 = 2.91m$

$L_{Tip} = 53.1$ m

$\theta_B = 60^\circ$, $\theta_{o.B} = 105$

$\frac{r_B}{L} = 5$

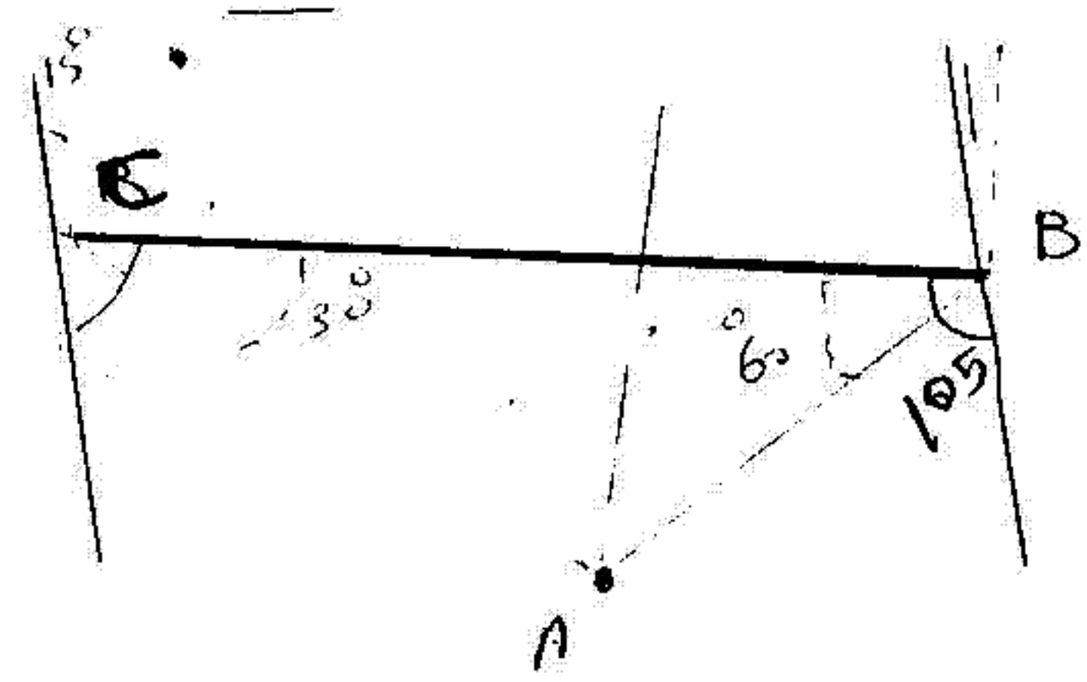
$(K_{D_A})_B = 0.13$

$\theta_C = 30^\circ$, $\theta_{o_C} = 75$

$\frac{r_c}{L} = 8.5$

$(K_{D_A})_C = 0.11$

$\boxed{H_A = 0.77m}$



Question (3):

(d)

$H_o = 4.0\ m \quad \alpha_o = 60^\circ \quad T = 6\ sec.$

$L_o =$

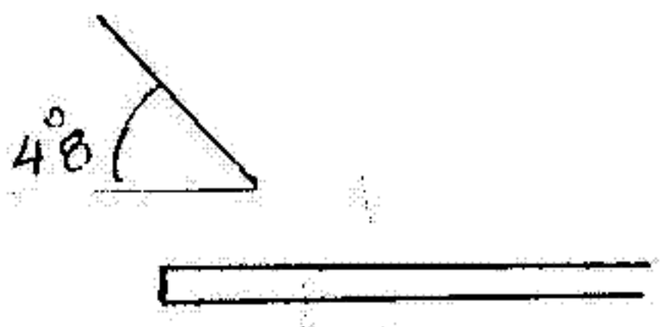
at sec I

$d = 10\ m \quad , d/L_o = 0.178$

$tah = 0.864 \quad , K_s = 0.914 \quad , G = 0.384 , ch = 1.99 , sh = 1.72$

$\sin\alpha = [\sin 60 * 0.864] = \quad ; \alpha = 48^\circ$

$\beta = 90 - 48^\circ = 42^\circ$



$K_r = \sqrt{\frac{\cos 60}{\cos 48}} = 0.86$

$H = 4 * 0.86 * 0.914 = 3.15\ m \quad , H/d = 0.315$ → No breaking

$H_{max} = 1.8\ H = 5.67\ m$

$\alpha_1 = 0.6 + 0.5\,G^2 = 0.667 \quad ; h_b = 10 + \frac{5 * 0.315}{50} = 10.1\ m$

$\alpha_2 = ((10.1-8)/30.3)\,(5.67/8)^2 = 0.0331$

$\alpha_3 = 1 - [(9/10.3)\,(1 - 1/ch)] = 0.565$

$\zeta^* = 0.75\,(5.67)\,(1 + 0.67) = 7.09\ m$

$P_1 = 0.5\,(1.03)(5.67)(1+0.67)(0.667 + 0.0331\,(0.747)^2) = 3.74\ t/m^2$

$P_2 = (1 - 3.5/7.09)\ 3.74 = 1.86\ t/m^2$

$P_3 = 0.565 * 3.74 = 2.11\ t/m^2$

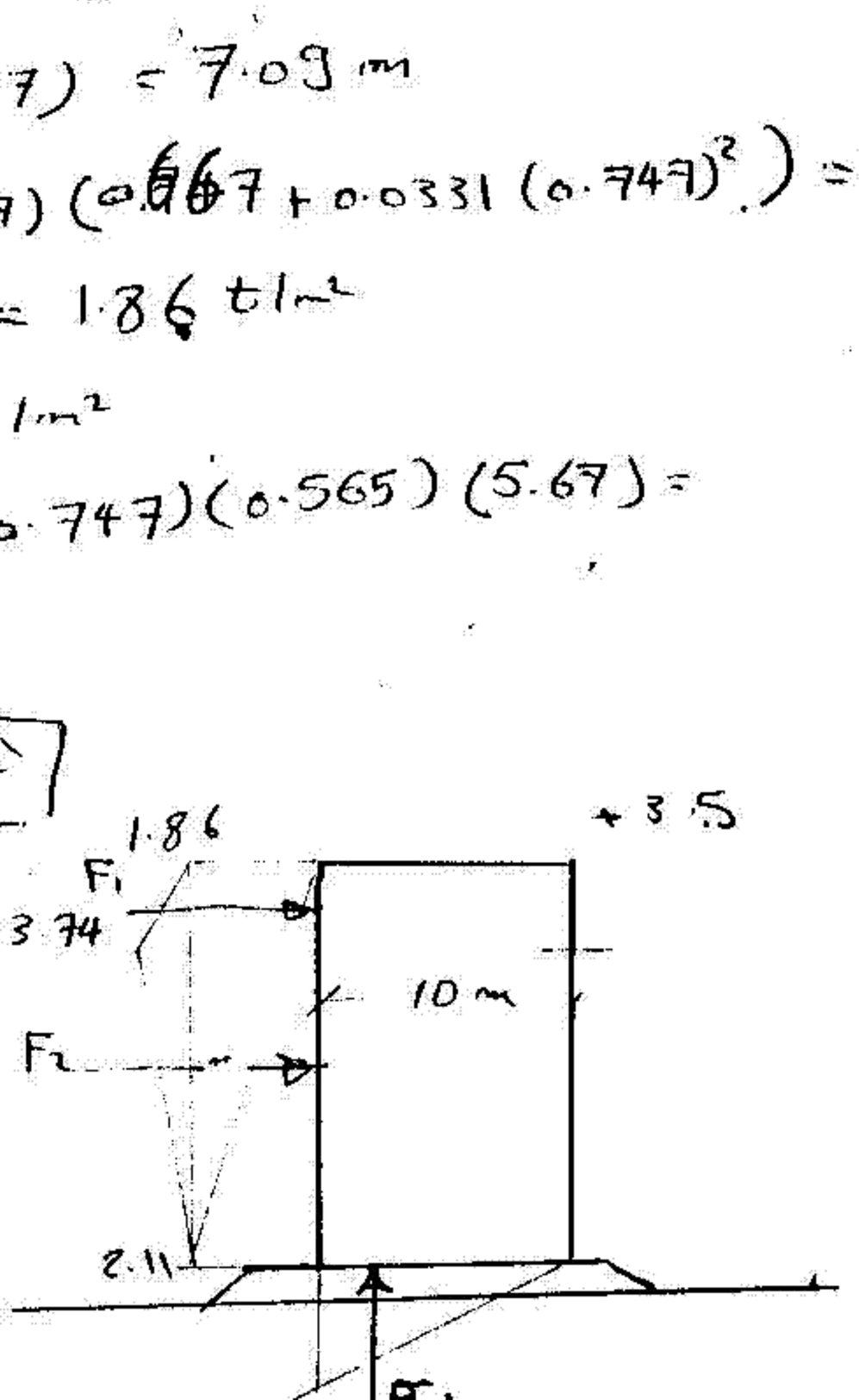
$P_U = 0.5\,(1.03)(1+0.67)(0.747)(0.565)(5.67) =$

$= 2.06\ t/m^2$

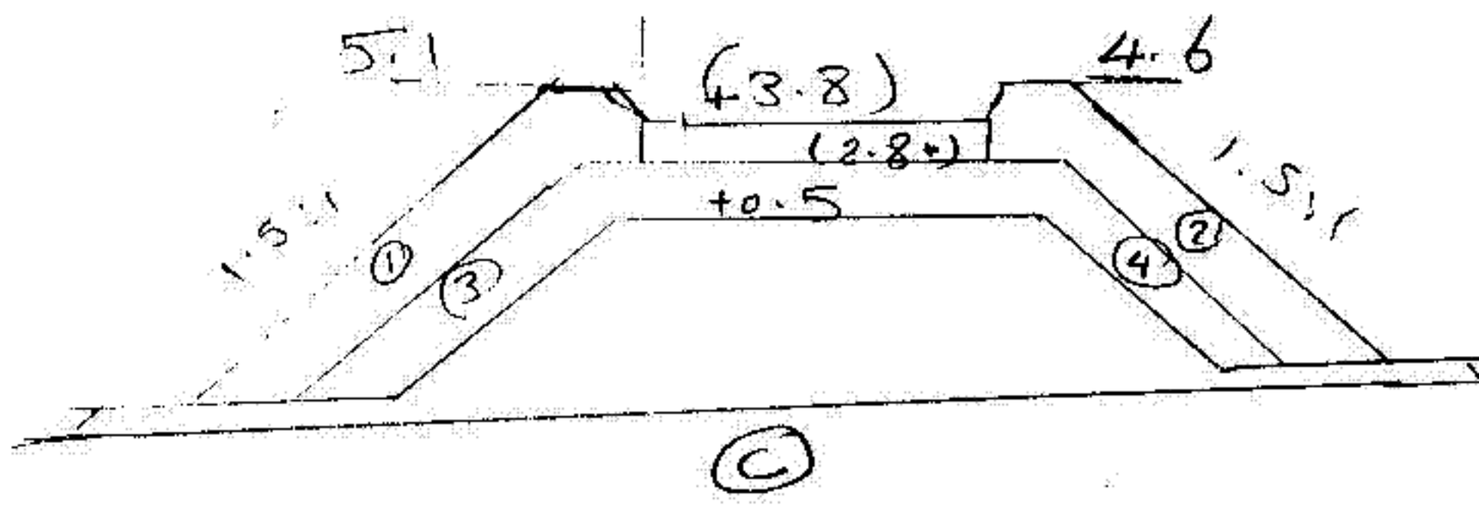
$F_1 = \frac{1.86 + 3.74}{2} * 3.5 = 9.8\ t/m$

$F_2 = \frac{3.74 + 2.11}{2} * 5 = 26\ t/m$

$F_U = \frac{2.06 * 10}{2} = 10.3\ t/m$



Q3 - b



$d/L_o = \frac{6}{56} = 0.107$

$K_s = 0.93$, $\tan\beta = 0.72$

$\alpha = \sin^{-1}[\sin\alpha_0 * \tan\beta / \beta] =$

$= 3.2°$

$K_r = \sqrt{\frac{\cos\alpha_0}{\cos\alpha}} = 0.771$ ∴ $H = 4 * 0.771 * 0.93 = 2.86$

$H/d = 0.47 < 0.75$ ∴ Non breaking Cond.

$W_{cy} = \frac{(2.86)^3 * 2.6}{4 * (\frac{2.6}{1.03} - 1)^3 * 1.5} = \frac{60.82}{21.2} = 2.868$ tons

$W_{tetrapods} = \frac{(2.86)^3 * 2.2}{8.3 (\frac{2.2}{1.03} - 1)^3 * 1.5} = \frac{51.1}{18.24} = 2.8$ ton → 3 tons.

$W_1 = 3$ Tons (Tetrapods)

$W_2 = 1.5$ (tetrapods)

$W_3 = 0.28$ (N stones)

$W_4 = 0.14$ (N stones)

$W_{core} = 14 - 1$ kg

$t_1 = 2 * 1.04 \sqrt[3]{3/2.2} = 2.3$m

$t_2 = 2 * 1.04 \sqrt[3]{1.5/2.2} = 1.83$

$t_3 = 2 * 1.15 \sqrt[3]{0.28/2.6} = 1.1$

$t_4 = 2 * 1.15 \sqrt[3]{0.14/2.6} = 0.88$

Core level = +0.5

Crest level = 0.0 + 1.25 H = +3.575

Con 4

ering Force

$$E = \frac{(W_1 + W_2)}{2g} V_{sh}^2$$

$W_1 = 1.3 * 60\,000 = 78$ mt $W_2 = 1.03\,(13)^2 * \frac{\pi}{4} * 270 = 36,894\,t$

$E = 58.6$ mt

$E_{transmitted} = 29.3$ mt $= 293$ KNm

E_t / Impact length $= 97.7$ KNm/m

to/2 cylindrical Factor 1000+500

Impact Force : 550KN/m = 55 t/m

Tension Force

$W_L = (1+3.1\sin\alpha)\, K_\rho \cdot F \cdot L \cdot V_m^2 = 5.91 * 10^6\, K_\rho$ = 177.3 KM

$W_t = 5.91 * 10^6\, K_t$ = 656.01 KN

$W_{th} = (0.5 - 0.13)(656.01)$ = 243 KN

$W_{tb} = (0.5 + 0.13)(656.01)$ = 413 KN