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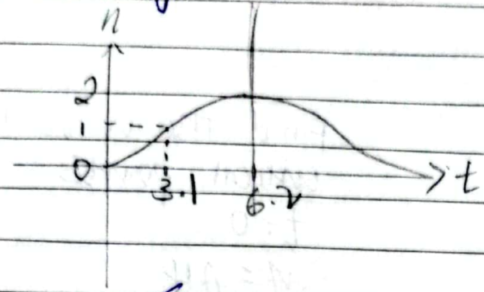
CV4116 AY 22-23

1a) i) The equation given in the question is ~~deterministic~~ discrete. We need to convert it to a continuous function to determine the probability.



Since the graph is symmetric, only ~~analy~~ analyze half of the graph.

(ii) ~~MSL = 1.0~~
~~$p(\eta > 1.0) = 3.1/6.2 = 0.5$~~

MSL = 1.0
$p(\eta > 1.0) = 1 - p(\eta < 1.0) = 1 - \frac{3.1}{6.2}$
$= 0.5$

(iii) ~~$p(\eta > 0.0) = 6.2/6.2 = 1.0$~~
~~$p(\eta > 2.0) = 0/6.2 = 0$~~

$p(\eta > 2.0) = 1 - p(\eta < 2.0) = 1 - 1$
$= 0$
$p(\eta > 0.0) = 1 - p(\eta < 0.0) = 1 - 0 = 1$

(iv) when $\eta = 0.35$
$t = 1.7$

$\eta = 1.0 + \cos(2\pi t / 12.4 + \pi)$
$= 1.0 - \cos(\pi t / 6.2)$

when $\eta = 1.75$
$t = 4.77$

$p(\eta > 0.35) = 1 - p(\eta < 0.35)$
$= 1 - 1.7/6.2 = 0.725$

$=$

$p(\eta > 1.75) = 1 - p(\eta < 1.75) = 1 - \frac{4.77}{6.2}$
$= 0.231$

(v) $\eta = 1.0 + \cos(2\pi t / 12.4 + \pi)$

$t = \cos^{-1}\left[\frac{(\eta - 1.0) - \pi}{\pi} \times 6.2\right]$ $\frac{dt}{d\eta} = \frac{1}{\sqrt{1-(\eta-1)^2}}$

probability $(\eta_p > \eta > 0) = \frac{t_p}{6.2}$

$p(\eta_p + \Delta\eta_p > \eta > 0) - p(\eta_p > \eta > -1)$
$= \Delta t_p / 6.2$

$p(\eta_p) = [p(\eta_p + \Delta\eta_p > \eta > 0) - p(\eta_p > \eta > 0)] / \Delta\eta_p$
$= \frac{1}{6.2} (dt/d\eta)_{\eta = \eta_p}$

$= (1/6.2)(6.2/\pi)\left(1 / \sqrt{1 - (\eta-1)^2}\right) = \frac{1}{\pi}\left[\frac{1}{\sqrt{1-(\eta_p-1)^2}}\right]$

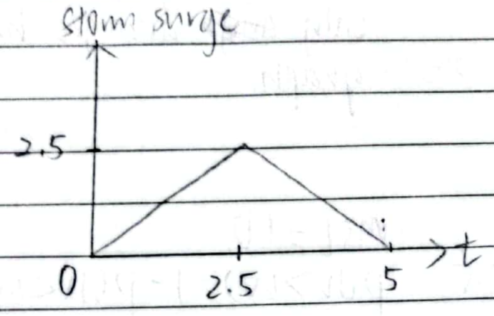
Besform

b) i) Duration limited

From figure 11-2-25 $H_{mo} = 2.2\ m$

figure 11-2-26 $T = 4.5s$

ii)



Find the wave height @ critical points

$t=0$

$\eta = 0.4$

total height $= 0.4 + 0$

$= 0.4$

$t = 2.5$

$\eta = 0.7$

total height $= \cancel{3} \; 2.5 + 0.7$

$= 3.2$

$t = 5.0$

$\eta = 0.3$

total height $= 0.3 + 0$

$= 0.3$

$\therefore$ max height $= 3.2m$

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2 a) (i) $L_0 = \frac{gT^2}{2\pi}$

$= 156$

$\frac{d}{L} < \frac{1}{2}$

$d < 78$

$L = T\sqrt{gd}$

$= 10\sqrt{9.8d}$

$\frac{d}{L} > \frac{1}{20}$

$d > \frac{10}{20}\sqrt{9.8d}$

$d^2 > \frac{1}{4}(9.8)d$

$d > 2.45$

$2.45 < d < 78$

(ii) $K = 2\pi/L$

deepwater

$K = 0.04$, $d = 78$ $Kd = 3.142$

$2kd = 6.24$

$K_S = \sqrt{\frac{1}{\tanh(kd)\left[1 + \frac{2kd}{\sinh(2kd)}\right]}}$

$= 0.99$

shallow water

$K = 2\pi/49$, $d = 2.45$, $kd = 0.314$

$2kd = 0.628$

$= 0.128$

$K_S =$ ~~0.964~~ 1.31

$0.99 < K_s < 1.31$

(iii) deepwater

max velocity @ surface

$z = 0$

$u = \frac{H}{2}\frac{gT}{L}$

$= \left(\frac{1}{2}\right)\left(\frac{9.8 \times 10}{156}\right)$

$= 0.314$

shallow water

$H = K_s H_0 = 1.31$

$z = 0$

$u = \left(\frac{H}{2}\right)\left(\frac{gT}{L}\right)$

$= \left(\frac{1.31}{2}\right)\left(\frac{9.8 \times 10}{49}\right)$

$= 1.31$

Subsurface pressure, max @ $z = -d$

$p = \frac{\rho g H}{2}\left[\frac{1}{\cosh(2\pi d/L)}\right] + \rho g d = \frac{(1025)(9.8)(1)}{2}\left[\frac{1}{\cosh(3.142)}\right]$

$-1025(9.8)(78)$

$= 7835$ Pa (deepwater)

$p = \frac{\rho g H}{2}\left[\frac{1}{\cosh\left(\frac{2\pi d}{L}\right)}\right] + \rho g d$ $\Rightarrow = 31$ kPa

$= \frac{(1025)(9.8)(1.31)}{2}\left[\frac{1}{\cosh(0.314)}\right] + (1025)(9.8)(2.45)$

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b) ~~N~~ Because the range of transitional water depth ~~is~~ depends on depth and wavelength ~~and~~ Not the deep water angle.

~~deepwater~~

~~$\frac{d}{gT^2} = 0.08$~~

shallow water

$\frac{d}{gT^2} = 0.0025$

$H = K_R K_s H_o$
$= 0.92(1)$
$= 0.92$

@ $60° \rightarrow K_R K_s = 0.92$

$H/d = 0.37 < 0.78$

3a) i) $\Omega_b = \frac{H_b}{H_o}$

$= 0.56\left(\frac{H_o'}{L_o}\right)^{-1/5}$

$= 1.32$

$H_b = (1.32)(1.7)$
$= 2.25$

$L_o = \frac{gT^2}{2\pi}$
$= ~~45.6~~ 126$

$\tan\beta = 0.02$

$a = 13.8$
$b = 0.926$

$\gamma_b = 0.926 - \frac{(13.8)(2.25)}{(9.81)(81)}$

$= 0.887$

$d_b = 2.54 \text{ m}$

ii) ~~farther closer~~ ∵ Ω_b depends on H_o' and $H_o' = K_r H_o$, K_r is always < 1.0 means Ω_b will be larger from $\Omega_b = 0.56\left(\frac{H_o'}{L_o}\right)^{-1/5}$ means the breaking wave height will be larger since γ_b only depend on $\tan\beta$, it remains unchanged. From $\gamma_b = H_b/d_b$, d_b should be greater

K_r is always <1.0, H_o' will always be smaller, ~~d_b needed to be smaller for it to break, taking the assumption $H_o/d_b = 0.78$~~ Ω_b will be larger and the waves break with greater waveheight means it will break later (means closer)

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b) caisson $H_{design} = 1.67 H_s$
$= 1.169$

$\eta^* = 0.75(1+\cos\beta)\lambda_1 H_{design}$ $\cos\beta = 1$ take $\rho g = 10250$
$= 1.754$

No overtopping $\eta^* \leq h_c$
$\therefore p_2 = 0$

$$\alpha_1 = 0.6 + 0.5\left[\frac{4\pi h_s/L}{\sinh(4\pi h_s/L)}\right]^2$$
$$= 0.6 + 0.5[0.683]^2 = 0.833$$

$$\alpha_2 = \min\left\{\frac{h_b - d}{3h_b}\left(\frac{H_{design}}{d}\right)^2, \frac{2d}{H_{design}}\right\}$$
$$= \min\left\{\frac{5-3.5}{(3)(5)}\left[\frac{1.169}{1.5}\right]^2, \frac{(2)(1.5)}{1.169}\right\} = \min\{\cancel{0.142}\ 0.061, 2.566\}$$
$$= \cancel{0.142}\ 0.06$$

$$\alpha_3 = 1 - \frac{h_w - h_c}{h_s}\left[1 - \frac{1}{\cosh(2\pi h_s/L)}\right]$$
$$= 1 - \frac{3.5}{5}\left[1 - \frac{1}{\cosh(2\pi \times 5/40)}\right]$$
$$= 0.828$$

$\therefore p_1 = 0.5(2)(0.833 + \cancel{0.142}\ 0.061)(1025 \times 10 \times 1.169)$
$= \cancel{11683}\ 10712$

$\therefore \cancel{p}\ p_3 = \alpha_3 p_1$
$= \cancel{9673.5\ Pa}\ 8869.6\ Pa$

The rubble base is pervious where water might goes in and causing an overturning moment that might effect the stability of the caisson.

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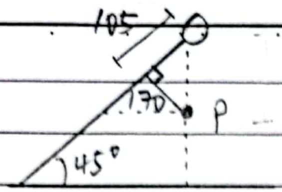
4) a)



$H_A = K' H_i + C_R (K'_{img\,pt}) H_i$

$= 0.17(1) = 0.17\,m$

From Figure 2-33

$K' = 0.17$

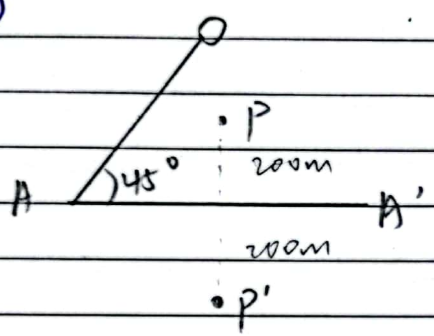
$X/L = 1.75$

$Y/L = 2.833$

$\beta = 45°$

$R = 3.33$

b)



$\beta = 45°$

$R = 600/60 = 10$

$K'_{imgpt} = 0.095$

$H_A = 0.2175\,m$

c) $W = mg$

$$M = \frac{\rho_s H^3}{K_D (\rho_s/\rho_w - 1)^3 \cot\alpha}$$

$$= \frac{(2600)(1.27)^3}{4.0\,(1.6)^3\,(2)}$$

$= 162.5\,kg$

$W = 1625\,kN$

$H_{1/10} = 1.27\,H_s$

$= 1.27$

check breaking $= \frac{1.27}{5}$

$= 0.254 < 0.78$