UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	COASTAL AND HARBOR ENGINEERING
COURSE CODE	:	BFW4033 / BFW40303
PROGRAMME	:	4BFF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** FROM SIX (6) QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIXTEEN (16)** PAGES

Q1 (a) With the aid of sketches, show the following

(i) Coast (1 mark)

(ii) Inshore (1 mark)

(iii) Offshore (1 mark)

(iv) Shore (1 mark)

(b) Discuss **FOUR (4)** problems faced by Malaysia coasts. (16 marks)

Q2 (a) Based on the relative depth, classify the following waves

(i) wave height $H = 5$ m, water depth $d = 5$ m, and wave length $L = 100$ m. (2 marks)

(ii) wave height $H = 8$ m, water depth $d = 15$ m, and wave length $L = 150$ m. (2 marks)

(iii) wave height $H = 3$ m, water depth $d = 8$ m, and wave length $L = 250$ m. (2 marks)

(b) A wave with height $H = 2.5$ m and period $T = 8$ s propagates shoreward from a depth $d = 200$ m to a depth $d = 3$ m. Find

(i) Wave length and celerity at depth 3 m. (5 marks)

(ii) Wave length and celerity at depth 200 m. (4 marks)

(iii) Maximum horizontal and vertical local velocities of the surface at depth 3 m. (5 marks)

Q3 (a) With the aid of sketches, briefly explain the wave processes of

(i) Diffraction

(3 marks)

(ii) Reflection

(3 marks)

(iii) Refraction

(3 marks)

(b) A 2.2 m-high deepwater wave is propagating towards a 1:20 beach, with the deepwater wave crest making an angle of $\alpha_0 = 30°$ with the shoreline. As the wave moves into shallower water, its speed reduces from 12.5 m/s to 2.5 m/s. Compute the wave height and depth at breaking.

(11 marks)

Q4 (a) Describe **THREE (3)** factors which influence the height and period of wind-generated waves.

(6 marks)

(b) **Figure Q4** shows the ocean surface elevation recorded during an event. Determine

(i) Significant wave height H_s
(ii) Maximum wave height H_{max}
(iii) Average of the highest 10% of the wave height H_{10}

(8 marks)

(c) Based on the coastal camp experience, describe how the wave celerity and wave frequency are determined on site.

(6 marks)

Q5 A rock revetment with slope 1:2.5 and crest level 4.5 m CD is to be built on a beach with foreshore gradient of 1:100. The significant wave height is $H_s = 3.0$ m, peak wave period $T_p = 10$ s, and design water level DWL = 3.5 m CD.

(a) Determine whether the overtopping performance of the structure is acceptable to justify its use to protect a paved promenade based on **Figure Q5**.

(10 marks)

(b) Propose a modification that should be made to the revetment to ensure the paved promenade is safe for use.

(3 marks)

(c) Determine suitable size of rock armours to be placed on the slope of the structure assuming 'no damage' level. Assume seawater density $\rho_w = 1025$ kg/m^3, rock armour density $\rho_r = 2700$ kg/m^3, and $K_D = 3.0$.

(7 marks)

Q6 (a) Briefly discuss **TEN (10)** major steps involved in developing a coastal project from defining the problem statement to evaluation of project performance.

(10 marks)

(b) Estimate the volume of fill material V required to nourish a beach with a berm height $B = 5.0$ m and width $Y = 50$ m where significant wave height $H_s = 3.5$ m. The depth of closure $H = 6.75H_s$, and the sedimentary parameters are $\sigma_{\varphi b} = 0.75$, $\sigma_{\varphi n} = 0.60$, $M_{\varphi b} = 2.30$, $M_{\varphi n} = 1.85$. Ignore the renourishment factor R_J.

(10 marks)

- END OF QUESTIONS -

TERJEMAHAN:

S1 (a) Dengan bantuan lakaran, tunjukkan yang berikut

(i) Pesisir pantai

(1 markah)

(ii) Pantai dalam

(1 markah)

(iii) Lepas pantai

(1 markah)

(iv) Pantai

(1 markah)

(b) Bincangkan **EMPAT (4)** masalah yang dihadapi oleh kawasan pantai Malaysia.

(16 markah)

S2 (a) Berdasarkan kedalaman relatif, klasifikasikan ombak-ombak berikut:

(i) tinggi ombak $H = 5$ m, kedalaman air $d = 5$ m, dan panjang ombak $L = 100$ m

(2 markah)

(ii) tinggi ombak $H = 8$ m, kedalaman air $d = 15$ m, dan panjang ombak $L = 150$ m

(2 markah)

(iii) tinggi ombak $H = 3$ m, kedalaman air $d = 8$ m, dan panjang ombak $L = 250$ m

(2 markah)

(b) Sebuah ombak dengan ketinggian $H = 2.5$ m dan tempoh $T = 8$ s bergerak ke arah pantai dari kedalaman $d = 200$ m ke kedalaman $d = 3$ m. Kira

(i) Panjang dan laju ombak pada kedalaman 3 m.

(5 markah)

(ii) Panjang dan laju ombak pada kedalaman 200 m.

(4 markah)

(iii) Halaju tempatan maksimum mengufuk dan pugak di permukaan pada kedalaman 3 m.

(5 markah)

S3 (a) Dengan bantuan lakaran, huraikan secara ringkas proses-proses ombak berikut

(i) Pembelauan

(3 markah)

(ii) Pemantulan

(3 markah)

(iii) Pembiasan

(3 markah)

(b) Satu ombak laut dalam setinggi 2.2 m bergerak ke sebuah pantai berkecerunan 1:20, dengan puncak ombak laut dalam membentuk sudut $\alpha_0 = 30°$ dengan garis pantai. Semasa ombak bergerak ke kedalaman yang lebih cetek, halaju rambatnya berkurangan dari 12.5 m/s ke 2.5 m/s. Kira tinggi ombak dan kedalaman ketika ombak pecah.

(11 markah)

S4 (a) Huraikan **TIGA (3)** faktor yang mempengaruhi tinggi dan tempoh ombak janaan angin.

(6 markah)

(b) **Rajah Q4** menunjukkan paras permukaan laut yang direkodkan bagi satu peristiwa. Tentukan

(i) Tinggi ombak berkesan H_s
(ii) Tinggi ombak maksimum H_{max}
(iii) Tinggi purata bagi 10% ombak-ombak tertinggi H_{10}

(8 markah)

(c) Berdasarkan pengalaman kem pantai, huraikan bagaimana halaju rambat dan frekuensi ombak ditentukan di tapak.

(6 markah)

S5 Sebuah struktur pelindung pantai berbatu yang berkecerunan 1:2.5 dengan paras puncak 4.5 m CD akan dibina di pantai yang berkecerunan 1:100. Tinggi ombak berkesan ialah H_s = 3.0 m, tempoh ombak puncak T_p = 10 s, dan paras air rekabentuk DWL = 3.5 m CD.

(a) Tentukan samada prestasi struktur tersebut boleh diterima sebagai pelindung bagi laluan pejalan kaki berturap merujuk pada **Rajah S5**.

(10 markah)

(b) Nyatakan secara ringkas satu pengubahsuaian yang perlu dilakukan kepada struktur pelindung tersebut bagi menjamin keselamatan laluan pejalan kaki berturap tersebut.

(3 markah)

(c) Kira saiz pelindung batu yang sesuai diletakkan pada cerun struktur tersebut dengan andaian keadaan 'tiada kerosakan'. Andai ketumpatan air laut ρ_w = 1025 kg/m^3, ketumpatan pelindung batu ρ_r = 2700 kg/m^3, dan K_D = 3.0.

(7 markah)

S6 (a) Bincangkan secara ringkas **SEPULUH (10)** langkah utama yang terlibat dalam pembangunan sebuah projek pantai, iaitu daripada mengenalpasti masalah projek sehinggalah kepada penilaian prestasi projek.

(10 markah)

(b) Kira isipadu bahan tambakan V yang diperlukan untuk pembajaan sebuah pantai dengan tinggi benteng B = 5.0 m dan lebar Y = 50 m, dimana tinggi ombak berkesan min H_s = 3.5 m. Kedalaman dasar (*depth of closure*) $H = 6.75H_s$, dan parameter sedimen ialah $\sigma_{\varphi b} = 0.75$, $\sigma_{\varphi n} = 0.60$, $M_{\varphi b} = 2.30$, $M_{\varphi n} = 1.85$. Abaikan pekali penambakan R_J.

(10 markah)

- SOALAN TAMAT -

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Supplementary equations

$$H_i = H_o K_s K_r$$

where, $K_s = \sqrt{\dfrac{C_o}{C\left[1 + \dfrac{\left(\frac{4\pi d}{L}\right)}{\sinh\left(\frac{4\pi d}{L}\right)}\right]}}$, and $K_r = \sqrt{\dfrac{\cos\alpha_o}{\cos\alpha}}$

Unrefracted deepwater wave height $H'_o = H_o K_r$

Snell's law : $\dfrac{\sin\alpha}{C} = \dfrac{\sin\alpha_o}{C_o}$

$$T_m = 0.82 T_p$$

$$R^* = \frac{R_c}{T_m\sqrt{gH_s}}$$

$$Q^* = Ae^{\left(-\frac{BR^*}{r}\right)}$$

$$q = Q^* T_m g H_s$$

$$M_{50} = \frac{\rho_r H_s^3}{K_D \cot\alpha \Delta^3}$$

$$D_{50} = \left(\frac{M_{50}}{\rho_r}\right)^{\frac{1}{3}}$$

$$\Delta = \frac{\rho_r}{\rho_w} - 1$$

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Table 1. Characteristic equations of small-amplitude wave

Characteristic	Transitional water ($0.04 < d/L < 0.5$)	Deep water ($d/L_o \geq 0.5$)
Wave celerity	$C = \frac{L}{T} = \frac{gT}{2\pi}\tanh\left(\frac{2\pi d}{L}\right)$	$C_o = \frac{L}{T} = \frac{gT}{2\pi}$
Wave length	$L = \frac{gT^2}{2\pi}\tanh\left(\frac{2\pi d}{L}\right)$	$L_o = \frac{gT^2}{2\pi}$
Displacement		
a. horizontal	$\xi = -\frac{H}{2}\frac{\cosh\left[2\pi\frac{(z+d)}{L}\right]}{\sinh\left(2\pi\frac{d}{L}\right)}\sin\theta$	$\xi = -\frac{H}{2}e^{\frac{2\pi z}{L}}\sin\theta$
b. vertical	$\zeta = \frac{H}{2}\frac{\sinh\left[2\pi\frac{(z+d)}{L}\right]}{\sinh\left(2\pi\frac{d}{L}\right)}\cos\theta$	$\zeta = \frac{H}{2}e^{\frac{2\pi z}{L}}\cos\theta$
Velocity		
a. horizontal	$u = \frac{H}{2}\frac{gT}{L}\frac{\cosh\left[2\pi\frac{(z+d)}{L}\right]}{\cosh\left(2\pi\frac{d}{L}\right)}\cos\theta$	$u = \frac{\pi H}{T}e^{\frac{2\pi z}{L}}\cos\theta$
b. vertical	$w = \frac{H}{2}\frac{gT}{L}\frac{\sinh\left[2\pi\frac{(z+d)}{L}\right]}{\cosh\left(2\pi\frac{d}{L}\right)}\sin\theta$	$w = \frac{\pi H}{T}e^{\frac{2\pi z}{L}}\sin\theta$
Acceleration		
a. horizontal	$a_x = \frac{g\pi H}{L}\frac{\cosh\left[2\pi\frac{(z+d)}{L}\right]}{\cosh\left(2\pi\frac{d}{L}\right)}\sin\theta$	$a_x = 2H\left(\frac{\pi}{T}\right)^2 e^{\frac{2\pi z}{L}}\sin\theta$
b. vertical	$a_z = -\frac{g\pi H}{L}\frac{\sinh\left[2\pi\frac{(z+d)}{L}\right]}{\cosh\left(2\pi\frac{d}{L}\right)}\cos\theta$	$a_z = -2H\left(\frac{\pi}{T}\right)^2 e^{\frac{2\pi z}{L}}\cos\theta$

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Table 2. Functions of d/L for even increments of d/L_o

d/L_o	d/L	$2\pi d/L$	$\tanh 2\pi d/L$	$\sinh 2\pi d/L$	$\cosh 2\pi d/L$
0.03000	0.07135	0.4483	0.4205	0.4634	1.1021
0.03100	0.07260	0.4562	0.4269	0.4721	1.1059
0.03200	0.07385	0.4640	0.4333	0.4808	1.1096
0.03300	0.07507	0.4717	0.4395	0.4894	1.1133
0.03400	0.07630	0.4794	0.4457	0.4980	1.1171
0.03500	0.07748	0.4868	0.4517	0.5064	1.1209
0.03600	0.07867	0.4943	0.4577	0.5147	1.1247
0.03700	0.07984	0.5017	0.4635	0.5230	1.1285
0.03800	0.08100	0.5090	0.4691	0.5312	1.1324
0.03900	0.08215	0.5162	0.4747	0.5394	1.1362
0.06000	0.1043	0.6553	0.5753	0.7033	1.2225
0.06100	0.1053	0.6616	0.5794	0.7110	1.2270
0.06200	0.1063	0.6678	0.5834	0.7187	1.2315
0.06300	0.1073	0.6739	0.5874	0.7256	1.2355
0.06400	0.1082	0.6799	0.5914	0.7335	1.2405
0.06500	0.1092	0.6860	0.5954	0.7411	1.2447
0.06600	0.1101	0.6920	0.5993	0.7486	1.2492
0.06700	0.1111	0.6981	0.6031	0.7561	1.2537
0.06800	0.1120	0.7037	0.6069	0.7633	1.2580
0.06900	0.1130	0.7099	0.6106	0.7711	1.2628
0.9000	0.9000	5.655	1.000	142.9	142.9
0.9100	0.9100	5.718	1.000	152.1	152.1
0.9200	0.9200	5.781	1.000	162.0	162.0
0.9300	0.9300	5.844	1.000	172.5	172.5
0.9400	0.9400	5.906	1.000	183.7	183.7
0.9500	0.9500	5.969	1.000	195.6	195.6
0.9600	0.9600	6.032	1.000	208.2	208.2
0.9700	0.9700	6.095	1.000	221.7	221.7
0.9800	0.9800	6.158	1.000	236.1	236.1
0.9900	0.9900	6.220	1.000	251.4	251.4

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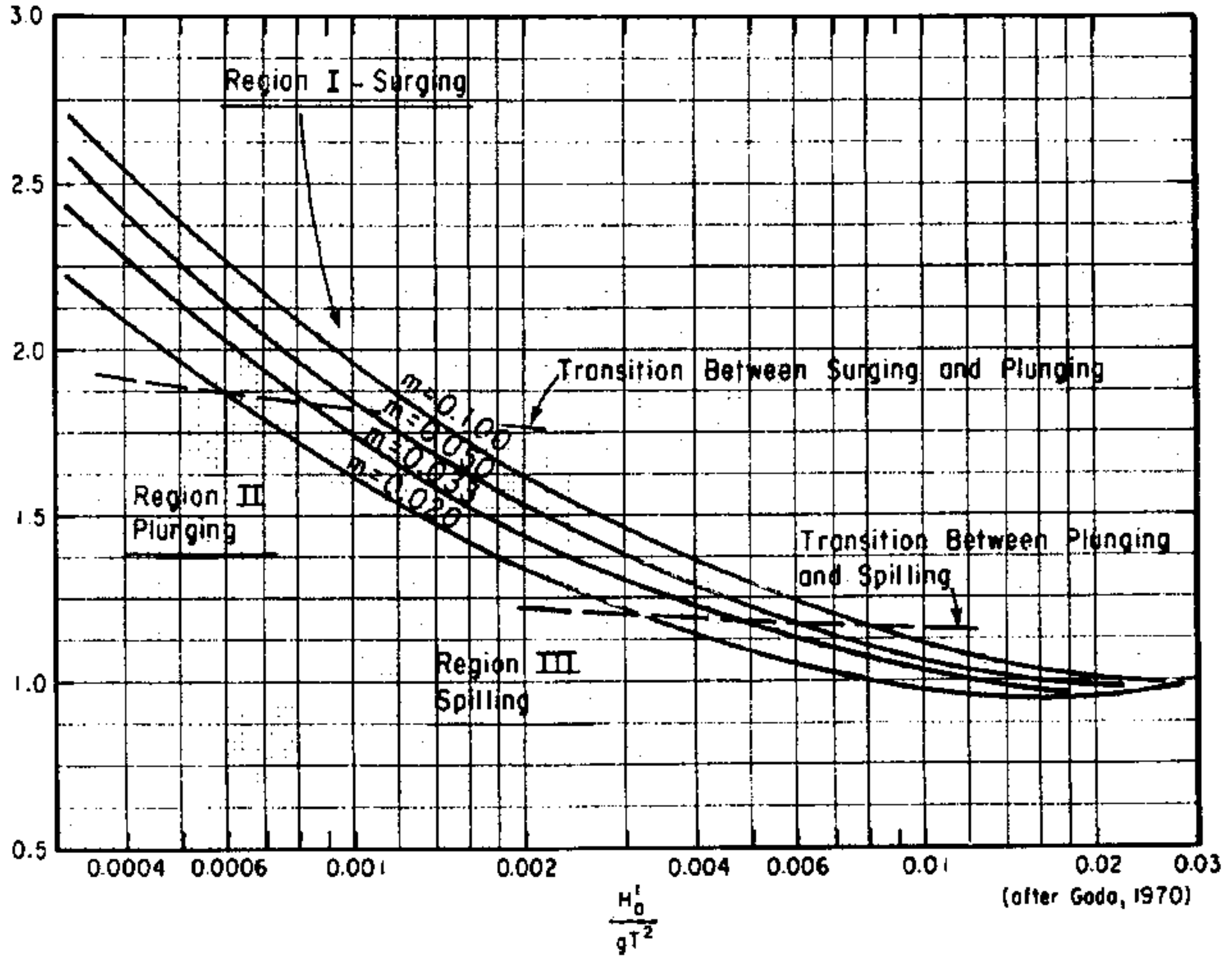

Figure 1. Breaker height index versus deepwater wave steepness

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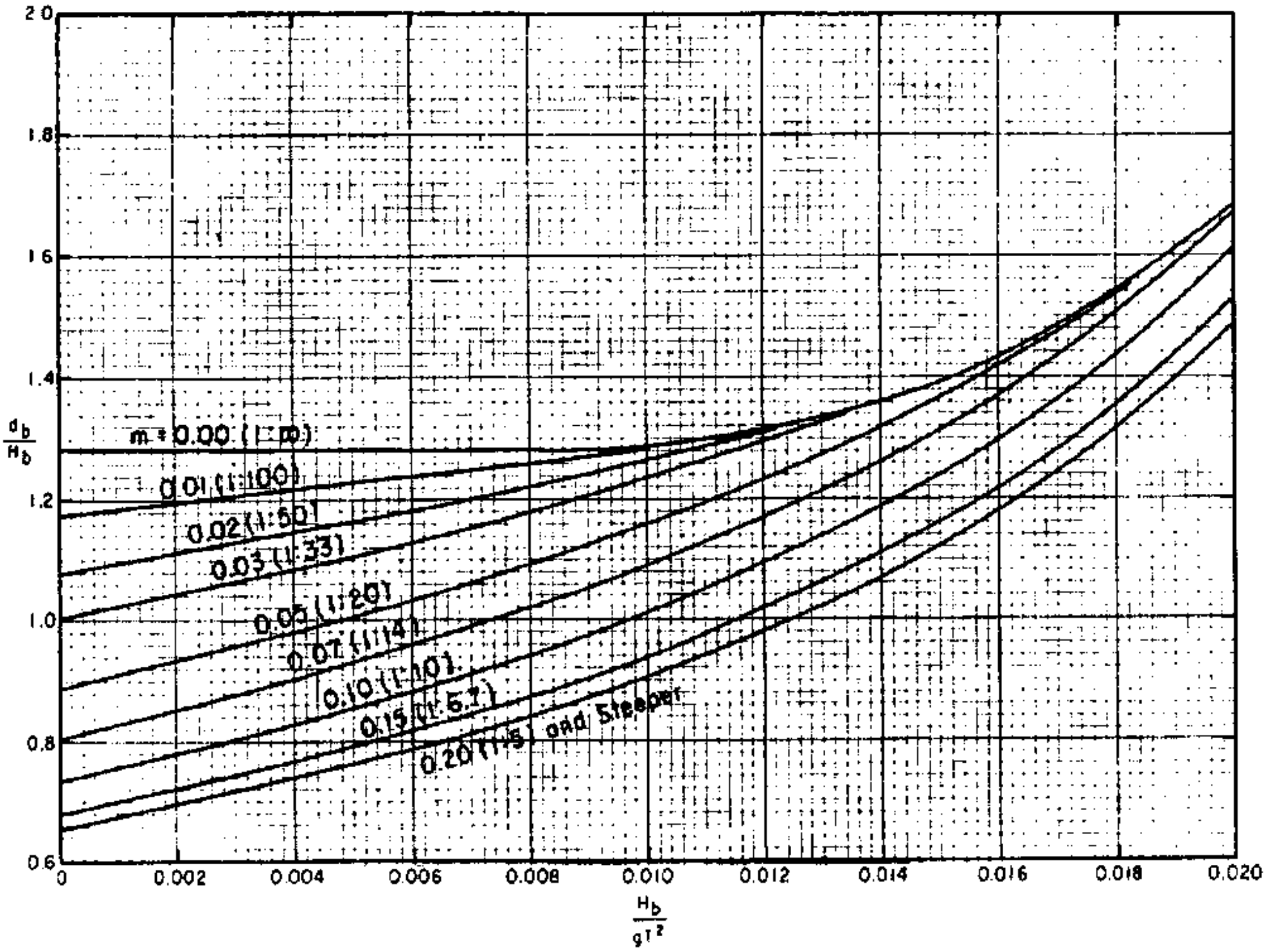

Figure 2. Breaker index versus wave steepness

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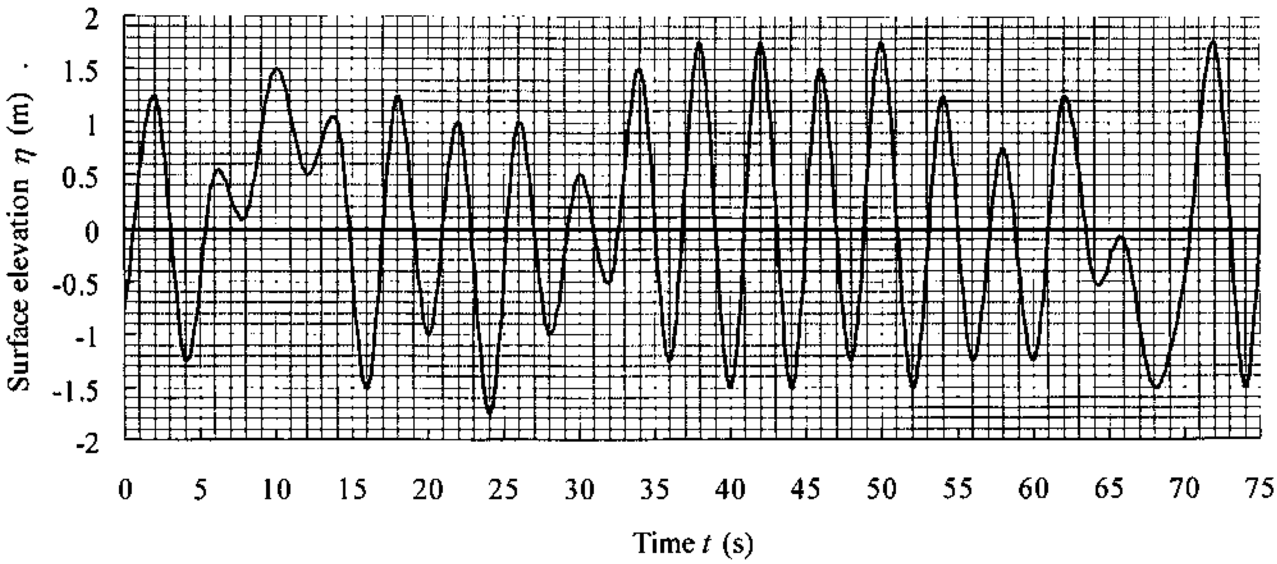

Figure Q4 / Rajah S4

Table 3. Ratio of H_n/H_s from Rayleigh distribution

n	H_n/H_s
1	1.67
2	1.56
5	1.40
10	1.27
20	1.12
50	0.89
100	0.63

Table 4. Owen parameters

Structure slope	A	B
1:1.5	0.0102	20.12
1:2.0	0.0125	22.06
1:2.5	0.0145	26.10
1:3.0	0.0163	31.90
1:3.5	0.0178	38.90
1:4.0	0.0192	46.96
1:4.5	0.0215	55.70
1:5.0	0.0250	65.20

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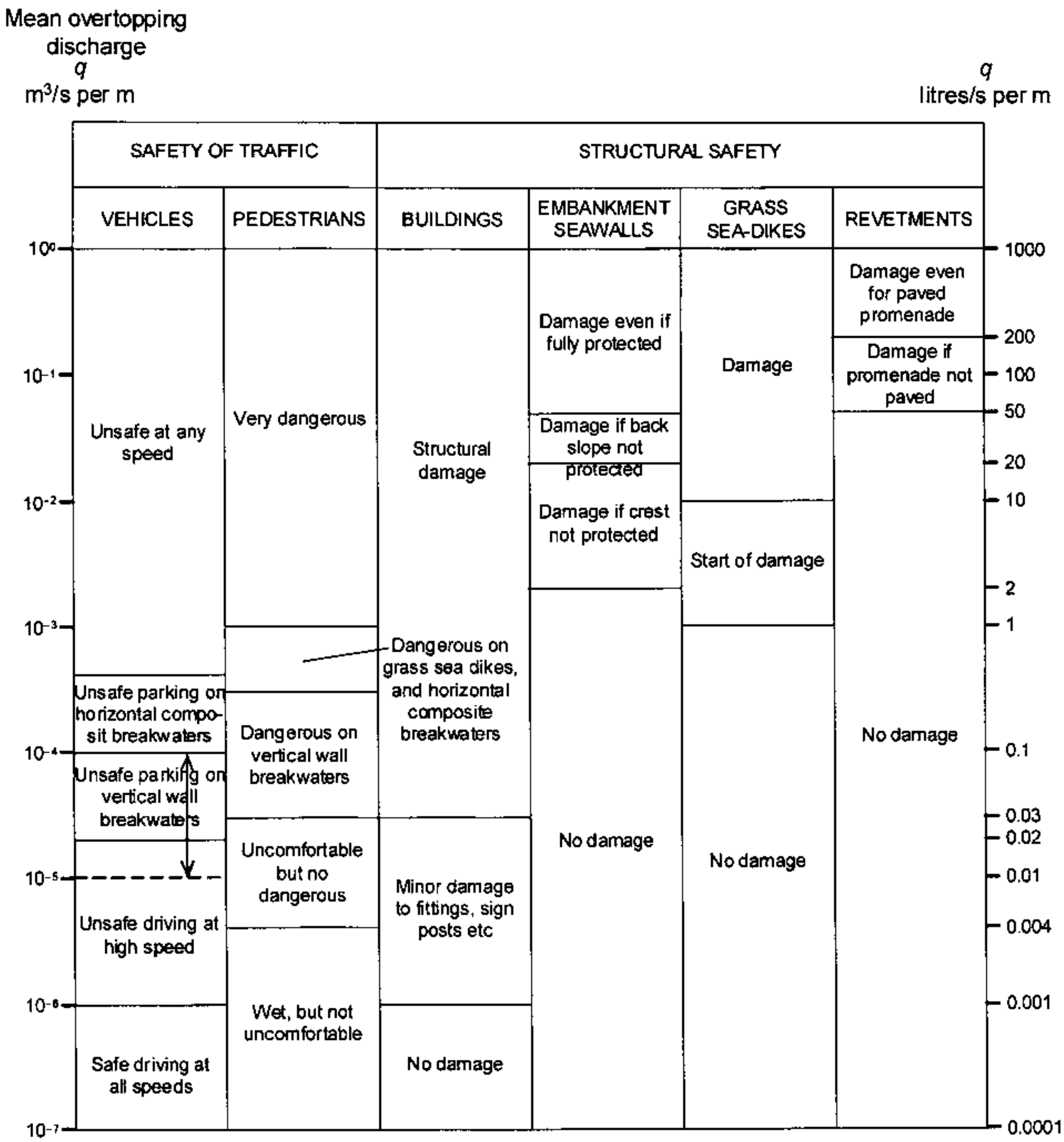

Figure Q5 / Rajah S5

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Table 5. Roughness coefficient *r*

Type of embankment/revetment	Roughness coefficient *r*
Smooth, impermeable	1.0
Stone blocks, pitched or mortared	0.95
Concrete blocks	0.90
Stone blocks, granite sets	0.85 – 0.90
Turf	0.85 – 0.90
Rough concrete	0.85
One layer of stone rubble on impermeable base	0.80
Stones set in cement, ragstone etc	0.75 – 0.80
Two or more layers of open rock armour	0.50 – 0.60
Open stone asphalt	0.80
Fully grouted stone	0.60 – 0.80
Partial grouted stone	0.60 – 0.70

Table 6. Relationship between M_ϕ and σ_ϕ of the native material and borrow material

<table>
<tr><th>Case</th><th>Quadrant</th><th>Relationship of phi means</th><th>Relationship of phi standard deviations</th></tr>
<tr><td>I</td><td>1</td><td>$M_{\phi b} > M_{\phi n}$
borrow material is finer than native material</td><td rowspan="2">$\sigma_{\phi b} > \sigma_{\phi n}$
borrow material is more poorly sorted than native material</td></tr>
<tr><td>II</td><td>2</td><td>$M_{\phi b} < M_{\phi n}$
borrow material is coarser than native material</td></tr>
<tr><td>III</td><td>3</td><td>$M_{\phi b} < M_{\phi n}$
borrow material is coarser than native material</td><td rowspan="2">$\sigma_{\phi b} < \sigma_{\phi n}$
borrow material is better sorted than native material</td></tr>
<tr><td>IV</td><td>4</td><td>$M_{\phi b} > M_{\phi n}$
borrow material is finer than native material</td></tr>
</table>

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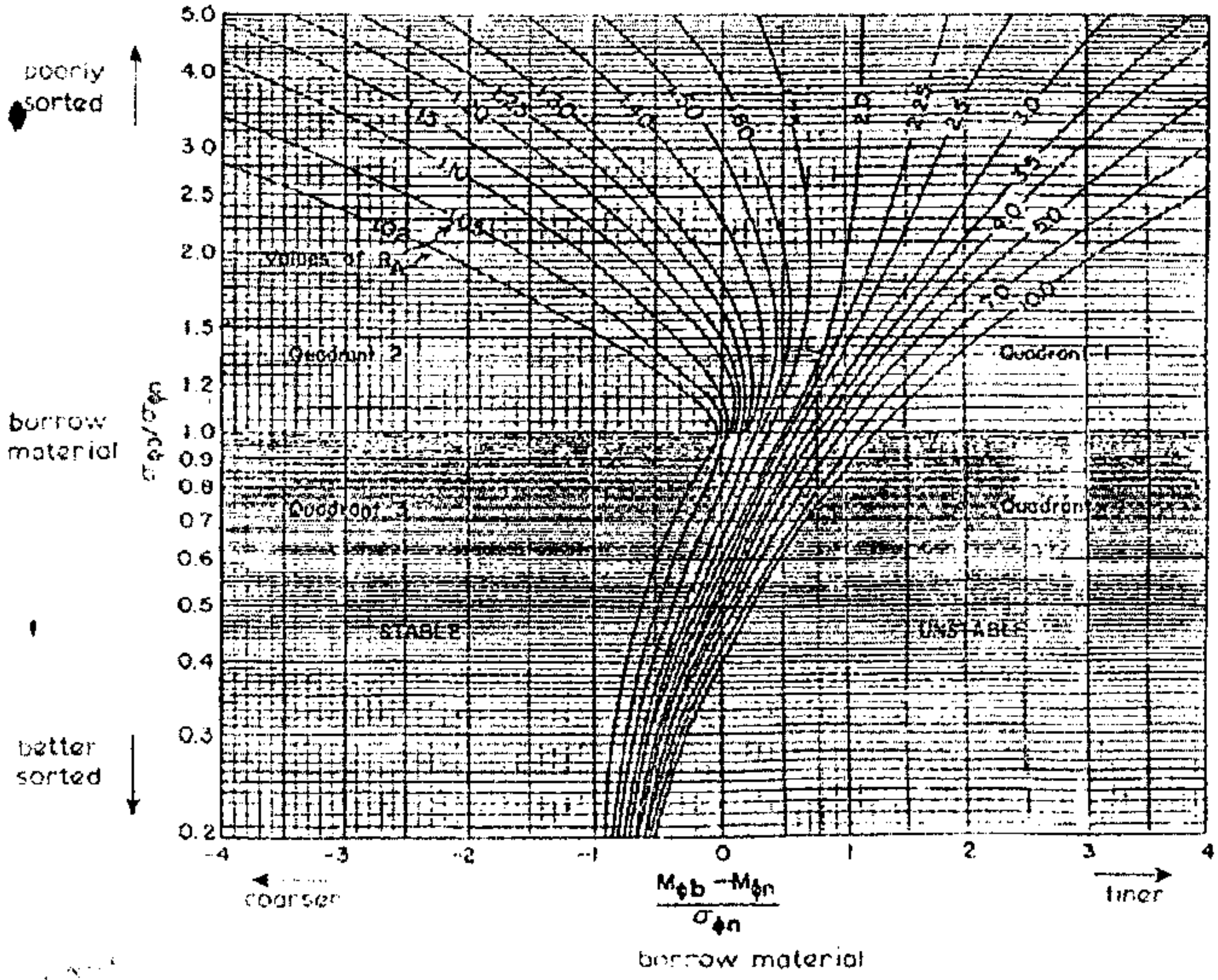

Figure 3. Isolines of the adjusted SPM fill factor R_A