UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	COASTAL & HARBOUR ENGINEERING
COURSE CODE	:	BFW 4033 / BFW 40303
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	DECEMBER 2012/JANUARY 2013
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **FIVE (5)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOURTEEN (14)** PAGES

Q1 (a) State the following

(i) Length of Malaysia coastline

(2 marks)

(ii) **TWO (2)** common types of coast found along Malaysia shore

(2 marks)

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

(16 marks)

Q2 (a) Provide **THREE (3)** of the following main natural forces which are involved in the generation of ocean waves

(i) Disturbing force

(3 marks)

(ii) Restoring force

(3 marks)

(b) A wave with height 3 m and period 7 s propagates shoreward from a depth $d = 150$ m to a depth $d = 5$ m. Find

(i) Wave length and celerity at depths 150 m and 5 m

(9 marks)

(ii) Maximum horizontal and vertical local velocities of the surface at depth 5 m

(5 marks)

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

(i) Reflection

(3 marks)

(ii) Refraction

(3 marks)

(iii) Diffraction

(3 marks)

(b) A 2.5 m-high deepwater wave is propagating towards a 1:10 beach, with its crest making an angle of $\alpha_0 = 30°$ with the shoreline. As the wave moves into shallower water, its speed reduces from 15 m/s to 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 ρ_w = 1025 kg/m^3, rock armour density ρ_r = 2700 kg/m^3, and K_D = 3.0.

(7 marks)

Q6 (a) Briefly discuss **EIGHT (8)** considerations to be made in accomplishing an economically desired coastal protection design.

(12 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.

(8 marks)

TERJEMAHAN:

S1 (a) Nyatakan yang berikut

(i) Panjang garisan pantai Malaysia

(2 markah)

(ii) **DUA (2)** jenis pantai umum yang boleh ditemui di sepanjang pantai Malaysia.

(2 markah)

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

(16 markah)

S2 (a) Berikan **TIGA (3)** daya-daya semulajadi utama yang mempengaruhi penjanaan ombak lautan

(i) Daya gangguan

(3 markah)

(ii) Daya pemulihan

(3 markah)

(b) Sebuah ombak dengan ketinggian 3 m dan tempoh 7 s bergerak ke arah pantai dari kedalaman $d = 150$ m ke kedalaman $d = 5$ m. Kira

(i) Panjang dan laju ombak pada kedalaman 150 m dan kedalaman 5 m

(9 markah)

(ii) Halaju tempatan maksimum mengufuk dan pugak di permukaan pada kedalaman 5 m.

(5 markah)

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

(i) Pemantulan

(3 markah)

(ii) Pembiasan

(3 markah)

(iii) Pembelauan

(3 markah)

(b) Satu ombak laut dalam setinggi 2.5 m bergerak ke sebuah pantai berkecerunan 1:10, dengan puncak ombak membentuk sudut $\alpha_0 = 30°$ dengan garis pantai. Semasa ombak bergerak ke kedalaman yang lebih cetek, halaju rambatnya berkurangan dari 15 m/s ke 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 bagaiman halaju rambat dan frekuensi ombak ditentukan di tapak.

(6 markah)

S5 Sebuah struktur pelindung pantai berbatu yang berkecerunan 1:2.5 dengan paras puncak 5.0 m CD akan dibina di pantai yang berkecerunan pantai 1:100. Tinggi ombak berkesan ialah $H_s = 3.0$ m, tempoh ombak puncak $T_p = 8$ 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 $\rho_w = 1025$ kg/m^3, ketumpatan pelindung batu $\rho_r = 2700$ kg/m^3, dan $K_D = 3.0$.

(7 markah)

S6 (a) Bincangkan secara ringkas **LAPAN (8)** pertimbangan yang perlu dibuat bagi mencapai rekabentuk perlindungan pantai yang ekonomi.

(12 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.

(8 markah)

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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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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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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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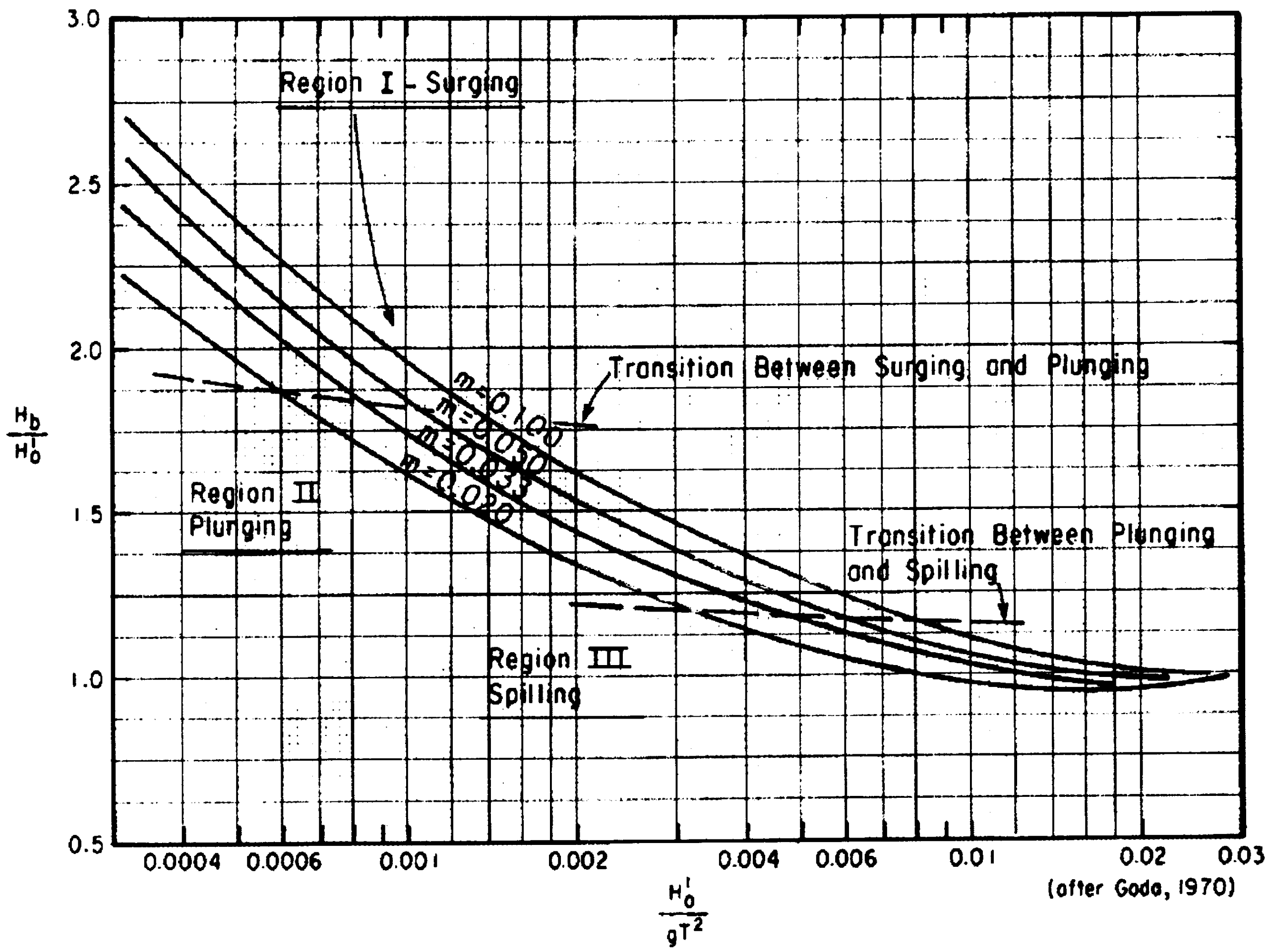

Breaker height index versus deepwater wave steepness

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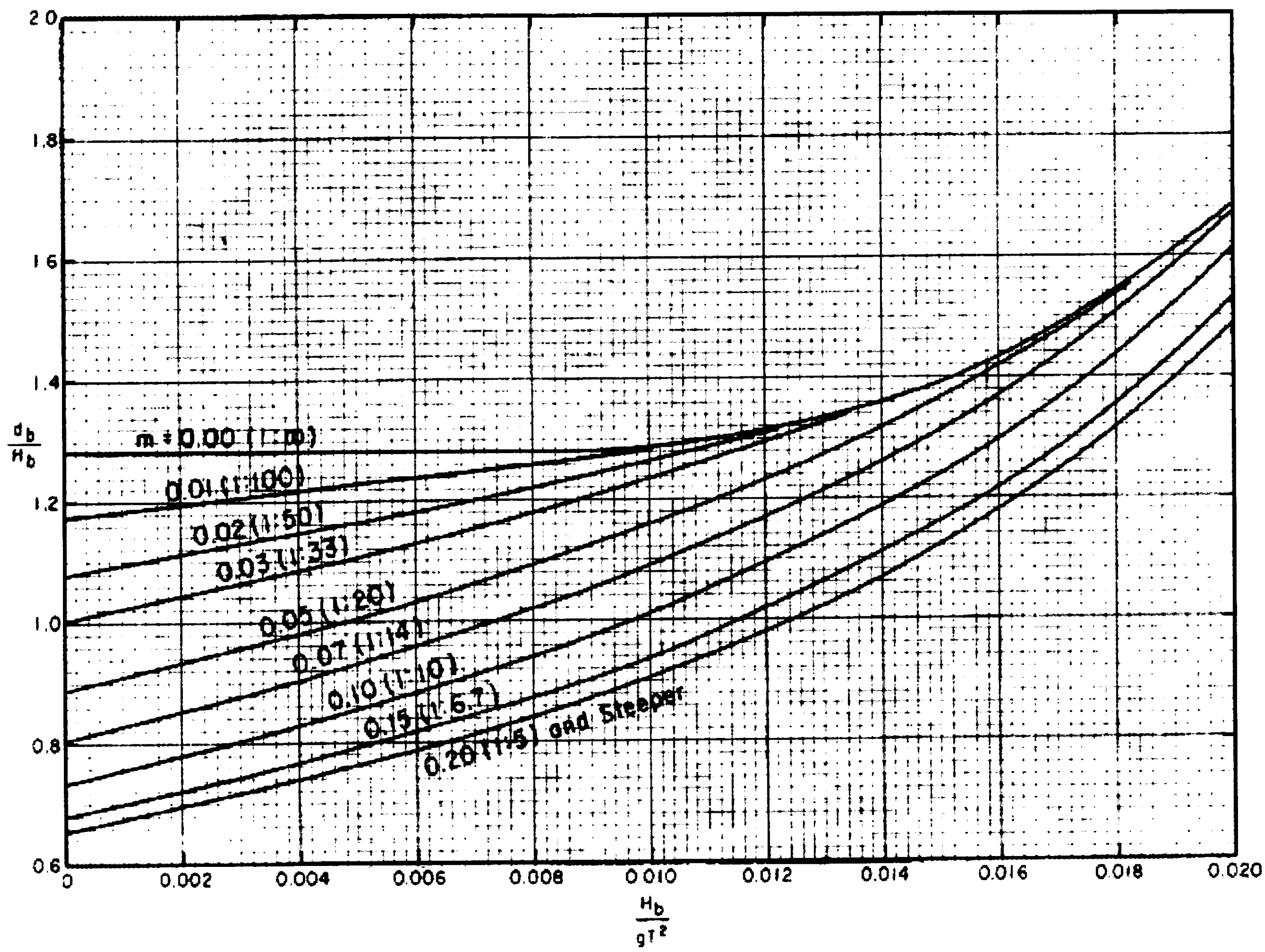

Breaker index versus wave steepness

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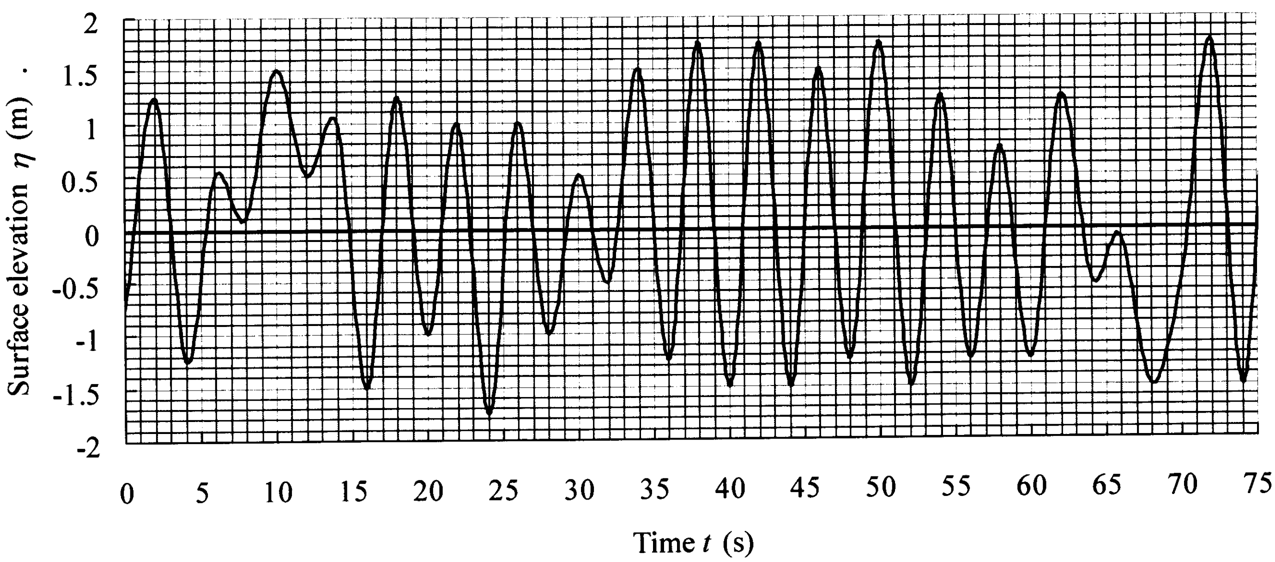

Figure Q4 / Rajah S4

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

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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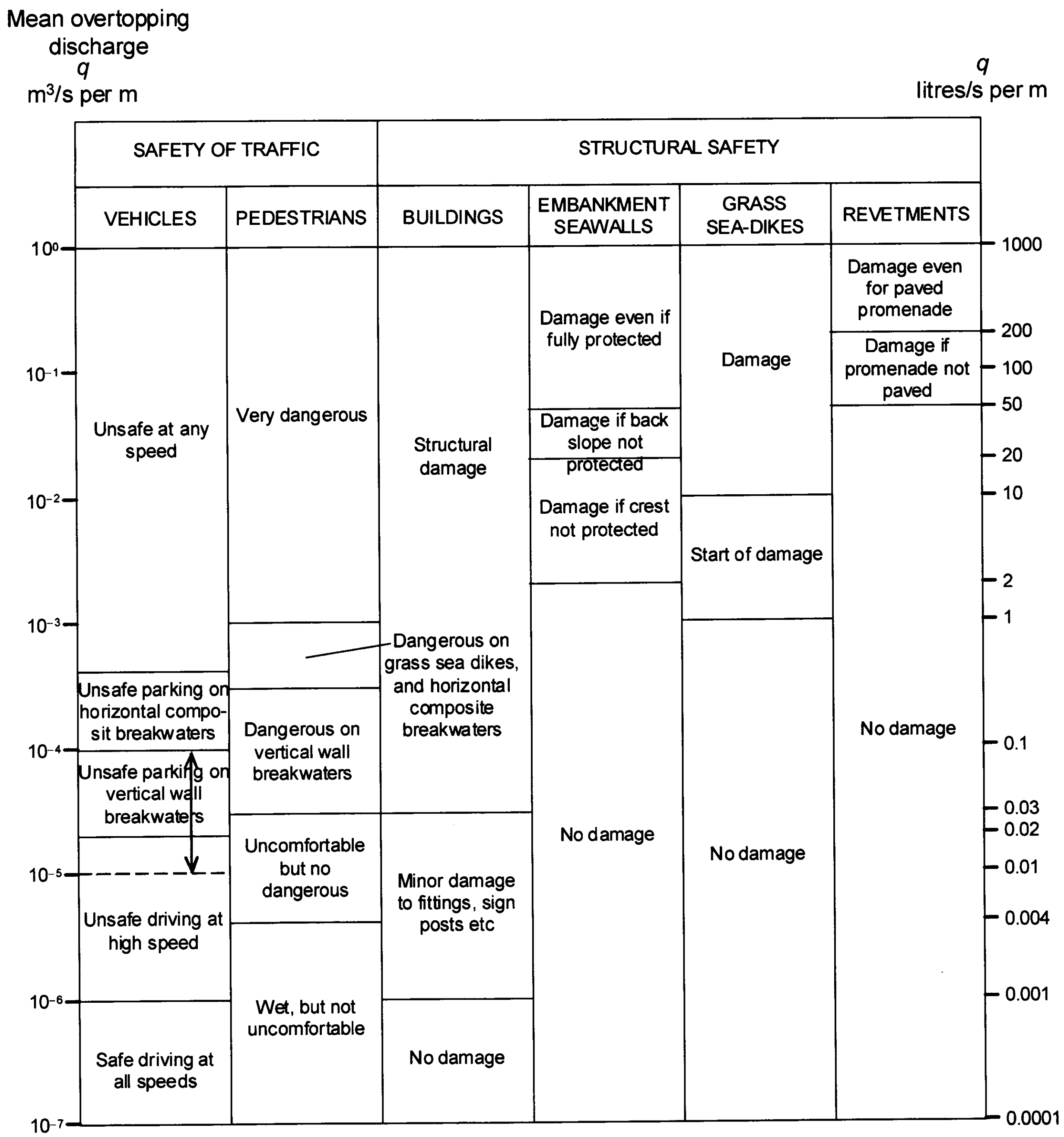

<u>**Figure Q5 / Rajah S5**</u>

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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

Relationship between M_ϕ and σ_ϕ of the native material and borrow material

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

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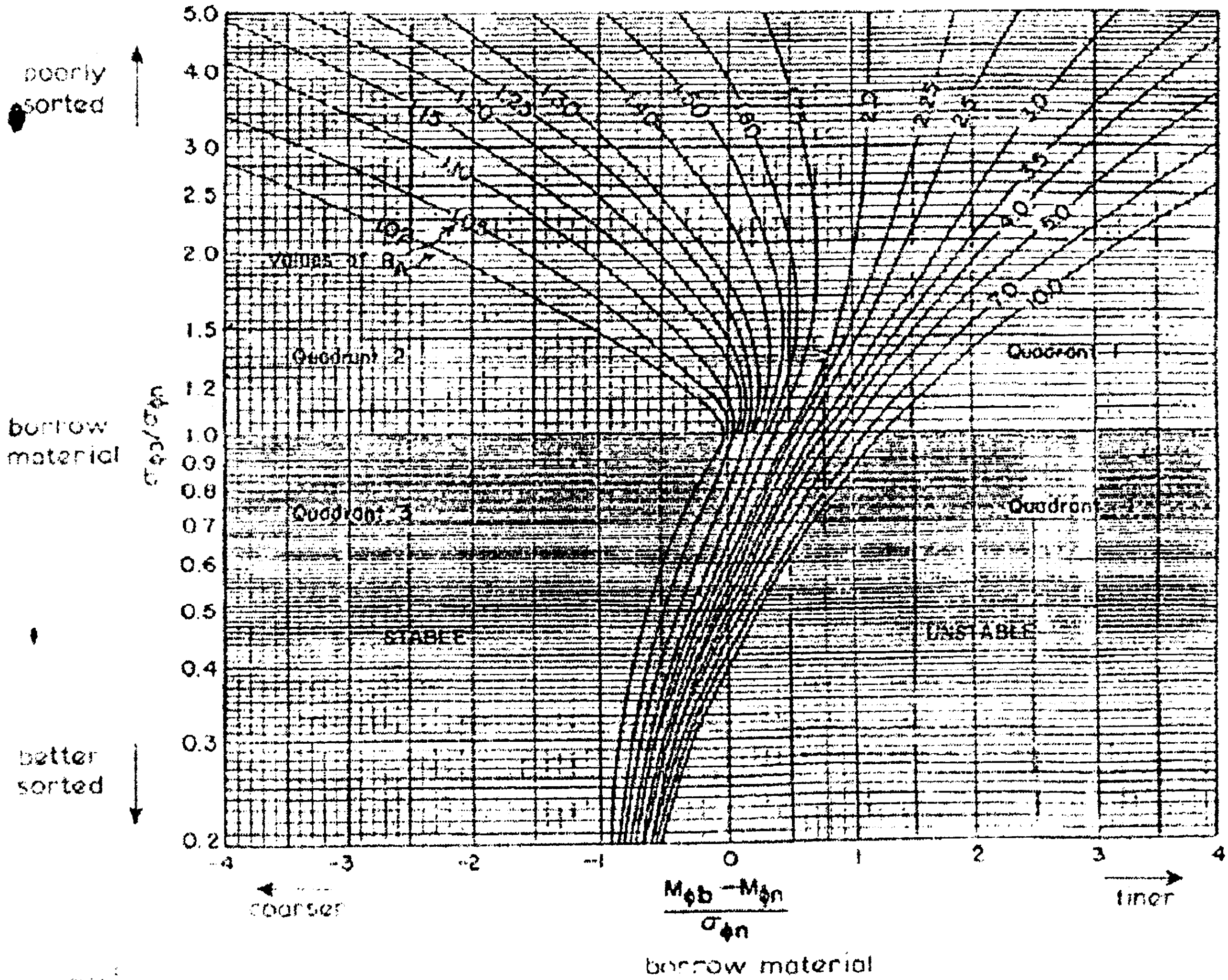

Isolines of the adjusted SPM fill factor R_A