UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	COASTAL AND HARBOR ENGINEERING
COURSE CODE	:	BFW 4033 / BFW 40303
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FIFTEEN (15)** PAGES

Q1 (a) Discuss the importance of coastal engineering knowledge in managing:

(i) Coastal erosion (2 marks)

(ii) Disposal of effluents into the sea (2 marks)

(iii) Harbor development (2 marks)

(b) Describe briefly **TWO (2)** distinct types of coast which can be found along Malaysia shore. (4 marks)

(c) State the **TEN (10)** terminologies of the small-amplitude ocean wave variables shown in Figure **Q1**. (10 marks)

Q2 (a) Describe how the following ocean features are generated.

(i) Wave (2 marks)

(ii) Tide (2 marks)

(iii) Current (2 marks)

(b) A wave with period 7 s propagates shoreward from a depth d = 150 m to a depth d = 5 m. At depths 150 m and 5 m, find

(i) Wave length and celerity (9 marks)

(ii) Wave height if deepwater wave height H_o = 1.5 m and no refraction occurs. (5 marks)

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

(i) Shoaling (3 marks)

(ii) Diffraction (3 marks)

(iii) Refraction (3 marks)

(b) A 2.5 m-high deepwater wave is propagating towards a 1:30 beach, with its crest making an angle of 30° with the shoreline. As the wave moves into shallower water, its speed reduces from 10 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) Describe **TWO (2)** types of instrumentations used in wind-generated wave measurements.

(6 marks)

(c) Figure **Q4** show the surface elevation recorded during a storm event. The maximum wave height is given as $H_{max} = 0.911 H_s \sqrt{\ln N}$. Compute

(i) Significant wave height H_s

(ii) Maximum wave height H_{max}

(iii) Average of the highest 20% of the wave height H_{20}

(8 marks)

Q5 A beach revetment with slope 1:3, crest level 6 m above chart datum (CD), toe at 0 m CD, and foreshore gradient of 1:200 is to be designed. The significant wave height is found to be H_s = 3.5 m, wave period T_p = 7 s, and design water level DWL = 3 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) 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 = 2.0.

(10 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.

(5 marks)

(b) Estimate the volume of fill material V required to nourish a beach with a berm height B = 1.2 m and required width Y = 30 m where mean significant wave height H_s = 1.5 m. The depth of closure H can be approximated using the simplified CEM equation $H = 6.75 H_s$. Ignore the renourishment factor R_J and the following statistical sedimentary parameters can be used to determine the overfill factor R_A: $\sigma_{\varphi b} = 0.75$, $\sigma_{\varphi n} = 0.60$, $M_{\varphi b} = 2.30$, $M_{\varphi n} = 1.85$,

(15 marks)

TERJEMAHAN:

S1 (a) Bincangkan kepentingan pengetahuan kejuruteraan pantai dalam pengurusan:

(i) Hakisan pantai

(2 markah)

(ii) Pelupusan sisa buangan ke dalam laut

(2 markah)

(iii) Pembangunan pelabuhan

(2 markah)

(b) Huraikan secara ringkas **DUA (2)** jenis pantai utama yang boleh didapati di sepanjang pantai Malaysia.

(4 markah)

(c) Nyatakan **SEPULUH (10)** terminologi bagi pembolehubah ombak beramplitud kecil yang ditunjukkan dalam Rajah **S1**.

(10 markah)

S2 (a) Huraikan bagaimana ciri-ciri ombak berikut dijana.

(i) Ombak

(2 markah)

(ii) Pasang surut

(2 markah)

(iii) Arus

(2 markah)

(b) Satu ombak dengan tempoh 7 s bergerak ke arah pantai daripada kedalalaman d = 150 m ke suatu kedalaman d = 5 m. Pada kedalaman 150 m dan kedalaman 5 m, kira

(i) Panjang dan laju ombak

(9 markah)

(ii) Tinggi ombak jika tinggi ombak laut dalam H_o = 1.5 m dan pembiasan tidak berlaku.

(5 markah)

Q3 (a) Berbantukan lakaran, huraikan secara ringkas proses-prose ombak berikut

(i) Pencetekan

(3 markah)

(ii) Pembelauan

(3 markah)

(iii) Pembiasan

(3 markah)

(b) Satu ombak laut dalam setinggi 2.5 m bergerak ke sebuah pantai berkecerunan 1:30, dengan puncak ombak membentuk sudut 30° dengan garis pantai. Semasa ombak bergerak ke kedalaman yang lebih cetek, lajunya berkurangan dari 10 m/s ke 5 m/s. Kira tinggi ombak dan kedalaman dimana ombak pecah.

(11 markah)

Q4 (a) Huraikan **TIGA (3)** faktor yang mempengaruhi tinggi dan tempoh ombak janaan angin.

(6 markah)

(b) Huraikan **DUA (2)** jenis peralatan yang digunakan untuk menjalankan pengukuran ombak janaan angin.

(6 markah)

(c) Rajah **Q4** menunjukkan paras permukaan air yang direkodkan dalam satu peristiwa ribut. Tinggi maksimum ombak diberi sebagai $H_{max} = 0.911 H_s \sqrt{\ln N}$. Kira

(i) Tinggi ombak berkesan H_s

(ii) Tinggi ombak maksimum H_{max}

(iii) Tinggi purata bagi 20% ombak-ombak tertinggi H_{20}

(8 markah)

Q5 Sebuah struktur pelindung pantai berkecerunan 1:3, paras puncak 6 m di atas datum carta (CD), kaki pada 0 m CD, dan kecerunan depan pantai 1:200 perlu direkabentuk. Tinggi ombak berkesan adalah $H_s = 3.5$ m, tempoh ombak $T_p = 7$ s, dan paras air rekabentuk DWL = 3 m CD.

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

(10 markah)

(b) 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 $K_D = 2.0$.

(10 markah)

Q6 (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.

(5 markah)

(b) Kira isipadu bahan tambakan V yang diperlukan untuk membaja sebuah pantai dengan tinggi benteng yang diperlukan $B = 1.2$ m dan lebar yang diperlukan $Y = 30$ m, dimana tinggi ombak berkesan min $H_s = 1.5$ m. Kedalaman yang dibenarkan (*depth of closure*) H boleh dianggarkan menggunakan persamaan mudah CEM iaitu $H = 6.75 H_s$. Abaikan pekali penambakan R_J dan statistik parameter sedimen berikut boleh digunakan untuk menentukan faktor penambakan R_A:

$\sigma_{\varphi b} = 0.75$, $\sigma_{\varphi n} = 0.60$, $M_{\varphi b} = 2.30$, $M_{\varphi n} = 1.85$,

(15 markah)

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Supplementary equations

$$H_i = H_o K_s K_r$$

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

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

$$T_m = 0.82T_p$$

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

$Q^* = Ae^{\left(-\frac{BR^*}{r}\right)}$ where, $A = 0.0163$, $B = 31.9$, and $r = 0.55$

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

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

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

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

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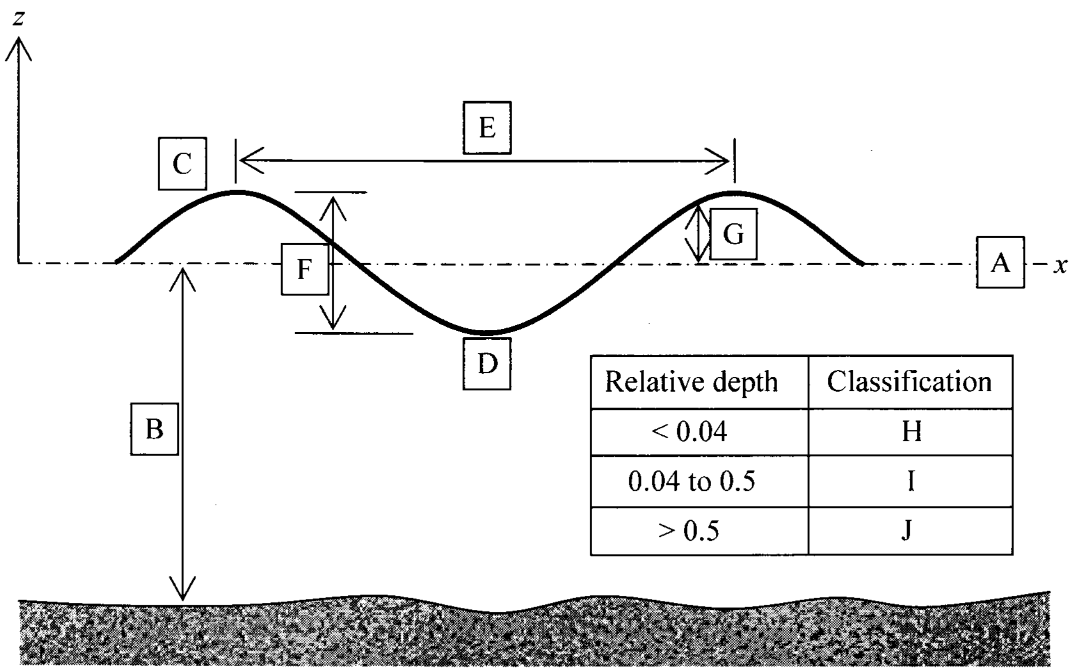

Relative depth	Classification
< 0.04	H
0.04 to 0.5	I
> 0.5	J

Figure Q1 / Rajah S1

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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 $2\pi d/L$
0.06000	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
0.07000	0.1139	0.7157	0.6144	0.7783	1.2672
0.07100	0.1149	0.7219	0.6181	0.7863	1.2721
0.07200	0.1158	0.7277	0.6217	0.7937	1.2767
0.07300	0.1168	0.7336	0.6252	0.8011	1.2813
0.07400	0.1177	0.7395	0.6289	0.8088	1.2861
≥ 1.000	1.000	6.283	1.000	267.7	267.7

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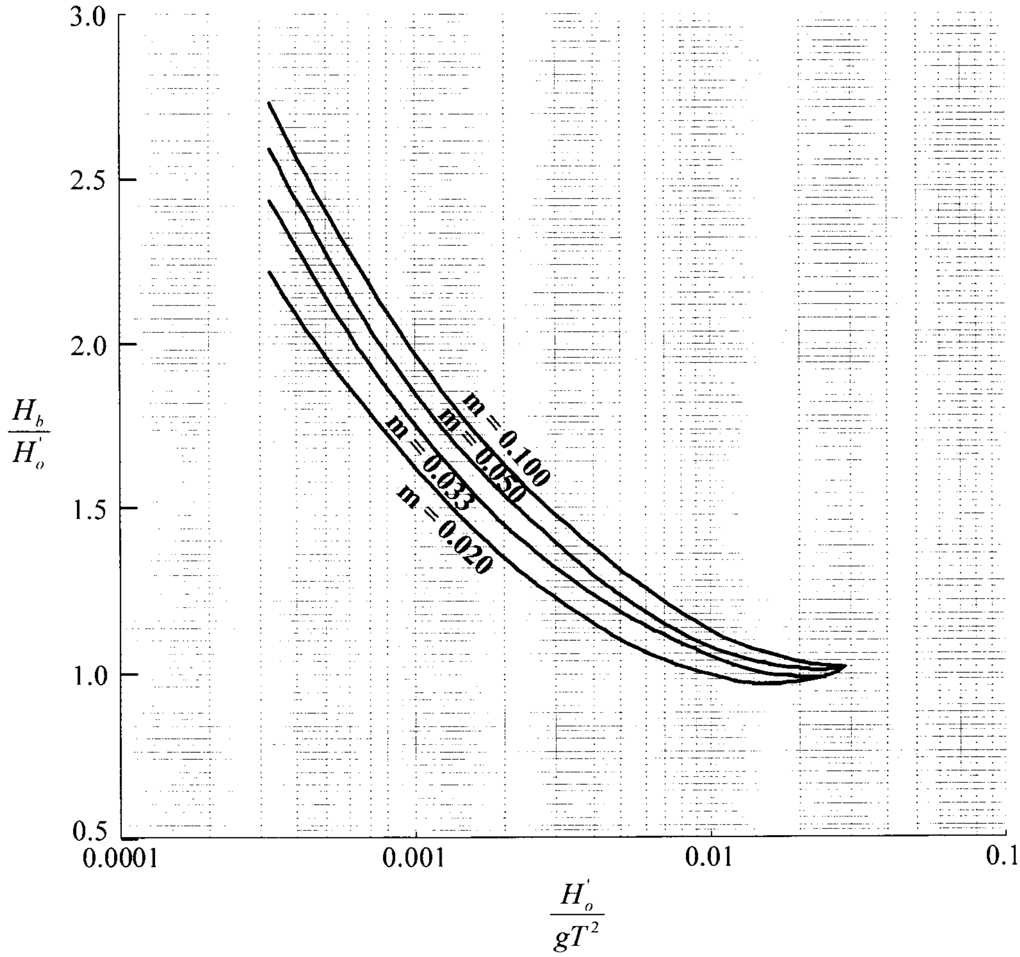

Breaker height index versus deepwater wave steepness

Appendix VI

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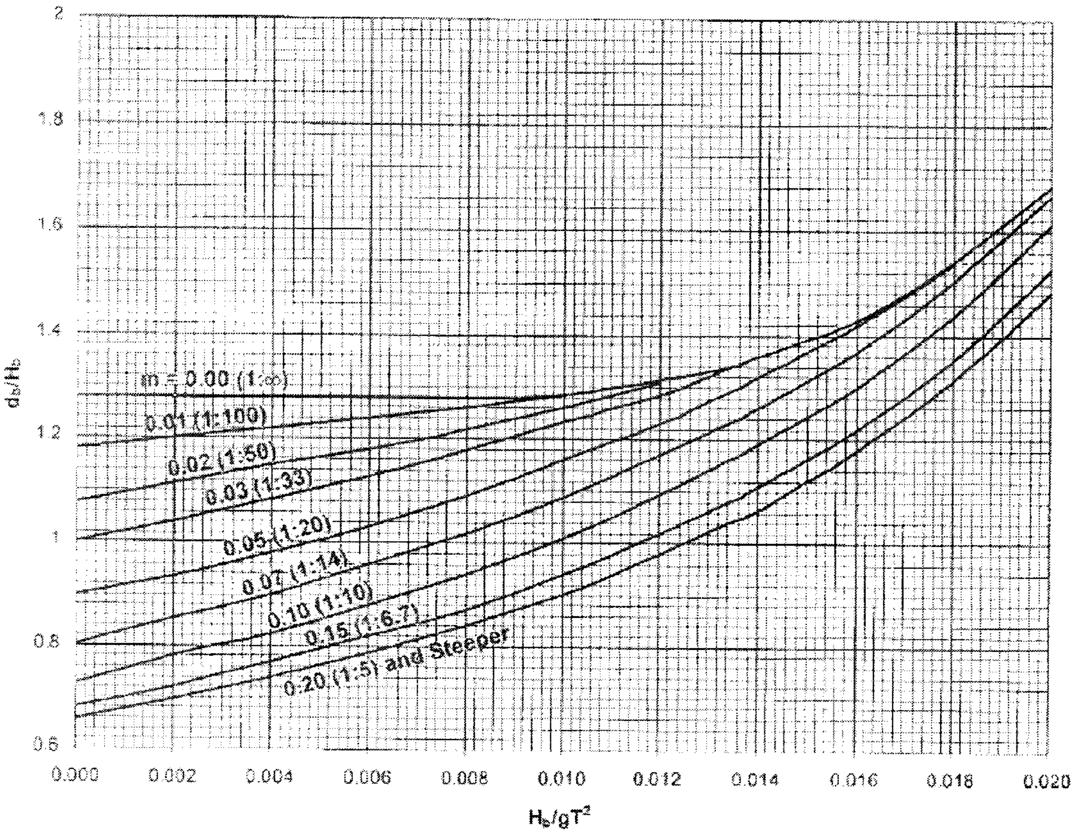

Breaker index versus wave steepness

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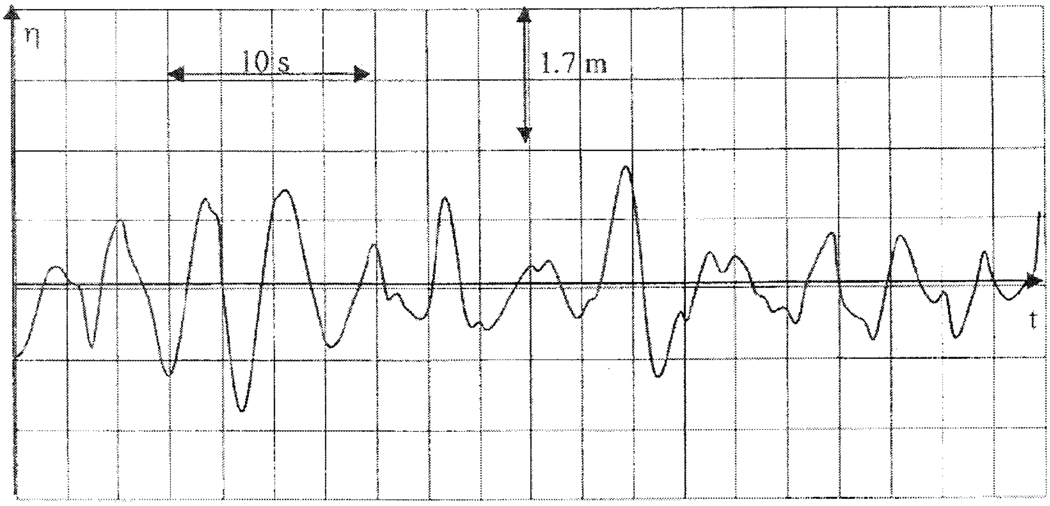

Figure Q4 / Rajah S4

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

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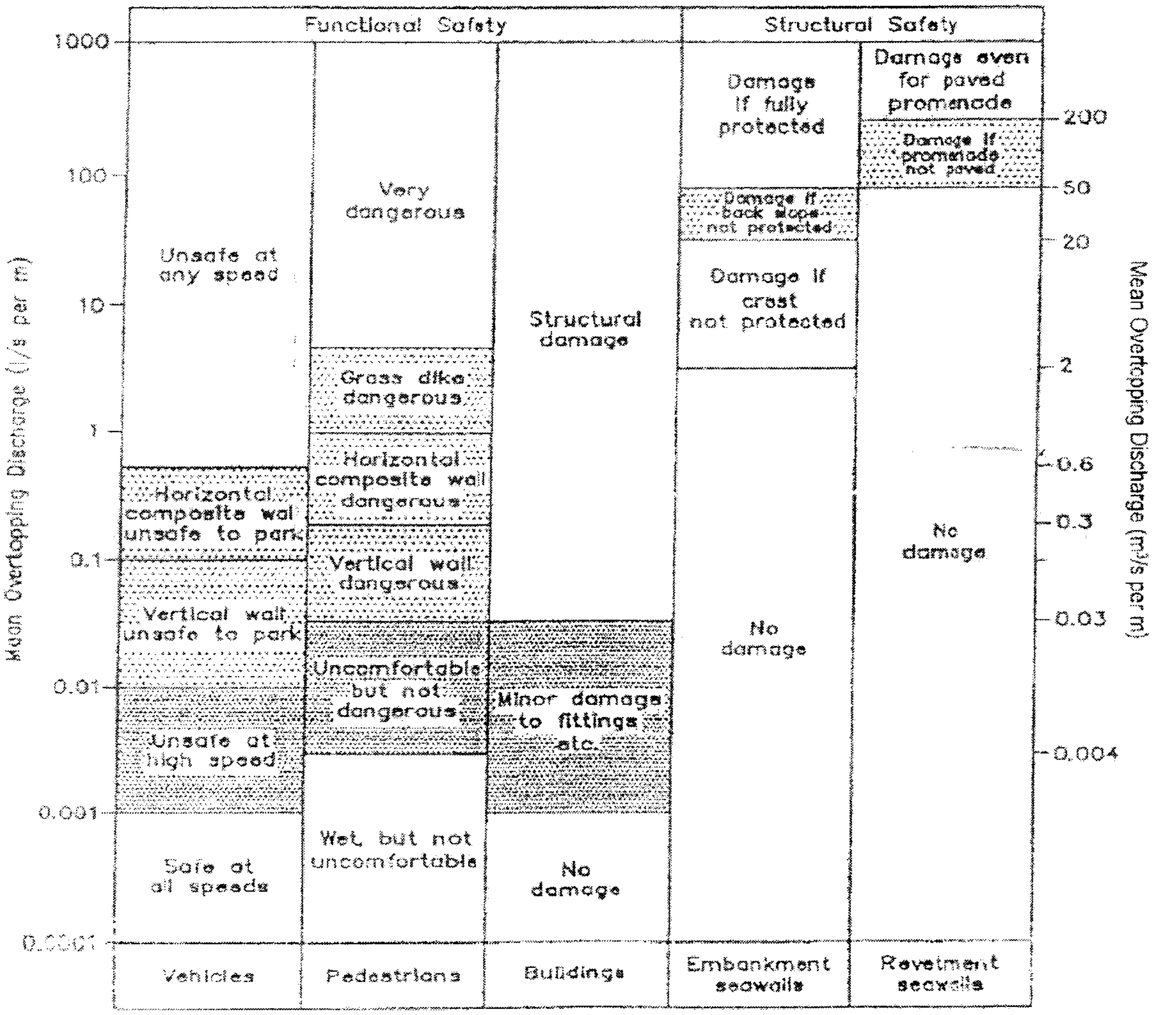

Figure Q5 / Rajah S5

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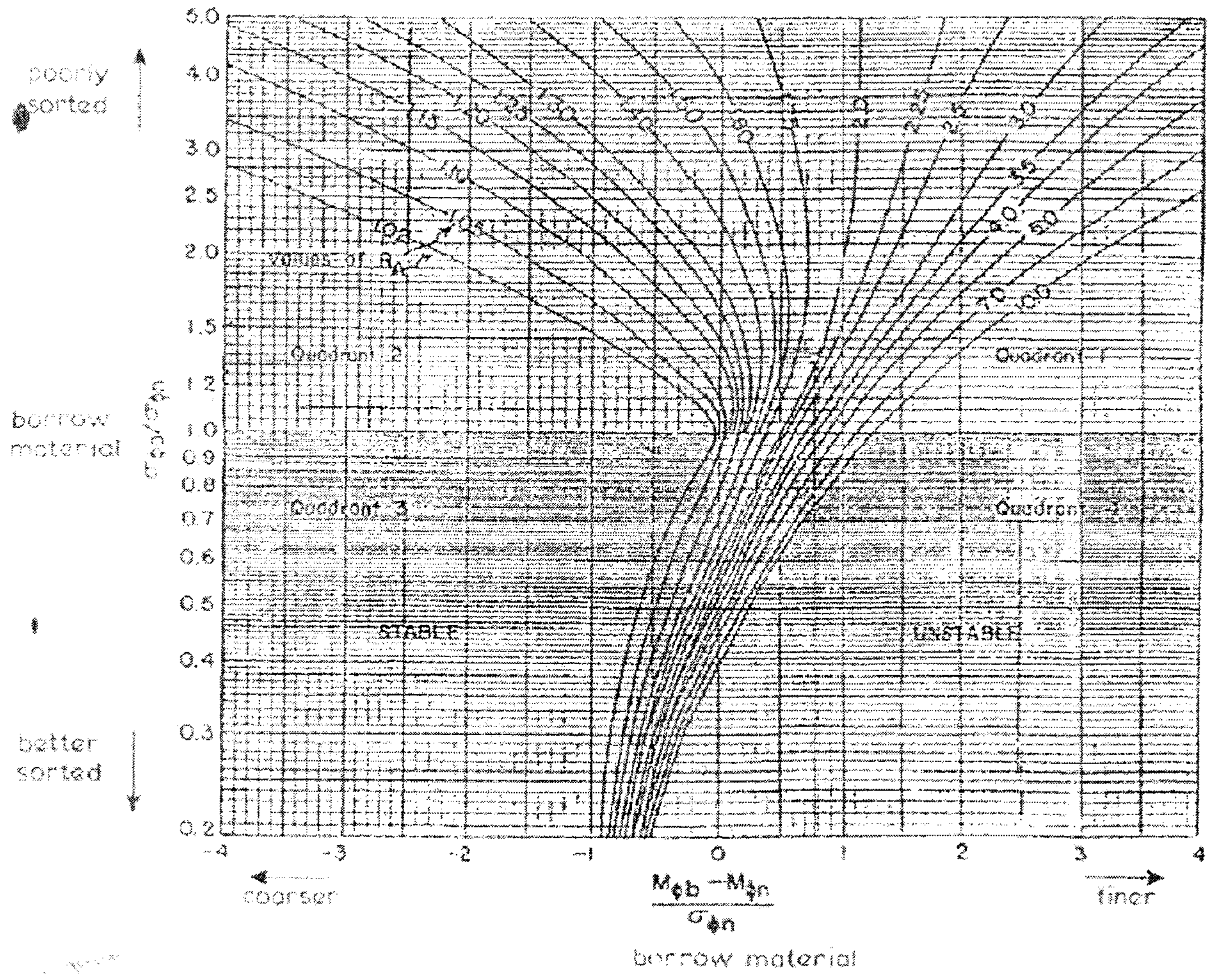

Isolines of the adjusted SPM fill factor R_A

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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	