UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

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

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

Q1 (a) Discuss **THREE (3)** problems faced by Malaysia coasts.

(9 marks)

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

(4 marks)

(c) State the **SEVEN (7)** terminologies of the small-amplitude ocean wave variables shown in Figure **Q1**.

(7 marks)

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

(i) Wave

(2 marks)

(ii) Spring tide

(2 marks)

(iii) Diurnal tide

(2 marks)

(b) A wave with height 2 m and period 10 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) Breaking

(3 marks)

(ii) Refraction

(3 marks)

(iii) Diffraction

(3 marks)

(b) A 2.5 m-high deepwater wave is propagating towards a 1:20 beach, with its crest making an angle of 30° with the shoreline. As the wave moves into shallower water, its speed reduces from 12 m/s to 6 m/s. Compute the wave height and depth at breaking.

(11 marks)

Q4 (a) Based on the coastal camp experience, describe how the wave celerity and wave frequency are determined on site.

(6 marks)

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

(6 marks)

(c) 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 20% of the wave height H_{20}

(8 marks)

Q5 A beach revetment with slope 1:2.5, crest level 5.0 m CD, and foreshore gradient of 1:100 is to be designed. The significant wave height is found to be H_s = 3.0 m, wave period T_p = 8 s, and design water level DWL = 3.5 m CD. Assuming roughness coefficient of rock armour r = 0.50,

(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) Briefly state 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) Bincangkan **TIGA (3)** masalah yang dihadapi oleh kawasan pantai Malaysia.
(9 markah)

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

(c) Nyatakan **TUJUH (7)** terminologi bagi pembolehubah ombak beramplitud kecil yang ditunjukkan dalam Rajah **S1**.
(7 markah)

S2 (a) Huraikan bagaimana proses-proses laut berikut dijana.
(i) Ombak
(2 markah)
(ii) Pasang surut perbani
(2 markah)
(iii) Pasang surut diurnal
(2 markah)

(b) Satu ombak dengan ketinggian 2 m dan tempoh 10 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) Pemecahan
(3 markah)
(ii) Pembiasan
(3 markah)
(iii) Pembelauan
(3 markah)

(b) Satu ombak laut dalam setinggi 2.5 m bergerak ke sebuah pantai berkecerunan 1:20, dengan puncak ombak membentuk sudut 30° dengan garis pantai. Semasa ombak bergerak ke kedalaman yang lebih cetek, halaju rambatnya berkurangan dari 12 m/s ke 6 m/s. Kira tinggi ombak dan kedalaman ketika ombak pecah.
(11 markah)

S4 (a) Berdasarkan pengalaman kem pantai, huraikan bagaimana halaju rambat ombak dan frekuensi ombak diperolehi di tapak.

(6 markah)

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

(6 markah)

(c) 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 20% ombak-ombak tertinggi H_{20}

(8 markah)

S5 Sebuah struktur pelindung pantai berkecerunan 1:2.5, paras puncak 5.0 m CD, dengan kecerunan pantai 1:100 perlu direkabentuk. Tinggi ombak berkesan adalah $H_s = 3.0$ m, tempoh ombak $T_p = 8$ s, dan paras air rekabentuk DWL = 3.5 m CD. Dengan andaian pekali kekasaran pelindung batu $r = 0.50$,

(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)

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

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 : $\dfrac{\sin\alpha}{C} = \dfrac{\sin\alpha_o}{C_o}$

$$T_m = 0.82 T_p$$

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

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

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

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

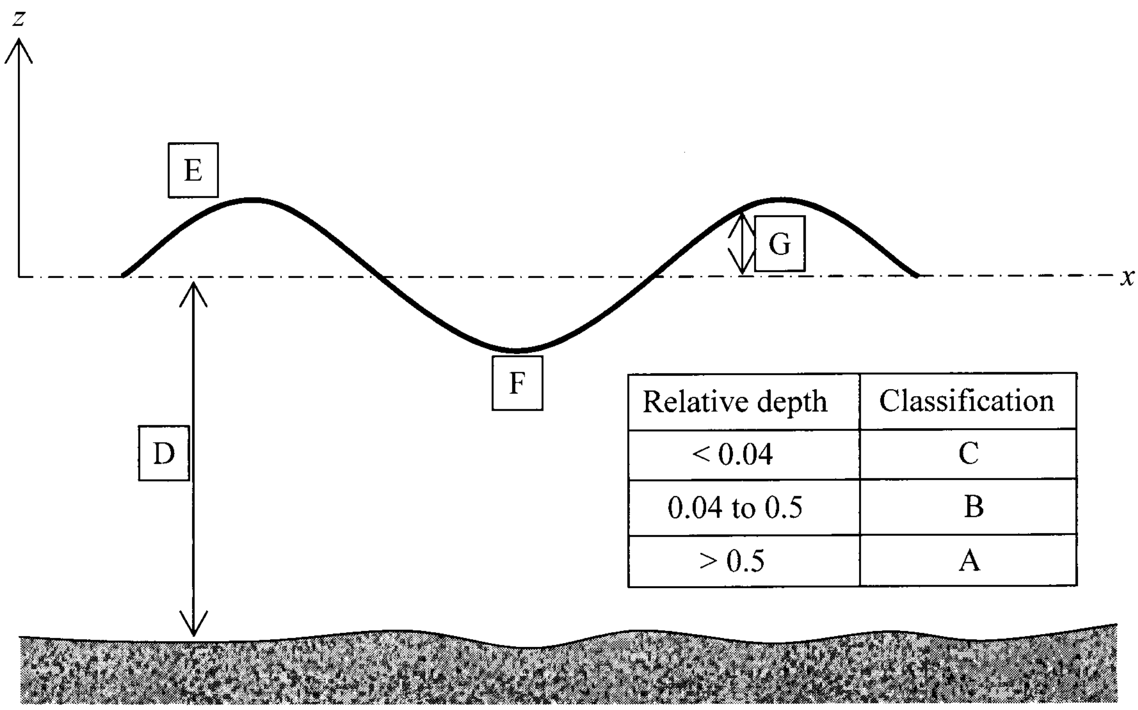
$$D_{50} = \left(\frac{M_{50}}{\rho_r}\right)^{\frac{1}{3}}$$

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

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033



Relative depth	Classification
< 0.04	C
0.04 to 0.5	B
> 0.5	A

Figure Q1 / Rajah S1

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

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	$a_z = -\frac{g\pi H}{L}\frac{\sinh\left[2\pi\frac{(z+d)}{L}\right]}{\cosh\left(2\pi\frac{d}{L}\right)}\cos\theta$	$a_z = -2H\left(\frac{\pi}{T}\right)^2 e^{\frac{2\pi z}{L}}\cos\theta$

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

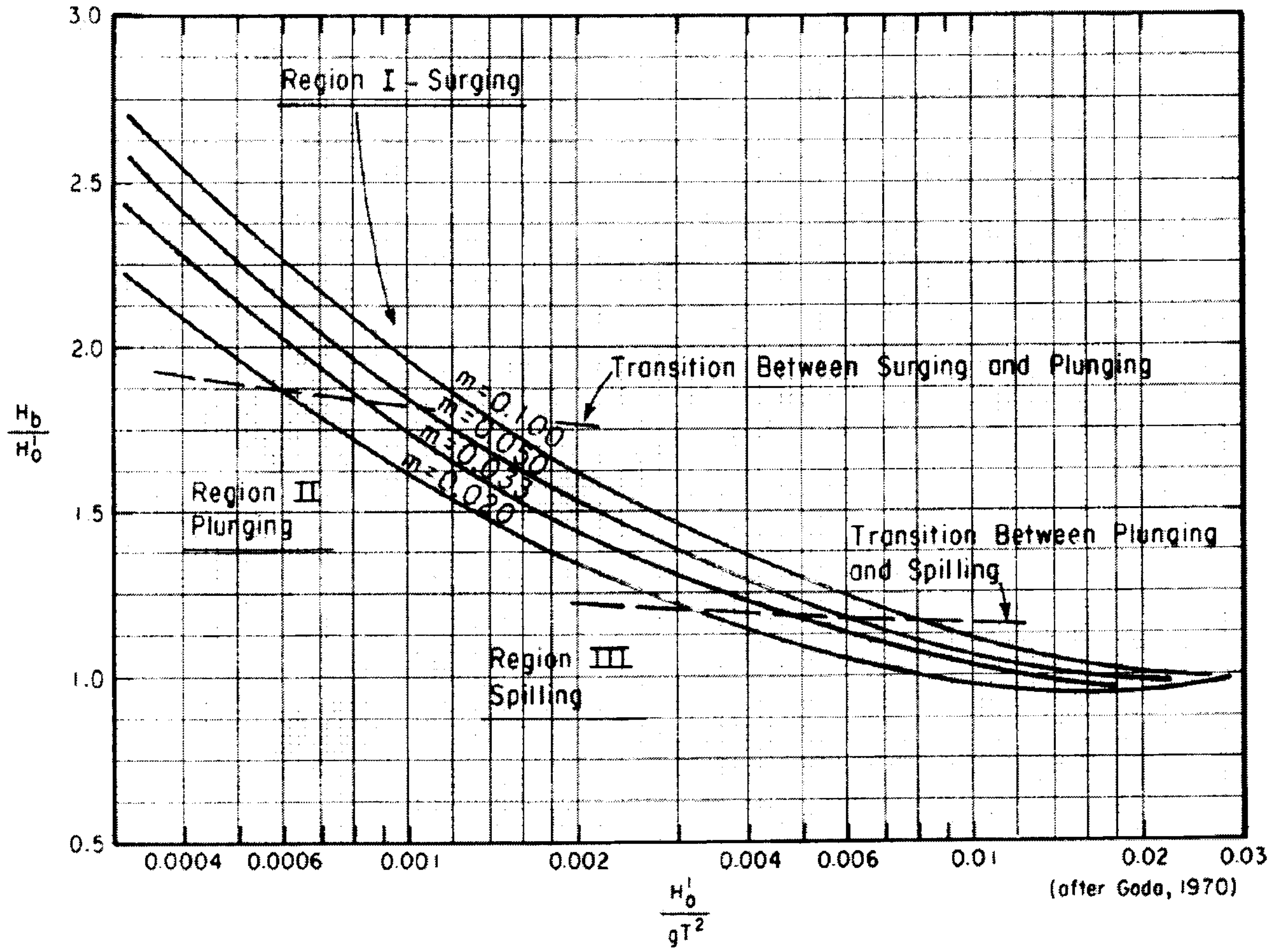
Functions of d/L for even increments of d/L_0

d/L_0	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
0.9000	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

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

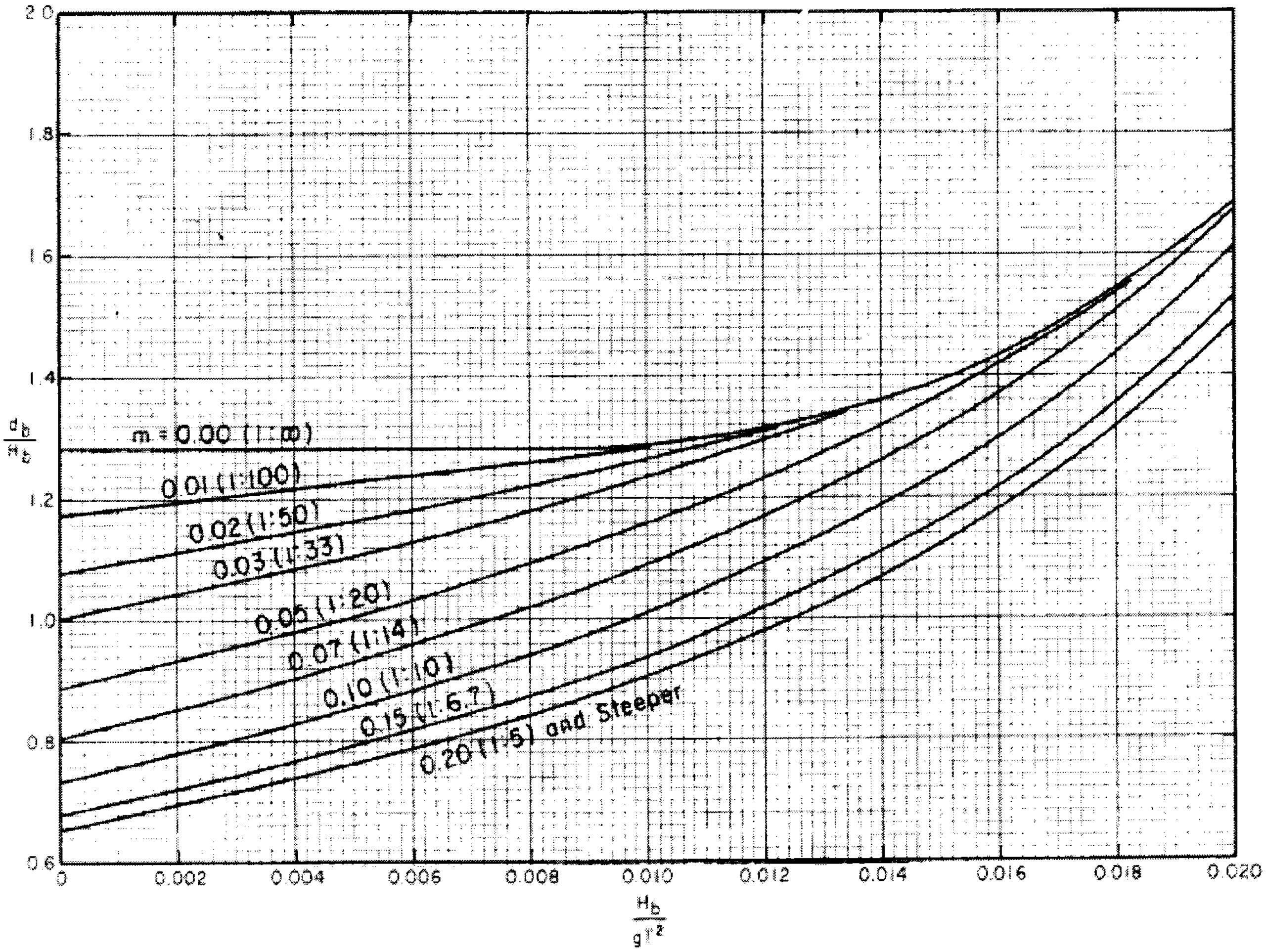


Breaker height index versus deepwater wave steepness

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033



Breaker index versus wave steepness

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

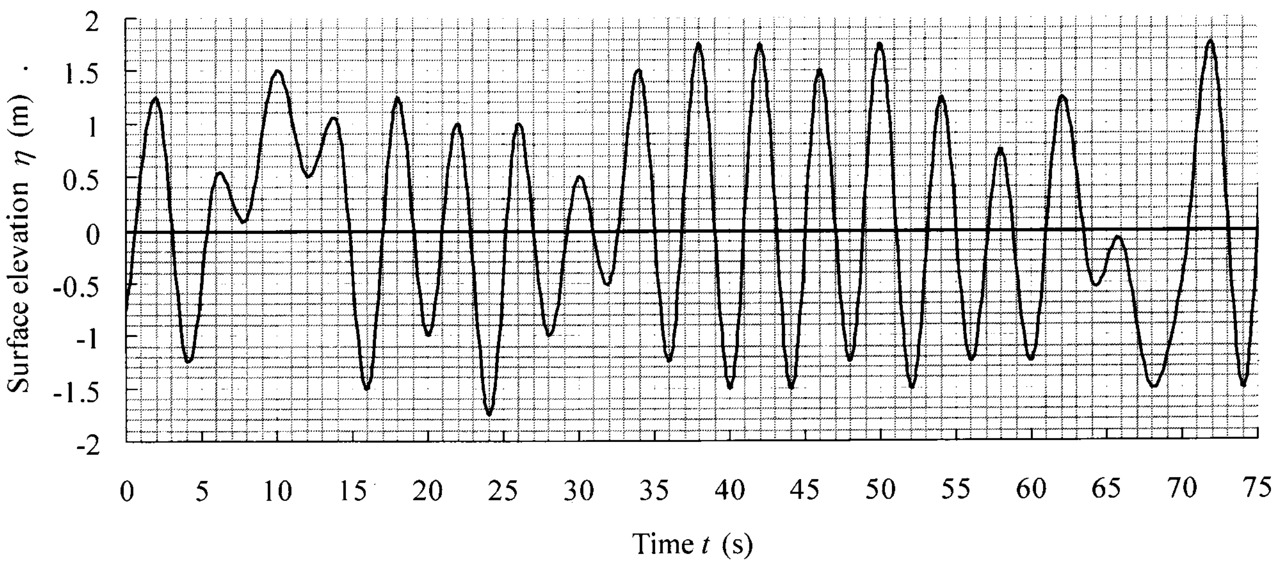


Figure Q4 / Rajah S4

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

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

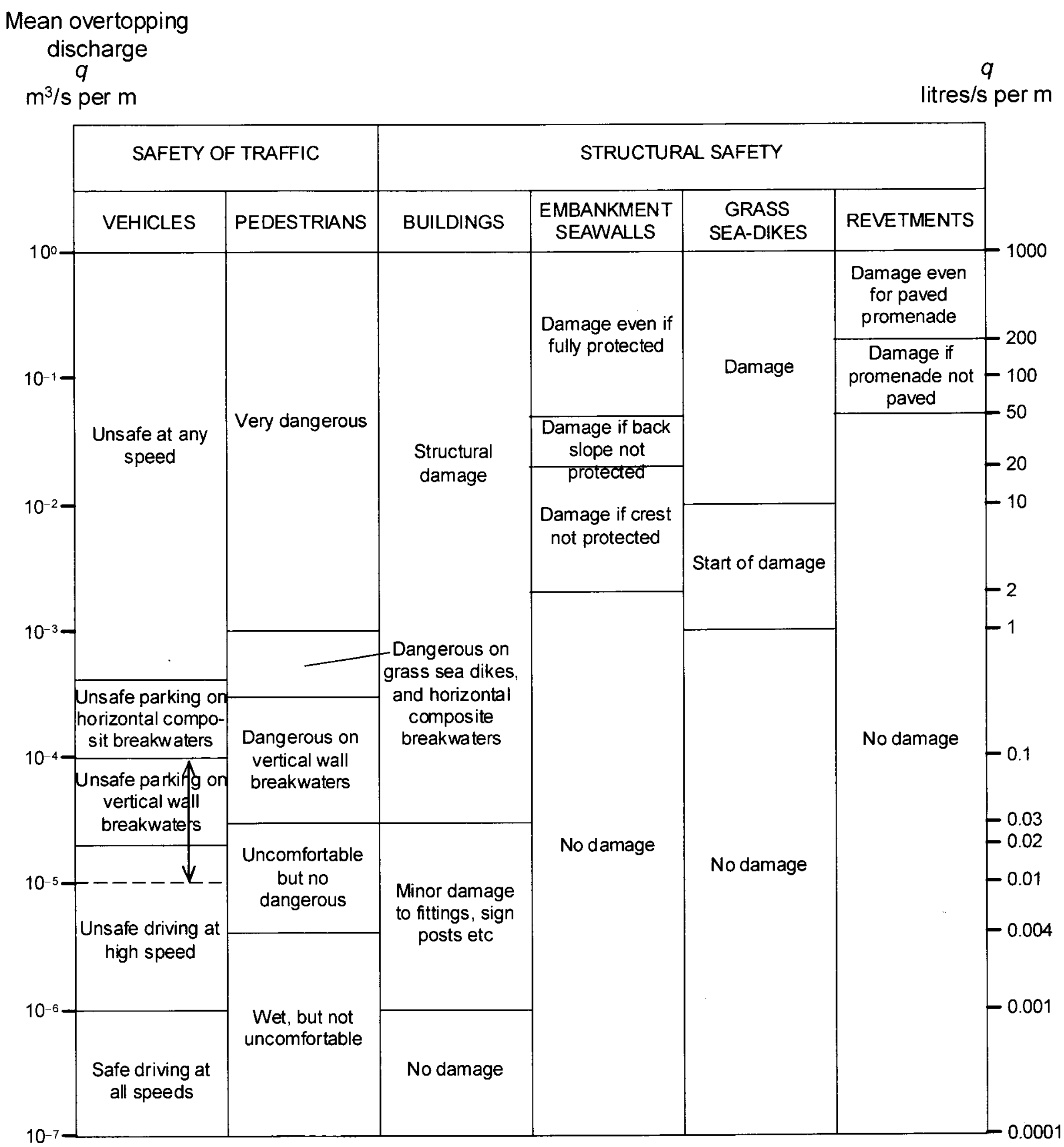
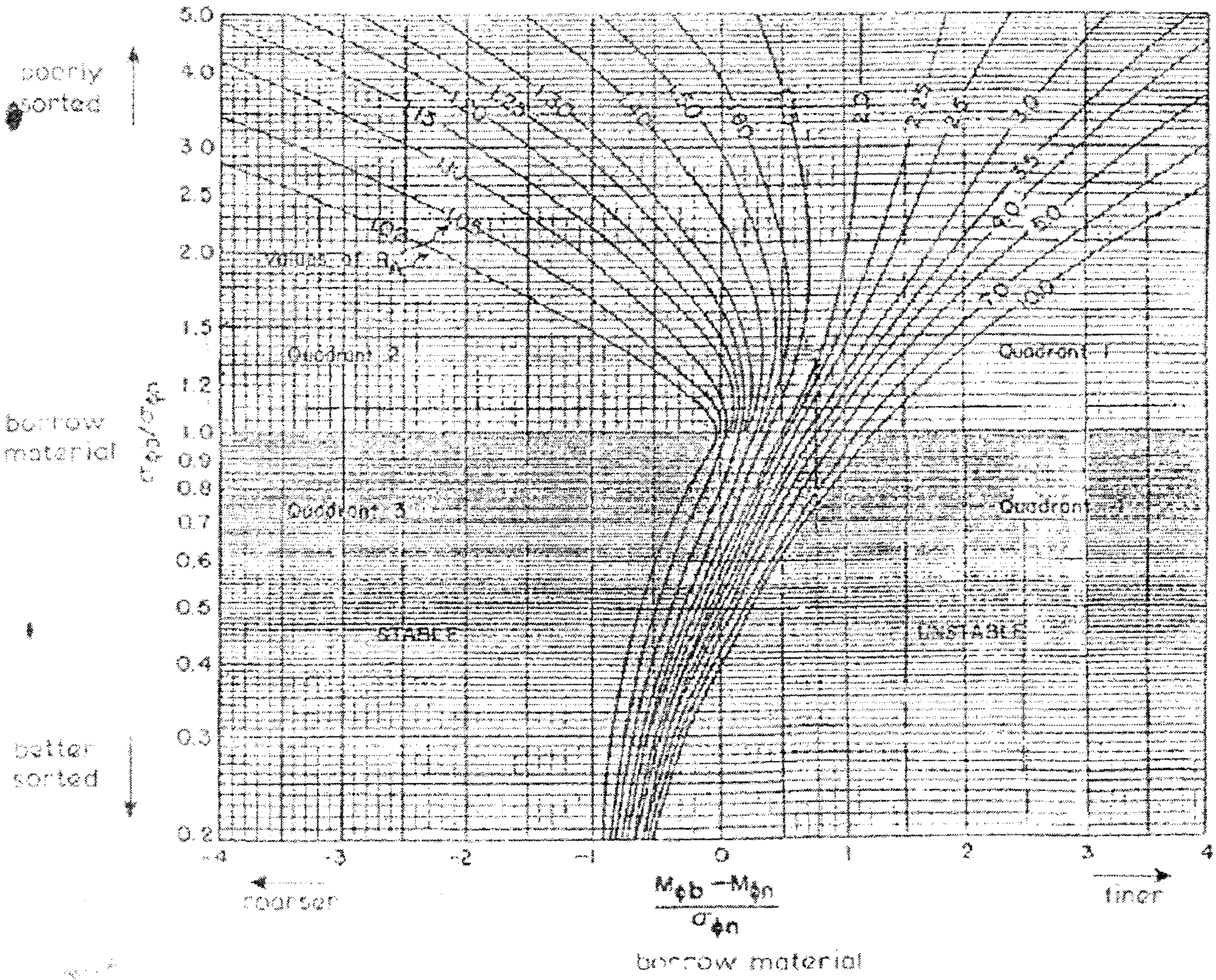


Figure Q5 / Rajah S5

Appendix IX

FINAL EXAMINATION	
SEMESTER/SESSION: II/2011/2012	PROGRAMME : 4BFF
COURSE NAME : COASTAL AND HARBOR ENGINEERING	COURSE CODE : BFW40303/BFW4033



Isolines of the adjusted SPM fill factor R_A

FINAL EXAMINATION

SEMESTER/SESSION: II/2011/2012 PROGRAMME : 4BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303/BFW4033

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	