Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	COASTAL AND HARBOUR ENGINEERING
COURSE CODE	:	BFW40303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY.

THIS QUESTION PAPER CONSISTS OF **THIRTEEN (13)** PAGES

Q1 (a) There are several issues and problems in coastal area resulted from unplanned human activities that give rise to a host problem. As a coastal engineer, define and explain **FOUR (4)** of the issues affecting the shoreline.

(10 marks)

(b) Each coastal project has its own unique characteristics and this implies the variability of the environmental variables. Briefly explain **FIVE (5)** characteristics that effects environmental forces in planning and design of coastal projects.

(15 marks)

Q2 (a) The geometric relationship of moon and sun locations on the Earth's surface result in creation of three different types of tides. With the aid of sketches, discuss **THREE (3)** types of tides in the Earth – Moon system.

(6 marks)

(b) Discuss **FOUR (4)** common types of coast found based on typical coastal features (phenomenological or morphological).

(10 marks)

(c)

Standard Port	LAT	MLWS	MLWN	MSL	MHWN	MHWS	HAT
Port Dickson	−0.1	0.3	1.1	1.5	1.9	2.8	3.4

where,

LAT – lowest astronomical tide
MLWS – mean low water springs
MLWN – mean low water neaps
MSL – mean sea level
MHWN – mean high water neaps
MHWS – mean high water springs
HAT – highest astronomical tide

Based on the Port Dickson tidal levels, determine

(i) Mean tidal range at Port Dickson

(2 marks)

(ii) MLWS, MLWN, MHWN, and MHWS with reference to Land Survey Datum (LSD). Note that the Admiralty Chart Datum (ACD) refers to LAT. The ACD is 1.45 m below LSD.

(7 marks)

Q3 (a) Explain the difference between Longshore Currents and Onshore-Offshore Currents.

(6 marks)

(b) Classify the following small amplitude wave based on its relative depth.

(i) Wave with height $H = 0.5$ m, and length $L = 150$ m, propagating over a depth $d = 10$ m.
(ii) Wave with height $H = 0.25$ m, and length $L = 250$ m, propagating over a depth $d = 6$ m.

(8 marks)

(c) A 2.0 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 10 m/s to 5 m/s. Compute the wave height and depth at breaking. Use **Figure 3 (c)(i)** and **Figure 3 (c)(ii)** for calculation if needed.

(11 marks)

Q4 (a) With the aid of sketches, describe a series of waves travelling from deep water into a region where the seabed has an influence over them.

(i) Refraction
(ii) Reflection
(iii) Diffraction
(iv) Breaking

(6 marks)

(b) **Figure Q4(b)** 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 5% of the wave height H_5

(9 marks)

(c) A beach revetment with slope 1:2.5, crest level 4.5 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 $T_p = 10$ s, and design water level DWL = 3.5 m CD. Assuming roughness coefficient of rock armour $r = 0.50$. Determine whether the overtopping performance of the structure is acceptable to justify its use to protect a paved promenade based on **Figure Q4(c)**.

(10 marks)

Q5 (a) As an engineer, you need to identify the important factor in coastal structure and harbour design. Identify **FIVE (5)** development factors involves in coastal and harbour construction.

(5 marks)

(b) With the aid of sketch, describe a coastal structure below.

(i) Seawall
(ii) Groin
(iii) Breakwater
(iv) Revetment

(8 marks)

(c) Determine the volume of fill material V required to nourish a beach with a berm height B = 5.0 m and width Y = 45 m where significant wave height H_s = 3.5 m. The depth of closure H = 6.75 H_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. Use **Figure 5 (c)** for calculation if needed.

(12 marks)

- END OF QUESTIONS –

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FINAL EXAMINATION

SEMESTER/SESSION: II/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

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/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

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/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

TABLE 1: 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

FINAL EXAMINATION

SEMESTER/SESSION: II/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

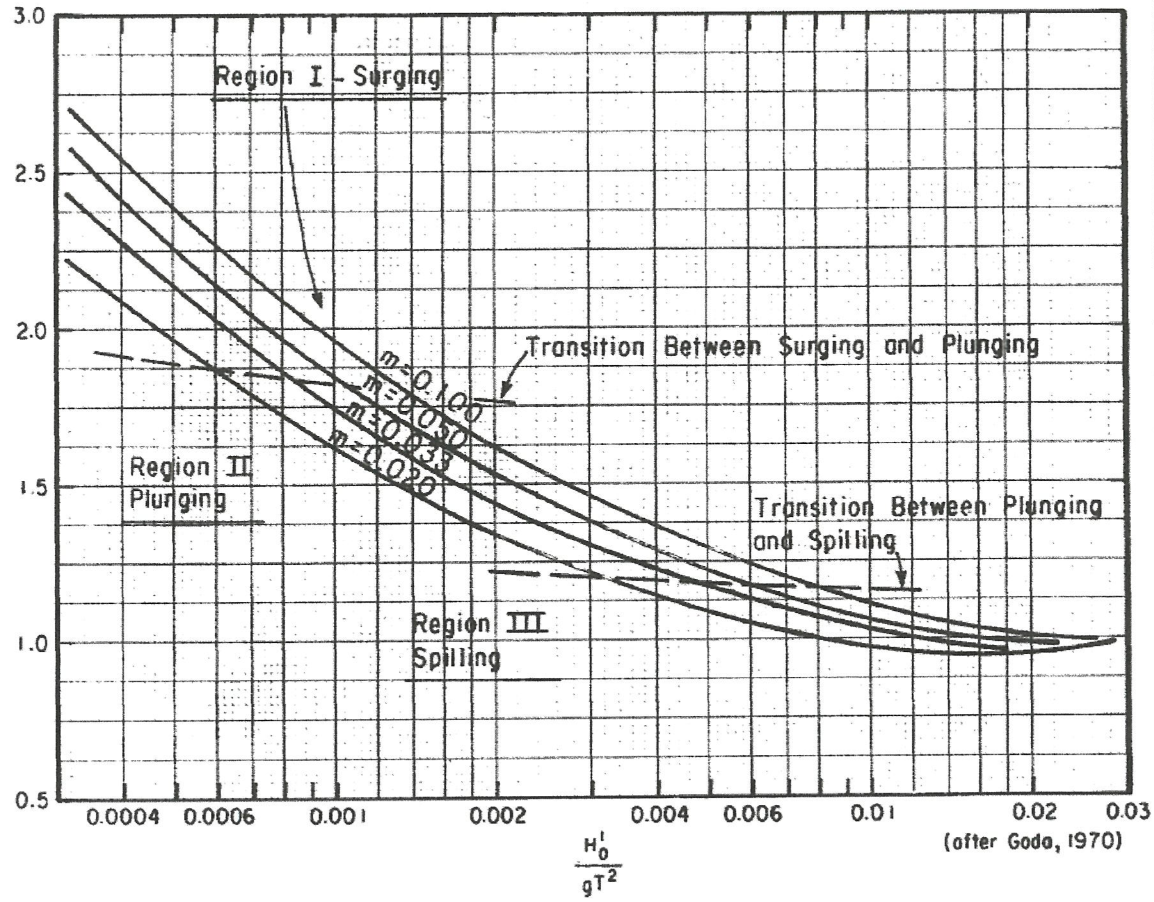

FIGURE 3(c)(i): Breaker height index versus deepwater wave steepness

FINAL EXAMINATION

SEMESTER/SESSION: II/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

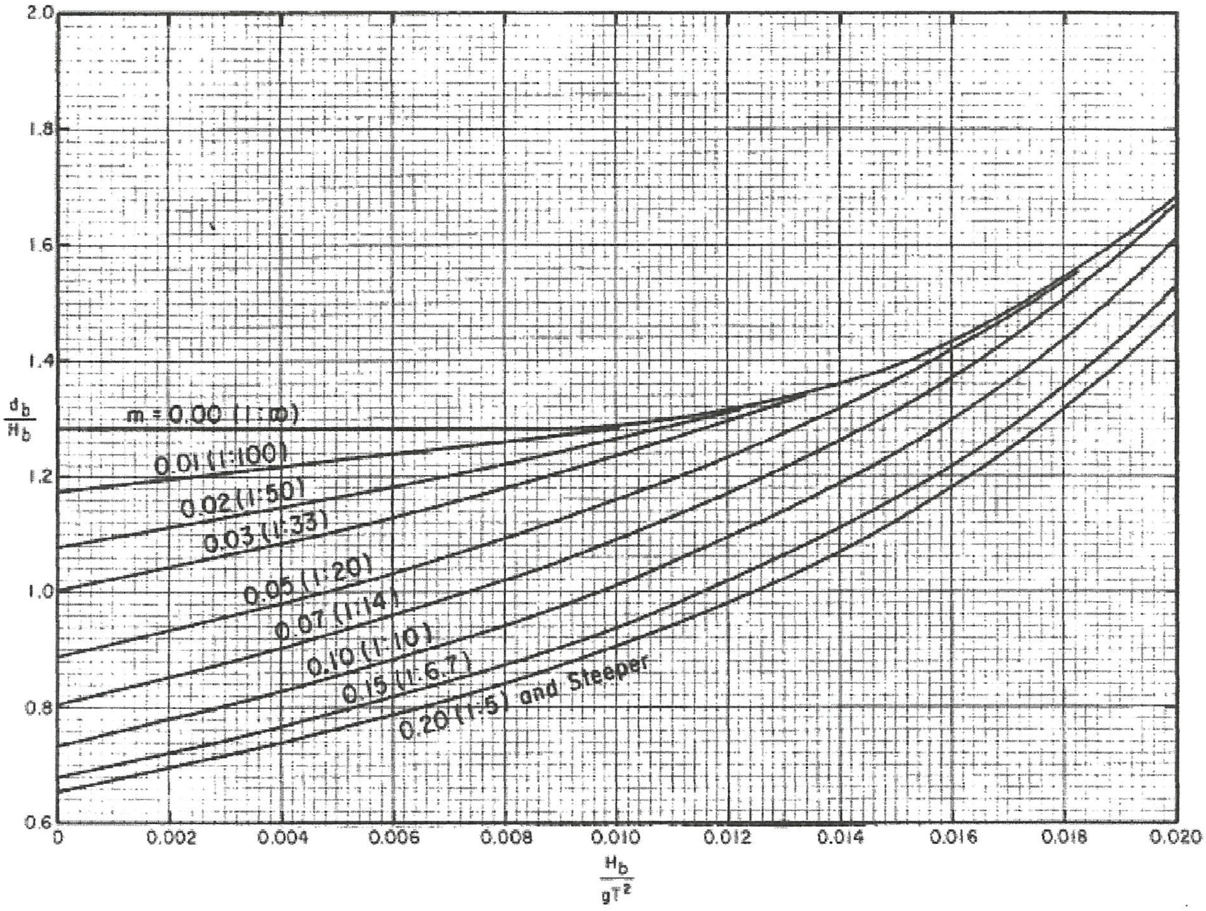

FIGURE 3 (c)(ii): Breaker index versus wave steepness

FINAL EXAMINATION

SEMESTER/SESSION: II/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

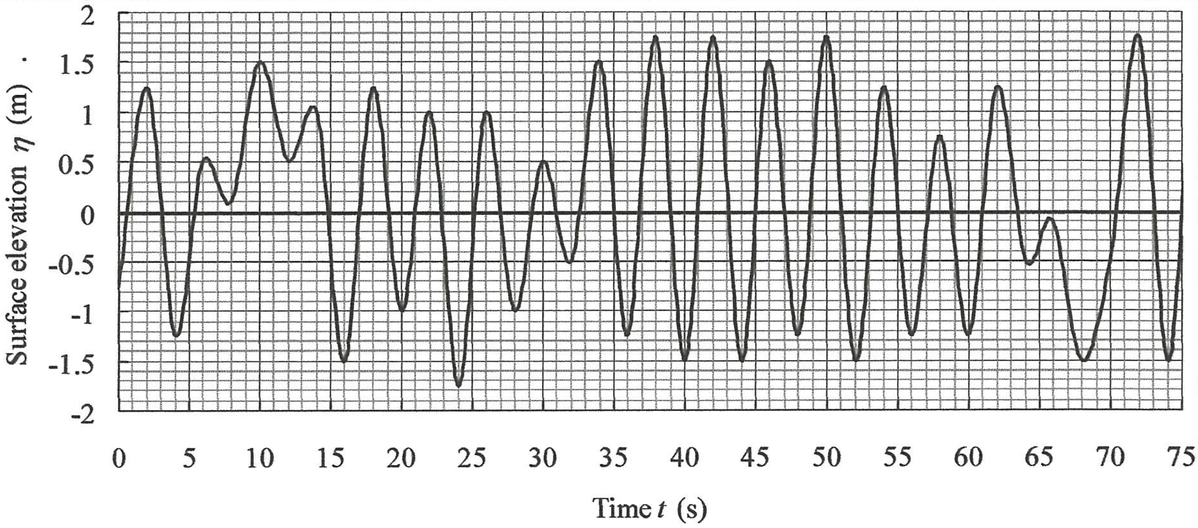

FIGURE Q4(b)

TABLE 2: 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 3: 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/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

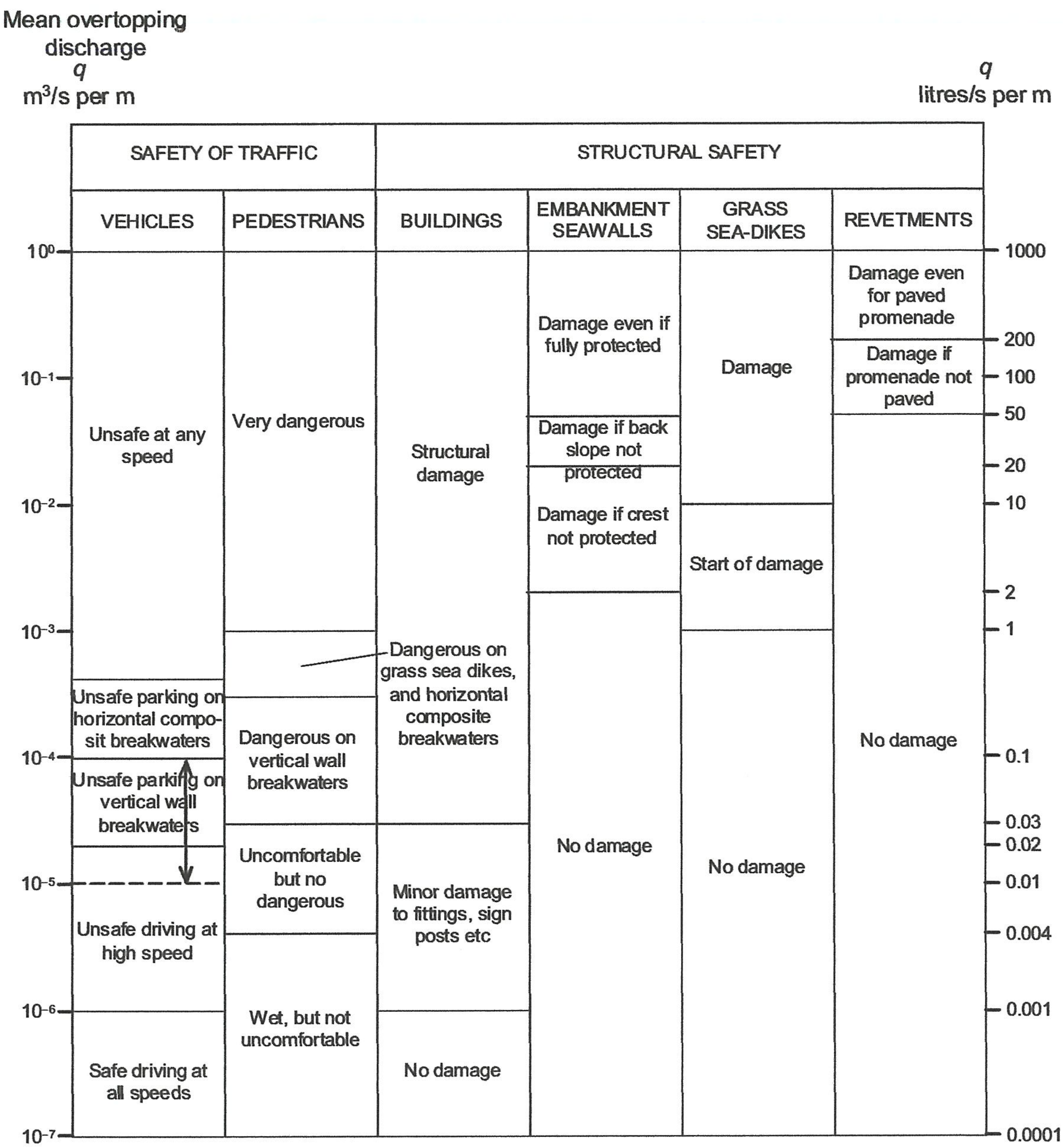

FIGURE Q4(c)

FINAL EXAMINATION

SEMESTER/SESSION: II/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

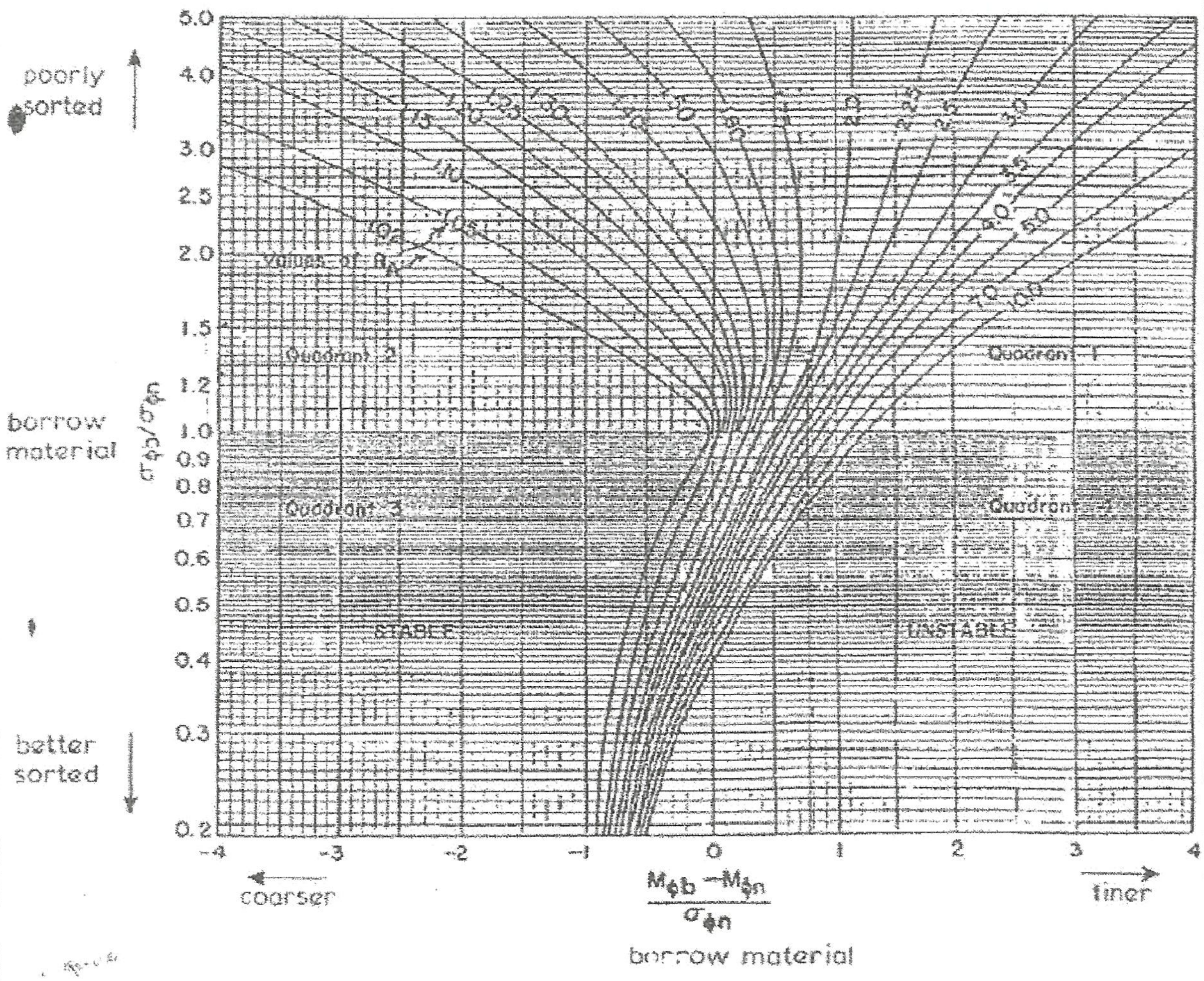

FIGURE 5 (c): Isolines of the adjusted SPM fill factor R_A

FINAL EXAMINATION

SEMESTER/SESSION: II/2017/2018 PROGRAMME : BFF

COURSE NAME : COASTAL AND HARBOR ENGINEERING COURSE CODE : BFW40303

TABLE 4: 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	