UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	COASTAL AND HARBOR ENGINEERING
COURSE CODE	:	BFW40303
PROGRAMME	:	4BFF
EXAMINATION DATE	:	DECEMBER 2013/ JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **TWELVE (12)** 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) 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 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) 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 5% of the wave height H_5

(8 marks)

Q5 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 $r = 0.50$,

(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 $\rho_w = 1025$ kg/m^3, rock armour density $\rho_r = 2700$ kg/m^3, and $K_D = 3.0$.

(7 marks)

Q6 (a) Briefly discuss **THREE (3)** gages used in wave measurements.

(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 $Y = 45$ 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)

- END OF QUESTION -

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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 $K_r = \sqrt{\dfrac{\cos\alpha_o}{\cos\alpha}}$

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

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

$$T_m = 0.82T_p$$

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

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

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

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

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

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

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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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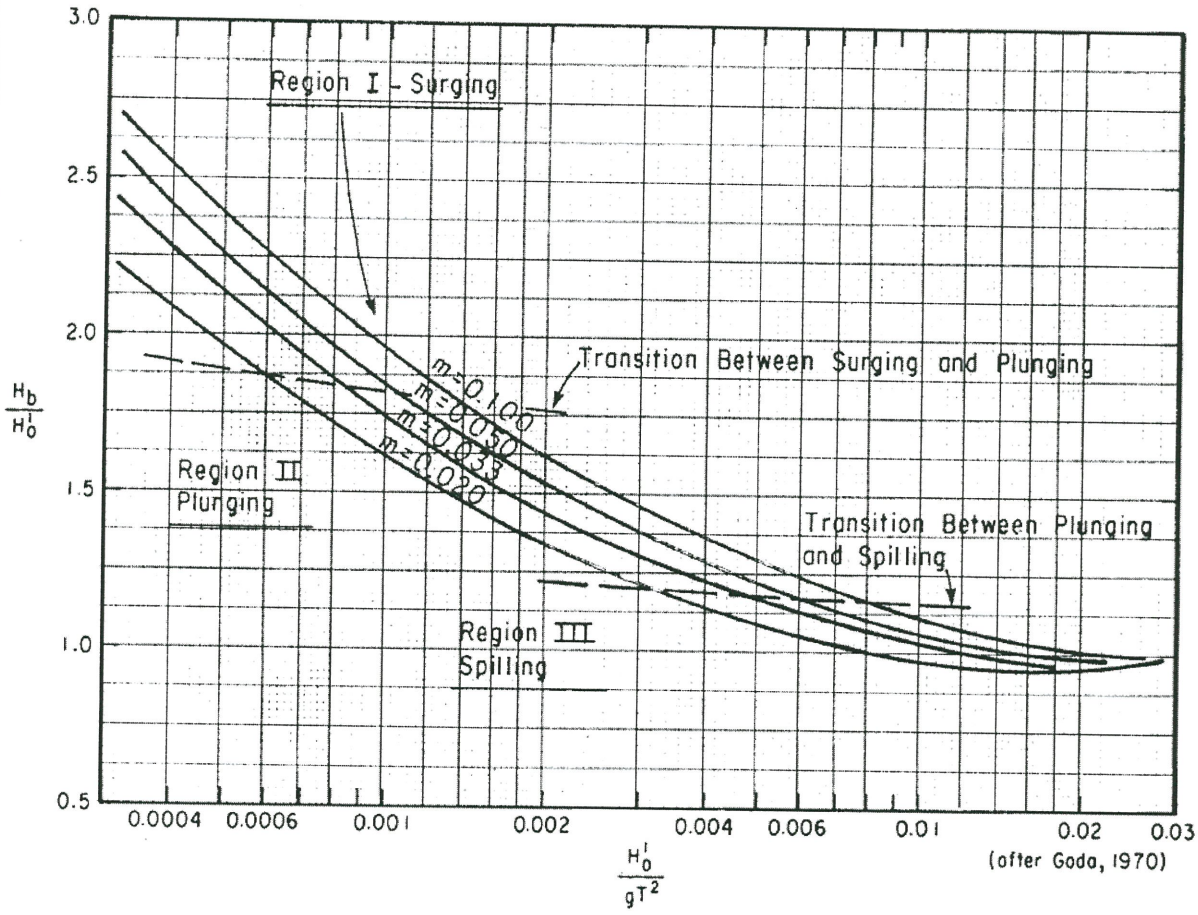

Breaker height index versus deepwater wave steepness

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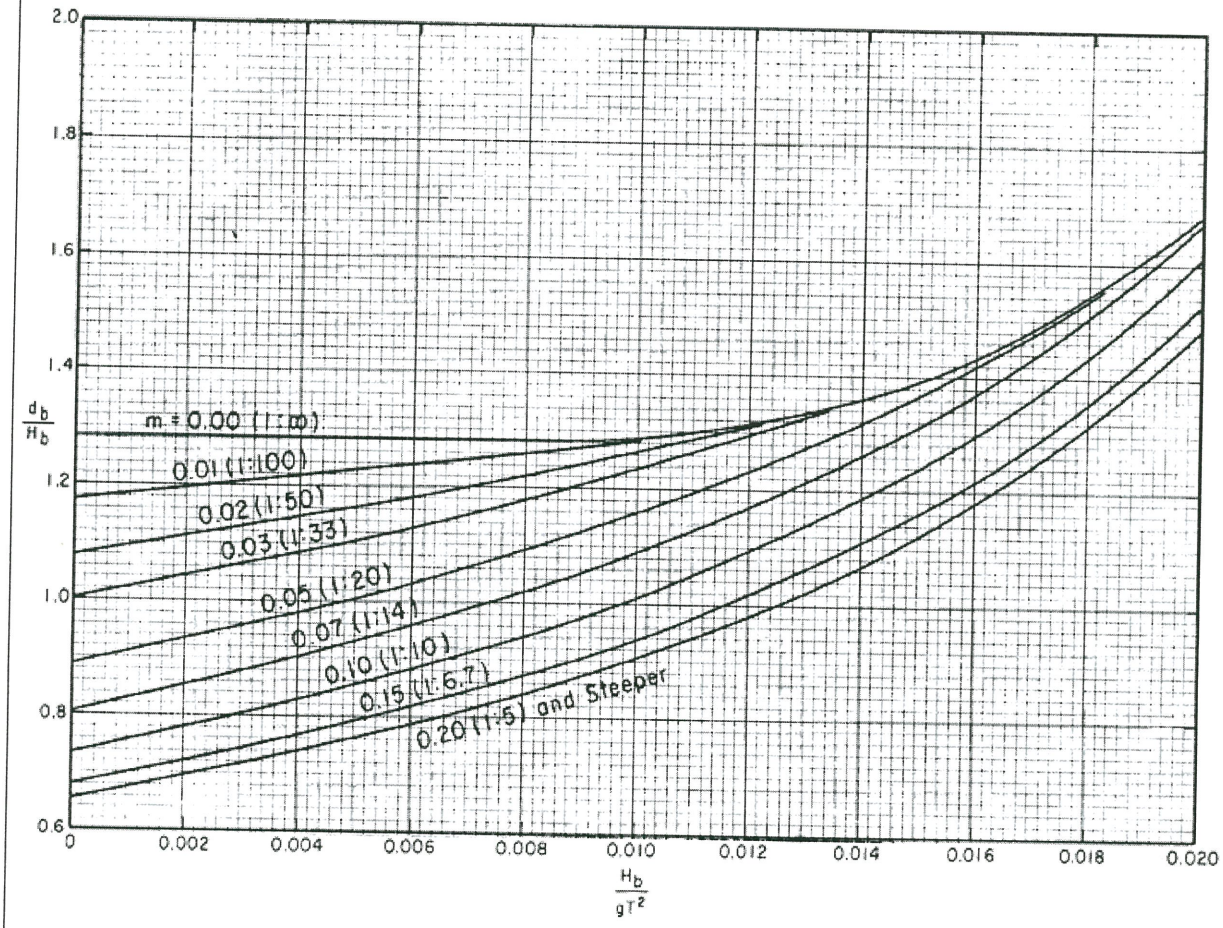

Breaker index versus wave steepness

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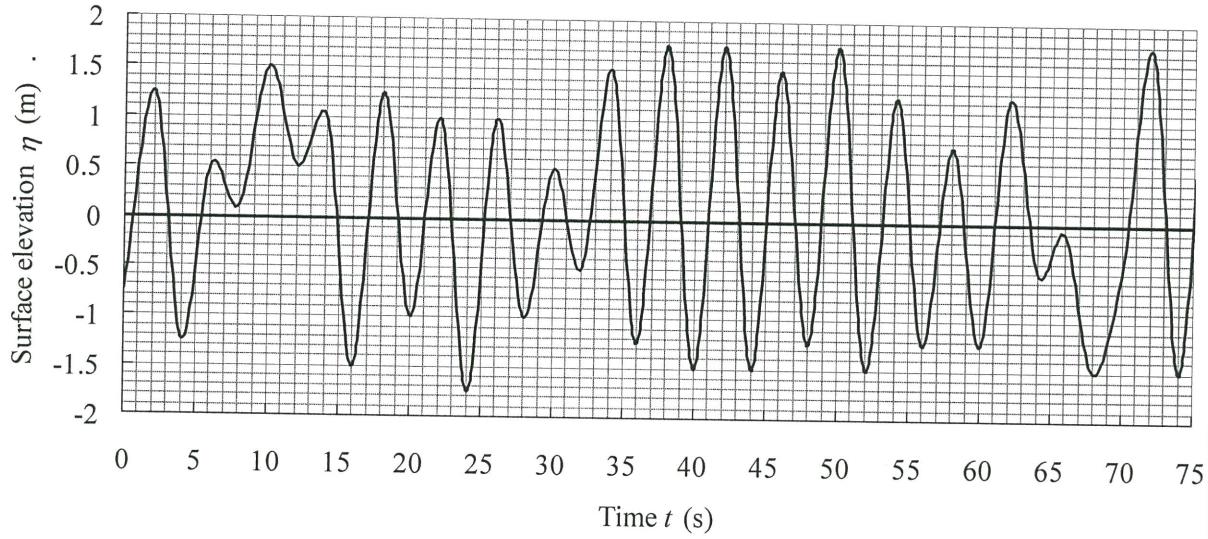

Figure Q4

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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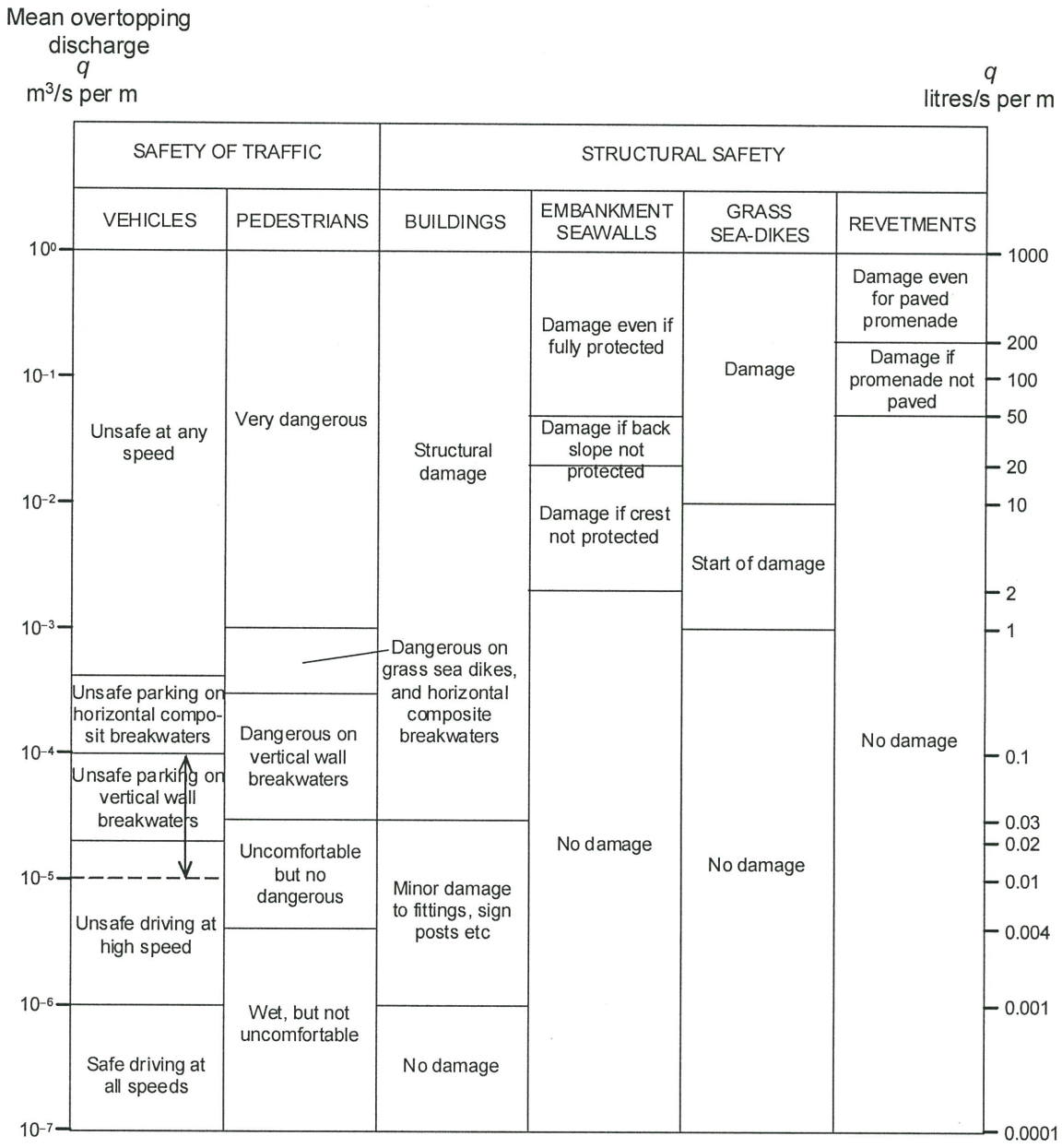

Figure Q5

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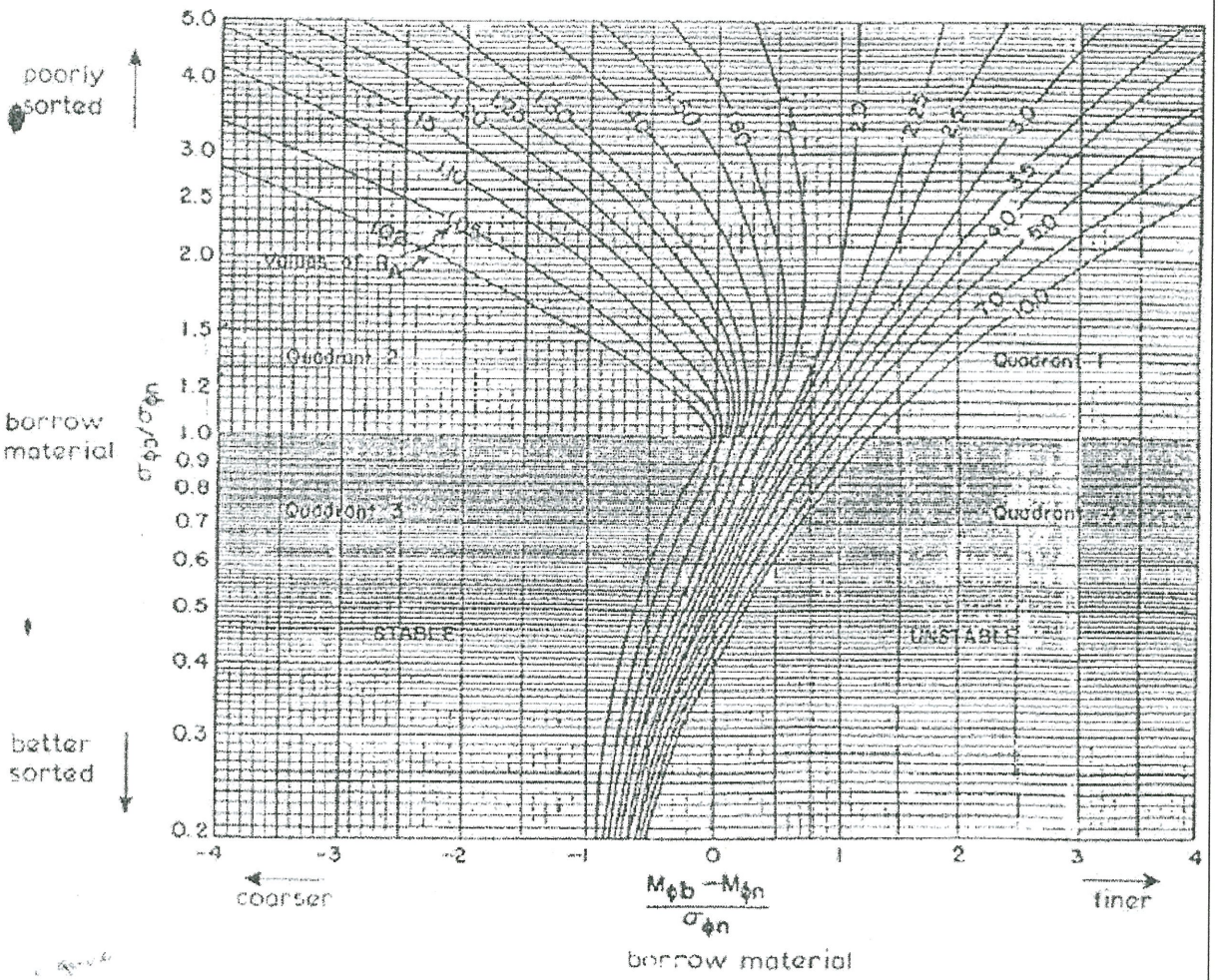

Isolines of the adjusted SPM fill factor R_A

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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	