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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	COASTAL AND HARBOUR ENGINEERING
COURSE CODE	:	BFW40303
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015/JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

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Q1 (a) Define the following coastal area morphologies and sketch typical coastal area as follows:

(i) Backshore
(ii) Shoreline
(iii) Coastline
(iv) Berm
(v) Surfzone

(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) Briefly discuss **TWO (2)** human activities which have negative impacts to coastal environment.

(5 marks)

(b)

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.

(8 marks)

(c) A sinusoidal wave with amplitude a = 0.25 m and wave period T = 7.5 s propagates over a depth d = 6 m. Calculate the horizontal displacement ξ and vertical displacement ζ at:

(i) Depth $z = 0$ and phase angle $\theta = \frac{\pi}{2}$

(ii) Depth $z = -d$ and phase angle $\theta = \frac{\pi}{2}$

(10 marks)

Q3 (a) Explain **THREE (3)** controlled factor in wind generated waves

(6 marks)

(b) Define the one dimensional wave gauges in wave measurement program

(i) Staff gauges
(ii) Pressure gauges
(iii) Acoustic gauges
(vi) Photo Pole gauges

(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.

(11 marks)

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

(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 5% of the wave height H_5

(9 marks)

(c) Given the wave respectively, C_o = 15.6 m/s, mean water depth, d = 2.3 m and wave celerity, C = 4.75 m/s which has a deep water height of 2 m and a period of 10 s and n = 1. Assume the wave crests in deep water are oriented at an angle of 35^0 with the shoreline and that the nearshore bottom contours are essentially straight and parallel to the shoreline. Determine the wave height and crest orientation with respect to the shoreline when the wave propagates into water 2.3 m deep.

(10 marks)

Q5 (a) As an engineer, you need to identify the important factors 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.

(12 marks)

- END OF QUESTION –

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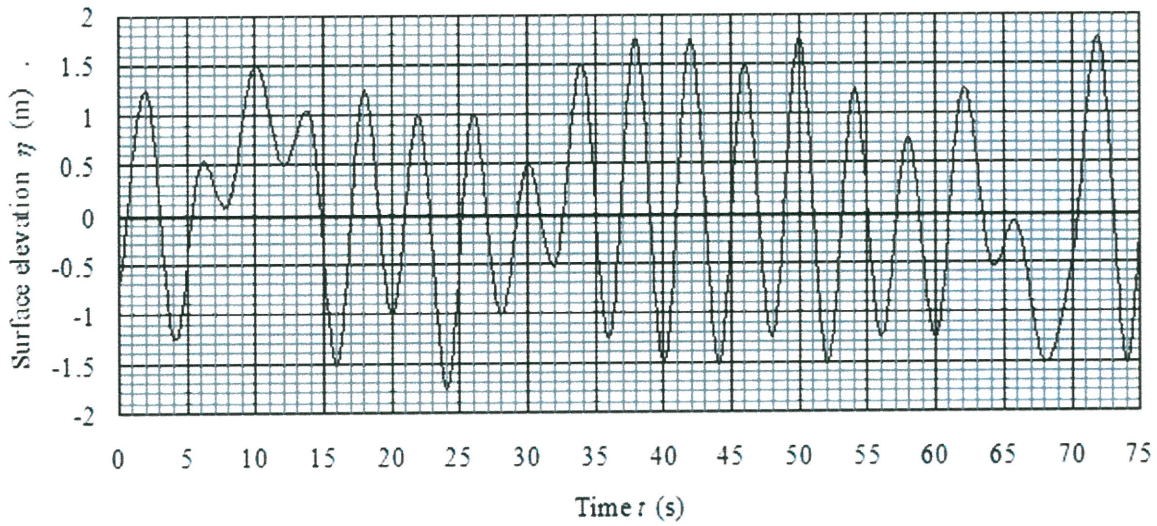

FIGURE Q4

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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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Supplementary Materials

Table1: 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 2: 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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Table 3: 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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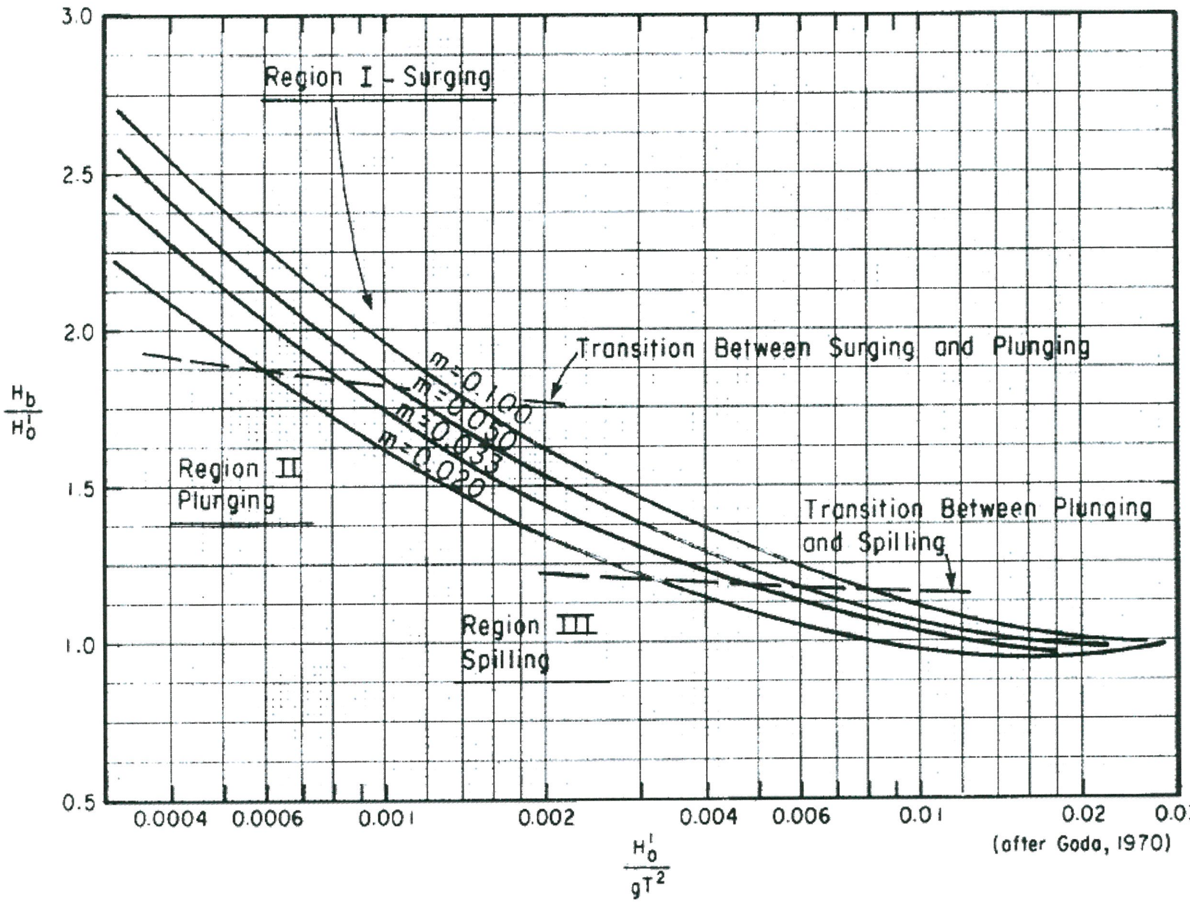

Figure of breaker height index versus deepwater wave steepness

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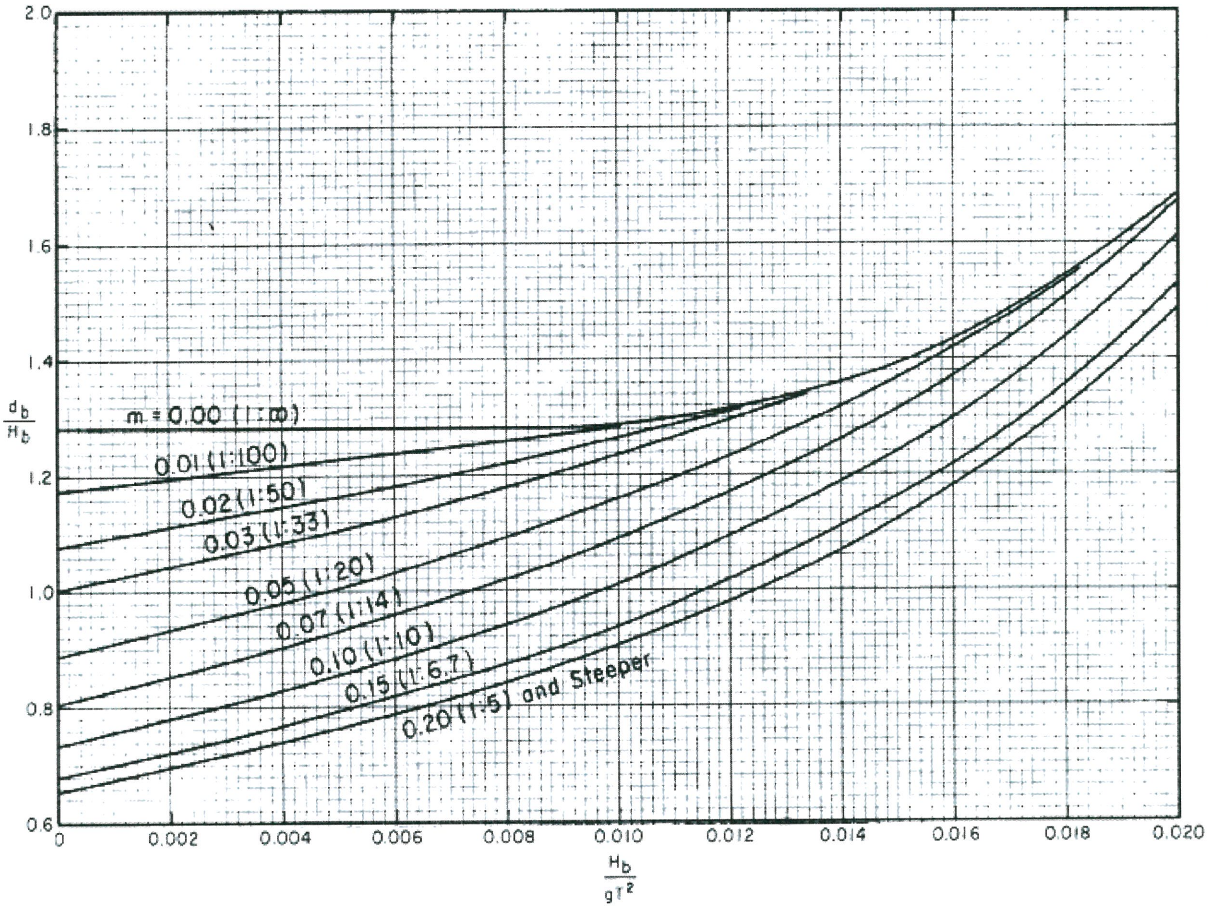

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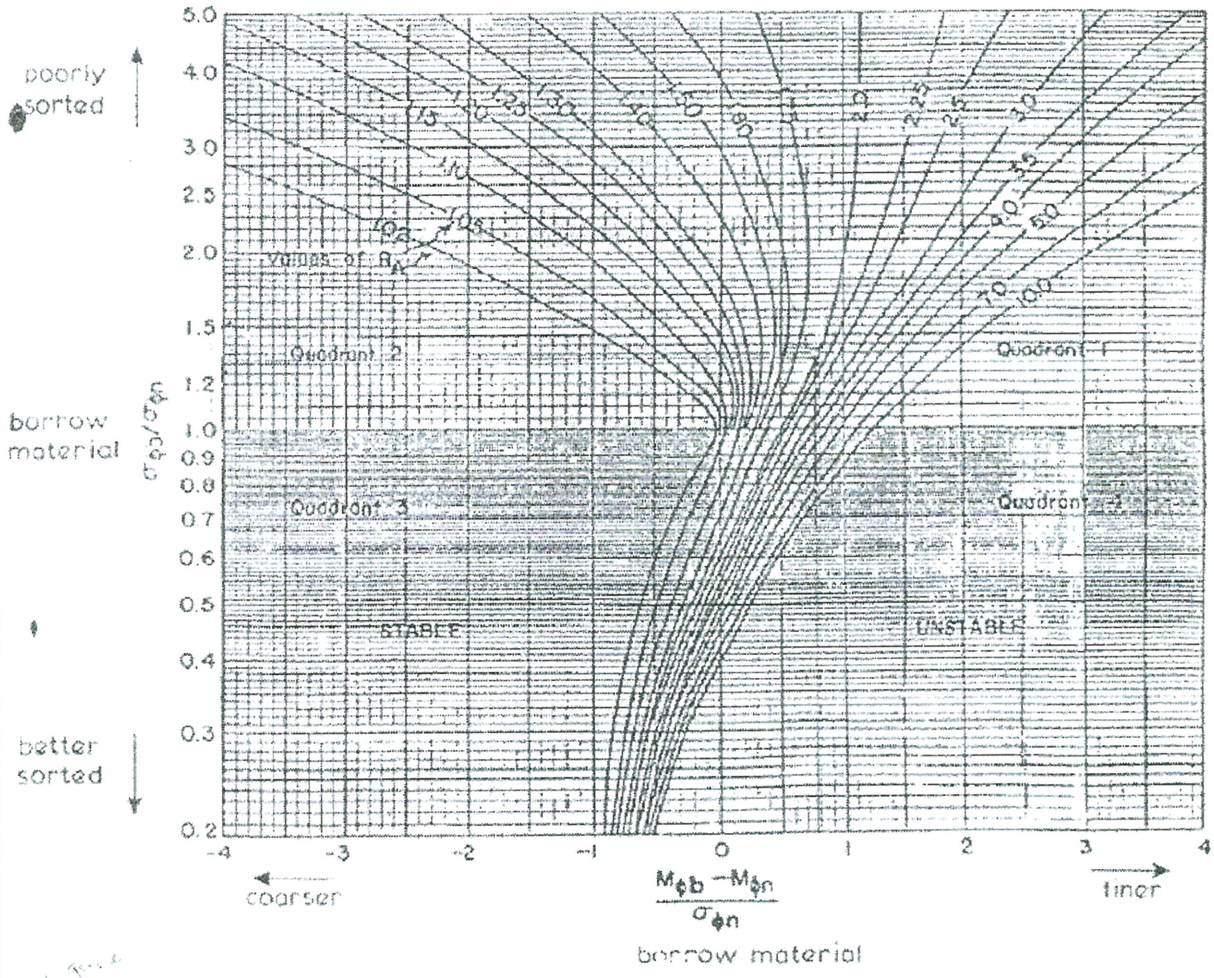

Figure of Isolines of the adjusted SPM fill factor R_A

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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	