UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	CIVIL ENGINEERING MATERIAL
COURSE CODE	:	BFC10502
PROGRAMME	:	1 BFF
EXAMINATION DATE	:	APRIL / MAY 2011
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER ALL QUESTION IN PART A AND THREE (3) QUESTIONS IN PART B. ATTACH THE APPENDIX IN YOUR ANSWER SCRIPT.

THIS PAPER CONSISTS OF TWELVE (12) PAGES

PART A

Q1 You are assigned to complete the laboratory experiment. The first objective is to complete the mix design form according to DOE method. Before doing the concrete mix, you need to carry out the sieve analysis in determining the percentage passing of 600μm.
Given,

i. Characteristic compressive strength, 32 N/mm^2 at 28 days with a 10% defective rate (k = 1.28)
ii. Ordinary Portland cement
iii. Slump required, 10 – 30 mm
iv. Maximum crushed aggregate size, 20mm,
v. Relative density of crushed aggregate (SSD), 2700 kg/m^3
vii. Standard deviation is 8 N/mm^2
viii. Trial mix (cube size) is 100mm x 100mm x 100mm

(a) List **Five (5)** process involved in sieve analysis test for fine aggregate.

(5 marks)

(b) Table **Q1** show the result of sieve analysis for fine aggregate. Complete the table.

(14 marks)

(c) Use the result of percentage passing 600μm obtained in Table **Q1** to complete the Design Mix Form.

(12 marks)

(d) The second objective of experiment is to determine the compressive strength of cubes in 3 days, 7 days, 14 days and 28 days. The total of cubes used is 12 cubes. Referring to the complete of Design Mix Form, determine the new mass of water, cement, fine aggregate and coarse aggregate.

(4 marks)

(e) The third objective of experiment is to use the recycled aggregate in concrete mix. The percentage of recycled aggregate used to replace the coarse aggregate is 0%, 10%, 20%, 30% and 40%. Referring to the new mass of coarse aggregate that obtained in **Q1 (d)**, determine the mass of recycled aggregate and coarse aggregate used in this experiment.

(5 marks)

PART B

Q2 (a) Give the definition, the usage and the chemical composition of the cement.

(6 marks)

(b) Name **Two (2)** types of Portland Cement. Explain each of it.

(6 marks)

(c) List **five (5)** tests can be conducted on cement.

(5 marks)

(d) What is the cement hydration? Give **One (1)** example.

(3 marks)

Q3 (a) List **three (3)** types of clay used in brick manufacturer.

(3 marks)

(b) A severe weathering clay brick were tested for water absorption and saturation coefficient according to ASTM C67 procedure. The following data;

Dry mass specimen = 1.822 kg
Saturated mass after 24 hour submersion in cold water = 2.044 kg
Saturated mass after 5 hour submersion in boiling water = 2.060 kg

i. Calculate the water absorption after 24 hour submersion in cold water.

(3 marks)

ii. Calculate the water absorption after5 hour submersion in boiling water.

(3 marks)

iii. Calculate the saturation coefficient.

(3 marks)

iv. The maximum saturation coefficient for ASTM requirement is 0.9. Does the result satisfy the ASTM requirement?

(1 mark)

(c) Name **Three (3)** advantages of the bricks if it fulfills the ASTM requirement.

(3 marks)

(d) One unit of concrete masonry is tested according to ASTM C140 procedure and produced the following result;

Mass of unit as received = 10.355 g
Saturated mass of unit = 11.088 g
Oven dry mass of unit = 9894 g

i. Determine the percentage of water absorption.

(2 marks)

ii. Determine the moisture content of the unit as a percent of total absorption.

(2 marks)

Q4 (a) List **Three (3)** types of hardwood and explain all.

(6 marks)

(b) Give **Three (3)** advantages and **Three (3)** disadvantages of using timber as a construction material.

(6 marks)

(c) Explain briefly **Four (4)** types of timber treatment and curing method.

(8 marks)

Q5 (a) List **Four (4)** classification of steel.

(4 marks)

(b) Explain the process involved in Bessemer process and sketch the diagram of Bessemer converter.

(8 marks)

(c) Give **Two (2)** differences between hardness and hardenability.

(4 marks)

(d) You are assigned to determine the hardenability of steel. As an Engineer of Quality Assurance in steel factory, what should you do?

(4 marks)

Q6 Briefly discuss the following topics:

(a) The use of bitumen in the field of civil engineering

(5 marks)

(b) The advantages of Elastomer Rubber

(5 marks)

(c) The types and uses of plastic.

(5 marks)

(d) The types and uses of glass in industries

(5 marks)

BAHAGIAN A

S1 Anda ditugaskan untuk menjalankan eksperimen makmal. Objektif yang pertama untuk melengkapkan borang rekabentuk campuran konkrit menurut kaedah DOE. Sebelum melakukan campuran konkrit, anda perlu menjalankan analisis pengasingan untuk mendapatkan peratus melepasi 600μm.

Diberi;

i. Kekuatan mampatan ciri, 32 N/mm^2 pada hari ke-28 dengan kadar peratus rosak 10% (k = 1.28)
ii. Normal Portland Simen
iii. Slump yang dikehendaki, 10 – 30 mm
iv. Saiz maksimum agregat terhancur, 20 mm
v. Ketumpatan bandingan agregat terhancur, 2700 kg/m^3
vi. Kadar peratus rosak 8%
vii. Campuran percubaan (saiz kiub):100mm x 100mm x 100mm

(a) Senaraikan **Lima(5)** proses yang terlibat dalam melakukan ujian analisis pengasingan untuk batu baur halus.

(5 markah)

(b) Jadual **Q1** menunjukkan keputusan analisis pengasingan untuk batu baur halus. Lengkapkan jadual ini dan tentukan peratus melepasi ayakan 600 μm.

(14 markah)

(c) Menggunakan keputusan peratus melepasi 600μm yang diperolehi dari Jadual **Q1**, lengkapkan borang rekabentuk campuran konkrit menurut kaedah DOE.

(12 markah)

(d) Objektif kedua eksperimen ialah untuk mendapatkan kekuatan 'compressive' kiub untuk 3 hari, 7 hari, 14 hari dan 28 hari. Jumlah kiub yang digunakan ialah 12. Merujuk kepada borang rekabentuk campuran konkrit yang lengkap, dapatkan berat baru bagi air, simen, batu baur halus dan batu baur kasar.

(4 markah)

(e) Objektif ketiga eksperimen ialah menggunakan batu baur terpakai di dalam bancuhan konkrit. Peratus batu baur terpakai yang digunakan untuk menggantikan batu baur kasar ialah 0%, 10%, 20%, 30% and 40%. Merujuk kepada berat baru batu baur kasar yang telah diperolehi dalam **S1 (d)**, dapatkan berat batu baur terpakai dan batu baur kasar untuk eksperimen ini.

(5 markah)

BAHAGIAN A

S2 (a) Terangkan makna simen, kegunaan dan campuran kimianya.

(6 markah)

(b) Senaraikan **Dua (2)** jenis Portland Simen. Terangkan setiap satu.

(6 markah)

(c) Senaraikan **Lima (5)** ujian yang boleh dilakukan ke atas simen.

(5 markah)

(d) Terangkan proses hidrasi simen.

(3 markah)

S3 (a) Senaraikan **Tiga (3)** jenis tanah liat yang digunakan untuk pembuatan bata.

(3 markah)

(b) Beberapa bata tanah liat telah diuji untuk penyerapan air dan pekali saturasi mengikut ASTM C67. Berikut adalah data yang diperolehi,

Berat kering specimen = 1.822 kg
Berat saturasi selepas 24 jam rendaman dalam air sejuk = 2.044 kg
Berat saturasi selepas 5 jam rendaman dalam air mendidih = 2.060 kg

i. Kira penyerapan air selepas 24 jam rendaman dalam air sejuk.

(3 markah)

ii. Kira penyerapan air untuk 5 jam rendaman dalam air mendidih

(3 markah)

iii. Kira pekali ketepuan.

(3 markah)

iii. Pekali ketepuan untuk keperluan ASTM ialah 0.9. Adakah keputusan memenuhi keperluan ASTM?

(1 markah)

(c) Senaraikan **Tiga (3)** kepentingan bata sekiranya ia memenuhi piwaian ASTM..

(3 markah)

(d) Satu unit konkrit masonry telah diuji mengikut ASTM C140 dan berikut adalah data yang diperolehi;

Berat unit yang diterima = 10.355 g
Berat unit untuk saturasi = 11.088 g
Berat kering untuk unit = 9894 g

i. Kirakan peratus air serapan.

(2 markah)

ii. Kirakan kandungan lembapan sebagai peratus jumlah penyerapan

(2 markah)

S4 (a) Senaraikan **tiga (3)** jenis kayu keras dan terangkan kesemuanya.

(6 markah)

(b) Berikan **tiga (3)** kebaikan dan **tiga (3)** keburukan menggunakan kayu sebagai bahan pembinaan.

(6 markah)

(c) Terangkan secara ringkas **empat (4)** jenis rawatan kayu dan pengawetan.

(8 markah)

S5 (a) Senaraikan **empat (4)** klasifikasi besi.

(4 markah)

(e) Terangkan proses yang terlibat dalam Bessemer dan lakarkan rajah Bessemer converter.

(8 markah)

(c) Berikan **dua (2)** perbezaan antara 'hardness' dan 'hardenability'.

(4 markah)

(d) Sebagai Jurutera Kualiti di kilang besi., anda ditugaskan untuk mendapatkan 'hardenability' besi. Apa yang perlu anda lakukan?

(4 markah)

S6 Bincangkan secara ringkas untuk topik di bawah:

(a) Kegunaan bitumen di lapangan kejuruteraan awam.

(5 markah)

(b) Kebaikan Elastomer Rubber

(5 markah)

(c) Jenis dan kegunaan plastik.

(5 markah)

(d) Jenis dan kegunaan gelas dalam industri.

(5 markah)

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NAME : _____

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LECTURER NAME: _____

SECTION NO. : _____

Table 1: Result of Sieve Analysis

BS410 Sieve size (mm)	Weight of aggregate retained (g)	Percentage retained	Cumulative percentage passing
5.00mm	0		
2.36mm	35		
1.18mm	42		
600μm	45		
300μm	50		
150μm	34		
Pan	10		

NAME : _____

STUDENT ID. NO: _____ I/C NO or PASSPORT NO. : _____

LECTURER NAME: _____

SECTION NO. : _____

Design Mix Form

Job title .....

Stage	Item		Reference or calculation	Values
1	1.1	Characteristic strength	Specified	..... N/mm² at ..... days Proportion defective ..... %
	1.2	Standard deviation	Fig 3	..... N/mm² or no data ..... N/mm²
	1.3	Margin	C1 or Specified	(*k* = ...) ..... × ..... = ... N/mm² ..... N/mm²
	1.4	Target mean strength	C2	..... + ... = ... N/mm²
	1.5	Cement strength class	Specified	42.5/52.5
	1.6	Aggregate type: coarse Aggregate type: fine		Crushed/uncrushed Crushed/uncrushed
	1.7	Free-water/cement ratio	Table 2 Fig 1	.....
	1.8	*Maximum free-water/ cement ratio*	*Specified*	..... Use the lower value [ ]
2	2.1	Slump or Vebe time	Specified	Slump ..... mm or Vebe time ..... s
	2.2	Maximum aggregate size	Specified	..... mm
	2.3	Free-water content	Table 3	..... [ ] kg/m³
3	3.1	Cement content	C3	..... + ... = ... kg/m³
	3.2	*Maximum cement content*	*Specified*	..... kg/m³
	3.3	*Minimum cement content*	*Specified*	..... kg/m³
				use 3.1 if ≤ 3.2 use 3.3 if > 3.1 [ ] kg/m³
	3.4	Modified free-water/cement ratio		..... [ ]
4	4.1	Relative density of aggregate (SSD)		..... known/assumed
	4.2	Concrete density	Fig 2	..... kg/m³
	4.3	Total aggregate content	C4	..... − ..... − ..... = ... kg/m³
5	5.1	Grading of fine aggregate	Percentage passing 600 μm sieve	..... %
	5.2	Proportion of fine aggregate	Fig 3	..... %
	5.3	Fine aggregate content	C5	..... × ..... = [ ] kg/m³
	5.4	Coarse aggregate content	C5	..... − ..... = [ ] kg/m³

Quantities	Cement (kg)	Water (kg or litres)	Fine aggregate (kg)	Coarse aggregate (kg) 10 mm	20 mm	40 mm
per m³ (to nearest 5 kg)	.....	.....	.....	.....	.....	.....
per trial mix of ..... m³	.....	.....	.....	.....	.....	.....

Items in italics are optional limiting values that may be specified (see Section 7).
Concrete strength is expressed in the units N/mm². 1 N/mm² = 1 MN/m² = 1 MPa. (N = newton; Pa = pascal.)
The internationally known term 'relative density' used here is synonymous with 'specific gravity' and is the ratio of the mass of a given volume of substance to the mass of an equal volume of water.
SSD = based on the saturated surface-dry condition.

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Table 2: Approximate compressive strengths of concrete made with a free water/cement ratio of 0.5 according to the DOE Method

Type of cement	Cement strength class	Type of coarse aggregate	Compressive strength* (MPa(psi)) at the age of (days)			
			3	7	28	91
Ordinary Portland (Type I)	42.5	Uncrushed	22 (3200)	30 (3200)	42 (6100)	49 (7100)
Sulfate-resisting Portland (Type V)		Crushed	27 (3900)	36 (5200)	49 (7100)	56 (8100)
Rapid-hardening Portland (Type III)	52.5	Uncrushed	29 (4200)	37 (5400)	48 (7000)	54 (7800)
		Crushed	34 (4900)	43 (6200)	55 (8000)	61 (8900)

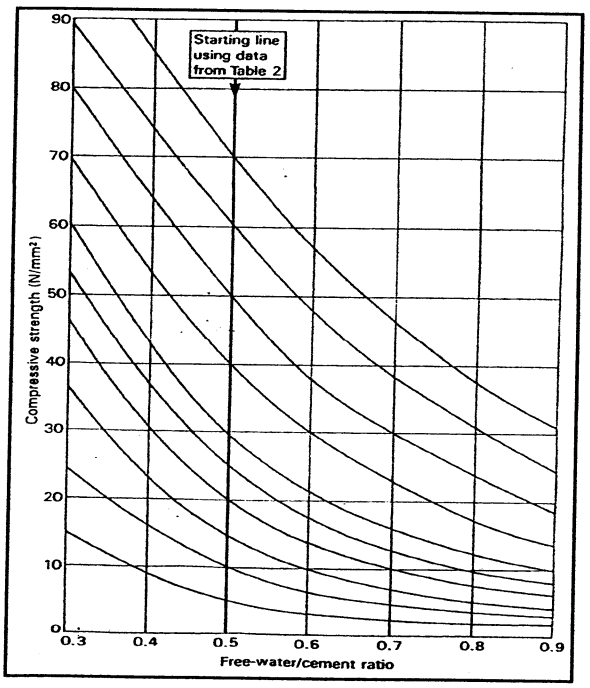

Figure 1: Relationship between cube compressive strength and free water/cement ratio

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Table 3 Approximate free-water contents (kg/m^3) required to give various levels of workability

Slump (mm)		0–10	10–30	30–60	60–180
Vebe time (s)		>12	6–12	3–6	0–3
Maximum size of aggregate (mm)	Type of aggregate				
10	Uncrushed	150	180	205	225
	Crushed	180	205	230	250
20	Uncrushed	135	160	180	195
	Crushed	170	190	210	225
40	Uncrushed	115	140	160	175
	Crushed	155	175	190	205

Note: When coarse and fine aggregates of different types are used, the free-water content is estimated by the expression:

$$\frac{2}{3} W_f + \frac{1}{3} W_c$$

where W_f = free-water content appropriate to type of fine aggregate
and W_c = free-water content approporiate to type of coarse aggregate.

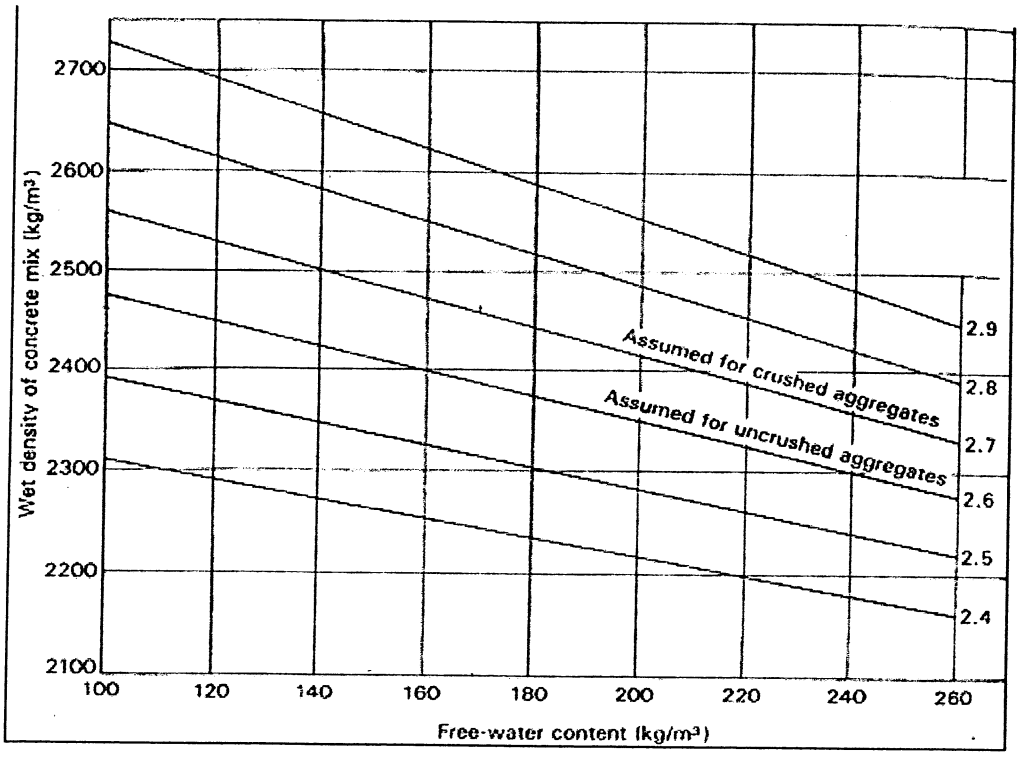

Figure 2: Estimate wet density of fully compacted concrete

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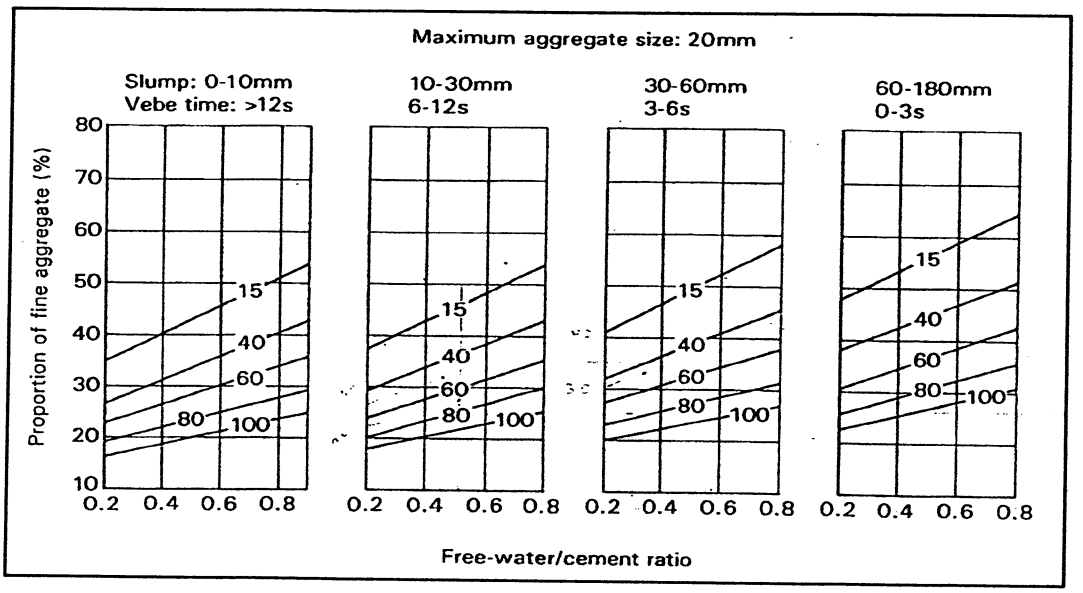

Figure 3: Proportions of fine aggregates for grading zones 1,2,3,4