UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	CIVIL ENGINEERING MATERIALS
SUBJECT CODE	:	BFC 1032
COURSE	:	BFF
EXAMINATION DATE	:	APRIL / MAY 2010
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS FROM **PART A** AND **THREE (3)** QUESTIONS FROM **PART B.**

THIS PAPER CONSISTS NINE (9) PAGES

PART A: ANSWER ALL QUESTIONS

Q1 (a) What is the definition of fresh concrete?

(2 marks)

(b) State the British Standards for testing the workability, compressive strength and durability of concrete.

(3 marks)

(c) List **Three (3)** main characteristics of workability

(3 marks)

(d) List **Two (2)** methods of concrete mix design.

(2 marks)

(e) Write mathematical expressions showing the relationship between target mean strength, characteristic strength and margin for the mix design of concrete. State the typical values of probability factors and standard deviation used in the mix design.

(5 marks)

(f) Complete the concrete mix design form provided according to the DOE method.
Given,

i. Characteristic compressive strength, 30 N/mm^2 at 28 days with a 5% defective rate (k = 1.64)
ii. Portland cement class 42.5
iii. Slump required, 30 – 60 mm
iv. Maximum crushed aggregate size, 20mm,
v. Relative density of crushed aggregate, 2700 kg/m^3
vi. Maximum free-water/ cement ratio 0.55
vii. Percentage passing 600μm sieve is 55%

(10 marks)

PART B: ANSWER THREE (3) QUESTIONS ONLY

Q2 (a) Explain briefly the process to produce cement based on wet and dry methods with the aid of sketches, flow chart and labels.

(10 marks)

(b) List **Four (4)** types of Portland cements. Then, briefly explain **One (1)** of them.

(6 marks)

(c) What are the definitions of initial setting time and final setting time of cement?

(4 marks)

(d) Write and explain the chemical reaction during cement hydration.

(3 marks)

(e) List **Two (2)** types of cement testing.

(2 marks)

Q3 (a) State the British Standards for sampling and testing of aggregates. Describe briefly the tests for particle size distribution.

(7 marks)

(b) Aggregates are assumed to be saturated surface dry when used in the concrete mix design. Describe briefly a method to determine free water on aggregate.

(5 marks)

(c) List **Four (4)** types of aggregate physical properties

(4 marks)

(d) Sketch the Los Angeles abrasion machine and briefly describe the test to evaluate the aggregate toughness and abrasion resistance.

(4 marks)

(e) Write short notes on the use of alternative aggregates for sustainable construction in countries facing problems of depleting resources.

(5 marks)

Q4 (a) List **Three (3)** types of brick available in the market.

(3 marks)

(b) The percentage of water absorption is indicated the degree of burning.

(i) Give **Two (2)** tests that can be used to perform in absorption test.

(2 marks)

(ii) The data below is obtained from brick test in the laboratory.

Brick size A	: 220 mm x 110 mm x 65 mm
Brick size B	: 219 mm x 112 mm x 64 mm
Mass of dried brick size A	: 2.65 kg
Mass of wet brick size A	: 2.9 kg
Mass of dried brick size B	: 2.70 kg
Mass of wet brick size B	: 2.88 kg

List the procedure involved in determining the compressive strength for brick. Calculate the average percentage of water absorption and average density.

(10 marks)

(c) Sketch and explain the process involved in manufacturing the calcium silicate brick.

(6 marks)

(d) All brickwork should be kept dry and free from contamination. How does this situation give the influence to the properties of brick?

(4 marks)

Q5 (a) List **Two (2)** types of tropical timber species

(2 marks)

(b) Write **Four (4)** characteristics for each softwood and hardwood

(8 marks)

(c) Briefly explain the formation of annual ring for temperate species

(5 marks)

(d) Briefly explain about the difference between heavy hardwood and light hardwood

(6 marks)

(e) The use of timber structure is decreasing compared to the other materials such as concrete and steel. In your opinion, what is the best method to increase the use of timber and at the same time to ensure the green house effect is still preserved.

(4 marks)

Q6 (a) Give **Three (3)** example types of steel and list the uses of each types of steel that available in the market.

(6 marks)

(b) List **Four (4)** differences between mild steel and high yield steel as the bar reinforcement in concrete.

(4 marks)

(c) Bessemer process is one of the methods of manufacturing steel. Sketch the schematic diagram of Bessemer converter and explain the process involved.

(10 marks)

(d) 'Steel versus concrete'.
Some parties claim that steel material can be used to replace the concrete application in the building construction building. What is your opinion?

(5 marks)

BAHAGIAN A: JAWAB SEMUA SOALAN

S1 (a) Apakah definisi konkrit basah

(2 markah)

(b) Nyatakan Piawaian British bagi ujian kebolehkerjaan, kekuatan mampatan dan ketahanan konkrit

(3 markah)

(c) Senaraikan **Tiga (3)** ciri-ciri utama kebolehkerjaan

(3 markah)

(d) Senaraikan **Dua (2)** kaedah rekabentuk campuran konkrit.

(2 markah)

(e) Tulis persamaan-persamaan matematik yang menunjukkan hubingan antara sasaran purata kekuatan, kekuatan ciri dan jidar untuk rekabentuk campuran konkrit. Nyatakan nilai-nilai tipikal bagi faktor-faktor kemungkinan dan sisihan piawai yang digunakan dalam rekabentuk campuran.

(5 markah)

(f) Lengkapkan borang rekabentuk campuran konkrit yang dilampirkan menurut kaedah DOE

Diberi,

i. Kekuatan mampatan cirri, 30 N/mm^2 pada hari ke-28 dengan kadar peratus rosak 5% (k = 1.64)
ii. Kelas simen Porland 42.5
iii. Slump yang dikehendaki, 30 – 60 mm
iv. Saiz maksimum agregat terhancur, 20 mm
v. Ketumpatan bandingan agregat terhancur, 2700 kg/m^3
vi. Air bebas/ nisbah air maksimum ialah 0.55
vii. Peratus melepasi ayakan 600μm ialah 55%

(10 markah)

BAHAGIAN B: JAWAB TIGA (3) SOALAN SAHAJA

S2 (a) Terang secara ringkas proses pembuatan simen berdasarkan kepada kaedah basah dan kering dengan menggunakan bantuan lakaran, carta alir dan label.

(10 markah)

(b) Senaraikan **Empat (4)** jenis simen Portland. Kemudian, terangkan secara ringkas salah satu antaranya.

(6 markah)

(c) Apakah definisi masa pemejalan awal dan masa pemejalan akhir

(4 markah)

(d) Tulis dan jelaskan tindakbalas kimia semasa proses hidrasi

(3 markah)

(e) Senarai **Dua (2)** jenis ujian simen

(2 markah)

S3 (a) Nyatakan piawaian British untuk persampelan dan ujian agregat. Terangkan dengan ringkas ujian-ujian bagi pembahagian saiz partikel.

(7 markah)

(b) Agregat dianggap sebagai permukaan kering tepu apabila digunakan dalam rekabentuk campuran konkrit. Terangkan dengan ringkas kaedah untuk menentukan air bebas pada agregat

(5 markah)

(c) Senaraikan **Empat (4)** jenis ciri-ciri fizikal agregat

(4 markah)

(d) Lakarkan mesin Abrasion Los Angeles dan terangkan dengan ringkas ujian untuk menilai kekerasan dan ketahanan agregat

(4 markah)

(e) Tulis nota pendek tentang penggunaan agregat alternatif untuk pembinaan mampan kepada negara-negara yang menghadapi masalah kekurangan sumber.

(5 markah)

S4 (a) Senaraikan **Tiga (3)** jenis batu-bata yang terdapat dalam pasaran.

(3 markah)

(b) Peratus serapan air menujukkan jumlah darjah pembakaran.

(i) Beri **Dua (2)** ujian yang boleh digunakan bagi ujian serapan.

(2 markah)

(ii) Maklumat di bawah diperolehi semasa ujian batu-bata di makmal.

Batu-bata saiz A : 220 mm x 110 mm x 65 mm
Batu-bata saiz B : 219 mm x 112 mm x 64 mm

Berat kering batu-bata saiz A : 2.65 kg
Berat basah batu-bata saiz A : 2.9 kg

Berat kering batu-bata saiz A : 2.70 kg
Berat basah batu-bata saiz A : 2.88 kg

Senaraikan prosedur yang terlibat dalam menentukan kekekuatan mampatan batu-bata. Kirakan peratus purata serapan air dan purata ketumpatannya.

(10 markah)

(c) Lakar dan jelaskan proses-proses yang terlibat dalam pembuatan batu-batu kalsium silika

(6 markah)

(d) Semua batu-bata disimpan kering dan bebas dari pencemaran. Bagaimanakah situasi ini dapat mempengaruhi batu-bata?

(4 markah)

S5 (a) Senaraikan **Dua (2)** jenis spesis kayu tropika

(2 markah)

(b) Tuliskan **Empat (4)** ciri untuk setiap kayu lembut dan kayu keras

(8 markah)

(c) Jelaskan dengan ringkas pembentukan gelang tahunan bagi spesis kayu beriklim sederhana

(5 markah)

(d) Jelaskan dengan ringkas perbezaan antara kayu keras berat dan kayu keras ringan

(6 markah)

(e) Penggunaan kayu sebagai komponen struktur dalam pembinaan semakin berkurangan berbanding bahan-bahan lain seperti konkrit dan keluli. Pada pendapat anda, apakah kaedah yang sesuai untuk meningkatkan semula penggunaan kayu dan pada masa yang sama memastikan kesan rumah hijau dipelihara.

(4 markah)

S6 (a) Berikan **Tiga (3)** jenis keluli dan senaraikan kegunaan bagi setiap jenis keluli yang berada di pasaran.

(6 markah)

(b) Senaraikan **Empat (4)** perbezaan antara keluli kekuatan sederhana dan keluli 'kekuatan alah tinggi sebagai bar keluli di dalam konkrit.

(4 markah)

(c) Proses Bessemer adalah salah satu kaedah pengeluaran keluli. Lakarkan rajah Bessemer "converter" dan jelaskan proses yang terlibat.

(10 markah)

(d) 'Keluli lawan konkrit'.
Sesetengah pihak mendakwa keluli boleh digunakan untuk menggantikan pengunaan konkrit dalam pembinaan bangunan. Apakah pendapat anda mengenai perkara ini?

(5 markah)

APPENDIX: CIVIL ENGINEERING MATERIALS (BFC 1032)

NAME : _____

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

LECTURER NAME : _____

SECTION NO. : _____

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 4	..... Use the lower value [ ]
	1.8	*Maximum free-water/ cement ratio*	*Specified*	.....
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 5	..... 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 6	..... %
	5.3	Fine aggregate content	C5	..... × ..... = [ ] kg/m³
	5.4	Coarse aggregate content		..... − ..... = [ ] 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)	.....	.....	.....	.....	.....	.....
oer 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.

Table 2 Approximate compressive strengths (N/mm^2) of concrete mixes made with a free-water/cement ratio of 0.5

Cement strength class	Type of coarse aggregate	Compressive strengths (N/mm^2) Age (days) 3	7	28	91
42.5	Uncrushed	22	30	42	49
	Crushed	27	36	49	56
52.5	Uncrushed	29	37	48	54
	Crushed	34	43	55	61

Throughout this publication concrete strength is expressed in the units N/mm^2.
$1\ N/mm^2 = 1\ MN/m^2 = 1\ MPa$. (N = newton; Pa = pascal.)

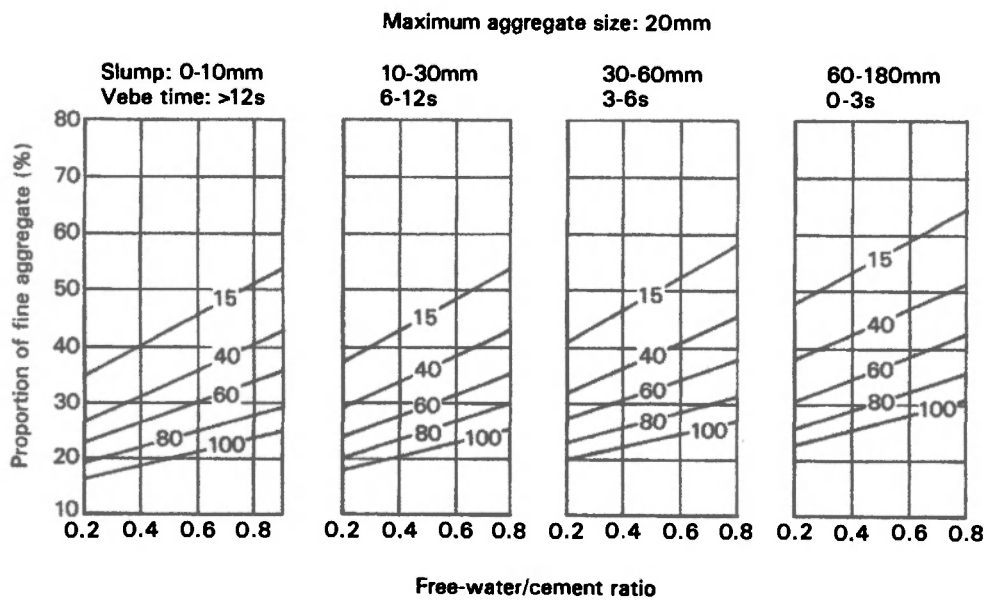

Table 3 Approximate free-water contents (kg/m^3) required to give various levels of workability

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:

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

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

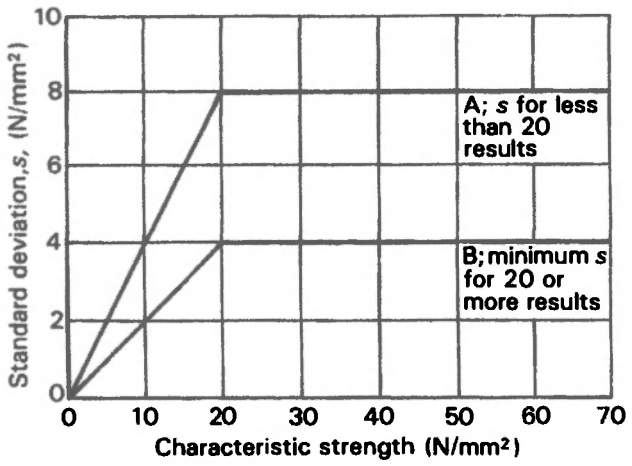

Figure 3
Relationship between standard deviation and characteristic strength

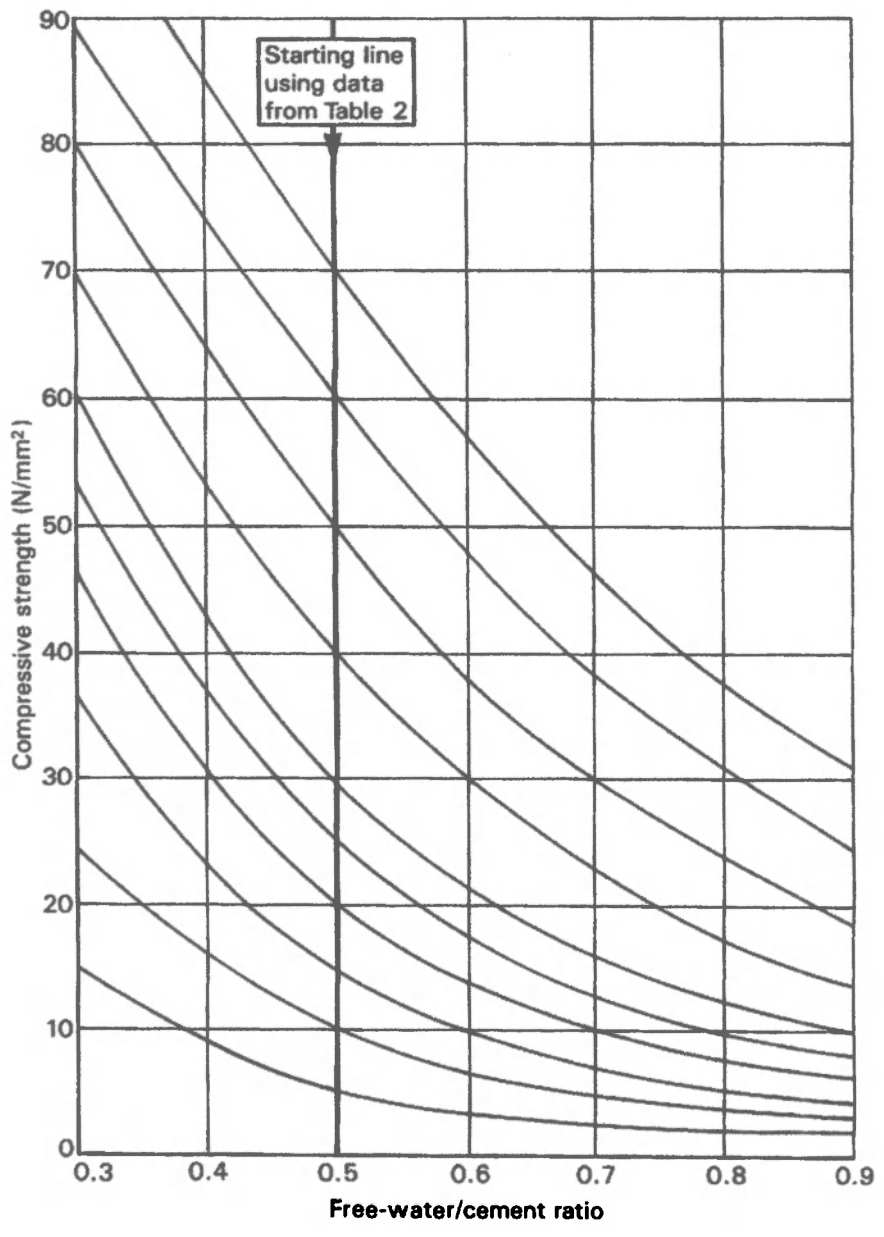

Figure 4
Relationship between compressive strength and free-water/cement ratio