Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	CIVIL ENGINEERING MATERIAL
COURSE CODE	:	BFC10502
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY/ AUGUST 2023
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) The construction industry uses a variety of cement types, each having unique characteristics. Proposed a suitable type of cement with justification to construct the following structure:

(i) Reinforced concrete beam

(2 marks)

(ii) Concrete wall rendering

(2 marks)

(iii) Large dams

(2 marks)

(iv) Foundations with high sulphate ground water

(2 marks)

(b) Cement is a crucial material in the construction of buildings. However, because it is a manufactured material created through various processes, it is important to ensure compliance with consistency and strength test. Discuss procedures of the test.

(12 marks)

(c) **TABLE Q1** shows the results of a sieve analysis test performed on a sample of fine aggregate. Examine the data and determine the fine aggregate modulus.

(15 marks)

TABLE Q1

Sieve Size, (mm)	Weight Retained, (g)
4.75	0
2.36	56.9
2	83.1
1.18	83.1
0.6	151.4
0.3	40.4
0.15	72
0.075	58.3
Pan	15.6

Q2 (a) As a batching plant engineer, you are required to produce a concrete mixture for pre-cast concrete beams with grade C40. Using the following data:

Characteristic strength of concrete	: 40 N/mm^2 at 28 days
Proportion defective	: 10% (k=1.28)
Standard deviation	: 8 N/mm^2
Type of cement	: Ordinary Portland Cement
Slump	: 30-60 mm
Maximum crush aggregate	: 20 mm
Type of fine aggregate	: River sand
Relative density of crushed aggregate (SSD)	: 2.7
Percentage passing 600 μm fine aggregate	: 60%

(i) Complete the design mix using concrete design mix form given.

(20 marks)

(ii) Calculate the volume of the raw material (cement, water, fine, and coarse aggregate) of the concrete beam with the dimension of 300 mm x 600 mm x 6 m length.

(5 marks)

(b) Several tests including density, water absorption, and compression were performed on fired clay bricks. The obtained results are presented in **TABLE Q2.**

TABLE Q2

Brick no.	Brick size				Water absorption test		Compression test
	length (mm)	Width (mm)	Depth (mm)	Mass (kg)	Mass dry (kg)	Mass wet (kg)	Maximum force (kN)
1	213	98	70	2.52	2.5	2.82	313
2	212	98	70	2.5	2.48	2.8	323
3	211	97	69	2.48	2.47	2.77	357

(i) Calculate the average density of brick.

(3 marks)

(ii) Calculate the average percentage water absorption of brick.

(3 marks)

(iii) Determine the average compressive strength of brick in unit N/mm^2.

(4 marks)

Q3 (a) The specific gravity (SG) of wood A and B is 0.4 and 0.5, respectively. Based on this information, determine which wood can be used as a structural component for constructing the building. Justify your answer.

(5 marks)

(b) List and illustrate **FIVE (5)** various flaws that can be found in wood.

(10 marks)

(c) Sketch the stress-strain relationship of a steel reinforcement. On that sketch, determine the region of yield strength, modulus of elasticity and ultimate stress.

(8 marks)

(d) Steel in the market has many types. State **SEVEN (7)** characteristics of high carbon steel.

(7 marks)

– END OF QUESTIONS –

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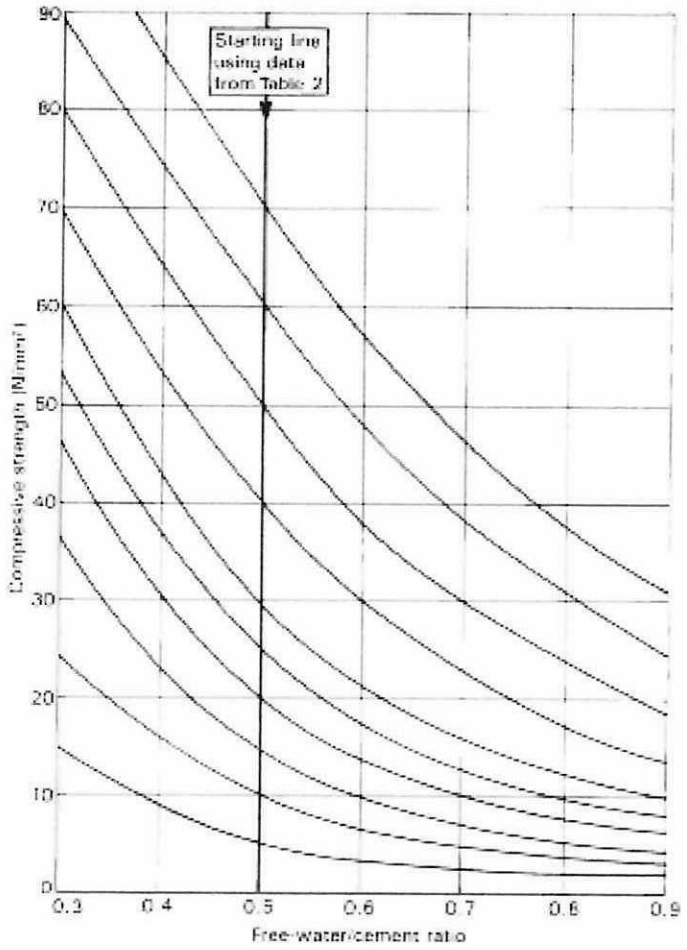

FIGURE Q2(a)

Table 2 Approximate compressive strengths (N/mm²) of concrete mixes made with a free-water/cement ratio of 0.5

Cement strength class	Type of coarse aggregate	Compressive strengths (N/mm²) 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/mm². 1 N/mm² = 1 MN/m² = 1 MPa. (N = newton; Pa = pascal.)

FIGURE Q2(b)

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Table 3 Approximate free-water contents (kg/m³) 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 appropriate to type of coarse aggregate

FIGURE Q2(c)

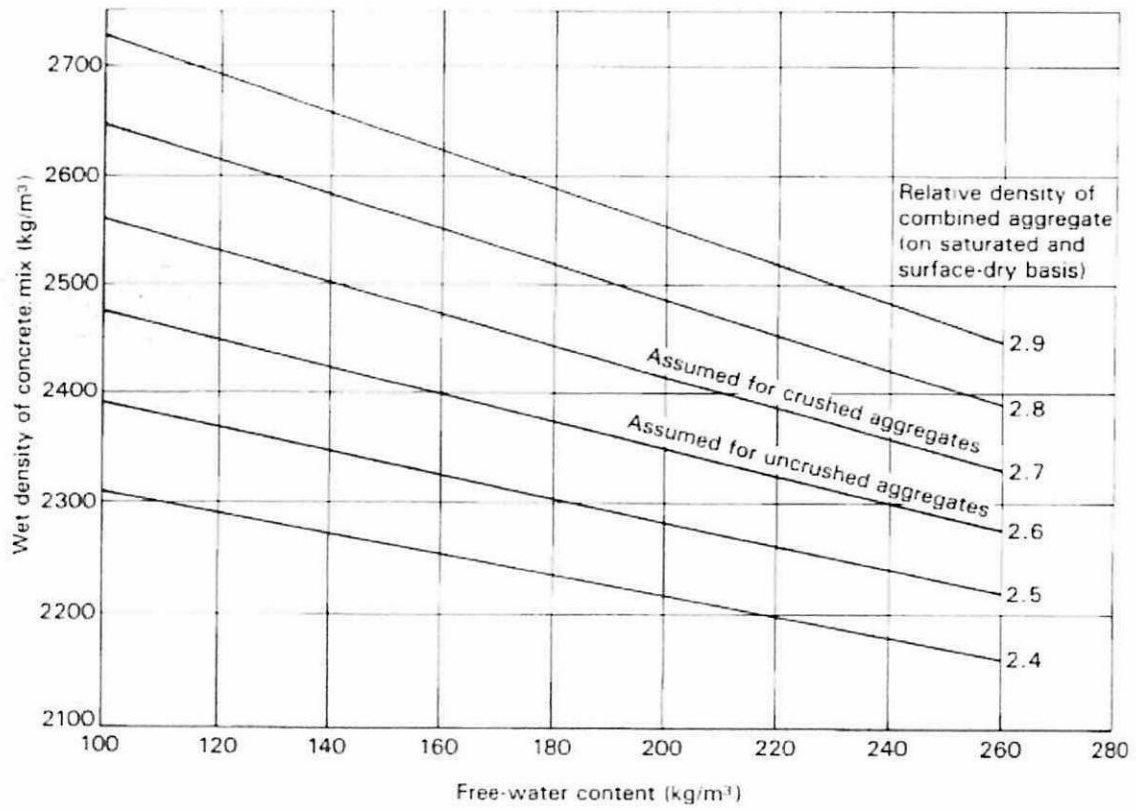

FIGURE Q2(d)

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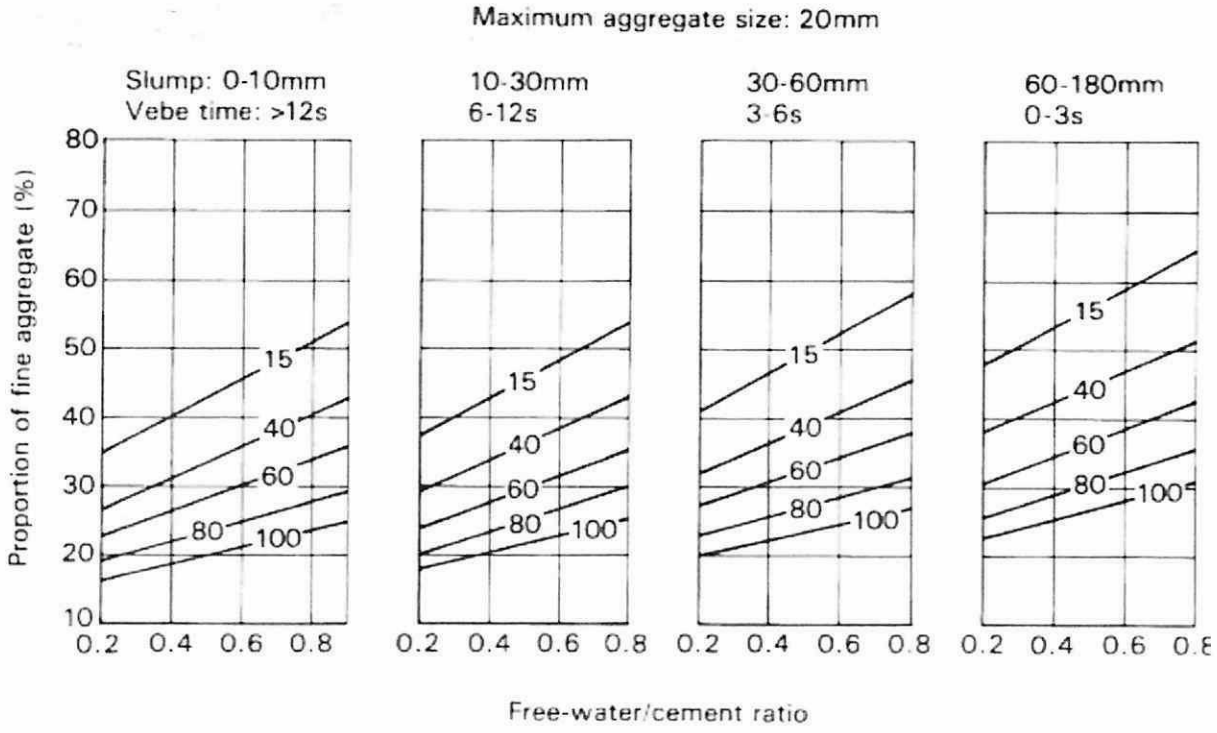

FIGURE Q2(e)

Concrete Mix Design Form

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	(k=.....) .....**x**.....=.....N/mm2
			Specified	..... 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		Crushed/Uncrushed
		Aggregate type: fine		Crushed/Uncrushed
	1.7	Free-water/cement ratio	Table 2, Fig. 4	.....
	1.8	Max. 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	Max. 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
			Do not use less than 3.3 or more than 3.2	..... 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 micron sieve	.....%
	5.2	Proportion of fine aggregate	Fig. 6	.....%
	5.3	Fine aggregate content	C5	..... **x** ..... = ...kg/m³
	5.4	Coarse aggregate content		..... -. ..... = ...kg/m³

Quantities	Cement (kg)	water (kg or lt)	Fine aggregate (kg)	Coarse aggregate (kg)		
				10 mm	20 mm	40 mm
Per m³ (to nearest 5 kg)						
Per trial mix of ..... m³						