Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	CIVIL ENGINEERING MATERIALS
COURSE CODE	:	BFC 10502
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS.
		2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.

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

Q1 (a) There are various types of cement with different properties and their uses in construction industry. Propose suitable type of cement based on type of structures with appropriate reason.

(i) Reinforced concrete beam
(ii) Concrete wall rendering
(iii) Large dams
(iv) Foundations with high sulphate ground water

(8 marks)

(b) Cement is one of the most important material in building construction. However, as it is a manufactured material produced by various process, propose the procedure of testing to ensure compliance with standard consistency and strength of cement.

(12 marks)

(c) A sieve analysis test was conducted for sample of fine aggregate and obtained the results as shown in **Table Q1**. Calculate the percent passing of each sieve and classify the fineness of fine aggregate based on fineness modulus analysis.

(15 mark)

Q2 (a) As a design engineer at a batching plant company, you have been asked to design a concrete mix for pre-cast concrete beams with G40. By considering data given:

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

(i) Propose an appropriate design to fulfill the requirement of G40 by using a form in Appendix A.

(20 marks)

(ii) If the beam with a dimension of 300 mm x 600 mm and 6 m length was proposed, calculate the possible volume needed for the precast concrete beam and justify the quantities of cement, water, fine and coarse aggregate content for that volume.

(5 marks)

(b) Some testing on fire clay brick was performed such as density, water absorption and compression test. The result obtained has shown in **Table Q2.**

(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) A simple lab test for specific gravity (SG), on two samples of timber indicate that sample A has SG=0.4 and sample B has SG=0.5. Based on this information alone, which wood sample would you choose as a structural member for your construction project? Briefly explain your reason.

(5 marks)

(b) Timber is a natural product and every natural product has some imperfection. Most of the defects in timber cause weakness of other sorts of difficulties. State **FIVE (5)** main types of defect in timber with an appropriate illustration.

(10 marks)

(c) Draw a typical stress-strain behaviour of steel subjected to tension. On the graph, show the modulus of elasticity, the yield strength, the ultimate stress and the rupture stress.

(8 marks)

(d) There are various types of steel. Identify **SEVEN (7)** characteristic of high carbon steel.

(7 marks)

– END OF QUESTIONS –

Name: _____ Matrix 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	.....
	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 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	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 Q1

Sieve Size, mm	4.75	2.36	2.00	1.18	0.60	0.30	0.15	0.075	Pan
Weight Retained, g	0	56.9	83.1	83.1	151.4	40.4	72.0	58.3	15.6

TABLE Q2

Brick no.	Brick size				Water absorption test		Compression test
	length (mm)	Width (mm)	Depth (mm)	Mass (kg)	Mass dry (g)	Mass wet (g)	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

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

FIGURE Q2(a)

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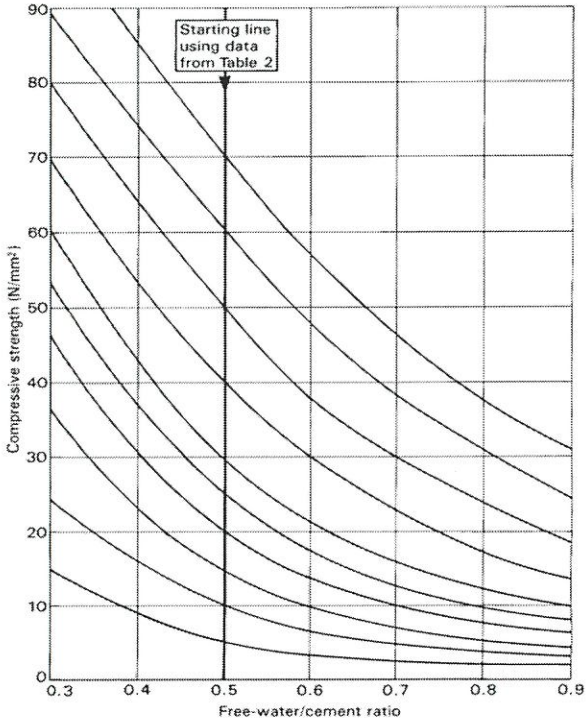

FIGURE Q2(b)

Slump (mm)		0–10	10–30	30–60	60–180
Vebe time (s)		>12	6–12	3–6	0–3
Maximum size of aggregate (am)	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:

$$^{2}/_{3}W_{f} + {}^{1}/_{3}W_{c}$$

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)

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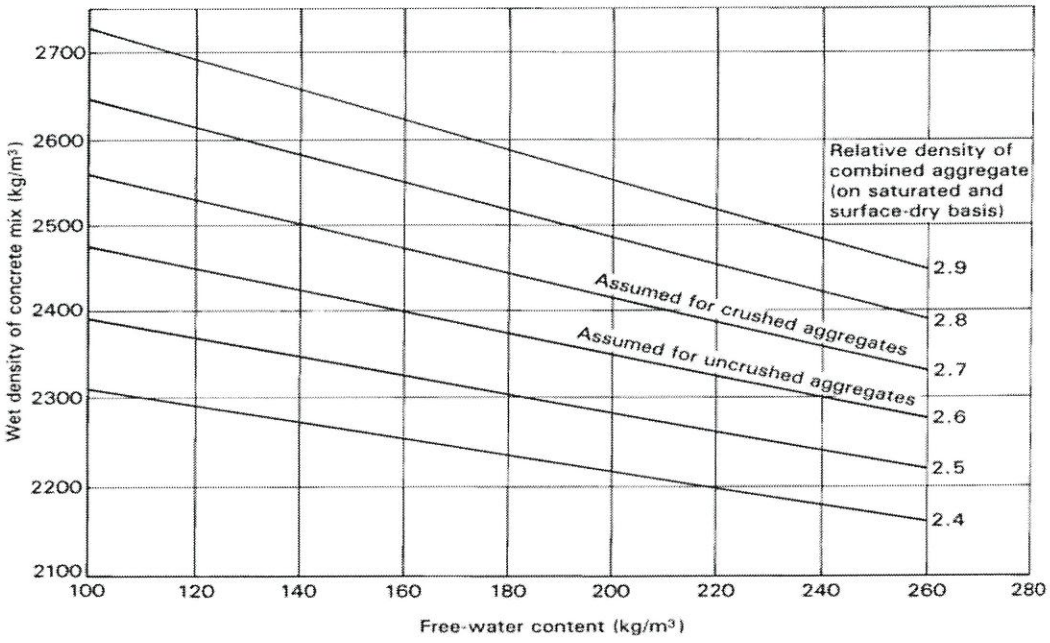

FIGURE Q2(d)

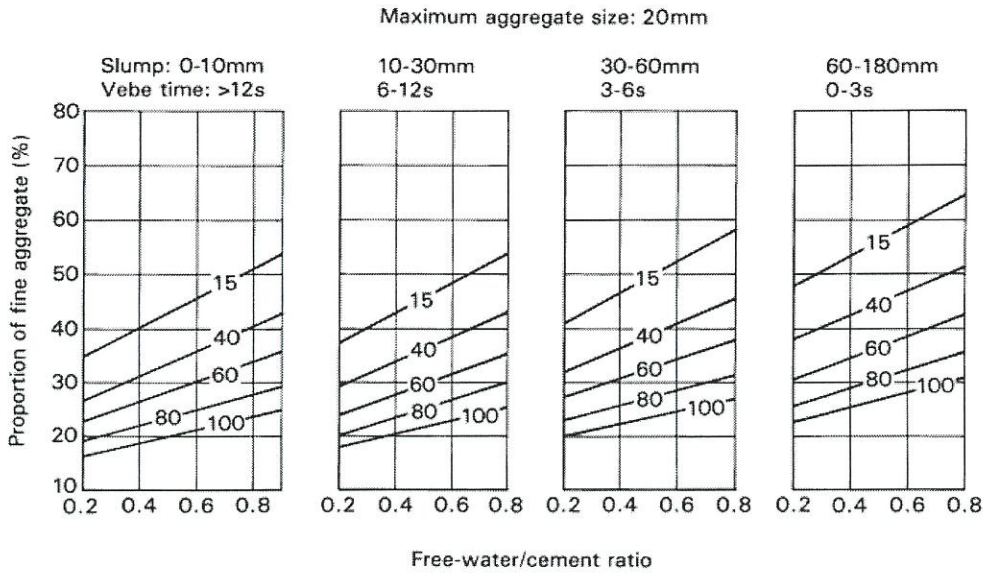

FIGURE Q2(e)