Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	CONCRETE TECHNOLOGY
COURSE CODE	:	BFS 40603
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND 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 **EIGHT (8)** PAGES

Q1 Micro-cracking is initiated at the interface area between coarse aggregate and mortar paste. During failure, the crack pattern occurred and affected the durability of the concrete.

(a) Name the '***H***' area shown in **Figure Q1**.

(2 marks)

(b) Discuss the effect of '***H***' area that generally contributed to reduce the concrete strength.

(9 marks)

(c) Describe the brittle condition of concrete failure under a "tension state".

(9 marks)

Q2 (a) As an R&D Engineer which responsible for concrete mix design, you are facing the following problems;

i) Work at the site had to stop due to the rain, but it involved a large quantity of fresh concrete mix.
ii) More time is expected for the concrete work.
iii) Improve concrete's resistance to alkali-silica reactivity.
iv) Concrete mix for congested reinforcements.
v) Concrete mix will be hauled a long distance.
vi) High early strength concrete is required, but not necessarily high ultimate strength.

Suggest a suitable admixture for each of the problems.

(10 marks)

(b) Some mineral admixtures are pozzolanic. Elaborate on several important reasons that are desirable to use pozzolanic material.

(10 marks)

Q3 Perform a concrete mix design for a 40 MPa characteristic strength normal weight concrete with no admixture at 28 days. Use a suitable Concrete Mix Design Form. You also need to determine the amount of each material required to produce 64000 m^3 concrete.
Reference can be made to **Table Q3** and **Figure Q3 (a) - (f).**

(20 marks)

Q4 High strength concrete has compressive strengths of up to 100 MPa as appose to the lightweight concrete which has compressive strengths of less than 50 MPa.

(a) Distinguish thermal conductivities criteria between the light-weight concrete and the high-strength concrete.

(8 marks)

(b) Discuss the effects and the importance of water absorption and the moisture content of lightweight aggregate concrete.

(6 marks)

(c) Describe the importance of the fresh state properties of high-strength concrete

(6 marks)

Q5 Old structure has the tendency to crack consistent with the serviceability period of the building. There are various types of cracks occurred in structures. **Figure Q5** shows one of the crack pattern that appeared on the surface of a column.

(a) Name the crack shown in **Figure Q5**.

(2 marks)

(b) Clarify the causes of that crack.

(6 marks)

(c) State **THREE (3)** rectification methods and **THREE (3)** prevention methods for that crack.

(12 marks)

– END OF QUESTIONS –

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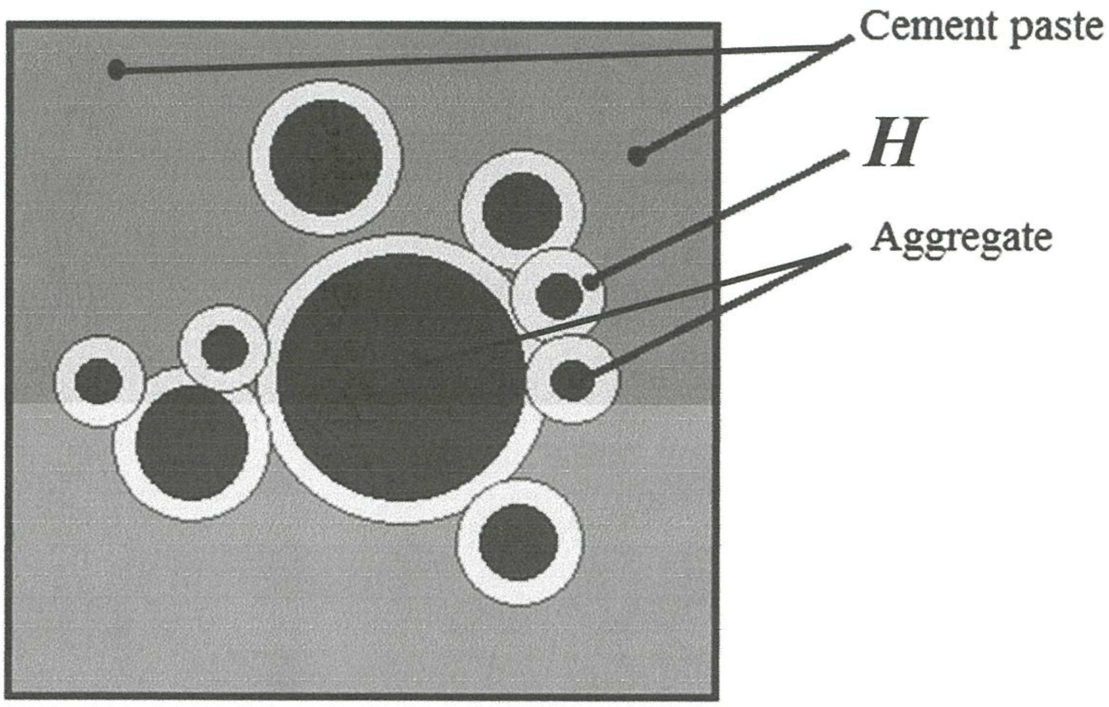

FIGURE Q1

TABLE Q3

Proportion of defectives	10%
Cement strength class	42.5 (Ordinary Portland Cement)
Type of fine aggregate	Sources from river quarry
Type of coarse aggregate	Sources from rock quarry
Maximum aggregate size	40 mm
Maximum water cement ratio	0.6
Minimum cement content	300kg for 1m^3
Desired slump	0 – 10 mm
Fine aggregate passing 600 µm	50%

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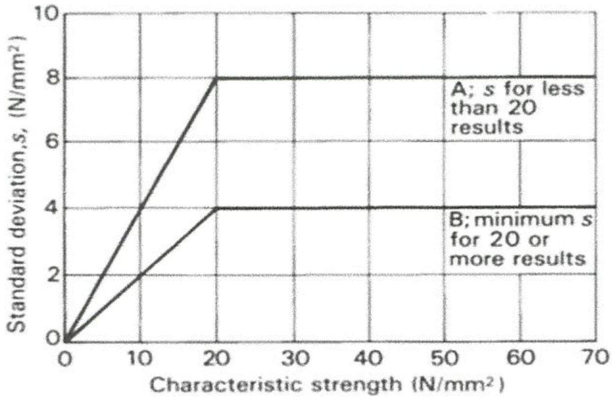

FIGURE Q3 (a)

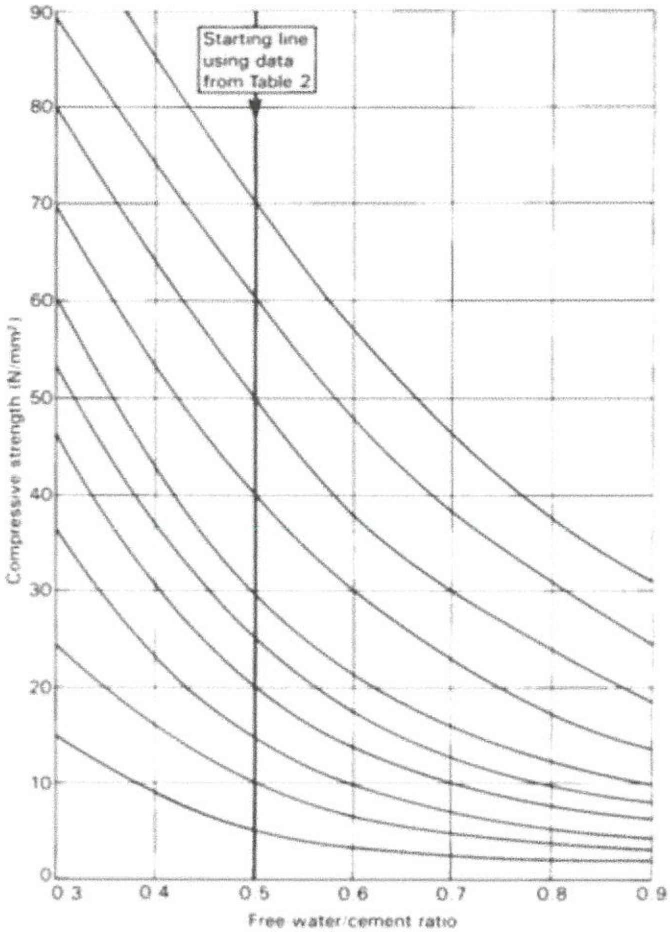

FIGURE Q3 (b)

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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.)

FIGURE Q3 (c)

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

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

FIGURE Q3 (d)

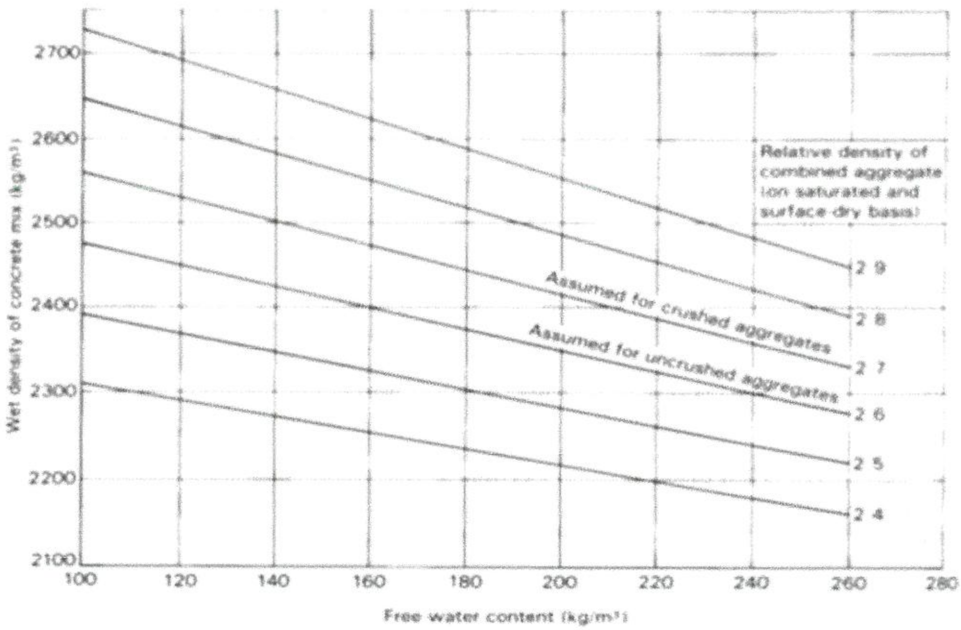

FIGURE Q3 (e)

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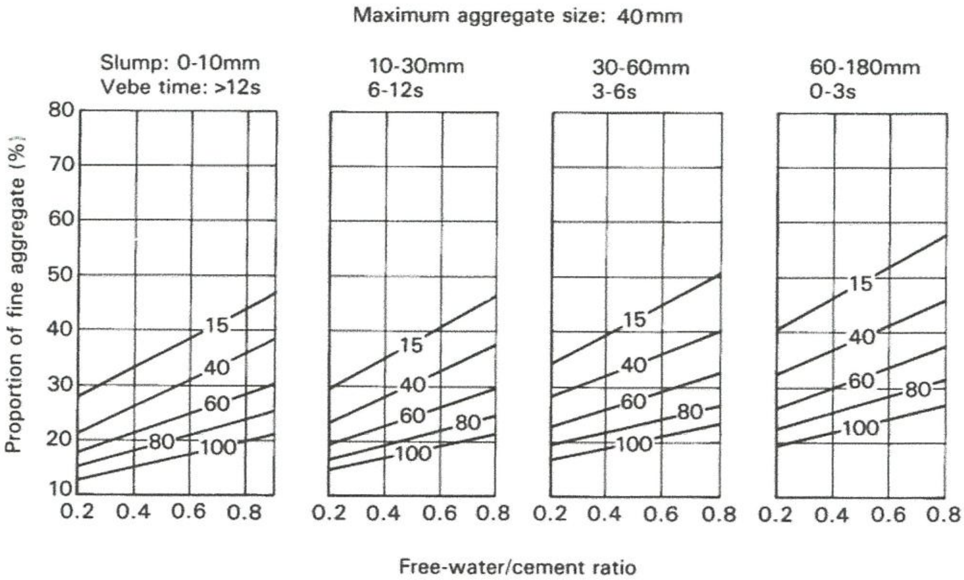

FIGURE Q3 (f)

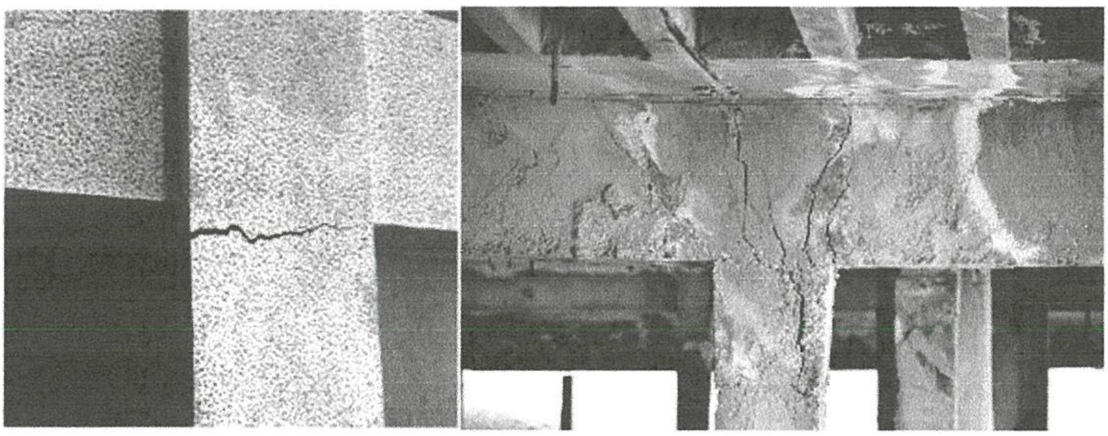

FIGURE Q5

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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 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	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.