Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	CONCRETE TECHNOLOGY
COURSE CODE	:	BFS40603
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 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 **EIGHT (8)** PAGES

Q1 (a) Emphasis the precaution when concreting in hot weather condition.

(7 marks)

(b) There were some parameters influencing the expansion of that structure attack. Analysis and explain **FOUR (4)** parameters related to these chemical processes in concrete (refer **FIGURE Q1(b)**).

(8 marks)

(c) Elaborate the effect and method to reduce sulphate attack in concrete.

(10 marks)

Q2 One big cement manufacturing company asks you to recommend suitable blended cement for Industrial Building System (IBS) concrete construction.

(a) Suggest **THREE (3)** of blended cement suitable for this construction.

(3 marks)

(b) From the answer of **Q2(a)**, justify the properties of blended cement that you suggest.

(10 marks)

(c) 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.

Recommend a suitable admixture for each of the problems.

(12 marks)

Q3 (a) List **FIVE (5)** factors that influence the choice of mix design.

(5 marks)

(b) Complete the concrete mix design form provided according to the Design of Normal Concrete Mixes for 3 units solid concrete prism with size 500mm x 100mm x 100mm. Refer concrete requirement in **Table Q3** and use **Figure Q3(a) - Q3(f)** to complete the design form in **Figure Q3(g)**.

(20 marks)

Q4 (a) State and explain the classification of lightweight concrete.

(5 marks)

(b) Lightweight aggregates consist of natural and artificial. List and describe **FOUR (4)** types from each of natural and artificial lightweight aggregates.

(8 marks)

(c) Elaborate those properties of lightweight concrete,

(i) Absorption

(ii) Drying shrinkage

(iii) Thermal conductivity

(12 marks)

– END OF QUESTIONS –

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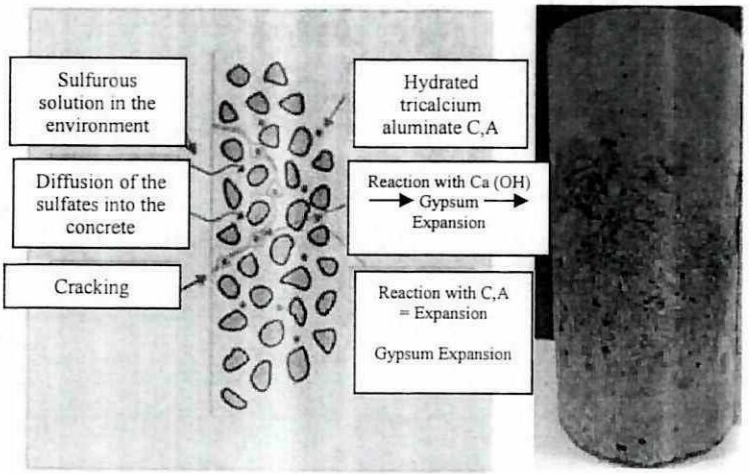

Figure Q1(b)

Table Q3

Item	Value
Concrete Strength	45 MPa at 28 days
Defective rate	2.5%
Cement type	Ordinary Portland Cement
Slump required	10 - 30 mm
Type of aggregates	Crushed fine aggregates and crushed coarse aggregates
Maximum aggregate size	40 mm
Maximum cement content	420 kg/m^3
Minimum cement content	320 kg/m^3
Maximum free-water/cement	0.5
Percentage passing 600 μm sieve	40%

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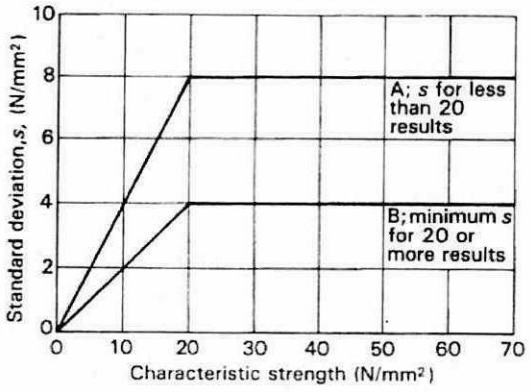

Figure Q3(a)

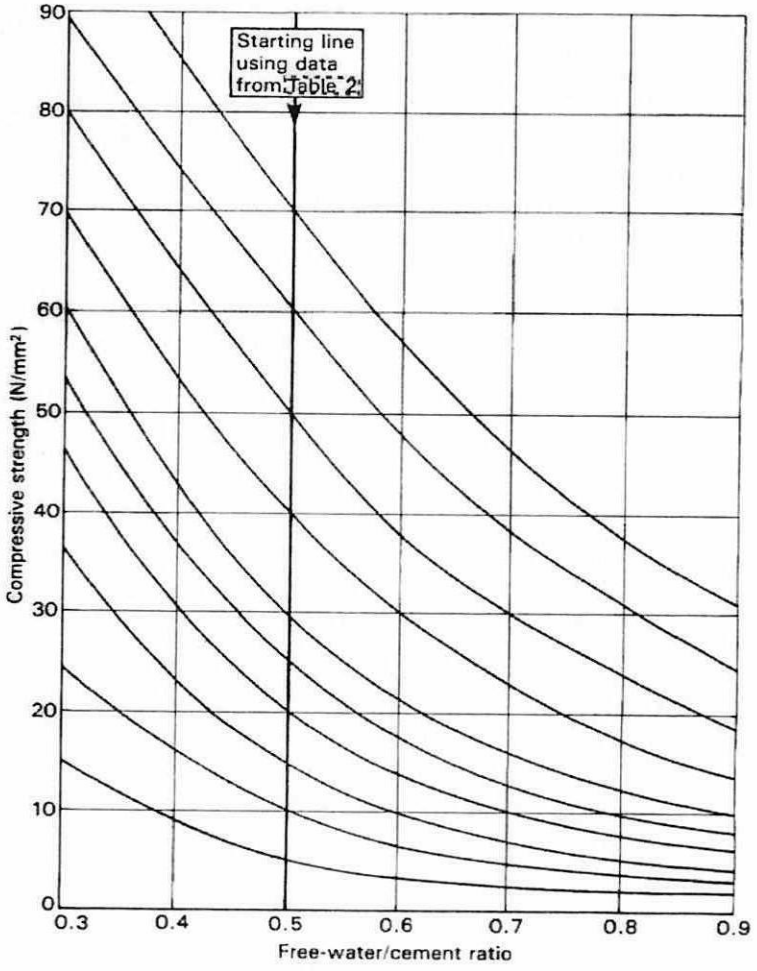

Figure Q3(b)

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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

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

Figure Q3(d)

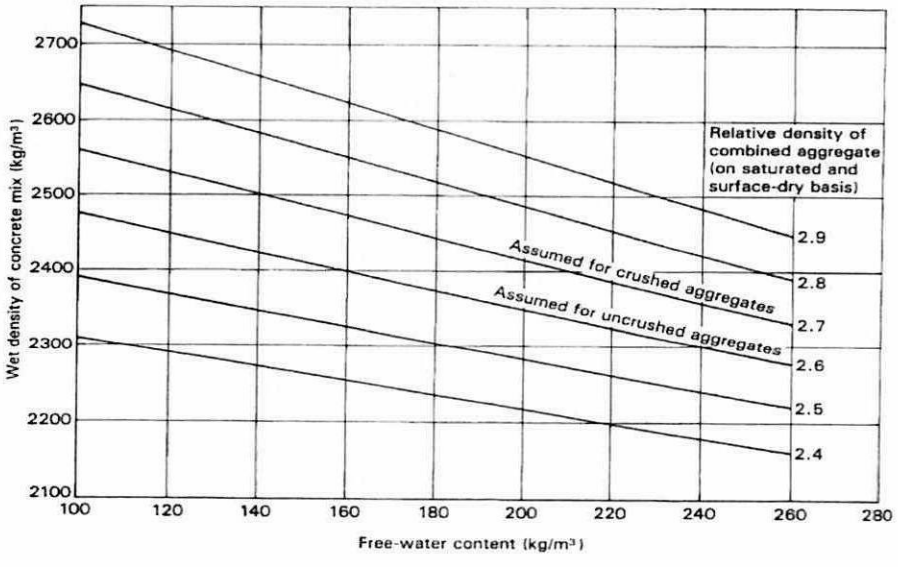

Figure Q3(e)

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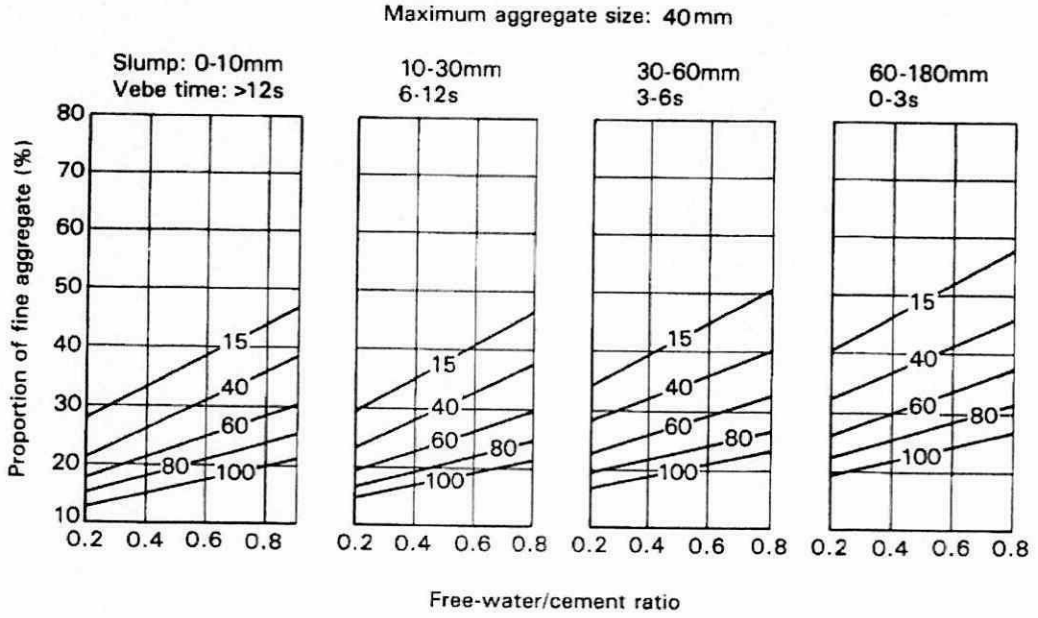

Figure Q3(f)

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Concrete mix design 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 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.

Figure Q3(g)