Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	CIVIL ENGINEERING MATERIAL
COURSE CODE	:	BFC 10502
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2024
DURATION	:	2 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ 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) Cement is the main material in the concrete making. Selection of the correct cement type plays an important role in producing concrete with good quality. Recommend the suitable cement type for the following construction.

(i) Residential building

(ii) Brickworks

(iii) Dam

(iv) Precast concrete

(v) Wastewater treatment plant

(5 marks)

(b) Bricks are commonly used as a building envelope or partition wall in building construction. Specify the types of bricks available in the Malaysia market.

(5 marks)

(c) State the differences between fired clay bricks and unfired clay bricks. Suggest a brick that are suitable in reducing the corbon footprint and environmentally friendly.

(7 marks)

(d) **Table Q1.1** shows the results for the water absorption and compression test of bricks. Based on the table, answer questions (i) and (ii).

Table Q1.1 Water absorption and compression test results

Brick no.	Length (mm)	Width (mm)	Depth (mm)	Mass dry brick (kg)	Mass wet brick (kg)	Maximum force (kN)
1	214	98	70	2.5	2.84	311
2	212	98	70	2.49	2.81	300
3	212	99	69	2.46	2.81	331

(i) Calculate the average water absorption of brick in percent.

(4 marks)

(ii) Calculate the average compressive strength of brick in N/mm^2.

(4 marks)

Q2 (a) **Table Q2.1** shows the result of sieve analysis for fine aggregate. Based on the table, answer question (i) and (ii).

Table Q2.1 Fine aggregate sieve analysis

Sieve size (mm)	Mass retained (g)	Percentage retained (%)	Cummulative percentage retained (%)	Cummulative percentage passing (%)
5	0	0	0	
2.36	30	15	15	
1.18	42	21	36	
0.6	40	20	56	
0.3	48	24	80	
0.15	34	17	97	
Pan	6	3	100	

(i) Calculate the cumulative percentage passing for each sieve size. Then determine the cumulative percentage passing for 600μm.

(3 marks)

(ii) Determine the fineness modulus for the fine aggregate.

(2 marks)

(b) Considering the cumulative percentage passing as in answer (a)(i), calculate the concrete design mix for grade G35 using the Design of Normal Concrete Mixes method based on the specifications in **Table Q2.2**. By referring to figure **APPENDIX A.1** to **A.5,** propose suitable concrete mix design.

(20 marks)

Table Q2.2 Specification concrete mixes design

Proportion defective	10% (k= 1.28)
Standard deviation	8 N/mm^2
Cement strength class	42.5 (Ordinary Portland Cement)
Type of both aggregate	Sources from stone quarry
Maximum aggregate size	20 mm
Relative density of aggregate (SSD)	2.7
Slump required	30-60m

Q3 (a) List **FIVE (5)** factors that affect strength of timber.

(5 marks)

(b) Give **FIVE (5)** methods to treatment and curing timber.

(5 marks)

(c) Distinguish **THREE (3)** properties of softwood and hardwood.

(6 marks)

(d) In wood formation, illustrate and explain the part of 'cambium' and 'pith'.

(9 marks)

Q4 (a) Name **FOUR (4)** classification of steel.

(4 marks)

(b) Describe **FOUR (4)** steel structure that commonly used in construction.

(6 marks)

(c) List **THREE (3)** non-ferrous metals used in construction.

(3 marks)

(d) Name different types of glasses, and briefly describe the properties of each category.

(6 marks)

(e) Describe the properties and uses of aluminium as a material of construction.

(6 marks)

- END OF QUESTIONS -

APPENDIX A

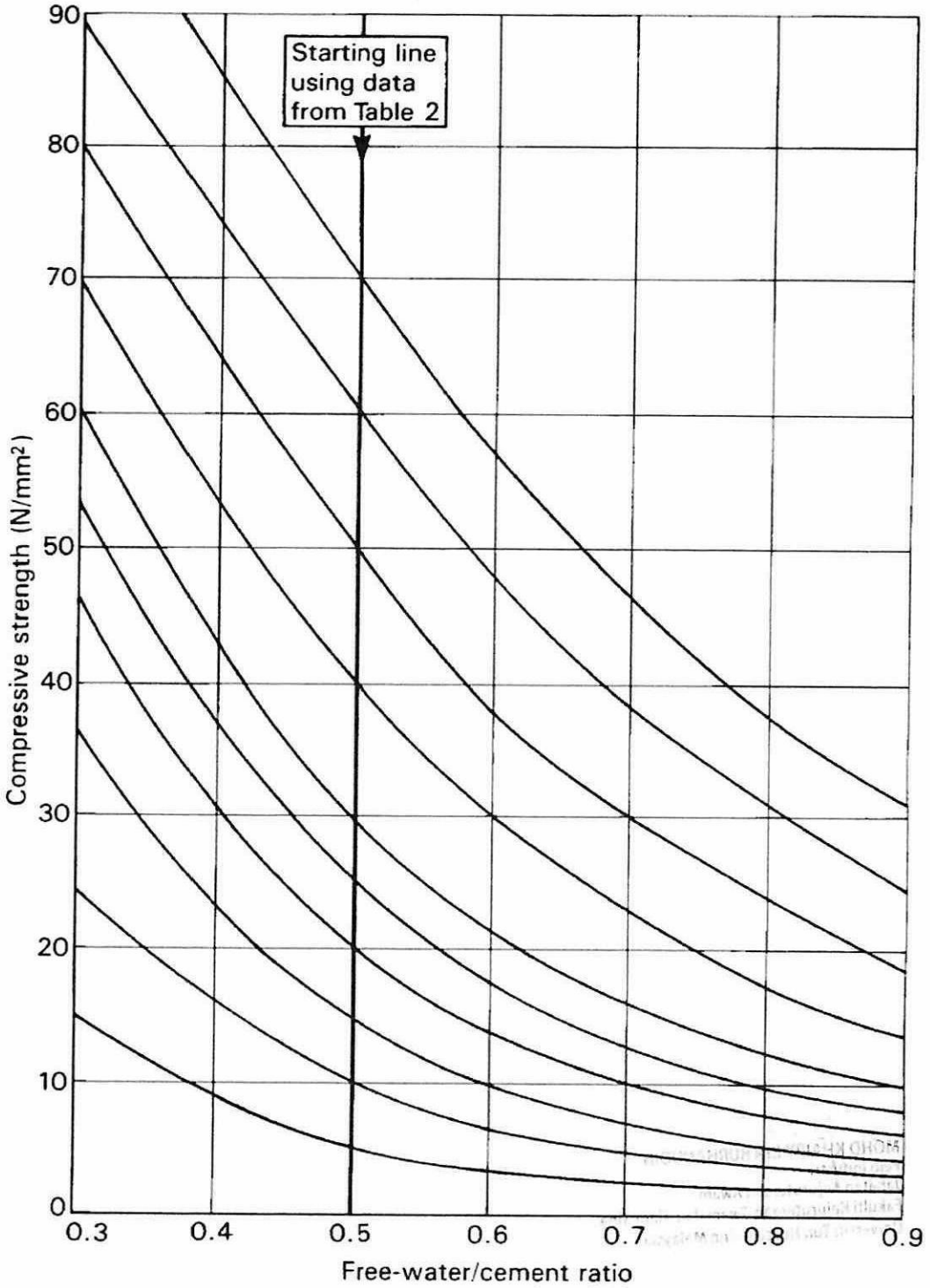

Figure APPENDIX A.1

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 strength (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. $1\ N/mm^2 = 1\ MN/m^2 = 1MPa$. (N = newton; Pa = pascal)

Figure APPENDIX A.2

Table 3: Approximate free water content (kg/m^3) required to give variuos 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 is 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 APPENDIX A.3

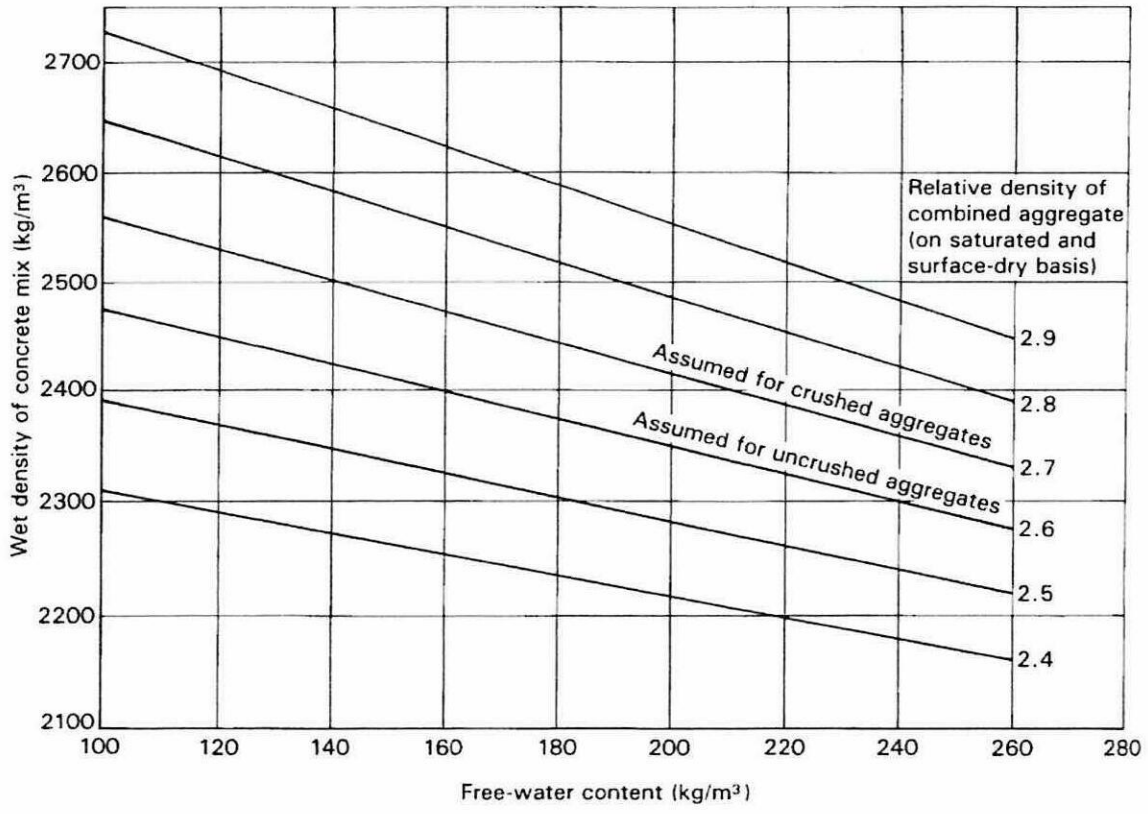

Figure APPENDIX A.4

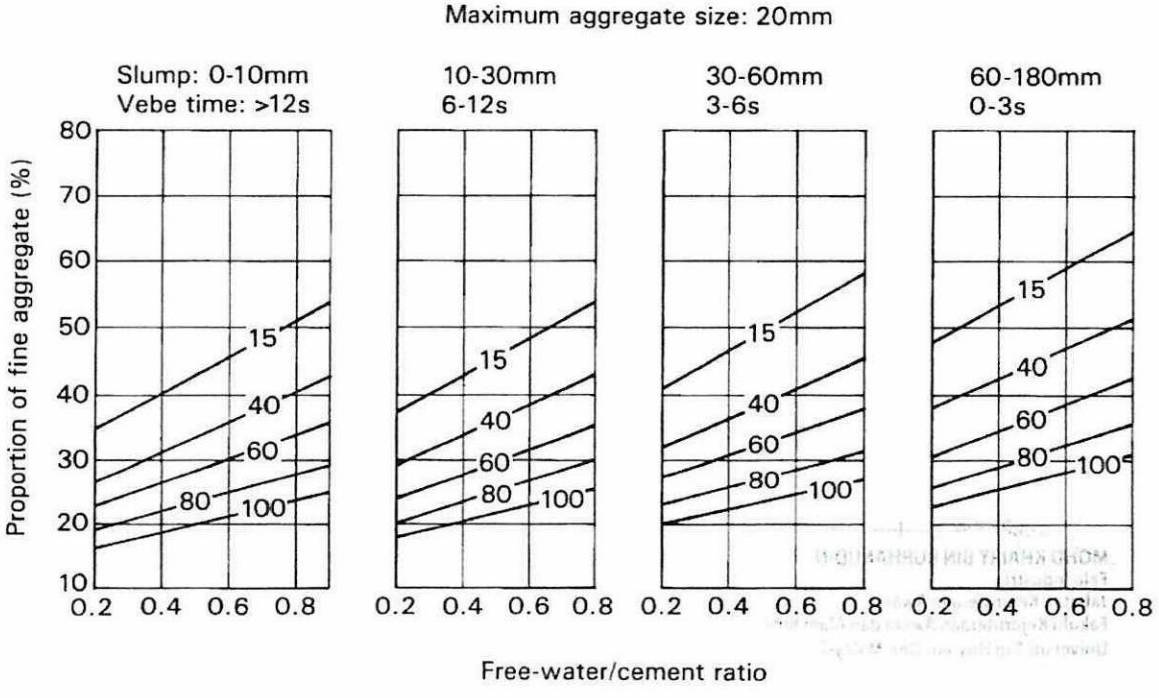

Figure APPENDIX A.5

CONCRETE MIXES DESIGN FORM

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.