Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2022/2023

| | | |
|---|---|---|
| COURSE NAME | : | CIVIL ENGINEERING MATERIALS |
| COURSE CODE | : | BFC10502 |
| PROGRAMME CODE | : | BFF |
| EXAMINATION DATE | : | FEBRUARY 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 **EIGHT (8)** PAGES

**Q1** As a civil engineer at a concrete batching plan, you are responsible to ensure that the production of concrete comply with the design.

(a) Identify type and strength classes of cement for normal concrete mix design.

(2 marks)

(b) Sieve analysis for fine aggregate should be carried out to determine the percentage value for passing 600μm and gradation curve. Analyse the data from fine aggregate sieve analysis test in **Table Q1(a)**.

(8 marks)

(c) Based on properties in **Table Q1(b)**, determine normal concrete mix design for Grade 30. Use **Figure Q1(a) - Q1(f)** to complete the design form in **Figure Q1(g)**.

(20 marks)

**Q2** (a) Discuss the significant of water absorption in masonry production.

(5 marks)

(b) Briefly describe **FIVE (5)** different types of bricks and their application in construction.

(10 marks)

(c) List and sketch **FIVE (5)** types of bonds in brick masonry wall construction.

(10 marks)

**Q3** (a) Briefly explain the definition of alloy steel.

(2 marks)

(b) Identify **THREE (3)** different alloying agents and describe their effects.

(9 marks)

(c) Two samples of timber were tested for specific gravity (SG), the results show that sample A has SG=0.5 and sample B has SG=0.7. Justify which sample that suitable as a structural member for your construction project.

(6 marks)

(d) Illustrate types of timber defects:

i) knotholes,
ii) split and checks,
iii) crooking,
iv) cupping.



(8 marks)

**Q4** (a) Differentiate between bitumen and tar.

(4 marks)

(b) List and describe **TWO (2)** techniques for achieving self-healing in concrete.

(4 marks)

(c) Describe corrosion factor of aluminium and suggest the prevention method.

(6 marks)

(d) Name **THREE (3)** different categories of glasses and briefly describe their properties.

(6 marks)

**– END OF QUESTIONS –**

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**Table Q1(a)**

| Sieve size (mm) | Sieve mass (g) | Sieve mass + fine aggregated retained (g) |
|---|---|---|
| 5 | 450 | 450 |
| 2.36 | 368 | 398 |
| 1.18 | 362 | 404 |
| 0.6 | 345 | 385 |
| 0.3 | 316 | 364 |
| 0.15 | 314 | 348 |
| Pan | 362 | 368 |

**Table Q1(b)**

| | |
|---|---|
| Characteristic strength of concrete | 30 $N/mm^2$ at 28 days |
| Proportion of defectives | 2.5% (k=1.96) |
| Standard deviation | 8 $N/mm^2$ |
| Type of fine aggregate | Sources from river quarry |
| Type of coarse aggregate | Sources from rock quarry |
| Maximum aggregate size | 20 mm |
| Slump value | 0 – 10 mm |

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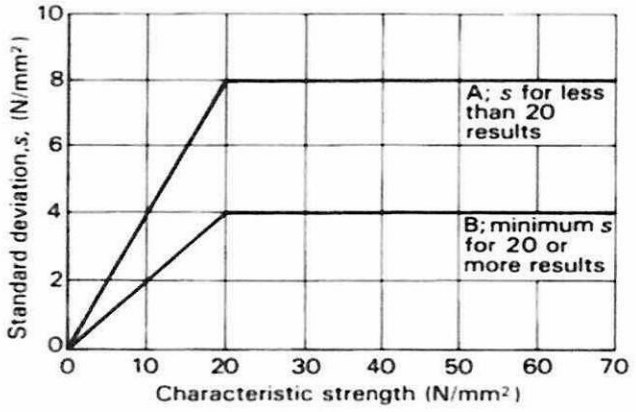


**Figure Q1(a)**

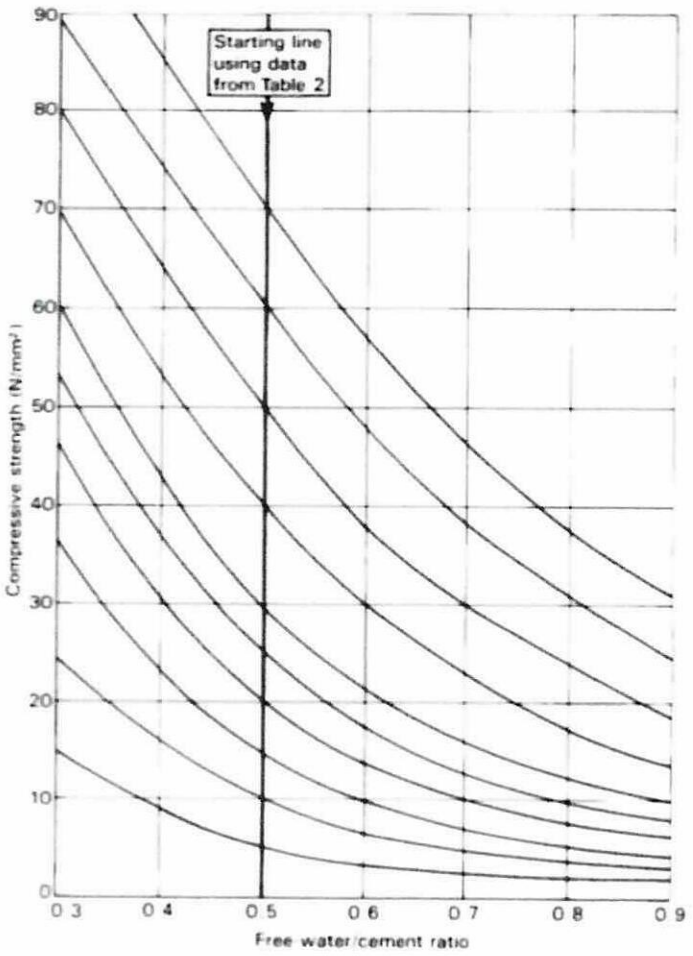


**Figure Q1(b)**

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**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 Q1(c)**

**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 |

**Figure Q1(d)**

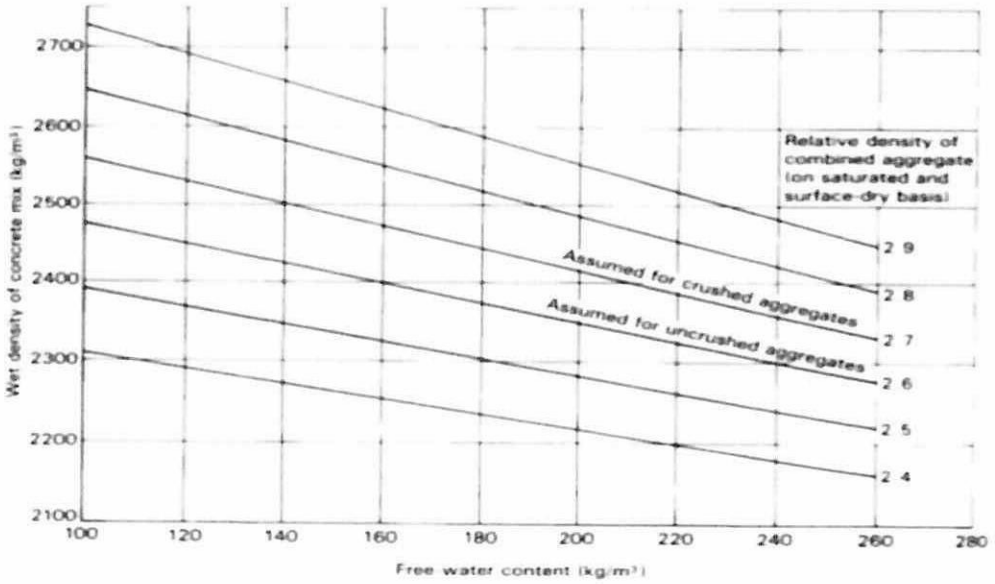


**Figure Q1(e)**

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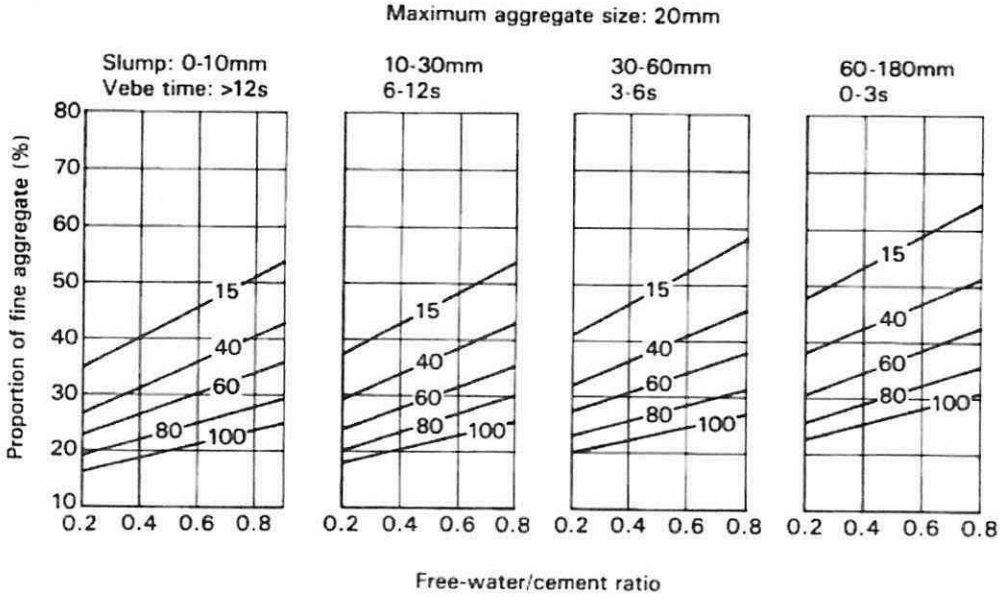


**Figure Q1(f)**

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**Job title** .....

| Stage | Item | | Reference or calculation | Values |
|---|---|---|---|---|
| 1 | 1.1 | Characteristic strength | Specified | ..... N/mm² at ..... days<br>Proportion defective ..... % |
| | 1.2 | Standard deviation | Fig 3 | ..... N/mm² or no data ..... N/mm² |
| | 1.3 | Margin | C1 or Specified | (k = .....) ..... x ..... = ..... N/mm²<br>..... 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<br>Aggregate type: fine | | Crushed/uncrushed<br>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<br>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 | | ..... − ..... = ☐ 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 | | | | | | |

**Figure Q1(g)**