# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER 1
## SESSION 2015/2016

| | | |
|---|---|---|
| COURSE NAME | : | CONCRETE TECHNOLOGY |
| COURSE CODE | : | BFS 40603 |
| PROGRAMME | : | BACHELOR OF CIVIL ENGINEERING WITH HONOURS |
| EXAMINATION DATE | : | DECEMBER 2015/JANUARY 2016 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER **FOUR (4)** QUESTIONS ONLY |

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

**Q1** (a) Briefly explain the durability of concrete.

(3 marks)

(b) Explain the strength development and permeability of concrete containing ground granulated blast furnace slag (GGBS).

(5 marks)

(c) State the influence of water/cement ratio and age on permeability of concrete.

(6 marks)

(d) Analyze in detail about the statistical quality control and acceptance criteria of concrete.

(11 marks)

**Q2** (a) What are the factors affecting concrete strength?

(3 marks)

(b) What are the various types of chemical attacks encountered by concrete?

(5 marks)

(c) How does air entrainment minimize the effects of freezing and thawing cycle in concrete?

(6 marks)

(d) Discuss the shear strength of lightweight aggregate concrete as compared to normal aggregates concrete.

(11 marks)

**Q3** (a) Briefly explain the applications of self-compacting concrete (SCC) in civil engineering construction.

(3 marks)

(b) What are the important differences between silica fume and Class F fly ash.

(5 marks)

(c) Describe the differences between pozzolanic reaction and slag reaction

(6 marks)

(d) Discuss the probable mechanisms which enable the proposed supplementary cementitious material in combination with Portland cement and superplasticizing admixture to facilitate and to ensure the concrete will comply with the stringent stipulated durability and performance requirements.

(11 marks)

**Q4** (a) Briefly explain **THREE (3)** types of agriculture ash used in concrete.

(3 marks)

(b) Explain the advantages of using NDT methods for evaluating concrete structures over conventional destructive methods.

(5 marks)

(c) Describe the method of manufacturing of high density concrete.

(6 marks)

(d) What is the main deterioration mechanism that affects concrete highway bridges? Describe how this mechanism causes the damage to structures that are subjected to tropical weather conditions; hot and humid.

(11 marks)

**Q5** (a) Explain the design aspects of aerated concrete.

(4 marks)

(b) State the differences between polymer impregnated concrete and polymer modified concrete.

(6 marks)

(c) Using requirements that are specified for concrete mix design Grade 35 as shown in **TABLE 1** and **FIGURE Q5 (a) - (f)**, Complete the concrete mix design form for unrestricted design.

(15 marks)

**- END OF QUESTIONS -**

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**TABLE 1**

| Item | Value |
|---|---|
| Characteristic Strength at 28 days | 35 $N/mm^2$ |
| 5 % Defective Rate | K = 1.96 |
| Cement Type | Ordinary Portland cement (42.5) |
| Slump Required | 10-30 mm |
| Maximum Aggregate Size | 20 mm |
| Free-water/ Cement Ratio | 0.45 |
| Minimum Cement Content | 290 $Kg/m^3$ |

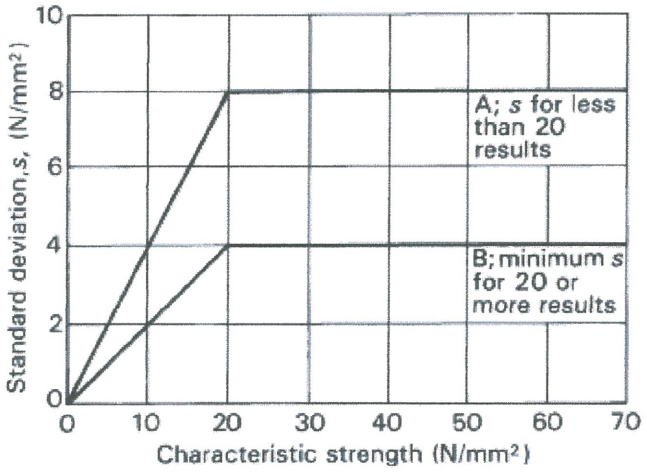


**FIGURE 5 (a) Relationship between standard deviation and characteristic strength**

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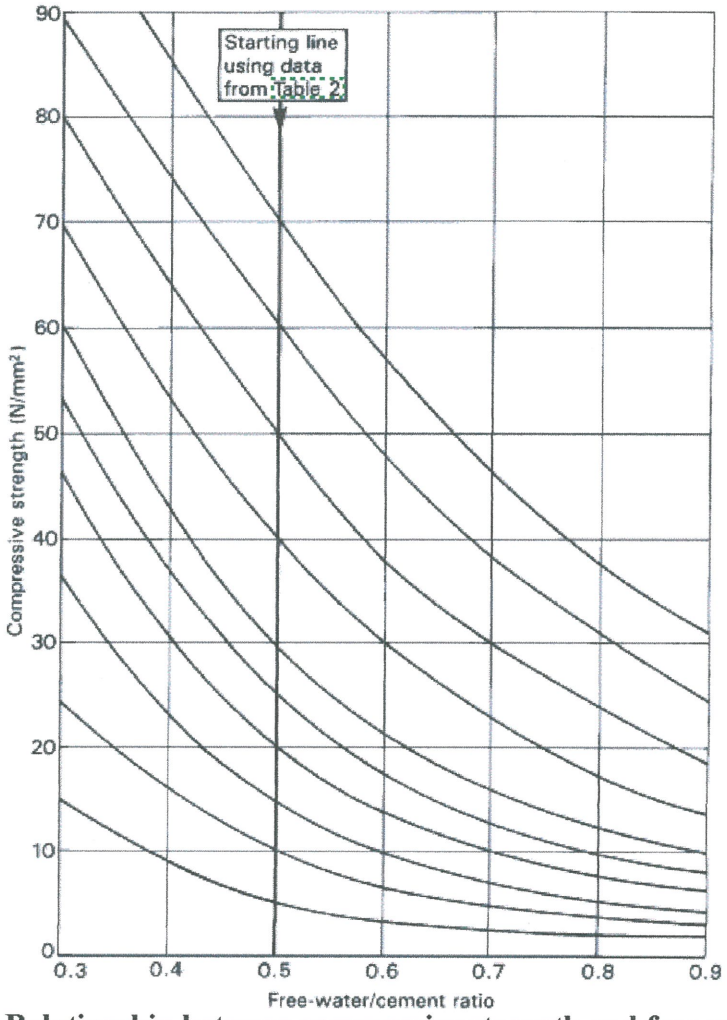


**FIGURE 5 (b) Relationship between compressive strength and free-water/cement ratio**

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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 5 (c) Approximates compressive strength for cement strength Class**

| 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 |

Note: When coarse and fine aggregates of different types are used, the free-water content is estimated by the expression:

**FIGURE 5 (d) Approximates free water contents**

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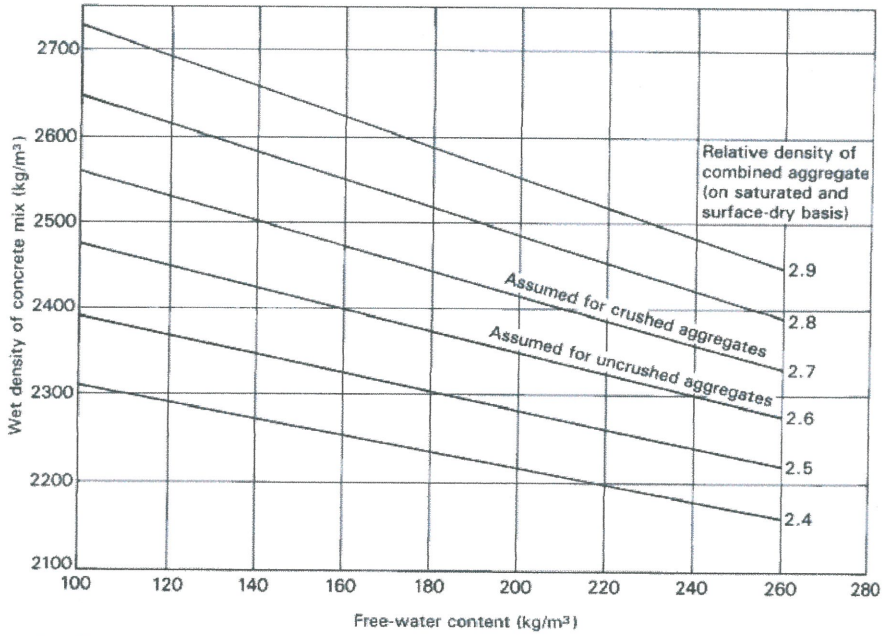


**FIGURE 5 (e) Estimated wet density of fully compacted concrete**

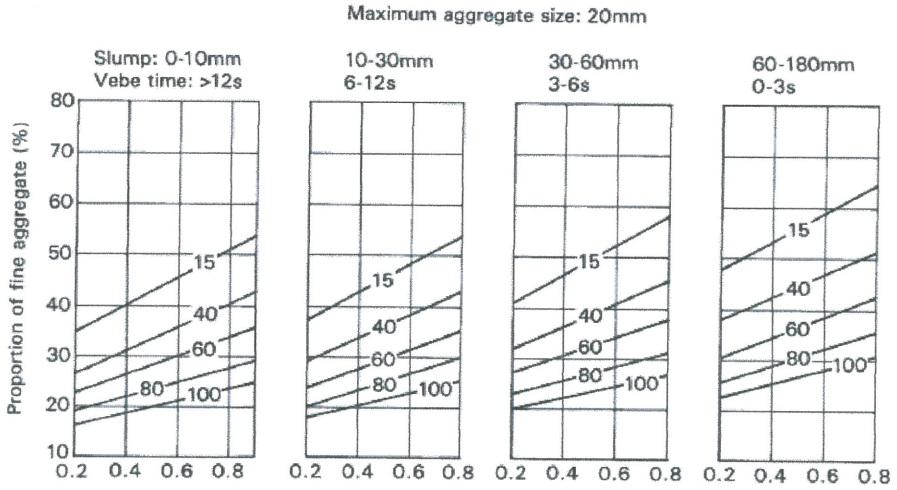


**FIGURE 5 (f) Free water / Cement Ratio**