

**SECOND YEAR SECOND SEMESTER EXAMINATIONS**  
**FOR THE DEGREE OF**  
**BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING**

**COURSE CODE:**                      **CSE 224**

**COURSE TITLE:**                      **Engineering Materials**

**Instruction to Candidates**

1. This paper contains **SIX (6)** questions
2. Answer **ANY FIVE (5)** questions
3. No unauthorized materials are allowed in the examination room
4. Time: 3 hours

### Question One

- a) Define the term cement. (2 marks)
- b) List the main four compounds of Portland cement. (4 marks)
- c) Describe the heat of hydration against time. (4 marks)
- d) Describe the wet process of cement manufacture . (10 marks)

### Question Two

- a) State the grading requirements for fine and coarse aggregate according to BS 882. (5 marks)
- b) Define workability. (3 marks)
- c) State the factors that affect workability. (5 marks)
- d) List the type of admixtures and describe their functions in concrete. (7 marks)

### Question Three

Design a mix with a mean 28 days compressive strength (measured on standard cubes) of 40 MPa with a 8% standard deviation and 2.5% defective rate ( $k = 1.96$ ); slump of 125 mm; crushed aggregates with a maximum size of 20 mm; specific gravity of aggregates of 2.65; 60 per cent of fine aggregates passes the 600  $\mu\text{m}$  sieve; no air entrainment required; ordinary Portland cement to be used. (20 mark)

### Question Four

- a) List the two types of concrete sulfate attack and explain in brief. (5 marks)
- b) Describe how to conduct a carbonation test on concrete specimens to be tested. (5 mark)
- c) Describe the mechanism of chloride corrosion in concrete. (5 marks)
- d) Write the formula of measuring concrete air and vapour intrinsic permeability coefficient  $k$ . (5 marks)

### Question Five

- a) Outline the technical terms that relate to natural of timber. (9 marks)
- b) Trees may be classified according to their manner of growth in to main divisions. Give an outline of these divisions with examples (11 marks)

### Question Six

- a) Discuss the following timber defects:
  - i. Rind galls
  - ii. Wandering hearts
  - iii. Excrescences
  - iv. Wind cracks
  - v. Druxiness(6 marks)
- b) Explain why it is advantageous to use seasoned timber (8 marks)

- c) Discuss the different methods of preserving timber. (3 marks)
- d) Discuss the various types of preservative treatments of timber. (3 marks)

Type of cement	Type of coarse aggregate	Compressive strengths (N/mm <sup>2</sup> )			
		Age (days)			
		3	7	28	91
Ordinary Portland (OPC) or sulphate-resisting Portland (SRPC)	Uncrushed	22	30	42	49
	Crushed	27	36	49	56
Rapid-hardening Portland (RHPC)	Uncrushed	29	37	48	54
	Crushed	34	43	55	61

1 N/mm<sup>2</sup> = 1 MN/m<sup>2</sup> = 1 MPa (see footnote on earlier page).

Table 1. Approximate compressive strength (N/mm<sup>2</sup>) of concrete mixes made with a free-water/cement ratio of 0.5

Slump (mm)		0-10	10-30	30-60	60-180
Vebe time(s)		> 12	6-12	3-6	0-3
Maximum size 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

Table 2. Approximate free-water contents (kg/m<sup>3</sup>) required to give various levels of workability

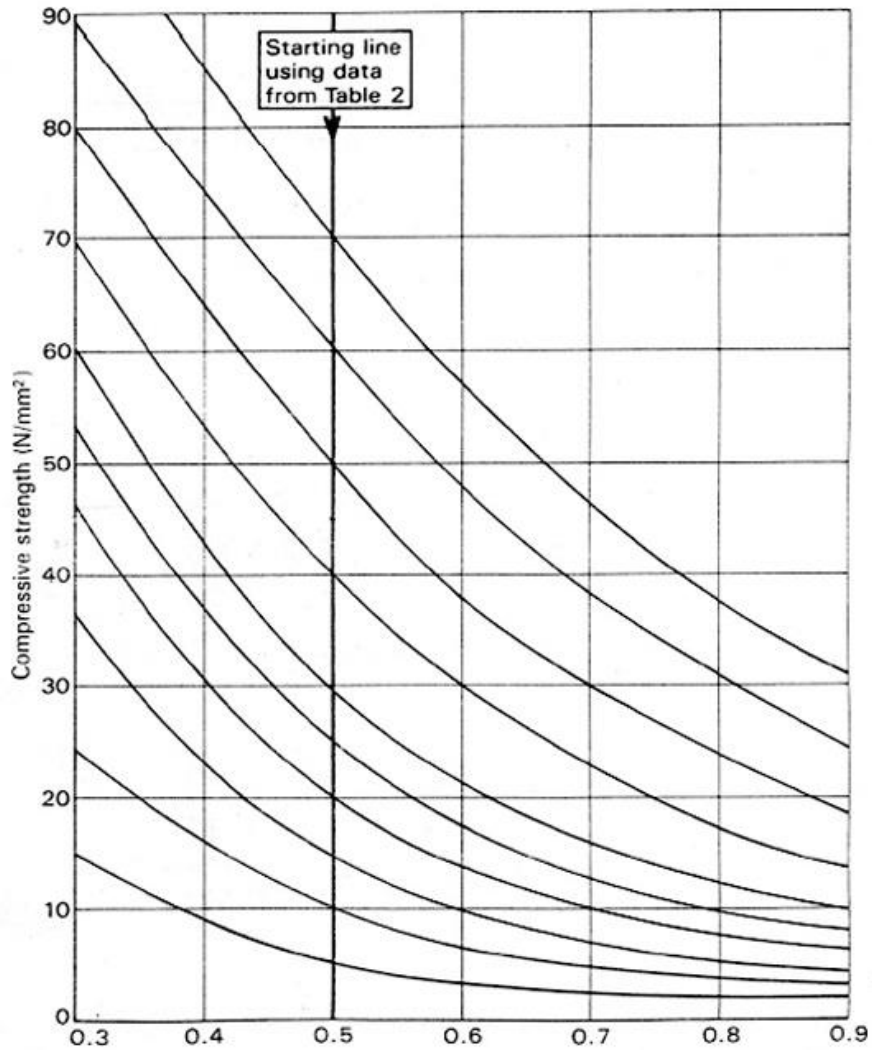


Figure 1. Relationship between compressive strength and free-water/cement ratio.

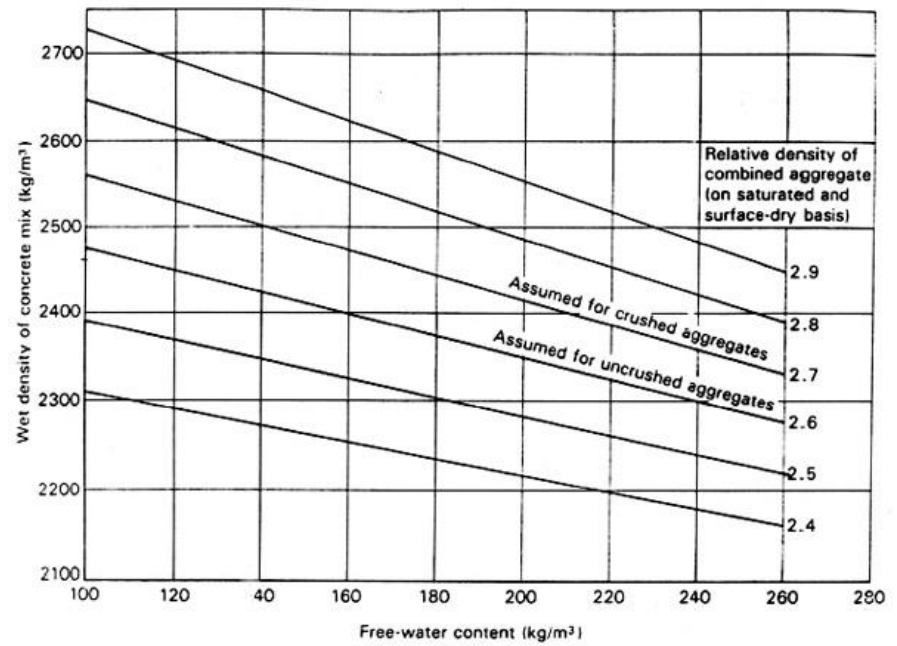


Figure 2. Estimated wet density of fully compacted concrete

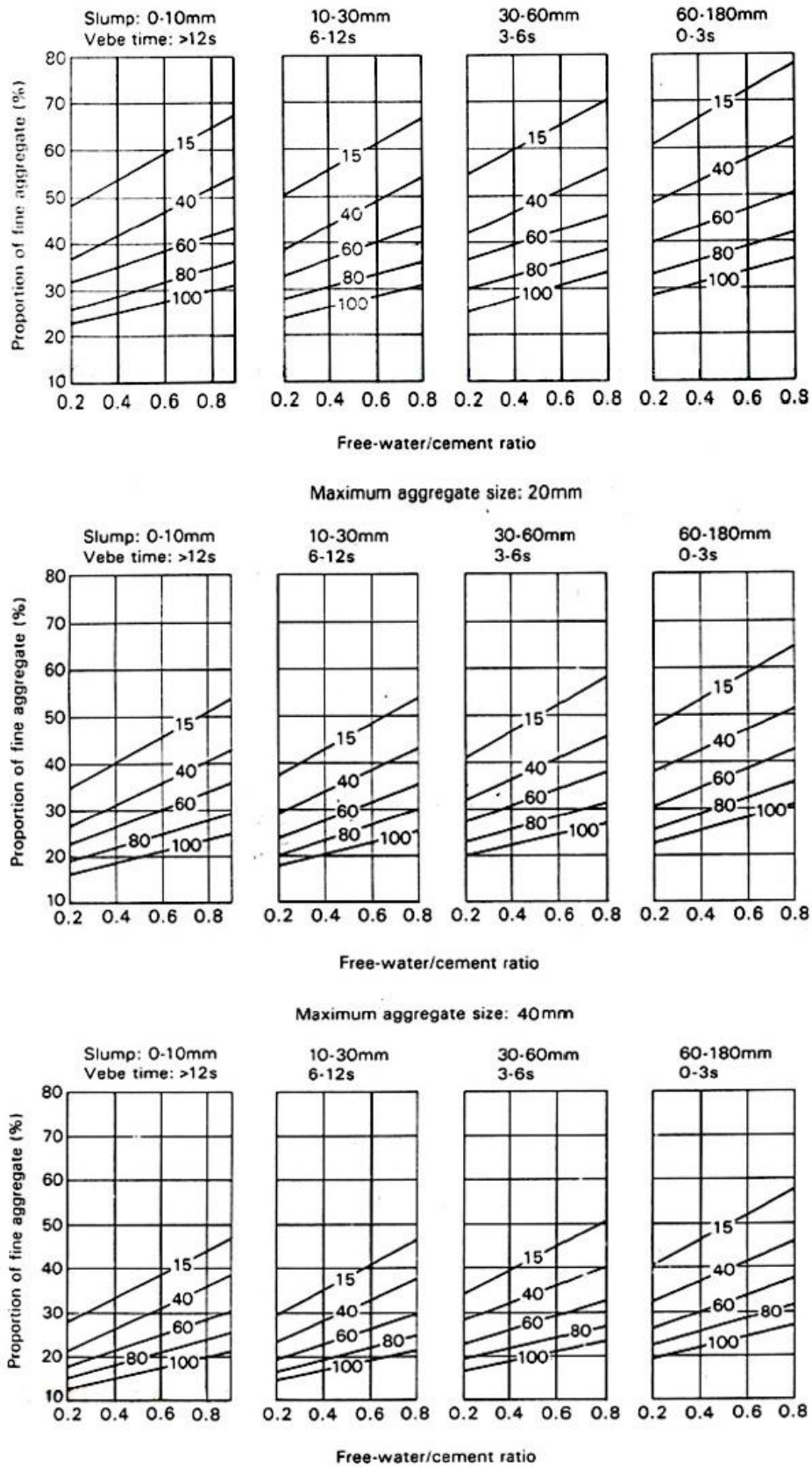


Figure 3. Recommended proportions of fine aggregate according to percentage passing a 600 μm sieve