



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 3 Examination in Engineering: October-2019

Module Number: CE 3202

Module Name: Concrete Technology

[Three Hours]

[Answer ALL questions, each question carries twelve marks]

- Q1. a) Briefly explain why admixtures are used in concrete. [2 Marks]
- b) Formwork used in concreting should be removed early for its repetitive use. Name a suitable type of cement that can be used to remove the formwork early. Justify your choice. [3 Marks]
- c) Less permeable concrete is desired due to its resistance for chemical attacks. List three actions which can reduce the permeability of concrete. [3 Marks]
- d) How to minimize the 'bleeding' of concrete? Explain two methods to minimize bleeding. [4 Marks]
- Q2. The 28 days compressive strength of concrete made from crushed coarse aggregate (20mm maximum aggregate size) and offshore sea sand (after being subjected to natural weathering), at water to cement ratio (W/C) of 0.5 is 49 MPa. The percentage of offshore sea sand passing the 600 μm sieve is about 60%. Specific gravity of the coarse and fine aggregate mix is 2.65.
- a) Calculate target strength for Grade 40 concrete.

Note:-

Target strength is the mean strength of the concrete at which no more than 5% of test specimen fall below specified characteristic strength of concrete.

Considering the general variability of the concrete mixing and the materials, it is safe to assume standard deviation of the concrete mix to be 4 MPa.

Compressive strength of concrete cube test is assumed to follow standard normal distribution and the value of 95% confidence interval for standard normal distribution is equal to 1.64.

[1 Mark]

- b) Assuming that both the fine and coarse aggregate are in saturated surface dry condition (SSD), find mix proportions for the calculated target strength in part (a) that has workability equivalent to 60-180 mm slump measured using the standard slump cone test.

Note:-

Following tables, charts and instructions are extracts from the British method of mix section are provided.

Trial water contents for the different workability requirements are given in Table Q2.1.

Trend of change of compressive strength to water/cement ratio is given in Fig. Q2.1.

Variation of fresh concrete density against water content for different values of specific density of fine and coarse aggregate mix is shown in Fig. Q2.2.

Fig. Q2.3 indicate content of fine aggregate as a percentage of total aggregate depending on the water/cement ratio, workability requirement, maximum size of aggregate and fineness ratio of fine aggregate used in the mix.

Water content of the mixed aggregate should be calculated as 1/3 of the water requirement of the coarse aggregate and 2/3 of the water requirement of the fine aggregate.

[5 Marks]

- c) For a given day it is found that the natural moisture content of the coarse aggregate is 0.85% and for sea sand is 1.5%. Assuming that the moisture absorption for the SSD condition of the two aggregates, coarse and fine, is 0.5% and 0.9% respectively, find the adjusted mix proportions for the Grade 40 concrete.
- [3 Marks]
- d) What are the durability concerns in the use of sea sand as fine aggregate in concrete and explain how it affect the durability of concrete structures? How could you improve sea sand to minimize any adverse effects in concrete structures?
- [3 Marks]
- Q3. a) What are the major types of the accidents that can be occurred in construction sites?
- [2 Marks]
- b) Identify three root causes for accidents in construction sites.
- [3 Marks]
- c) Discuss the problems associated with the improvement of safety, health and welfare aspects in a construction site.
- [4 Marks]
- d) Recommend two improvements needed in legal framework to enhance safety conditions in construction sites.
- [3 Marks]
- Q4. a) Explain with examples, cause of occurrence and how we can minimize wastage of materials in local construction sites.
- [3 Marks]
- b) What are the precautions that can be taken in concreting in hot weather condition?
- [3 Marks]
- c) Briefly explain two problems associated with over-vibration of concrete.
- [2 Marks]
- d) Compare advantages and disadvantages of using timber formwork and steel formwork.
- [4 Marks]
- Q5. a) Spalling is the major potential risk to life safety from concrete under fire. Explain this statement.
- [2 Marks]

- b) Briefly describe the fire performance evaluation method of concrete. [4 Marks]
- c) Explain why fiber reinforced concrete is more suitable for thin concrete. [2 Marks]
- d) Briefly discuss what is the sulphate attack in concrete and explain why sulphate resistant cement can be used as a remedy for the sulphate attack. [4 Marks]

Table Q2.1 Trial water contents to achieve different workability requirements.

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

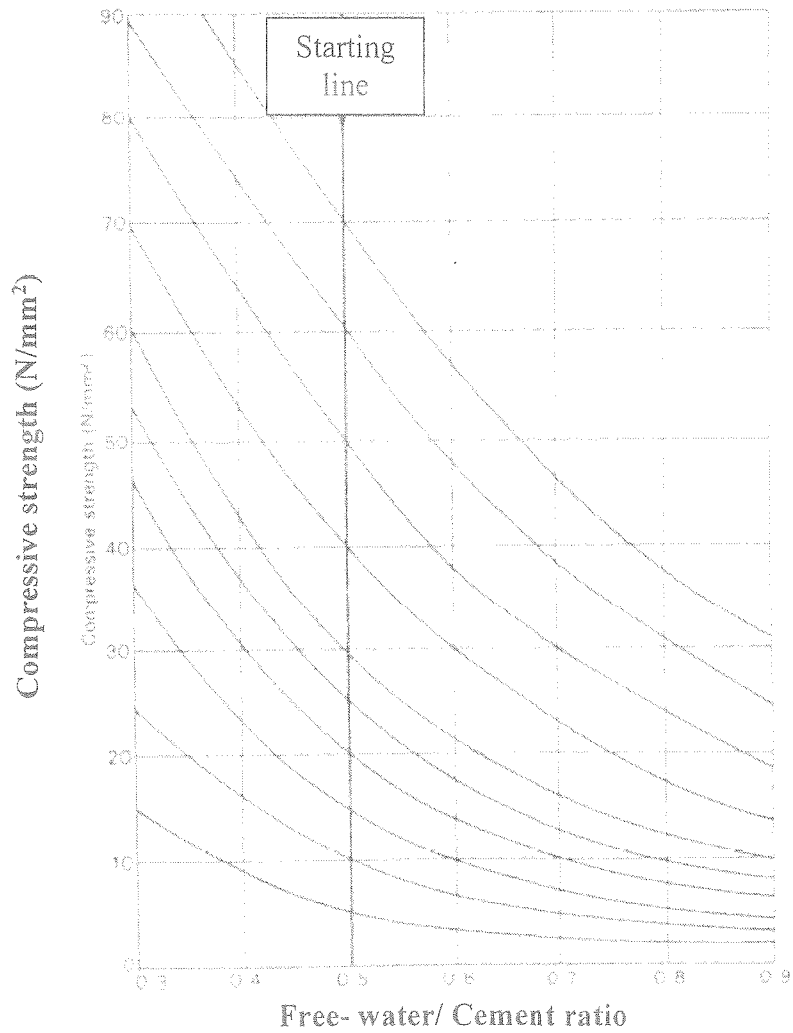


Fig. Q2.1 Compressive strength against free water cement ratio

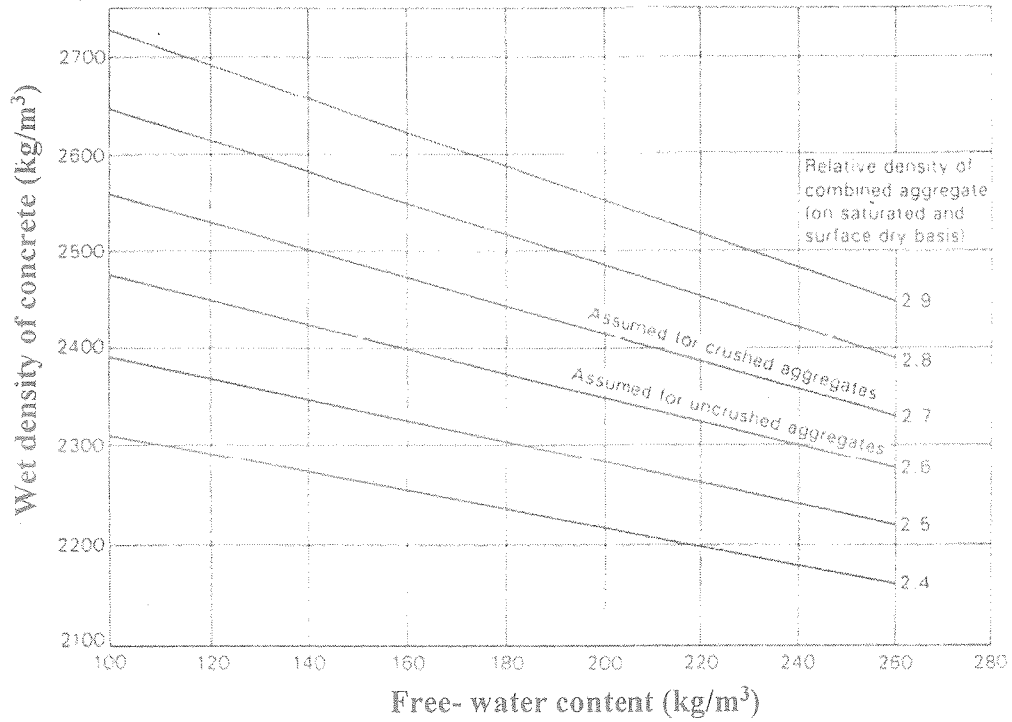


Fig. Q2.2 Wet density of concrete against the free water content for different relative density of the aggregate mix.

Maximum aggregate size: 20mm

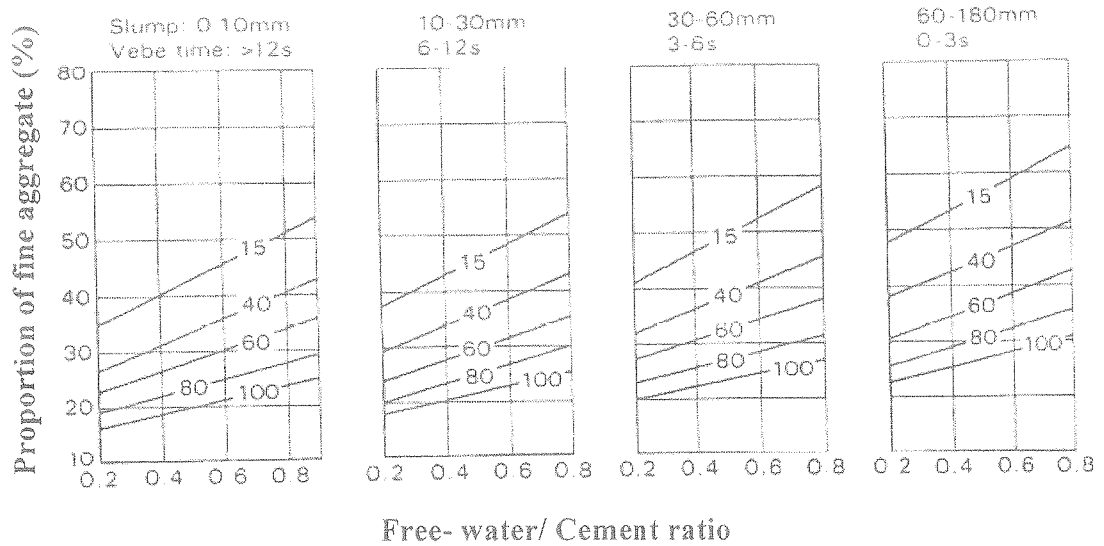


Fig. Q2.3 Fine aggregate content as a percentage of total aggregate content determined for different free water cement ratio and workability for 20mm maximum aggregate size