BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Spring) Examination 2024: Oct 2024 - Nov 2024

Student Group: 36<Earned Credit Hours ≤ 72

Subject: EWCE 201, Construction Materials

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory.
c. Answer any other **TWO** out of the remaining **THREE** questions from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Design a concrete mix for 30 yard^3 using ACI Method to achieve a compressive strength of 5,500 psi at 28 days. Use the following parameters: **15**
(i) Slump: 4 inch
(ii) Water Cement ratio (W/C): 0.50
(iii) Coarse aggregate:
SSD bulk specific gravity: 2.60
Dry rodded unit wt: 350 lb/ft^3
Moisture content: 1%
Absorption capacity: 2%
Max aggregate size: $\frac{3}{4}$"
(iv) Fine aggregate:
Specific gravity of cement: 3.15
SSD bulk specific gravity: 2.65
Fineness Modulus: 2.70
Moisture content: 1%
Absorption capacity: 2%

Graphs and charts are attached.

b. Describe the procedure of slump test and explain its significance in assessing the workability of concrete. **05**

c. Discuss the curing process of concrete and its importance in construction. **05**

d. Explain the process of wood seasoning and its significance. **05**

Question 2

a. Define stress, strain and explain their relationship using the concept of Young's Modulus of Elasticity with neatly sketched figure. **04+04 =08**

b. Define elasticity and plasticity. How these properties influence the behavior under load? Provide examples of material that are highly plastic and elastic, and discuss their application. **04+04+04 =12**

c. What are the different phases of matter? How do they impact the properties of Engineering materials? **05**

d. What are the differences between ferrous and non-ferrous metals? What are their typical applications? **05**

Question 3

a. Design a concrete mix for $10m^3$ using British standard method to achieve a compressive strength of 5000 psi at 28 days. Use the following parameters: **15**
(i) Max aggregate size: 20mm
(ii) Slump: 75mm
(iii) Water cement (W/C) ratio: 0.40
(iv) Air content: 2% (non-air entrained concrete)
(v) Specific gravity of cement: 3.15
(vi) Specific gravity of coarse aggregate: 2.70
(vii) Specific gravity of fine aggregate: 2.65
(viii) Dry rodded bulk density of coarse aggregate: 1600 kg/m^3
(ix) Moisture content of aggregate: 2%
(x) Absorption capacity of aggregate: 1%

Assume any reasonable data if necessary. Graphs and charts are attached.

b. Briefly describe the design consideration of river bank protection work. **05**

c. Define segregation and bleeding of concrete. How to minimize segregation? **05**

d. Write down short notes (any two) on: **05**
(a) Creep
(b) Fatigue
(c) Toughness
(d) Hardness

Question 4

a. What is decomposition of materials? How single and double displacement of ions takes place after decomposition? Explain with chemical reactions. **06**

b. Draw the cross section of the trunk of an exogenous tree leveling different items and discuss the structure of timber. **06**

c. How do geotextile improve soil stability and protection against erosion in Cox's Bazar, Bangladesh? **05**

d. What is riprap and its application in coastal engineering? What are the advantage and disadvantage of using riprap in coastal engineering? Explain with figure. **03+03+03 =09**

e. Describe chemical composition and its purpose in brick production. **04**

SECTION-B

Question 5 (Compulsory)

a. Briefly explain the five groups of construction materials. Give an example for each. Also, state one use for each group. **15**

b. Describe the applications of FRP in the building industry. **06**

c. Classify aggregates based on size, weight and shape. **09**

Question 6

a. Describe the sources of sand. **09**

b. State six uses of lime. **06**

c. Illustrate the commercial forms of plastic giving an example for each form and state seven properties of rubber. **08+07 =15**

Question 7

a. Write short notes on: **09**
(i) Dense gradation
(ii) Gap gradation
(iii) Open gradation

b. State three laboratory and three field tests of cement. **06**

c. Explain the types of cast iron with one property and one use for each. **15**

Question 8

a. State three properties and three functions of sand. **06**

b. Explain the manufacturing process of glass and state five properties of asbestos. **10+05 =15**

c. Find the Fineness Modulus of the sand with the following sieve analysis results. **09**

Sieve No.	Sieve Size (mm)	Material Retained (gm)
#4	4.75	0
#8	2.36	20
#16	1.18	30
#30	0.60	20
#50	0.30	10
#100	0.15	10
#200	0.075	5
PAN	-	5

Some required informations

Table 6.3.1 — Recommended slumps for various types of construction*

Types of construction	Slump, in.	
	Maximum†	Minimum
Reinforced foundation walls and footings	3	1
Plain footings, caissons, and substructure walls	3	1
Beams and reinforced walls	4	1
Building columns	4	1
Pavements and slabs	3	1
Mass concrete	2	1

*Slump may be increased when chemical admixtures are used, provided that the admixture-treated concrete has the same or lower water-cement or water-cementitious material ratio and does not exhibit segregation potential or excessive bleeding.

†May be increased 1 in. for methods of consolidation other than vibration.

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Table 6.3.3 — Approximate mixing water and air content requirements for different slumps and nominal maximum sizes of aggregates

Slump, in.	Water, lb/yd³ of concrete for indicated nominal maximum sizes of aggregate							
	⅜ in.*	½ in.*	¾ in.*	1 in.*	1-½ in.*	2 in.*†	3 in.†‡	6 in.†‡
Non-air-entrained concrete								
1 to 2	350	335	315	300	275	260	220	190
3 to 4	385	365	340	325	300	285	245	210
6 to 7	410	385	360	340	315	300	270	—
More than 7*	—	—	—	—	—	—	—	—
Approximate amount of entrapped air in non-air-entrained concrete, percent	3	2.5	2	1.5	1	0.5	0.3	0.2
Air-entrained concrete								
1 to 2	305	295	280	270	250	240	205	180
3 to 4	340	325	305	295	275	265	225	200
6 to 7	365	345	325	310	290	280	260	—
More than 7*	—	—	—	—	—	—	—	—
Recommended averages‖ total air content, percent for level of exposure:								
Mild exposure	4.5	4.0	3.5	3.0	2.5	2.0	1.5**,¶	1.0**,¶
Moderate exposure	6.0	5.5	5.0	4.5	4.5	4.0	3.5**,¶	3.0**,¶
Severe exposure#	7.5	7.0	6.0	6.0	5.5	5.0	4.5**,¶	4.0**,¶

Table 6.3.4(a) — Relationship between water-cement or water-cementitious materials ratio and compressive strength of concrete

Compressive strength at 28 days, psi*	Water-cement ratio, by weight	
	Non-air-entrained concrete	Air-entrained concrete
6000	0.41	—
5000	0.48	0.40
4000	0.57	0.48
3000	0.68	0.59
2000	0.82	0.74

Table 6.3.6 — Volume of coarse aggregate per unit of volume of concrete

Nominal maximum size of aggregate, in.	Volume of oven-dry-rodded coarse aggregate* per unit volume of concrete for different fineness moduli of fine aggregate+			
	2.40	2.60	2.80	3.00
⅜	0.50	0.48	0.46	0.44
½	0.59	0.57	0.55	0.53
¾	0.66	0.64	0.62	0.60
1	0.71	0.69	0.67	0.65
1½	0.75	0.73	0.71	0.69
2	0.78	0.76	0.74	0.72
3	0.82	0.80	0.78	0.76
6	0.87	0.85	0.83	0.81

*Volumes are based on aggregates in oven-dry-rodded condition as described in ASTM C 29.

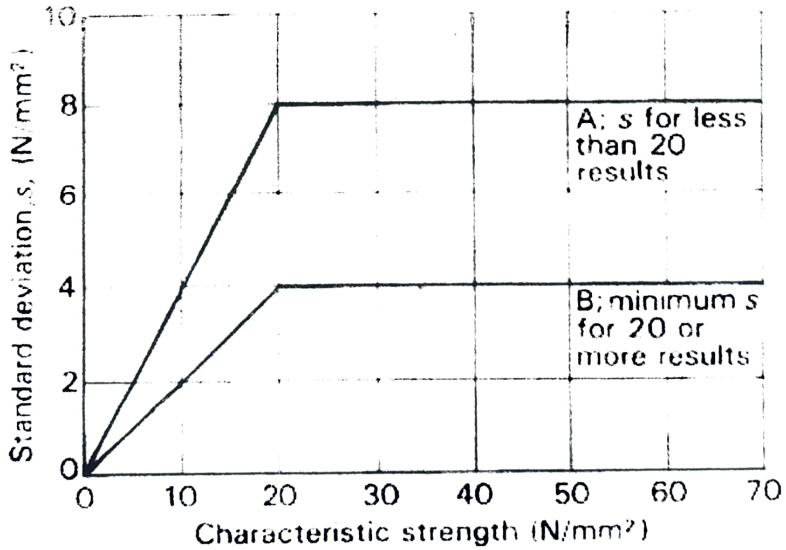


Figure 1: Relationship between standard deviation and characteristic strength.

Cement strength class	Type of coarse aggregate	Compressive strengths (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

Table 1: Typical compressive strengths of concrete

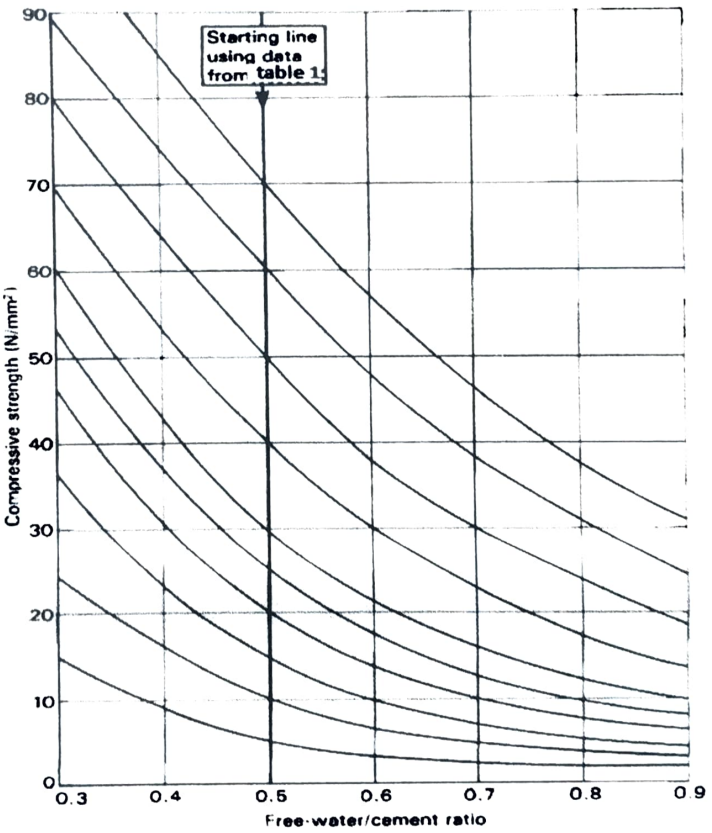


Figure. 2: Relationship between compressive strength and water/ cement ratio

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

Table 2: Approximate free-water contents (kg/m3) required to give various levels of workability.

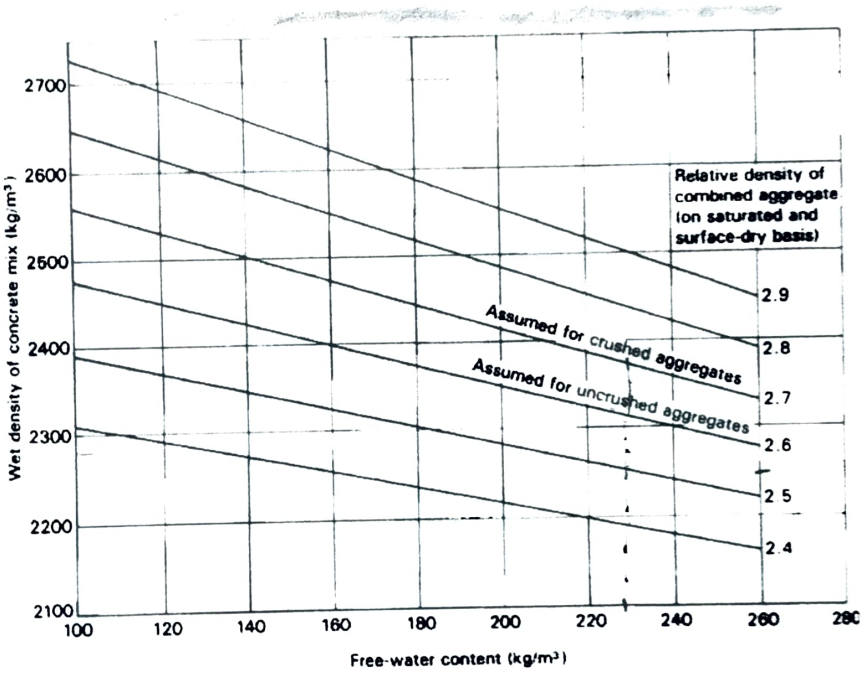


Figure 3: Estimated wet density of fully compacted concrete

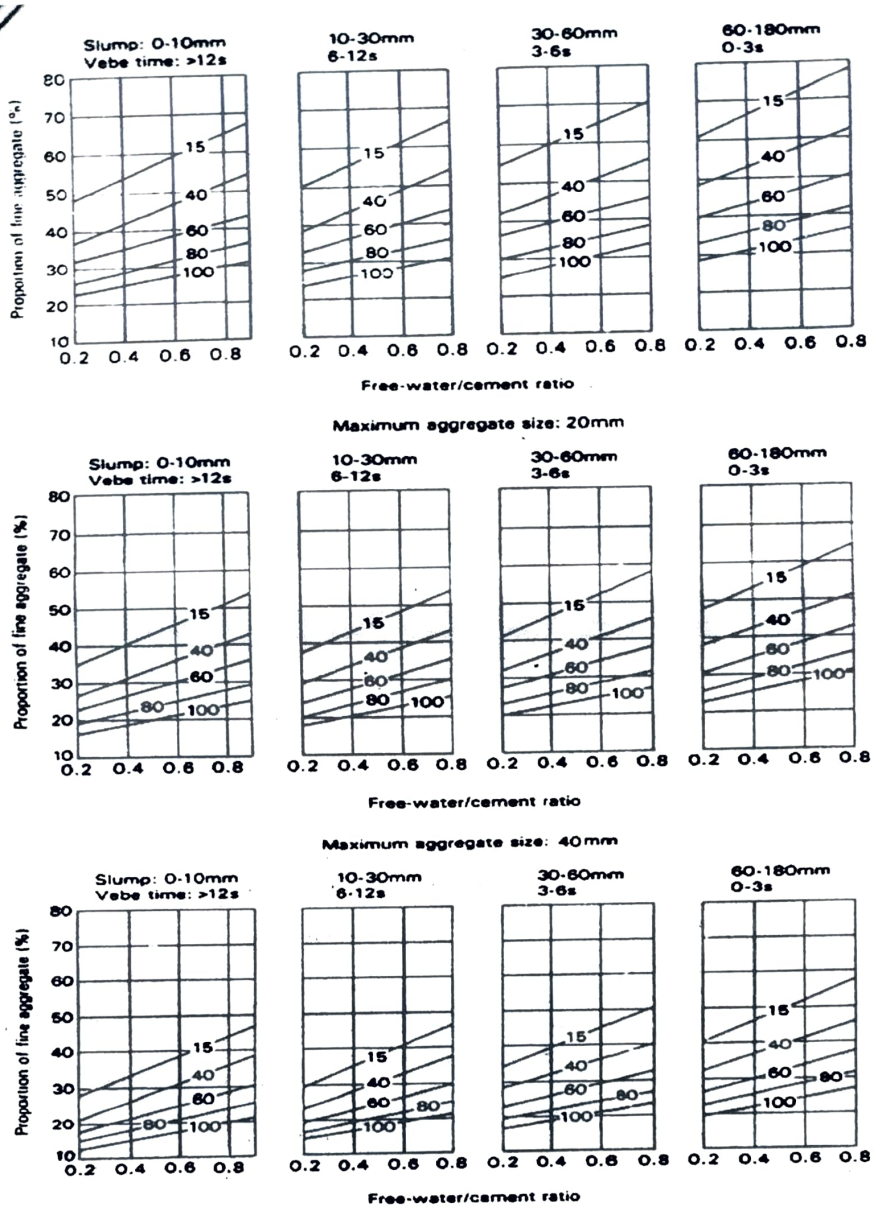


Figure 4: Recommended proportions of fine aggregate according to percentage passing a 600 µm sieve.