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Daffodil International University

B. Sc. in Civil Engineering

Final Examination, Spring - 2025

Course Code: CE 201	Course Title: Engineering Materials	
Section: BN1 & BN2	Level-Term: 2-1	Teacher's Initial: AU
Full Marks: 40	Date: May 22, 2025	Time: 2.0 Hours

Note: There are eight questions in total. Answer all of them. Right hand margin indicates full marks.

1. The combined fineness modulus of fine aggregate (FA) and coarse aggregate (CA), having values of 2.85 and 6.77 respectively, was found to be 5.30. If 8.49 cubic feet of well-packed combined aggregate is required, Calculate the initial volumes of FA and CA to be mixed. Assume a shrinkage factor of 0.75.**[CO2, C3]** [05]
2. Design a concrete mix for column located above ground where moderate freezing and thawing may occur. The required average strength will be 4500psi. The coarse aggregate has a nominal maximum size of 25 mm and a dry-rodded mass of 100 lb/ft³. The other properties of the ingredients are as follows: [10]
   - Cement: Type I with a specific gravity of 3.15.
   - Coarse aggregate: bulk specific gravity = 2.70, absorption = 1.2% and surface moisture = 1.5 %.
   - Fine aggregate: bulk specific gravity = 2.60, absorption = 1%, fineness modulus = 2.7, and surface moisture = 2 %. **[CO3, C5]**
3. Briefly demonstrate the causes and control measures of segregation in concrete. **[CO2, C3]** [04]
4. Illustrate the stress-strain curve of mild steel. **[CO1, C2]** [03]
5. Write short note on the following: **[CO1, C1]** [08]
   - I. Light weight concrete
   - II. Ingredients of paints
   - III. FRP
   - IV. Uses of Ferrocement
6. Briefly describe the main objectives of timber seasoning. **[CO1, C1]** [03]
7. Briefly describe the factors affecting the strength of concrete. **[CO1, C2]** [04]
8. Briefly describe, with a neat sketch, the relationship between the water-to-cement ratio and the compressive strength of concrete. **[CO1, C2]** [03]

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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

Temperature, °F	Density, lb./ft.³
60	62.368
65	62.337
70	62.302
75	62.261
80	62.216
85	62.166

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

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**,‡‡