

TE/CIVIL/SEM V/CB CS

07 JUN 2019



(3 Hours)

(Total Marks: 80)

- Note: 1. Question number 1 is compulsory; attempt any three out of remaining five questions.
 2. Assume suitable data if required and mention it clearly.
 3. Draw neat sketches wherever necessary. Figure to the right indicates full marks.

1. Attempt any four.
 - (a) Explain hydration of cement and requirement of water in hydration [20]
 - (b) Write a short note on maturity of concrete.
 - (c) Explain the properties of fresh concrete.
 - (d) Mention methods of prevention of steel corrosion. Explain any one in brief.
 - (e) Write a short note on waste material-based concrete.

2. (a) What are the special problems encountered in hot weather concreting? How are they rectified? [06]
- (b) Design a concrete mix by IS 10262: 2009 for the following data: [14]
 - i. Characteristic compressive strength required in the field at 28 days grade designation = M 25
 - ii. Standard Deviation = 4.0
 - iii. Nominal maximum size of aggregate = 20 mm
 - iv. Shape of C.A aggregate = Angular
 - v. Degree of workability required at site = 50-75 mm slump
 - vi. Type of exposure = mild
 - vii. Method of concrete placing = Pumpable concrete
 - viii. Specific gravity of cement = 3.15
 - ix. Specific gravity of C.A = 2.84
 - x. Specific gravity of F.A = 2.64
 - xi. Aggregates are assumed to be in saturated surface dry condition.
 - xii. F.A belongs to Zone II

Table 2 Maximum Water Content per Cubic Metre of Concrete for Nominal Maximum Size of Aggregate
(Clauses 4.2, A-5 and B-5)

Sl No.	Nominal Maximum Size of Aggregate mm	Maximum Water Content ¹⁾ kg
(1)	(2)	(3)
i)	10	208
ii)	20	186
iii)	40	165

NOTE — These quantities of mixing water are for use in computing cementitious material contents for trial batches.

¹⁾ Water content corresponding to saturated surface dry aggregate.

Table 3 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate
(Clauses 4.4, A-7 and B-7)

Sl No.	Nominal Maximum Size of Aggregate mm	Volume of Coarse Aggregate ¹⁾ per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone IV	Zone III	Zone II	Zone I
(1)	(2)	(3)	(4)	(5)	(6)
i)	10	0.50	0.48	0.46	0.44
ii)	20	0.66	0.64	0.62	0.60
iii)	40	0.75	0.73	0.71	0.69

¹⁾ Volumes are based on aggregates in saturated surface dry condition.

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m ³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m ³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	-	300	0.55	M 20
ii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

3. (a) Explain cracking mechanism in FRC member subjected to flexure with neat labelled sketch. [08]
- (b) What are the effects of aspect ratio on relative strength and toughness of concrete. [03]
- (c) What are the factors to get good concrete performance in aggressive environment? [04]
- (d) Explain various methods of curing of concrete. [05]

4. (a) What is non-destructive testing of concrete? What are the various tests involved? Explain any one in detail with a neat sketch. [10]
- (b) Define High performance concrete. Give its constituents. What are the various parameters considered in the production of H.P.C? [05]
- (c) Define cold weather concrete. What are the precautions to be taken during cold weather concreting? [05]

5. (a) Explain Alkali Carbonate reaction in concrete in detail. [05]
- (b) Explain in detail the advantages and disadvantages of light weight aggregate concrete. [05]
- (c) Design a concrete mix by ACI method for the following data: [10]
 - i. Characteristic compressive strength required in the field at 28 days grade designation = M 20
 - ii. Standard Deviation = 4.0
 - iii. Nominal maximum size of aggregate = 20 mm
 - iv. Type of cement = Type 1
 - v. Shape of C.A aggregate = Crushed Angular
 - vi. Degree of workability required at site = 100 mm slump
 - vii. Type of exposure = mild
 - viii. Dry rodded density of coarse aggregate = 1640 kg/mm³
 - ix. Specific gravity of cement = 3.15
 - x. Specific gravity of C.A = 2.78
 - xi. Specific gravity of F.A = 2.72
 - xii. Degree of supervision = Good
 - xiii. Maximum water cement ratio = 0.50
 - xiv. Fineness modulus = 2.8
 - xv. Aggregates are assumed to be in saturated surface dry condition.

6. Write a short note on any four of the following:
- (a) Self-Compacting concrete
 - (b) Sulphur concrete
 - (c) Properties of metallic fibers
 - (d) Gap graded concrete
 - (e) Durability of concrete

[20]

Table 6: Approximate mixing water and air contents for different slumps and max. size of aggregates

Slump (mm)	Maximum quantity of water (kg/m ³) for specified nominal maximum size of aggregate [®]							
	10	14	20	28	40	56*	80*	150*
1. Non-air-entrained concrete								
Stiff-plastic (25-50)	207	199	190	179	166	154	130	113
Plastic (75-100)	228	216	285	193	181	169	145	124
Flowing (150-175)	243	228	216	202	190	178	160	-
Approximate Entrapped air (%)	3.0	2.5	2.0	1.5	1.0	0.5	0.3	0.2
2. Air-entrained concrete								
Stiff-plastic (25-50)	181	175	168	160	150	142	122	107
Plastic (75-100)	202	193	184	175	165	157	133	119
Flowing (150-175)	216	205	197	184	174	166	154	-
3. Recommended average total air content (%)								
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 7: Water-Cement Ratio and Compressive Strength Relationship

28-day compressive strength [#] (N/mm ²)	Water/cementing material ratio by mass*	
	Non-air-entrained concrete	Air-entrained concrete
45	0.38	0.30
40	0.42	0.34
35	0.47	0.39
30	0.54	0.45
25	0.61	0.52
20	0.69	0.60
15	0.97	0.70

Table 8: Volume of Coarse Aggregate per Unit Volume for Different Fine aggregate Fineness Modulus

Nominal maximum size of coarse aggregate (mm)	Bulk volume of oven-dry-rodged coarse aggregate (m ³) fineness modulus of fine aggregate			
	2.40	2.60	2.80	3.00
10	0.50	0.48	0.46	0.44
14	0.59	0.57	0.55	0.53
20	0.66	0.64	0.62	0.60
28	0.71	0.69	0.67	0.65
40	0.75	0.73	0.71	0.69
56	0.78	0.76	0.74	0.72
80	0.82	0.80	0.78	0.76
150	0.87	0.85	0.83	0.81