MANIPAL INSTITUTE OF TECHNOLOGY
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MANIPAL INSTITUTE OF TECHNOLOGY

SIXTH SEMESTER B. TECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, MAY 2023

ADVANCES IN CONCRETE TECHNOLOGY (CIE 4051)

(– 05 - 2023)

TIME: 3 HRS. **MAX. MARKS: 50**

Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.

Q. NO	QUESTION	MARKS	CO	BL
1A	Discuss the inherent drawbacks of concrete.	**3**	**1**	**2**
1B	Illustrate with a relevant graph the relation between strength and the water-cement ratio of concrete.	**3**	**1**	**2**
1C	Discuss the following types of shrinkage, i) plastic shrinkage and ii) autogenous shrinkage. Describe the effects of the creep of concrete.	**4**	**1**	**2**
2A	List the factors that necessitate the advances in concrete technology.	**2**	**1**	**2**
2B	Discuss the factors affecting i) compressive strength, ii) elastic modulus, iii) bond strength, and iv) impact strength of concrete.	**4**	**2**	**2**
2C	Illustrate, with a neat sketch, the phases of concrete microstructure. Discuss the influence of these phases on the properties of hardened concrete.	**4**	**2**	**2**
3A	Illustrate the role of aggregate size on the compressive strength of concrete.	**3**	**2**	**2**
3B	Illustrate the provisions in IS 10262:2019 that ensure 95% of the results fall within the range of characteristic strength.	**3**	**3**	**3**
3C	The test data for designing the M75 mix is below for severe exposure conditions and a 120 mm slump. Cement: OPC 53 Fly ash: 30% as a replacement for cement Maximum nominal size of aggregates: 20 mm Fine aggregate: Conforming to grading Zone-II Chemical admixture: 1.1% PCE-based superplasticizer Determine i) target mean strength, ii) cement and water content, iii) water-to-cementitious material ratio, and iv) coarse and fine aggregate content per unit volume of total aggregates.	**4**	**3**	**3**

4A	List the possible benefits of using lightweight concrete in structural applications. Discuss possible recommendations to tackle possible issues related to workability, w/c ratio, flowability, and durability while designing lightweight aggregate concrete.	**5**	**3**	**2**
4B	Discuss the characteristics of high-strength concrete considering i) development of strength, ii) heat of hydration, and iii) shrinkage and creep.	**3**	**4**	**2**
4C	Discuss the role of i) fillers and ii) aggregates in designing a self-consolidating concrete.	**2**	**4**	**2**
5A	Compare SIFCON and SIMCON on i)preparation and fiber content and ii) application.	**2**	**4**	**2**
5B	Explain the physical process of concrete deterioration. Discuss the measures to control them.	**5**	**5**	**2**
5C	Illustrate with a neat sketch the setup of the Ultrasonic test and its interpretation.	**3**	**5**	**2**

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/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	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

Table 10 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate for Water-Cement/Water-Cementitious Material Ratio of 0.30

(Clause 6.2.7)

Sl No.	Nominal Maximum Size of Aggregate mm	Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate		
		Zone III	Zone II	Zone I
(1)	(2)	(3)	(4)	(5)
i)	10.0	0.56	0.54	0.52
ii)	12.5	0.58	0.56	0.54
iii)	20.0	0.68	0.66	0.64

Table 1 Value of X
(*Clause* 4.2)

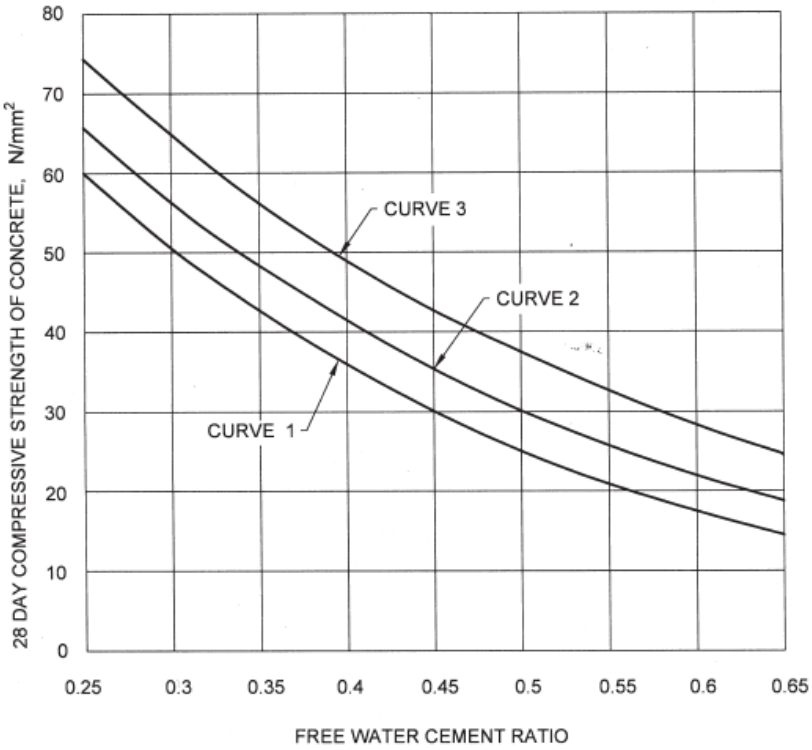
Sl No.	Grade of Concrete	Value of X
(1)	(2)	(3)
i)	*M*10, *M*15	5.0
ii)	*M*20, *M*25	5.5
iii)	*M*30, *M*35, *M*40, *M*45, *M*50, *M*55, *M*60	6.5
iv)	M65 and above	8.0

Table 2 Assumed Standard Deviation
(*Clause* 4.2.1.3)

Sl No.	Grade of Concrete	Assumed Standard Deviation N/mm^2
(1)	(2)	(3)
i)	*M*10, *M*15	3.5
ii)	*M*20, *M*25	4.0
iii)	M30, M35, M40, M45, M50, M55, M60	5.0
iv)	*M*65, *M*70, *M*75, *M*80	6.0

Table 8 Recommended w/cm for High Strength Concrete made with HRWRA
(*Clause* 6.2.5)

Sl No.	Target Compressive Strength at 28 Days N/mm^2	Water–Cementitious Materials Ratio		
		Nominal Maximum Size of Aggregate		
		10.0 mm	12.5 mm	20.0 mm
(1)	(2)	(3)	(4)	(5)
i)	70	0.36	0.35	0.33
ii)	75	0.34	0.33	0.31
iii)	80	0.32	0.31	0.29
iv)	85	0.30	0.29	0.27
v)	90	0.28	0.27	0.26
vi)	100	0.26	0.25	0.24



Curve 1 : for expected 28 days compressive strength of 33 and < 43 N/mm².
Curve 2 : for expected 28 days compressive strength of 43 and < 53 N/mm².
Curve 3 : for expected 28 days compressive strength of 53 N/mm² and above.