

# Techno India NJR Institute of Technology



## Course File

## Concrete Technology (4CE4- 08)

For Techno India NJR Institute of Technology  
पंकज पोखवाल  
Dr. Pankaj Kumar Porwal  
(Principal)

Bharat Kr. Suthar  
(Assistant Professor)  
Department of CE



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

### II Year-IV Semester: B.Tech. (Civil Engineering)

#### 4CE4-08: CONCRETE TECHNOLOGY

Credit: 3

Max. Marks: 150 (IA:30, ETE:120)

3L+0T+0P

End Term Exam: 3 Hours

SN	CONTENTS	Hrs.
1	<b>Introduction:</b> to objective, scope and outcome of the subject	1
2	<b>Ingredients of concrete:</b> Cement: hydration of cement and its basic compounds, structure of hydrated cement, C-S-H gel, heat of hydration, gel-space ratio etc.	2
3	<b>Aggregates:</b> types, physical properties and standard methods for their determination, including Grading of aggregates as per IS. Manufactured sand- properties and IS Specifications for use in concrete.	2
4	<b>Concrete:</b> Grade of concrete, proportioning of ingredients, water content and its quality, water/cement ratio and its role, Properties of fresh concrete including workability, air content, Flow ability, Segregation, Bleeding and Viscosity etc. Factors affecting, methods of determination.	4
5	Properties of hardened concrete such as strengths, permeability, creep, shrinkage, factors influencing, Standard tests on fresh and hardened concrete as per IS code. Aggregate- cement interface, its effect on properties of concrete.	4
6	<b>NDT:</b> Introduction and their importance. Application & use of Rebound Hammer, Ultra-sonic pulse velocity meter, Rebar & Cover meter, half-cell potential meter, corrosion resistivity meter, core sampling. Interpretation of their results,	4
7	<b>Concrete Handling in Field:</b> Batching, mixing, placing and transportation of concrete, equipments for material handling, various methods their suitability and precautions. Compaction of concrete: methods & equipments. Curing of concrete: various methods their suitability.	4
8	Durability of concrete. Causes of deterioration, Carbonation, Tests for durability assessment	3
9	<b>Admixture in concrete:</b> Chemical and mineral admixtures, their types and uses: accelerator, retarders, water-proofing, plasticisers, super plasticizers-types, their suitability. Fly ash-properties for use in concrete, specifications of flyash as per IS 3812, and effect on properties of concrete. GGBFS, Microsilica and metakaolin- properties, specifications and utility in concrete.	7

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Dr. Pankaj Kumar Porwal  
(Principal)



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10	Concrete mix design (IS method)- with and without water reducing admixtures	2
11	<b>Form work:</b> Requirements, their types. Typical formworks and shuttering/centering for Columns, beams, slabs, walls, etc. Slip and moving formwork.	3
12	<b>Special types of concrete:</b> Sulphate resisting concrete, under water concreting, pumpable concrete: methods and issues in making, salient properties and applications.	3
13	Concretes with tailored properties- including high performance concrete, with specific properties in fresh and hardened states, self-compacting concrete-materials, mix proportioning, test methods, use and applications with case studies.	3
<b>TOTAL</b>		<b>42</b>

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## Course Overview:

The course on “Concrete Technology” focuses on concrete making materials including supplementary cementations materials. Concrete production process also forms a part of the discussion. Going through the course one would develop first-hand knowledge on concrete production process and properties and uses of concrete as a modern material of construction. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete. This course broadly encompasses the study of properties of ingredients of concrete, design of concrete mix, production of concrete and various concreting operations. Cementing material is the vital component of the concrete, hence study of process of manufacturing of cement, types of cement and their properties are covered in this course. Study of properties of aggregates and water also finds their due coverage in the course. Process of concrete production and concreting operations also forms an essential component of the course. In addition to the study of special purpose concretes, the course also provides the due coverage of admixtures which are added to modify the properties of concrete. Properties of concrete in plastic as well as in hardened stage find its due coverage in this course. The course aims at imparting knowledge and skill to supervise concreting operations involving proportioning, mixing, transporting, placing, compacting, finishing and curing of concrete. Hence this course has its stand alone value also.

## Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Application	Understand chemistry, properties, and classification of cement, fly ash, aggregates and admixtures, and hydration of cement in concrete.
2	Application	Execute the test for fresh concrete.
3	Analysis	Execute the test for hardened concrete with destructive and non-destructive testing instruments.
4	Design	Implement India standard codes procedure for design concrete mix of desired grade.
5	Application	Learner can state the concrete handling equipments and different special concrete types.

## Prerequisites:

1. Student will be able to Understand chemistry, properties, and classification of cement, fly ash, aggregates and admixtures, and hydration of cement in concrete.
2. Student will be able to Prepare and test the fresh concrete.
3. Students will be able to Test hardened concrete with destructive and non-destructive testing instruments.
4. Students will be able to Design concrete mix of desired grade.
5. Students will be able to Get acquainted to concrete handling equipments and different special concrete

types.

### Course Outcome Mapping with Program Outcome:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO247.1	3	1	2	1	1	2	2	1	1	1	1	1	2	1	1
CO247.2	3	2	2	1	1	1	1	1	1	1	1	2	2	1	1
CO247.3	3	1	2	1	1	2	2	1	1	1	1	1	2	1	1
CO247.4	3	3	3	3	2	2	2	1	1	1	1	2	2	1	1
CO247.5	3	1	2	1	1	2	1	1	1	1	1	1	2	1	1
CO247 (AVG)	3	1.6	2.2	1.4	1.2	1.8	1.6	1	1	1	1	1.4	2	1	1

### Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	1	<b>INTRODUCTION:</b> Objective, scope and outcome of the course.
2	2	Student should be able to understand hydration of cement and its Basic compounds
3	2	Student should be able to understand Structure of hydrated cement, C-S-H gel
4	2	Student should be able to understand Heat of hydration, gel-space ratio etc
5	3	Student should be able to understand Types, physical properties of aggregate.
6	3	Student should be able to understand Standard methods for their determination, including Grading of Aggregates as per IS
7	3	Student should be able to understand Manufactured sand- properties and IS Specifications for use in Concrete.
8	4	Student should be able to understand Grade of concrete, proportioning of ingredients, water Content and its quality
9	4	Student should be able to understand Water/cement ratio and its role, Properties of fresh concrete Including workability
10	4	Student should be able to understand Air content, Flow ability, Segregation, Bleeding and Viscosity etc
11	4	Student should be able to understand Factors affecting, methods of determination
12	5	Student should be able to understand PROPERTIES OF HARDENED CONCRETE. Strengths and permeability
13	5	Student should be able to understand Creep, shrinkage, factors influencing

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14	5	Student should be able to understand Standard tests on fresh and hardened concrete as per IS code
15	5	Student should be able to understand Aggregate- cement interface, its effect on properties of concrete
16	6	Student should be able to understand Application of NDT & use of Rebound Hammer
17	6	Student should be able to understand Ultra-sonic pulse velocity meter, Rebar & Cover meter
18	6	Student should be able to understand Half-cell potential meter, corrosion resistivity meter
19	6	Student should be able to understand Core sampling. Interpretation of their results
20	7	Student should be able to understand CONCRETE HANDLING IN FIELD: Batching, mixing
21	7	Student should be able to understand Placing and transportation of concrete
22	7	Student should be able to understand Equipment's for material handling, various methods their suitability And precautions
23	7	Student should be able to understand Compaction of concrete: methods & equipment's
24	7	Student should be able to understand Curing of concrete: various methods their suitability
25	8	Student should be able to understand DURABILITY OF CONCRETE: Causes of deterioration
26	8	Student should be able to understand Carbonation process.
27	8	Student should be able to understand Tests for durability assessment.
28	9	Student should be able to understand about Chemical and mineral admixtures, their Types and uses
29	9	Student should be able to understand about Accelerator, retarders
30	9	Student should be able to understand about Water-proofing, plasticizers
31	9	Student should be able to understand about Super plasticizers-types, their suitability
32	9	Student should be able to understand about Fly ash-properties for use in concrete
33	9	Student should be able to understand Specifications of fly ash as per IS 3812, and effect on properties of Concrete
34	9	Student should be able to understand about GGBFS: properties, specifications and utility in concrete
35	9	Student should be able to understand about Micro silica: properties, specifications and utility in concrete

36	<b>9</b>	Student should be able to understand about Metakaolin: properties, specifications and utility in concrete
37	<b>10</b>	Student should be able to understand CONCRETE MIX DESIGN (IS METHOD): with water reducing admixtures
38	<b>10</b>	Student should be able to understand Concrete mix design (IS method): without water reducing Admixtures
39	<b>10</b>	Student should be able to understand about Form work: Requirements, their types
40	<b>10</b>	Student should be able to understand about Typical formworks and shuttering/centering for Columns, beams
41	<b>11</b>	Student should be able to understand about TYPICAL FORMWORKS AND SHUTTERING/centering for slabs, walls, etc
42	<b>11</b>	Student should be able to understand about Slip and moving formwork

#### **TEXT/REFERENCE BOOKS**

1. Concrete Technology by M. S. Shetty, S. Chand & Co.
2. Concrete Technology by Neville & Brooks, Pearson Education.
3. Concrete: Microstructure, Properties & Materials by Mehta P. K, Tata McGraw Hill.

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**Course Level Problems (Test Items):**

<b>CO.NO.</b>	<b>Problem description</b>
<b>1</b>	A. Explain flakiness index and elongation index B. Describe field testing of cement. C. Distinguish between setting and hardening of cement.
<b>2</b>	A. State factors affecting durability of concrete and state prevention for any one. B. State factors affecting durability of concrete and state prevention for any one C. State methods of application of repair materials for cracked concrete and explain any one method .
<b>3</b>	A. Explain procedure to determine soundness test of cement. B. Explain procedure to determine aggregate crushing value test. C. Explain procedure to determine aggregate impact value test.
<b>4</b>	A. State methods of mixing of concrete and explain any one. B. State different methods of transportation of concrete . C. State different methods of compaction of concrete.
<b>5</b>	A. Explain procedure to determine compressive strength test of cement. B. Explain procedure to determine soundness test of cement. C. Explain procedure to determine aggregate crushing value test.

**Assessment Methodology:**

1. Practical exam in lab where they have to analyze problem statement. (Once in a week)
2. Assignments one from each unit.
3. Midterm subjective paper based on topics as mentioned in the modules. (Twice during the semester)
4. Final paper at the end of the semester subjective.

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(Principal)



## Teaching and Learning resources unit-wise:

INTRODUCTION: Objective, scope and outcome of the course.

Video Tutorials: <https://youtu.be/cx5gPKp9QEc>

Theory concepts: [https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20\(larger\)%20aggregates.](https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20(larger)%20aggregates.)

Concrete.

Video Tutorials: <https://youtu.be/UU6PccuoleE>

Theory concepts: <https://en.wikipedia.org/wiki/Concrete>

A. flakiness and elongation test

Video Tutorials: <https://youtu.be/pZOBN-hIgiE>

Theory concepts: <https://helptheengineer.com/determination-of-indices-flakiness-and-elongation/#:~:text=The%20Flakiness%20Index%20of%20aggregates,1.8%20times%20their%20mean%20dimension.>

B. concrete preparation

Video Tutorials: <https://youtu.be/3UyqRqcdWLw>

Theory concepts: [http://www.madehow.com/Volume-1/Concrete.html#:~:text=First%2C%20the%20cement%20\(usually%20Portland,placed%2C%20compacted%2C%20and%20cured.](http://www.madehow.com/Volume-1/Concrete.html#:~:text=First%2C%20the%20cement%20(usually%20Portland,placed%2C%20compacted%2C%20and%20cured.)

A. concrete crack

Video Tutorials: <https://youtu.be/lwKFUy9W0>

Theory concepts: <https://concretesupplyco.com/6-concrete-cracks/#:~:text=When%20the%20top%20of%20a,or%20pattern%20to%20concrete%20surfaces.>

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Dr. Pankaj Kumar Porwal  
(Principal)

B. admixtures

Video Tutorials: <https://youtu.be/bl4g38BuvIA>

Theory concepts: [https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20\(larger\)%20aggregates.](https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20(larger)%20aggregates.)

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Dr. Pankaj Kumar Porwal  
(Principal)

Previous Year Question Papers:

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paper

<b>4E4112</b>	Roll No. <u>15ECTCE049</u>	Total No. of Pages : <u>4</u>
	<b>4E4112</b> <b>B. Tech. IV-Sem. (Main &amp; Back) Exam; April-May 2017</b> <b>Civil Engineering</b> <b>4CE2A Concrete Technology</b>	

Time : 3 Hours

Maximum Marks : 80  
Min. Passing Marks : 26

**Instructions to Candidates :-**

*Attempt any five questions, selecting one question from each unit. All Questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly. Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. IS 10262

2. NIL

**UNIT - I**

- 1 (a) What is the size in 'mm', below which the if particle size is, it is termed 'fine aggregate' and more than this size is called 'Coarse aggregate'. 2
- (b) Describe the method of determination of 'specific gravity' of fine aggregate. 8
- (c) Which of the following statements are true :
- (i) In specifying Grade of Concrete, the digits after 'M' refers to compressive strength of concrete at 7 days age.
- (ii) Proportioning of ingredients of concrete with cement only as the cementitious material in the case of a major concrete work involving M25 Grade requires cement approx 400 kg/m<sup>3</sup>.

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paper

- (iii) 'Slump test' can be performed at work site.  
(iv) An increase in water/cement ratio results in decrease in compressive strength of concrete.

6

OR

- 1 (a) Select 'True' statements :
- (i) Hydration of cement produces heat in the mass of 'cement and water'.  
(ii) Structure of hydrated cement remains changing between the age of one day and seven days.  
(iii) C-S-H gel in a hydrated cement paste gets dissolved in water.  
(iv) Flowability measuring tests are 'V funnel' and 'Slump flow'.
- (b) Describe the phenomenon of 'bleeding' in concrete and discuss factors affecting it.
- (c) Describe 'bulking' of aggregates and method to determine it.

6

4

6

UNIT - II

- 2 (a) Select 'correct' statements out of the following :
- (i) Permeability of concrete depends on 'pressure head'.  
(ii) Creep of concrete does not depend upon its 'age'.  
(iii) Shrinkage of concrete depends upon 'relative humidity'.  
(iv) Rebound hammer reading mainly depends on 'hardness' of concrete surface.
- (b) Discuss factors affecting compressive strength of concrete.
- (c) Discuss the range of values of ultrasonic pulse velocity in concrete and quality of concrete associated with them.

6

8

2

OR

- 2 (a) Given below are the failure loads of concrete core samples along with their size and age. The samples were collected from a concrete road.

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S.No.	Core size in mm (diameter, height)	Age (in days)	Compressive Failure Load in kN
1	142, 260	120	600
2	142, 245	35	670
3	142, 235	30	478
4	142, 270	140	590
5	142, 225	100	580
6	142, 210	65	495

If the concrete grade of the concrete road is M40, comment on the core sample test results, associated compressive strength and its interpretation.

10

- (b) Discuss aggregate cement interface and its characteristics. How it may get affected in a concrete containing flyash ?

6

UNIT - III

- 2 (a) Name three types of concrete mixers, write about their suitability for different concretes.

6

- (b) Name three types of compaction equipments for concrete and discuss their applications.

3

- (c) Write fine aggregate/coarse aggregate ratio which you shall select for the cases listed below :

- (i) w/c 0.50, slump 100 mm, maximum size of aggregate 20 mm  
(ii) w/c 0.50 slump 50 mm, maximum size of aggregate 10 mm

4

OR

- 3 (a) Discuss various methods of curing concrete and their suitability.

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- (b) Discuss durability of concrete, factors affecting it particularly effect of water/cement ratio on it.

8

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Dr. Pankaj Kumar Porwal  
(Principal)

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UNIT - IV

- 4 (a) Discuss role of 'retarders' in concrete and applications areas of concrete requiring use of 'retarders'. 4
- (b) Discuss physical and chemical properties of silica fume. 4
- (c) Discuss various types of superplasticizers, their respective properties and application areas. 6
- (d) What is the use of 'air-entraining' agents in concrete. 2

OR

- 4 (a) Write typical dosages of accelerators, in concrete. 2
- (b) Design a concrete mix of M25 Grade by IS method with following data : specific gravities of cement, fine aggregate and coarse aggregates as 3.12, 2.90 and 2.60 respectively. Water absorption values for fine and coarse aggregates as 0.80 and 0.50 percentage respectively. Free moisture as nil in both types of aggregates. Slump to be 100 mm. Degree of quality control-good. Exposure condition moderate. Determine and list quantities of ingredients in  $\text{kg/m}^3$  of concrete. 14

UNIT - V

- 5 (a) Discuss formwork with appropriate figures for : 8
- (1) Columns
- (2) Slabs. 8
- (b) Describe salient points and applications of under water concreting. 8

OR

- 5 (a) List three typical performance criteria for a concrete required to be transported approx 2 hours before placement through pump in construction of a public building likely to get water splashes, once in use. 6
- (b) Draw figure of formwork/shuttering for beams, walls and arches. 10

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- Dr. Pankaj Kumar Porwal  
(Principal)

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UNIT - IV

- 4 (a) Discuss role of 'retarders' in concrete and applications areas of concrete requiring use of 'retarders'. 4
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- (c) Discuss various types of superplasticizers, their respective properties and application areas. 6
- (d) What is the use of 'air-entraining' agents in concrete. 2

OR

- 4 (a) Write typical dosages of accelerators, in concrete. 2
- (b) Design a concrete mix of M25 Grade by IS method with following data : specific gravities of cement, fine aggregate and coarse aggregates as 3.12, 2.90 and 2.60 respectively. Water absorption values for fine and coarse aggregates as 0.80 and 0.50 percentage respectively. Free moisture as nil in both types of aggregates. Slump to be 100 mm. Degree of quality control-good. Exposure condition moderate. Determine and list quantities of ingredients in kg/m<sup>3</sup> of concrete. 14

UNIT - V

- 5 (a) Discuss formwork with appropriate figures for : 8
- (1) Columns
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OR

- 5 (a) List three typical performance criteria for a concrete required to be transported approx 2 hours before placement through pump in construction of a public building likely to get water splashes, once in use. 6
- (b) Draw figure of formwork/shuttering for beams, walls and arches. 10

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- Dr. Pankaj Kumar Porwal  
(Principal)

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Dr. Pankaj Kumar Porwal  
(Principal)