

3.2 CONCRETE TECHNOLOGY

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RATIONALE

Diploma holders in Civil Engineering are supposed to supervise concreting operations involving proportioning, mixing, transporting, placing, compacting, finishing and curing of concrete. To perform above functions, it is essential to impart knowledge and skills regarding ingredients of concrete and their properties; properties of concrete in plastic and hardened stage, water cement ratio and workability; proportioning for ordinary concrete; concreting operations and joints in concrete.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

- CO1: Conduct various tests on aggregate in laboratory to evaluate their characteristics
- CO2: Interpret the grading charts of different aggregates and evaluate fineness modulus of aggregates
- CO3: Evaluate workability and strength of concrete
- CO4: Recognise bleeding, segregation, harshness defects in fresh concrete
- CO5: Explain hydration process of cement, water to cement (w/s) ratio and analyze relationship between compressive strength and w/c ratio
- CO6: Conduct various destructive and non-destructive (NDT) test

DETAILED CONTENTS

UNIT I

1. Introduction to Concrete

- 1.1 Definition of concrete, properties of concrete. Advantages and disadvantages of concrete.

2. Ingredients of Concrete

- 2.1 Cement: Introduction only

- 2.2 Aggregates:

- 2.2.1 Classification of aggregates according to size and shape

2.2.2 Characteristics of aggregates: Particle size and shape, surface texture, specific gravity of aggregate; bulk density, water absorption, surface moisture, bulking of sand, deleterious materials soundness

2.2.3 Grading of aggregates: coarse aggregate, fine aggregate; All-in- aggregate; fineness modulus; interpretation of grading charts

2.3 Water: Water Quality requirements as per IS:456-2000

UNIT II

3. Water Cement Ratio

3.1 Hydration of cement principle of water-cement ratio, Duff Abram's Water-cement ratio law: Limitations of water-cement ratio law and its effects on strength of concrete

4. Properties of Concrete

4.1 Properties in plastic state: Workability, Segregation, Bleeding and Harshness

4.1.1 Factors affecting workability, Measurement of workability: slump test, compacting factor; Recommended slumps for placement in various conditions as per IS:456-2000/SP-23

4.2 Properties in hardened state: Strength, Durability, Impermeability, Dimensional changes.

4.3 Concrete mix design (Introduction only)

4.4 Introduction to Admixtures (chemicals and minerals) for improving performance of concrete

UNIT III

5. Concreting Operations

5.1 Storing of Cement:

5.1.1 Storing of cement in a warehouse

5.1.2 Storing of cement at site

5.1.3 Effect of storage on strength of cement

5.1.4 Determination of warehouse capacity for storage of Cement

**5.2 Storing of Aggregate: Storing of aggregate at site

**5.3 Batching (to be shown during site visit)

5.3.1 Batching of Cement

5.3.2 Batching of aggregate by:

- Volume, using gauge box (farma) selection of proper gauge box
- Weight spring balances and batching machines

5.3.3 Measurement of water

****5.4 Mixing:**

- 5.4.1 Hand mixing
- 5.4.2 Machine mixing - types of mixers, capacities of mixers, choosing appropriate size of mixers, operation of mixers.
- 5.4.3 Maintenance and care of mixers

UNIT IV

- **6.1** Transportation of concrete: Transportation of concrete using: wheel barrows, transit mixers, chutes, belt conveyors, pumps, tower crane and hoists etc.
- **6.2** Placement of concrete: Checking of form work, shuttering and precautions to be taken during placement
- 6.3** Compaction:
 - 6.3.1 Hand compaction
 - 6.3.2 Machine compaction - types of vibrators, internal screed vibrators and form vibrators
 - 6.3.3 Selection of suitable vibrators for different situations
- 6.4** Finishing concrete slabs - screeding, floating and trowelling
- 6.5** Curing:
 - 6.5.1 Objective of curing, methods of curing like ponding, membrane curing, steam curing, chemical curing
 - 6.5.2 Duration for curing and removal of form work
- 6.6** Jointing: Location of construction joints, treatment of construction joints, expansion joints in buildings - their importance and location
- 6.7** Defects in concrete: Identification of defects and methods of removing defects.

UNIT V**7. Special Concretes (only features)**

- 7.1** Concreting under special conditions, difficulties, and precautions before, during and after concreting
 - 7.1.1 Cold weather concreting
 - 7.1.2 Under water concreting
 - 7.1.3 Hot weather concreting
- 7.2** Ready mix concrete
- 7.3** Fly ash concrete

8. Importance and methods of non-destructive tests (introduction only)

- 8.1.** Rebound Hammer Test
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8.2. Pulse Velocity method

NOTE: ** A field visit may be planned to explain and show the relevant things

PRACTICAL EXERCISES

1. To determine the physical properties of cement such as fineness, consistency, setting time, soundness, and compressive strength of cement as per IS Codes
2. To determine flakiness at elongation Index of coarse aggregate
3. To determine silt content in fine aggregate
4. Determination of specific gravity and water absorption of aggregates
5. Determination of bulk density and voids of aggregates
6. Determination of particle size distribution of fine, coarse and all-in aggregate by sieve analysis (grading of aggregate)
7. To determine bulking of fine aggregates
8. To determine workability by slump test and to verify the effect of water, fine aggregate/coarse aggregate ratio and aggregate/Cement ratio on slump
9. Compaction factor test for workability
10. Non destructive test on concrete by:
 - a) Rebound Hammer Test
 - b) Ultrasonic Pulse Velocity Test
11. To determine compressive strength of concrete cubes for different grades of concrete
12. To determine flexural strength of concrete beam

RECOMMENDED BOOKS

1. KT Rao, A Kasundra and Khandekar, "Concrete Technology by Krishnamurthy, AA. Dhanpat Rai and Sons, Delhi.
2. BL Gupta and Amit Gupta, "Textbook of Concrete Technology", Standard Publishers Distributors, Delhi.
3. BL Handoo, LD Puri, and Sanjay Mahajan, "Concrete Technology", Satya Prakashan, New Delhi.
4. Hemant Sood, LN Mittal and PD Kulkarni, "Laboratory Manual on Concrete Technology" by; CBS Publishers, New Delhi.
5. Birinder Singh, "Concrete Technology", Kaption Publications, Ludhiana.
6. Dr. Hemant Sood, Module on "Special Concretes", NITTTR Chandigarh.

7. “Video programme on different experiments in ‘Concrete Technology’”, NITTTR, Chandigarh.
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

INSTRUCTIONAL STRATEGY

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various stages of concreting operations. While working in the laboratory, efforts should be made to provide extensive practical training to students to make them confident in the preparation and testing of concrete. Teachers should also organize viva examination to develop understanding about concepts and principles involved. The experiments may also be demonstrated to students Periods through video programmes developed in the field of ‘concrete technology’ by NITTTR, Chandigarh. This subject contains five units of equal weightage.