

25CE301 BUILDING MATERIALS AND CONCRETE TECHNOLOGY

UNIT -IV

FRESH AND HARDENED CONCRETE - DETAILED NOTES

1. FRESH CONCRETE

Definition

Fresh concrete is the concrete that is freshly mixed and can be molded, placed, compacted, and finished before it hardens.

Fresh concrete should possess:

- Workability
- Cohesiveness
- Proper setting characteristics
- Resistance to segregation and bleeding

WORKABILITY OF CONCRETE

Definition

Workability is the ease with which concrete can be mixed, transported, placed, compacted, and finished without segregation.

Factors Affecting Workability

Factor	Effect on Workability
Water content	Higher water increases workability
Aggregate size	Larger size increases workability
Aggregate shape	Rounded aggregates improve workability
Aggregate texture	Smooth texture increases workability
Cement content	More cement improves workability
Admixtures	Plasticizers improve workability

Measurement of Workability

1. Slump Cone Test

Purpose

Measures consistency and workability of concrete.

Apparatus

- Slump cone

- Tamping rod
- Base plate

Procedure

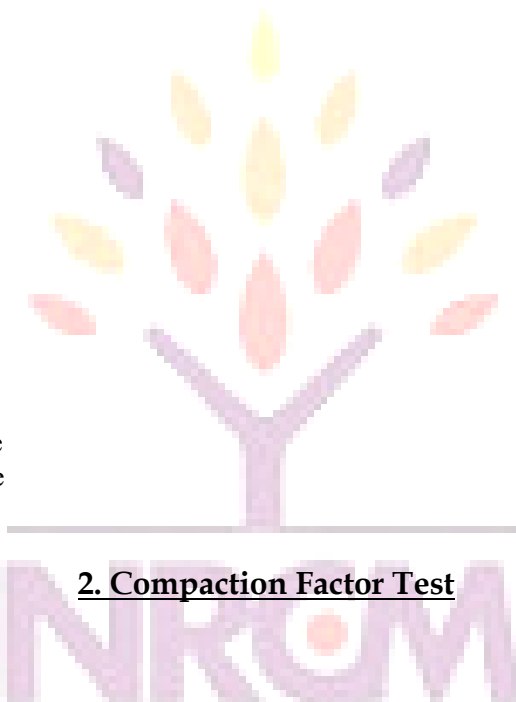
1. Place cone on base plate.
2. Fill concrete in 4 layers.
3. Tamp each layer 25 times.
4. Lift cone vertically.
5. Measure slump.

Types of Slump

1. True slump
2. Shear slump
3. Collapse slump

Interpretation

- Low slump → Stiff concrete
- High slump → Wet concrete



2. Compaction Factor Test

Purpose

Measures workability of low-workability concrete.

Principle

Ratio of partially compacted concrete weight to fully compacted concrete weight.

Compaction Factor = $\frac{\text{Weight of Partially Compacted Concrete}}{\text{Weight of Fully Compacted Concrete}}$

Uses

- Road concrete
- Pavement concrete

3. Vee-Bee Consistometer Test

Purpose

Measures workability of very stiff concrete.

Principle

Time required to remold concrete from conical shape to cylindrical shape under vibration.

Unit

- Seconds

4. Flow Table Test

Purpose

Measures flowability of highly workable concrete.

Procedure

1. Fill concrete in cone.
2. Lift cone.
3. Drop table repeatedly.
4. Measure spread diameter.

SEGREGATION

Definition

Separation of coarse aggregates from cement paste in concrete.

Causes

- Excess water
- Improper handling
- Poor grading
- Excess vibration

Effects

- Honeycombing
- Reduced strength
- Non-uniform concrete

Prevention

- Proper mix proportion
- Controlled water content
- Proper compaction

BLEEDING

Definition

Bleeding is the upward movement of water in freshly placed concrete.

Causes

- Excess water
- Poor grading
- Insufficient fines

Effects

- Weak surface
- Cracks
- Reduced bond

Prevention

- Use well-graded aggregates
- Reduce water content
- Use admixtures

SETTING TIME OF CONCRETE

Initial Setting Time

Time during which concrete remains workable.

Final Setting Time

Time at which concrete becomes hard.

Importance

- Helps in transportation and placing
- Important for finishing operations

BATCHING OF CONCRETE

Definition

Measurement of concrete ingredients in proper proportions.

Types of Batching

1. Volume Batching

Ingredients measured by volume.

Advantages

- Simple
- Economical

Disadvantages

- Less accurate

2. Weight Batching

Ingredients measured by weight.

Advantages

- Accurate
- Uniform quality

Disadvantages

- Costly equipment



MIXING OF CONCRETE

1. Hand Mixing

Procedure

Concrete materials mixed manually on watertight platform.

Advantages

- Simple
- Suitable for small works

Disadvantages

- Less uniform
- Labor intensive

2. Machine Mixing

Definition

Mixing using concrete mixer machine.

Advantages

- Uniform mixing
- Faster operation
- Better quality

TRANSPORTING OF CONCRETE

Purpose

To carry concrete from mixing place to placing point without segregation.

Methods

1. Wheelbarrows
2. Buckets
3. Belt conveyors
4. Transit mixers
5. Pumps

PLACING OF CONCRETE

Precautions

- Place near final position
- Avoid free fall from height
- Continuous placing preferred

COMPACTION OF CONCRETE

Definition

Removal of air voids from concrete.

Methods

1. Hand Compaction

- Rodding
- Tamping

2. Mechanical Compaction

- Needle vibrator

- Surface vibrator
- Table vibrator

Importance of Compaction

- Increases strength
- Reduces voids
- Improves durability

FINISHING OF CONCRETE

Definition

Process of leveling and smoothing concrete surface.

Methods

- Floating
- Troweling
- Brushing

CURING OF CONCRETE

Definition

Maintaining moisture and temperature after placing concrete.

Importance of Curing

1. Improves strength
2. Prevents cracks
3. Reduces shrinkage
4. Ensures hydration

Methods of Curing

1. Water Curing

- Ponding
- Spraying
- Wet coverings

2. Membrane Curing

Use of curing compounds.

3. Steam Curing

Used in precast concrete works.

HARDENED CONCRETE

Definition

Concrete that has gained sufficient strength after setting and curing.

STRENGTH GAIN WITH AGE

Concrete gains strength gradually with time due to hydration.

Age	Approximate Strength
1 day	16%
3 days	40%
7 days	65%
14 days	90%
28 days	99%

COMPRESSIVE STRENGTH

Definition

Ability of concrete to resist compressive load.

Test

Cube compression test.

Compressive Strength = $\frac{\text{Load}}{\text{Area}}$

TENSILE STRENGTH

Definition

Ability of concrete to resist tension.

Concrete is weak in tension.

Test

Split tensile test.

FLEXURAL STRENGTH

Definition

Ability of concrete to resist bending stresses.

Importance

Important in:

- Pavements
- Beams
- Slabs

FACTORS AFFECTING STRENGTH OF CONCRETE

Factor	Effect
Water-cement ratio	Lower ratio increases strength
Cement content	More cement increases strength
Aggregate quality	Strong aggregates improve strength
Compaction	Proper compaction increases strength
Curing	Proper curing increases strength

WATER-CEMENT RATIO

Definition

Ratio of weight of water to weight of cement.

Water-Cement Ratio = $\frac{\text{Weight of Water}}{\text{Weight of Cement}}$
Water-Cement Ratio = $\frac{\text{Weight of Cement}}{\text{Weight of Water}}$

ABRAM'S LAW

Statement

Strength of concrete is inversely proportional to water-cement ratio.

$\text{Strength} \propto \frac{1}{\text{Water-Cement Ratio}}$
 $\text{Strength} \propto \frac{1}{\text{Water-Cement Ratio}}$

Importance

- Controls strength
- Controls durability
- Controls permeability

MATURITY CONCEPT Definition

Relationship between temperature, curing time, and strength development.

Significance

- Estimates strength development
- Useful in cold weather concreting

SHRINKAGE OF CONCRETE

Definition

Reduction in volume of concrete due to moisture loss.

Types of Shrinkage

1. Plastic shrinkage
2. Drying shrinkage
3. Thermal shrinkage

Effects

- Cracking
- Reduced durability

Prevention

- Proper curing
- Low water-cement ratio
- Use of admixtures

CREEP OF CONCRETE

Definition

Time-dependent deformation under sustained load.

Factors Affecting Creep

- Water-cement ratio
- Age of loading
- Humidity
- Aggregate properties

Effects of Creep

- Deflection in beams
- Cracking
- Loss of prestress

IMPORTANT DIFFERENCES

Segregation vs Bleeding

Segregation

Separation of aggregates
Non-uniform concrete

Bleeding

Upward movement of water
Weak surface

Hand Mixing vs Machine Mixing

Hand Mixing

Less uniform
Suitable for small works

Machine Mixing

Uniform mixing
Suitable for large works

IMPORTANT UNIVERSITY QUESTIONS

1. Define workability and explain factors affecting it.
2. Explain slump cone test with procedure.
3. Discuss compaction factor and Vee-Bee tests.
4. Explain segregation and bleeding in concrete.
5. Write notes on batching and mixing of concrete.
6. Explain transporting, placing, and compaction of concrete.
7. Discuss methods and importance of curing.
8. Explain compressive, tensile, and flexural strength of concrete.
9. Explain Abram's law and water-cement ratio.
10. Write notes on shrinkage and creep of concrete.

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