25CE301 BUILDING MATERIALS AND CONCRETE TECHNOLOGY

UNIT-III

AGGREGATES AND ADMIXTURES – DETAILED NOTES
1. AGGREGATES

Definition

Aggregates are inert granular materials such as sand, gravel, crushed stone, and slag used along with cement and water to produce concrete.

Aggregates occupy about 70–80% volume of concrete and greatly influence its strength, durability, and economy.

Functions of Aggregates

1. Provide bulk to concrete
2. Reduce shrinkage
3. Increase strength
4. Improve durability
5. Reduce cost of concrete
6. Resist wear and abrasion

Classification of Aggregates

Based on Size

Fine Aggregate

Aggregates passing through 4.75 mm IS sieve are called fine aggregates.

Examples

- Natural sand
- Manufactured sand (M-sand)

Uses

- Mortar
- Plastering
- Concrete works

Coarse Aggregate

Aggregates retained on 4.75 mm IS sieve are called coarse aggregates.

Examples

- Crushed stone
- Gravel

Uses

- Concrete
- Pavements
- Foundations

Based on Source

Type	Description
Natural Aggregates	Obtained from natural deposits
Artificial Aggregates	Manufactured industrial products
Recycled Aggregates	Obtained from demolished structures

Based on Shape

Shape	Characteristics
Rounded	Smooth surface
Angular	Sharp edges
Irregular	Partly rounded
Flaky	Small thickness
Elongated	Large length compared to width

Properties of Aggregates

1. Specific Gravity

Definition

Ratio of weight of aggregate to weight of equal volume of water.

Specific Gravity=Weight of AggregateWeight of Equal Volume of WaterSpecific\ Gravity = \frac{Weight\ of\ Aggregate}{Weight\ of\ Equal\ Volume\ of\ Water}Specific Gravity=Weight of Equal Volume of WaterWeight of Aggregate

Importance

- Determines strength of concrete
- Helps in mix design

Typical Values

- Normal aggregates: 2.6 to 2.8

2. Bulk Density

Definition

Weight of aggregate required to fill a container of unit volume.

Bulk Density=Weight of AggregateVolume of ContainerBulk\ Density = \frac{Weight\ of\ Aggregate}{Volume\ of\ Container}Bulk Density=Volume of ContainerWeight of Aggregate

Types

- Loose bulk density
- Compacted bulk density

Importance

- Concrete mix proportioning
- Transportation calculations

3. Grading of Aggregates

Definition

Distribution of particle sizes in aggregates.

Importance

- Reduces voids
- Improves workability
- Reduces cement requirement

4. Shape of Aggregates

Rounded Aggregates

- Better workability
- Lower bond strength

Angular Aggregates

- Higher strength
- Lower workability

5. Surface Texture

Types

- Smooth
- Rough
- Granular
- Crystalline

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Importance

Surface texture affects bond between cement paste and aggregate.

TESTS ON AGGREGATES

1. Sieve Analysis Test

Purpose

Determines particle size distribution of aggregates.

Procedure

1. Arrange sieves in descending order.
2. Place aggregate sample.
3. Shake sieves mechanically.
4. Measure material retained on each sieve.

Importance

- Determines grading
- Helps in mix design
- Reduces voids in concrete

2. Aggregate Impact Value Test

Purpose

Determines toughness of aggregates against impact load.

Impact Value=Weight of FinesOriginal Weight×100Impact\ Value = \frac{Weight\ of\ Fines}{Original\ Weight}\times100Impact Value=Original WeightWeight of Fines×100

Significance

- Lower impact value indicates stronger aggregate.

Recommended Values

- Less than 30% for concrete roads

3. Aggregate Crushing Value Test

Purpose

Determines resistance to crushing under compressive load.

Crushing Value=Weight of Crushed MaterialOriginal Weight×100Crushing\ Value = \frac{Weight\ of\ Crushed\ Material}{Original\ Weight}\times100Crushing Value=Original WeightWeight of Crushed Material×100

Importance

- Indicates strength of aggregate

Recommended Value

- Less than 30% for strong concrete

4. Flakiness Index Test

Definition

Determines percentage of flaky particles in aggregate.

Flaky Aggregate

Thickness is less compared to length and width.

Effects of Flaky Aggregates

- Reduces strength
- Poor workability
- Higher voids

WATER FOR CONCRETE

Requirements of Water

Water used in concrete should be:

1. Clean
2. Free from oils
3. Free from acids
4. Free from salts
5. Potable quality

Uses of Water in Concrete

1. Mixing concrete
2. Hydration of cement
3. Curing of concrete

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Water for Mixing

Functions

- Helps hydration
- Provides workability

Water for Curing

Importance

- Maintains moisture
- Increases strength
- Prevents cracks

Effects of Impurities in Water

Impurity	Effect
Salts	Efflorescence
Organic matter	Delays setting
Oils	Reduces bond
Acids	Weakens concrete

ADMIXTURES

Definition

Admixtures are materials added to concrete before or during mixing to improve properties of concrete.

Functions of Admixtures

- Improve workability
- Reduce water content
- Increase strength
- Control setting time
- Improve durability

Types of Admixtures

1. Plasticizers

Definition

Admixtures that improve workability without increasing water content.

Advantages

- Better flowability
- Reduced water-cement ratio
- Improved strength

2. Super Plasticizers

Definition

High-range water reducing admixtures.

Properties

- Very high workability
- High strength concrete
- Self-compacting concrete

Uses

- Bridges
- High-rise buildings

3. Retarders

Definition

Admixtures that delay setting time of concrete.

Uses

- Hot weather concreting
- Mass concrete works

Advantages

- Prevents cold joints
- Improves workability time

4. Accelerators Definition

Admixtures that speed up setting and hardening.

Uses

- Cold weather concreting
- Emergency repairs

Example

- Calcium chloride

5. Air-Entraining Agents

Definition

Admixtures that introduce tiny air bubbles in concrete.

Advantages

- Improves frost resistance
- Improves workability
- Reduces segregation

6. Pozzolanic Admixtures

Definition

Materials containing silica which react with lime in presence of water.

Examples

- Fly ash
- Silica fume
- Rice husk ash

Advantages of Pozzolanic Admixtures

- Increased durability
- Reduced heat of hydration
- Improved impermeability
- Economical concrete

Effects of Admixtures on Concrete Properties

Admixture	Effect
Plasticizers	Increase workability
Super plasticizers	High strength and flowability
Retarders	Delay setting
Accelerators	Increase early strength
Air entraining agents	Improve durability
Pozzolanic admixtures	Increase long-term strength

Advantages of Using Admixtures

1. Better workability
2. Reduced cracking
3. Improved durability
4. Higher strength
5. Economical concrete
6. Reduced permeability

IMPORTANT DIFFERENCES
Fine Aggregate vs Coarse Aggregate

Fine Aggregate	Coarse Aggregate
Passes 4.75 mm sieve	Retained on 4.75 mm sieve
Sand	Gravel, crushed stone
Used in plastering	Used in concrete

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Plasticizers vs Super Plasticizers

Plasticizers	Super Plasticizers
Moderate water reduction	High water reduction
Normal concrete	High-performance concrete

IMPORTANT UNIVERSITY QUESTIONS

1. Explain classification and properties of aggregates.
2. Discuss sieve analysis test on aggregates.
3. Explain aggregate impact and crushing value tests.
4. Write notes on flakiness index test.
5. Explain requirements of water for concrete.
6. Discuss effects of impurities in water.
7. Explain different types of admixtures.
8. Write notes on plasticizers and super plasticizers.
9. Explain retarders and accelerators.
10. Discuss pozzolanic admixtures and their effects on concrete.

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