Unit-2

Fresh Concrete: Workability – Factors affecting workability – Measurement of workability by different tests – Setting times of concrete – Effect of time and temperature on workability – Segregation & bleeding – Mixing, vibration and revibration of concrete – Steps in manufacture of concrete – Quality ofmixing water.

Concept-1

Workability of Concrete – Factors Affecting Workability

Workability is the property of fresh concrete that determines how easily it can be mixed, placed, compacted, and finished without segregation or excessive bleeding. It plays a crucial role in ensuring durability, strength, and construction efficiency.

Factors affecting workability

Workable concrete shows very less internal friction between particles and overcomes the frictional resistance with just the amount of compacting efforts provided. Workability of the concrete depends on a number of interrelating factors. Water content, aggregate properties, use of admixtures, fineness of cement are the factors affecting workability.

1. Water-Cement Ratio (W/C Ratio):

- The **water-cement ratio** is the most critical factor affecting workability.
- A **higher W/C ratio** increases fluidity, making concrete easier to work with, but it reduces strength and durability.
- A **lower W/C ratio** leads to a stiffer mix, making it difficult to place and compact, but improves strength.
- The **optimum W/C ratio** ensures a balance between workability and strength.

2. Aggregate Size, Shape, and Texture:

- **Larger aggregates** reduce the surface area, requiring less water, which improves workability.
- **Smaller aggregates** increase surface area, demanding more water, reducing workability.
- **Rounded aggregates** (e.g., river gravel) improve workability as they reduce internal friction.

- **Angular aggregates** (e.g., crushed stone) require more paste for lubrication, reducing workability.
- **Smooth-textured aggregates** reduce water demand, enhancing workability.
- **Rough-textured aggregates** need more cement paste, decreasing workability.

3. Grading of Aggregates:

- **Well-graded aggregates** (a mix of different sizes) fill voids efficiently, reducing water demand and improving workability.
- **Poorly graded aggregates** (uniform size distribution) create more voids, increasing water demand and reducing workability.
- **Gap-graded aggregates** (missing intermediate sizes) cause segregation, leading to poor workability.

4. Cement Content:

- **Higher cement content** increases paste volume, improving cohesion and workability.
- However, **excess cement** may make the mix sticky, reducing ease of placement.
- **Lower cement content** may cause segregation and harshness, reducing workability.

5. Use of Admixtures:

- **Plasticizers & Superplasticizers** improve workability by reducing water demand without affecting strength.
- **Air-entraining agents** introduce tiny air bubbles, enhancing workability and durability in freezing conditions.
- **Retarders** slow down setting time, improving workability in hot weather.

6. Temperature and Weather Conditions:

- **High temperatures** cause faster water evaporation, reducing workability and increasing the risk of cracks.
- **Low temperatures** slow down hydration, temporarily improving workability but delaying setting time.
- **Windy conditions** accelerate drying, requiring additional water or curing measures to maintain workability.

7. Mixing Time and Method:

- **Proper mixing** ensures even distribution of materials, improving workability.
- **Under-mixing** leads to inconsistent concrete with poor cohesion.
- **Over-mixing** may result in air entrainment, reducing workability and increasing segregation.

8. Slump and Compaction Effort:

- **Higher slump value** (measured using a slump test) indicates better workability.
- **Low slump** suggests stiff, difficult-to-handle concrete, requiring more effort for placement.
- **Excessive vibration or compaction** may cause segregation, reducing uniformity and workability.

Workability is a **key factor in ensuring strong, durable, and high-quality concrete**. It is influenced by **water content, aggregate properties, cement ratio, admixtures, temperature, and mixing techniques**. By optimizing these factors, concrete mix designs can achieve the **ideal balance of workability and strength**, improving **construction efficiency and durability**.

Concept-2

Effect of Time and Temperature on Workability

Workability refers to the **ease with which concrete can be mixed, placed, compacted, and finished** without segregation or bleeding. Time and temperature significantly impact workability by influencing **water content, setting time, and overall consistency** of the mix.

1. Effect of Time on Workability

Concrete undergoes **slump loss** over time due to **evaporation of water, hydration of cement, and absorption by aggregates**. The key effects include:

- **Loss of Moisture**: As concrete sits for a longer duration, water evaporates, reducing fluidity and making it harder to place and finish.
- **Hydration of Cement**: The reaction between cement and water continues over time, causing stiffening and reducing workability.
- **Absorption by Aggregates**: Some aggregates absorb water from the mix, further reducing available moisture for workability.
- **Delayed Placement Issues**: If concrete is not placed on time, it becomes **difficult to compact**, leading to **honeycombing and reduced strength**.
- **Use of Retarders**: To counteract time-related workability loss, chemical retarders are used to **slow down the setting process** and extend workability.

2. Effect of Temperature on Workability

Temperature variations influence the **evaporation rate, cement hydration, and water demand**, directly affecting workability.

Effect of High Temperature:

- **Increased Evaporation**: Hot weather accelerates water loss, making concrete dry and difficult to handle.
- **Rapid Setting**: Higher temperatures speed up hydration, reducing the time available for placement and finishing.
- **Higher Water Demand**: To maintain workability, additional water is required, which may weaken the concrete mix.
- **Risk of Cracking**: Faster drying increases shrinkage cracks and reduces long-term durability.
- **Use of Admixtures**: Plasticizers, superplasticizers, and retarders are added to control slump loss and extend workability.

Effect of Low Temperature:

- **Delayed Setting Time**: Cold weather slows down hydration, improving workability temporarily but delaying strength gain.
- **Reduced Water Evaporation**: Lower temperatures retain moisture, keeping concrete workable for a longer duration.
- **Risk of Freezing**: If the temperature drops too low, water in the mix may freeze, causing expansion and weakening the structure.

Time and temperature play a **critical role** in determining the workability of concrete. High temperatures cause **rapid setting and water loss**, reducing workability, while low temperatures **delay setting but can lead to freezing issues**. Proper mix design, use of **admixtures, controlled curing, and timely placement** are essential to maintain optimal workability under varying conditions.

Concept-3

Measurement of workability by different tests

1. Slump Cone Test for Concrete Workability

The Slump Cone Test is one of the most commonly used methods to measure the workability or consistency of fresh concrete. Workability refers to how easily concrete can be mixed, placed, compacted, and finished without segregation or bleeding. The test is simple, quick, and widely used in construction sites to assess the quality of fresh concrete before placement.

Objective of the Test

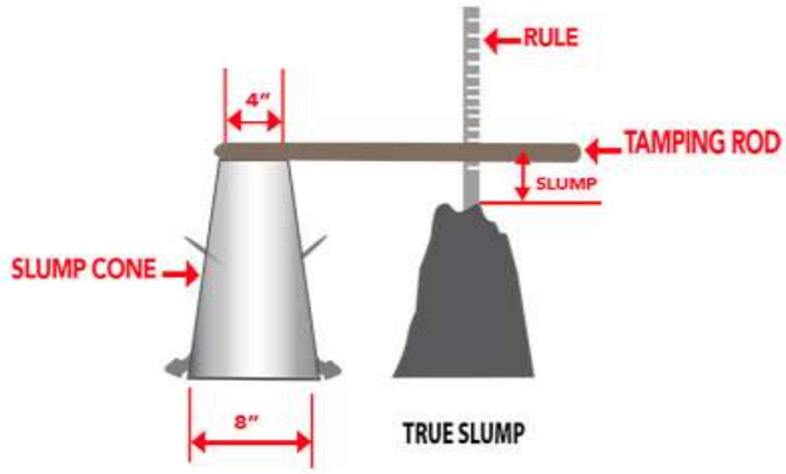
The main objectives of the slump test are:

- To determine the workability of fresh concrete.
- To assess consistency and cohesion of concrete mix.
- To ensure uniformity in different batches of concrete.
- To detect any variation in water content that may affect strength and durability.

Apparatus Required

The following equipment is required for conducting the slump test:

1. Slump Cone (Abrams Cone) – A frustum-shaped metal cone with the following dimensions:
    - Height = 30 cm
    - Bottom Diameter = 20 cm
    - Top Diameter = 10 cm
2. Tamping Rod – A steel rod of 16 mm diameter and 600 mm length, with a rounded end for compacting the concrete.
3. Measuring Scale – To measure the height difference after the test.
4. Base Plate – A rigid, non-porous metal or glass plate on which the cone is placed.
5. Fresh Concrete Mix – The concrete sample to be tested.



Test Procedure

Step 1: Preparation of Surface

- Place the slump cone on a leveled, non-absorbent base plate.
- Ensure that the surface is clean, rigid, and moist to avoid water absorption.

Step 2: Filling the Cone with Concrete

- The cone is filled in three layers, each approximately one-third of the total height of the cone.
- Layer 1: Fill the cone one-third of its height and tamp it 25 times using the tamping rod.
- Layer 2: Fill the cone up to two-thirds of its height and again tamp 25 times.
- Layer 3: Fill the cone completely and tamp the final 25 times.

Step 3: Striking Off Excess Concrete

- Once the cone is completely filled and compacted, the excess concrete is leveled off with the top edge of the cone using a trowel or rod.

Step 4: Lifting the Cone

- The slump cone is carefully lifted vertically upwards in 5 to 10 seconds without disturbing the concrete.
- As the cone is lifted, the concrete slumps or settles down due to gravity.

Step 5: Measuring the Slump

- The height difference between the top of the slump cone and the highest point of the slumped concrete is measured using a scale.
- This height difference is recorded as the slump value in millimeters (mm).

Types of Slumps Observed

The shape of the slumped concrete can indicate the consistency and stability of the mix:

True Slump

- The concrete subsides uniformly while maintaining its shape.
- Indicates good workability and proper water content.
- Suitable for reinforced concrete structures.

Shear Slump

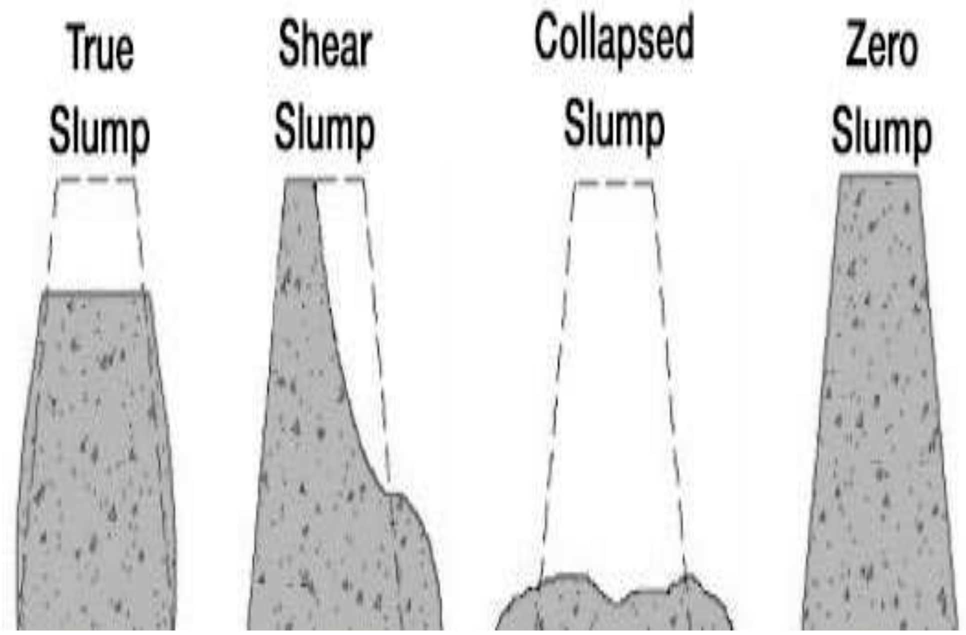
- One side of the concrete shears off and slides away.
- Indicates lack of cohesion in the mix.
- May require more water or better mixing.

Collapse Slump

- The concrete completely collapses like a heap.
- Indicates too much water in the mix (high workability).
- Not suitable for construction as it leads to segregation.

Zero Slump

- The concrete retains its original shape without slumping.
- Indicates very low water content and high stiffness.
- Suitable for road pavements and dry concrete applications.



Slump Value (mm)	Workability Type	Suitable Applications
0 – 25 mm	Very Low Workability	Roads, pavements
25 – 50 mm	Low Workability	Mass concrete foundations
50 – 100 mm	Medium Workability	Beams, slabs, columns
100 – 150 mm	High Workability	Highly reinforced structures
>150 mm	Very High Workability	Pumped concrete, underwater concreting

Significance of the Slump Test

- Quality Control – Helps ensure consistency in concrete batches.
- Workability Assessment – Determines how easy it is to place and compact concrete.
- Detection of Mix Variations – Identifies changes in water-cement ratio.
- Prevention of Defects – Avoids issues like segregation and bleeding in concrete.

The Slump Cone Test is a simple and effective way to evaluate the workability and consistency of concrete before placing it in construction. It provides quick results, helping engineers adjust the mix as needed to ensure quality and durability in structures.

2. Compaction Factor Test for Concrete Workability

The Compaction Factor Test is a laboratory-based test used to measure the workability of fresh concrete, especially for mixes with low workability that cannot be easily tested using the Slump Test. It provides a numerical compaction factor value that represents the degree of compaction achieved under standard conditions.

Objective of the Test

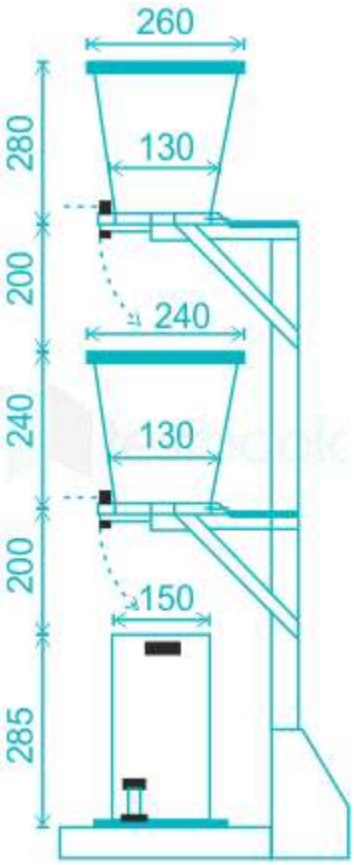
- The primary objectives of the compaction factor test are:
- To determine the workability of concrete, especially for stiff mixes (low slump).
- To assess the degree of compaction of concrete.
- To ensure uniformity in concrete batches.
- To verify whether the mix has the correct water-cement ratio.

Apparatus Required

The test requires the following equipment:

Compaction Factor Apparatus

- Consists of two conical hoppers (upper and lower) and a cylindrical receiving container.
- Each hopper has a hinged door at the bottom for controlled release of concrete.
- The receiving cylinder has a height of 30 cm and a diameter of 15 cm.
- Tamping Rod – A 16 mm diameter, 600 mm length steel rod for compacting concrete.
- Weighing Balance – To measure the weight of the concrete.
- Trowel – For leveling and handling the concrete.
- Fresh Concrete Mix – The concrete sample to be tested.



Test Procedure

Step 1: Filling the Upper Hopper

- Place the compaction factor apparatus on a level, firm surface.
- Fill the upper hopper with freshly mixed concrete without compaction.
- Level the surface using a trowel.

Step 2: Releasing Concrete into the Lower Hopper

- Open the trap door at the bottom of the upper hopper.
- Allow the concrete to fall freely into the lower hopper.
- Ensure that the concrete does not compact while falling.

Step 3: Releasing Concrete into the Cylinder

- Open the trap door of the lower hopper.
- Let the concrete fall freely into the cylindrical container below.

Step 4: Compaction of Concrete

- After the concrete is in the receiving cylinder, compact it fully by using a tamping rod or vibrating table.

- Ensure full compaction to remove any air voids.

Step 5: Weighing the Concrete

- Weight of partially compacted concrete (W1):
- Weigh the concrete without any further compaction.
- Weight of fully compacted concrete (W2):
- Refill the cylinder with the same concrete and fully compact it.
- Then weigh the fully compacted concrete.
- Calculation of Compaction Factor
- $\textbf{Compaction Factor} = \frac{\textbf{Weight of partially compacted concrete (W1)}}{\textbf{Weight of fully compacted concrete (W2)}}$
- Higher Compaction Factor → More workability (more flowable mix).
- Lower Compaction Factor → Stiffer mix, harder to place.

Compaction Factor	**Workability Level**	**Typical Application**
0.95 – 1.00	High Workability	Pumped concrete, precast structures
0.92 – 0.95	Medium Workability	Beams, slabs, columns
0.85 – 0.92	Low Workability	Pavements, roads, mass concreting
<0.85	Very Low Workability	Dry concrete, roller-compacted concrete

Significance of the Compaction Factor Test

- More Accurate than the Slump Test for low-workability concrete.
- Helps in quality control of concrete production.
- Ensures proper water-cement ratio for durability and strength.
- Avoids issues like honeycombing due to improper compaction.

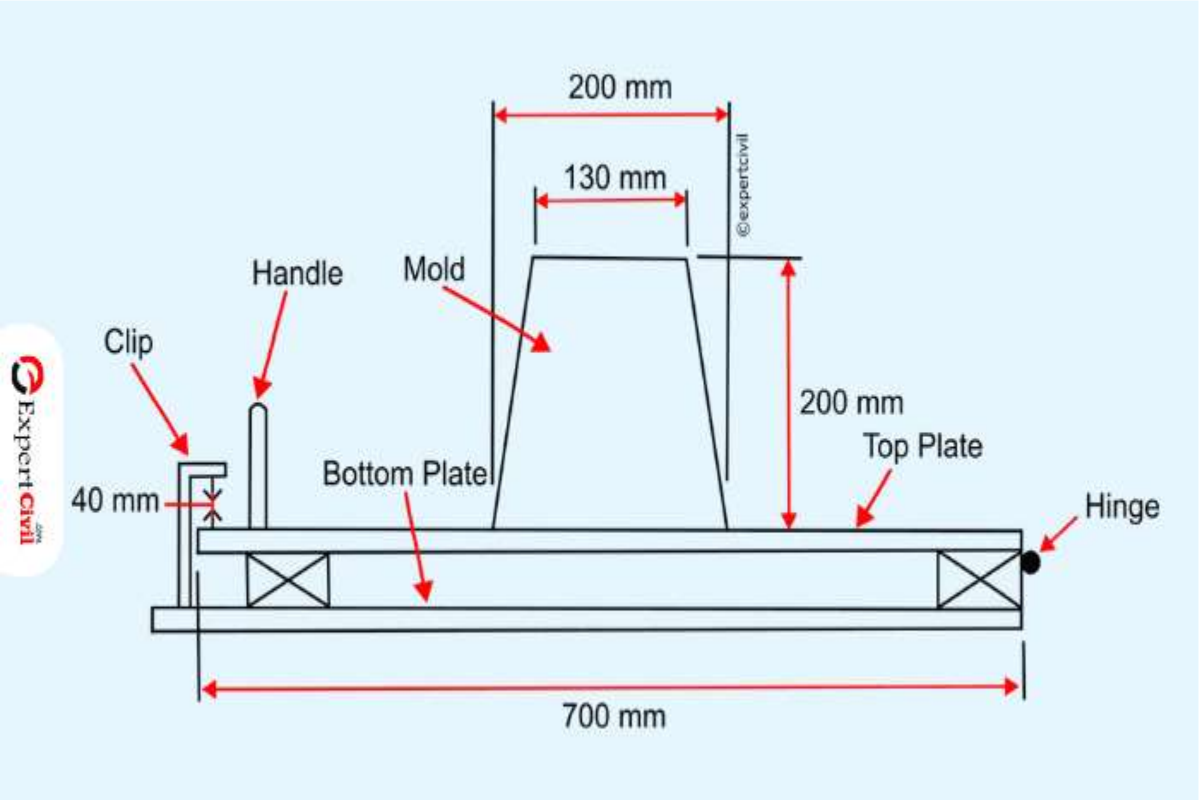
The Compaction Factor Test is an important method for determining the workability of concrete, particularly for stiff or dry mixes that are difficult to test using the Slump Test. It helps in ensuring proper mix design, leading to better strength and durability in construction.

3. Flow Table Test for Concrete Workability

The Flow Table Test is a laboratory test used to measure the workability and consistency of fresh concrete, particularly for highly workable concrete (such as self-compacting concrete and highly flowable concrete used in precast structures). It evaluates the flowability and cohesion of concrete by measuring the spread (flow) of concrete after being subjected to jolting on a flow table.

Objective of the Test

- To determine the flowability and consistency of fresh concrete.
- To assess the cohesiveness of concrete and check for segregation.
- To ensure that the concrete mix has adequate workability for placement and finishing.
- To compare different concrete mixes for quality control in construction.



Apparatus Required

- Flow Table
- A circular steel table of 76.2 cm diameter, hinged at one side and capable of dropping 12.5 mm vertically.
- Marked with concentric circles for easy measurement of flow spread.
- Mold (Abrams Cone or Slump Cone)
- A frustum-shaped metal mold with a top diameter of 17 cm, bottom diameter of 25 cm, and height of 12 cm.

- Tamping Rod
- A 16 mm diameter, 600 mm length steel rod with a rounded tip for compacting the concrete.
- Measuring Scale
- For measuring the flow diameter of concrete after the test.
- Fresh Concrete Mix

Test Procedure

Step 1: Preparation of the Flow Table

- Place the flow table on a firm, level surface and ensure it is clean.

Step 2: Placing the Concrete in the Mold

- Position the Abrams cone (slump cone) at the center of the table.
- Fill the mold with fresh concrete in two layers, each tamped 10–15 times using the tamping rod to ensure uniformity.
- Level the top surface of the concrete with a trowel.

Step 3: Removing the Mold

- Carefully lift the mold vertically without disturbing the concrete mass.
- The concrete will spread under its own weight.

Step 4: Applying Jolting Action

- Raise the flow table by 12.5 mm and drop it 15 times in about 15 seconds.
- This causes the concrete to spread further on the table.

Step 5: Measuring the Flow Spread

- Measure the maximum diameter (D1) and minimum diameter (D2) of the spread concrete.
- Calculate the average flow diameter (Davg) using:
- $D_{avg} = \frac{D1+D2}{2}$
- The flow percentage is then calculated as:
- Flow% $= \frac{D_{avg}-250}{250} \times 100$
- (where 250 mm is the original base diameter of the mold).

Flow Percentage (%)	Workability	Application
0 – 20%	Very Low	Dry concrete, roads, RCC structures
20 – 35%	Low	Footings, pavements, mass concreting
35 – 50%	Medium	Beams, columns, slabs
50 – 75%	High	Highly flowable concrete, self-compacting concrete
>75%	Very High	Underwater concreting, special applications

Significance of the Flow Table Test

- Best suited for highly workable concrete that cannot be tested using the slump test.
- Helps in quality control for self-compacting and flowing concrete.
- Detects segregation issues—if concrete spreads unevenly, it may indicate poor mix design.
- Ensures uniformity in batch production of concrete.

The Flow Table Test is an effective method for determining the workability of high-flow concrete, particularly for self-compacting concrete and precast structures. It ensures that concrete has sufficient flowability for placement and finishing while maintaining cohesion and uniformity.

Concept-4

Setting Time of Concrete

Setting time refers to the time taken for fresh concrete to start hardening and gain rigidity after mixing. It is classified into:

1. Initial Setting Time:

- The time when concrete loses plasticity and begins to stiffen.
- As per IS 456:2000, for ordinary Portland cement (OPC), the initial setting time should be at least 30 minutes.
- Affected by temperature, water content, cement type, and admixtures.

2. Final Setting Time:

- The time when concrete becomes completely rigid and can bear some load.
- For OPC, the final setting time should not exceed 10 hours.
- Ensures that the concrete is firm enough for further construction activities.

Factors Affecting Setting Time:

- Cement Type: Rapid-hardening cement sets faster than OPC.
- Water Content: Excess water slows down setting time.
- Temperature: High temperatures accelerate setting, while cold weather delays it.
- Admixtures: Retarders slow down setting, while accelerators speed it up.

Concept-5

Effect of Setting Time on Workability

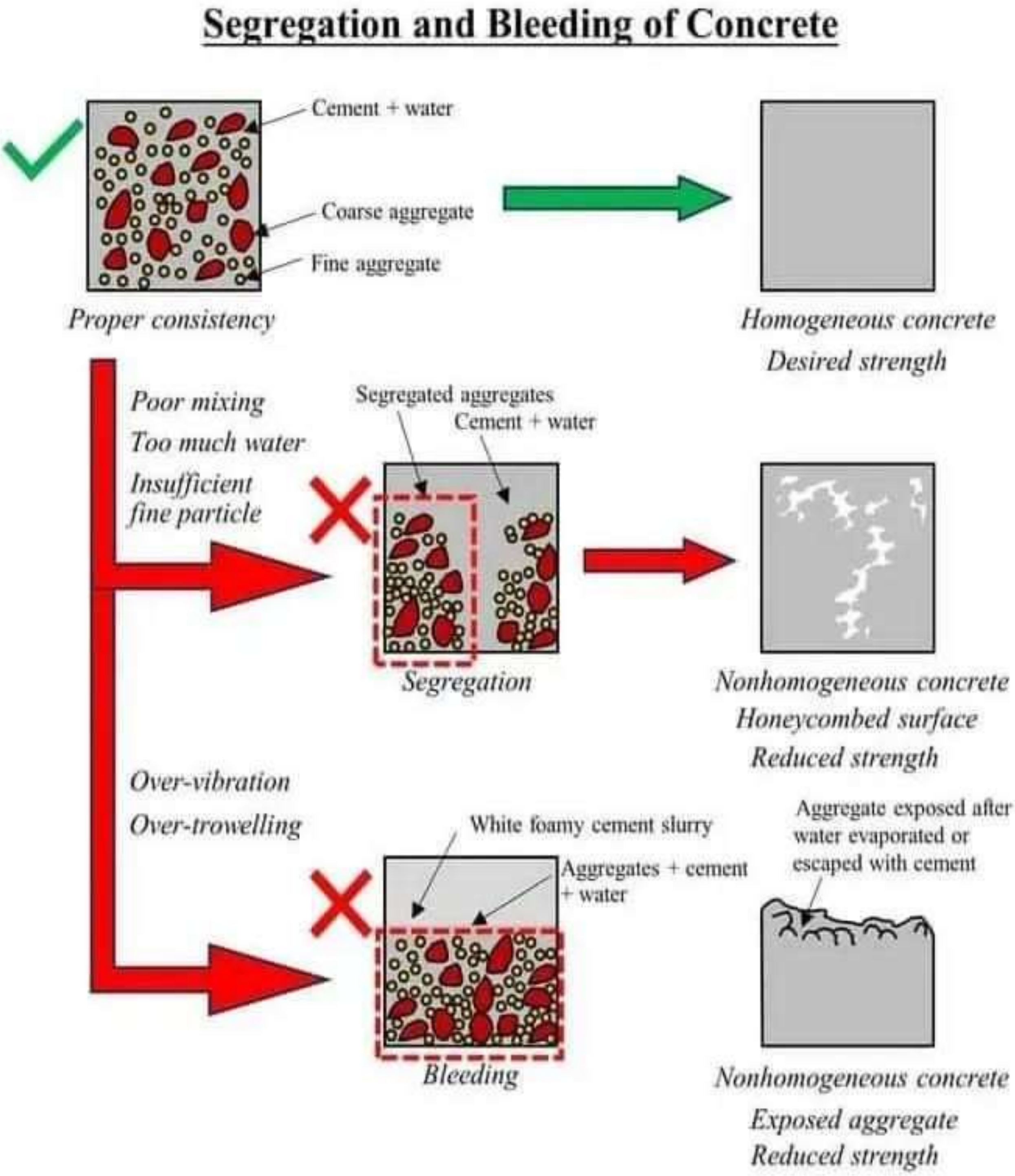
Setting time significantly influences the **workability** of concrete, as it determines how long the concrete remains **fluid and workable** before it starts hardening.

1. **Shorter Setting Time (Rapid Setting):**
   - Reduces workability window, making placement and finishing difficult.
   - Causes early stiffening, leading to poor compaction and segregation.
   - Increases risk of cold joints if pouring is delayed.
2. **Longer Setting Time (Delayed Setting):**
   - Maintains workability for an extended period, aiding large pours.
   - Reduces early stiffening, ensuring proper compaction and finishing.
   - However, excessive delay can increase bleeding and shrinkage cracks.
3. **Impact of Temperature and Admixtures:**
   - High temperatures reduce setting time, decreasing workability.
   - Retarders extend setting time, improving workability in hot conditions.
   - Accelerators reduce setting time for quick construction but limit workability.

A balanced setting time ensures optimum workability, allowing proper mixing, placing, and finishing while avoiding segregation or excessive drying.

Concept-6

Segregation and Bleeding in Concrete



1. Segregation

Segregation is the separation of concrete ingredients due to improper mix proportions, handling, or placement. It occurs when the coarse aggregates separate from the cement paste and fine aggregates, leading to an uneven mix and weak concrete.

Causes of Segregation:

- Excessive Water Content: Makes the mix too fluid, allowing aggregates to settle.
- Poorly Graded Aggregates: Large aggregates separate from finer materials.
- Improper Mixing & Handling: Dropping concrete from height or excessive vibration.
- Overuse of Vibration: Forces aggregates to settle at the bottom.

Effects of Segregation:

- Loss of Strength: Weakens concrete due to uneven distribution.
- Increased Permeability: Leads to water ingress and durability issues.
- Formation of Honeycombs: Gaps and voids reduce structural integrity.

Prevention of Segregation:

- Use well-graded aggregates to ensure uniformity.
- Maintain proper water-cement ratio to avoid excessive fluidity.
- Handle and place concrete carefully without excessive vibration or free fall.
- Use air-entraining agents to improve cohesion.

2. Bleeding

Bleeding is the upward movement of water in fresh concrete due to the settling of heavier cement and aggregates. The excess water forms a thin layer on the surface, leading to weak and porous concrete.

Causes of Bleeding:

- High Water-Cement Ratio: More water in the mix results in excessive bleeding.
- Poor Cement Quality: Finer cement reduces bleeding, while coarser cement increases it.
- Lack of Fines in Mix: Insufficient fine materials reduce cohesion.

Effects of Bleeding:

- Formation of Weak Surface Layer: Known as a laitance layer, reducing bond strength.
- Cracking and Shrinkage: Weakens the top layer, leading to cracks.
- Increased Setting Time: Water on the surface delays finishing operations.

Prevention of Bleeding:

- Reduce water content and use a lower water-cement ratio.
- Use finer cement and properly graded aggregates.
- Add air-entraining agents to help distribute water evenly.
- Ensure proper curing to avoid excess water evaporation.

Both segregation and bleeding negatively impact the strength, durability, and finish of concrete. Proper mix design, water control, and handling techniques are essential to prevent these issues and ensure high-quality concrete structures.

Concept-7

Manufacture of Concrete – Mixing, Vibration, and Revibration

The manufacture of concrete involves several key steps to ensure a homogeneous, strong, and durable mix. The main processes include batching, mixing, transportation, placing, compaction (vibration and revibration), and curing.

1. Batching

Batching is the measurement of ingredients in the correct proportions before mixing. It can be done in two ways:

- Volume Batching – Measuring cement, sand, and aggregates by volume (less accurate).
- Weight Batching – Measuring materials by weight using weighing machines (preferred for accuracy).

2. Mixing of Concrete

Mixing ensures uniform distribution of cement, aggregates, water, and admixtures to create a cohesive and workable mix. It is done in two ways:

- Hand Mixing – Done manually on a platform, suitable for small projects but requires extra effort for uniformity.
- Machine Mixing – Performed using batch mixers or continuous mixers, ensuring better consistency and efficiency.

During mixing, proper water-cement ratio is maintained to avoid segregation and bleeding while ensuring workability.

3. Transportation

Concrete should be transported quickly and efficiently to prevent segregation and slump loss. Common methods include:

- Wheelbarrows & Buckets – For small sites.
- Transit Mixers – Used for ready-mix concrete (RMC) over long distances.
- Pumps & Chutes – For large-scale construction and high-rise buildings.

4. Placing of Concrete

Concrete should be placed as close as possible to its final position to prevent segregation. It should be done:

- Layer by layer, avoiding large free fall distances.
- Using formwork and shovels to distribute evenly.
- Ensuring that no delays occur to avoid premature setting.

5. Vibration (Compaction of Concrete)

Vibration is the process of compacting concrete to remove entrapped air and ensure proper bonding between aggregates. It improves density, strength, and durability.

Types of Vibration:

1. Internal Vibration – Using poker vibrators inside the concrete.
2. External Vibration – Vibrating formwork for pre-cast elements.
3. Surface Vibration – Using vibrating screeds for slabs.
4. Table Vibration – Used in laboratories and small precast units.

Vibration should be done uniformly and quickly to avoid honeycombing and weak zones.

6. Revibration of Concrete

Revibration is the reapplication of vibration at a later stage (before the final setting time) to eliminate settlement cracks and improve bonding.

Benefits of Revibration:

- Reduces voids and trapped air, increasing strength.
- Improves bonding between old and fresh concrete layers.
- Reduces plastic shrinkage cracks and enhances durability.

Revibration must be done carefully to avoid disturbing the setting process and should not be done once the concrete has hardened.

7. Curing

Curing is the process of maintaining moisture and temperature to ensure complete hydration of cement. Methods include:

- Ponding & Water Spraying – Common for slabs and pavements.
- Membrane Curing – Using curing compounds to retain moisture.
- Steam Curing – Used for precast concrete elements for faster strength gain.

The manufacture of concrete follows a structured process from batching to curing. Proper mixing, vibration, and revibration are essential to achieve high-quality, strong, and durable concrete for construction.

Concept-8

Quality of Mixing Water in Concrete

Water is a key component in concrete, directly influencing hydration, strength, workability, and durability. The quality of mixing water should meet IS 456:2000 and IS 3025 standards to prevent structural issues. It must be clean, free from harmful substances, and non-corrosive to reinforcement steel.

Requirements for Mixing Water Quality

Water used in concrete mixing should:

- Be free from excessive alkalis, acids, oils, salts, and organic impurities.
- Have a pH of at least 6 to prevent chemical instability.
- Meet the prescribed limits for chlorides, sulfates, solids, and other impurities as per IS 3025.

Effects of Impurities in Mixing Water

1. Effect of Suspended Particles (Silt, Clay, Mud, and Organic Matter)

- Suspended particles like silt, clay, and mud make concrete less workable and affect bonding between cement and aggregates.
- High mud content leads to honeycombing and weak zones, reducing strength.
- IS 456:2000 sets a limit of 2000 mg/L of suspended solids to prevent excessive fines in concrete.

- Water with high suspended particles should be allowed to settle or filtered before use.

2. Effect of Salts and Chlorides

- Chlorides in water can cause reinforcement corrosion, reducing the life of concrete structures.
- High chloride content leads to rust formation, causing expansion and cracks in concrete.
- Permissible chloride limits:
    - 500 mg/L for reinforced concrete (RCC)
    - 2000 mg/L for plain concrete
- If chloride levels exceed the limit, water treatment or use of inhibitors is required.

3. Effect of Sulfates

- Sulfates react with calcium hydroxide and aluminates in cement, forming expansive compounds that cause cracks and reduce durability.
- Excess sulfates lead to sulfate attack, which weakens concrete over time.
- Maximum allowable sulfate content: 400 mg/L
- Sulfate-rich water should be avoided, especially in marine and industrial areas.

4. Effect of Organic and Inorganic Solids

- Organic materials like decayed leaves, algae, and industrial waste interfere with cement hydration, delaying setting time and reducing strength.
- IS 456:2000 limits organic solids to 200 mg/L and inorganic solids to 3000 mg/L.
- Organic-rich water promotes air entrainment, which can reduce concrete strength.

5. Effect of Acidity and Alkalinity

- Highly acidic water (pH below 6) accelerates reinforcement corrosion and weakens the concrete mix.
- Highly alkaline water (pH above 8.5) may cause delayed setting and affect long-term strength.
- Acidity limit: To neutralize 100 mL of water, it should not require more than 5 mL of 0.02N NaOH.
- Alkalinity limit: To neutralize 100 mL of water, it should not require more than 25 mL of 0.02N H_2SO_4.

Testing and Frequency of Water Quality Checks

- Water from each source must be tested before starting construction and then every three months.
- Municipal water is tested every six months under IS 3025 guidelines.
- Concrete made with test water should not show more than 10% strength reduction compared to distilled water.

Impurities in mixing water negatively affect **workability, strength, setting time, and durability**. Using **chloride-rich or sulfate-laden water** can cause **corrosion and cracking**, reducing the lifespan of concrete structures. **Proper water testing and treatment** are essential to ensure **high-quality, long-lasting concrete**.