DETERMINATION OF WORKABILITY OF FRESH CONCRETE BY SLUMP TEST

Aim:

To determine the workability of concrete by Slump test as per **IS : 1199 - 1959**

Apparatus:

- Mould - in the form of the frustum of a cone having the following internal dimensions:

Dimensions	cm
Bottom diameter	20
Top diameter	10
Height	30

- Tamping Rod – 16 mm in diameter and 0.6 m long and rounded at one end

Procedure:

1. Initially, a known volume of cement concrete is prepared with a required proportion of ingredients and water – cement ratio.
2. The internal surface of the mould is thoroughly cleaned and freed from superfluous moisture and any set concrete before commencing the test.
3. The mould is placed on a smooth, horizontal, rigid and non-absorbent surface, such as a carefully levelled metal plate, the mould being firmly held in place while it is being filled.
4. The mould is filled in four layers, each approximately one-quarter of the height of the mould.
5. Each layer is tamped with twenty-five strokes with the rounded end of the tamping rod. The strokes are distributed in a uniform manner over the cross-section of the mould and for the second and subsequent layers shall penetrate into the underlying layer. The bottom layer is tamped throughout its depth.
6. After the top layer has been rodded, the concrete is struck off level with a trowel or the tamping rod,

so that the mould is exactly filled. Any mortar which may have leaked out between the mould and the base plate is cleaned away.

7. The mould is removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside and the slump is measured immediately by determining the difference between the height of the mould and that of the highest point of the specimen being tested.
8. The above operations are carried out at a place free from vibration or shock and within a period of two minutes after sampling.
9. The nature of the slump is analysed to get the workability of the given cement concrete sample.

   True Slump refers to general drop of the concrete mass evenly all around without disintegration.

   Shear Slump implies that the concrete mix is deficient in cohesion. Consequently, it may undergo segregation and bleeding and thus is undesirable for durability of concrete.

   Collapse indicates that concrete mix is too wet.

10. The slump measured is recorded in terms of millimetre of subsidence of the specimen during the test.

Observation:

The nature of the slump observed is

Slump measured =

Result:

The Slump observed for given sample = _____mm.

DETERMINATION OF WORKABILITY OF FRESH CONCRETE BY COMPACTION FACTOR TEST

Aim:

To determine the workability of cement concrete by Compaction Factor test as per **IS : 1199 - 1959**

Apparatus:

Compaction Factor Apparatus - consists of the two conical hoppers mounted above a cylindrical mould.

Procedure:

1. The sample of concrete to be tested is placed gently in the upper hopper, using the hand scoop.
2. The hopper is filled level with its brim and the trap-door is opened so that the concrete falls into the lower hopper.
3. Certain mixes have a tendency to stick in one or both of the hoppers. If this occurs, the concrete may be helped through by pushing the rod gently into the concrete from the top. During this process, the cylinder is covered by the trowels.
4. Immediately after the concrete has come to rest, the cylinder is uncovered, the trap-door of the lower hopper opened and the concrete is allowed to fall into the cylinder.
5. The excess of concrete remaining above the level of the top of the cylinder is then cut off by holding a trowel in each hand, with the plane of the blades horizontal and moving them simultaneously one from each side across the top of the cylinder, at the same time keeping them pressed on the top edge of the cylinder. The outside of the cylinder is then wiped clean.
6. The above operation is carried out at a place free from vibration or shock.
7. The Weight of the concrete in the cylinder is determined to the nearest 10 g. This weight is known as "The Weight of Partially Compacted Concrete".
8. The cylinder is refilled with concrete from the same sample in layers approximately 5 cm deep, the layers being heavily rammed or preferably vibrated so as to obtain full compaction.
9. The top surface of the fully compacted concrete is carefully struck off level with the top of the cylinder and the outside of the cylinder is wiped clean.
10. The Weight of the concrete in the cylinder is determined to the nearest 10 g. This weight is known as "The Weight of Fully Compacted Concrete".
11. Then the compaction factor for the given sample of cement concrete is found out by using the formula,

Compaction Factor = (Weight of Partially Compacted Concrete / Weight of Fully Compacted Concrete) * 100

Observation and Calculation:

Mix Proportion :
Water-Cement ratio =

S. No	Weight of Empty Cylinder (W1)	Weight of Cylinder with Partially Compacted Concrete **(W_2)**	**Weight of the cylinder with Fully compacted concrete (W_3)**	Weight of **partially compacted concrete ($W4 = W_2 - W_1$)**	Weight of **fully compacted concrete ($W5 = W3 - W_1$)**	**Compacting Factor = (W4/W5) * 100**
1						
2						
3						

Result:

The compaction factor of the Concrete is _____%.

DETERMINATION OF WORKABILITY OF FRESH CONCRETE BY VEE-BEE CONSISTOMETER

Theory:

It determines the time required for transforming, by vibration, a concrete specimen in the shape of a conical frustum into a cylinder.

Aim:

To determine the workability of concrete by using Vee-Bee Consistometer as per **IS : 1199 - 1959**

Apparatus:

The Vee-Bee Consistometer consists of

a) A vibrator table resting upon elastic supports
b) A metal pot
c) A sheet metal cone, open at both ends
d) A standard iron rod

Procedure:

1. Slump test is performed in the sheet metal cylindrical pot of the Consistometer.
2. The glass disc attached to the swivel arm is moved and placed just on the top of the slump cone in the pot and before the cone is lifted up, the position of the concrete cone is noted by adjusting the glass disc attached to the swivel arm.
3. The cone is then lifted up and the slump is noted on the graduated rod by lowering the glass disc on top of the concrete cone.
4. The electrical vibrator is switched on and the concrete is allowed to spread out in the pot.
5. The vibration is continued until the whole concrete surface uniformly adheres to the glass disc and the time taken for this to be attained is noted with a stop watch. The time is recorded in seconds.

Observation and Calculation:

Trial	**1**	**2**
Initial reading on the graduated rod, a		
Final reading on the graduated rod, b		
Slump (b) – (a), mm		
Time for complete remoulding, seconds		

Result:

The consistency of the concrete is _____ sec

Determination of Compressive Strength of Concrete

Aim:

To determine the compressive strength of concrete as per IS : 516 - 1959

Apparatus:

Cube moulds of size 150 x 150 x 150 mm

Tamping rod of 16 mm diameter and 600 mm long with rounded end

Trowel

Compression Testing Machine

Procedure:

Proportioning and Mixing :

1. The quantities of cement, aggregate and water are determined by weight.
2. The ingredients are mixed by hand or preferably in the laboratory batch mixer, in such a manner as to avoid loss of water or other materials.
3. In assembling the mould for use, the joints between the sections of mould are thinly coated with mould oil and a similar coating of mould oil is applied between the contact surfaces of the bottom of the mould and the base plate in order to ensure that no water escapes during the filling.
4. The interior surfaces of the assembled mould are thinly coated with mould oil to prevent adhesion of the concrete.

Compacting :

5. The concrete is filled into the mould in layers approximately 5 cm deep and each layer is subjected to 35 strokes with tamping rod, distributed uniformly over the cross-section of the mould.
6. The strokes shall penetrate into the underlying layer and the bottom layer is rodded throughout its depth.
7. Where voids are left by the tamping bar, the sides of the mould are tapped to close the voids.
8. After the top layer has been compacted, the surface of the concrete is finished level with the top of the mould, using a trowel and covered with a glass or metal plate to prevent evaporation.
9. The test specimens are stored in a place, free from vibration, in moist air of at least 90 percent relative humidity and at a temperature of 27° ± 2°C for 24 hours ± ½ hour from the time of addition of water to the dry ingredients.

Curing :

10. After this period, the specimens are marked and removed from the moulds and are immediately submerged in clean, fresh water.
11. The water in which the specimens are submerged is renewed every seven days and is maintained at a temperature of 27° ± 2°C.
12. The specimens are not allowed to become dry at any time until they have been tested.

Testing :

13. Compression tests of cube specimens are made as soon as practicable after removal from curing pit. Test-specimens during the period of their removal from the curing pit and till testing, they are kept moist by a wet blanket covered and tested in a moist condition.
14. Tests are made at recognized ages of the test specimens, the most usual being 7 and 28 days.

Number of Specimens:

15. Three specimens are made for testing at each selected age.
16. Specimens stored in water are tested immediately on removal from the water and while they are still in the wet condition. Surface water and grit shall be wiped off the specimens and any projecting fins removed.

Testing:

17. The bearing surfaces of the testing machine are wiped clean
18. The specimen is placed in the machine in such a manner that the load is applied to opposite sides of the cubes as cast
19. No packing is used between the faces of the test specimen and the steel platen of the testing machine
20. The load is applied without shock and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained.
21. The maximum load applied to the specimen is recorded and the appearance of the concrete and any unusual features in the type of failure are noted.

Observation and Calculation:

Size of the specimen =
Area of the specimen =

Specimen no.	**1**	**2**	**3**
Load on cubes, kN			
Compressive Strength, N/mm2			
Average Compressive Strength, N/mm2			

Result:

The compressive strength of concrete is _____ **N/mm²**.

Determination of Flakiness Index of Coarse Aggregate

Aim: -

To determine the flakiness Index of a given aggregate sample

Apparatus: -

Thickness gauge

I.S. sieves of sizes 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3mm

Balance

Procedure:

1. The sample is sieved with the set of sieves arranged in order
2. A quantity of aggregate is taken sufficient to provide the minimum number of 200 pieces of any fraction to be tested
3. Each fraction is gauged in turn for thickness on the metal gauge
4. The total amount passing the gauge is weighed to an accuracy of atleast 0.1 percent of the weight of the test sample
5. The flakiness index is the total weight of the material passing the various thickness gauges expressed as a percentage of the total weight of the sample gauged

Observation and Calculation:

SIZE OF AGGREGATE		**Weight of the** aggregate taken (g)	**Weight of aggregate Passing through Thickness Gauge (g)**
PASSING THROUGH I.S. SIEVE mm	**RETAINED ON I.S. SIEVE mm**		
63	**50**		
50	**40**		
40	**31.5**		
31.5	**25**		
25	**20**		
20	**16**		
16	**12.5**		
12.5	**10.0**		
10	**6.3**		

Result:

The flakiness index of the given sample of aggregates is _____%.

Determination of Elongation Index of Coarse Aggregate

Aim:

To determine the Elongation Index of the given sample of coarse aggregate

Apparatus:

Elongation gauge

I.S. sieves of sizes 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3mm

Balance

Procedure:

1. The sample is sieved with the set of sieves arranged in order
2. A quantity of aggregate is taken sufficient to provide the minimum number of 200 pieces of any fraction to be tested
3. Each fraction is gauged individually for length on the metal gauge
4. The total amount retained by the length gauge is weighed to an accuracy of atleast 0.1 percent of the weight of the test sample

The elongation index is the total weight of the material retained on the various length gauges, expressed as a percentage of the total weight of the sample gauged

Observation and Calculation :

SIZE OF AGGREGATE		Weight of the aggregate taken (g)	Weight of aggregates Retained in Elongation Gauge (g)
PASSING THROUGH I.S. SIEVE mm	RETAINED ON I.S. SIEVE mm		
63	50		
50	40		
40	31.5		
31.5	25		
25	20		
20	16		
16	12.5		
12.5	10.0		
10	6.3		

Result :

The elongation index of a given sample of aggregate is _____%

DETERMINATION OF AGGREGATE CRUSHING VALUE

Aim:

To determine the crushing strength of given coarse aggregate as per **IS: 2386 part – IV**

Apparatus:

A 15-cm diameter open-ended steel cylinder, with plunger and base-plate
A straight metal tamping rod of circular cross-section 16 mm in diameter and 45 to 60 cm long, rounded at one end
A balance of capacity 3 kg
IS Sieves of sizes 12.5, 10and 2.36 mm
A compression testing machine capable of applying a load of 46 tonnes and which can be operated to give a uniform rate of loading so that the maximum load is reached in 10 minutes
For measuring the sample, cylindrical metal measure with 11.5 cm diameter and 18 cm height

Procedure:

1. The sample passing 12.5 mm sieve and retained on 10 mm sieve is selected.
2. The aggregate is tested in surface dry condition.
3. The quantity of aggregate is such that the depth of material in the cylinder, after tamping is 10 cm.
4. The cylindrical measure is filled in three layers of approximately equal depth, each layer being tamped 25 times with the rounded end of the tamping rod and finally leveled off, using the tamping rod as a straight edge.
5. The weight of the material comprising the test sample is determined.
6. The cylinder of the test apparatus is put in position on the base-plate and the test sample added in thirds, each third being subjected to 25 strokes from the tamping rod.
7. The surface of the aggregate is carefully levelled and the plunger inserted so that it rests horizontally on this surface, care being taken to ensure that the plunger does not jam in the cylinder.
8. The apparatus, with the test sample and plunger in position, is placed between the platens of the testing machine and loaded at as uniform a rate as possible so that the total load is reached in 10 minutes. The total load is 40 tonnes.
9. The load is released and the whole of the material removed from the cylinder and sieved on a 2.36-mm IS Sieve.
10. The fraction passing the sieve is weighed

Observation and Calculation:

S.No.	Weight of the empty cylinder (g)	Weight of the cylinder with aggregate (g)	Weight of Aggregate taken (g)	Weight of aggregate passing through 2.36 mm sieve (g)	Aggreate crushing value %
1					
2					
				Average	

Aggregate Crushing Value = Weight of aggregate passing through 2.36 mm sieve

$$\frac{\text{Weight of aggregate passing through 2.36 mm sieve}}{\text{Weight of aggregate taken}} \times 100$$

Result:

The crushing strength of given sample of coarse aggregate =

DETERMINATION OF AGGREGATE IMPACT VALUE

Aim:

To determine the aggregate impact value of given coarse aggregate as per I.S-2386 Part IV.

Apparatus:

Impact testing machine

A cylindrical steel cup of internal diameter 102 mm and depth 50mm

IS Sieves of sizes 12.5, 10 and 2.36 mm

A cylindrical metal measure of internal diameter 75 mm and depth 50 mm

Tamping rod of 10 mm diameter and 230 mm long, rounded at one end

Balance

Procedure:

1. The test sample consists of aggregates passing 12.5mm sieve and retained on 10mm sieve.
2. The aggregate comprising the test sample is dried in an oven for a period of four hours at a temperature of 100 to 110°C and cooled.
3. The measure is filled with the aggregate in three layers and each layer tamped with 25 strokes of the rounded end of the tamping rod.
4. After the third layer is tamped, the surplus aggregate struck off, using the tamping rod as a straight-edge.
5. The net weight of aggregate in the measure is determined
6. The whole of the test sample is placed in the steel cup, which is fixed firmly in position on the base of the machine and compacted by a single tamping of 25 strokes of the tamping rod.
7. The hammer is raised until its lower face is 380 mm above the upper surface of the aggregate in the cup and allowed to fall freely on to the aggregate.
8. The test sample is subjected to a total of 15 blows each being delivered at an interval of not less than one second.
9. The crushed aggregate is removed from the cup and is sieved on the 2.36-mm IS Sieve.
10. The fraction passing the sieve is weighed
11. The fraction retained on the sieve is also weighed and if the total weight is less than the initial weight by more than one gram, the result is discarded and a fresh test made. Two tests are made.

Observation and Calculation:

S.No.	Weight of the empty measure (g)	Weight of the measure with aggregate (g)	Weight of Aggregate taken (g)	Weight of aggregate passing through 2.36 mm sieve (g)	Weight of aggregate retained on 2.36 mm sieve (g)	Aggreate impact value %
1						
2						
					Average	

Aggregate Impact Value = Weight of aggregate passing through 2.36 mm sieve

$$\frac{\text{Weight of aggregate passing through 2.36 mm sieve}}{\text{Weight of aggregate taken}} \times 100$$

Result:

The impact value of the given sample of coarse aggregate =

DETERMINATION OF AGGREGATE ABRASION VALUE

Aim:

To determine the abrasion value of given coarse aggregate by Los Angeles method

Apparatus:

Los Angeles abrasion testing machine

Set of IS sieves

Procedure:

1. The test sample consists of clean aggregate which has been dried in an oven at 105 to 110°C to substantially constant weight and shall conform to one of the gradings
2. The test sample and the abrasive charge is placed in the Los Angeles abrasion testing machine
3. The machine is rotated at a speed of 20 to 33 rev/min. For gradings A, B, C and D, the machine is rotated for 500 revolutions; for gradings E, F and G, it is rotated for 1000 revolutions.
4. At the completion of the test, the material is discharged from the machine and a preliminary separation of the sample is made on l.70 mm IS Sieve.
5. The material coarser than the 1.70 mm IS Sieve is washed and dried in an oven at 105 to 110°C to a substantially constant weight and accurately weighed to the nearest gram.
6. The difference between the original weight and the final weight of the test sample is expressed as a percentage of the original weight of the test sample. This value is reported as the percentage of wear.

Observation and Calculation:

S.No.	**Weight of Aggregate taken (g)**	**Weight of aggregate retained on 1.70 mm sieve (g)**	**Weight of aggregate passing through 1.70 mm sieve (g)**	**Aggreate abrasive value %**
1				
2				
			Average	

Aggregate Abrasive Value = Weight of aggregate passing through 1.70 mm sieve

$$\frac{\text{Weight of aggregate passing through 1.70 mm sieve}}{\text{Weight of aggregate taken}} \times 100$$

Result: The abrasive value of the given sample of coarse aggregate =

SIEVE ANALYSIS OF COARSE AND FINE AGGREGATES

AIM

To determine the particle size distribution of given sample of coarse and fine aggregates by sieving as per IS: 2386 (Part I) - 1963.

Apparatus:

1. Set of IS Sieves
2. Balance

Procedure:

1. The sample is brought to an air-dry condition before weighing and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100 to 110°C.
2. The air-dry sample is weighed and sieved successively on the appropriate sieves starting with the largest. Care is taken to ensure that the sieves are clean before use.
3. Each sieve is shaken separately over a clean tray until not more than a trace passes, but in any case for a period of not less than two minutes.
4. The shaking is done with a varied motion, backwards and forwards, left to right, circular clockwise and anti-clockwise and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions. Material shall not be forced through the sieve by hand pressure, but on sieves coarser than 20 mm, placing of particles is permitted.
5. Light brushing with a soft brush on the under side of the sieve may be used to clear the sieve openings, in case of fine aggregate
6. On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.
7. The percentage passing in each sieve is calculated and is checked against the limits given in IS : 383 – 1970
8. Fineness modulus is calculated in case of fine aggregate.

Observation and Calculation:

Sieve Analysis of Coarse Aggregate

Nominal Size of the aggregate =

Weight of sample taken =

IS Sieve Designation	Weight of aggregate retained (g)	% Weight Retained	Percentage Passing	Percentage passing as per IS : 383 - 1970

Sieve Analysis of Fine Aggregate

Weight of sample taken =

IS Sieve Designation	Weight of aggregate retained (g)	% Weight Retained	Percentage Passing	Zone I	Zone II	Zone III	Zone IV
10 mm							
4.75 mm							
2.36 mm							
1.18 mm							
600 micron							
300 micron							
150 micron							

Fineness Modulus = Cumulative Percentage Weight Retained / 100

Result: