(19A01404P) Concrete Technology Lab

- **PREPARED BY**

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COURSE OUTCOMES

CO	CO STATEMENT (After the completion of course the student will be able to)	TAXONAMY
C416.1	Determine the consistency and fineness of cement	Apply
C416.2	Determine the setting times, specific gravity and soundness of cement	Apply
C416.3	Determine the compressive strength and workability of concrete	Apply
C416.4	Determine the specific gravity and water absorption of coarse aggregates	Apply
C416.5	Assess the non-destructive techniques on concrete	Evaluate

Experiments List as per affiliated University

List of Experiments:

1. Grading Curve of Coarse & Fine aggregates
2. Bulking of Fine aggregate
3. Specific gravity of Fine and coarse aggregate
4. Specific gravity, fineness, Initial and final setting times of Cement
5. Soundness and Compressive Strength test of Cement
6. Slump, compaction factor and Vee-Bee time tests on concrete.
7. Compressive and split tensile strength of concrete.
8. Non destructive tests on concrete (any two)

List with Additional Experiments

List of Experiments:

1. Grading curve of coarse aggregates
2. Grading curve of fine aggregates
3. Bulking of Fine aggregate
4. Specific gravity of coarse aggregate
5. Specific aggregate of fine aggregate
6. Specific gravity of cement
7. Fineness of cement
8. Normal Consistency of cement
9. Initial setting time and final setting time of cement
10. Compressive strength test of cement
11. Slump & Compaction factor tests on concrete
12. Compressive strength of concrete
13. Non-Destructive testing on concrete

List of Additional Experiments:

1. Experiment on the Bulk Density of Aggregates
2. Water Absorption of Coarse Aggregates

Introduction to Concrete Technology Lab

In its simplest form, concrete is a mixture of paste and aggregates (rocks). The paste, composed essentially of portland cement and water, coats the surface of the fine (small) and coarse (larger) aggregates. Through a series of chemical reactions called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete. Within this process lies the key to a remarkable trait of concrete: it's plastic and malleable when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks and superhighways, houses and dams.

Course Objectives

- ✓ The objective of concrete laboratory is to determine the physical properties of building construction materials like cement, fine and coarse aggregate.
- ✓ The tests include determination of specific gravity, fineness, normal consistency, setting times, workability and soundness of cement, fineness modulus of fine and coarse aggregate, strength of cement mortar, cement concrete. Students can design the mix, make the specimens and test the same for their respective strengths.

Fineness of Cement

FINENESS OF CEMENT BY DRY SIEVING

Objective: To determine the finess of a given sample of cement.
Reference: IS : 4031 (Part 1) – 1988.

Overview :

Fineness of cement is measured by sieving it on standard sieve. The proportion of cement of which the grain sizes are larger than the specified mesh size is thus determined.

Sieve Lid

Weighing Balance

Sieve with Pan

Sieve Shaking Machine

Apparatus :

- 90 μ Sieve with pan & Lid
- Weighing Balance
- Sieve Shaker

Procedure :

- Weigh approximately 10 gm of cement and place it on the sieve.
- Shake the sieve by sieve shaker.
- Remove and weigh the residue.

Technical Discussion:

- Fineness of cement affects hydration rate and the strength. Increasing fineness causes an increased rate of hydration, high strength, and high heat generation.
- Bleeding can be reduced by increasing fineness. Increased fineness can also lead to the requirement of more water for workability, resulting in a higher possibility of dry shrinkage.

Consistency of Cement

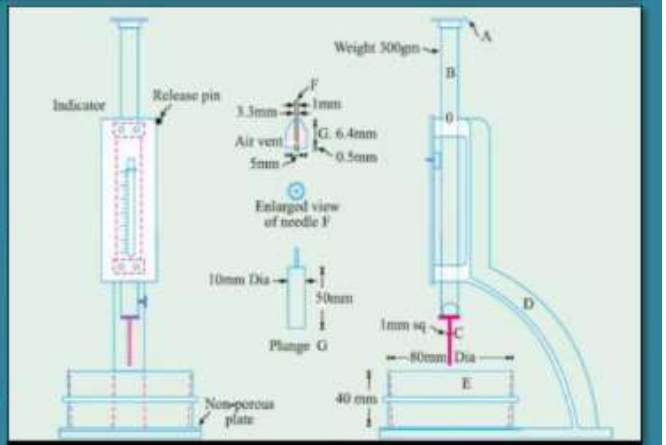
NORMAL CONSISTENCY OF CEMENT

Objective : To determine the normal consistency of a given sample of cement.
Reference : IS : 4031 (Part 4)-1988 & IS : 5513-1976.

Overview :
Standard consistency of a cement paste is defined as that consistency which will permit a vicat plunger having 10 mm dia and 50 mm length to penetrate to a depth of 33-35 mm from top of the mould.

Apparatus :
- Vicat apparatus
- Balance
- Gauging Trowel, Stop Watch, etc.

Procedure :
- Take 400 gm of cement and mix with water.
- Fill the vicat mould with cement paste.
- Place the whole assembly under the rod bearing plunger.
- Release the plunger allowing it to sink into the paste and measure the depth of penetration, until the depth of penetration becomes 33 to 35 mm.



VICAT APPARATUS

Technical Discussion :
Consistency test helps to determine water content for other tests like:
- Initial and final setting time
- Soundness
- compressive strength

Setting Time of Cement

SETTING TIME OF STANDARD CEMENT

Objective : To determine the initial and final setting time of a given sample of cement.
Reference : IS : 4031 (Part 4)-1988, IS : 4031 (Part 5) - 1988 & IS : 5513-1976.

Overview : ***Initial setting*** time is that time period between the time water is added to cement and time at which 1 mm^2 section needle fails to penetrate the cement paste.
Final setting time is that time period between the time water is added to cement and the time at which 1 mm needle makes an impression on the paste in the mould but 5 mm attachment does not make any impression.

Apparatus :
- Vicat apparatus
- Balance
- Stop-watch
- Gauging Trowel, Glass plate etc.

Procedure :
- Take 300 gm of cement and mix with water.
- Start a stop-watch.
- The paste should be filled within 3-5 minutes.
- Initial and final setting time is noted.

VICAT APPARATUS

Technical Discussion :
- Initial setting time test is important for transportation, placing and compaction of cement concrete.
- Initial setting time duration is required to delay the process of hydration or hardening.
- Final setting time is the time taken for the cement paste or cement concrete to harden sufficiently and attain the shape of the mould in which it is cast.

Specific Gravity of Cement

SPECIFIC GRAVITY OF CEMENT

Objective : To determine specific gravity of a given sample of hydraulic cement.
Reference : IS : 4031 (Part 11) - 1988.

Overview :
Specific gravity is defined as the ratio between the weight of a given volume of cement and weight of an equal volume of water.

LECHATELIER FLASK

Apparatus :
- Lechatelier flask 250 ml (or) Pycnometer (100 ml)
- Balance & Water bath

Procedure :
- Weigh the empty flask.
- Fill the cement up to half of the flask (about 50gm) and weigh with its stopper.
- Add Kerosene to the cement up to the top of the bottle. Weigh the flask with cement and kerosene.
- Empty the flask. Fill the bottle with kerosene up to the top and weigh the flask.

Technical Discussion: Every material has its own specific gravity, and it usually ranges between 0.1 – 100. If the specific gravity of the material is less than 1, then that material floats in water. If the material has a specific gravity greater than 1, then it sinks in water.

Specific gravity of cement or Density of cement is ranging between 3.1-3.16 g/cc by this, cement is 3.16 times heavier than water of the same volume.

Compressive Strength Test of Cement

COMPRESSIVE STRENGTH TEST OF CEMENT

Objective : To determine the compressive strength of a given sample of cement.
Reference : IS : 4031 (Part 6)-1988, IS : 10080-1982, IS : 650-1966 & IS: 269-1976

Overview :
Compressive strength of cement is determined by compressive strength test on mortar cubes compacted by means of a standard vibration machine. Standard sand (IS:650) is used for the preparation of cement mortar. The specimen is in the form of cubes 70.6mm x 70.6mm x 70.6mm

Apparatus :
- Cube Mould of 70.6 mm size
- Vibration Machine
- Gauging Trowel, Stop Watch, Graduated Cylinders, etc.

Cube Mould & Cement Cube

Technical Discussion:
- Compression testing provides data on the integrity and safety of materials, and ensure that the finished product is fit-for-purpose and manufactured to the highest quality
- Compressive strength = $\frac{\text{Load}}{\text{Cross sectional area of specimen}}$
- The quantity of cement, standard sand and water shall be as follows: Cement = 200 (g), Standard Sand = 600 (g) and Water = [(P/4)+3] (% of mass of cement+sand), whether P is the % of water required to produce a paste of standard consistency.
- As the compressive strength of the mortar is less then the required strength so it cannot be used for permanent constructions.

Slump Test on Concrete

SLUMP TEST OF CONCRETE

Objective : To determine the relative consistency of freshly mixed concrete by the use of Slump Test.
Reference : IS: 7320-1974, IS: 1199-1959 & SP : 23-1982.

Overview :
This test is performed to measure consistency or workability of fresh concrete, where the nominal maximum size of aggregate does not exceed 38 mm using slump test apparatus.

Apparatus :
- Slump cone (Height = 30 cm, Base dia = 20 cm, Top dia = 10 cm)
- Tamping rod (Length = 60 cm, Dia = 16 mm)

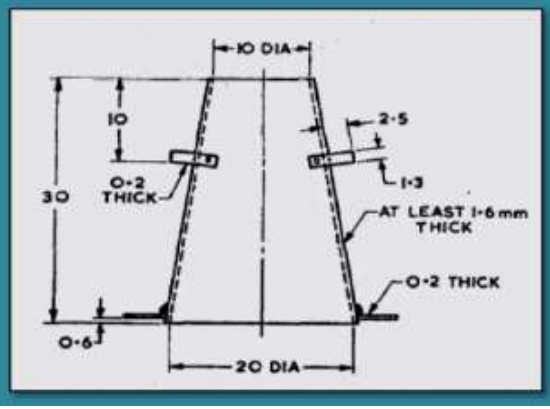
Procedure:
- Place the mixed concrete in the cleaned slump cone in four layers, each layer is temped 25 times with a standard 16 mm diameter steel rod.
- Remove the cone Immediately, rising it slowly and carefully in the vertical direction.
- The decrease in the height of the center of the slumped concrete is called slump.
- As soon as the concrete settlement comes to as stop, measure the subsistence of the concrete in mm/cms which gives the slump value.

Slump Range (mm)	Workability	Slump Class
10-40	Low	S1
50-90	Medium	S2
100-150	High	S3

Slump Test on Concrete

Types of Slump:

- **True Slump:** The concrete mass after the test when slumps evenly all around without disintegration is called the true slump.
- **Shear Slump:** When one-half of the concrete mass slide down the other is called the shear slump. This type of slump is obtained in a lean concrete mix.
- **Collapse Slump:** When the sample is collapsed due to adding excessive water, it is known as collapse slump.
- **Zero Slump:** For very stiff or dry mixes it does not show any changes of the slump after removing the slump cone



Technical Discussion:

- The slump is measured immediately by determining the difference between the height of the mould and that of the highest point of specimen.
- After completion of the slump test, to get an idea on cohesiveness of concrete, tap slightly the outer perimeter of the slumped concrete. If it subsides further, then it is an indication of good quality concrete having required cohesiveness. But if it gets collapsed or shears away then the concrete lacks cohesiveness and this is an indication of poor quality concrete

Vee-Bee Test of Concrete

VEE-BEE TEST OF CONCRETE

Objective : To determine the workability of the freshly mixed concrete.
Reference : IS: 1199-1956.

Overview :
Vee-bee test is used to determine the consistency of concrete by using a Vee-Bee consistometer.

Apparatus :
- A vibrator table resting on elastic supports
- A sheet metal cone, open at both ends
- A metal pot & A standard iron rod.

The degree of workability in Vee-Bee test is classified based on the time taken in seconds.

Workability	Vee-Bee Time (in Second)
Very low workability	> 20 Seconds
Low workability	6 – 12 Seconds
Medium workability	3– 6 Seconds
High workability	o – 3 Seconds

Procedure:
- Place the slump cone in the sheet metal pot of the consistometer and fill it with fresh concrete.
- Move the glass disc attached to the swivel arm and place it just on top of the slump cone in the pot
- Note the position of the concrete cone by adjusting the glass disc attached to the swivel arm.
- Lift the cone and note the slump on the graduated rod by lowering the glass disc on top of the concrete cone.
- Switch on the electrical vibrator and allow the concrete to spread out in the pot. Continue the vibration until the whole concrete to spread out in the pot. Continue the vibration until the whole concrete surface adheres uniformly to the glass disc.

Compaction Factor Test of Concrete

COMPACTION FACTOR TEST OF CONCRETE

Objective : To determine the workability of the concrete mix of given proportion.
Reference : IS: 1199-1959

Overview :
The compaction factor test is used for concrete which have low workability for which slump test is not suitable. It was developed by Road Research Laboratory in United Kingdom and is used to determine the workability of concrete

Apparatus :
- Compacting factor apparatus, Hand scoop, Weighing balance, etc.

Procedure:
- Fill concrete in the upper hopper and the trap–door is opened so that the concrete falls into the lower hopper.
- When concrete has come to rest in the lower hopper, the trap door of the lower hopper opened and the concrete is allowed to fall into the cylinder.
- The weight of the concrete in the cylinder is measured. This is known as 'the weight of partially compacted concrete.
- Refilled the cylinder with concrete and vibrated to obtain full compaction and weight it

Technical Discussion:
- Compaction Factor = $\frac{\text{Weights of partially compacted concrete}}{\text{Weights of fully compacted concrete}}$
- Each test, therefore should be carried out at a constant time interval after the mixing is completed, if strictly comparable results are to be obtained.

Workability	Compaction Factor
Very stiff	0.70
Stiff	0.75
Stiff plastic	0.85
Plastic	0.90
Flowing	0.95

Compacting factor Apparatus

Major Equipments List

S. No.	Equipment	Quantity	Cost / unit (RS)	Total cost in RS
1.	Density Basket	1	3169	3169
2.	Le-Chartelier Flask	1	1637	1637
3.	VICAT Apparatus	1	1958	1958
4.	Le-chartlier Mould	1	1424	1424
5.	Compression Testing Machine	1	84550	84550
6.	Slump Test Apparatus	1	1246	1246
7.	Compaction Factor Test	1	14685	14685
8.	Vee-Bee Consistometer	1	22695	22695
9.	Concrete Testing Hammer	1	26630	26630
10.	Vibrating Table	1	35155	35155
11.	Longitudinal Compressometer, Digital	1	18795	18795
12.	Flexure testing machine, 100kN	1	131367	131367
13.	Beam Mould, 100x100x500 mm	2	5950	11900
14.	Beam Mould, 150x150x700 mm	2	11434	22868
15.	Mould for 70.6 mm cube	6	940	5640
16.	Cube Mould	12	700	8400
	Total			**392119**

Do's and Don'ts

DO s:

1. Know the location of all safety and energy equipment used in lab
2. Finalize yourself with all procedures before doing lab exercise
3. Keep your work area clean
4. Tie back all long hair and remove jewelries during the lab
5. Always be sure that electrical equipment is turned in the off position before plugging into socket

DON'T s:

1. Never experiment on your own
2. Never work in the lab alone
3. Never do experiment without preparation

Safety Measures in the Laboratory

Fire Extinguishers

First Aid Box

Miniature Circuit Breaker's (MCB's).

CC Camera surveillance