METHODIST
COLLEGE OF ENGINEERING & TECHNOLOGY
(An UGC-AUTONOMOUS INSTITUTION)
Accredited by NAAC with A+ and NBA
Estd : 2008
Affliated to Osmania University & Approved by AICTE

DEPARTMENT OF CIVIL ENGINEERING

LABORATORY MANUAL

Concrete Technology Lab

(2PC352CE)

BE III Semester (Autonomous): 2024-25

Name: ....

Roll No: ....

Branch: ....SEM:.......................

Academic Year: ....

Empower youth- Architects of Future World

METHODIST

COLLEGE OF ENGINEERING & TECHNOLOGY

Approved by AICTE New Delhi | Affiliated to Osmania University, Hyderabad

Estd: 2008

Abids, Hyderabad, Telangana, 500001

DEPARTMENT OF CIVIL ENGINEERING

LABORATORY MANUAL

Concrete Technology Lab

Prepared by

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Associate Professor

DEPARTMENT OF CIVIL ENGINEERING

VISION

To evolve into a centre of excellence for imparting holistic civil engineering education contributing towards sustainable development of the society.

MISSION

- To impart quality civil engineering education blended with contemporary and inter disciplinary skills.
- To provide enhanced learning facilities and professional collaborations to impart a culture of continuous learning.
- To involve in trainings and activities on communication skills, teamwork, professional ethics, environmental protection and sustainable development.

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

The Graduates of the programme shall be able to:

PEO1. Engage in planning, analysis, design, construction, operation and maintenance of built environment.

PEO2. Apply the knowledge of civil engineering to pursue research or to engagei n professional practice.

PEO3. Work effectively as individuals and as team members in multidisciplinary projects with organizational and communication skills.

PEO4. Demonstrate the spirit of lifelong learning and career enhancemen taligned to professional and societal needs.

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM OUTCOMES

Engineering Graduates will be able to:

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and civil engineering specialization to the solution of complex civil engineering problems.

- **PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **PO3. Design/development of solutions:** Design solutions for complex civil engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex civil engineering activities with an understanding of the limitations.

- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional civil engineering practice.

- **PO7. Environment and sustainability:** Understand the impact of the professional civil engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the civil engineering practice.

- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for and have the preparation and ability in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

Civil Engineering Graduates will be able to:

PSO 1. Investigate properties of traditional and latest construction materials using standard testing methods.

PSO 2. Use AutoCAD, STAAD Pro, ETABS, Revit Architecture and ANSYS software for computer aided structural analysis and design.

PSO 3. Describe the principles of sustainable development and green buildings for environmental preservation.

DEPARTMENT OF CIVIL ENGINEERING
CONCRETE TECHNOLOGY LABORATORY

FOREWORD

The concrete laboratory intends to train the students in the field of testing the ingredients of concrete and to study the behavior of fresh concrete, its workability and strength in hardened state, which are used directly or indirectly in the design of structural elements.

This instruction manual guides the students to conduct the test as per standard codal procedures. The student shall follow the guidelines indicated for conducting the tests more effectively and for better understanding and for logical interpreting the test results as per IS code.

- Before conducting any test, student shall come prepared with theoretical background of the corresponding test, specification as per code.
- Student must familiarize with the scope and purpose of the test.
- Student shall make sure to have the knowledge of measuring instruments like slide calipers and other gauges.
- Students shall acquaint themselves with the safe and correct usage of instruments/ equipments under the guidance of teaching or supporting staff of the laboratory.
- Students shall give importance to accuracy and precision while conducting the test and interpreting the test results.

DEPARTMENT OF CIVIL ENGINEERING

B.E.III Semester-(2024-25)

CONCRETE TECHNOLOGY LAB (2PC352CE)

Course Objectives

It is intended to make the students to:

- Conduct tests on cement.
- Conduct tests on Fine Aggregate and Coarse Aggregate.
- Conduct tests on concrete in fresh state.
- Conduct tests on hardened concrete in hardened state.
- Evaluate the strength and quality of concrete.

Course outcomes (COs):

After end of course, students will be able to:

CO 1. Determine the properties of given cement sample and assess its suitability for use in construction.

CO 2. Determine the properties of fine and coarse aggregate samples to assess their suitability for use in construction works.

CO 3. Measure the workability of concrete and recommend its suitability for structural works.

CO 4. Determine the compressive strength of concrete

CO 5. Conduct destructive and non-destructive tests to evaluate the quality and strength of concrete

DEPARTMENT OF CIVIL ENGINEERING

MAPPING OF COs WITH POs:

CO/PO	PO 1	PO2	PO 3	PO 4	PO 5	PO6	PO7	PO 8	PO 9	P O 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO1	3			1		2		1				1			
CO2	3			1		2		1	3			2	2		2
CO3	3			1		2		1	3			2	2		2
CO4	3			1		2		2	3			2	2		2
CO5	3			1		2		2	3			2	2		2
AVG	3.0			1.0		2.0		1.4	3.0			1.8	2.0		2.0

B.E. III Semester 2024-2025

Concrete Technology Lab (2PC 352 CE)

S.No.	Name of the Experiment	CO'S MAPPED	PO'S PSO'S
	CEMENT		
1	Determination of the specific gravity of the given cement sample.	CO1, CO2	PO1, PO4, PO6, PO8, PO9, PO12
2	Determination of the standard consistency of the given cement sample.	CO1, CO2	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
3	Determination of the initial setting time and final setting time of the given cement	CO1, CO2	PO1, PO4,PO6, PO8,PO9,PO12,PSO1,PSO3
	AGGREGATES		
4	Determination of the bulking of Fine Aggregate.	CO1, CO3	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
5	Determination of the bulk density, void ratio, porosity and specific gravity of	CO1, CO3	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
6	Determination of the bulk density, void ratio, porosity and specific gravity of given coarse Aggregate	CO1,CO3	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
7	Determination of the fineness modulus of Fine Aggregate.	CO1,CO3	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
8	Determination of the fineness modulus of Coarse Aggregate.	CO1,CO3	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
	FRESH CONCRETE		
9	Determination of the Workability of concrete mix using slump cone method	CO1,CO4	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
10	Determination of the Workability of concrete mix using compaction factor method	CO1,CO4	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
	HARDENED CONCRETE		
11.	Determination of the compressive strength of concrete cubes	CO1,CO5	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3
12	Demo on Non-destructive testing of concrete specimen	CO1,CO5	PO1, PO4, PO6, PO8,PO9,PO12,PSO1,PSO3

LABORATORY CODE OF CONDUCT

1. Students should report to the concerned labs as per the time table schedule with apron and shoes.
2. Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.
3. Students should bring a note book of about 100 pages and should enter the readings/observations into the note book while performing the experiment.
4. After completion of the experiment, certification of the concerned staff in- charge in the observation book is necessary.
5. Staff member in-charge shall award 40 marks for each experiment based on continuous evaluation and will be entered in the continuous internal evaluation sheet.
6. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate last session should be submitted and certified by the staff member in-charge.
7. The group-wise division made in the beginning should be adhered to, and no student is allowed to mix up with different groups later.
8. The components required pertaining to the experiment should be collected from the stores in-charge, only after duly filling in the requisition form/log register.
9. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
10. Any damage of the equipment or burn-out of components will be viewed seriously by either charging penalty or dismissing the total group of students from the lab for the semester/year.
11. Students should be present in the labs for the total scheduled duration.
12. Students are required to prepare thoroughly to perform the experiment before coming to Laboratory.
13. Procedure sheets/data sheets provided to the students, if any, should be maintained neatly and returned after the completion of the experiment.

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SPECIFIC GRAVITY OF CEMENT

Exp. No.: 1

AIM: To determine the specific gravity of given sample of cement.

APPARATUS:

- Weighing balance
- specific gravity bottle (50ml capacity)
- kerosene
- funnel

INTRODUCTION:

Specific gravity is defined as the ratio between weight of a given volume of material and weight of an equal volume of water. To determine the specific gravity of cement, kerosene is used which does not react with cement.

PROCEDURE:

1. Clean and dry the specific gravity bottle and weigh it with the stopper (W1).
2. Fill the specific gravity bottle with distilled water and weigh the bottle filled with water (W2)
3. Wipe dry the specific gravity bottle and fill with kerosene then fill it with fresh kerosene and weigh it with stopper (W3)
4. Pour out some of the kerosene out and introduce a weighed quantity of cement (about 50gms) into the bottle. Roll the bottle in inclined position until no further air bubbles rise to the surface. Fill the bottle to the top with kerosene and weigh it (W4)

.

OBSERVATIONS:

Description of item	Trial 1	Trial 2
Weight of empty bottle (W1 g)		
Weight of bottle + Water (W2 g)		
Weight of bottle + Kerosene (W3 g)		
Weight of bottle + Cement + Full Kerosene (W4 g)		
Weight of Cement (W5 g)		
Specific gravity of Kerosene, S_k= (W3-W1)/(W2-W1)		
Specific gravity of Cement, S=W5(W3-W1)/(W5+W3-W4)(W2-W1)		

Specific Gravity Bottle

RESULTS: Specific gravity of given Cement =---------------------------------------

NORMAL CONSISTENCY OF CEMENT

Exp. No.: 2

AIM: To determine the quantity of water required to produce a cement paste of standard consistency.

APPARATUS:

- Vicat's apparatus conforming to IS: 5513-1976
- Weighing Balance
- Gauging Trowel
- Stop Watch.

REFERENCE CODE:

- IS: 4031 (Pat 4) – 1988 methods of physical test for hydraulic cement
- IS : 5513-1996 for specification for Vicat's apparatus.

THEORY:

The standard consistency of a cement paste is defined as that consistency which will permit the vicat plunger to penetrate to a point 5 to 7 mm from the bottom of the vicat's mould. For finding out initial setting time, final setting time, soundness of cement and compressive strength of cement, it is necessary to fix the quantity of water to be mixed in cement in each case.

PROCEDURE:

1. Prepare a paste of weighed quantity of cement (300 grams) with a weighed quantity of potable or distilled water, starting with 26% water of 300g of cement.
2. Take care that the time of gauging is not less than 3 minutes, not more than 5 minutes and the gauging shall be completed before setting occurs.

3. The gauging time shall be counted from the time of adding the water to the dry cement until commencing to fill the mould.

4. Fill the vicat mould with this paste, the mould resting upon a non-porous plate.

5. After completely filling the mould, trim off the surface of the paste, making it in level with the top of the mould. The mould may slightly be shaken to expel the air.

6. Place the test block with the mould, together with the non-porous resting plate, under the rod bearing the plunger (10mm diameter), lower the plunger gently to touch the surface of the test block and quickly release, allowing it to penetrate into the paste.

7. This operation shall be carried out immediately after filling the mould.

8. Prepare trial pastes with varying percentages of water and test as described above until the amount of water necessary for making the standard consistency as defined above is obtained.

9. Express the amount of water as a percentage by weight of the dry cement. Repetition of the experiment fresh cement is to be taken.

OBSERVATION AND CALCULATION:

1. Type of cement……………………
2. Brand of cement…………………..
3. Time of Test……………………….
4. Room Temperature…………………

Trail No.	Weight of cement (gms)	Percentage by water ofdry Cement (%)	Amount of water added (ml)	Penetration(mm)
1				
2				
3				
4				

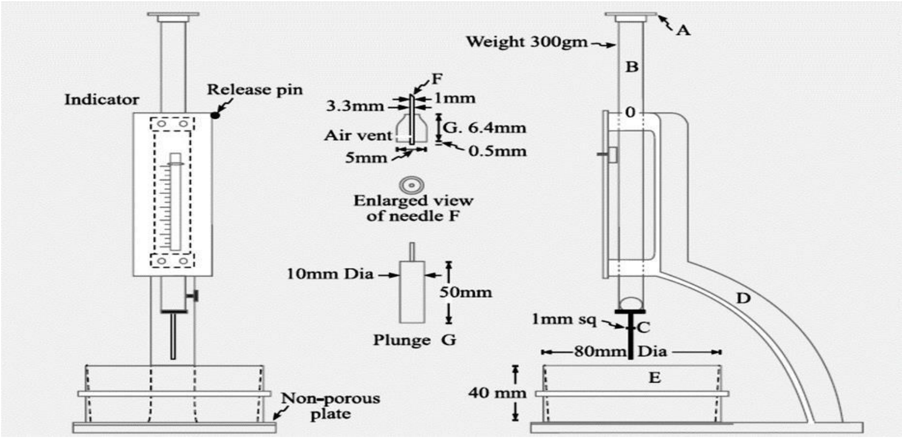


Fig.: Vicat Apparatus

RESULT: Normal consistency for the given sample of cement is.................................%

DETERMINATION OF SETTING TIME OF STANDARD CEMENT PASTE

Exp. No.: 3

AIM: To determine the initial and final setting time of a given sample of cement.

APPARATUS:

- Vicat apparatus conforming to IS : 5513-1976
- Weighing Balance
- Glass plate
- Gauging Trowel
- Stop Watch

REFERENCE CODE:

- IS: 4031 (Pat 4) – 1988 methods of physical test for hydraulic cement
- IS : 5513-1996 for specification for Vicat's apparatus.

THEORY:

Initial setting time is regarded as the time elapsed between the moments that the water is added to the cement to the time that the paste starts losing its plasticity. The final setting time is the time elapsed between the moment the water is added to the cement and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure.

PROCEDURE:

1. Preparation of Test Block: - Prepare a neat 300 gms cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency. Potable or distilled water shall be used in preparing the paste.
2. Start a stop-watch at the instant when water is added to the cement. Fill the Vicat mould with a cement paste gauged as above and the mould resting on a nonporous plate. Fill the mould completely and smooth off the surface of the paste making it level with the top of the mould.
3. Immediately after moulding, place the test block in the moist closet or moist room and allow it to remain there except when determinations of time of setting are being made.
4. Determination of Initial Setting Time: - Place the test block confined in the mould and resting on the non-porous plate, under the rod bearing the needle lower the needle gently until it comes in contact with the surface of the test block and quickly release, allowing it to penetrate into the test block.
5. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block beyond 5.0 ± 0.5 mm measured from the bottom of the mould shall be the initial setting time.
6. Determination of Final Setting Time: - Replace the needle of the Vicat apparatus by the needle with an annular attachment.
7. The cement shall be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression there on, while the attachment fails to do so.
8. The period elapsing between the time when water is added to the cement and the time at which the needle makes an impression on the surface of test block while the attachment fails to do so shall be the final setting time.

OBSERVATION:

1. Type of cement=.......................
2. Brand of cement=t.....................
3. Weight of given sample of cement is= gm
4. The normal consistency of a given sample of cement is= %
5. Volume of water addend for preparation of test block= ml

Observations:

Sl.No.	Setting Time (min)	Penetration (mm)
1		
2		
3		
4		
5		
6		

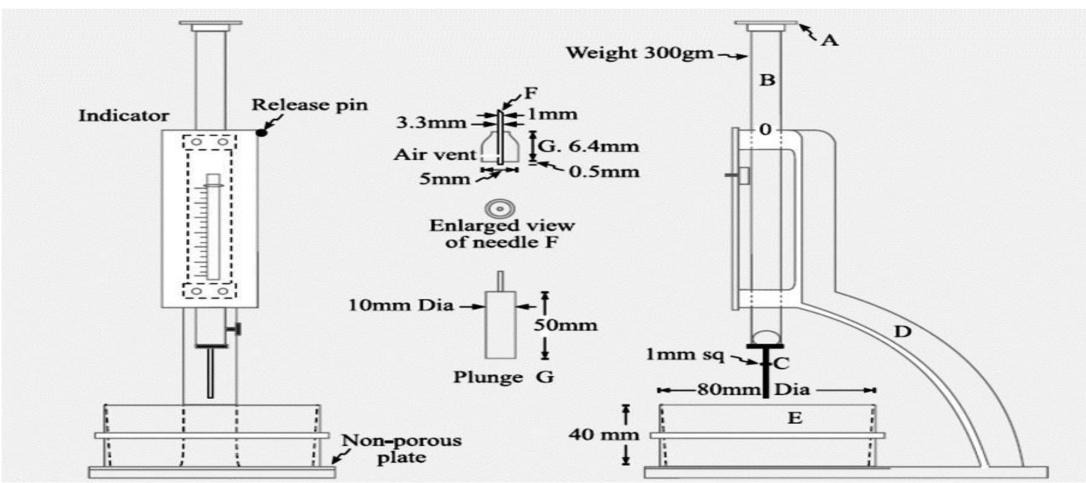


Fig.: Vicat Apparatus

RESULT:

1. The initial setting time of the cement sample is found to be............minutes
2. The final setting time of the cement sample is found to be...............minutes

BULKING OF SAND

Exp. No.: 4

AIM : To study the bulking of fine aggregate (IS:2386 (Part3) 1963).

APPARATUS:

- Weighing balance
- Weight box
- Mixing pan
- Measuring cylinder
- Rod for compaction

REFERENCE CODE: IS:2386(Part3)-1963

THEORY:

When dry comes into contact with moisture, thin film is formed around the particles which causes them to get apart from each other. This will result in increasing volume of the sand. This phenomenon is known as bulking of sand. For this reason, if sand is measured by volume, bulking should be properly accounted.

PROCEDURE:

1. Taken 500 gm(W1) of sand passing through 1.18 mm sieve.
2. Kept the sample in an oven in a tray at a temperature of 100oC-110oC for 24±0.5 hours.3.
3. Cool the sand in air tight container and weight it(W2), water content of the sample is (W1-W2) ×100/W1.
4. Taken out about 200 gm of sand and poured it into a pan.
5. Added 2% of water (by weight) and mixed well.
6. Poured the sand sample into a measuring cylinder.
7. Leveled the surface and read the volume in ml (h1).

8. Poured water into the measuring cylinder and completely inundated the sand and shaken it.

9. Leveled the surface and noted down the level in ml (h2).

10. Taken out the whole quantity of sand and continued the experiment by adding 2% water more each time and noted down the corresponding volume of sand until the dump sand volume starts decreasing.

11. Then (h2-h1) shows the bulking of the sample sand under test.

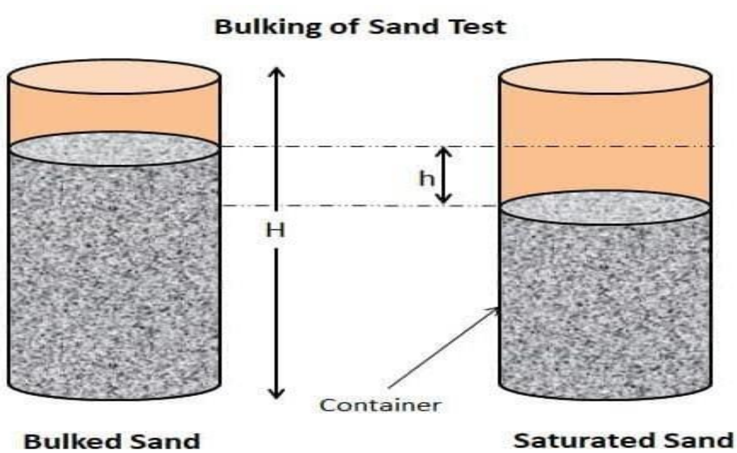
Percentage of bulking = (h1- h2/h2) ×100 %

Precautions:

1. While mixing water with sand grains, mixing should be thorough and uniform.
2. The sample should not be compressed while being filled in jar.
3. The sample must be slowly and gradually poured into measuring jar from its top.
4. Increase in volume of sand due to bulking should be measured accurately.

Observation and Result:

To draw the graph in between % of moisture added by weight along X-axis and % of increased volume along Y-axis. From the graph, the maximum % of bulking occurred to be picked, and % of water content at maximum bulking



Conclusion:

Questionnaire:

1. What do you mean by bulking of sand?

2. What is the effect of bulking of sand in concrete mix?

SPECIFIC GRAVITY OF FINE AGGREGATE

Exp. No.:5

AIM: To determine specific gravity, bulk density, porosity and void-ratio of a given sample of fine aggregate.

APPARATUS:

- Pycnometer bottle
- Taping rod
- Funnel

REFERENCE CODE: IS 2386 PART III-1963.

THEORY:

Specific gravity: It is defined as the mass of aggregate equivalent to capacity of water**.** The specific gravity determination is adopted for properties determination inclusive of the concrete designs based on cement in predicting the amount of moisture along with the yield determination. This however helps in the determination of excellence as well as its properties. This quality is however used for the strength determination & excellence. Sample with lesser specific gravity tend to be weaker as compared to those with a high-level value. Aggregates bulk density is quality measure determination in contrast to the normal samples density. This is utilized for quantification by substance into its volume used to evaluate ratio of voids.

Voids Ratio: It is defined as the proportion of voids to the solids volume of the aggregate sample.

Porosity: It is defined as the proportion of voids over the aggregate sample's total volume in terms of percentage.

Bulk density: It is defined as the sample weight ratio to the unit volume of it also termed as the unit weight.

PROCEDURE:

1. Take the empty pycnometer (w1) gms.

2. Take a sample of fine aggregate for which specific gravity is to be find out, transfer that to the pycnometer, and weight (w2).

3. Pour distilled water into pycnometer.

4. Eliminate the entrapped air by rotating the pycnometer.

5. Wipe out the outer surface of pycnometer and weight it (w3).

6. Transfer the aggregate of the pycnometer into a try care being taken to ensure that all the aggregate is transferred.

7. Refill the pycnometer with distilled water up to the mark and it should be completely dry from outside and take the weight w4

8. This experiment is repeated for two to three trials to have an accurate value

CALUCULATIONS:

Trail No	Weight of empty bottle (W1) g	Weight of empty bottle + Fine aggregate (W2) g	Weight of empty bottle + water + Fine aggregate (W3) g	Weight of empty bottle + water (W4) g
1				
2				
3				

Void-ratio = void's volume / solid's volume

$$= \frac{W_3 - W_1}{((W_4 - W_1) - (W_3 - W_2))}$$

Porosity = (volume of voids / total volume of aggregates) × 100

$$= \frac{W_3 - W_2}{(W_4 - W_1)} \times 100$$

$$\text{Specific gravity} = \frac{W_2 - W_1}{((W_4 - W_1) - (W_3 - W_2))}$$

$$\text{Bulk density} = \frac{W_2 - W_1}{(W_4 - W_1)}$$

RESULT: Specific Gravity of a given sample of fine aggregate is =

Bulk density of given sample of fine aggregate is=

Void Ratio of given sample of fine aggregate is=

Porosity of given sample of fine aggregate is=

SPECIFIC GRAVITY OF COARSE AGGREGATE

Exp. No.:6

AIM: To determine specific gravity, bulk density, porosity and void-ratio of a given sample of Coarse aggregate.

APPARATUS:

- Pycnometer bottle
- Taping rod
- Funnel

REFERENCE CODE: IS 2386 PART III-1963**.**

THEORY:

Specific gravity: It is defined as the mass of aggregate equivalent to capacity of water**.** The specific gravity determination is adopted for properties determination inclusive of the concrete designs based on cement in predicting the amount of moisture along with the yield determination. This however helps in the determination of excellence as well as its properties. This quality is however used for the strength determination & excellence. Sample with lesser specific gravity tend to be weaker as compared to those with a high-level value. Aggregates bulk density is quality measure determination in contrast to the normal samples density. This is utilized for quantification by substance into its volume used to evaluate ratio of voids.

Voids Ratio: It is defined as the proportion of voids to the solids volume of the aggregate sample.

Porosity: It is defined as the proportion of voids over the aggregate sample's total volume in terms of percentage.

Bulk density: It is defined as the sample weight ratio to the unit volume of it also termed as the unit weight.

PROCEDURE:

1. Take the empty pycnometer (w1) gm.
2. The sample is taken roughly half of same container and its mass is determined (w2) gm.
3 Fill up the bottle with water until the coarse aggregates level.
4. Eliminate the entrapped air by rotating the pycnometer.
5. Wipe out the outer surface of pycnometer and weight it (w3) gm.
6. Transfer the aggregate of the pycnometer into a try care being taken to ensure that all the aggregate is transferred.
7. Refill the pycnometer with distilled water up to the mark and it should be completely dry from outside and take the weight (w4)gm.
8. This experiment is repeated for two to three trials to have an accurate value

CALUCULATIONS:

Trail No	Weight of empty bottle (W1) g	Weight of empty bottle + Coarse aggregate (W2) g	Weight of empty bottle + water + Coarse aggregate (W3) g	Weight of empty bottle + water (W4) g
1				
2				
3				

Void-ratio = void's volume / solid's volume

$$= \frac{W_3 - W_1}{((W_4 - W_1) - (W_3 - W_2))}$$

Porosity = (volume of voids / total volume of aggregates) × 100

$$= \frac{W_3 - W_2}{(W_4 - W_1)} \times 100$$

$$\text{Specific gravity} = \frac{W_2 - W_1}{((W_4 - W_1) - (W_3 - W_2))}$$

$$\text{Bulk density} = \frac{W_2 - W_1}{(W_4 - W_1)}$$

RESULT: Specific Gravity of a given sample of fine aggregate is =

Bulk density of given sample of fine aggregate is=

Void Ratio of given sample of fine aggregate is=

Porosity of given sample of fine aggregate is=

FINENESS MODULUS OF FINE AGGREGATE

Exp. No.: 7

AIM: To determine fineness modulus of fine aggregate

APPARATUS:

- Test Sieves conforming to IS : 460-1962 Specification of 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron.
- Balance
- Gauging Trowel
- Stop Watch

REFERENCE CODE: IS: 383-1970

THEORY:

This is the name given to the operation of dividing a sample of aggregate into various fractions each consisting of particles of the same size. The sieve analysis is conducted to determine the particle size distribution in a sample of aggregate, which we call gradation. Many a time, fine aggregates are designated as coarse sand, medium sand and fine sand. These classifications do not give any precise meaning. What the supplier terms as fine sand may be really medium or even coarse sand. To avoid this ambiguity fineness modulus could be used as a yard stick to indicate the fineness of sand. The following limits may be taken as guidance: Fine sand : Fineness Modulus : 2.2 - 2.6, Medium sand : F.M. : 2.6 - 2.9, Coarse sand : F.M. : 2.9 - 3.2 Sand having a fineness modulus more than 3.2 will be unsuitable for making satisfactory concrete.

PROCEDURE:

1. The sample shall be brought to an air-dry condition before weighing and sieving. The air-dry sample shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.

2.The shaking shall be done with a varied motion, backward sand 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.

3. Material shall not be forced through the sieve by hand pressure. Lumps of fine material, if present, may be broken by gentle pressure with fingers against the side of the sieve.

4.Light brushing with a fine camel hair brush may be used on the 150-micron and 75- micron IS Sieves to prevent aggregation of powder and blinding of apertures.

5. On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

CALUCULATIONS:

I S Sieve	Weight Retained on Sieve (g)	Percentage of Weight Retained (%)	Percentage of Weight Passing (%)	Cumulative Percentage of Passing (%)	Remark
4.75 mm					
2.36 mm					
1.18 mm					
600 micron					
300 micron					
150 micron					
Pan					
Total				**ΣF**	

Fineness modulus is an empirical factor obtained by adding the cumulative percentages of aggregate retained on each of the standard sieves ranging from 4.75 mm to 150 microns and dividing this sum by an arbitrary number 100.

$$\textit{Finess Modulus, FM} = \frac{\textit{Total of Cumulative Percentage of Passing } (\%)(\Sigma F)}{100}$$

RESULT:

a) Fineness modulus of a given sample of fine aggregate is …….. that indicate Coarse sand/ Medium sand/Fine sand.

b. The given sample of fine aggregate is belong to Grading Zones I / II / III / IV

Table 3.15. Grading limits of fine aggregates IS: 383-1970

I.S. Sieve Designation	Percentage passing by weight for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90–100	90–100	90–100	95–100
2.36 mm	60–95	75–100	85–100	95–100
1.18 mm	30–70	55–90	75–100	90–100
600 micron	15–34	35–59	60–79	80–100
300 micron	5–20	8–30	12–40	15–50
150 micron	0–10	0–10	0–10	0–15

Questionnaire:

1. What is the role of fine aggregate in concrete?

2. How is fine aggregate classified as per Indian Standard (IS 383 1970)?

3. What is the basis of classification of fine aggregate as per Indian Standard (IS 383 1970)?

4. What type of sand (as per Indian Standard IS 383 1970) is found around Hyderabad?

FINENESS MODULUS OF COARSE AGGREGATE

Exp. No.: 8

AIM: To determine fineness modulus of coarse aggregate

APPARATUS:

- Test Sieves conforming to IS : 460-1962 Specification of 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron.
- weighing balance
- trays

mechanical sieve-shaker.

REFERENCE CODE: IS: 383-1970

THEORY:

Fineness modulus of coarse aggregates represents the average size of the particles in the coarse aggregate by an index number. It is calculated by performing sieve analysis with standard sieves. Higher the aggregate size higher the Fineness modulus hence fineness modulus of coarse aggregate is higher than fine aggregate. In general, however, a smaller value indicates a finer aggregate.

PROCEDURE:

1. Take 5 kg of coarse aggregate by quartering from the test sample.
2. Arrange the relevant sieves one above the other with the sieve size increasing from the top and put the pan at the bottom.
3. Put the set of sieves over the sieve shaker and shake 2 to 3 minutes.
4. Weigh the amount of aggregate retained on each sieve.

Precautions:

1. The sample should be taken by quartering.

2. The sieving must be done carefully to prevent the spilling of fine aggregate.

CALCULATIONS:

I S Sieve	Weight Retained on Sieve (g)	Percentage of Weight Retained (%)	Cumulative Percentage of retained (C)	Percentage of Weight Passing (%)	Remark
80mm					
40mm					
20mm					
10mm					
4.75 mm					
Pan					
Total					

$\sum C =$

Fineness modulus (excluding C for pan) = $(\sum C + 500)/100$

=------------------

Conclusion:

Questionnaire:

1. What is the role of coarse aggregate in concrete?
2. Does the coarse aggregate take part in any chemical reaction in concrete?
3. What is the role of angular coarse aggregate in the workability of concrete?
4. What type of coarse aggregate is found in the Hyderabad?
5. What is the significance of Fineness Modulus?
6. What do you understand by grading of aggregates?
7. What is single-sized aggregate and graded aggregate?
8. Why gradation of aggregate is important for concrete mix design?

Workability Test(Slump Test)

Exp. No.: 9

AIM: To determine the workability of concrete mix of given proportion by slump test.

APPARATUS:

- pan to mix concrete
- weighing balance
- trowel
- cone
- steel scale
- tamping rod
- mixing tray

REFERENCE CODE:

- IS: 456-2000, code for plain and reinforced concrete
- IS: 1199-1959 methods of sampling and analysis of concrete

THEORY:

This is the test extensively used in site work all over the world. Fresh unsupported concrete will flow to the sides and the vertical sinking of concrete is known as slump.

The slump cone is a hollow frustum made of thin steel sheet with internal dimensions, as the top diameter 10 cm. The bottom diameter 20 cm, and height 30cm.

PROCEDURE:

1. Mix the dry constituents thoroughly to get a uniform colour and then add water.

2. The internal surface of the mould is to be thoroughly cleaned and placed on a smooth, horizontal and non-absorbent surface.

3. Place the mixed concrete in the cleaned slump cone in 4 layers each approximately 1/4 in height of the mould. Tamp each layer 25 times with tamping rod. Using the tampering rod or a trowel strike of the excess concrete above the concrete cone. Measure the vertical height of cone (h1).

4. Slowly and carefully remove in the vertical direction. As soon as the cone is removed the concrete settles in vertical direction. Place the steel scale above top of settled concrete in horizontal position and measure the height of cone(h2).

5. Complete the experiment in two minutes after sampling.

6. The difference of two heights (h1-h2) gives the value of slump

OBSERVATIONS:

1) Type of cement=………………

2) Brand of cement=………………

3) Density of concrete=..............

Trail No	Proportion					Slump in (mm)
	w/c	W (litre)	C (kg)	FA(Kg)	CA(Kg)	

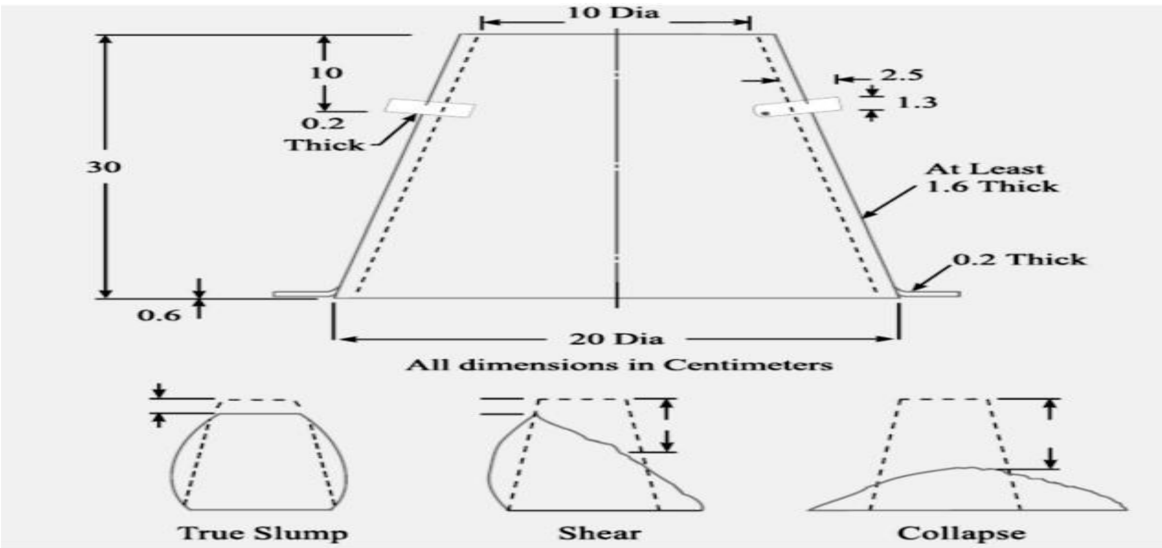


Fig. Different Types of Slump

Result: The slump of concrete= ....mm (indicate Low/ Medium/ High Degree of workability)

Workability Test(Compaction Factor Test)

Exp. No.: 1 0

AIM: To determine the workability of concrete mix of given proportion

APPARATUS:

- Testing Machine
- Specimen mould
- tamping rod
- weighing device
- Tools and containers for mixing

REFERENCE CODE:

- IS:5515-1983 Specification for compaction factor apparatus

THEORY:

The compaction factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete. The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more precise and sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration.

PROCEDURE:

1. Grease the inner surface of the hoppers and the cylinder and Fasten the hopper doors.
2. Weigh the empty cylinder accurately (W1. Kgs) an Fix the cylinder on the base with nuts and bolts.

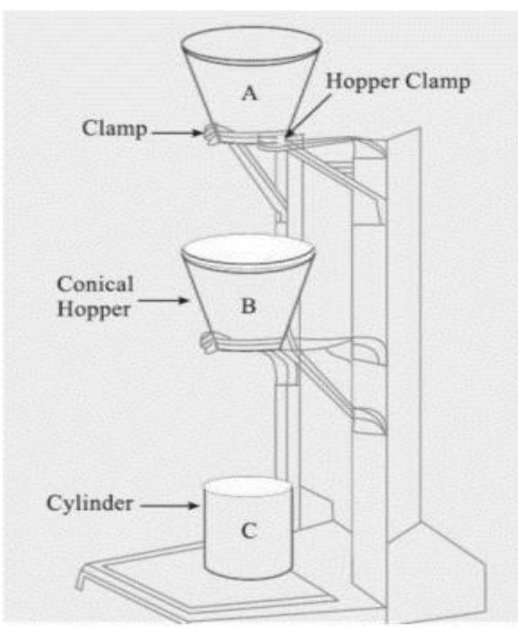
3. Mix coarse and fine aggregates and cement dry until the mixture is uniform in colour and then with water until concrete appears to be homogeneous.
4. Fill the freshly mixed concrete in upper hopper gently with trowel without compacting.
5. Release the trap door of the upper hopper and allow the concrete of fall into the lower hopper bringing the concrete into standard compaction.
6. Immediately after the concrete comes to rest, open the trap door of the lower hopper and allow the concrete to fall into the cylinder, bringing the concrete into standard compaction.
7. Remove the excess concrete above the top of the cylinder by a trowel.
8. Find the weight of cylinder i.e cylinder filled with partially compacted concrete(W2kgs)
9. Refill the cylinder with same sample of concrete in approx. 4 layers, tamping each layer with tamping for 25 times in order to obtain full compaction of concrete.
10. Level the mix and weigh the cylinder filled with fully compacted concrete (W3Kg).
11. Repeat the procedure for different for different a trowel.

OBSERVATIONS AND CALCULATIONS:

Weight of cylinder W1 =.............................Kgs

Trail No	Quantity of material					Mass of cylinder with fully compaction W3 (Kgs	Compaction Factor $\frac{(W1 - W2)}{(W3 - W1)}$
	W/C	W (litre)	C (kg)	FA(Kg)	CA(Kg)		

Compaction factor = $\frac{W2 - W1}{W3 - W1}$



RESULTS: Compaction factor is =.......................................

COMPRESSIVE STRENGTH OF CONCRETE CUBES

Exp. No.: 1 1

AIM: To determine the compressive strength of given concrete mixes.

APPARATUS:

- Testing Machine
- Specimen mould
- tamping rod
- weighing device
- Tools and containers for mixing.

REFERENCE CODE:

- IS : 1199-1959 method of sampling and analysis of concrete
- IS:516 – 1959 method of test for strength of concrete

THEORY:

Concrete is very strong in compression. It is assumed that whole of the compression will be taken up by the concrete while designing any RCC structure. The most important strength test for concrete is the compression test.

PROCEDURE:

1. Sampling of Materials - Samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air-dried condition. The cement samples on arrival at the laboratory shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material.

2. Proportioning - The proportions of the materials, including water in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work.

3. Weighing - The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight to an accuracy of 0.1 percent of the total weight of the batch.

4. Mixing Concrete - The concrete shall be mixed by hand or preferably in a laboratory batch mixer in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired number of test specimens.

5. Mould - Test specimens cubical in shape shall be 15 × 15 × 15 cm.

6. Compacting - The test specimens shall be made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance.

6. Curing - The test specimens shall be 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.

7. Placing the Specimen in the Testing Machine - The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen which are to be in contact with the compression platens.

8. In the case of cubes the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast that is not to the top and bottom.

9. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing shall be used between the faces of the test specimen and the steel platen of the testing machine.

10. The load shall be 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.

11. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted

CUBE (mould)

Compressive strength testing machine

OBSERVATION:

1) Mix proportion =………………………………
2) Date of casting=…………………………………
3) Date of Testing=…………………………………
4) Age of concrete=…………………………………
5) Curing history=……………………………………..

Trail No	Wt. of specimen kg	Mass of cylinder with fully compaction W3 (Kgs			Cross sectional area mm^2	Crushing load KN	Compressive strength N/mm^2
		L(mm)	B(mm)	H(mm)			
1							
2							
3							

$$\text{Compressive strength} = \frac{\text{Crushing load}}{\text{Cross sectional area}}$$

RESULT: Compressive strength of Concrete -------------- N/mm^2

NON-DESTRUCTIVE TESTING OF CONCRETE SPECIMEN
REBOUND HAMMER TEST

Exp. No.: 1 2

AIM: To determine the compressive strength of concrete by using the rebound hammer.

APPARATUS:

- Rebound Hammer instrument.
- Abrasive Stone

Theory:

The rebound hammer method could be used for:

(i) assessing the likely compressive strength of concrete with the help of suitable corelations between rebound index and compressive strength,

(ii) assessing the uniformity of concrete,

(iii) assessing the quality of the concrete in relation to standard requirements, and

(iv) assessing the quality of one element of concrete in relation to another.

Principle:

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring-controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. The surface hardness and therefore the rebound is taken to be related to the compressive strength of the concrete. The rebound is read off along a graduated scale and is designated as the rebound number or rebound index.

Apparatus Required :

Rebound Hammer : It consists of a spring controlled mass that slides on a plunger within a tubular housing.
The impact energy required for rebound hammers for different applications is given in Table 1 of IS: 1311.2.1992

S. No.	Application	Approx. Impact Energy required for Rebound hammer (Nm)
1	For Testing Normal Weight Concrete	2.25
2	For light-weight concrete or small and impact sensitive parts of concrete	0.75
3	For testing mass concrete for example, in roads, air field pavements and hydraulic structures	2.25

Table 1 : Impact Energy for Rebound hammer for different Applications.

PROCEDURE:

Hold the instrument firmly so that the plunger is perpendicular to the test surface. Gradually push the instrument toward the test surface until the hammer impacts. After impact, maintain pressure on the instrument and if necessary depress the button on the side of the instrument to lock the plunger in its retracted position. Read the rebound number on the scale to the nearest whole number and record the rebound number. Take ten readings from each test area. No two impact tests shall be closer together than 25 mm (1 in). Examine the impression made on the surface after impact, and if the impact crushes or breaks through a near-surface air void, disregard the reading and take another reading.

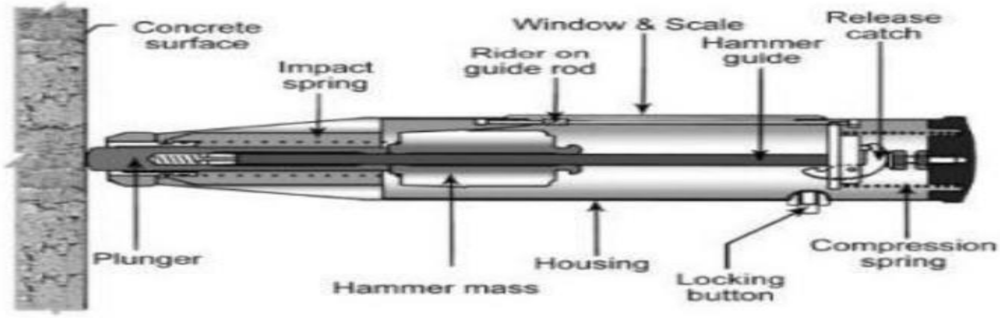


Fig.: Rebound Hammer

READING YOUR RESULTS:

Make at least ten readings from a concrete surface and discard the highest and lowest rebound numbers. Average the remaining eight numbers. If desired, take a few test readings before you complete your series of ten regular tests. Use the average rebound number to estimate the strength of the concrete. Compare your average rebound number to the chart shown on your Concrete Rebound Hammer.

Average Rebound Number	Quality of Concrete
>40	Very good hard layer
30 to 40	Good layer
20 to 30	Fair
<20	Poor concrete

Estd: 2008

METHODIST

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