

CONCRETE LABORATORY

INSTRUCTION MANUAL

for

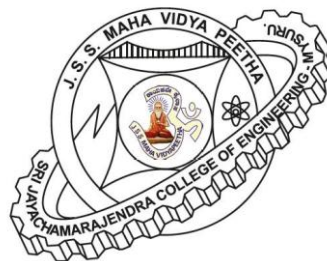
IV Semester B.E. Civil Engineering

*Compiled and Edited
by*

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Sri Jayachamarajendra College of Engineering, Mysuru – 570006.**



Department of Civil Engineering

Sri Jayachamarajendra College of Engineering, Mysuru- 570 006

Vision and Mission of the Department of Civil Engineering

VISION

- “To produce engineers having professional and leadership qualities with capacity to take up research and professional assignments in Civil Engineering and allied fields with focus on interdisciplinary and innovative approach and to compete in civil engineering profession at the global level”.

MISSION

- To impart quality and real time education to contribute to the field of Civil Engineering.
- To impart soft skills, leadership qualities and professional ethics among the graduates to handle projects independently.
- To develop graduates to compete at the global level.
- To deal with the contemporary issues and to cater to the societal needs.

Programme Educational Objectives (PEOs)

PEO1	To impart quality education and knowledge in contemporary science and technology to meet the challenges in the field of Civil Engineering and to serve the society.
PEO2	To impart the knowledge of analysis and design using the codes of practice and software packages.
PEO3	To inculcate the sense of ethics, morality, creativity, leadership, professionalism, self-confidence and independent thinking.
PEO4	To motivate the students to take up higher studies and innovative research projects.

Programme Specific Outcomes (PSOs)

PSO1	The student has the ability to apply the knowledge of Physics, Chemistry, Mathematics, Programming Skills and Soft Skills to solve Civil Engineering problems.
PSO2	The student has the proficiency in streams of Civil Engineering to visualise and execute the systems for sustainable living.
PSO3	The student has the practical knowledge and experimental skills to tackle Civil Engineering problems using technical and management skills, exhibiting professional ethics to meet the societal needs.
PSO4	The programme enables the faculty to develop academic proficiency by involving in research & innovation, interaction with industry and professional bodies through technical advice and Continuing Education Programs (CEP) to meet the needs of the user system.



Department of Civil Engineering

Sri Jayachamarajendra College of Engineering, Mysuru- 570 006

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

P01	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems – (Engineering knowledge)
P02	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences – (Problem analysis)
P03	Design solutions for complex 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 – (Design/development of solutions)
P04	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 – (Conduct investigations of complex problems)
P05	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations – (Modern tool usage)
P06	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice – (The engineer and society)
P07	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development – (Environment and sustainability)
P08	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice – (Ethics)
P09	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings – (Individual and team work)
P10	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 – (Communication)
P11	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 – (Project management and finance)
P12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change – (Life-long learning)

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.

It is hoped that this instruction manual will serve to orient the students in performing the test and preparing the report as per the Codal provision. The authors thank our Head of the department Dr. K. Prakash for his guidance and support. Also thank Mr. Naveen Kumar H.V. for his excellent efforts in bringing out this instruction manual in the present format.

Dr. Satish R.

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CONTENTS

	Page No.
• Foreword	v
• Contents	vii

CEMENT

1. Normal Consistency of Cement	1
2. Setting Time of Cement	2
3. Specific Gravity of Cement	6
4. Fineness Test of Cement by Sieve Analysis	8
5. Compression Strength Test	9
6. Soundness by Le-Chatelier's Method	13

FRESH CONCRETE

7. Slump Test	15
8. Compaction Factor Test	17
9. Vee- Bee Test	19

HARDENED CONCRETE

10. Compression Strength of Concrete	21
11. Split Tensile Test	24

AGGREGATES

12. Determination of Specific Gravity of Fine Aggregate	27
13. Shape Tests (Flaky, Elongation, and Angularity Number)	29
14. Impact Test	34
15. Crushing Test	37
16. Abrasion Test	39

NON-DESTRUCTIVE TESTING OF CONCRETE

REBOUND HAMMER TEST

17. Non Destructive Testing of Concrete	42
1. Rebound hammer test	

NORMAL CONSISTENCY OF CEMENT

Exp. No.: 1

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 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 of dry Cement (%)	Amount of water added (ml)	Penetration (mm)
1				
2				
3				
4				

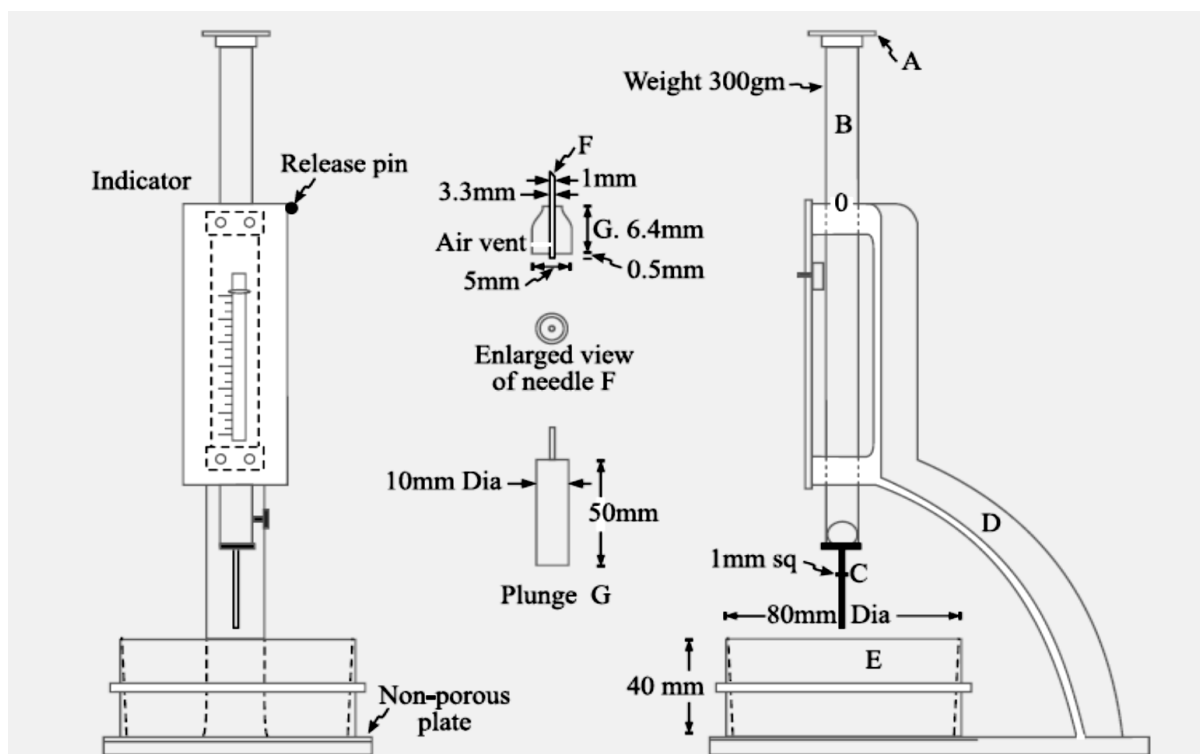


Fig.: Vicat Apparatus

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

DETERMINATION OF SETTING TIME OF STANDARD CEMENT PASTE

Exp. No.: 2

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=.....gms
4. The normal consistency of a given sample of cement is=.....%
5. Volume of water addend for preparation of test block=.....ml

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

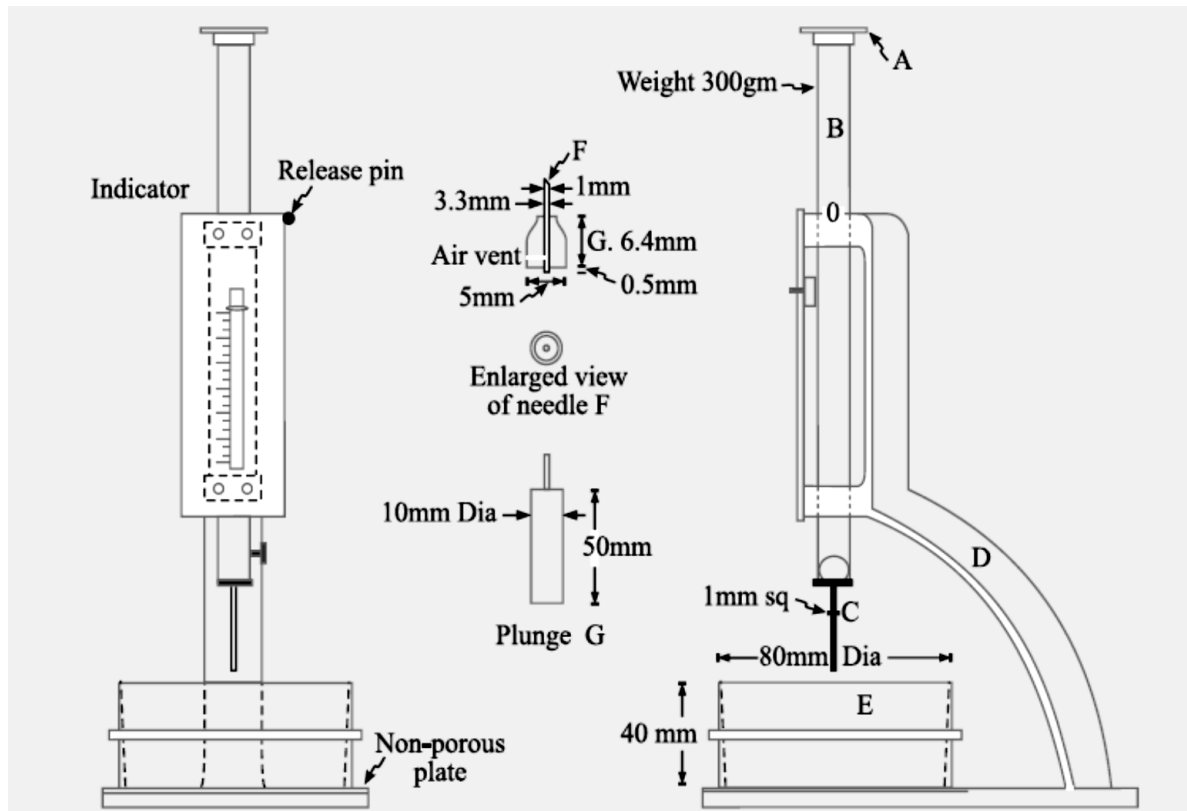


Fig.: Vicat Apparatus

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

SPECIFIC GRAVITY OF CEMENT

Exp. No.: 3

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 cement sample at least half of the bottle and weigh with stopper (W2).
3. Fill the specific gravity bottle containing the cement, with kerosene (free of water) placing the stopper and weigh it (W3), While doing this do not allow any air bubbles to remain in the specific gravity bottle.
4. After weighing the bottle, the bottle shall be cleaned and dried again.
5. Then fill it with fresh kerosene and weigh it with stopper (W4).
6. Remove the kerosene from the bottle and fill it with full of water and weigh it with stopper (W5).

OBSERVATIONS:

Description of item	Trial 1	Trial 2
Weight of empty bottle(W1 g)		
Weight of bottle + Cement (W2 g)		
Weight of bottle + Cement + Kerosene(W3 g)		
Weight of bottle + Full Kerosene(W4 g)		
Weight of bottle + Full Water(W5 g)		

$$(W2 - W1) * (W4 - W1)$$

$$\text{Specific gravity of Cement} = \frac{(W2 - W1) * (W4 - W1)}{((W4 - W1) - (W3 - W2)) * (W5 - W1)}$$



Fig.: Specific Gravity Bottle

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

FINENESS TEST OF CEMENT BY SIEVE ANALYSIS

Exp. No.: 4

AIM: To determine the fineness of the cement of the given sample by sieve analysis.

APPARATUS:

- IS: 90 μ test sieve
- bottom pan
- weighing balance,
- brush

REFERENCE CODE: IS 4031 (PART1): 1988, IS460 (PART1): 1985

THEORY: The degree of fineness of cement is a measure of the mean size of the grains. The finer cement has quicker action with water and gains early strength without change in the ultimate strength. Finer cement is susceptible to shrinkage and cracking.

PROCEDURE:

1. Accurately weigh 100 gms of cement sample and place it over the test sieve. Gently breakdown the air set lumps if any with fingers.
2. Hold the sieve with pan in both hands and sieve with gentle wrist motion, in circular and vertical motion for a period of 10 to 15 minutes without any spilling of cement.
3. Place the cover on the sieve and remove the pan. Now tap the other side of the sieve with the handle of brush and clean the outer side of the sieve.
4. Empty the pan and fix it below the sieve and continue sieving as mentioned in the steps 2 and 3. Totally sieve for 15 minutes and weigh the residue (Left over the sieve).

OBSERVATIONS:

1. Weight of cement taken =.....
2. Weight of cement retained after sieving =.....
3. Type of cement =.....
4. Brand of cement=.....
5. Room temperature=.....

$$\text{Percentage weight of Residue} = \frac{\text{Weight of sample left on the sieve}}{\text{Total weight of sample}}$$

RESULT: Fineness of the given sample is=.....%

COMPRESSIVE STRENGTH TEST OF HYDRULIC CEMENT

Exp. No.: 5

AIM: To determine the compressive strength of standard cement mortar cubes

THEORY: The compressive strength of cement mortars is determined in order to verify whether the cement conforms to IS specifications and whether it will be able to develop the required compressive strength of concrete. The average compressive strength of at least three mortar cubes (area of the face 50 cm²) composed of one part of cement and three parts of standard sand should satisfy IS code specifications.

REFERENCE: IS: 4031 (Pat 6) – 1988.

APPARATUS:

- Vibration Machine
- Poking Rod
- Cube Mould size conforming to IS : 10080-1982
- Weighing Balance
- Trowel
- Stop Watch
- Graduated Glass Cylinders

INTRODUCTION:

The compressive strength of cement mortars is determined in order to verify whether the cement conforms to IS specifications and whether it will be able to develop the required compressive strength of concrete. The average compressive strength of at least three mortar cubes (area of the face 50 cm²) composed of one part of cement and three parts of standard sand should satisfy IS code specifications.

PROCEDURE:

1. Preparation of test specimens:- Clean appliances shall be used for mixing and the temperature of water and that of the test room at the time when the above operations are being performed shall be $27 \pm 2^{\circ}\text{C}$. distilled water shall be used in preparing the cubes.
2. The material for each cube shall be mixed separately and the quantity of cement, standard sand and water shall be as follows: Cement 200 g and Standard Sand 600 g
 1. Water (P/4+0.3) percent of combined mass of cement and sand, where P is the percentage of water required to produce a paste of standard consistency.

2. Place on a nonporous plate, a mixture of cement and standard sand. Mix it dry with a trowel for one Minute and then with water until the mixture is of uniform colour. The quantity of water to be used shall be as specified in step 2. The time of mixing shall in any event be not less than 3 min and should the time taken to obtain a uniform colour exceed 4 min, the mixture shall be rejected and the operation repeated with a fresh quantity of cement, sand and water.
3. Moulding Specimens: - In assembling the moulds ready for use, treat the interior faces of the mould with a thin coating of mould oil.
4. Place the assembled mould on the table of the vibration machine and hold it firmly in position by means of a suitable clamp. Attach a hopper of suitable size and shape securely at the top of the mould to facilitate filling and this hopper shall not be removed until the completion of the vibration period.
5. Immediately after mixing the mortar in accordance with step 1 & 2, place the mortar in the cube mould and prod with the rod. Place the mortar in the hopper of the cube mould and prod again as specified for the first layer and then compact the mortar by vibration.
6. The period of vibration shall be two minutes at the specified speed of $12\,000 \pm 400$ vibration per minute.
7. At the end of vibration, remove the mould together with the base plate from the machine and finish the top surface of the cube in the mould by smoothing the surface with the blade of a trowel.
8. Curing Specimens:- keep the filled moulds in moist closet or moist room for 24 ± 1 hour after completion of vibration. At the end of that period, remove them from the moulds and immediately submerge in clean fresh water and keep there until taken out just prior to breaking.
9. The water in which the cubes are submerged shall be renewed every 7 days and shall be maintained at a temperature of $27 \pm 2^\circ\text{C}$. After they have been taken out and until they are broken, the cubes shall not be allowed to become dry.
10. Test three cubes for compressive strength for each period of curing mentioned under the relevant Specifications (i.e. 3 days, 7 days, 28 days)
11. The cubes shall be tested on their sides without any packing between the cube and the steel plattens of the testing machine. One of the plattens shall be carried on a base and shall be self-adjusting, and the load shall be steadily and uniformly applied, starting from zero at a rate of $35\text{ N/mm}^2/\text{min}$.

OBSERVATION:

- Type of cement=.....
- Brand of cement=.....
- Date of casting=.....

Trail No	Age of Cube	Dimensions Of the specimen (mm)			Weight of Cement Cube (gms)	Cross-Sectional area (mm ²)	Crushing Load (N)	Average Compressive strength (MPa)
		L mm	B mm	H mm				
1								
2								
3								
4								

$$\text{Compressive Strength} = \frac{\text{Crushing load}}{\text{Cross section area}}$$



Fig.: Universal Testing Machine

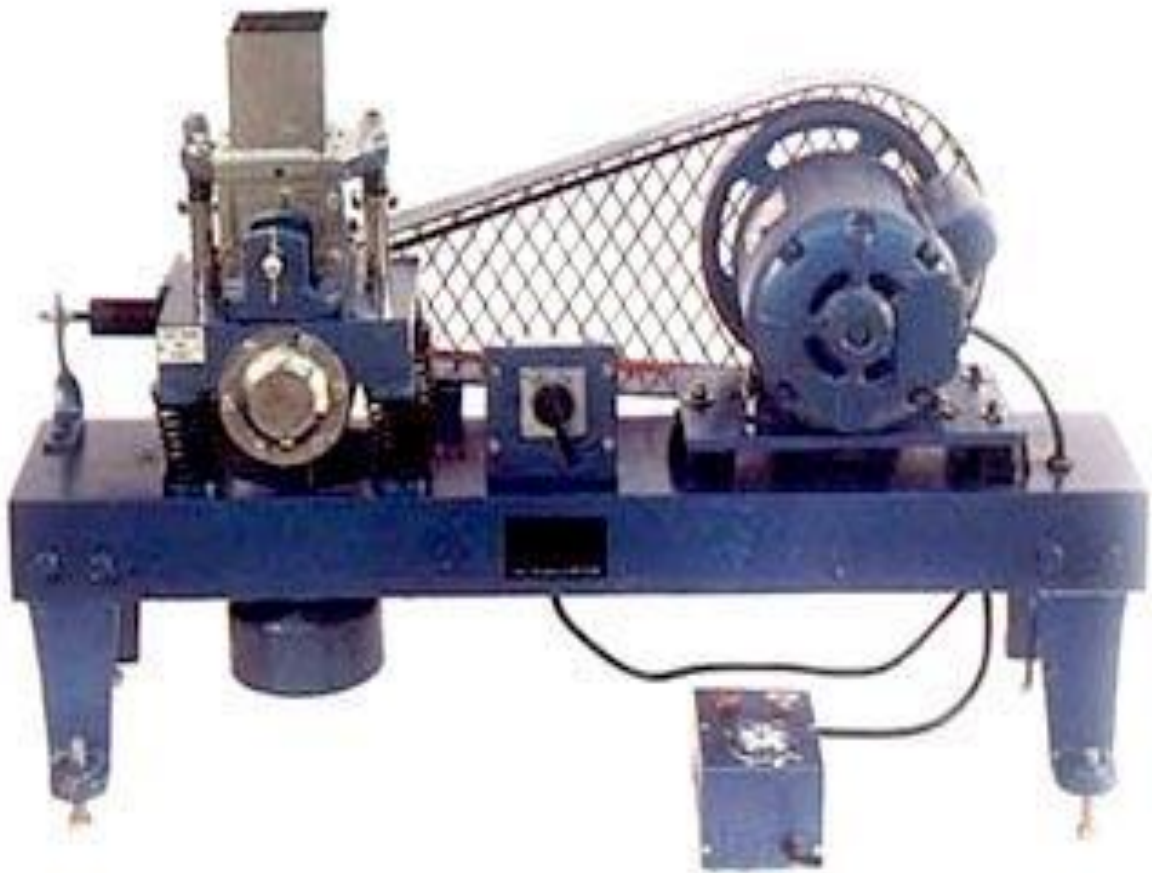


Fig.: Vibrator

RESULT: The average compressive strength of the given cement

- 1) 3 days N/mm²
- 2) 7 days..... N/mm²
- 3) 28 days..... N/mm²

SOUNDNESS OF CEMENT

Exp. No.: 6

AIM: To determine the soundness of the given sample of cement by: Le-chatlier's Method.

APPARATUS:

- Le-chatlier's apparatus
- Weighing Balance
- Water bath
- Measuring cylinder

REFERENCE CODE:

- IS : 4031 (Pat 3) – 1988 methods of physical test of hydraulic cement
- Part-3 determination of soundness

THEORY:

One of the most important properties of cement is its soundness. Unsoundness in cement is caused by expansion of some of the constituents like free lime produced in the manufacturing process of cement. Another possible cause of unsoundness is the presence of too high a magnesia content in the cement and presence of excess of lime than that could be combined with acidic oxide at kiln.

PROCEDURE:

1. Prepare a cement paste formed by gauging cement with 0.78 times water to give a paste of standard consistency. The gauging time should not be less than 3 minutes nor greater than 5 min.
2. On the inner surface of mould. Place the mould on glass sheet & fill it with cement paste taking care to keep the edges of the mould gently together cover the mould with another piece of glass sheet & place a small weight on this Covering glass sheet & immediately submerge the whole assembly in water at a temp of 27 °c & keep it for 24 hrs.
3. Take out the assembly from water after 24 hrs measure the distance flow the indicator points & record its.
4. Submerge the mould again in water in 25 to 30 minutes.
5. Remove the mould from the water. Allow it to cool & measure the distance the indicator points & record it. The difference b/w two measurements represent the same expansion of cement.
6. The sample should be tested & average of the results should be reported.

OBSERVATION:

Type of Cement Tested	
Initial Length Of The Specimen L1	
Final Length Of The Specimen L2	
Expansion Of The Specimen (L1- L2)	



Fig.: Soundness Testing Apparatus

RESULT: Soundness of cement =

SLUMP TEST

Exp. No.: 7

AIM: To determine the workability or consistency 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 cms. The bottom diameter 20 cms, and height 30cms.

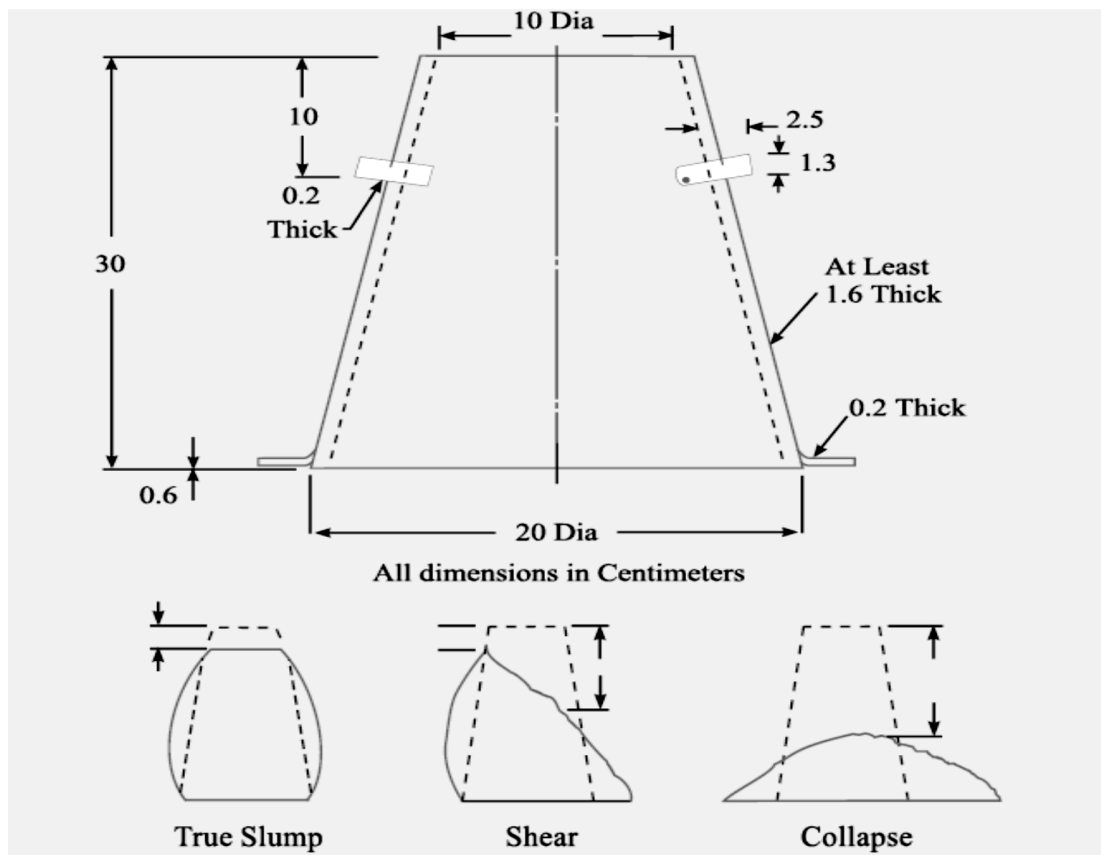
PROCEDURE

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 tamping rod or a trowel strike off the excess concrete above the concrete cone. Measure the vertical height of cone (h_1).
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 (h_2).
5. Complete the experiment in two minutes after sampling.
6. The difference of two heights ($h_1 - h_2$) gives the value of slump

OBSERVATIONS:

- 1) Type of cement=.....
- 2) Brand of cement=.....
- 3) Density of concrete=.....

Trail No	Proportion					SLUMP In MM	Remarks
	w/c	W litre	C kg	FA kg	CA kg		
1							
2							
3							
4							

**Fig. Different Types of Slump**

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

COMPACTION FACTOR TEST

Exp. No.: 8

AIM: To determine the workability of freshly mixed concrete by the of Compacting Factor Test.

APPARATUS:

- Compaction factor apparatus
- Weighing balance
- tamping rod Trowel
- Scoop about 150 mm long
- Tamper(16 mm in diameter and 600 mm length)
- Ruler
- Tools and containers for mixing or concrete mixer etc.

REFERENCE CODE:

- IS; 1199-1959 methods of sampling and analysis of concrete
- IS:5515-1983 Specification for compressive 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.

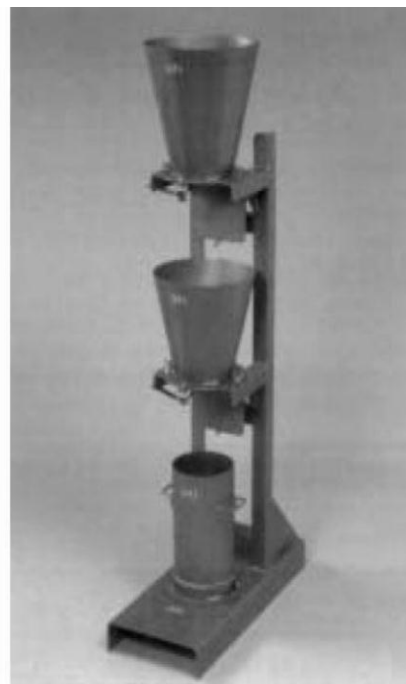
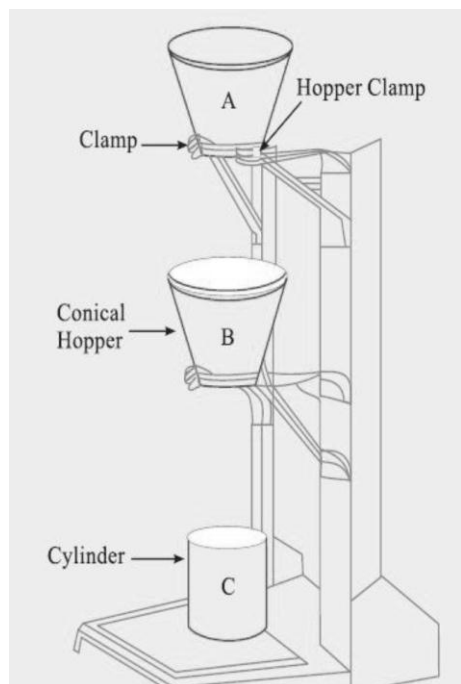
7. Remove the excess concrete above the top of the cylinder by a trowel.
8. Find the weight of cylinder i.e cylinder filled with partially compacted concrete(W2kgs)
9. Refill the cylinder with same sample of concrete in approx. 4 layers, tamping each layer with tamping for 25 times in order to obtain full compaction of concrete.
10. Level the mix and weigh the cylinder filled with fully compacted concrete (W3 Kg).
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 partially compaction W2 (Kgs)	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			
1								
2								
3								

$$\text{Compaction factor} = \frac{W_2 - W_1}{W_3 - W_1}$$



RESULTS: Compaction factor IS =.....

VEE-BEE CONSISTOMETER

Exp. No.: 9

AIM: To measure the workability of concrete by vee-bee consistometer test

APPARATUS:

- Vee-Bee consistometer test apparatus
- Stopwatch
- Standard iron rod
- Weighing device
- Tamper(16 mm in diameter and 600 mm length)
- Tools and containers for mixing

REFERENCE CODE:

- IS: 1199-1959 method of sampling and analysis of concrete
- IS: 456-2000 code of practice for plain and reinforced concrete
- IS: 10510:1983 specification for vee-bee consistometer

THEORY:

The Vee-bee consistometer (measures the remoulding ability of concrete under vibration. The test results reflect the amount of energy required to remould a quantity of concrete under given vibration conditions. The Veebee consistometer is applicable to concrete with slumps less than 5cm.

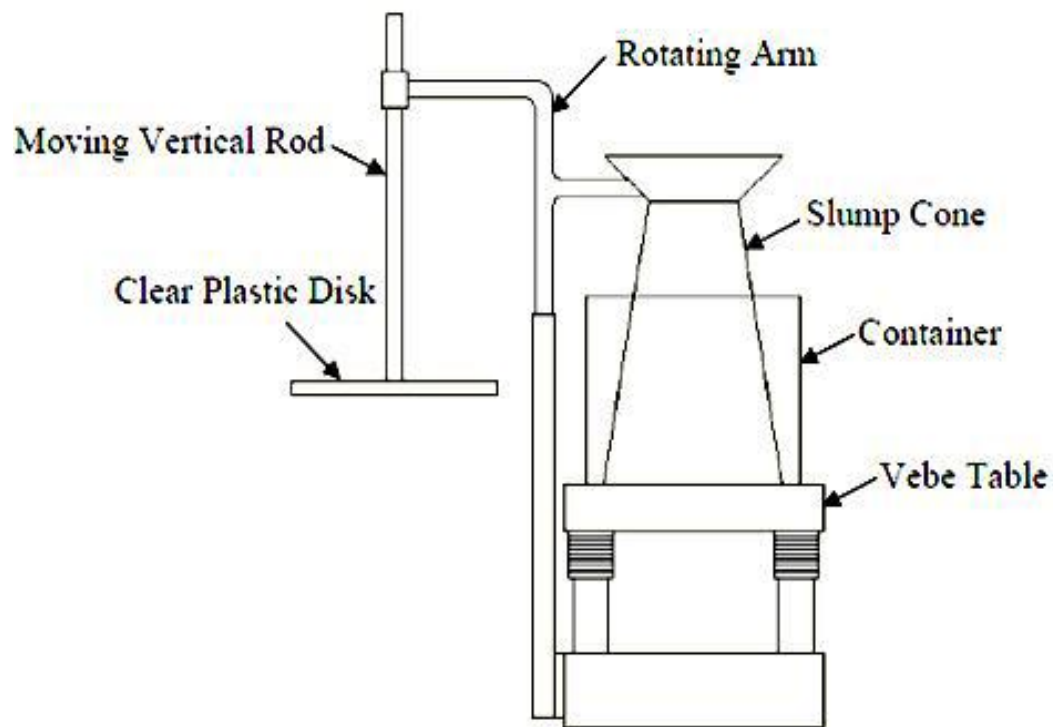
PROCEDURE:

1. Slump test as described earlier is performed, placing the slump cone inside the sheet metal cylindrical pot of the consistometer.
2. The glass disc attached to the swivel arm is turned and placed on the top of the concrete in the pot. The electrical vibrator is then switched on and simultaneously a stop watch started.
3. The vibration is continued till such a time as the conical shape of the concrete disappears and the concrete assumes a cylindrical shape. This can be judged by observing the glass disc from the top for disappearance of transparency.
4. Immediately when the concrete fully assumes a cylindrical shape, the stop watch is switched off. The time required for the shape of concrete to change from slump cone shape to cylindrical shape in seconds is known as Vee Bee Degree.
5. This method is very suitable for very dry concrete whose slump value cannot be measured by Slump Test, but the vibration is too vigorous for concrete with a slump greater than about 50 mm.

OBSERVATIONS:

- 1) Type of cement=.....
- 2) Brand of cement=.....

Trail no	Quantity of material					Slump mm	The Vee Bee Degree of concrete in sec	Remark
	W/c	W litre	C kg	FA kg	CA kg			
1								
2								
3								

**Fig. Veebee Consistometer**

RESULTS: The VEE-BEE Degree for 0.5 W/C =Sec

COMPRESSIVE STRENGTH OF CONCRETE CUBES

Exp. No.: 10

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 $15 \times 15 \times 15$ 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 $27^\circ \pm 2^\circ\text{C}$ for 24 hours $\pm \frac{1}{2}$ 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

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	Dimensions of the specimen			Cross sectional area mm ²	Crushing load KN	Compressive strength N/mm ²
		L mm	B mm	H mm			
1							
2							
3							

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



Fig.: Universal Testing Machine

RESULT: Compressive strength of Concrete -----N/mm²

SPLIT TENSILE STRENGTH OF CONCRETE

Exp. No.: 11

AIM: To determine the split tensile strength of concrete of given mix proportions.

APPARATUS:

- Compression testing machine
- tamping rods
- weighing device
- Tools and containers for mixing
- Tamper

REFERENCE CODE:

- IS:456:2000 code of practice for plain and reinforced concrete
- IS:5816:1999 Method of test for split tensile strength of concrete

THEORY:

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack.

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 - The cylindrical mould shall be of 150 mm diameter and 300 mm height conforming to IS: 10086-1982.
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.

7. 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 $27^{\circ} \pm 2^{\circ}\text{C}$ for 24 hours $\pm \frac{1}{2}$ hour from the time of addition of water to the dry ingredients.
8. Placing the Specimen in the Testing Machine - The bearing surfaces of the supporting and loading rollers shall be wiped clean, and any loose sand or other material removed from the surfaces of the specimen where they are to make contact with the rollers.
9. Two bearing strips of nominal (1/8 in i.e 3.175mm) thick plywood free of imperfections approximately (25mm) wide and of length equal to or slightly longer than that of the specimen should be provided for each specimen.
10. The bearing strips are placed between the specimen and both upper and lower bearing blocks of the testing machine or between the specimen and the supplemental bars or plates.
11. Draw diametric lines an each end of the specimen using a suitable device that will ensure that they are in the same axial plane. Centre one of the plywood strips along the centre of the lower bearing block.
12. Place the specimen on the plywood strip and align so that the lines marked on the ends of the specimen are vertical and cantered over the plywood strip.
13. Place a second plywood strip lengthwise on the cylinder, cantered on the lines marked on the ends of the cylinder. Apply the load continuously and without shock, at a constant rate within, the range of 689 to 1380 kPa/min splitting tensile stress until failure of the specimen
14. Record the maximum applied load indicated by the testing machine at failure. Note the type of failure and appearance of fracture

OBSERVATION AND CALCULATION:

- 1) Mix proportion =
- 2) Date of casting =
- 3) Date of Testing =
- 4) Age of concrete =

Trail No	Wt. of specimen kg	Diameter of specimen mm	Length of Specimen mm	Failure load P mm	Split tensile strength
1					
2					

Calculate the splitting tensile strength of the specimen as follows:

$$T = \frac{2P}{\pi DL}$$

where

D: diameter

L : Length, m

P : maximum applied load indicated by testing machine, kN

T : splitting tensile strength,

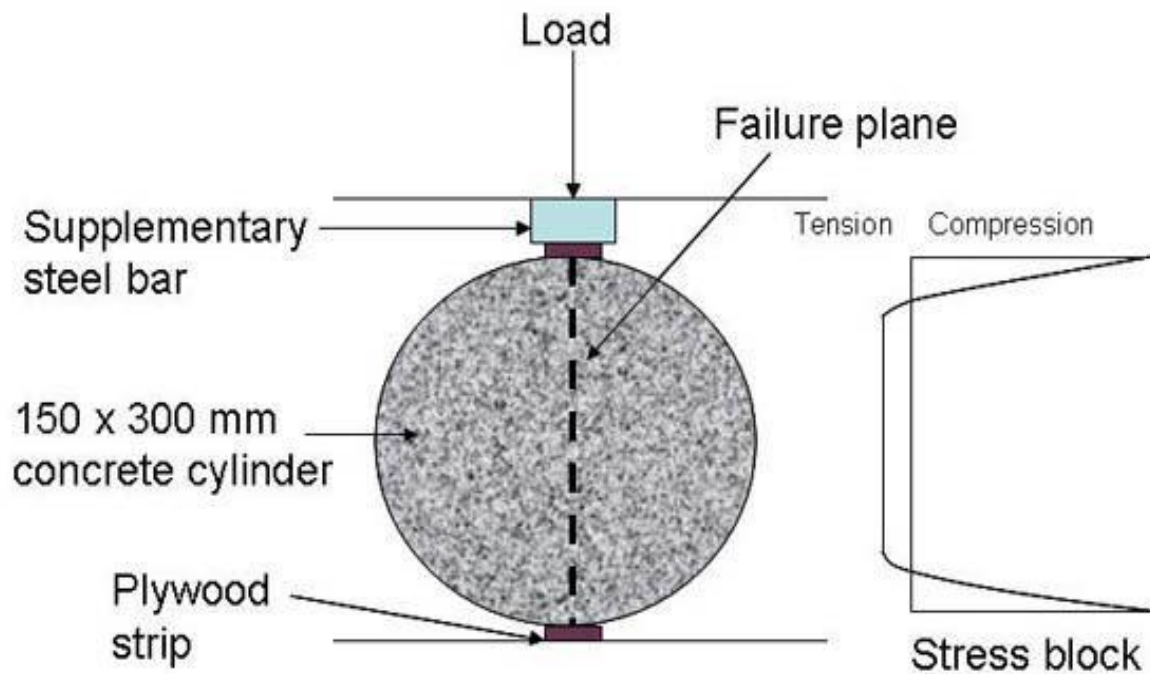


Fig.: Loading Arrangement for Determining Split Tensile Strength

RESULT:

- i) The average 7 Days Tensile Strength of concrete sample is found to be
- ii) The average 28 Days Tensile Strength of concrete sample is found to be

DETERMINATION OF SPECIFIC GRAVITY OF FINE AGGREGATE

Exp. No.: 12

AIM: To determine specific gravity of a given sample of fine aggregate.

APPARATUS:

- Pycnometer bottle
- Taping rod
- Funnel

PROCEDURE:

1. Take the empty pycnometer (w_1) gms.
2. Take a sample of fine aggregate for which specific gravity is to be find out and transfer that to the pycnometer and weight (w_2).
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 (w_3).
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 upto the mark and it should be completely dry from outside and take the weight w_4 .

CALUCULATIONS:

Trail No	Weight of empty bottle (W_1) gms	Weight of empty bottle + Fine aggregate (W_2) gms	Weight of empty bottle + water + Fine aggregate (W_3) Gms	Weight of empty bottle + water (W_4) gms
1				
2				

$$\text{Specific Gravity of Fine Aggregate} = \frac{(W_2 - W_1)}{(W_2 - W_1) (W_3 - W_4)}$$



Fig.: Pycnometer

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

SHAPE TEST

FLAKINESS INDEX:

Exp. No.: 13

AIM: To determining the flakiness index of the coarse aggregate.

APPARATUS:

- metal gauge
- Weighing Balance
- Gauging Trowel
- Sieves.

REFERENCE:

- IS : 2386 (Part I) – 1963 Method of tst for aggregates for concrete
- IS: 383-1970 specification for coarse and fine aggregate from natural source for concrete

THEORY:

The flakiness index of an aggregate is the percentage by weight of particles in it whose least dimension (thickness) is less than three-fifths of their mean dimension. Particle shape and surface texture influence the properties of freshly mixed concrete more than the properties of hardened concrete. Rough-textured, angular, and elongated particles require more water to produce workable concrete than smooth, rounded compact aggregate. Consequently, the cement content must also be increased to maintain the water-cement ratio. Generally, flat and elongated particles are avoided or are limited to about 15 % by weight of the total aggregate.

PROCEDURE

1. A quantity of aggregate shall be taken sufficient to provide the minimum number of 200 pieces of any fraction to be tested.
2. The sample shall be sieved with sieves specified in Table.
3. Then each fraction shall be gauged in turn for thickness on a metal gauge of the pattern shown in Fig or in bulk on sieves having elongated slots. The width of the slot used in the gauge or sieve shall be of the dimensions specified in column 3 of Table for the appropriate size of material.
4. The total amount passing the gauge shall be weighed to an accuracy of at least 0.1 percent of the weight of the test sample.

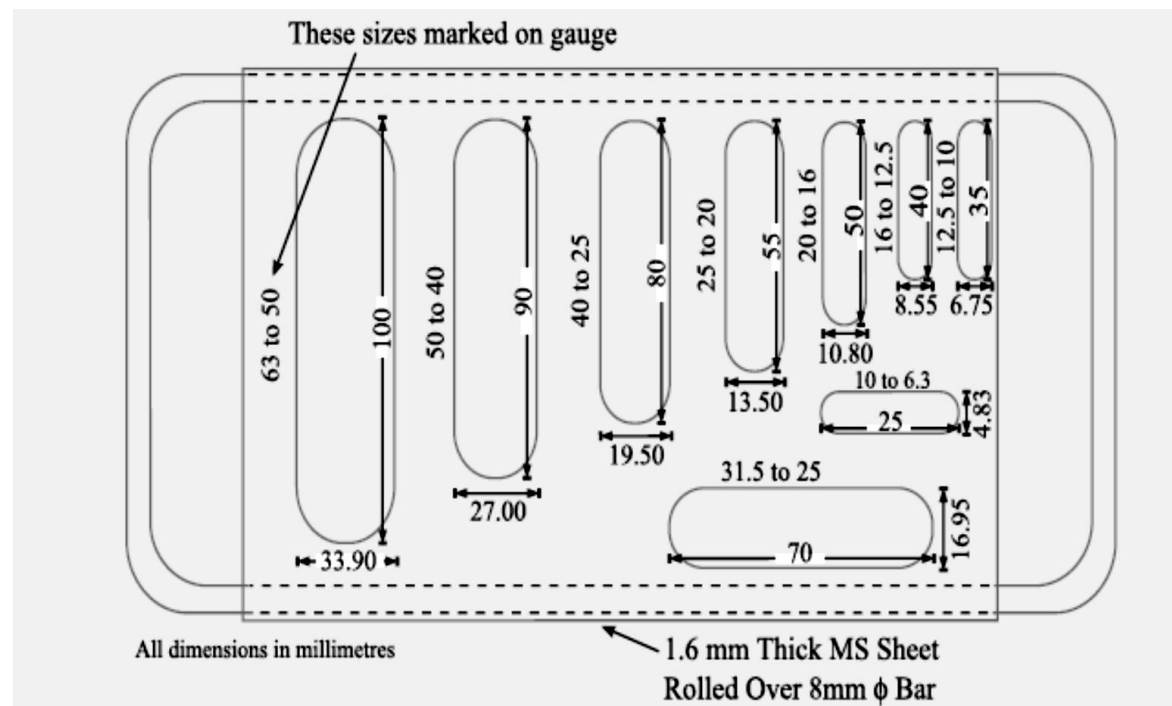
CALUCULATIONS:

$$\text{Flakiness Index} = 100 \times \frac{\sum w}{\sum W}$$

Where, w is the weights of material passing the various thickness gauges and W is the total weights of aggregate passing and retained on the specified sieves.

Dimensions of Thickness:

Size of Aggregate (mm)		Weight Retained on Thickness Gauge	Thickness Gauge (mm)	Weight Of flaky particles W g
Passing through IS sieve	Retained on IS sieve			
63	50		33.90	
50	40		27.00	
40	31.5		21.50	
31.5	25		16.95	
25	20		13.50	
20	16		10.80	
16	12.5		8.55	
12.5	10		6.75	
10	6.3		4.89	

**Fig.: Thickness Gauge**

Results: Flakiness index=.....

ELONGATION INDEX

AIM: To determining the elongation index of the coarse aggregate.

APPARATUS:

- metal gauge
- weighing Balance
- Gauging Trowel
- Sieves.

REFERENCE CODE:

- IS : 2386 (Part I) – 1963 Method of tst for aggregates for concrete
- IS: 383-1970 specification for coarse and fine aggregate from natural source for concrete

THEORY:

The elongation index of an aggregate is the percentage by weight of particles in it whose greatest dimension (thickness) is greater than one and four-fifths of their mean dimension. The test is not applicable to sizes smaller than 6.3mm.

PROCEDURE:

1. A quantity of aggregate shall be taken sufficient to provide the minimum number of 200 pieces of any fraction to be tested.
2. The sample shall be sieved with sieves specified in Table.
3. Each fraction shall be gauged in turn for length on a metal gauge of the pattern shown in Fig. The gauge length used shall be of the dimensions specified in column 4 of Table for the appropriate size of material.
4. The total amount of aggregate retained by the length gauge shall be weighed to an accuracy of at least 0.1 percent of the weight of the test sample.

CALUCULATIONS:

Elongation index = $100 \times (x/W) \%$

Where, x is the weight of materials retained on specified gauges and W is the total weights of aggregate passing and retained on the specified sieves.

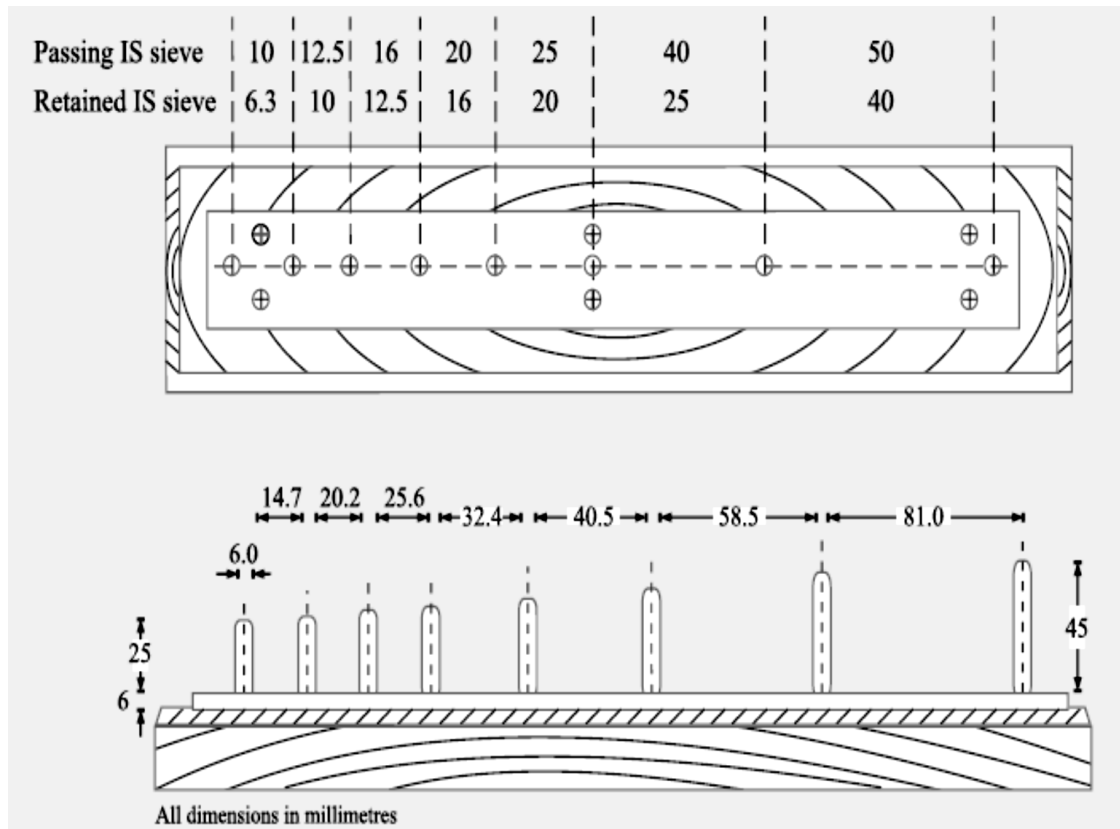


Fig.: Length Gauge

Dimensions of Length gauge

Size of Aggregate (mm)		Weight Retained on Length Gauge	Length Gauge (mm)	Weight of elongation particles X g
Passing through IS sieve	Retained on IS sieve			
63	50		-	
50	40		81.0	
40	31.5		58.5	
31.5	25		-	
25	20		40.5	
20	16		32.4	
16	12.5		25.5	
12.5	10		20.2	
10	6.3		14.7	

RESULTS: Elongation Particles=.....%

ANGULARITY NUMBER TEST

AIM: To determine the angularity number of coarse aggregate.

REFERENCE CODE:

- IS : 2386 (Part I) – 1963 Method of test for aggregates for concrete
- IS: 383-1970 specification for coarse and fine aggregate from natural source for concrete

THEORY: Angularity test helps us to determine the angularity of the coarse aggregate. Higher the angularity number better is the interlocking of the aggregate.

APPARATUS REQUIRED: Metal cylinder, Tamping rod, balance, metal scoop.

TEST DESCRIPTION:

First the metal mould calibrated by filling it with water and determining the weight of water in it. Then the mould is filled with clean dried aggregates in three layers. The weight of aggregate in the mould is recorded. determine the specific gravity of the aggregate. Finally the angularity number of aggregate is calculated.

PROCEDURE:

1. The aggregate is compacted in three layers, each layer being given 100 blows using the standard tamping rod at a rate of 2 blows/second by lifting the rod 5 cm above the surface of the aggregate and then allowing it to fall freely.
2. The blows are uniformly distributed over the surface of the aggregate.
3. After compacting the third layer, the cylinder is filled to overflowing and excess material is removed off with tamping rod as a straight edge.
4. The aggregate (water) with cylinder is then weighed. Three separate determinations are made and mean weight of the aggregate in the cylinder is calculated.

OBSERVATION AND CALCULATION:

Trail No	Volume of metal measures $V_1(\text{ml})$	Volume of water required to fill the metal measures containing aggregate $V_2 (\text{ml})$	Percentage of voids $(V_2/ V_1) \times 100$
1			
2			

$$\text{Percentage of voids} = \frac{V_2}{V_1} \times 10 = \underline{\hspace{2cm}}$$

$$\text{Angularity number} = V-33 = \underline{\hspace{2cm}}$$

RESULT: Aggregate angularity number = $\underline{\hspace{2cm}}$

AGGREGATE IMPACT VALUE TEST

Exp. No.: 14

AIM: To determine the aggregate impact value of given aggregates

APPARATUS REQUIRED:

- Impact testing machine
- cylinder, tamping rod
- IS Sieve
- Weighing balance.

REFERENCE CODE:

- IS : 2386 (Part IV) – 1963 methods of test for aggregate for concrete
- IS:383:1970- specification for coarse and fine aggregate from natural source for concrete
- IS:9377:1979-specification for apparatus for aggregate impact value test

THEORY:

The aggregate impact value gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from its resistance to a slow compressive load.

PROCEDURE:

1. The test sample consists of aggregates passing 12.5mm sieve and retained on 10mmsieve and dried in an oven for 4 hours at a temperature of 100oC to 110oC
2. The aggregates are filled up to about 1/3 full in the cylindrical measure and tamped 25 times with rounded end of the tamping rod
3. The rest of the cylindrical measure is filled by two layers and each layer being tamped 25 times.
4. The overflow of aggregates in cylindrically measure is cut off by tamping rod using it has a straight edge.
5. Then the entire aggregate sample in a measuring cylinder is weighed nearing to 0.01gm
6. The aggregates from the cylindrical measure are carefully transferred into the cup
7. Which is firmly fixed in position on the base plate of machine. Then it is tamped 25 times.

8. The hammer is raised until its lower face is 38cm above the upper surface of aggregate in the cup and allowed to fall freely on the aggregates. The test sample is subjected to a total of 15 such blows each being delivered at an interval of not less than one second. The crushed aggregate is then removed from the cup and the whole of it is sieved on 2.36mm sieve until no significant amount passes. The fraction passing the sieve is weighed accurate to 0.1gm. Repeat the above steps with other fresh sample.
9. Let the original weight of the oven dry sample be W_1 gm and the weight of fraction passing 2.36mm IS sieve be W_2 gm. Then aggregate impact value is expressed as the % of fines formed in terms of the total weight of the sample.

OBSERVATION AND CALCULATION:

$$\text{Aggregate impact value} = \frac{W_2}{W_1} \times 100 = \text{_____} \%$$

	Trail 1	Trail 2
Total weight of the aggregate filling the cylindrical metal measures W_1 gms		
Weight of aggregate passing through 2.36 mm sieve W_2 gms		
Aggregate impact = $(W_2/W_1) \times 100$ %		

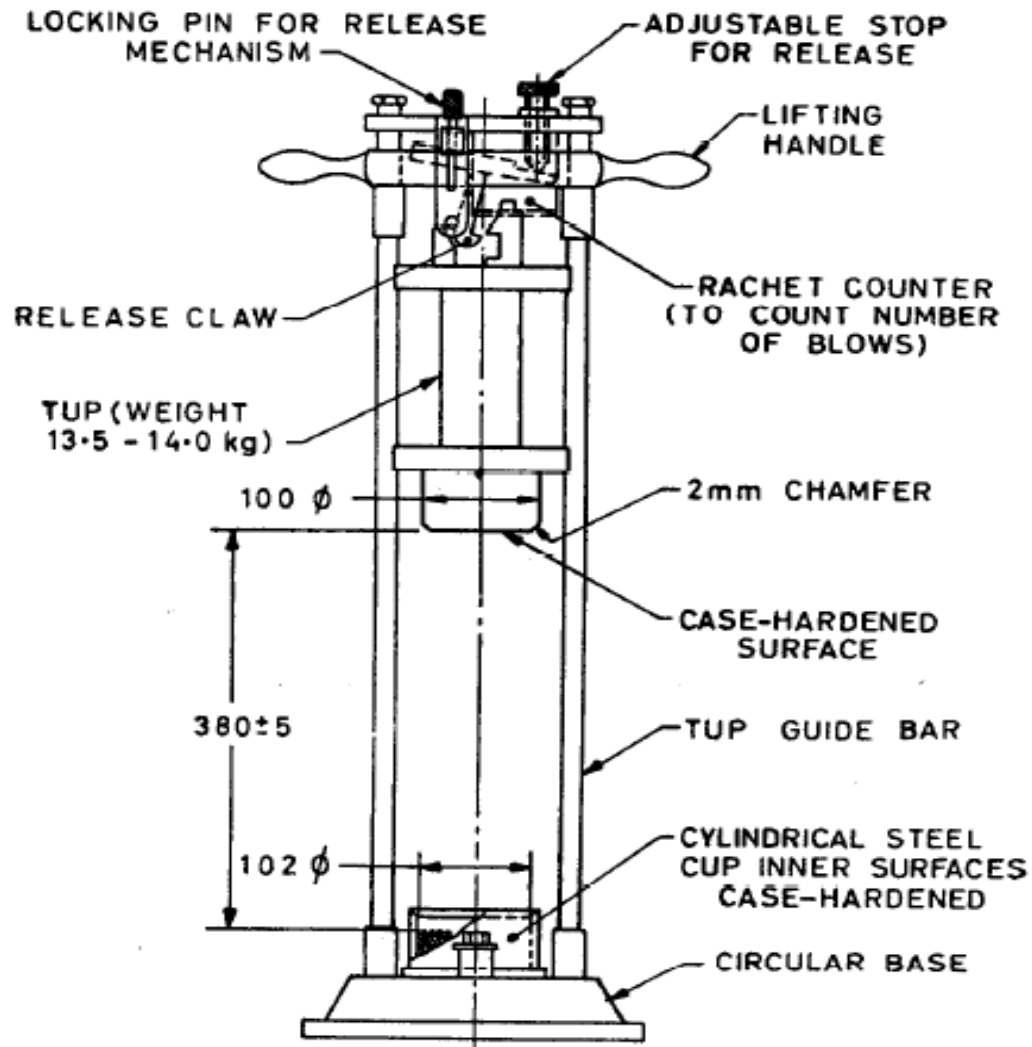


Fig.: Aggregate Impact Test Machine

RESULT= Aggregate Impact Value.....

AGGREGATE CRUSHING VALUE TEST

Exp. No.: 15

AIM: To determine the crushing value of the road aggregates

APPARATUS:

The apparatus of the aggregate crushing value test as per IS: 2386 (Part IV) – 1963 consists of:

- A 15cm diameter open ended steel cylinder with plunger and base plate, of the general form.
- A straight metal tamping rod of circular cross-section 16mm diameter and 45 to 60 cm long, rounded at one end.
- A balance of capacity 3k
- IS Sieves.
- A compression testing machine capable of applying load up to 40 tonnes.
- Cylindrical measure having internal dia. of 11.5cm & height 18 cm for measuring the sample.

REFERENCE CODE:

- IS : 2386 (Part IV) – 1963 method of test for aggregates for concrete
- IS:383:1970 specification for coarse and fine aggregate from natural source for concrete
- IS: 9376:1979 Specification for apparatus for measuring aggregate crushing value

THEORY:

The aggregate crushing value gives a relative measure of the resistance of an aggregate to crushing under a gradually applied compressive load. Crushing value is a measure of the strength of the aggregate. The aggregates should therefore have minimum crushing value.

PROCEDURE: The test sample: It consists of aggregates sized 12.5 mm - 10.0 mm (minimum 3kg). The aggregates should be dried by heating at 1000-1100 C for a period of 4 hours and cooled.

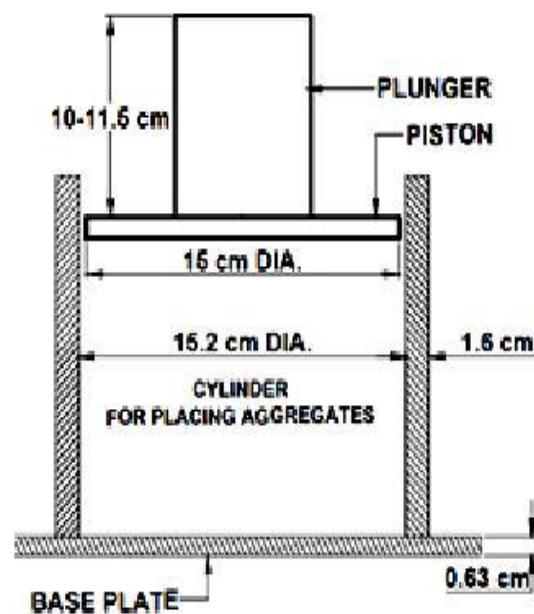
1. Sieve the material through 12.5 mm and 10.0 mm IS sieve. The aggregates passing through 12.5 mm sieve and retained on 10.0 mm sieve comprises the test material.
2. The cylinder of the test shall be put in position on the base-plate and the test sample added in thirds, each third being subjected to 25 strokes with the tamping rod.
3. The surface of the aggregate shall be carefully leveled.

4. The plunger is inserted so that it rests horizontally on this surface, care being taken to ensure that the plunger does not jam in the cylinder
5. The apparatus, with the test sample and plunger in position, shall then be placed between the plates of the testing machine.
6. The load is applied at a uniform rate as possible so that the total load is reached in 10 minutes. The total load shall be 40 tones.
7. The load shall be released and the whole of the material is removed from the cylinder and sieved on 2.36mm IS Sieve.
8. The fraction passing the sieve shall be weighed and recorded

OBSERVATION AND CALCULATION:

	Trail 1	Trail 2
Total weight of dry sample taken= W ₁ gms		
Weight of aggregate passing through 2.36 mm sieve W ₂ gms		
Aggregate crushing = (W ₂ /W ₁)*100 (%)		

$$\text{Aggregate impact value} = 100 \times \frac{W_2}{W_1}$$

**Fig.: Aggregate Crushing Test Apparatus**

RESULT: Aggregate Crushing Value=.....

AGGREGATE ABRASION VALUE TEST

Exp. No.: 16

AIM: To determine the abrasion value of coarse aggregate by the use of Los Angeles machine.

APPARATUS:

- Los Angeles Machine: It consists of a hollow steel cylinder, closed at both the ends with an internal diameter of 700 mm and length 500 mm and capable of rotating about its horizontal axis.
- Cast iron or steel balls, approximately 48 mm in diameter and each weighing between 390 to 445 g; 6 to 12 balls are required.
- IS sieve.
- Balance.

REFERENCE CODE: IS: 2386 (Part IV) – 1963, IS: 383-1970.

THEORY:

The abrasion value of the aggregates is determined in order to determine their Resistance against wearing. In this the aggregate sample is mixed with abrasive charge consisting standard balls & rotated in closed inclined cylinders for specific number of revolutions.

PROCEDURE:

1. The test sample shall consist 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 grading shown in Table 3.22. The grading or grading used shall be those most nearly representing the aggregate furnished for the work.
2. The test sample and the abrasive charge shall be placed in the Los Angeles abrasion testing machine and the machine rotated at a speed of 20 to 33 rev/min. For grading A, B, C and D, the machine shall be rotated for 500 revolutions; for grading E, F and G, it shall be rotated for 1 000 revolutions.
3. The machine shall be so driven and so counter-balanced as to maintain a substantially uniform peripheral speed. If an angle is used as the shelf, the machine shall be rotated in such a direction that the charge is caught on the outside surface of the angle.
4. At the completion of the test, the material shall be discharged from the machine and a preliminary separation of the sample made on a sieve coarser than the 1.70 mm IS Sieve.

5. The material coarser than the 1.70 mm IS Sieve shall be washed dried in an oven at 105 to 110°C to a substantially constant weight, and accurately weighed to the nearest gram

TABULAR COLUMN:**Specified Abrasive Charge**

Grading	Number of spheres	Weight of charge (gm)
A	12	5000 ± 25
B	11	4584 ± 25
C	8	3330 ± 20
D	6	2500 ± 15
E	12	5000 ± 25
F	12	5000 ± 25
G	12	5000 ± 25

Gradings of Test Samples

Sieve Size		Weight in gm. of Test Sample For Grade						
Passing	Retained on	A	B	C	D	E	F	G
mm	mm							
80	63	-	-	-	-	2500	-	-
63	50	-	-	-	-	2500	-	-
50	40	-	-	-	-	5000	5000	-
40	25	1250	-	-	-	-	5000	5000
25	20	1250	-	-	-	-	-	5000
20	12.5	1250	2500	-	-	-	-	-
12.5	10	1250	2500	-	-	-	-	-
10	6.3	-	-	2500	-	-	-	-
6.3	4.75	-	-	2500	-	-	-	-
4.75	2.36	-	-	-	5000	-	-	-

OBSERVATIONS:

	Trail 1	Trail 2
Total weight of dry sample taken= W1 gm		
Weight of portion passing 1.7 mm sieve= W2 gm		
Aggregate abrasion value = $(W2/W1) \times 100$ Value (%)		

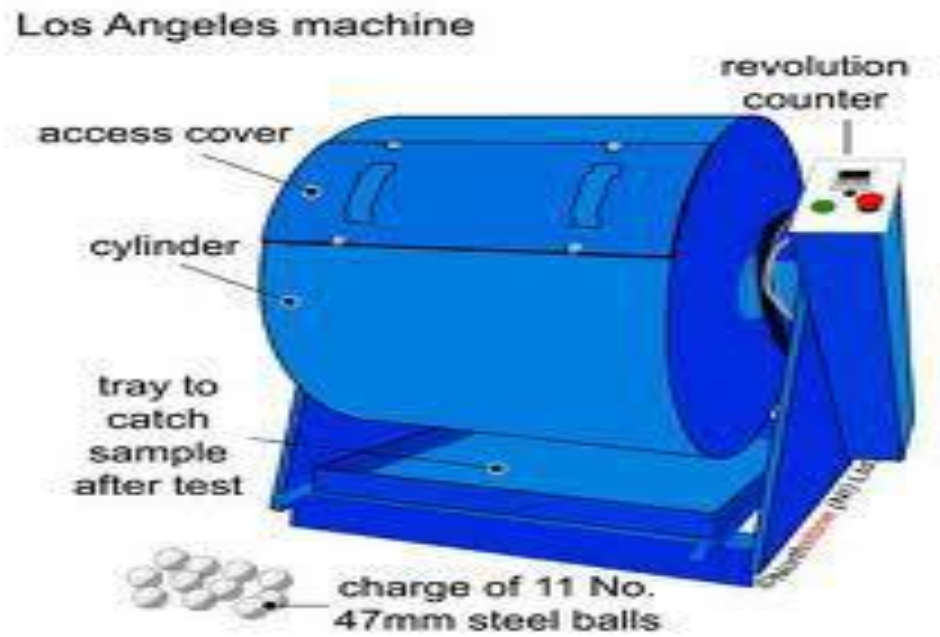


Fig.: Los Angeles Abrasion Testing Machine

RESULT: Mean Los Angeles Abrasion value =%

NON-DESTRUCTIVE TESTING OF CONCRETE

REBOUND HAMMER TEST

Exp. No.: 17

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

APPARATUS:

- Rebound Hammer instrument.
- Abrasive Stone

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.

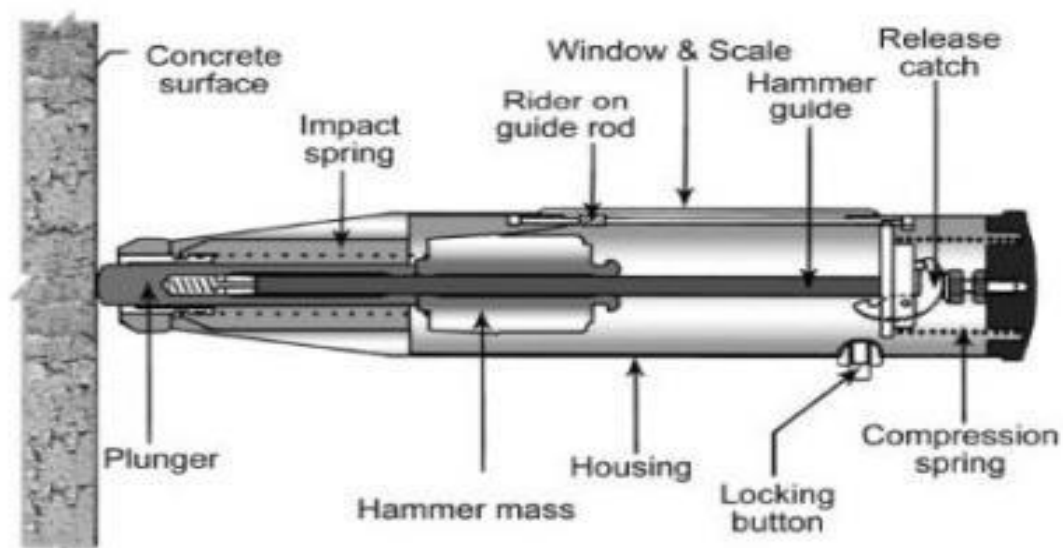


Fig.: Rebound Hammer

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