Concrete Technology Laboratory Record

Name of the student : …………………………………………………………….

Subject : …………………………………. Roll No. : …………………………

Branch: ……………………………….. Section : ………. Year : ……………

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

(Autonomous)

Nizampet Road, Bachupally, Hyderabad - 500 090

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GOKARAJU RANGARAJU

Institute of Engineering & Technology

Hyderabad.

CERTIFICATE

This is to certify that it is a bonafide record of practical work done in the ………………………………………………………………… laboratory in ………………… semester of ……… year during the academic year………………

Name of the student:……………………………………

Roll No. :……………………………………………..

Branch :……………………………………………..

Section :……………………………………………..

Signature of the	**Signature of**	**Signature of the**
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INDEX

S.No	Name of the Exp.	Page. No	Remarks	Grade	Signature
1	Normal Consistency test on cement				
2	Initial Setting time and final setting time of cement				
3	Fineness test of cement				
4	Specific gravity of cement				
5	Soundness test of cement				
6	Compressive strength of cement				
7	a)Sieve analysis of fine aggregate b) Sieve analysis of coarse aggregate				
8	a)Bulking of sand (Field test) b)Bulking of sand (Laboratory Test)				
9	Workability test on concrete using slump Cone				
10	Workability test on concrete using Compaction Factor test				
11	Workability test on concrete using Veebee consistometer test				
12	a)Compressive strength of concrete b)Youngs Modulus of concrete				
13	Split tensile strength test on concrete				

SYLLABUS

CONCRETE TECHNOLOGY LAB

1	Normal Consistency test on cement
2	Initial Setting time and final setting time of cement
3	Fineness test of cement
4	Specific gravity of cement
5	Soundness test of cement
6	Compressive strength of cement
7	a)Sieve analysis of fine aggregate b)Sieve analysis of coarse aggregate
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13	Split tensile strength test on concrete

Exp. No.:1 **Date:**

NORMAL CONSISTENCY OF CEMENT

Aim: To determine the normal consistency of a given sample of cement.

Equipment and materials required:

Vicat's apparatus consisting of a frame, scale, mould, attachment weight; a non porous plate; tray; needle; plunger; stop watch, etc.

Theory:

The object of conducting this test is to find out the amount of water to be added to the cement to get a paste of normal consistency or standard consistency, i.e., the paste of a certain standard solidity, which is used to fix the quantity of water to be mixed in cement before performing tests for setting time, soundness and compressive strength.

Definition:

It is defined as that consistency which will permit a Vicat plunger having 10mm diameter and 50mm length to penetrate to a depth of 33-35mm from top of the mould.

Procedure:

1. Take ordinary Portland cement of 300 grams and weight it in the electronic balance.
2. Prepare a paste with weighted quantity of water. For the first trial take 24 % (72ml) of weight of the cement.
3. Fill the paste in the mould within 3 to 5 minutes.
4. Shake the mould to expel air.

5. A standard plunger 10mm dia. and 50mm long is attached and brought down to touch the surface of the paste in the test block and quickly release it to sink in to the paste by its own weight. Allow plunger to cement paste to penetrate for 30 seconds.

6. Note down the depth of penetration of the plunger.

7. Conduct the second trail (28% of water) and find out the depth of penetration.

8. Conduct number of trails till the plunger penetrate for a depth of 33-35 mm from top.

9. The particular percentage of water which allows the plunger to penetrate to a depth of 33 –35 mm is known as the % of water required to produce a cement paste of standard or normal consistency of cement.

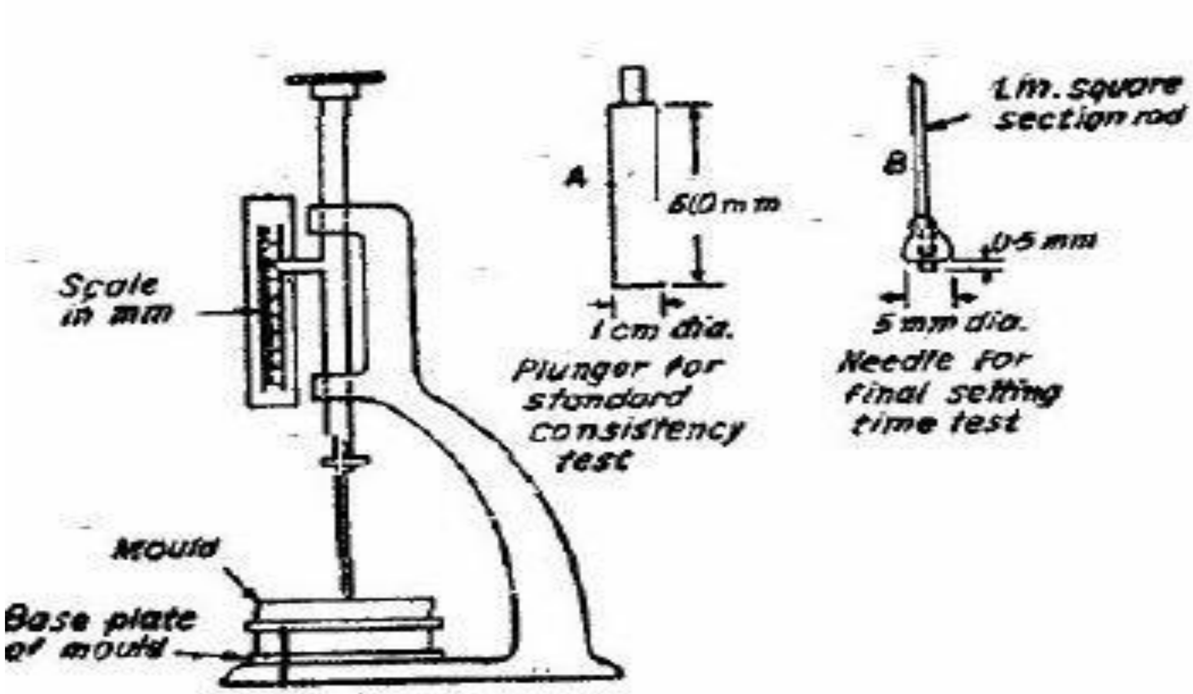


Fig 1 : Vicat apparatus

Table . 1: Initial & final setting times of different cements

Type of cement	Initial setting time in Min	Final setting time in min
Ordinary Portland cement (IS:269 - 1989)	30	600
Rapid Hardening cement (IS:8041 - 1990)	30	600
Low heat cement (IS:12600 - 1989)	60	600

Table. 2: Normal consistency test

Weight of cement	% OF WATER ADDED	I.R	F.R	PENETRARION
300 gm	24% BY Wt., OF CEMENT			
	26% BY Wt., OF CEMENT			
	28% BY Wt., OF CEMENT			
	30% BY Wt., OF CEMENT			
	31% BY Wt., OF CEMENT			
	32% BY Wt., OF CEMENT			
	33% BY Wt., OF CEMENT			
	34% BY Wt., OF CEMENT			
	35% BY Wt., OF CEMENT			

Calculations:

Result: The normal consistency of the given sample of cement is _________________________

Conclusion:

Exp. No.:2 **Date:**

INITIAL SETTING OF CEMENT

Aim: To determine initial setting and final setting of a given sample of cement.

Equipment and material required:

Vicat apparatus consisting of a frame, scale, mould, a non porous plate, tray, needle. measuring jar, water can, trowel stop watch weighing machine, cement and water.

Theory:

In actual construction dealing with cement dealing with cement paste, mortar, concrete, certain time is required for mixing, transporting, and placing. During this time the cement mixture should be in the plastic condition. The interval for which the cement products remains in plastic condition is known as setting time. Normally a minimum of 30 minutes called initial setting time and maximum of 10 hours called final setting time for OPC. We need to calculate the initial and final setting time as per IS: 4031 (Part 5) – 1988. To do so we need Vicat apparatus conforming to IS: 5513 – 1976, Balance, Gauging trowel

. When water is mixed with cement, the paste so formed remains pliable and plastic for a short time. During this period it is possible to disturb the paste and remix it without any deleterious effects. As the reaction between water and cement continues, the paste loses its plasticity. This early period in the hardening of cement is referred to as ‘setting’ of cement. Initial set is when the cement paste loses its plasticity and stiffens considerably. Final set is the point when the paste hardens and can sustain some minor load.

Both the Initial & Final setting points are arbitrary points and these are determined by Vicat needle penetration resistance.

Initial setting time can be understood as the time elapsed between the moment the water is added to the cement, to the time that the paste starts losing its plasticity. This is the time interval for which the cement products remain in plastic conditions. As such, activities such as mixing, transporting, placing, compacting & finishing should be completed within this time period.

Final setting time can be understood as the time elapsed between the moment the water is added to the cement, to the time when the paste has completely lost its plasticity. After placement, compaction & finishing of concrete, it is desirable that the concrete loses its plasticity in earliest possible time so that it becomes less vulnerable to damages from external agencies.

Procedure:

1. Prepare a neat cement paste with 0.85 times the water required to give a standard consistency or normal consistency.
2. Note down the time at which the water is added.
3. Fill the vicat mould with the cement paste within 3-5 minutes.
4. Shake the mould to ensure that the entrapped air is expelled.
5. Smooth the surface of the paste, making it level with the top of the mould.
6. Lower the needle gently into the surface of the paste and quickly released allowing it to sink into the paste by its own weight.
7. Note down the reading for every five minute.

8. Repeat the same procedure until the needle fails to pierce the block for above 5mm – 7mm, measure from the bottom and note down the time in the stop watch .
9. The difference between the two timing will give the initial setting time of the cement.

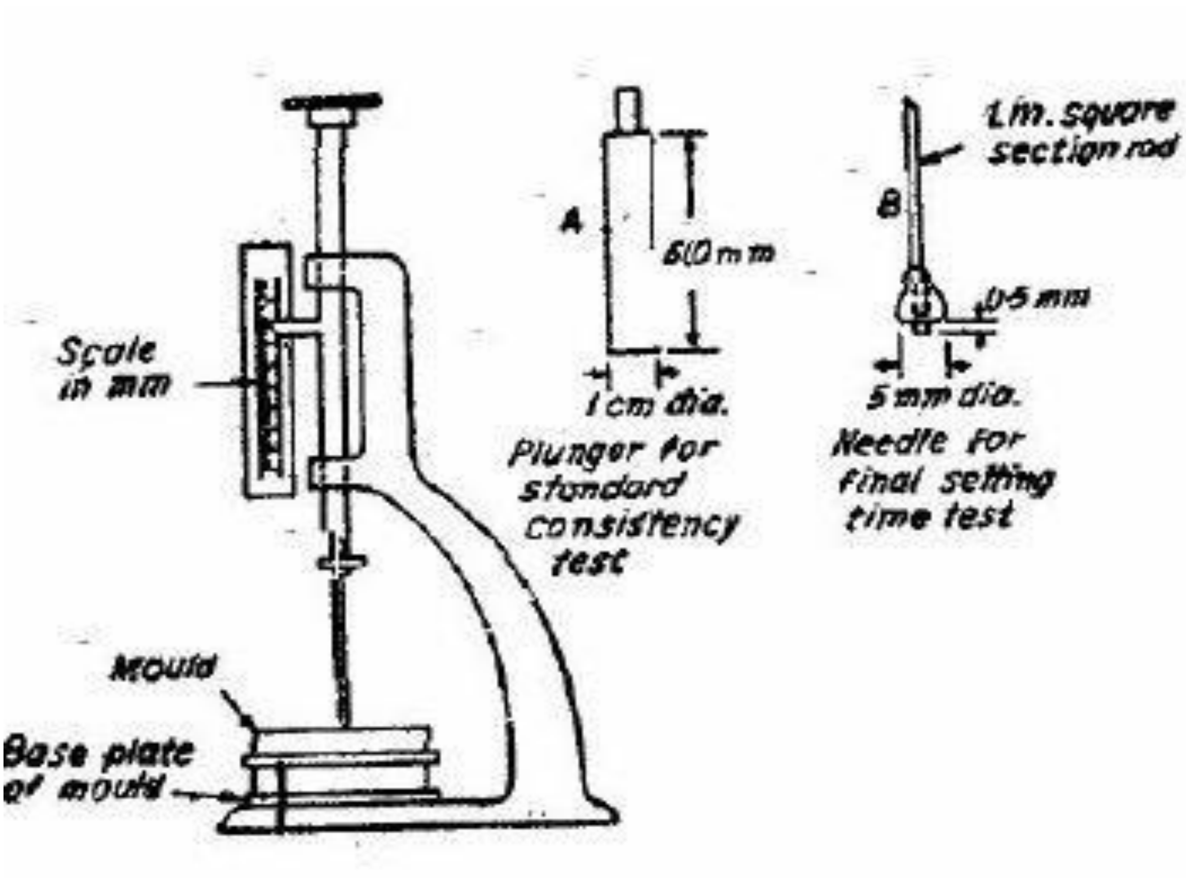


Fig 1: Vicat Apparatus

Table. 3: Initial setting time:

CEMENT	%OF WATER ADDED	TIME(Min)	Initial Reading	Final Reading	Depth of Penetration
300gms	**P x 0.85**				

Result: The initial setting of the given sample of cement is:___________________________

Conclusion:

Pre cautions:

1. Gauging should not exceed five minutes
2. Entrapped air in the mould should be expelled by shaking the mould.
3. Testing time should start after the cement paste is placed in the mould.

Viva Voce:

1. What is normal or standard consistency of a cement paste?
2. What are the factors affecting the result of the test?
3. What do you understand by the term flash setting?

Reference:

1. Indian Standard Methods of Physical Tests for cements IS: 4031, Indian Standards Institution.
2. Indian Standard Specifications for ordinary and low heat Portland cement IS: 269, Indian Standards Institution.
3. Neville. A. M, Properties of concrete, 3rd edition, Pitman publishing company, 1981.

Exp. No.:3 **Date:**

DETERMINATION OF FINENESS OF CEMENT

Aim: To determine the fineness of cement by Dry sieving.

Equipment and apparatus required:

Standard balance with 100 gm. Weighing capacity

IS:90 micron sieve confirming to IS:460-1962 and a Brush

Theory :

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

Technical Discussions:

1.Fineness of cement has a great effect on the rate of hydration and hence the rate of gain of strength.

2.Fineness of cement increases the rate of evolution of heat.

3.Finer cement offers a great surface area for hydration and hence faster the development of strength.

4.Increase in fineness of cement also increases the drying shrinkage of concrete and hence creates cracks in structures.

5.Excessive fineness requirement increases cost of grinding.

6.Excessive fine cement requires more water for hydration, resulting reduced strength and durability.

7.Fineness of cement affects properties like gypsum requirement, workability of fresh concrete & long term behavior of structure.

8.Coarse cement particles settle down in concrete which causes bleeding.

Fig. 2: 90 micron IS sieve

Procedure:

1. Break down any air-set lumps in the cement sample with fingers.
2. Weigh accurately 100 gms of the cement and place it on a standard 90 micron IS sieve.
3. Continuously sieve the samplefor 15 minutes.
4. Weigh the residue left after 15 minutes of sieving. Express its mass as a percentage (R1) of the quantity first placed in the sieve.
5. Repeat the steps 1 to 4 with a fresh sample to obtain R2.

- **Note ::** If **R1** & **R2** differ by more than **1%**, then carryout a third sieving and calculate **R3**.

TEST STANDARD REFERENCE:
IS:4031(Part 1):1996-Method of physical test for cement(Determination of fineness by dry sieving)

Precautions:

Before sieving, air set lumps of cement should be broken

Sieving should be done by rotating the sieve and not by translation.

Calculations:

Result:

The fineness modulus of the given cement sample is ____________________

Conclusion:

Exp. No.: 4 **Date:**

SPECIFIC GRAVITY OF CEMENT

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

Equipment and material required : Specific gravity bottle , Weighing Balance, Tray , Cement, Kerosene, water,

Theory:

In concrete technology, specific gravity of cement is made use of in design calculations of concrete mixes, and it is also used to calculate its specific surface. The specific gravity is defined as the ratio between the weight of a given volume of cement and weight of an equal volume of water. The most popular method of determining specific gravity of cement is by the use of Kerosene, which does not react with cement.

Definition of Specific gravity:

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

Procedure:

1. Weigh the specific gravity bottle dry (W_1).
2. Fill the bottle with distilled water and weigh the bottle (W_2).
3. Dry the specific gravity bottle and fill it with kerosene and weigh (W_3).
4. Pour some of the kerosene out and introduce a weighed quantity of cement(say W5) into the bottle .Roll the bottle gently in the position until no further air bubble rise to

the surface. Fill the bottle to the top with kerosene and weigh it (W4).

5. W5 Weight of the cement is taken as ¼ th to 1/3rd of the capacity of the bottle.

OBSERVATIONS & CALCULATIONS:

Weight of empty dry bottle (W_1)	=	gms
Weight of bottle + water (W_2)	=	gms
Weight of bottle + kerosene (W_3)	=	gms
Weight of bottle + cement + kerosene (W_4)	=	gms
Weight of cement (W_5)	=	gms

Specific gravity of kerosene = $g = \dfrac{W_3 - W_1}{W_2 - W_1}$

Specific gravity of cement =

$$G = \frac{W_5}{(W_5 + W_3 - W_4)} \times g$$

Result: The specific gravity of the sample of cement is:_____________________________

Conclusion:

Precautions:

- While pouring cement in the Specific gravity, care should be taken to avoid spilling and splashing of cement should not adhere to the inside of the flask above theliquid.
- The kerosene should be completely free from water.

Viva-voce:

1. Define specific gravity?
2. What the specific gravity of cement?

Exp. No.:5 **Date:**

SOUNDNESS OF CEMENT

(IS:4031-PART-3)

Aim: To determine the soundness of the given sample of cement.

Equipment & materials required:

Le-Chatelier apparatus:The apparatus for conducting the test consists of small split cylinder of spring brass or other suitable metal of 0.5 mm thickness, forming a mould 30mm internal diameter and 30mm high. On either side of the split mould are attached two indicators with pointed ends, the distance from these ends to the center of the cylinder being 165mm. The mould shall be kept in good condition with the jaws not more than 0.50mm apart.

Cement, water, Measuring jar, trowel, tray , non porous plates, container to boil , induction cook top, water bath with electric heating arrangement, stopwatch

Fig. 3: Le- Chatelier’s Apparatus

Theory:

When referring to Portland cement, "soundness" refers to the ability of a hardened cement paste to retain its volume after setting without delayed destructive expansion . This destructive expansion is caused by excessive amounts of free lime (CaO) or magnesia (MgO). Most Portland cement specifications limit magnesia content and expansion.

Excess of free lime and magnesia present in cement slake vary slowly and cause appreciable change in volume after setting.

In consequent cracks, distortion and disintegration results, thereby giving passage to water and other foreign matters which may have injurious effect on concrete and reinforcement. This defect is known as Soundness. The expansion can be prevented by limiting the quantity of free lime and magnesia in cement. The test is designed to accelerate the process of slaking by application of heat and to measure to extent of expansion and to see if this expansion is less than the specified limit.

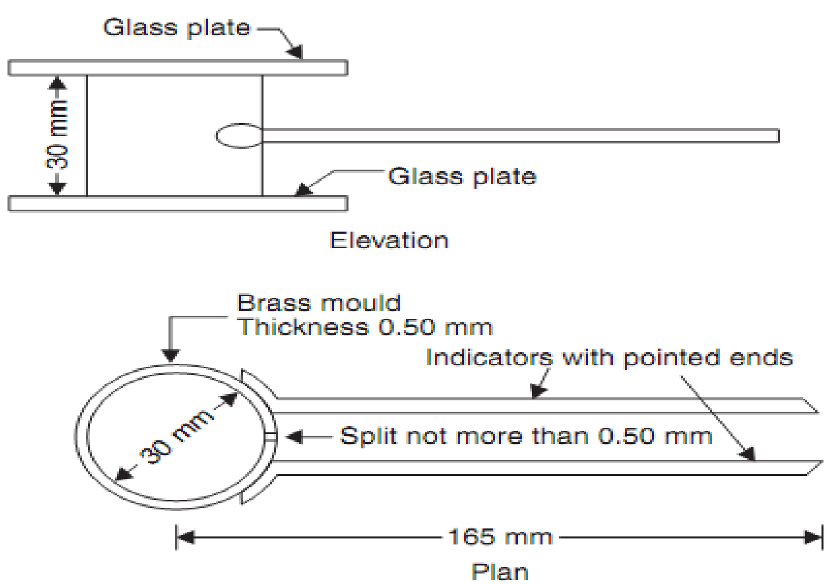


Fig. 4: Dimensions of Le- Chatelier's Apparatus

Procedure:

1. Prepare a cement paste formed by gauging cement with 0.78 times water required to give a paste of standard consistency. The gauging time should not be less than 3 minutes nor greater than 5 minutes.
2. Oil the inner surface of the mould. Place the mould on a glass sheet and 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 and peace a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of 27°Cand keep it for 24 hours.
3. Take out the assembly from water after 24 hrs. Measure the distance between the indicator points and record it (L1)
4. Submerge the mould again in water and bring the water to boiling in 25 to 30 minutes and keep it boiling for three hours.
5. Remove the mould from the water. Allow it to cool and measure the distance between the

   the

   indicator points and record it (L2).
6. Three samples should be tested and average of the results should be reported.

Observations:

1. Type and brand of cement ________________________________
2. Grade of cement _________________________________
3. Weight of cement sample(W_c)________________________________gm
4. Water required for standard consistency(P)______________________%
5. Water added to the cement sample = 0.78 X P X W_c = ________________

Table. 6: Observations for Soundness test of cement:

S.No: Sample	Distancebetween pointer ends		Difference	Average
	Before heating (L_1)	After heating (L_2)	$L_2 - L_1$	
1.	Sample A			
2.	Sample B			
3.	Sample C			

Results: The expansion of the cement in the Le Chatelier apparatus is found to be

____

Conclusion:

Viva-voce:

1. What do you understand by the term unsoundness? What is likely the cause of unsound cement?
2. What precautions should be taken while performing the test?
3. Why it is necessary to keep the cement paste moist in the test while it is setting?

Reference:

1. Indian Standard Specifications for ordinary and low heat Portland cement IS: 269, Indian Standards Institution.
2. Indian Standard, Methods of Physical tests for cement IS: 4031, Indian Standards Institution.
3. Neville. A. M, Properties of concrete, 3rd edition, Pitman publishing company, 1981.

Exp. No.:6 **Date:**

COMPRESSIVE STRENGTH OF CEMENT

(IS : 4031 – Part – 6)

Aim: To determine the compressive strength of 1:3 Cement sand mortar cubes after 3 days and 7 days,28 days curing.

Equipment and apparatus required:

Universal Testing Machine or Compression Testing Machine, Mould of size 7.06cm x 7.06cm--3No, vibrating machine, sand measuring cylinder, trowels, non-porous plate and Electronic Weighing Machine, Water Can, Measuring Jar, Cement, Sand and water.

Theory :

Strength of the hardened cement is most important for structural use. This strength depends upon the cohesion of the cement paste on its adhesion to the aggregate particles. Several forms of this test are direct tension, Compression and flexure. This strength depends upon the temperature and humidity conditions of the room, curing chamber etc. It increases with age; strength retrogression might be a sign of unsoundness or other faults in the cement.

Procedure:

1. Find out the normal or standard consistency (P) of the given sample of the cement using Vicat apparatus.
2. Take 600 gms of standard sand and 200 gms of cement. (C:M as 1:3)
3. Mix them in a non porous enamel tray for one minute.
4. Then add water of quantity ((P/4)+3%) of combined of sand and cement.(where P- percentage water required for standard or normal consistency).

5. Mix well to get a uniform colour.
6. Time of mixing should not be less than three minutes not more than four times.
7. Then fill the mould of size 7.06 cm.
8. Compact the mortar by using mortar vibrating machine compaction in a standard manner.
9. Keep the compacted cube in the mould at a temperature 27$\pm$ 2^0C for 24 hours.
10. After 24 hours the cubes are removed from the mould and immersed in clean fresh water.
11. Then these cubes are tested for compressive strength at the mentioned below:

    (OPC) Ordinary Portland Cement = 3 , 7 &28Days

    (RHC Rapid Hardening Cement) = 1 & 3 Days

    (LHC) Low Heat Cement = 3,7 & 28 Days

Table. 4: The average compressive strength shall not be less than the values given in the table

S.No	**Duration of time**	**OPC**	**RHC**	**LHC**
Unit		**MPa**	**Mpa**	**MPa**
1	1days(24 hours)	-	16	-
2	3 days(72 hours)	27	27	10
3	7days(178 hours)	37	-	16
4	28days(672 hours)	53	-	35

Testing of cement mortar cubes:

1. Just Before testing the cube take it out from the water and wipe it with dry cloth Measure the dimensions of the surface in which the load is to be applied. Let be ‘L’ and ‘B’ respectively.
2. Place the cube in compressive testing machine and apply the load uniformlyat the rate of 35N/mm^2.
3. Note the load at which the cube fails.
4. Calculate the compressive strength of the cube by using formula. The compressive strength at the end of three days should not be less than 27N/mm^2
5. Repeat the same procedure (steps 1 to 4) for other two cubes.
6. Repeat the whole procedure (Step 1 to 5) to find the compressive strength of the cube at the end of 7 days and it should not be less than 27 N/mm^2 and at 28 days not less than 53 N/mm^2, when we are conducting on 53 grade of cement.

Observations:

Size of the mould =

Weight of cement =

Weight of the Sand =

Percentage of water for normal consistency =

Amount of water added =[(P/4)+3%]

Table. 5 : Compressive strength observations:

S.No	Casted on	Tested on	Failure load	Compressive strength
1				
2				
3				

Calculations:

Area of the mould = $500mm^2$

Compressive strength = $\frac{\text{Load at Failure}}{\text{Area}}$

=

=

=

=

Result: The Compressive strength of the given sample of cement is:________________

Conclusion:

Viva voce:

1. What you understand by term ultimate strength of cement?
2. What precautions do you take during determination of compressive strength?
3. What is the significance of this test?

Reference:

1. Neville A.M, properties of concrete, 3rd Edn. Pitman Publishing Company, 1981.
2. Gambhir .M.L, Concrete Manual, 4th Edn., Dhanpat Rai & Sons, Delhi.

Exp. No.:7(a) **Date:**

PARTICLE SIZE DISTRIBUTION OF FINE AGGREGATES

Aim: To determine fineness modulus of fine aggregate and classifications based on IS: 383-1970

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, etc.

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 determinethe 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 finenessof 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.

Reference:

IS : 2386 (Part I) – 1963, IS: 383-1970, IS : 460-1962

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

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.

Observation:

Table. 8: Observations for Particle size distribution of Fine Aggregates

I S Sieve	Weight Retained on Sieve (gms)	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					
Total					

Calculation: :

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

Finess Modulus, FM =(Total of Cumulative Percentage of Passing (%))/100.

Conclusion / Result:

(i) Fineness modulus of a given sample of fine aggregate is______________________that indicate Coarse sand/ Medium sand/Fine sand.

(ii) The given sample of fine aggregate is belong to Grading Zones I / II / III / IV

Exp. No.:7(b) **Date:**

PARTICLE SIZE DISTRIBUTION OF COARSE AGGREGATES

Aim:

To determination of particle size distribution of coarse aggregates by sieving or screening.

Apparatus:

Test Sieves conforming to IS : 460-1962 Specification of 80 mm, 63 mm, 40 mm, 20 mm,16 mm, 12.5 mm,10 mm, 6.3mm, Gauging Trowel, Stop Watch, etc.

Theory:

Grading refers to the determination of the particle-size distribution for aggregate. Grading limits and maximum aggregate size are specified because grading and size affect the amount of aggregate used as well as cement and water requirements, workability, pumpability, and durability of concrete. In general, if the water-cement ratio is chosen correctly, a wide range in grading can be used without a major effect on strength. When gap-graded aggregate are specified, certain particle sizes of aggregate are omitted from the size continuum. Gap-graded aggregate are used to obtain uniform textures in exposed aggregate concrete. Close control of mix proportions is necessary to avoid segregation.

Reference:

IS : 2386 (Part I) – 1963, IS: 383-1970, IS : 460-1962

Table 3.14. Grading Limits for Coarse Aggregate IS: 383-1970

IS Sieve Designation	*Percentage passing for singlesized aggregate nominal size (by weight)*						*Percentage passing for Graded aggregate of nominal size (by weight)*			
	63 mm	*40 mm*	*20 mm*	*16 mm*	*12.5 mm*	*10 mm*	*40 mm*	*20 mm*	*16 mm*	*12.5 mm*
80 mm	100	–	–	–	–	–	100	–	–	–
63 mm	85–100	100	–	–	–	–	–	–	–	–
40 mm	0–30	85–100	100	–	–	–	95–100	100	–	–
20 mm	0–5	0–20	85–100	100	–	–	30–70	95–100	100	100
16 mm	–	–	–	85–100	100	–	–	–	90–100	–
12.5 mm	–	–	–	–	85–100	100	–	–	–	90–100
10 mm	–	0–5	0–20	0–30	0–45	85–100	10–35	25–55	30–70	40–85
4.75 mm	–	–	0–5	0–5	0–10	0–20	0–5	0–10	0–10	0–10
2.36 mm	–	–	–	–	–	0–5	–	–	–	–

Procedure:

1. The sample shall be brought to an air-dry condition before weighing and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100‖ to 110°C. 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. Each sieve shall be shaken separately over a clean tray until not more than a trace passes, but in any case for a period of not less than two minutes. 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. On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

Observation:

Table. 9: Observations for Particle size distribution of Coarse Aggregates

I S Sieve	Weight Retained on Sieve (gms)	Percentage of Weight Retained (%)	Percentage of Weight Passing (%)	Cumulative Percentage of Passing (%)	Remark
80 mm					
63 mm					
40 mm					
20 mm					
16 mm					
12.5 mm					
10 mm					
6.3 mm					
Total					

Calculation: :

Fineness modulus is an empirical factor obtained by adding the cumulative percentagesof aggregate retained on each of the standard sieves ranging from 80 mm to 6.3mm and dividing this sum by an arbitrary number 100.

Finess Modulus, FM =(Total of Cumulative Percentage of Passing (%))/100.

Conclusion / Result:

Fineness modulus of a given sample of Coarse aggregate is______________________`

Exp. No.:8 (a) **Date:**

BULKING OF SAND

(Field Test)

Aim: To determine the bulking factor of the given sample of fine aggregate (Sand).

Equipment required: Measuring cylinder, scoop, tray, stirring rod, steel ruler & measuring jar.

Ingredients: fine aggregate, water

Theory and Scope: When sand is measuring by volume, allowance should be made for the fact that it can occupy a greater volume when damp than when it is dry. This effect is knownas BULKING. The extent of the bulking varies with the moisture content and the coarseness of the sand. To determine the amount of bulking, use is made of the fact that sand saturated with water occupies the same volume as dry sand. Sand have a phenomenal property of bulking. Bulking of sand means increase in its volume due to presence of surface moisture. The volume increases with increase in moisture. The volume may increase up to 20% to 40%, when moisture content is 5 to 10% . It's actually a thin film of water around the sand grains and interlocking of air in between the sand grains and a film of water

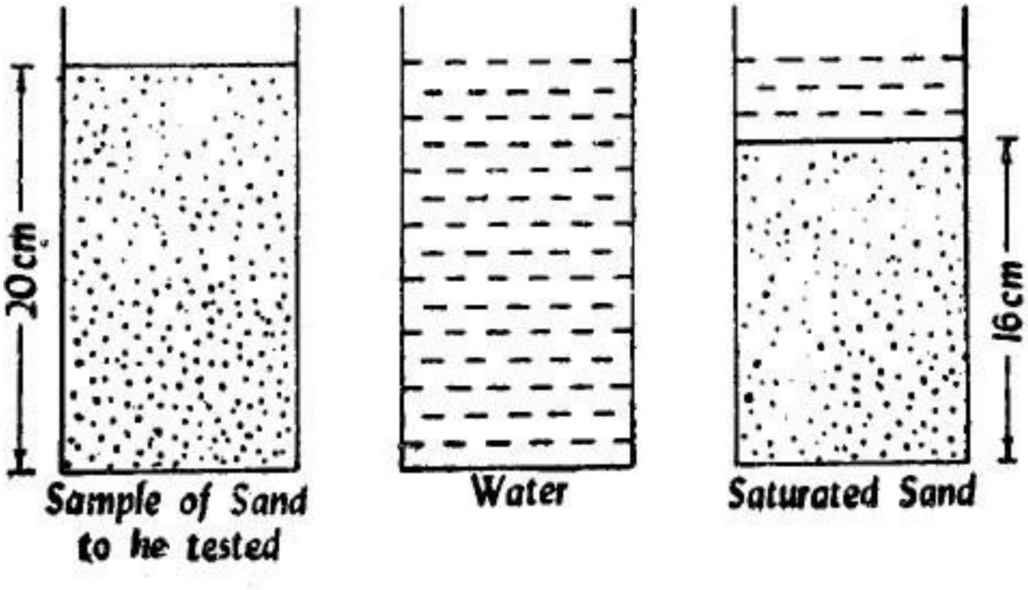


Fig. 5: Bulking of sand procedure

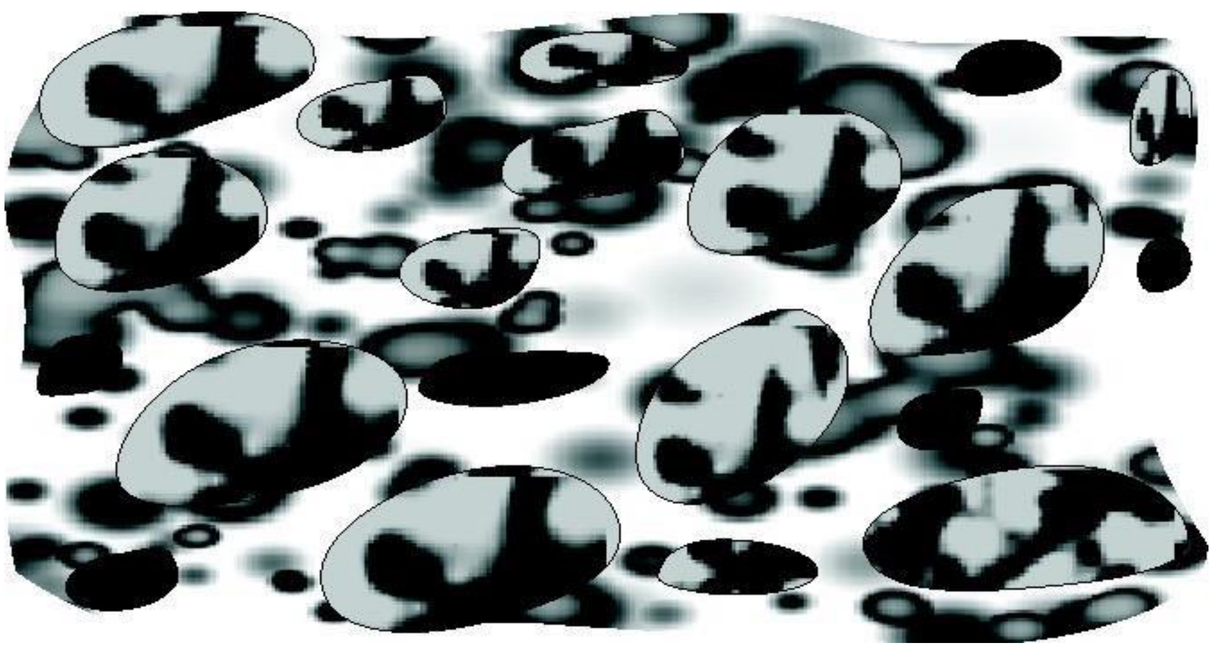


Fig. 6: Spaces between the aggregate particles are the void spaces

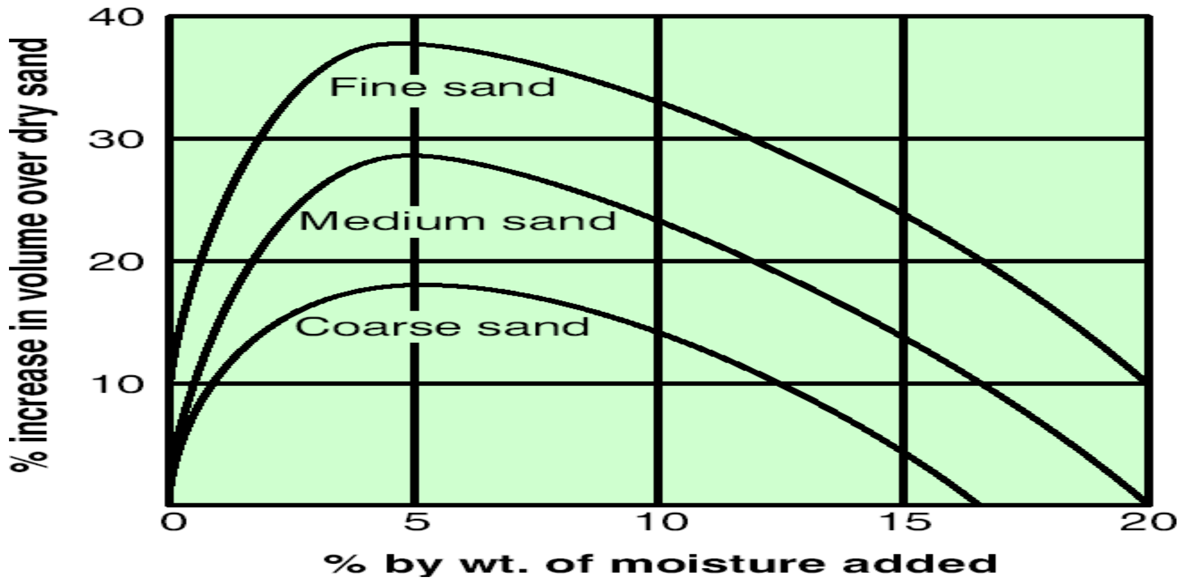


Fig. 7: Variation of % of bulking for different sands

Procedure:

1. Loosely fill the damp sand into the container to a height of D.
2. Pour the sand onto a tray and half fill the container with water.
3. Return the damp sand to the tray, stirring it to ensure that it is fully saturated.
4. When the sand has settled, its height D1 is again measured and recorded.

Observation and Calculation:

The percentage of bulking can be found using the formula:

$$\text{Percentage bulking} = \frac{D-D1}{D} \times 100$$

Result: The bulking of the given sample of sand is ______________________________

Conclusion:

Exp. No.:8 (b) **Date:**

BULKING OF SAND

(Laboratory Test)

Aim: To determine the maximum % of bulking of the given sample of fine aggregate(Sand).

Equipment required: Measuring cylinder, scoop, tray, stirring rod, steel ruler & measuring jar.

Ingredients: fine aggregate, water

Procedure:

1. Take one kg of oven dried (for 24 hours) sand and fill in the measuring jar.
2. Measure the height of the sand with the scale and note id down as h_1.
3. Place the sand in to the tray.
4. Add water to the sand.(1% of water to the weight of the sand).
5. Fill the same sand in the measuring jar and measure the height of the sand take it as h_2.
6. Repeat the steps until you find no change in the height of the sand.

Observations and Calculations:

Weight of the sand = W =

$\%$ of Bulking $=$ change in the height sand $\div$ intial height of sand

For example: for 1% ,% Bulking = $[(h1 - h2) \div h1]$*100

Table. 7: Observations for Bulking of sand test :

S.No	% moisture added	Initial value	Final value	% Bulking

Draw the graph between the % water on X-axis and % Bulking on Y -axis

Result: The maximum bulking of the given sample of Sand is ______________________________

Conclusion:

Disadvantages:

- Bulking of sand effects the concrete mixture, its proportions, its strength and many such aspects.
- Cracks develop in the structure.
- Reduces the load bearing capacity , its strength and its compatibility

Advantages:

- The sand seller earns a profit by selling less sand as the volume changes from less to more.

Viva-voce:

1. How can “bulking” occur more readily in smaller particles?
2. Explain how tension has an effect on “bulking”.
3. How would an increase of knowledge of “bulking” affect mixing quality concrete?
4. How do surface tension, capillarity and texture affect bulking?
5. How would the knowledge of bulking affect batch mixing quality ofconcrete by volume of ingredients (sand and water)?

6. References:

1. Concrete Technology by M.S. Shetty
2. Google

Exp. No.: 9 **Date:**

WORKABILITY OF FRESH CONCRETE USING SLUMP CONE TEST

Aim: To determine the workability of the cement concrete by slump test.

Equipment and material required:

1. Slump Cone metal mould in the form of a frustum of a cone open on both ends. Made of sheet metal 1.6 mm thick with suitable guides for lifting vertically up. Metallic mould in the form of a frustum of a cone having the internal dimensions as under

   Bottom diameter 20cm

   Top diameter 10cm

   Height 30cm
2. A steel tamping rod 16mm diameter, 0.6 meter or 60mm along with bullet end is used.
3. Steel Rule.
4. Tray. 5. Trowel 6. Measuring Jar 7. Cement 8. Coarse Aggregate
9. Fine Aggregate 10.Oil.

Theory:

Definition : *Workability:* It is “that property of freshly mixed concrete which determines the ease and homogeneity with which it can be mixed, placed consolidated and finished”. **Slump** is a measurement of concrete’s workability or fluidity. It’s an indirect measurement of concrete consistency or stiffness. Slump test is a method to determine the consistency of concrete. The consistency or stiffness, indicate how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirement for the finished product quality.

The test is carried out using a mould known as a slump cone or **Abrams cone**. The cone is placed on a hard non-absorbent surface. This cone is filled with fresh concrete in three stages, each time it is tamped using a rod of standard dimensions. At the end of the third stage, concrete is struck off flush to the top of the mould. The mould is carefully lifted vertically upwards, so as not to disturb the concrete cone. Concrete subsides. This subsidence is termed as slump, and is measured in to the nearest 5 if the slump is <100 mm and measured to the nearest 10 mm >100 mm slump mm. The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as true slump, shear slump or collapse slump. If a shear or collapse slump is achieved, a fresh sample should be taken and the test repeated. A collapse slump is an indication of too wet a mix. Only a true slump is of any use in the test. A collapse slump will generally mean that the mix is too wet or that it is a high workability mix, for which slump test is not appropriate. Very dry mixes; having slump 0 – 25 mm are used in road making, low workability mixes; having slump 10 – 40 mm are used for foundations with light reinforcement, medium workability mixes; 50 - 90 for normal reinforced concrete placed with vibration, high workability concrete; > 100 mm.

The Slump = The height of the cone – The height of the concrete cone after the slump

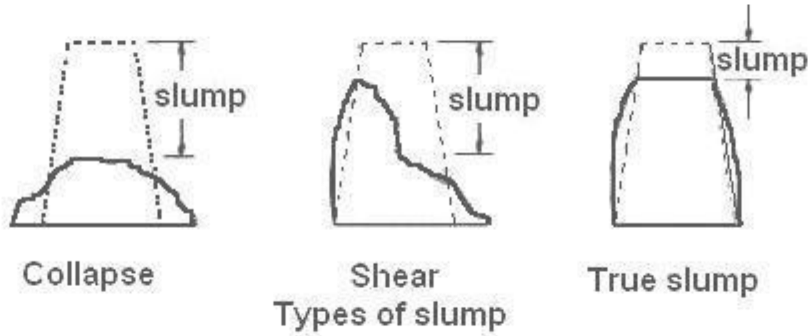


Fig. 8: Different types of slump

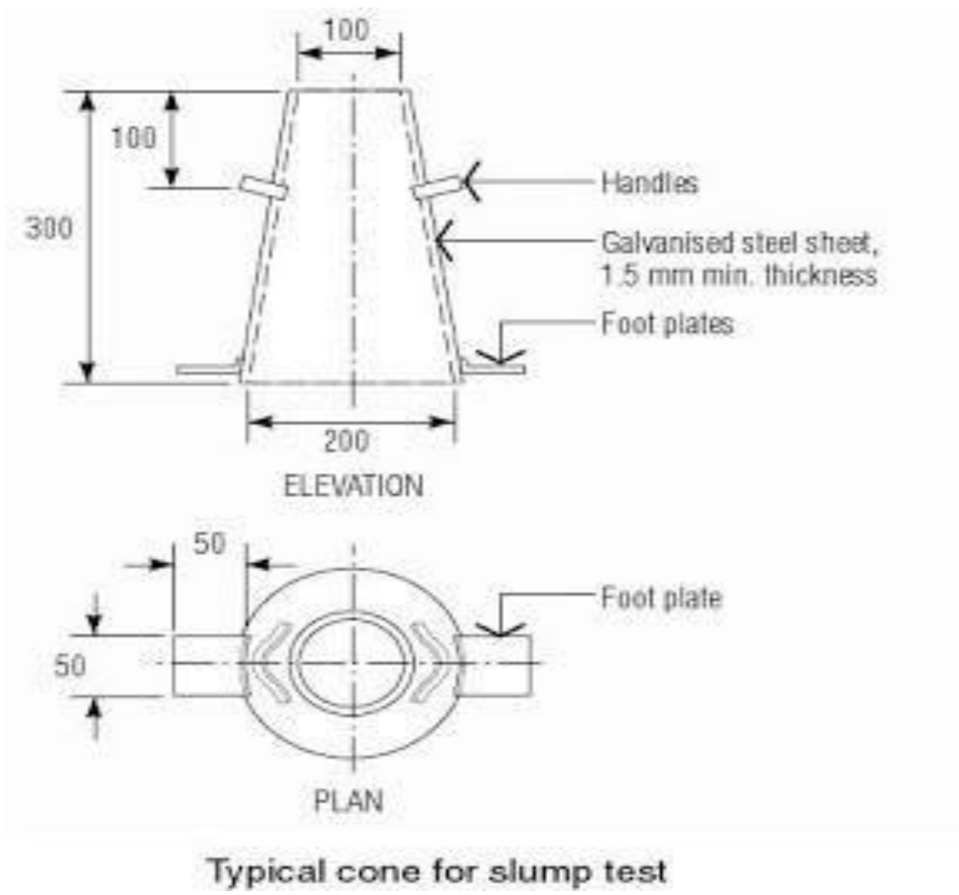


Fig. 9: Typical cone for slump test

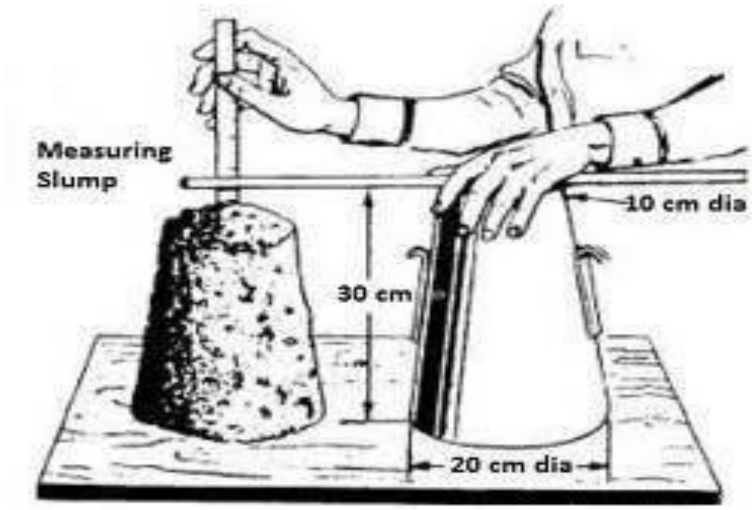


Fig. 10: Measuring of slump

Procedure:

1. The internal surface of the mould is thoroughly cleaned and applied with light coat of oil.
2. The mould is placed on a smooth, horizontal, rigid and nonabsorbent surface.
3. The mould is then filled in four layers with freshly mixed concrete, each approximately to one-fourth of the height of the mould.
4. Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross section).
5. After the top layer is tamped, the concrete is struck off the level with a trowel.
6. The mould is removed from the concrete immediately by raising it slowly in the vertical direction without any shaking or jerks.
7. The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.
8. This difference in height in mm is the slump of the concrete.

Observations:

Four mixes are to be prepared with water-cement ratio (by mass) of 0.50, 0.60, 0.70 and 0.80, respectively, and for each mix take 7.5 kg of coarse aggregates, 3.75kg of sand and 2.5kg of cement with each mix

Calculations:

Weight of cement = 2.5 kgs

Weight of fine aggregate = 3.75 kgs

Weight of coarse aggregate = 7.5 kgs

Water to cement ratio = 0.5

The slump observed =

Table. 10: Observations for slump

Water-Cement Ratio	Slump

Table. 11: Standard slump values for different W/C Ratios

S.No	Name of works	Slump in mm
1.	Concrete for roads and mass concrete	25 to 50
2	Concrete for R.C.C. beams and slabs	50 to 100
3.	Columns and Retaining walls	75 to 125
4	Mass concrete in foundation	25 to 50

Result: The total slump observed for given sample =___________________cm

Conclusion:

Exp. No.:10 **Date:**

WORKABILITY OF CONCRETE USING COMPACTION FACTOR TEST

Aim: To determine the workability of the cement concrete by compaction factor test.

Equipment and material required:

Compaction factor apparatus, tamping rod, trowel, measuring jar, water can, Cement, fine aggregate and coarse aggregate.

Theory:

Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199 – 1959. The apparatus used is Compacting factor apparatus. This test is usually being carried out in the laboratory and in specific condition that is construction site. It is sensitive and more accurate test compared to the slump test and suitable for low workability of the concrete mixture. Nevertheless the accuracy of the result will be reduced with the increased of the aggregate size (size exceed 20mm).

This compaction factor test has been developed at Road Research Laboratory U.K. This test works on the principle of determining the degree of the compaction achieved by a standard amount of work done by allowing the concrete to fall through a standard height .The degree of compaction is called as compaction factor ,is is measured by the density ratio. The ratio of the density actually achieved in the test to density of the same concrete fully compacted.

$$\text{Compaction factor} = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

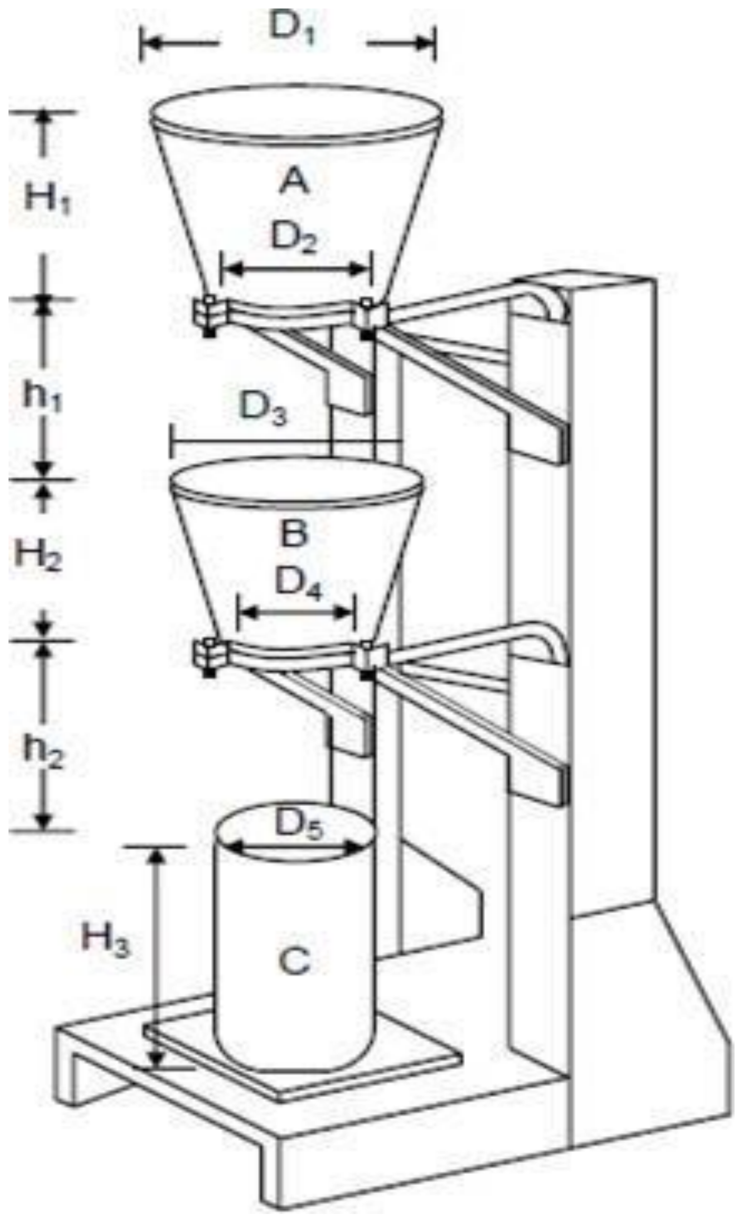


Fig. 11: Compaction factor apparatus

Table. 12: Dimensions of the Compacting Factor Apparatus for use with Aggregate not to exceeding 40mm Nominal Maximum Size

Description	Dimension in cm
Lower hopper , B	
Top internal diameter	**22.9**
Bottom internal diameter	**12.7**
Internal height	**22.9**
Cylinder, C	
Internal diameter	**15.2**
Internal height	**30.5**
Distance between bottom of upper hopper and top of lower hopper	**20.3**
Distance between bottom of lower hopper and top of cylinder	**20.3**

Procedure:

1. keep the apparatus on the ground and apply grease on the inner surface of the cylinders.
2. Measure the weight as W_1 kg by weighing the cylinder accurately and fix the cylinder on the base in such a way that the central points of hoppers and cylinder lie on one vertical line and cover the cylinder with a plate.
3. Use the concrete mixture of 1:1.5.:3 (optional) and water cement ratio of 0.5(optional).
4. Prepare the fresh concrete which give homogeneous mix.
5. Place the concrete into the upper hopper “A”. without any manual compaction.
6. Open the trapped door of the upper hopper, and is collected in the lower hopper “B”.
7. Open the trap clear of lower hopper so that the concrete is full into the cylinder “C” below.
8. Remove the excess concrete above the level of cylinder, clean the outside of cylinder.
9. When the concrete in the cylinder this weight of concrete was the weight of partially compacted concrete (W_2).
10. Empty the cylinder and refill with concrete in four layer compacting each layer well with 25 blows by using standard tamping rod.
11. Find out the weight of concrete in fully compacted stage. This weight was of fully compacted concrete (W_3).

Observations & calculations:

For 1:1.5:3 MIX Proportion: Amount of materials to be taken are

Cement = 2.5 kgs (2.5x1=2.5)

Fine aggregate = 3.75kgs (2.5x1.5=3.75)

Coarse aggregate = 7.5kgs(2.5x3=7.5)

Water / Cement Ratio = 0.5 (Say)

Weight of the empty cylinder = $\mathbf{W_1}$

Table. 13: Observations table for compaction factor test

S.No	W/C Ratio	Wt. of cylinder with partially compacted concrete (W_2)	Wt. of cylinder with fully compacted concrete (W_3)	Wt. of partially compacted concrete (W_2-W_1)	Wt. of fully compacted concrete (W_3-W_1)	Compaction Factor $= \frac{(W_2-W_1)}{(W_3-W_1)}$
1						
2						
3						

Amount of water required = 1.25ml (2.5x0.5=1.25)

Result :Compaction factor of the given sample of concrete is:________________________

Conclusion:

Precaution:

1. The cylinder should oiled correctly.
2. The weight of the sample should take accurately.
3. The concrete mix should be mix as per the given proportion.
4. The mix should be filled in cylinder in layers and it should be tamped with tamping rod.

Viva-voce:

1. What are the main differences between Slump Test and Compacting Factor Test.
2. What is the actual proportion or ratio of water and cement to build a concrete structure.
3. What are the standard used in compacting factor test.
4. What are main precaution that to be taken during the test.
5. What happen to the concrete mixture when the concrete consist of:
    a) high content of the aggregate?
    b) low water cement ratio?
    c) high content of cement?
6. Why must the compacting factor test be carried out immediately after the concrete being mixed?

Exp. No.:11 **Date:**

WORKABILITY OF CONCRETE USING VEE-BEE CONSISTOMETER

Aim: To measure the workability of concrete by Vee-Bee consistometer test as perIS: 1199 – 1959.

Equipment and Materials required: Vee-Bee consistometer test apparatus, Tray, Trowel, Tamping rod, cement , fine aggregate, coarse aggregate and oil.

Theory: The name vee-bee is derived from the initials of V. Bahrner of Sweden who developed the test. Sometimes this test is called V-B consist meter test. Vee-bee is a good laboratory test, particularly for very dry mixes. The workability of fresh concrete is a composite property, which includes the diverse requirements of stability, mobility, compactability, placeability and finishability. There are different methods for measuring the workability. Each of them measures only a particular aspect of it and there is really no unique test, which measures workability of concrete in its totality. This test gives an indication of the mobility and to some extent of the compactibility of freshly mixed concrete.

The test measures the relative effort required to change a mass of concrete from one definite shape to another (i.e., from conical to cylindrical) by means of vibration. The amount of effort called remoulding effort is taken as the time in seconds required to complete the change. The results of this test are of value in studying the mobility of the masses of concrete made with varying amounts of water, cement and with various types of grading of aggregate.

The time required for complete remolding in seconds is considered as a measure of workability and is expressed as the number of Vee-Bee seconds. The method is suitable for dry concrete. For concrete of slump in excess of 20mm, the remolding is so quick that the time cannot measured.

Suitability: This method is suitable for dry concrete having very low workability.

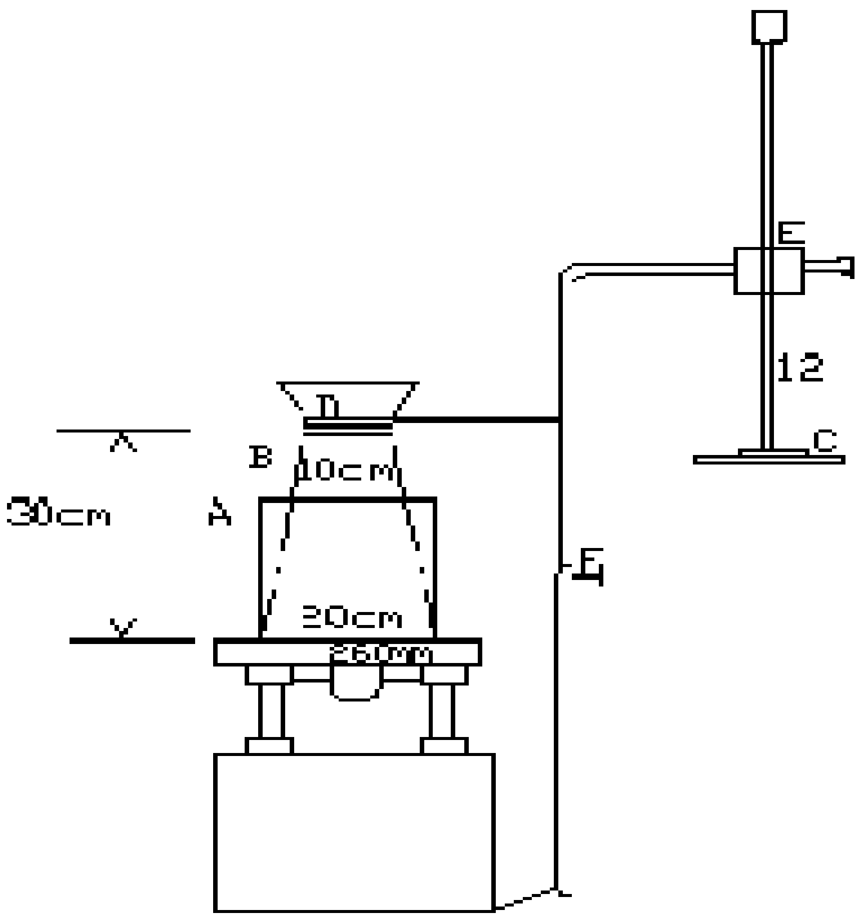


Fig. 12:Vee – Bee Consistometer

A= cylindrical pot
B= sheet metal cone
C= glass disc
D= swivel arm
E=glass disc adjustable screw
F= adjustable screw

Procedure:

Preparation concrete:

1. Test for M20 (1: 1.5: 3).
2. Take 2.5kgs of cement , 3.75 kgs of fine aggregate and 7.5 kgs of coarse aggregate.
3. Mix them in dry , until you get uniform colour.
4. Take W/C ratio as 0.4 (2.5 kg X 0.4 = 1Ltr).
5. Add the water until you get uniform mix.

Test Procedure:

1. The internal surface of the cone and cylinder is thoroughly cleaned and applied with light coat of oil.
2. Place the cone in the centre of the cylinder .
3. The mould is then filled in four layers with freshly mixed concrete, each approximately to one-fourth of the height of the mould.
4. Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross section).
5. After the top layer is tamped, the concrete is struck off the level with a trowel.
6. The mould is removed from the concrete immediately by raising it slowly in the vertical direction without any shaking or jerks.
7. Note down the slump The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.
8. The glass plate rider id then brought into position so that it is touching the top of the concrete.
9. At a time switch on stop clock and vibrating machine.

10. The concrete cone is then subjected to vibrating action by starting the vibrator. The stop watch is started as soon as the vibrator is switched on . the concrete is allowed to spread out in the cylindrical container.
11. The vibration is until the concrete surface becomes horizontal surface is noted. The time recorded in seconds gives the degree of workability.

Table. 14: Degree of workability with respect to Vee-Bee Seconds

S.No	Time in seconds	Degree of workability
1	20 – 30	Very low
2	10 – 20	Low
3	7 – 10	Medium
4	3 -7	High
5	1 – 3	Very high

Table. 15: Calculations and observation:

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

Result: The consistency of the concrete is__________________________sec.

Conclusion:

Viva Voce:

1. Describe the factors affecting the choice of the method of test.
2. What are the advantages and disadvantages of Vee-Bee method of test over the other methods?

Reference:

1. Neville. A. M, Properties of concrete, 3rd edition, Pitman publishingcompany, 1981.
2. Gambhir. M. L, Concrete manual, 4th edition, Dhanpat Rai and Sons, Delhi.

Exp. No.:12(a) **Date:**

COMPRESSIVE STRENGTH OF CONCRETE

Aim: To determine the compressive strength and young's modulus of the concrete.

Equipment and materials required: Compression testing machine,

Molds - Cubical in form, made of non-absorbent material, and substantial enough to hold their form during the molding of test specimens. Standard molds shall be 15cm X 15 cm X 15 cm. Molds shall be water tight and the base plate or bottom shall be at right angles to the axis of the cube.

Tamping Rod - a round straight steel rod 16 mm in diameter and 600 mm in length. Oneend shall be a hemisphere 16 mm in diameter.

Sampling Equipment - scoop or shovel, trowel, containers, Trays, tape, Measuring jar.

Curing Equipment - a moist storage cabinet or room capable of maintaining specimens at a temperature within ± 1 degrees of 27 ^{o} C and capable of maintaining a moist condition in which free water is maintained on the surfaces of the specimens.

Theory: One of the purposes of testing hardened concrete is to confirm that the concrete used at site has developed the required strength. As the hardening of the concrete takes time, one will not come to know, the actual strength of concrete for some time. This is inherent disadvantage in conventional test. But, if strength of concrete is to be known at an early period, accelerated strength test can be carried out to predict 28 days strength. But mostly when correct materials are used and careful steps are taken at every stage of the work, concretes normally give the required strength. The tests results also have a deterring effect on those responsible for construction work. This results of the test on hardened concrete even if they are known late, helps to reveal the quality of concrete and enable adjustments to be made in the production of further concretes. Tests are made by casting cubes or cylinders from the representative concrete or cores cut from the actual concrete. It is to be remembered that standard compression test specimens give a measure of the potential strength of the concrete, and not of the strength of the concrete in structure.

Percentage strength of concrete at various ages: The strength of concrete increases with age. below shows the strength of concrete at different ages in comparison with the strengthat 28 days after casting.

Table. 16: % of strengths with age

AGE	STRENGTH PER CENT
1 Day	16%
3 Days	50%
7 Days	60%
28 Days	85% to 90%

Table. 17: Compressive strength of different grades of concrete at 7 and 28 days

Grade of concrete	Minimum compressive strength N/mm^2 at 7 days	Specified characteristic compressive strength N/mm^2 at 28 days
M15	10	15
M20	13.5	20
M25	17	25
M30	20	30
M40	27	40
M45	30	45

Fig. 13:Mould **Fig. 14: Casted cube**

Procedure:

Preparation of cube specimens

The proportion and material for making these test specimens are from the same concrete used in the field.

Specimen

6 cubes of 15 cm size Mix. M20 or above

Mixing

Mix the concrete either by hand or in a laboratory batch mixer

Hand mixing

1. Mix the cement and fine aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform color
2. Add the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch
3. Add water and mix it until the concrete appears to be homogeneous and of the desired consistency

Sampling

1. Clean the mounds and apply oil
2. Fill the concrete in the molds in layers about 50mm.
3. Compact each layer with 25strokes per layer for 100mm cube and35strokes for 150mm cube a using a tamping rod (steel bar 16mm diameter and 60cm long, bullet pointed at lower end)
4. Level the top surface and smoothen it with a trowel

Curing

The test specimens are stored in moist air for 24hours and after this period the specimens are marked and removed from the molds and kept submerged in clear fresh water until taken out prior to test.

Precautions

The water for curing should be tested every 7days and the temperature of water must be at 27 ± 2^{oC}.

Procedure:

1. Remove the specimen from water after specified curing time and wipe out excess water from the surface.
2. Take the dimension of the specimen to the nearest 0.2mm
3. Clean the bearing surface of the testing machine
4. Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
5. Align the specimen centrally on the base plate of the machine.

6. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
7. Apply the load gradually without shock and continuously at the rate of 140kg/cm2/minute till the specimen fails
8. Record the maximum load and note any unusual features in the type of failure.

Note:

Minimum three specimens should be tested at each selected age. If strength of any specimen varies by more than 15 per cent of average strength, results of such specimen should be rejected. Average of there specimens gives the crushing strength of concrete. The strength requirements of concrete.

Calculations:

Size of the cube =15cm x15cm x15cm

Area of the specimen (calculated from the mean size of the specimen) =225cm^2

Characteristic compressive strength (f_{ck})at 7 days =

Expected maximum load =f_{ck} x area

Range to be selected is …………………..

Similar calculation should be done for 28 day compressive strength

Maximum load applied =……….tones = ... N

Compressive strength = (Load in N/ Area in mm$^{2)}$=.................... N/mm^2

= .... N/mm^2

Report:

a) Identification mark

b) Date of test

c) Age of specimen

d) Curing conditions, including date of manufacture of specimen

g) Appearance of fractured faces of concrete and the type of fracture if they are unusual

Result

Average compressive strength of the concrete cube =..................N/ mm^2 (at 7 days)

Average compressive strength of the concrete cube =..............N/mm^2 (at 28 days)

Conclusion:

Exp. No.:12(b) **Date:**

YOUNGS MODULUS OF CONCRETE

Aim:

To determine the youngs modulus of concrete by Plotting stress strain curve for concrete.

Theory: -

The results obtained from this experiment are used to study the behaviour of concrete subjected to prolonged loading which has special importance as the concrete is not truly elastic material since it possesses the ability to ‘creep’ during and after the application of load. The modulus of elasticity of concrete and its corresponding compressive strength are required in the design calculations of concrete structures. In the field of Reinforced Cement Conerte design it is extensively used in the form of modular ratio. The modulus of elasticity can be determined by measuring the compressive strain when a sample is subjected to a compressive stress. Indian Standards stipulate that height should be at least twice the diameter. Two extensometers should be used to check on eccentric loading and they should be mounted diametrical opposite. The ultimate compressive strength of concrete shall be determined by testing three cubes at the time when the specimen is tested for determining the modulus of elasticity. The modulus of elasticity is taken as the slope of the chord from the origin to some arbitrarily chosen point on the stress strain curve.This is called secant modulus. Sometimes it is taken as slops of the tangent at the origin or the slope of tangent at some arbitrary chosen stress (called tangent modulus) but the tangent at the origin is difficult to draw accurately.

Apparatus:

- Mixing pan
- Tamping bar
- Trowels
- Capping apparatus
- Extensometer with illuminated scale and telescope
- A testing machine.
-

Procedure:

(1) Take mix proportion as 1:2:4 by mass and water cement ratio as 0.50. Take 28kg of coarse aggregate, 14kg of fine aggregate and 7kg of cement and prepare the concrete mix.

(2) Prepare three 150mm cubes and three 150x300mm cylinders.

(3) Apply a proper capping to the top of the cylinders.

(4) Cure these specimens under water for 28 days

(5) Test the three cubes in wet condition for compressive strength after 28 days of curing and determine the average compressive strength.

(6) Mount the extensometer to a cylinder on its opposite sides and parallel to its axis. The cylinders are also tested in wet condition.

(7) Load the cylinder at the rate of $14N/mm^2$ per minute and at a regular interval of loading (generally two tones) record the extensometer readings.

(8) Calculate the stress and strains for each cylinder and plot stress-strain curves of concrete.

(9) Determine the modulus of elasticity (secant modulus) at 30 percent to cube strength.

RESULT: Modulus of Elasticity of concrete……………..

VIVA QUESTIONS:

1) What is the significance of stress strain curve of concrete?
2) Define Tangent (i) Modules of Concrete
   (ii) Secant Modules of Concrete
3) What are dimensions of the concrete sample to be used to determine the modules of elasticity of concrete?
4) What is the name of arrangement that is fixed to the concrete sample during testing?
5) What is the use of compress meter?

Exp. No.:13 **Date:**

SPLIT TENSILE STRENGTH OF HIGH STRENGTH CONCRETE

AIM: To determine the Splitting tensile strength of given concrete.

APPARATUS:

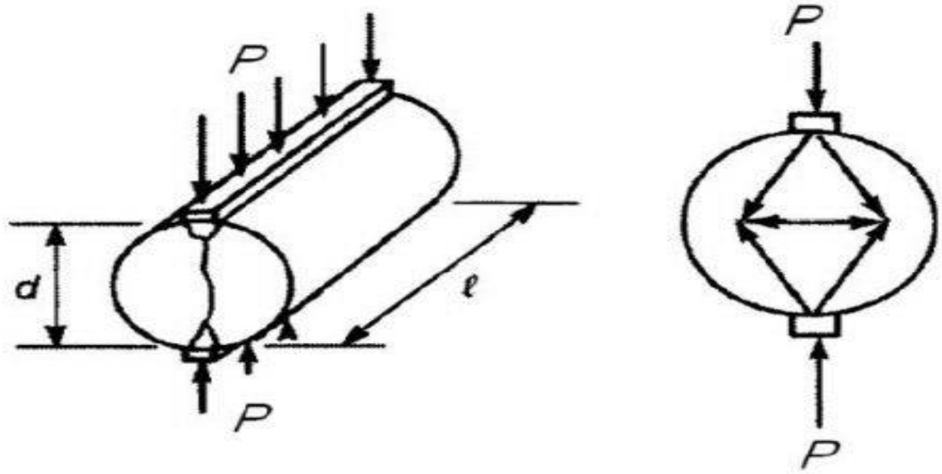
1. Testing machine
2. Bearing strips
3. Plate or supplementary bearing bar
4. Concrete specimen moulds

REFERENCE CODE: IS 5816 1999.

THEORY:

The tensile strength of concrete is one of the basic and important properties which greatly affect the extent and size of cracking in structures. Moreover, the concrete is very weak in tension due to its brittle nature. Hence. it is not expected to resist the direct tension. So, concrete develops cracks when tensile forces exceed its tensile strength.

Therefore, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. Furthermore, splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The procedure based on the ASTM C496 (Standard Test Method of Cylindrical Concrete Specimen) which similar to other codes IS 5816 1999.



PROCEDURE:

1. Initially, take the wet specimen from water after 7, 28 of curing; or any desired age at which tensile strength to be estimated.
2. Then, wipe out water from the surface of specimen
3. After that, draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place.
4. Next, record the weight and dimension of the specimen.
5. Set the compression testing machine for the required range.
6. Place plywood strip on the lower plate and place the specimen.
7. Align the specimen so that the lines marked on the ends are vertical and centred over the bottom plate.
8. Place the other plywood strip above the specimen.
9. Bring down the upper plate so that it just touch the plywood strip.
10. Apply the load continuously without shock at a rate within the range 0.7 to 1.4 MPa/min (1.2 to 2.4 MPa/min based on IS 5816 1999)
11. Finally, note down the breaking load(P)

OBSERVATIONS:

1. Maximum applied load indicated by testing machine (P) =..................................
2. Diameter of the specimen (D) =...............................
3. Length of specimen in mm (L)=............................

Splitting tensile strength in MPa=T= $\frac{2P}{\Pi LD}$

RESULT:

Splitting tensile strength of given concrete =……………….N/mm^2