PREFACE

This lab manual covers the complete syllabus of III B Tech I Semester, Civil Engineering course titled **"*CONCRETE TECHNOLOGY LAB MANUAL*"** of **R.G.M.C.E.T (AUTONOMUS), Nandyal.**

This ***Concrete Technology lab Manual*** aims at:

- Imparting knowledge of Material testing so that one can find the various properties the Materials.
- Developing the student in learning the various principles of Concrete technology and an insight in understanding properties of materials, so that they can characterize, transform and use the knowledge gained in solving the various related Engineering problems.

Salient Features of the Lab Manual are:

Completely covers the Experiments of **III B.Tech I Semester**, **C.E.** of **R.G.M.C.E.T (AUTONOMUS), Nandyal.**

- Simple & Systematic
- Viva questions.

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Concrete Technology Lab Manual

School of Civil Engineering
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List of Experiments

1. **Determination of the fineness of cement by dry sieving method.**
2. **Determination of the Standard consistency of Cement Paste.**
3. **Determination of the initial and final setting times of cement.**
4. **Determination of the soundness of the given cement**
5. **Determination of specific gravity of cement.**
6. **Determination of the compressive strength of the given cement.**
7. **Determination of fineness modulus value by conducting sieve analysis for fine aggregate**
8. **Determination of specific gravity of fine aggregate**
9. **Determination of specific gravity of coarse aggregate**
10. **Determination of the aggregate crushing value of the given aggregate.**
11. **Determination of the impact value of the given aggregate.**
12. **Determination of Los angles abrasion value of the given aggregate.**
13. **a) Determination of the flakiness index of coarse aggregate**
    b) Determination of the Elongation index of coarse aggregate
14. **Mix Design by IS 10262-2009**
15. **Workability Test (a) Slump cone (b) Compaction Factor**
16. **Compressive Test of Concrete Cube**

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Construction materials Testing Lab Manual

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List of Experiments (I Cycle)

1. **Determination of the fineness of cement by dry sieving method.**
2. **Determination of the Standard consistency of Cement Paste.**
3. **Determination of the initial and final setting times of cement.**
4. **Determination of the soundness of the given cement**
5. **Determination of specific gravity of cement.**
6. **Determination of the compressive strength of the given cement.**

List of Experiments (II Cycle)

7. **Determination of specific gravity of Fine aggregate.**
8. **Determination of fineness modulus value by conducting sieve analysis for fine aggregate.**
9. **Determination of specific gravity of coarse aggregate.**
10. **Determination of the aggregate crushing value of the given aggregate**
11. **Determination of the impact value of the given aggregate.**
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EXPERIMENT NO: 1

DATE: 06/11/20

TITLE: Fineness of Cement by dry sieving method

Aim: To determine the fineness of the given sample of Cement by Dry-Sieving Method

Reference: **IS:4031 (part-1)-1996**

Theory:

The fineness of cement has an important bearing on the rate of hydration and hence on the rate of gain of strength and also on the rate of evolution of heat. Finer cement offers a greater surface area for hydration and hence faster the development of strength. Increase in fineness of cement is also found to increase the drying shrinkage of concrete Different cements are ground to different fineness.

Fineness of cement is tested in two ways :

(a) By sieving.

(b) By determination of specific surface (total surface area of all the particles in one gram of cement) by

Air-permeability apparatus. Expressed as cm^2/gm or m^2/kg. Generally Blaine Air permeability apparatus is used.

Apparatus: Test Sieve 90 microns, Balance, Gauging Trowel, Brush, etc.

Procedure:

1. Weigh accurately 100 g of cement and place it on a standard 90 micron IS sieve.
2. Break down any air-set lumps in the cement sample with fingers.
3. Continuously sieve the sample giving circular and vertical motion for a period of 15 minutes.
4. Weigh the residue left in the sieve. As per IS code the percentage residue should not exceed 10%.

Precautions: Air set lumps in the cement sample are to be crushed using fingers and not to be pressed with the sieve. Sieving shall be done holding the sieve in both hands and with gentle wrist motion. More or less continuous rotation of the sieve shall be carried out throughout sieving.

Observations:

Sl.No.	Weight of cement taken in g (W_1)	Weight of residue in g (W_2)	% of weight residue $(W_2 / W_1)X$
1	100	4	$\frac{4}{100} \times 100 = 4\%$

Calculations:

Weight of cement taken (W_1) = 100 g

Weight of residue (W_2) = 4 g

Result: Fineness of given sample of cement = 4%

Conclusions: We done the experiment to determine the finess of cement is 4%. As Is code the % residue should not exceed 10%.

30/06

EXPERIMENT NO: 2 DATE: 14/7/18

TITLE: **Standard Consistency of Cement**

Aim: To determine the Standard Consistency of a given sample of Cement.

Reference: **IS:4031 (part-4) -1988, IS : 5513-1976.**

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. This experiment is intended to find out the quantity of water to be mixed for a given cement to give a cement paste of normal consistency and can be done with the help of vicat apparatus.

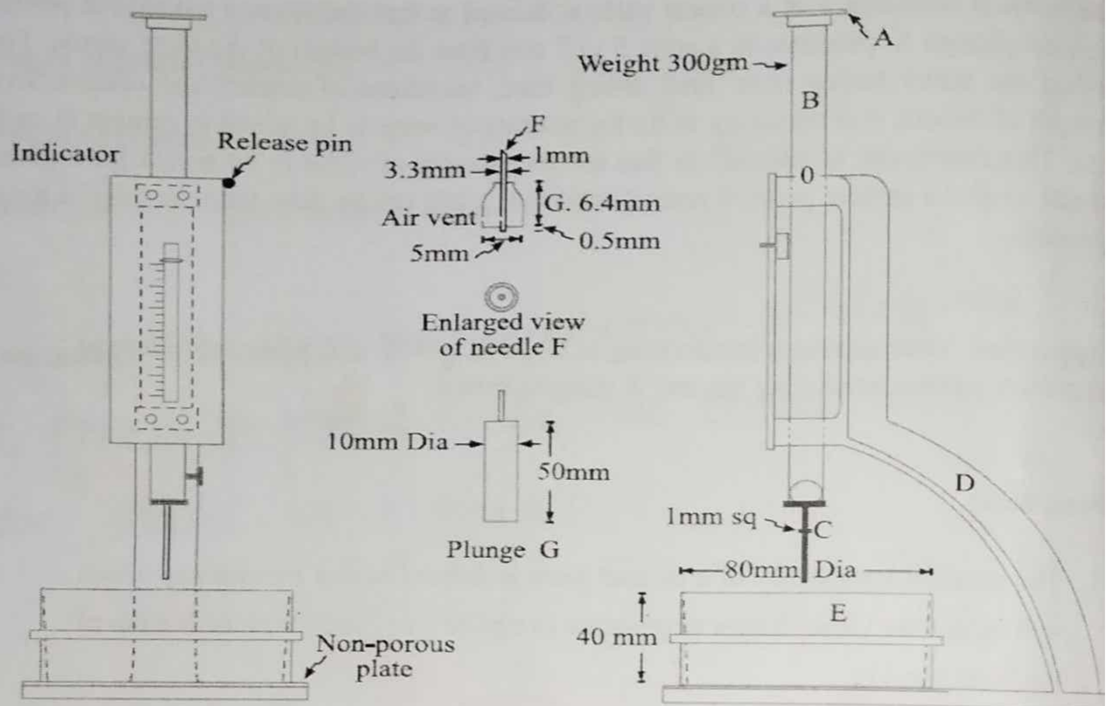
Apparatus: Vicat apparatus (conforming to IS: 5513 - 1976) with plunger (10 mm in diameter) balance, measuring jar, tray & gauging trowel.

Procedure:

1. 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.
2. Initially a cement sample of about 400 g is taken in a tray and is mixed with a known percentage of water by weight of cement, say starting from 26% and then it is increased by every 2% until the normal consistency is achieved.
3. Prepare a paste of 400 g of Cement with a weighed quantity of potable or distilled water, taking care that the time of gauging is not less than 3 minutes, nor more than 5 min, and the gauging shall be completed before any sign of setting occurs. The gauging time shall be counted from the time of adding water to the dry cement until commencing to fill the mould.
4. Fill the Vicat mould (E) with this paste, the mould resting upon a non-porous plate. After completely filling the mould, smoothen the surface of the paste, making it level with the top of the mould. The mould may be slightly shaken to expel the air.

5. Place the test block in the mould, together with the non-porous resting plate, under the rod bearing the plunger; lower the plunger gently to touch the surface of the test block, and quickly release, allowing it to sink into the paste. This operation shall be carried out immediately after filling the mould.
6. Prepare trial pastes with varying percentages of water and test as described above until the amount of water necessary for making up the standard consistency as defined in Step 1 is found.

Figure:



Observation :

Express the amount of water as a percentage by mass of the dry cement in the first place of decimal.

Sr. No.	Weight of cement (gms)	Percentage by Water on dry Cement (%)	Amount of Water added (ml)	Penetration (mm)
1	400	26%	104	30
2	400	28%	112	15
3	400	30%	120	12
4.	400	32%	128	7

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Precautions: Clean appliances shall be used for gauging. In filling the mould the operator hands and the blade of the gauging trowel shall alone be used. The temperature of cement, water and that of test room, at the time when the above operations are being performed, shall be 27 + 2 C. For each repetition of the experiment fresh cement is to be taken.

Result: Standard Consistency for the given sample of cement is = 32%.

Conclusions: We done the experiment, to determine The standard. Consistency test. is 32%. by doing This experiment

∴ the error is 4mm.

14/07/18

EXPERIMENT NO: 3 **DATE:** 21/

TITLE: **Initial And Final Setting of Cement**

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

Reference: **IS:4031 (part-5) -1988, IS : 5513-1976.**

Theory:

For convenience, 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. This time should not be more than 10 hours, which are referred to as final setting time. Initial setting time should not be less than 30 minutes.

Apparatus: Vicat apparatus (conforming to IS: 5513-1976) with attachments, Stop watch, balance, measuring jar, tray & gauging trowel.

Procedure:

Preparation of Test Block:

1. Prepare a neat cement paste by gauging 400 grams of cement with 0.85 times the water required to give a paste of standard consistency.
2. Potable or distilled water shall be used in preparing the paste.
3. The paste shall be gauged in the manner and under the conditions prescribed in determination of consistency of standard cement paste.
4. Start a stopwatch at the instant when water is added to the cement.
5. Fill the mould with the cement paste gauged as above the mould resting on a nonporous plate.
6. Fill the mould completely and smooth off the surface of the paste making it level with the top of the mould. The cement block, thus prepared in the mould is the test block.

Determination of Initial Setting Time:

1. Place the test blocks confined in the mould and rest it on the non-porous plate, under the rod bearing initial setting needle, lower the needle gently in contact with the surface of the test block and quickly release, allowing it to penetrate into the test block.
2. In the beginning, the needle will completely pierce the test block.
3. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block to a point 5 to 7 mm measured from the bottom of the mould shall be the initial setting time.

Determination of Final Setting Time:

1. Replace the needle of the Vicat apparatus by the needle with an annular attachment.
2. 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 thereon, while the attachment fails to do so.

The period elapsed 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

Precautions :Clean appliances shall be used for gauging. All the apparatus shall be free from vibration during the test. The temperature of water and that of the test room, at the time of gauging shall be 27 ^{0}C $\pm$ 2^{0} C. Care shall be taken to keep the needle straight.

Observation & Calculation:

0.85×P

Weight of cement taken = 400gm.

Weight of water taken for making specimen= 0.85 x P = $\left[0.85 \times \frac{32}{400}\right] \times 400$

Where P is the normal consistency.

= 108.8ml.

Result:

Initial Setting time of cement: 72 minutes.

Final setting time of cement:

Conclusion:

We done the experiment, to determine the initial setting and final setting time of given sample of cement. by using vicat apparatus.

21/07/18

EXPERIMENT NO: 4 **DATE:** 14

TITLE:

Soundness of Cement

Aim: To determine the soundness of the given sample of cement by "Le Chatelier" Method.

Reference: **IS:4031 (part-3) -1988.**

Theory:

It is very important that the cement after setting shall not undergo any appreciable change of volume. Certain cements have been found to undergo a large expansion after setting, causing disruption of the set and hardened mass. This will cause serious difficulties for the durability of structures when such cement is used. The unsoundness in cement is due to the presence of excess of lime than that could be combined with acidic oxide at the kiln. It is also likely that too high a proportion of magnesium content or calcium sulphate content may cause. unsoundness in cement Soundness of cement may be determined by two methods, namely Le-chatelier and Autoclave method.

The apparatus for conducting the test consists of small split cylinder of spring brass or other suitable metal of 0.5mm thickness forming a mould 30 mm internal diameter and 30mm high. On either side of the split mould are attached to indicators with pointed ends, the distance from these ends to the center of the cylinder being 165 mm. The mould shall be kept in good condition with the jaws not more than 50mm apart.

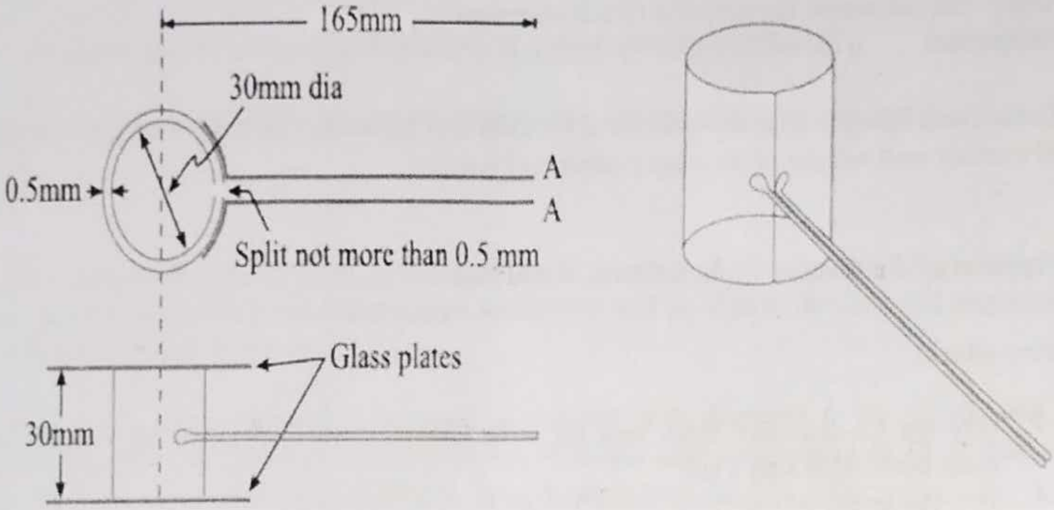
Apparatus: Le- Chatelier test apparatus, Balance, Gauging Trowel, Water Bath & measuring jar etc.

Procedure:

1. Place the lightly oiled mould on a lightly oiled glass sheet and fill it with cement paste formed by gauging cement with 0.78 times the water required to give a paste of standard consistency.
2. The paste shall be gauged in the manner and under the conditions prescribed in determination of consistency of standard cement paste, taking care to keep the edges of the mould gently together
3. While this operation is being performed cover the mould with another piece of glass sheet, place a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of $27^{0} - 2^{0}$ C and keep there for 24 hours.
4. Measure the distance separating the indicator points.
5. Submerge the moulds again in water at the temperature prescribed above.
6. Bring the water to boiling, with the mould kept submerged for 25 to 30 minutes, and keep it boiling for three hours.
7. Remove the mould from the water allow it to cool and measure the distance between the indicator points.
8. The difference between these two measurements represents the expansion of the cement.

For good quality cement this expansion should not be more than 10mm

Figure:



Observations:

Type of cement:

Normal Consistency: P= 32 %

Water required for soundness test =0.78 X P - 0.78x32 = 24.96

Initial distance = 13 mm

Final distance = 15 mm

Expansion of cement = 2 mm

Result:

Soundness of the given cement: 2 mm

Conclusion: we done the experiment to determine the soundness of cement Generally, it should not more than 10mm.

22/09/18

EXPERIMENT NO: 5 **DATE:**

TITLE: **Specific Gravity Cement**

Aim: To determine the Specific Gravity Cement
Reference: ((IS: 4031-PART 11-1988)

Definition: Specific gravity is defined as the ratio between the weight of a given volu[me] of cement and weight of an equal volume of water

Apparatus: Lechatelier flask, Balance, Water bath

Procedure:

1. **Dry the Le-chatelier flask and fill with kerosene oil or Naptha to a point on th[e] stem between 0 and 1 ml.**
2. **Dry the inside of the flask above the level of the liquid.**
3. **Immerse the flask in a constant temp water bath maintained at room temp fo[r] sufficient time.**
4. **Record the level of the kerosene oil in the flask as initial reading.**
5. **Introduce about 60 g of cement into the flask so that the level of kerosene rises t[o] about say 22 ml mark. Splashing should be avoided and cement should not b[e] allowed to adhere to the sides of the flask above the liquid.**
6. **Insert the glass nipple into the flask and roll it gently in an inclined position to fre[e] the cement from air until no further air bubble rises to the surface of the liquid.**
7. **Keep the flask again in constant temp water bath and note down the new liqui[d] level as final reading.**

Calculation

The difference between the first and final readings represents the volume of liquid displaced by the mass of cement used in test.

The density is calculated as per the below mentioned formula to the second place of decimal.

$$Density = \frac{mass of cement, g}{displaced volume, cm^3} = \frac{64}{20.7} = 3.09 \text{ g/} \approx 3.1$$

$$S.gravity = \frac{Density}{Standard.density} = \frac{3.09 \times 10^3}{1000} = 3.09 \approx 3.1$$

Results :

specific gravity of cement = 3.09 ≃ 3.1

Conclusion : We done the experimment, to determined the speific gravity of cement by [illegible] flash range (3.1 to 3.15)

16

EXPERIMENT NO: 6 **DATE:**

TITLE: **Compressive Strength of Cement**

Aim: To determine the compressive strength of a given sample of cement..

Reference: **(IS:4031-Part 6-1988), IS:10080-1982, IS:650-1966, IS:269-1976**

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.

Apparatus: The standard sand to be used in the test shall conform to IS : 650-1966, Vibration Machine, Poking Rod, Cube Mould of 70.6 mm size conforming to IS : 10080-1982, Balance, Gauging Trowel, Stop Watch, Tray & Measuring Jar.

Standard Sand: The standard sand to be used in the test shall conform to IS: 650-1991 or sand passing 100 percent through 2 mm sieve and retained 100 percent on 90 micron IS sieve.

2mm to 1mm	33.33 percent
1mm to 500 microns	33.33 percent
500mm to 90 microns	33.33 percent

Procedure:

Mix proportions and mixing:

1. Clean appliances shall be used for mixing and the temperature of the water and that of the test room at the time when the above operations are being performed shall be 27 + 2°C.
2. Place in a container a mixture of cement and standard sand in the proportion of 1:3 by weight mix it dry, with a trowel for one minute and then with water until the mixture is of uniform color.
3. The quantity of water to be used shall be as specified below.
4. In any element, it should not take more than 4 minutes to obtain a uniform colored mix.
5. If it exceeds 4 minutes the mixture shall be rejected and the operation repeated with a fresh quantity of cement, sand and water.
6. The material for each cube shall be mixed separately and the quantity of cement standard
   Sand and water shall be as follows:

   Cement = 200 gms
   Standard sand = 600 grms

$\left(\frac{32}{4}+3\right) \times 800 = \frac{8800}{100} = 88 ml.$

Water = (P/4 + 3.0) percent of combined weight of cement and sand, where p is the percentage of water required to produce a paste of standard consistency.

Moulding Specimens:

1. In assembling the moulds ready for use, cover the joints between the halves of the mould with a thin film of petroleum jelly and apply a similar coating of petroleum jelly between the contact surfaces of the bottom of the mould and its base plate in order to ensure that no water escapes during vibration.
2. Treat the interior faces of the mould with a thin coating of mould oil.
3. Place the assembled mould on the table of the vibration machine and firmly hold it is position by means of suitable clamps.
4. Securely attach a hopper of suitable size and shape at the top of the mould to facilitate filling and this hopper shall not be removed until completion of the vibration period.
5. Immediately after mixing the mortar, place the mortar in the cube mould and rod with a rod.
6. The mortar shall be rodded 20 times in about 8 seconds to ensure elimination of entrained air and honeycombing.
7. Place the remaining quantity of mortar in the hopper of the cube mould and rod again as specified for the first layer and then compact the mortar by vibrations.
8. The period of vibration shall be two minutes at the specified speed of 12,000 $\pm$ 400 vibrations per minute.
9. 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 surface with the blade of a trowel.

Curing Specimen:

1. Keep the filled moulds at a temperature of $27 + 2^0$ C in an atmosphere of at least 90 % relative humidity for about 24 hours after completion of vibration.
2. At the end of that period remove them from the moulds.
3. Immediately submerge in clean fresh water and keep them under water until testing.
4. The water in which the cubes are submerged shall be renewed every 7 days and shall be maintained at a temperature of $27\,^0C \pm 2^0C$.
5. After they have been taken out and until they are tested the cubes shall not be allowed to become dry.

Testing:

1. Test three cubes for compressive strength at the periods mentioned under the relevant specification for different hydraulic cements, the periods being reckoned from the completion of vibration.
2. The compressive strength shall be the average of the strengths of three cubes for each period of curing.
3. The cubes shall be tested on their sides without any packing between the cube and the steel plates of the testing machine.
4. One of the platens shall be carried base and shall be self adjusting and the load shall be Steadily and uniformly applied starting from zero at a rate of 350 Kgs/Cm^2/ min

. The cubes are tested at the following periods

Ordinary Portland cement	3, 7 and 28 days.
Rapid hardening Portland cement	1 and 3 days.
Low heat Portland cements	3 and 7 days.

Calculation:

Calculate the compressive strength from the crushing load and the average area over which the load is applied. Express the results in N/mm^2 to the nearest 0.05 mm^2.

Compressive strength in N/mm^2 = P/A = $\frac{77.16\times10^3}{70\times70} = 15.74\ N/mm^2$

Result :

1. The average 3 Days Compressive Strength of given cement sample is found to be ....
2. The average 7 Days Compressive Strength of given cement sample is found to be ....15.74 N/mm^2
3. The average 28 Days Compressive Strength of given cement sample is found to be ....

Conclusion: As per IS 4031 part 6 1988, IS : 10080 - 1982. IS 650 - 1966, IS : 269 - 1976.

The compressive strength

33 Grade Cement is 33 N/mm^2

43 Grade cement is 43 N/mm^2

53 Grade Cement is 53 N/mm^2

The compressive strength of cement sample is founded is 15.74 N/mm^2.

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DATE: 1/8/1

EXPERIMENT NO: 7

TITLE: Particle Size Distribution of Fine Aggregates

Aim : To Determine the fineness modulus of fine aggregate and classification based on IS:383-1970.

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

Theory:

This is the name given to the operation of dividing a sample of aggregate into various fractions, each consisting of particles of the same size. The sieve analysis is conducted to determine the particle size distribution in a sample of aggregate, which we call gradation. Many a times, 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 yardstick to indicate the fineness of sand.

The following limits may be taken as guidance: Fine sand : Fineness Modulus : 2.2 - 2.6, Medium sand : F.M. : 2.6 - 2.9, Coarse sand : F.M. : 2.9 - 3.2

Sand having a fineness modulus more than 3.2 will be unsuitable for making satisfactory concrete.

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.

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 :

I S Sieve	Weight Retained on Sieve (gms)	Percentage of Weight Retained (%)	Percentage of Weight Passing (%)	Cumulative Percentage of Retained (%)	Remark
4.75 mm	6	0.6	99.4	0.6	
2.36 mm	30	3	96.4	3.6	
1.18 mm	220	22	74.4	25.6	
600 micron	320	32	42.4	57.6	
300 micron	283	28.3	14.1	85.9	
150 micron	104	10.4	3.7	96.3	
Total	37	3.7 100 %	0	100	

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

$$\frac{0.6+3.6+25.6+57.6+85.9+96.3}{100}$$

$$= 2.696$$

Precautions:

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

Result

i) Fineness modulus of a given sample of fine aggregate is 2.69 that indicate Coarse sand/ Medium sand/

Fine sand.

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

Conclusions: We done the experiment, to determine the fineness of fine aggregate and the type of sand and the type of Grading zone.

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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

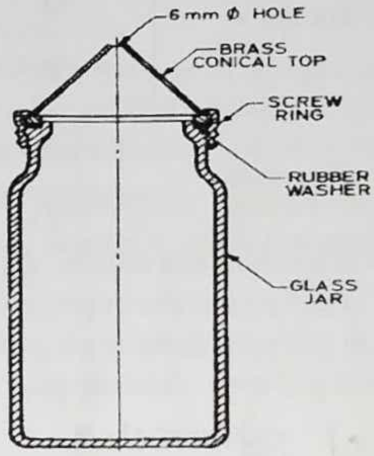
EXPERIMENT NO: 8 DATE: 21-7-18

TITLE: Specific Gravity of Fine Aggregates

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

Reference: **IS : 2386 (Part III) - 1963**

Apparatus: Pycnometer, A measuring jar, well-ventilated oven, Filter papers and funnel, etc.



Procedure:

1. A sample of about 500 g shall be placed in the tray and covered with distilled water at a temperature of 22 to 32°C. Soon after immersion, air entrapped in or bubbles on the surface of the aggregate shall be removed by gentle agitation with a rod. The sample shall remain immersed for 24 ± 1/2 hours.

2. The water shall then be carefully drained from the sample, by decantation through a filter paper, any material retained being returned & to the sample. The fine aggregate including any solid matter retained on the filter paper shall be exposed to a gentle current of warm air to evaporate surface moisture and the material just attains a free-running condition. The saturated and surface-dry sample shall be weighed (weight A).

3. The aggregate shall then be placed in the pycnometer which shall be filled with distilled water. Any trapped air shall be eliminated by rotating the pycnometer on its side, the hole in the apex of the cone being covered with a finger. The pycnometer shall be dried on the outside and weighed (weight B).

4. The contents of the pycnometer shall be emptied into the tray, care being taken to ensure that all the aggregate is transferred. The pycnometer shall be refilled with

distilled water to the same level as before, dried on the outside and weighed (weight C).

5. The water shall then be carefully drained from the sample by decantation through a filter paper and any material retained returned to the sample. The sample shall be placed in the oven in the tray at a temperature of 100 to 110°C for 24 f 1/2 hours, during which period it shall be stirred occasionally to facilitate drying. It shall be cooled in the air-tight container and weighed (weight D).

6. Calculations— Specific gravity and water Absorption shall be calculated as follows:

$$\text{Specific Gravity} = \left[\frac{D}{A-(B-C)}\right] = G = \frac{(W_2-W_1)}{(W_2-W_1)-(W_3-W_4)}$$

$$\text{Water Absorption} = \frac{100\,(A-D)}{D} = \frac{(1420-620)}{(1420-620)-(1992-1512)}$$

$G = 2.5.$

A = weight in g of saturated surface - dry sample,
B = weight in g of pycnometer or gas jar containing sample and filled with distilled water,
C = weight in g of pycnometer or gas jar filled with distilled water only, and
D = weight in g of oven - dried sample.

1] weight of pycnometer $(W_1) = 620g$
2] weight of pycnometer + sand $(W_2) = 1420g$
3] weight of pycnometer + sand + water $(W_3) = 1992g$
4] weight of pycnometer + water $(W_4) = 1512g$

Result :

i) The Specific Gravity of a given sample of fine aggregate is found to be ..2.5

ii) The Water Absorption of a given sample of fine aggregate is found to be ..—.... %

Conclusion :

We done the experiment . to determine the specific gravity of fine Aggregate . Generally sepific gravity of fine aggregate is 2.5 ...

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EXPERIMENT NO: 9

DATE: 21-7-18

TITLE: Specific Gravity of Coarse Aggregates

Aim : To determine specific gravity of a given sample of Coarse aggregate.

Reference: **IS : 2386 (Part III) - 1963**

Apparatus: A wire basket of not more than 6-3 mm mesh, A stout watertight container in which the basket may be freely suspended, well-ventilated oven, Taping rod, An airtight container of capacity similar to that of the

Theory:

The specific gravity of an aggregate is considered to be a measure of strength or quality of the material.The stones having low specific gravity are generally weaker than those with higher specific gravity values. The specific gravity test helps in identification of stone.

Water absorption gives an idea of strength of rock.The stones having a more water absorption are more porous in nature and are generally considered unsuitable unless they are found to be acceptable based on strength, impact and hardness tests.

Procedure:

1. A sample of not less than 2000 g of the aggregate shall be thoroughly washed to remove finer particles and dust, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22°C to 32°C with a cover of at least 5 cm of water above the top of the basket.
2. Immediately. after immersion the entrapped air shall be removed from the sample by lifting the basket containing it 25 mm above the base of the tank and allowing it to drop 25 times at the rate of about one drop per second. The basket and aggregate shall remain completely immersed during the operation and for a period of 24 ± 1/2 hours afterwards.
3. The basket and the sample shall then be jolted and weighed in water at a temperature of 22°C to 32°C (weight A_1).
4. The basket and the aggregate shall then be removed from the water and allowed to drain for a few

   minutes, after which the, aggregate shall be gently emptied from the basket on to one of the dry clothes, and the empty basket shall be returned to the water and weighed in water (weight A_2).

5. The aggregate placed on the dry cloth shall be gently surface dried with the cloth, transferring it to the second dry cloth when the first will remove no further moisture. The aggregate shall then be weighed (weight B).

6. The aggregate shall then be placed in the oven in the shallow tray, at a temperature of 100 to 110°C and maintained at this temperature for 24 ± 1/2 hours. It shall then be removed from the oven, cooled in the airtight container and weighed (weight C).

7. Calculations— Specific gravity, apparent specific gravity and water &sorption shall be calculated as follows:

Specific Gravity of C.A

$$\text{Specifc Gravity} = \frac{C}{A-B}$$

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

$$\text{ApparentSpecifc Gravity} = \frac{C}{C-B}$$

$$= \frac{(1530 - 620)}{(1530 - 620) - (2116 - 1512)}$$

$$\text{Water Absorption} = \frac{100(B-C)}{C}$$

A = Weight of saturated aggregate in water = $(A_1 - A_2)$

B = Weight of the saturated surface - dry aggregate in air

$G = 2.97$

C = Weight of ovendried aggregate in air.

A_1 = Weight of aggregate and basket in water

A_2 = Weight of empty basket in water

1] Weight of pycnometer (W_1) = 620 g
2] Weight of pycnometer + coarse aggregate (W_2) = 1530 g
3] Weight of " " + " " + water (W_3) = 2116
4] Weight of " + water (W_4) = 1512.

Result :

i) The Specific Gravity of a given sample of Coarse aggregate is found to be 2.97

ii) The Water Absorption of a given sample of Coarse aggregate is found to be ……… %

Conclusion : We done the experiment to determine the specific gravity of coarse aggregate. Generally specific gravity of coarse aggregate is = 2.7 - 3.

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EXPERIMENT NO: 10

DATE:

TITLE: Aggregate Crushing Test 28/7/18.

Aim : To determine the aggregate crushing value of the given specimen.

Reference: **IS : 2386 (Part IV) – 1963, IS: 383-1970**

Theory:

The aggregate crushing value gives a relative measure of the resistance of an aggregate to crushing under a gradually applied compressive load. With aggregate of _aggregate crushing value 30 or higher, the result may be anomalous, and in such cases the _ten percent fines value should be determined instead.

Apparatus:

The apparatus for the standard crushing test consists of the following:

1. Steel cylinder with open ends, and internal diameter 25.2 cm, square base plate plunger having a piston of diameter 15 cm, with a hole provided across the stem of the plunger so that a rod could be inserted for lifting or placing the plunger in the cylinder.
2. Cylindrical measure having an internal diameter of 11.5 cm and height 18 cm.
3. Steel tamping rod with one rounded end, having a diameter of 1.6 cm and length 45 cm to 60 cm.
4. Balance of capacity 3 kg with accuracy up to 1 g.
5. Compression testing machine capable of applying load of 40 tonnes, at a uniform rate of loading of 4 tonnes per minute.

Procedure:

1. The aggregate passing 12.5 mm sieve and retained on 10 mm IS sieve is selected for standard test.
2. The aggregate should be surface dry condition before testing.
3. The aggregate may be dried by heating at a temperature 100^0C to 110^0C for a period of 4 hours and is tested after being cooled to room temperature.
4. The cylindrical measure is filled by the test sample of aggregate in three layers of approximately equal depth, each layer is being tamped 25 times by the rounded end of the tamping rod.
5. After the third layer is tamped, the aggregate at the top of the cylindrical measure is leveled off by using the tamping rod as a straight edge. About 6.5 kg of aggregate is required for preparing two test samples. The test samples thus taken is then weighed. The same weight of the sample is taken in the repeat test.

6. The cylinder of the test apparatus is placed in position on the base plate, 1/3 of the test sample is placed in the cylinder and tamped 25 times by the tamping rod. Similarly, the other two parts of the test specimen are added, each layer being subjected to 25 blows.
7. The total depth of the material in the cylinder after tamping shall however be 10cm.
8. The surface of the aggregates is leveled and the plunger inserted so that it rests on this surface in level position.
9. The cylinder with the test sample and plunger at a uniform rate of 4 tonnes per minute until the load is 40 tonnes, and then the load is released.
10. Aggregates including the crushed portion are removed from the cylinder and sieved on 2.36mm IS sieve. The material which passes this sieve is collected.

The above crushing test is repeated on second sample of the same weight in accordance with above test procedure. Thus two tests are made for the same specimen for taking an average value.

Observations:

Sample Number	Total wt. of dry Sample (W_1g)	Wt. Of sample retained on 2.36 IS sieve (W_2 g)	Weight of fines Passing 2.36 IS sieve, (W_3 g)	Aggregate crushing value $\frac{W_3 \times 100}{W_1}$	Average aggregate crushing value
1.	3116	2774	342	10.97%	

Calculation:

Total weight of dry sample taken = W_1 gm. = 3116gm
Weight of the portion of crushed material retained on 2.36mm IS sieve = W_2 g. = 2774 gm
Weight of the portion of crushed material passing 2.36mm IS sieve = W_3 g. = 342gm

The aggregate crushing value is defined as the ratio of the weight of fines passing the specified IS sieve to the total weight of sample expressed as a percentage. The value is usually recorded up to the first decimal place.

Aggregate crushing value = $(W_3/W_1)X100$ => $\frac{342 \times 100}{3116}$ = 10.97%

Result : The mean of the crushing value obtained in the two tests is reported as aggregate crushing value.
= 10.97%

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Conclusion : We done the experiment to determined the Aggregate crushing test less than

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for base course = 40%

EXPERIMENT NO: 11

DATE: 7/7/18

TITLE: Aggregate Impact Test

Aim : To determine the aggregate impact value of the given coarse aggregate.

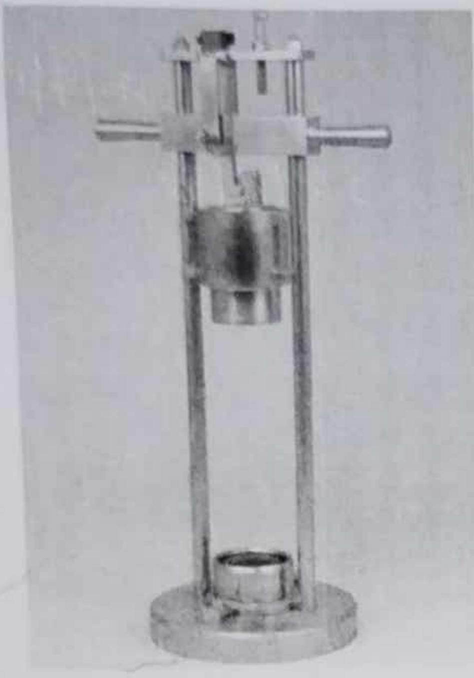
Reference: **IS : 2386 (Part IV) – 1963, IS: 383-1970**

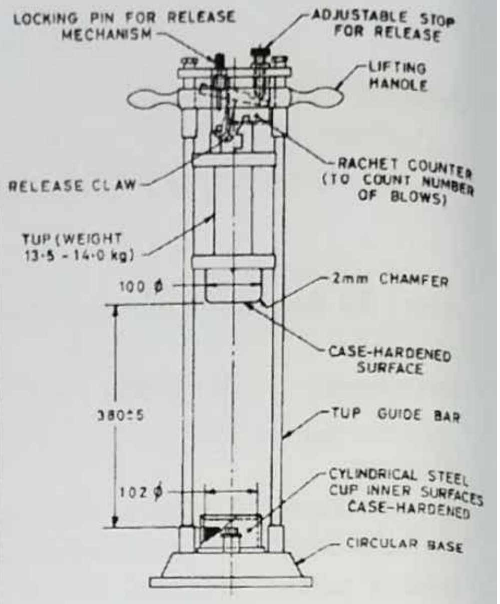
Theory:

Toughness is the property of a material to resist impact. Due to traffic loads, the road stones are subjected to the pounding action or impact and there is possibility of stones breaking into smaller pieces. The road stones should therefore be tough enough to resist fracture under impact. A test designed to evaluate the toughness of stones i.e., the resistance of stones to fracture under repeated impacts may be called an impact test for road stones.

Procedure:

1. The test sample consists of aggregates passing 12.5 mm sieve and retained on 10 mm sieve and dried in an oven for four hours at a temperature 100^0C to110^0C and cooled.
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. Further quantity of aggregates is then added up to about 2/3 full in the cylinder and 25 strokes of the tamping rod are given.
3. The measure is now filled with aggregates to overflow, tamped 25 times. The surplus aggregates are struck off using the tamping rod as straight edge.
4. The net weight of the aggregates in the measure is determined to the nearest gram and this weight of the aggregates is used for carrying out duplicate test on the same material.
5. The impact machine is placed with its bottom plate flat on the floor so that the hammer guide columns are vertical. The cup is fixed firmly in position on the base of the machine and the whole of the test sample from the cylindrical measure is transferred to the cup and compacted by tamping with 25 strokes.
6. The hammer is raised until its lower face is 38 cm above the upper surface of the aggregates in the cup, and allowed to fall freely on the aggregates.
7. The test sample is subjected to a total of 15 blows, each being delivered at an interval of not less than 1 second.
8. The crushed aggregate is then removed from the cup and the whole of it is sieved on the 2.36 mm sieve until no further significant amount passes. The fraction passing the sieve is weighed accurate to 0.1 g. The fraction retained on the Sieve is also weighed and if the total weight of the fractions passing and retained on the sieve is added, it should not be less than the original weight of the specimen by more than 1 gram, the result should be discarded and a fresh test made.





All dimensions in millimetres.
FIG. 2 AGGREGATE IMPACT TEST MACHINE

Observation:

S.No.	Details	Trail Number		Average
		1	2	
1	Total weight of aggregate sample filling the cylindrical measure = W_1 g	358	–	
2	Weight of aggregate retained on 2.36 mm sieve after the test = W_2 g	319		
3	Weight of aggregate passing 2.36 mm sieve after the test = W_3 g	39		
4	$W_1 - (W2 + W_3)$	0		
5	Aggregate Impact value = percent fines $=(W_3/W_1)X100$	10.89		

Calculation:

The aggregate impact value is expressed as percentage of fines formed in terms of the total weight of sample.

Let the original weight of the oven dry sample be W_1 g and the weight of the fraction passing 2.36 mm IS sieve be W_3 g.

Aggregate Impact value $=(W_3/W_1)X100$

$= \frac{39}{358} \times 100 = 10.89\%$

Aggregate impact value is to classify the stones in respect of their toughness property as indicated below:

Aggregate impact values	*classification*
<10%	Exceptionally strong
10-20%	Strong
20-30%	Satisfactory for road construction
>35%	Weak for road surfacing

Result: The aggregate impact value of given sample of C.A is 10.89%.

Conclusion: By conducting the aggregate impact of the C.A is 10.89%. Hence C.A samples are classif-ed as strong.

14/07/18

916
1262

EXPERIMENT NO: 12 **DATE:** 1|9|18

TITLE: Abrasion Test

Aim : To determine the abrasion value of coarse aggregate by using Los Angles machine.

Reference: **IS : 2386 (Part IV) – 1963, IS: 383-1970**

Apparatus: The apparatus consists of Los Angles Machine & Sieves. The Los Angles Abrasion Testing Machine consists of a hallow steel cylinder, closed to both ends having a inside diameter of 700 mm and inside length of 500 mm , IS.Seive:1.70mm and Steel balls etc.

Theory:
Abrasive Charge-The abrasive charge shall consist of cast iron spheres or steel spheres approximately 48 mm in. Diameter and each weight between 390 and 445 g.

Due to the movements of traffic, the road stones used in the surfacing course are subjected to wearing action at the top. Resistance to wear or hardness is hence an essential property for road aggregates, especially when used in wearing course. Thus road stones should be hard enough to resist the abrasion due to the traffic. When fast moving traffic fitted with pneumatic tyres move on the road, the soil particles present between the wheel and road surface causes abrasion on the road stone. Steel tyres of animal drawn vehicles which rub against the stones can cause considerable abrasion of the stones on the road surface. Hence in order to test the suitability of road stones to resist the abrading action due to traffic, tests are carried out in the laboratory.

Abrasion test on aggregates are generally carried out by any one of the following methods.

(i) Los Angeles abrasion test (ii) Deval abrasion test (iii)Dorry abrasion test

Of these tests, the Los Angeles abrasion test is more commonly adopted as the test values of aggregates have been correlated with performance of studies. The ISI has suggested that wherever possible, Los Angeles abrasion test should be preferred.

In addition to the above abrasion tests, another test which is carried out to the test the extent to which the aggregates in wearing surface get polished under traffic, is '*Polished stone value*' test. Samples of aggregates are subjected to an accelerated polishing test in a machine and friction test is carried out on the polished specimen. The results of this test are useful only for comparative purpose and specifications are not yet available.

The principles of Los Angeles abrasion test is to find the percentage wear due to the relative rubbing action between the aggregates and steel balls used as abrasive charge; pounding action of these balls also exist while conducting the test. Some investigators believe this test to be more dependable as rubbing and pounding action simulate the field conditions where both abrasion and impact occur. Los Angeles abrasion test has been standardized by the ASTM, AASHO and also by the ISI. Standard specifications of Los Angeles abrasion values are also available for various types of pavement constructions

Procedure:

1. Clean aggregates dried in an oven at 105-110^{0}C to constant weight, conforming to any one of the grading A to G as per table 1 is used for the test.
2. The grading or gradings used in the test should be nearest to the grading to be used in the construction. Aggregates weighing 5 kg for grading A,B,C or D and 10 kg for gradings E, F or G may be taken as test specimen and placed in the cylinder.
3. The abrasive charge is also chosen in accordance with Table 1 depending on the grading of the aggregate and is placed in the cylinder of the machine.
4. The cover is then fixed dust-tight. The machine is rotated at a speed of 30 to 33 revolutions per minute. The machine is rotated for 500 revolutions for gradings A, B, C & D, for gradings E, F & G; it shall be rotated for 1,000 revolutions.
5. The machine should be balanced and driven in such a way as to maintain uniform peripheral speed.
6. After the desired number of revolutions, the machine is stopped and the material is discharged from the machine taking care to take out entire stone dust. Using a sieve of size larger than 1.70 mm IS sieve, the material is first separated into two parts and the finer portion is taken out and sieved further on a 1.7 mm IS sieve.
7. The portion of material coarser than 1.7mm is washed and dried in an oven at 105 to 110^{0}C to constant weight and weighed correct to one gram.

Observation

Type of aggregate = coarse aggregate   Weight of charge = 4584± 25

Grading = B   No. of revolution = 500

No. of spheres used = 11

S.No.	Details	Test Number 1	2	Average
1	Weight of specimen = W_1 g	5000		
2	Weight of specimen after abrasion test, coarser than 1.70 mm IS sieve = W_2 g	4598		
3	Loss in weight due to wear = $(W1 - W_2) = W_3$ g	402		
4	Percentage wear = =(W_3/W_1)X100	8.04		

percentage wear = $\frac{402}{5000} \times 100 = 8.04\%$

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Calculations:

The difference between the original and final weights of the sample is expressed as a percentage of the original weight of the sample is reported as the percentage wear.

Let the original weight of the aggregate = W_1 g

Weight of aggregate retained on 1.70mm IS sieve after the test = W2 g.

Loss in weight due to wear = $(W1 - W_2) = W_3$ g

Los Angeles abrasion value, % = $(W_3 / W_1) \times 100$

Table 1: Grading of Test Samples

*Tolerance of ± 12 percent permitted.

Sieve size (square hole) Passing (mm)	Weight of test sample in gm Retained on (mm)	A	B	C	D	E	F	G
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			

Table 2: Selection of Abrasive Charge

6.3
4.75
2.36

Grading	No of Steel balls	Weight of charge in 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

<25% for wearing course.

Results: The abrasion value of coarse aggregate = 8.04%

Conclusion :- We done the experiment and determined the abrasion value of coarse aggregate.

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EXPERIMENT NO: 13

DATE: 4-8-18

TITLE: Shape Tests

a) Flakiness Index - (width wise)

Aim : To determine the Flakiness Index of given aggregates.

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

Apparatus: The apparatus consists of a standard thickness gauge, IS sieves of sizes 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3 mm and a balance to weigh the samples.

Theory:
The Flakiness index of aggregates is the percentages by weight of particles whose least dimension (thickness) is less than three-fifths (0.6) of their mean dimension. The test is not applicable for sizes smaller than 6.3 mm.

Procedure:

1. The sample is sieved with the sieves mentioned in table-1.
2. A minimum of 200 pieces of each fraction to be tested are taken and weighed=W_1gm.
3. In order to separate flaky materials, each fraction is then gauged for thickness on a thickness gauge.
4. The width of the slot used should be of the dimensions specified in column (3) of table-1 for the appropriate size of material.
5. The amount of flaky material passing the gauge is weighed to an accuracy of at least 0.1 percent of the test sample.

TABLE-1

Size of aggregate		Thickness gauge (0.6 times the mean sieve), mm
Passing through IS sieve mm	Retained on IS sieve, mm	
1	2	3
63.0	50.0	33.90
50.0	40.0	27.00
40.0	25.0	19.50
31.5	25.0	16.95
25.0	20.0	13.50
20.0	16.0	10.80
16.0	12.5	8.55
12.5	10.0	6.75
10.0	6.3	4.[illegible]

Observation

Size of aggregates		Weight of the fraction consisting of at least 200 pieces, g	Thickness gauge size, mm	Weight of aggregates in each fraction passing thickness gauge, g
Passing through IS sieve, mm	Retained on IS sieve, mm			
1	2	3	4	5
63	50		23.90	
50	40		27.00	
40	25		19.50	
31.5	25 retain →	5286	16.95	952
25	20 →	3144	13.50	560
20	16 →	1622	10.80	372
16	12.5		8.55	
12.5	10.0		6.75	
10.0	6.3		4.89	
Total		$\sum W = 10052$		$\sum w = 1884$

Calculation :

In order to calculate flakiness index of the entire sample of aggregates first the weight of each fraction of aggregate passing and retained on the specified set of sieves is noted.

Let the weight of the flaky material passing the gauge be w_1 g. Similarly the weights of the fractions passing and retained the specified sieves, W_1, W_2, W_3 etc. are weighed and the total weight $W_1 + W_2 + W_3 + \ldots = Wg$ is found. Also the weights of material passing each of the specified thickness gauges are found $= w_1, w_2, w_3 \ldots$ and the total weight of material passing the different thickness gauges $= w_1 + w_2 + w_3 + \ldots = w$ g. is found. Then the flakiness index is the total weight of the flaky material passing the various thickness gauges expressed as a percentage of the total weight of the sample gauged.

Flakiness Index = $(w_1+w_2+w_3\ldots\ldots / W_1+W_2+W_3\ldots)X100$

$$= \frac{1884}{10052} \times 100 = 18.74\%$$

Results: Flakiness index of the given aggregate is 18.74%

04/08/18

Conclusion: We conclude the flakiness index should not exceed is more than 15%. ... is less than 6.3mm should not be used. It is used as asphalt

b) Elongation Index – (Length wise)

Aim : To determine the Elongation Index of given aggregates.

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

Apparatus: The apparatus consists of length gauge, sieves of the sizes specified and the balance.

Theory:

The particle shape of aggregate is determined by the percentages of flaky and elongated particles contained in it. For the base course and construction of bituminous and cement concrete types, the presence of flaky and elongated particles are considered undesirable as they may cause inherent weakness with possibilities of breaking down under heavy loads.

The elongation index of an aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than one and four fifth times (1.8 times) their mean dimension. The elongation test is not applicable to sizes smaller than 6.3 mm.

Procedure:

1. The sample is sieved through the IS sieves specified in table 1 .
2. A minimum of 200 pieces of each fraction is taken and weighed.
3. In order to separate elongated material, each fraction is then gauged individually for length in a length gauge.
4. The gauge length used should be those specified in column 4 of the table for the appropriate material.
5. The pieces of aggregates from each fraction tested which could not pass through the specified gauge length with its long side are elongated particles and are collected separately to find the total weight of aggregate retained on the length gauge from each fraction.
6. The total amounts of elongated material retained on the length gauge are weighed to an accuracy of at least 0.1 percent of the weight of the test sample.

1) For bituminous carpet (wearing course) – 30%.
2) Asphalt (or) concrete / bituminous mix = 25%.
Bituminous macadam = 15%.

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TABLE-1

Size of aggregate		Thickness gauge (0.6 times the mean sieve), mm
Passing through IS sieve mm	Retained on IS sieve, mm	
1	2	3
63.0	50.0	-
50.0	40.0	81.00
40.0	25.0	58.50
31.5	25.0	-
25.0	20.0	40.50
20.0	16.0	32.40
16.0	12.5	25.60
12.5	10.0	20.20
10.0	6.3	14.70

Observation:

Size of aggregates		Weight of the fraction consisting of atleast 200 pieces, g	Length gauge size, mm	Weight of aggregates in each fraction retained on length gauge, g
Passing through IS sieve, mm	Retained on IS sieve, mm			
1	2	3	4	5
63	50		-	-
50	40		81.0	
40	25		58.0	
31.5	25		-	-
25	20	3144	40.50	234
20	16	1622	32.4	257
16	12.5		25.5	
12.5	10.0		20.2	
10.0	6.3		14.7	
Total		W= 4766		x= 491

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Calculation:

In order to calculate the elongation index of the entire sample of aggregates, the weight of aggregate, which is retained on the specified gauge length from each fraction, is noted.

With its longest side and those elongated pieces which do not pass the gauge are separated and the total weight determined = W_1 gm.

Similarly the weight of each fraction of aggregate passing and retained on specified sieve sizes are found, W_1, W_2, W_3……. And total weight of the sample determined = $W_1 + W_2 + W_3 + \ldots = W$ gm.

Also the weight of material from each fraction retained on the specified gauge length are found = $x_1, x_2, x_3 \ldots$ and the total weight retained is determined = $x_1 + x_2 + x_3 + \ldots = X$ gm.

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

Elongation Index =

$$(x_1+x_2+x_3+\ldots / W_1+W_2+W_3+\ldots) X100 = \frac{491}{4766} \times 100$$

$$= 10.30\%$$

Results: The elongation index of given aggregate = 10.3%

Conclusion: we done the experiment the elongation of given sample is 10.30%. It is less than 10% suitable else not suitable.

04/08/14

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EXPERIMENT NO: 14 **DATE:**

TITLE: Mix Design

Aim: Design M20 Grade of Concrete by using IS-10262-2009

a] Grade designation = m20

b] Type of cement = OPC 53

c] max. Nominal size Agregate = 20mm

d] mini. Cement Content = 300 kg/m³

e] Maximum w/c ratio = 0.55

(f) workability = 50m

(g) exposure condition = mlid

(h) Method of Concerte = pumping placement

(i) Degree of supervision = Good

k] Type of Aggregate = Crushing angular aggregate

(m) maximum cement Content = 450 kg/m³

(n) Chemical admixture type = superplasticizer.

Test Data material

a) cement used = OPC 53 grade

(b) s.gravity of cement = 3.15

(c) Chemical admixtura = NO.

(d) s.gravity = 2.75

1) C. A =

2) fi A = 2.74

(e) water absorption

1) C. A = 0.5%.

2) F.A = 1%.

A-6 mix Calculation

a) volume of concrete = 1m³

b) volume of cement = mass of cement / s.gravity of cement × 1/100

= 250/315 × 1/100 = 0.111 m³

(c) Volume of water = mass of water / s.gravity of water × 1/100

= 186/1 × 1/100 = 0.186 m³

(d) volume of aggregate =

1) Volume of C.A = 0.696 m³ × 0.56 = 0.389 m³

2) volume of fA = 0.696 × 0.44

(e) mass of C.A = s.gravity volume × 0.389

= 0.389 × 1000 × 2.74

= 1065.3 kg/m³

(f) mass of F.A =

0.306 × 2.74 × 1000

= 8384.44 kg/m3

Cement = 372 kg/m³

water = 186 kg/m3

w/c = 0.5

Cement : water = CA

372 : 838.44 = 1065.3

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f) Free moisture = Nil

(1) C.A = Nil

(2) F.A = ?

(g) Sieve analysis

I] C.A =

3- Targent mean Compressive strength

$f_{ck}' = f_{ck} + 1.65s$

f_{ck}' = Target average compressive strength @ 28 days

f_{ck} = characteristic compressive strength @ 28 days.

s = standard deviation.

standard deviation s = 5 N/mm²

∴ Target strength = 20+1.65×5

= ~~118.203 N/mm²~~

= 103.5 N/mm²

A-4 selection of w/c.

from table IS 456, maximum w/c = 0.55

0.20 < 0.55 here ok.

A-5 selection of water content

maximum water content = 186 lit

estimated w/c for 100mm slump = $186 + \frac{6}{100} \times 186$

= 1976

Calculation of cement content

w/c ratio = 0.40

Cement content = $\frac{140}{0.~~50~~}$ = 350 kg/cm³

From the table 5 of IS 456, minimum content

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EXPERIMENT NO: 15 **DATE:** 22-9-18

TITLE: <u>Workability Test</u>

a) Slump Cone Test

Aim: To determine the relative consistency of freshly mixed concrete by the use of Slump Test.

Theory :

The word —workability or workable concrete signifies much wider and deeper meaning than the other terminology —consistency often used loosely for workability. Consistency is a general term to indicate the degree of fluidity or the degree of mobility.

The factors helping concrete to have more lubricating effect to reduce internal friction for helping easy compaction are given below:

1) Water Content
2) Mix Proportions
3) Size of Aggregates
4) Shape of Aggregates
5) Surface Texture of Aggregate
6) Grading of Aggregate
7) Use of Admixtures.

Slump Test:

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in laboratory or at site of work. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of the placability of the concrete. The pattern of slump is shown in Fig. It indicates the characteristic of concrete in addition to the slump value. If the concrete slumps evenly it is called true slump. If one half of the cone slides down, it is called shear slump. In case of a shear slump, the slump value is measured as the difference in height between the height of the mould and the average value of the subsidence

Apparatus :

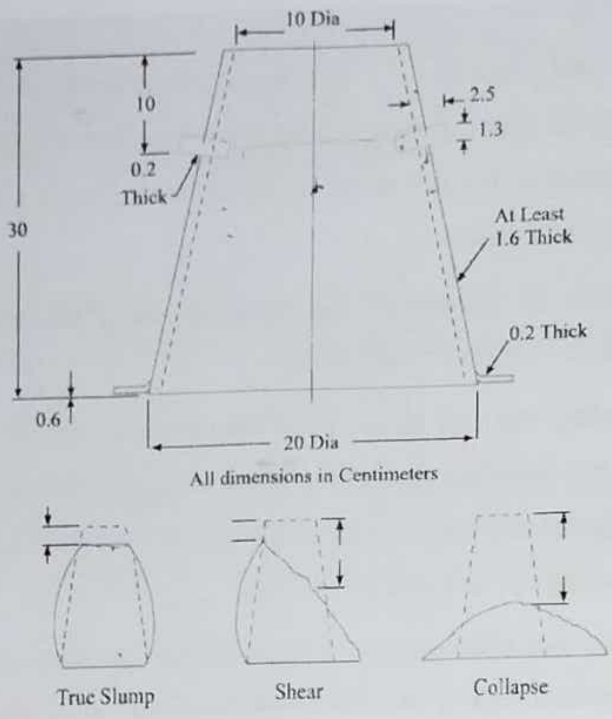
The Slump Cone apparatus for conducting the slump test essentially consists of a metallic mould in the form of a frustum of a cone having the internal dimensions as under: Bottom diameter: 20 cm, Top diameter: 10 cm, Height: 30 cm and the thickness of the metallic sheet for the mould should not be thinner than 1.6 mm

Weights and weighing device, Tamper (16 mm in diameter and 600 mm length), Ruler, Tools and containers for mixing, or concrete mixer etc.

Procedure:

1. Dampen the mold and place it on a flat, moist, nonabsorbent (rigid) surface. It shall be held firmly in place during filling by the operator standing on the two foot pieces. Immediately fill the mold in three layers, each approximately one third the volume of the mold.
2. Rod each layer with 25 strokes of the tamping rod. Uniformly distribute the strokes over the cross section of each layer.
3. In filling and rodding the top layer, heap the concrete above the mold before rodding start. If the rodding operation results in subsidence of the concrete below the top edge of the mold, add additional concrete to keep an excess of concrete above the top of the mold at all time.
4. After the top layer has been rodded, strike off the surface of the concrete by means of screeding and rolling motion of the tamping rod.
5. Remove the mold immediately from the concrete by raising it carefully in the vertical direction. Raise the mold a distance of 300 mm in 5 ± 2 sec by a steady upward lift with no lateral or torsional motion.
6. Immediately measure the slump by determining the vertical difference between top of the mold and the displaces original center of the top surface of the specimen. Complete the entire test from the start of the filling through removal of the mold without interruption and complete it within 2½ min.
7. If a decided falling away or shearing off of concrete from one side or portion of the mass occurs, disregard the test and make a new test on another portion of the sample. If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of concrete from the mass of specimen, the concrete lacks necessary plasticity and cohesiveness for the slump test to be applicable.
8. After completion of the test, the sample may be used for casting of the specimens for the future testing

Figure:



Observation : 65mm, 55mm, 85mm

1. The vertical difference between top of the mold and the displaces original center of the top surface of the specimen ..68...... mm
2. The pattern of slump is shown True Slump/Shear Slump/ Collapse Slump

Results: The relative consistency of freshly mixed concrete by use of slump test is the pattern of slump is True slump is 68 mm.

Conclusion: We done the experiment to determine the consistency of freshly mixed concrete of slump by using slump cone test.

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Date: 22-9-18

b) Compaction Factor Test

Aim: To determine the relative consistency of freshly mixed concrete by the use of Compacting Factor Test.

Theory:

5-7mm

Compacting Factor Test: 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. The method applies to plain and air-entrained concrete, made with lightweight, normal weight or heavy aggregates having a nominal maximum size of 40 mm or less but not to aerated concrete or no-fines concrete.

Apparatus:

Compacting Factor Apparatus, Trowel, Scoop about 150 mm long., Balance capable of weighing up to 25 kg with the sensibility of 10 g. Weights and weighing device, Tamper (16 mm in diameter and 600 mm length), Ruler, Tools and containers for mixing, or concrete mixer etc.

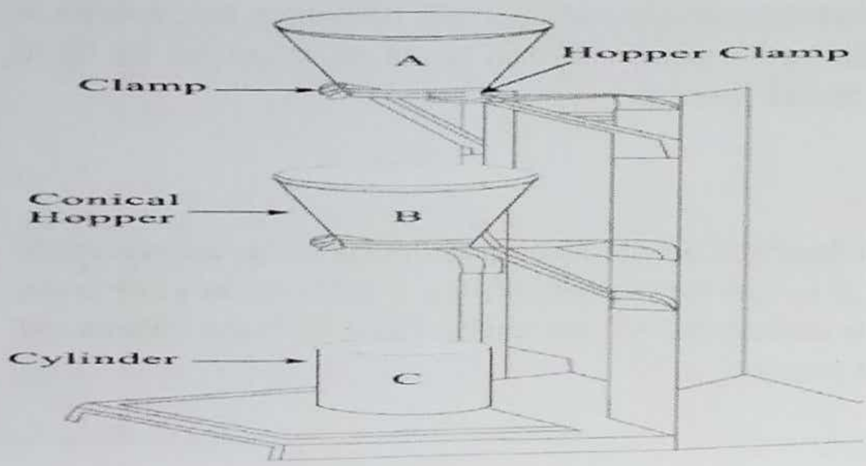
Procedure :

1. The internal surface of the hoppers and cylinder shall be thoroughly clean and free from superfluous moisture and any set of concrete commencing the test.
2. The sample of concrete to be tested shall be placed gently in the upper hopper using the scoop. The trap door shall be opened immediately after filling or approximately 6 min after water is added so that the concrete fails into the lower hopper. During this process the cylinder shall be covered.
3. Immediately after the concrete has come to the rest the cylinder shall be uncovered, the trap door of the lower hopper opened and the concrete allowed falling to into the cylinder.
4. For some mixes have a tendency to stick in one or both of the hoppers. If this occurs the concrete shall be helped through by pushing the tamping rod gently into the concrete from the top.
5. The excess of concrete remaining above the level of the top of the cylinder shall then be cut off by holding a trowel in each hand, with the plane of the blades horizontal, and moving them simultaneously one from each side across the top of the cylinder, at the same time keeping them pressed on the top edge of the cylinder. The outside of the cylinder shall then be wiped clean. This entire process shall be carried out at a place free from vibration or shock.
6. Determine the weight of concrete to the nearest 10 g. This is known as "weight of partially compacted concrete", W_p.
7. Refill the cylinder with concrete from the same sample in layers approximately 50 mm depth. The layers being heavily rammed with the compacting rod or vibrated to obtain full compaction. The top surface of the fully compacted

concrete shall be carefully struck off and finished level with the top of the cylinder. Clean up the outside of the cylinder.

8. Determine the weight of concrete to the nearest 10 g. This is known as "weight of fully compacted concrete", W_f.
9. The compacting factor, Fc can be calculated as follows:

$$\text{The compacting factor} = \frac{\text{"weight of partially compacted concrete"}.\ W_p.}{\text{"weight of fully compacted concrete"}.\ W_f.}$$



Figure

Observation:

The compacting factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete. It shall normally be stated to the nearest second decimal place.

S.No	**Description** (kg)	Sample
1.	Weight of Empty Cylinder (W1)	7.454
2.	Weight of Cylinder + Free Fall Concrete (W2)	19.426
3.	Weight of Cylinder + Hand Compacted Concrete (W3)	19.816
4.	Weight of Partially Compacted Concrete (W_p=W2-W1)	11.972
5.	Weight of Fully Compacted Concrete (W_f=W3-W1)	12.362
6.	The Compacting Factor =W_p/W_f	0.968

Results: the relative Consistency of freshly mixed concrete by use Compaction factor is 0.968

Conclusions : We done the experiment, to determine compaction factor of freshly mixed Concrete

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EXPERIMENT NO: 16 **DATE:** 22-9-18

TITLE: Compressive Strength of Concrete Cube

Aim: Determine Compressive Strength of Cubic Concrete Specimens

Objective: The test method covers determination of compressive strength of cubic concrete specimens. It consists of applying a compressive axial load to molded cubes at a rate which is within a prescribed range until failure occurs.

Apparatus: Compressive testing machine, Cube mould 150mm size, Weights and weighing device, Mixer & Vibrator.

Procedure:

1) **Sampling of Materials** - Samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air-dried condition. The cement samples, on arrival at the laboratory, shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material.
2) **Proportioning** - The proportions of the materials, including water, in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work.
3) **Weighing** - The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of the batch.
4) **Mixing Concrete** - The concrete shall be mixed by hand, or preferably, in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired number of test specimens.
5) **Mould** - Test specimens cubical in shape shall be 15 × 15 × 15 cm. If the largest nominal size of the aggregate does not exceed 2 cm, 10 cm cubes may be used as an alternative. Cylindrical test specimens shall have a length equal to twice the diameter.
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° ± 2°C for 24 hours ± ½ 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 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.
9) 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.
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.

Observations:

S.No	Compressive Strength(N/mm^2)		
	3Days	7Days	28Days

Results:

Conclusions