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LABORATORYMANUAL

CONCRETE TECHNOLOGY LAB

DEPARTMENT OF CIVIL ENGINEERING

RGUKT BASAR

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List of Experiments

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1.Fineness of cement test.

AIM: for a given sample of cement, determine the fineness of cement.

BACKGROUND INFORMATION:

Strengthdevelopmentofconcreteistheresultofthereactionofwaterwith cementparticles.Thereactionalwaysstartswiththecementavailableatthe surfaceofparticles.Thuslargerthesurfaceareaavailableforreaction,greateris therateofhydration.Rapiddevelopmentofstrengthrequiresgreaterdegreeof fineness.Rapidhardeningcement,therefore,requiresgreaterdegreeoffineness.

Thecementshouldbeuniformlyfine.Ifthecementisnotuniformlyfine,the concrete made out of it will have poor workability and will required a larger quantity of water while mixing. Also bleeding can occur i.e. even before the concrete set water comes out of the surface due to settlement of concrete particles.

However, too much fineness is also undesirable, because the cost of grindingthecementtohigherfinenessisconsiderable.Finercementdeteriorates morequicklywhenexposetoairrequiresgreateramountofgypsumforproper retardation. Also amount of water requirement for the paste of standard consistency isgreater.

Maynumberofparticlesshouldhavesize<100µ.Smallestparticlemay havesizeof1.5µ.Averagesizeofparticlecanbe10µ.Particlebelow3µplays majorroleinone-daystrength.Particlessizefrom3µto25µplaysimportantroll in28daysstrength.Forthecommercialcement,25to30%particleshouldbeless than7µinsize.Itis,hence,necessarytoensurecertainamountofcoarsenessin thecement,butmaximumlimittothiscoarsenessshellbeasfollowtoobtain minimum degree ofgrinding.

Aftersievingthecementonastandard90µI.S.testsieve,theresidueby massshellnotexceed10%ofordinaryPortlandcement&5%forrapidhardening cement.Therearethreemethodofcheckingfinenessofcement.

1. By dry sieving as describedabove,
2. Blaineairpermeabilitymethodand
3. By wetsieving.

To study method 2 and 3 reference shall be made to I.S.: 4031.

MAIN EQUIPMENTS:

1. Simple mass balance.
2. I.S. Test sieve of 90µ (I.S.400-1962).
3. Trowel.
4. Tray 30mm X30cm.
5. Bristlebrushwith25cmhandle

PROCEDURE:

1. Massaccurately100gmofcementandplaceitonastandardI.S.Sieve90µ.
2. Breakdownanyairsetlumpsinthesamplewithfingers,butdonotrubonthe sieve.
3. Continuouslysievethesamplebyholdingthesieveinbothhandsandgivinga gentlewristmotionormechanicalsieveshakermaybeusedforthispurpose.The sievingshouldcontinuefor15minutes.

PRECAUTION:

1. Thecleaningofthesieveshouldbedoneverygentlywiththehelpofabrushi.e.-25mmor40mmbristlebrushwith25cmhandle.
2. After sieving, the cement must be removed from the bottom surface o sieve gently.
3. Simplebalanceshouldbecheckedbeforeuse.
4. Sievingmustbecarriedoutcontinuously.

OBSERVATION:

	Sample-I	**Sample-II**
Mass of cement – gms (M))	100	100
I.S. Sieve –Microns	90/75	90/75
Sieving time –Min	15	15
Mass Retained on sieve – gms(M1)		
% Mass Retained on sieve = (M1/M) × 100		

RESULTS:

Conclusion:

2.STANDARD CONSISTENCY OF CEMENT

AIM: To determine the quantity of water required to produce a cementpaste of standardconsistency.

DEFNITION: Standard consistency is defined as that consistency which will permit the Vicat's plunger to penetrate to a point 5 to 7 mm from the bottom of the Vicat mould when the cement is tested.

APPARATUS: 1. Vicat's apparatus, Mould,Plunger.

2. Standardtrowel
3. Stopwatch.
4. Weighingbalance

DESCRIPTION:

The Vicat's apparatus consists of a frame and a moving rod weighing 300 gm. The plunger is kept at the lower end of the rod. It is a cylinder 10 mm. Diameter, A pointer connected to the rod will move along with it when it is released, over a graduated scale kept in front of it. The cement paste to be tested is kept in the Vicat's mould kept below the rod on a glass plate.

PROCEDURE:

1. Carefully weigh 400 gm of cement and place it on a non-poroussurface.
2. Form a crator in the centre in which add about 100 to 120 cc. ofwater.
3. Thoroughly mix the cement with water and fill, the Vicat's mould withthe paste.
4. The interval from the moment of adding water to the dry cement to the moment of commencing to fill the mould is known as the time ofgauging

and shall not be less than 3 minutes and more than 5 minutes. Lower the plunger gently and test the penetration.

1. If the penetration is between 5 to 7 mm from the bottom of the mould the quantity of water added is the requiredconsistency.
2. Otherwise repeat the test with different percentages of water until the required penetration is obtained. Express the amount of water as a percentage by weight of the drycement.

OBSERVATIONS:

S. No.	Weight of Cement W_1	Weight of water W_2	Reading on scale mm	W_2 / W_1	Standard consistency

CALCULATIONS: Weight of cement taken $=W_1$.

Weight of water added when the plunger has a penetration of 5 to 7 mm from the bottom of the mould = W_2

Percentage of water for standard consistency $p = (W_2 / W_1) \times 100$

RESULT: Percentage of water for standard consistencyis

Conclusion:

3.INITIAL AND FINAL SETTING TIME OF CEMENT

AIM: To determine the initial and final setting times of cement.

APPARATUS: The Vicat's apparatus, Needle, Annular ring, Trays, Balance and Weights.

PROCEDURE:

1. Preparation of Test Block: Prepare a neat cement paste by gauging the cement with 0.85 times the water required to give the paste of standard consistency. Start a stopwatch at the instant when water is added to the cement. Fill the Vicat's mould with a cement paste with in three to five minutes after addition of water. Fill the mould completely and smooth off the surface of this paste making it level with the top of the mould. The cement block thus prepared in the mould is testblock.
2. Clean appliances shall be used for gauging. The temperature of water and that of the test room at the time of gauging shall be with in $(27 \pm 2)^{0}$C.
3. During the test the block shall be kept at a temperature of $(27 \pm 2)^{0}$C and at least 90% relativehumidity.

a) Determination of Initial SettingTime:

Place the test block confined in the mould and resting on the nonporous plate, under the rod bearing the 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. In the beginning the needle will completely pierce the test block. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block for 5 to 7 mm measured from the bottom of the mould. The period elapsing between the time when water is added to the cement and this time shall be initial settingtime.

b) Determination of Final SettingTime:

Replace the needle of the Vicat's apparatus with the needle with a circular attachment. The cement shall be considered as finally set, when upon lowering the needle gently to the surface of the test block the needle makes an impression there on, while the attachment fails to do so. In other words the paste has attained such hardness that the centre needle does not pierce through the paste more than0.5mm.

The period elapsing between the time when water is added to the cement and the time at which the needle makes an impression on the surface on the test block while the attachment fails to do so shall be the final setting time.

OBSERVATIONS:

INITIAL SETTING TIME:

S. No.	Time	Reading on the scale of Vicat's apparatus

FINAL SETTING TIME:

S. No.	Time	Reading on the scale of Vicat's apparatus

RESUL T:

=Initial setting time ofthecement

= Final setting time ofthecement

Conclusion:

4.Slump cone test

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

APPARATUS: Iron Pan to mix concrete, weighing machine, trowel, slump cone, scale and tamping rod.

DESCRIPTION: The slump cone is a hollow frustum made of thin steel sheet with internal dimensions as, the top diameter 10cm, the bottom diameter 20 cm, and height 30 cm .It stands on a plane non- porous surface. To facilitate vertical lifting from molded concrete it is provided with a suitable guide attachment and suitable foot places and handles. The tamping rod is 16mm dia 60cm long and is bullet pointed at the lower end.

THEORY:

Unsupported concrete, when it is fresh, will flow to the sides and a sinking in height will take place. This vertical settlement is called slump. Slump is a measure indicating the workability of cement concrete and also slump gives an idea of W/C ratio needed for concrete to be used for different works. Slump increases with W/C ratio. A concrete is said to be workable if it can be easily mixed and easily placed compacted and easilyfinished.

PROCEDURE:

Mixes are prepared with W/C. ratio 0.4, 0.5, 0.55 and 0.6. For each mix take

C.A. =10kg, F.A. =5kg and Cement = 2.5kg.

1) Mix the dry constituents to get a uniform color and then addwater.
2) The internal surface of the mould is to be thoroughly cleaned and place on a smooth, horizontal, rigid and non-absorbentsurface.
3) Place the mixed concrete in the cleaned slump cone in 4 layers each approximately ¼ in height of the mould . Tamp each layer 25 times with tampingrod.
4) Remove the cone immediately, rising it slowly and carefully in the verticaldirection.
5) As soon as the concrete settlement comes to a stop, measure the subsidence of the concrete in mm, which gives theslump.

OBSERVATIONS:

S. No.	W/C Ratio	Slump	Type of Slump
1	0.45		
2	0.5		
3	0.55		
4	0.6		
5	0.65		

RESULT:

SPECIFICATIONS:

As per I.S: 456 the degree of workability is classified as follows.

Degreeofworkability	Slump
Verylow	0mm to25mm
Low	25mm to50mm
Medium	50 mm to 100mm.
High	100 mm to 175mm.

Conclusion:

5.VEE–BEE consistometer test.

AIM: To find workability of concrete by Vee-Bee consistency test in terms of Vee Bee Seconds

APPARATUS:
Vee Bee consistometer, Stopwatch, Balance, Tray, Tamping rod, measuring jar, Weights and Trowels.

THEORY:
The consistometer is used for determining the consistency of concrete by vibrating and transforming a concrete specimen from the shape of conical frustum into a cylinder.

DESCRIPTION:
The consistometer consists of a

1. A vibrator table, which vibrates a rate of 3000 vibrations / min.
2. A metal pot, which holds the specimen when the concrete is vibrated. It is secured to the vibrator table by bolts.
3. Slump cone of 300 mm high, 200 mm at the bottom and 100 mm at the top (Open both ends).
4. Swivel arm holder: A tube, which is fixed the rear of the base of the vibrator table. It has 4 positioning slots for swivel arm to position the metal cone over the slump cone or Perspex disc on the specimen or to position both of them away.
5. Swivel arms the Swivel moves freely inside the swivel arm holder. A metal rod and a guide sleeve are fixed to the swivel arm. The graduated metal rod passes through the guide sleeve.
6. Metal cone - this is in the form of a frustum of cone with open ends (funnel). This is fixed to the swivel arm
7. Graduated rod
8. Tamping rod. A metal rod of 16 mm x 60 cm. long with one end bullet ended.

PROCEDURE:

1. Position the metal cone over the slump cone. Place the concrete inside the slump cone in 4 layers each approximately 1/4 of the height. Strokes are applied by the rounded end of the tamping rod. Distribute the strokes in a uniform manner over the cross section.
2. After the top layer has been rodded, position the metal cone of the swivel arm away, and strike off the concrete, level with the top of the cone using a trowel so that the mould is exactly filled.

3. Remove any material spilled inside the metal pot or sticking on to the side of the slump filled.
4. Position the Perspex disc over the cone and note down the reading on the graduated rod (L1). After keeping the disc away, lift the slump cone vertically and remove.
5. Position the disc over the concrete. Note down the reading of the graduated rod (L2). The difference in the readings gives the slump in Centimeters.
6. Switch on the vibrator starting a stopwatch simultaneously. Allow the concrete to spread out in the pot. When the whole concrete surface uniformly adheres to the Perspex disc, stop the watch, simultaneously, switch off the vibrator. Note down the time in seconds. Also note the reading on the graduated rod (L3).
7. The consistency of the concrete is expressed in Vee-Bee degrees which are
equal to the time in seconds.
8. Repeat the procedure of different W/C ratios viz.: 0.4, 0.5, 0.55, 0.6 & 0.65.
9. Draw a graph between slump in centimeters and Vee – Bee Degrees.
10. Knowing the dia of the disc and the height of the concrete after Vibration (30+ L1 – L3), the Volume of the concrete can be computed.

Observations:

S. No.	W/C Ratio	Slump (mm)	Vee–Bee Seconds

RESULT:

SPECIFICATIONS:

INFERENCE:

6.Compaction factor test

AIM: To determine the workability of concrete mix of given proportions by compacting factor test.

APPARATUS: Compacting factor apparatus, Balance, Weights, Trays, Tamping rod and Trowels.

DESCRIPTION: Compacting factor apparatus consists of two conical hoppers mounted above a cylindrical mould and fixed to a stand one above the other. The hoppers are provided with trap doors at the bottom. The dimensions of various parts are given below.

1. Upper Hopper Dimensions in cm.

Top internal dia. 25.4

Bottom 12.7

Internal height 27.9

2. Lower Hopper Dimension in cm.

Top internal dia. 22.9

Bottom 12.7

Internal height 22.9

3. Cylinder Dimension in cm.

Internal Diameter 15.2

Internal Height 30.5

Distance between bottom of upper hopper and top of lower hopper is 20.3 cm. Distance between bottom of lower hopper and top of cylinder is 20.3 cm.

DEFINITION:

Compacting factor is defined as the ratio of weight of partially compacted concrete to the weight of fully compacted concrete.

PROCEDURE:

Four mixes are prepared with W/C., ratios 0.4, 0.5, 0.55, 0.6 and 0.65. For each mix take 2.5 kg of cement, 5 kg of fine aggregate and 10 kg of coarse aggregate.

1. Mix the dry constituents to get a uniform color and then add water.
2. The internal surfaces of the hoppers and cylinder are thoroughly cleaned.
3. The sample of concrete to be tested is placed gently in the upper hopper.
4. The hopper is filled level with its brim and the trap door is opened so that the concrete falls into the lower hopper.
5. If concrete has a tendency to stick to the sides of the hopper, the concrete should be slowly pushed down by inserting the tamping rod into the concrete.
6. Immediately after the concrete comes to door of the lower hopper, it is opened and the concrete is allowed to fall into the cylinder.
7. The excess of concrete in the cylinder above the top is cut off and made level with trowels. The outside of cylinder is wiped clean.
8. The weight of the concrete in the cylinder is then determined. This weight is known as weight of partially compacted concrete.
9. The cylinder is refilled with concrete from the same sample in six layers and each is rammed thoroughly.
10. The top of fully compacted concrete should be carefully struck off level with top cylinder. The outside of the cylinder is wiped a clean and the weight of fully compacted concrete is found.

OBSERVATIONs

S. No.	W/C	W_1	W_2	$W_2–W_1$	W_3	$W_3–W_1$	C.F. =($W_2–W_1$ / $W_3–W_1$)

CALCULATIONS:

Weight of cylinder W1 =

Weight of cylinder + partially compacted W2 =

Weight of Partially compacted concrete (W2-W1) =

Weight of cylinder + fully compacted concreteW3 = Weight of fully compacted concrete (W3-W1) = Compacting factor (W2-W1) / (W3-W1). =

RESULTS:

Maximum workability of concrete is occurring at a water / cement ratio of

SPECIFICATIONS:

According to IS 456, the degree of workability in classified as follows:

Degree of workability Compacting factor.

Very Low 0.75 to 0.8

Low 0.8 to 0.85

Medium 0.85 to 0.92

High 0.92 & above.

GRAPH:

A graph is drawn with water / cement ratio on x-axis and values of compaction factor on y-axis.

INFERENCE:

7.Flow table test.

Aim:

To measure the flow and workability of the concrete by using flow table

Apparatus required:

Flow table test apparatus

Procedure:

The apparatus consists of flow table about 76cm. in diameter over which concentric

circles are marked. A mould made from smooth meta

l casing in the form of a frustum of a cone is used with the following internal dimensions. The base is 25cm. in diameter upper surface 17cm. in diameter and height of the cone is 12cm.

1.The table top is cleaned of all gritty material and is wetted. The mould is kept on the center of the table, firmly held and is filled in two layers.

2.Each layer is rodded 25 times with a tamping rod 1.6cm in diameter and 61cm long rounded at the lower tamping end.

3.After the top layer is rodded evenly the excess of concrete which has overflowed the mould is removed.

4.The mould if lifted vertically upward and the concrete stands on its own without support.

The table is then raised and dropped 12.5cm 15times in about 15 seconds.

5.The diameter of the spread concrete is measured in about 6 directions to the nearest 5mm

and the average spread is noted. The flow of concrete is the percentage increase in the

average diameter of the spread concrete over the base diameter of the mould.

6.The value could range anything from 0 to 150 per cent. A close look at the pattern of spread of concrete can also give a good indication of the characteristics of concrete such as tendency for segregation.

Spread diameter in cm -25

Flow, per cent = -------------------------------------x 100

25

Result:

The flow percent of the concrete is

Viva Voce:

1.

Define workability of concrete?

2.

What is the significance of flow test?

3.

What is the water cement ratio for workable concrete?

8. Bulking of sand test.

AIM: To ascertain the bulking Phenomena of given sample of sand.

APPARATUS: Special Vessel for unit volume, tray, balance and weights,

THEORY:

Increase in volume of sand due to presence of moisture is known as Bulking of sand.

Bulking is due to the formation of thin film of water around the sand grains and the interlocking of air in between the sand grains and the film of water.

When more water is added a sand particles got submerged and volume again becomes equal to dry volume of sand.

To compensate the bulking effect extra sand is added in the concrete so that the ration of coarse to fine aggregate will not change from the specified value.

Fine sands shown greater percentage of bulking than coarse sands with equal percentage of Moisture.

PROCEDURE:

Compact the sand in three layers in the vessel, each layer being given 25 strokes, and Strike level at top.

Weigh it and dump it into a tray. Add a certain percent of water by weight (say 2%) of dry compacted tray.

Add a certain percent of water by weight (say 2%) of dry compacted sand.

Mix, well till uniformly moist. Fill the container with the wet sand without any tamping strike tip surface level, and find weight of the wet loose sand.

Repeat this with moisture contents of 4,6,8,10,12,14,16,18 and 20%.

Observations

S. No.	% of water added (X%)	Wt. of wet sand W_2 gm	Wt. of dry sand in wet sand W_3 gm. $= W_2 / (1+0.01\,x)$	Bulk Factor $= W_1 / W_3$	Bulking % = (B.F-1) * 100
1	2				
2	4				
3	6				
4	8				
5	10				
6	12				
7	14				
8	16				
9	18				
10	20				

CALCULATIONS:

Weight of unit volume of dry compacted sand = W_1 Weight of loose wet sand of unit volume = W_2

If moisture content be x% in sand, and if W_3 is weight of dry sand in W_2 of loose wet sand,

Then $W_2 = W_3 + (0.01) \times W_3$

$W_3 = W_2 / (1+0.01\,X)$.

Bulking factor (B.F.) $= W_1 / W_3$.

Bulking percentage $= (W_1 - W_3) \times 100 / W_3$.

or (B.F. –1) X 100.

GRAPH: Plot graph between B.F. on (Y- axis) and water content on (X- axis).

RESULT:

1. Moisture content at maximum bulking=
2. Percentage of maximum bulking=

SPECIFICATION:

Interface:

9. Silt content test.

Aim: To determine silt content in a given sample of fine aggregate by sedimentationmethod.

Theory: This is a gravimetric method for determining the clay, fine silt and fine dust, which includes particles up to 20 microns. Differences in the nature and density of materials or in the temperature at the time of testing may vary the separation point.

Apparatus:

A watertight screw-topped glass jar of dimensions similar to a 1-kg fruit preserving jar, A device for rotating the jar about its long axis, with this axis horizontal, at a speed of 80 ± 20 rev/min,
A sedimentation pipette, A 1 000-ml measuring cylinder, scale, well-ventilated oven, Taping rod etc.

Chemical:
A solution containing 8 g of sodium oxalate per liter of distilled water shall be taken. For use, this stock solution is diluted with distilled water to one tenth (that is 100 ml diluted with distilled water to one liter).

Procedure:
1.Approximately 300 g of the sample in the air-dry condition, passing the 4.75-mm IS Sieve, shall be weighed and placed in the screw-topped glass jar, together with 300 ml of the diluted sodium oxalatesolution. The rubber washer and cap shall be fixed, care being taken to ensure water tightness.
2.The jar shall then be rotated about its long axis, with this axis horizontal, at a speed of 80 ± 20rev/min for a period of 15 minutes
3.At the end of 15 minutes, the suspension shall be poured into the 1 000-ml measuring cylinder and the residue washed by gentle swirling and decantation of successive 150-ml portions of sodium oxalate solution, the washings being added to the cylinder until the volume is made up to 1000 ml.
4.The suspension in the measuring cylinder shall be thoroughly mixed by inversion and the tube and contents immediately placed in position under the pipette.
5.The pipette A shall then be gently lowered until the tip touches the surface of the liquid, and then lowered a further 10 cm into the liquid.
6.Three minutes after placing the tube in position, the pipette A and the bore of tap B shall be filled by opening B and applying gentle suction at C.
7.A small surplus may be drawn up into the bulb between tap B and tube C, but this shall be allowed to run away and any solid matter shall be washed out with distilled water from E.

8.The pipette shall then be removed from the measuring cylinder and its contents run into a weighed container, any adherent solids being washed into the container by distilled water from E through the tap B.

9.The contents of the container shall be dried at 100 to 110°C to constant weight, cooled and weighed.

10.Calculations—The proportion of fine silt and clay or fine dust shall then be calculated from the following formula:

Percentage of Clay and Fine silt or fine dust: $\frac{100}{W_1}\left(\frac{1000 w_2}{V} - 0.8\right)$

Conclusion / Result:

The clay, fine silt and fine dust content of given sample of fine aggregate is found to be .... %

10. Fineness modulus for fine aggregate and course aggregate test.

AIM: To determine the grading of Aggregate and fineness modulus of coarse and fine Aggregate by sieving them dry.

BACKGROUND INFORMATION:

In cement mortar, Aggregate contains 55% of volume of mortar. While in case of mass concrete, Aggregate contains 85% of volume of concrete. Size of Aggregate used in concrete ranges from several cms to fraction of millimeters. The maximum size actually used varies but in any mix, particles of different sizes are incorporated, the particle' size distribution being referred to as grading. The grading means the art of combining various sizes of particles composing the Aggregates to produce dense and economic mixture using minimum cement per unit volume for a given strength. The principle of grading is that smaller particles fill up the voids between larger particles. .

Strength of concrete depends on Water/Cement ratio provided that mix is workable. The most important factor for making concrete workable is well gradation of Aggregates. Well-graded Aggregates mean least voids i.e. it will required minimum paste to fill up voids. Less quantity of water and· cement is used that means it will have more strength, durability and economy.

For the making of good quality concrete it is a common practice to use Aggregate at least in two size groups, the main division being between fine Aggregates often called sand not larger than 4.75 mm and coarse Aggregates, which comprises of material at least (75mm in size. 4.75mm size sieve makes the distinction between fine and coarse Aggregates.

Sieve analysis is carried out to test the grading of Aggregates. The Aggregates are sieved successfully through the sieves. Confirming to I.S 460-1962. Sieve analysis is the operation of dividing the sample of Aggregates into fraction, each consist the particles of the same size.

The test sieves used for concrete Aggregates have square opening and their properties are as per I.S. 460-1962. Sieves are described by the size of opening (in mm) for larger sizes, and the microns for sieves smaller then 1.18mm size, one micron being 10-6 meters.

All sieves are mounted in frames, which can rest. The material retained on each sieve after shaking represents the fraction of Aggregates coarser than the sieve in question but finer than the sieve used before 20mm diameter frame is used for 4.75mm or smaller size and 30cm to 45cm diameter frames for 4.75mm and larger sizes. 4.75 are dividing line between the fine and coarse Aggregates.
The sieves used for concrete Aggregates consist of a series in which the clear opening in any sieve is one half of the opening of the next larger sieve size.

Sieving can be done either manually or mechanically. In the manual operation the sieve is shaken giving movements in all possible directions to give chance to all particles for passing.

Before the sieves analysis is performed the Aggregate sample has to be air dried in order to avoid lumps of fine particles and to prevent clogging of finer sieves. . .
The Aggregate are sieved successfully through each sieve given in table-1 and the percentage· by mass retained on each sieve recorded in the tabular form; Standard grading is given in table. 2 and 3 the Aggregates shall be described as belonging to any of the grading zones based on the results obtained by the sieve analysis.

The results of sieve analysis are also to be recorded graphically, ordinate indicating percentage passing and abscissa indicating sieve size on logarithmic scale. Logarithmic scale is used to represent sieve of large variation in size.

Fineness modulus of coarse and fine Aggregate is also determined. Fineness modulus is defined as the sum of the cumulative % retained on the sieves of standard series divided by 100. The fineness modulus is an empirical factor and can be looked upon as the massed average size of a sieve on which the material is retained, the sieves being counted from the finest. This can be used for measuring slight variation in the Aggregate from the same sources a day-to-day check. Smaller the value of fitness modulus finer is the sand. For good grade of concrete fitness modulus of sand should be between 2.25-3.35 may not be satisfactory in grading. Some fraction of particles may absent, which does not define well-graded F.A.

For high- strength & durable concrete, sand from zone I to III can be used but mix should be properly designed. For reinforced. Concrete sand of zone IV should not be used. If course is used in concrete, it will result in harshness, bleeding & segregation (i.e. stony mix) and if fine sand is used in concrete, water requirement will be more & it affects durability of concrete.

Sieve analysis for coarse Aggregates shall be carried out on 9 sieves: (40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron). For fine Aggregate 6 sieves (4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron) are used.

Table-1: Coarse Aggregate

I.S. Sieve (mm)	**% passing for single size Aggregates of normal size(mm)**				**% passing from graded Agg. Of nominal size (mm)**	
	63	**40**	**20**	**10**	**40**	**20**
80	100	-	-	-	100	-
63	85-100	100	-	-	-	-
40	0-30	85-100	100	-	95-100	100

20	0-5	0-20	85-100	-	30-70	95-100
10	-	-	0.5-20	85-100	10-35	25-55
4.75	-	-	0.5	0-20	0-5	0-10

Table-2:- Fine Aggregate: GRADING

I.S. Sieve	**Percentage passing for**			
	Grading Zone 1	**Grading Zone 2**	**Grading Zone 3**	**Grading Zone 4**
10.00mm	100	100	100	100
4.75mm	90-100	90-100	90-100	90-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-900	55-100	90-100
600micron	15-34	35-59	60-79	80-100
300micron	5-20	8-30	12-40	15-50
150micron	0-10	0-10	0-10	0-15

For Crushed stone sand permissible % passing through 150 micron is 20%

MAIN EQUIPMENTS:

Set of sieves confirming to IS 460-1962, known quantities of coarse and fine Aggregates.

PROCEDURE:

1. Massed quantities of materials shall be taken and sieved successfully through the specified sieves. Sieves shall be cleaned before used.

2. Each sieve shall shake separately over a clean tray for a period of not less than 2 minutes. the shaking shall be done with motions backward and forwards, left to right, circular clockwise and counter clockwise with frequent jarring, so that material is kept moving over solve surface.

3. On completion of sieving the material retained over each sieve together with any

4. Material cleaned from the mesh shall be massed on a balance and recorded. .

5. The percentage by mass retained by each sieve shall be calculated and the results shall be recorded.

6. The cumulative %is calculated.

OBSERVATIONS:

Mass of Coarse Aggregate = kg.

And Mass of fine Aggregate = kg

Sieve Size	**Mass Retained(gm)**	**Cumulative Mass retained (gm)**	**Cumulative % Massretained**	**Cumulative % Masspassing**
Fine Aggregate:				
4.75mm				
2.36mm				
1.18mm				
600 µ(0.06mm)				
300µ (0.03mm)				
150µ (0.015mm)				

Below 150µ`				
Total				
Fineness modulus =				
(b)Coarse Aggregate:				
40mm				
20mm				
12.5mm				
10mm				
4.75mm				
2.36mm				
1.18mm				
600µ				
300µ				
150µ				
Below 150µ				
Total				
Fineness modulus =				

CURVE: Draw grading curves for both the materials on semi log graph paper.

DISCUSSION: Specified limits of fineness modulus.

Maximum size of Aggregates	Fitness Modulus	
	Minimum	**Maximum**
Fine Agg.	2	3.5
Coarse Agg.		
20mm	6	6.9
40mm	6.9	7.5
80mm	7.5	8.0
150mm	8.0	8.5

It may happen that in some cases the Agg. Is not uniformly graded but still may confirm to the specified fineness modulus. So the fineness shall be taken as a guide only

Result:

	Fine Aggregate	Coarse Aggregate	Comment
Fineness modulus Confirm to limits? Grading curve confirms to specification?			

Conclusion:

11. Soundness test for cement.

AIM: Determination of soundness of cement with Le- chatelier apparatus.

REFERENCE: IS. 269-1979

BACKGROUND INFORMATION:

It is very important that cement after setting shall not undergo any appreciable change of volume. The unsoundness of cement is caused by the undesirable expansion of some of its constituents after setting large change in volume result in disintegration and several cracking. The unsoundness is due to presence of free lime, magnesia and sulphate. The free lime hydrates very slowly because it is covered by thin film of cement, which prevents directs contact between lime and water. After setting time and moisture hydrates.

Unsoundness may reduce 6%

1. Mgo up to <0.5%
2. Fine grinding
3. Allowing the cement to acrate for several days
4. Through mixing
5. Magnesium up to 6%

Le-chatelier test for free time only but presence of magnesia cannot be indicated. It is >3% soundness by Autoclave test.

MAIN EQUIPMENTS:

Le-chatelier apparatus, two glass plates

PROCEDURE:

1. 50 gms Of cement is weighted and quantity of water required is 0.78 time std. consistency (0.78P) & mix it in standard manner.

2. Fill this mixture in to the mould and keep on the glass plate
3. The mould covered on the top with another glass plate.
4. The whole assembly immersed in water for 24 hrs at 27-32 degrees C temperature.
5. Measure the mould again in water, which is boiled at boiling temperature for 25- 30 min.
6. Keeps it boiling for 3 hrs.
7. Remove the mould from water and allow it to cool.
8. Measure the distance between indicator points.

OBSERVATION TABLE:

Initial distance between indicator (mm) (1)	**Distance between indicator after submerging in water for 24hrs (2)**	**Distance between indicator after submerging in boiling water for 3 hrs(3)**	**Expansion of cement (4) = (3)-(2)**

RESULT: The expansion of ordinary Portland cement is mm.

COCLUSION: The expansion of ordinary Portland, rapid, low heat cement should not exceed 10 mm.

12. Specific gravity of cement.

AIM: To determine the specific gravity of cement

DEFINITION: Specific gravity of cement is defined as the ratio of weight of a given volume of cement at a given temperature to the weight of an equal volume of distilled water at the same temperature both weights being taken in air.

APPARATUS: Specific gravity bottle, weighing balance

MATERIAL: Kerosene free of water, naphtha having a specific gravity not less than 0.7313 shall be used in the specific gravity determination.

PROCEDURE:

1. Wt. of empty dry specific gravity bottle = W1
2. Wt. of bottle + Cement (filled 1/4 to 1/3) = W2
3. Wt. of bottle + Cement (Partly filled) + Kerosene = W3
4. Wt. of bottle + Kerosene (full). = W4
5. Wt. of bottle + water (full) = W5

Specific gravity of kerosene Sk = (W4 – W1) / (W5 – W1)

(W2 –W1) x Sk

Specific gravity of Cement = --------------------------- (W4 – W1) – (W3 – W2)

RESULT: Specific Gravity of cement =

SPECIFICATIONS:

Conclusion:

13. Compressive strength of concrete cube.

AIM: To determine compressive strength for

1. M 15 conc. a) w/c = 0.55 b) w/c = 0.60 c) w/c = 0.65
2. M 20 conc. a) w/c = 0.45 b) w/c = 0.5 c) w/c = 0.55

BACKGROUND INFORMATION:

Concrete is primarily strong in compression and in actual construction. The concrete is used in compression. Concrete, which is strong in compression, is also good in other quality. Higher the compression strength better is the durability.

Bond strength is important in R.C.C. Compressive strength also indicated extent of control exercised during construction. Resistance to abrasion and volume stability improves with the compressive strength. Test for compressive strength in therefore very important in quality control of concrete.

Preparation and conduct of compressive strength is comparatively easy and gives consistent results than tensile strength or flexural strength. This test for determining compressive strength of concrete has therefore assumed maximum importance.

Cylinder used is 150 mm diameter and 300 mm height. Whenever cylinders are used for compressive strength results, the cube strength can be used to calculate with the following formula:

Minimum cylinder strength required = 0.8 × compressive strength specified for 150 mm cube.

MAIN EQUIPMENTS:

1. Cube moulds 100 mm size and 150 mm size as per I.s.156-1959 cylinder mould 150 mm diameter X 300 mm high as per I.s.156-1959.
2. Towels.
3. G.I. sheet for mixing.
4. Tamping rod of 16 mm diameter and 600 mm long bullet point at the lower end.
5. Glass plate thicker than 6.5 mm or machined metal plate 1.3 mm thickness and of dimensions greater than 175 mm.
6. 100 tone compression testing machine.

PROCEDURE:

1. Fill concrete into the mould in layer approximately 50 mm deep by moving the scoop around the top edge of the mould as the concrete slides form it, in order to ensure the symmetrical distribution of the concrete within the mould.

2. Compaction:

If compaction is done by hand tamps the concrete with the standard rod, strokes being uniformly distributed over the cross section of the mould. For 15cm cube, number of strokes should not be less than 35 per layer and 25 strokes for 10cm cubes. For the cylindrical specimens, number of strokes shall not be 30 per layer. Tamp the sides of the mould to close the voids left by tamping bars.

3. If compaction is done by vibration then each layer is compacted· by means of a suitable vibrating hammer or vibrator or vibrating table. Mode and quantum of vibration of laboratory specimen shall be nearly the same as those adopted in actual operation

4. Capping:

Cylindrical specimens are capped with a thick layer of neat cement generally 2 or 3 hours after molding operations. Caps shall be formed by Blass plate or metal plate. Work the plate on the mould till its lower surface rests on the top of the mould. The cement for the capping shall be mixed to a stiff plate for about 2 hours before it is to be used in order to avoid tendency of the cap to shrink. Adhesive of the paste to the cawing to the capping plate can be avoided by coating the plate with a thin of oil or grease.

5. Curing:

Storing the specimen in a place for 24 + 0.5 hours from time addition of water to dry ingredients~ Remove the specimen from the mould and keep it immediately submerged in clean, fresh water and keep them until taken out just prior to rest. Water in which the specimen is submerged shall be renewed at every 7 days.

6. Test For Compressive Strength:

6.1. Age of test: Usually testing is done after 7 days and 28 days. The days being measured from the time water is added to the dry ingredients.

6.2. Test at least 3 specimens at a time.

6.3. Test the specimen immediately or removal from the water and white they are still in the wet condition. Wipe off the surface water. If the specimens are received dry. Keep them in water for 24 hours before testing.

6.4. Note down the dimension nearest to 0.2 mm and also the mass.

7. Placing Specimen In The Machine:

7.1 Place the specimen in such a manner that the load shall be applied to opposite sides of the cube as cast i.e. not to the top and the bottom.

7.2 Align carefully the center of the thrust of the spherica1 seated plate.

7.3 Apply load slowly and at the rate of 14 N/mm2 /min. till the cube breaks.

7.4 Note the maximum load and appearance of the concrete failure i.e. whether· Aggregates have broken or cement paste separates from the Aggregates etc.

8. Precautions:

See that the load is applied in the center. Even a small eccentricity can cause serious deviation.

Observations:

Sr. No.		Specimen	1	2	3	4	5
1.	Concrete mix M w/c Ratio						
2.	Identification No.						
3.	Produced on	Date					
		Time					
4.	Tested on	Date					
		Time					
5.	Age of testing	Hrs.					
6.	Measurements	Length l mm					
		Breath b mm					
		Height d mm					
7.	Area in compression	A=a × b mm^2					
8.	Volume	V = A × c mm^3					
9.	Mass of cube	(M_c) N					
10.	Unit wt. ofcube	W_c /Vkg/m^3					
11.	Breaking load	(P)N					
12.	Compressive strength	f_{ck} = P/A N/mm^2					
13.	Avg. compressive St.	f_{ck} = N/mm^2					
14.	%Deviationfromavg. value						

RESULT:

Thecompressivestrengthoftheconcreteat28days$f_{ck}$is

1.M 15 w/c= 0.55, f_{ck} =

2.M15w/c=0.60,f_{ck}=

3.M15w/c=0.65,f_{ck}=

4.M15w/c=0.45,f_{ck}=

5.M15w/c=0.50,f_{ck}=

6.M15w/c=0.55,f_{ck}=

CONCLUSION: