Fineness of Cement by Sieving

AIM :

To determine the fineness of cement by sieving.

SCOPE OF THE TEST:

To determine the percentage of residue of a given sample of cement on 90 μ I.S. sieve and assess the rate of hydration of cement when water is added to it.

THEORY :

When water chemically reacts with the cement, the development of strength of concrete takes place. This reaction always starts at the surface of the cement particles and is called hydration of cement. Thus larger the surface area available for reaction, greater is the rate of hydration and strength development, which in turn depends on the degree of fineness. The fine grinding of cement clinkers to smaller sizes results in greater number of particles, the summation of their surface area being comparatively larger than those of coarser particles. Therefore early strength development requires greater degree of fineness and rapid hardening cements are more finely ground.

The fineness of cement is indicated by minimum specific surface area which is defined as surface area of cement particles per gram of cement. For ordinary Portland cement, the specific surface area should not be less than 2250cm^2/g. The specific surface area of cement can be measured by Blaine's air permeability apparatus.

However, fineness of cement can be indirectly checked by sieving method which is easily done in the laboratory. Additionally, this method is indicative of formation of lumps in the cement due to poor storage or chemical reaction with atmospheric moisture.

Although fineness of cement particles is useful but two much fineness is also undesirable because of high cost of grinding, susceptibility to quick deterioration under exposure to air and increased shrinkage but less prone to bleeding. Again greater fineness requires greater amount of gypsum for proper retardation of setting.

INSTRUMENTS/ EQUIPMENTS REQUIRED :

(1) Test sieve 90μ size (conforming to I.S:460 part-I)

(2) A nylon or bristle brush (25mm to40mm bristle length) for cleaning the sieve

(3) Tray of size 300mm x300mm

(4) Trowel

(5) Weighting balance of accuracy 0.002gm (minimum)

SPECIMEN/MATERIALS REQUIRED :

The sample of cement shall be taken according to the requirement of I.S:3535 and relevant standard specification for the type of cement being tested. The representative sample of cement selected shall be thoroughly mixed before testing.

PROCEDURE :

(1) About 100gm of cement is accurately weighed and placed on a standard 90μ I.S sieve.

(2) Any air set lumps in the sample is broken down with finger but rubbing on the sieve should be avoided.

(3) The sample is continuously sieved by a mechanical sieve shaker or manually by holding the sieve in both the hands and giving a gentle wrist motion for a period of 15minutes.

(4) The residue is weighed which should not exceed the following limits

(a) For ordinary cement ⩾ 10%

(b) For rapid hardening cement ⩾ 5%

PRECAUTIONS :

(1) After sieving, the cement must be removed from the bottom surface of the sieve gently .

(2) Cleaning of the sieve should be done very gently with bristle brush .

OBSERVATION & CALCULATION :

The mass of cement retained on 90 μ I.S sieve is calculated as percentage of original mass.

Sample No.	Mass of sample cement (W) gm	Mass retained on sieve (W_1) gm	% of mass retained $= \left(\frac{W_1}{W}\right) \times 100$	Mean percentage
1.				
2.				
3.				

RESULT :

Fineness value of cement by sieving = _____%.

CONCLUSION :

(Comment on the result by comparing with standard values)

Normal Consistency of Cement

2

AIM :

To determine normal consistency for a given sample of cement.

SCOPE OF THE TEST :

To determine the quantity of water required to produce a cement paste of standard consistency. It is used as a parameter for other tests like setting time, soundness and compressive strength test of cement.

THEORY :

Consistency of a cement paste qualitatively means relative plasticity or stiffness which is also a quantitative measure of water requirement to satisfy surface lubrication of cement particles to make a workable mix. Therefore the normal consistency of a cement is defined as the percentage of water by weight of cement required to produce a cement paste of standard plasticity or arbitrary stiffness which permits a standard plunger of 10 mm diameter to penetrate up to a depth of 5 to 7mm above the bottom of the Vicat's mould .

The percentage of water in the cement paste for standard consistency (P) may vary from cement to cement and even from batch to batch of the same cement .Standard consisting values of ordinary Portland cement(OPC) generally ranges from 28% to 35%expressed as a percentage by weight of dry cement.

INSTRUMENTS / EQUPIMENTS / APPARATUS REQUIRED :

1. Vicat's apparatus with plunger of 10mm dia and 50mm long and Vicat's mould with glass /mild steel base plate .The Vicat's mould is of single piece truncated conical form with internal dia 70±5mm at top, 80±5mm at the bottom and a height of 40 ± 0.2mm or it may be split type having internal dia of 80±0.1mm of same height.
2. Balance of capacity 1 kg, sensitive up to 0.1gm.
3. Trowel (small, weighing about 210g)
4. Standard spatula
5. Non- porous plate or marble stone slab.
6. Enamel trough, measuring glass (100cc – 2nos).
7. Thermometer, stop watch etc.

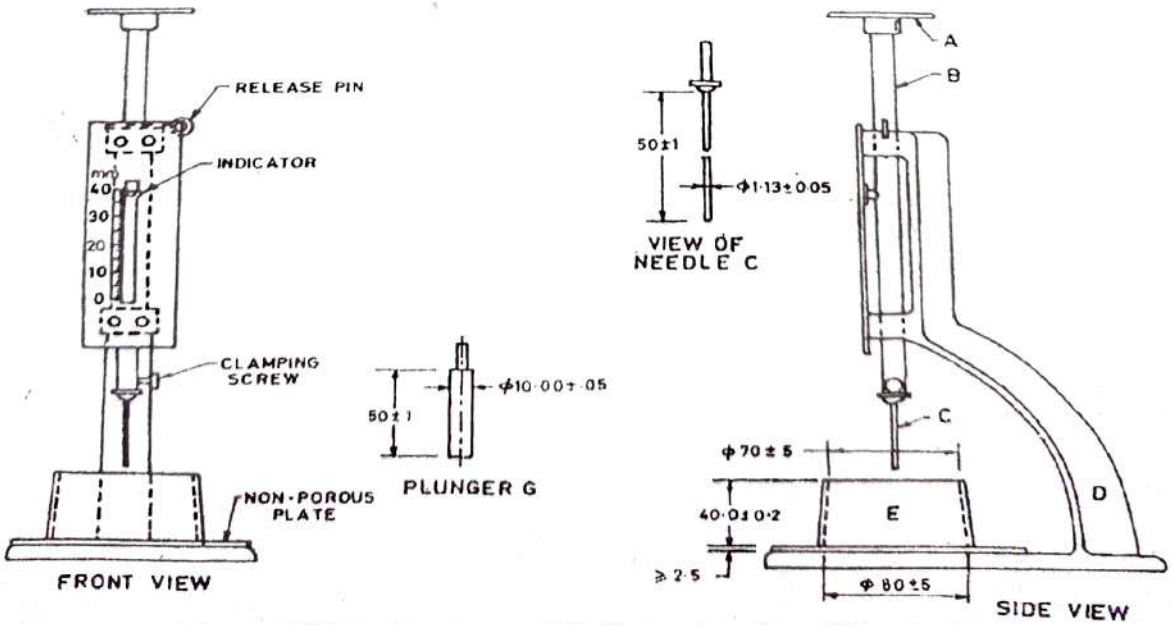
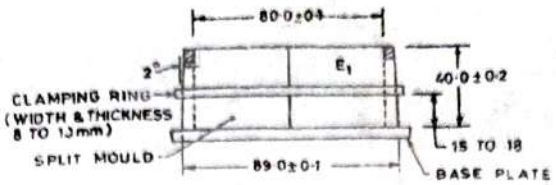


Fig. 2.1 Vicat Apparatus (All dimensions in millimetres)



All dimensions in millimetres

SPLIT TYPE VICAT MOULD

Fig. 2.2 Consistency & Setting time

EXPERIMENTAL SETUP :

The Vicat Plunger , made up of polished brass , 10mm diameter , 50 mm long with a threaded projection at the upper end for fixing into the movable rod and also having the lower edge flat , shall be fixed to the Vicat's apparatus in proper position . The plunger when resting on the non-porous plate at the bottom of the mould should indicate a reading of zero in its scale.

SPECIMEN / MATERIALS REUIRED :

1. Portland Cement 400 gm approximately (for each trial) from the sample to be taken as per IS: 3535.
2. Potable or distilled water

PROCEDURE :

(A) Preparation of sample cement paste

(1) About 400gm of dry cement is weighed accurately and placed in the enamel trough.
(2) 25% of the clean water is added and mixed uniformly by means of spatula.
(3) The gauging time [i.e. the time of mixing –from the time of the addition of water to the dry cement until commencing to fill the mould] is to be not less than 3 minutes and not more than 5 minutes.

(B) *Determination of normal consistency* :

(1) The Vicat's mould is filled with cement paste, while resting on a non-porous plate.
(2) The surface of the cement paste is made level with the top of the mould by a trowel .The mould is slightly shaken to expel air bubbles.
(3) Then the mould filled with the cement paste is placed together with the non-porous plate under the rod bearing the plunger .The bottom of the plunger is gradually lowered to touch the surface of the cement paste.
(4) The plunger is released quickly allowing it to sink into the paste for 5 seconds and the reading on the graduated scale is taken.
(5) A reading of 5 to 7mm is desired for normal consistency of the cement paste. In case the reading is different, the following steps are followed.
(6) The trial paste is prepared with varying percentage of water (1or2 % more than the previous) and the test is repeated until the plunger penetrates up to a depth of 5mm to 7mm above the bottom of the mould .
(7) The amount of the water as a percentage by mass of dry cement to the first place of decimal is reported as normal consistency.

PRECAUTIONS :

1. The temperature of the cement, water and that of the laboratory at the time of test is to be maintained at 27 ± 2°C and the relative humidity of the test room should be 65±5 percent.
2. Appliances to be used for gauging should be neat and clean.
3. The gauging time should be within specified limits and it should be completed before any sign of setting occurs.
4. Plunger and mould must be clean for each trial.
5. The representative sample of cement selected is to be thoroughly mixed before testing.

OBSERVATION AND CALCULATION :

Sl. No.	Type/Grade of cement	Manufacture or Brand	Mass of cement sample	Quantity of water added	%of water added	Unpenetrated depth in mm	Remarks

RESULT :

Normal consistency of the cement sample = _____

CONCLUSION :

(Comment on the result by comparing with standard values)

Initial and Final Setting Time of Cement

3

AIM :

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

SCOPE OF THE TEST :

To know the initial and final setting time of cement so as to determine the time of mixing and placing of cement mortar / concrete at site and also the undisturbed time to be allowed after placement .

THEORY :

The term setting of cement refers to stiffening of the cement paste i.e. the phenomenon of changing from the fluid or plastic state to solid / rigid state is called setting of cement. However, the hardening of cement due to its hydration, which results in strength development, is different from setting.

When the cement is mixed with water, the three main compounds of cement i. e. tri -calcium silicate (C_3S), tri-calcium aluminates (C_3A) and di- calcium silicate (C_2S) react with water. C_3S hydrates more rapidly and develop early strength, generates heat more rapidly and has less resistance to chemical attack. Whereas C_2S hydrates and hardens slowly; it adds to ultimate strength and provides more resistance to chemical attack. On the contrary, C_3A is fast reacting and generates large amount of heat and causes initial setting.

The setting time measures the time taken for the cement paste to offer a certain degree of resistance to the penetration of a special attachment pressed into it . Two periods of time are used to assess the setting behavior. These are called initial setting time and the final setting time. The terms of initial and final set are used to describe arbitrarily chosen stages of setting.

Initial setting time is defined as the period or the time starting from the instant of mixing of water to reaching a state at which the cement paste looses its plasticity. It indicates the end of slow and steady rate of chemical reaction after which rapid rise in temperature occurs due to faster rate of chemical reaction. Practically to standardize, it is defined as the period elapsing between the time when water is added to the cement and the time at which a standard needle (C) of 1mm square section penetrates no deeper than to a point 5mm ± 0.5mm from the bottom of the Vicat's mould with the cement paste. Minimum initial setting time as specified by BIS is 30 minutes for ordinary and rapid hardening Portland cement and 60 minutes for low heat cement.

The final setting time is the time taken to reach the stage when the paste becomes a rigid mass. To standardize practically, it is defined as the period elapsing between the time when water is added to the cement and the time at which a standard needle (F) just makes an impression on the surface of the test block while the annular attachment fails to do so. Maximum value of final setting time is 600 minutes for all types of cement according to BIS specification. However, final setting time chemically implies a maximum rise of temperature in the sample.

INSTRUMENTS / EQUIPMENTS / APPARATUS REQUIRED :

(1) Vicat 's apparatus with mould and non-porous plate

(2) Needle (C) for the initial setting time and needle (F) for the final setting time.

(3) Balance of capacity 1 kg and sensitivity 0.1gm.

(4) Trowel (weighing about 210gm)

(5) Measuring cylinder (100cc-2 nos)
(6) Standard spatula, Enamel tray.
(7) Thermometer.

EXPERIMENTAL SET UP :

Same as for normal consistency.

SPECIMEN/ MATERIALS REQUIRED :

(1) Ordinary Portland cement of around 500gms .The sample is to be taken in accordance with the requirements of IS: 3535 and the representative sample of cement selected is to be thoroughly mixed before testing.
(2) Potable or distilled water.

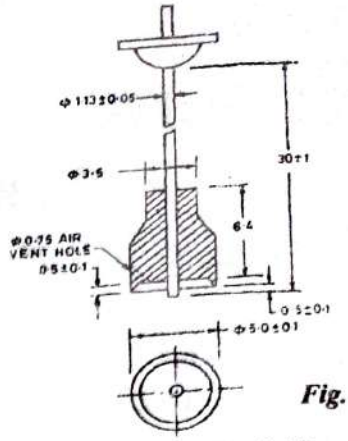


Fig. 3.1

Enlarged View of Needle 'F'
All dimension in mm
Vicat Apparatus

PROCEDURE :

(A) Preparation of sample cement paste

(1) About 400 - 450gm of ordinary Portland cement is weighed accurately (W) having known standard consistency (P).
(2) Exactly the 0.85 times the percentage of water required for standard consistency i.e. 0.85P of water of the weight of cement is taken and added to the cement (W).
(3) The time is reckoned from the instant water is added to the cement and sample is uniformly mixed with the spatula over a glass plate / non –porous plate / tray.
(4) The mixing or gauging time (counted from the instant of adding water to the dry cement up to the filling of the mould) is to be between 3- 5minutes.

(B) Determination of initial setting time

(1) The prepared cement paste is filled in the Vicat's mould which is placed on a non-porous plate and the upper surface of the paste is smoothened off, making it level with the top of the mould to obtain the test block .
(2) The mould resting on the non- porous plate is placed under the rod bearing the needle 'C' and it is lowered gently so as to be in contact with the surface of the test block and quickly released allowing the needle to penetrate into the test block.
(3) In the beginning, the needle may completely pierce the test block and this procedure is repeated with some time interval until the reading becomes 5±0.5mm, measured from the bottom of the mould.
(4) Corresponding time taken is noted as the initial setting time.

(C) Determination of final setting time :

(1) The needle 'C' is replaced with the needle with annular attachment 'F' for the final setting time in the Vicat's apparatus.
(2) The needle is released gently as described in the initial setting time, till the needle just makes an impression there on while the annular attachment fails to do so after about 1½ hours of the initial setting, at intervals of 10 minutes.
(3) The period elapsing between the time, water is added to the cement and the time at which the needle only makes an impression on the surface of the test block is recorded as the final setting time.
(4) If a scum is found to be formed on the surface, the underside of the test block may be used for the determination of final setting time.

Initial and Final Setting Time of Cement

PRECAUTIONS :

1. The needle is to be cleaned every time before use.
2. There should be no jerk but gentle release of the needle when it comes in contact with the surface of the test block.
3. The position of the mould is shifted and rotated while taking penetration or impression readings so that no readings are repeated at the same point.
4. The test is to be carried out in a room having 90% relative humidity at a temperature of 27±2°C.
5. The experiment is to be performed at a place away from vibrations and other disturbances.

OBSERVATION :

Weight of the cement sample (W) = _____gm.

Standard consistency of sample cement (P) = _____%

Weight of water to be added = 0.85 × P × W = _____gm or ml.

Sl.No.	Time in minutes	Vicat's apparatus reading

RESULT :

(a) Initial setting time of the cement sample = _____mins.

(b) Final setting time of the cement sample= _____mins.

Soundness Test of Cement

4

AIM :

To verify the soundness of cement by Le-Chetelier apparatus method.

SCOPE OF THE TEST :

To assess the susceptibility of the cement to volume change after setting.

THEORY :

It is desirable that the cement paste, once it has set; should not undergo change in volume and cement, which exhibit no such appreciable change, are described as sound. The unsoundness of cement is caused by undesirable expansion of some of its constituents after setting, which may result in disintegration and severe cracking.

Such expansion occurs due to the reaction of free lime (CaO), magnesia and calcium sulphate. Free lime hydrates very slowly because a thin film of cement, which prevents direct contact between lime and water, when the cement sets, covers it. Also, hard –burnt excess free lime in cement hydrates very slowly. Of course, slacked lime occupies larger volume and as a result of this expansion, severe cracking takes place. Magnesia also reacts with water in a similar manner to that of lime. Calcium sulphate is also liable to cause expansion through the formation of calcium sulpho-aluminates from excess gypsum.

Cement is said to be sound if it does not undergo significant volume change during hardening process and it is presumed to be unsound, when the percentage of free lime and magnesia is more than that specified. However, the unsoundness may be reduced by limiting the magnesia content to less than 0.5 percent, by fine grinding, by allowing the cement to aerate for several days and through proper mixing.

There are two methods by which the soundness of cement can be determined namely (1) Le-Chetelier method and (2) Auto clave method. In Le-Chetelier test, the expansion in cement should not be more than 10mm according to I. S. : 269. However, it may be noted that expansion due to the presence of free lime only is mostly reflected in Le-Chetelier's test.

In this method, the field condition of exposure of cement to natural weathering agents is simulated by accelerated hydration due to boiling of the specimen in water in the laboratory.

INSTRUMENTS / EQUIPMENT /APPARATUS REQUIRED :

1. Le-chetelier apparatus
2. Glass plates -2 no's
3. Lead weight
4. Trowel
5. Measuring cylinder
6. Enamel tray
7. Balance
8. Water bath
9. Thermometer
10. Stop watch

Le-chetelier's apparatus is made of a small split cylinder of brass having 0.5mm thickness and height of 30mm. On either side of the split are attached two indicators with pointed ends. The length of this attachment from the center of the split cylinder is 165mm. The mould shall be kept in good condition with the jaws not more than 0.5mm apart.

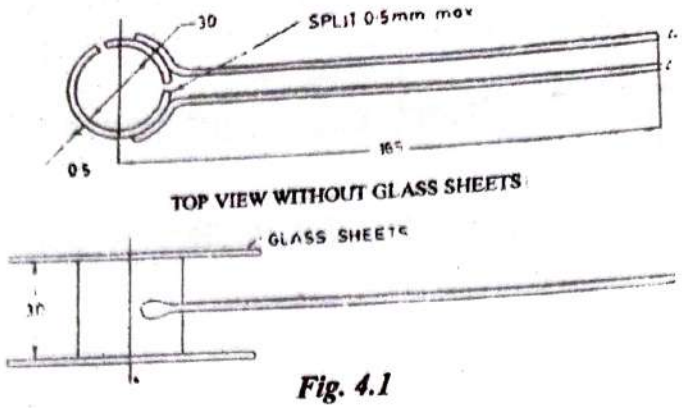


Fig. 4.1

SPECIMEN / MATERIALS REQUIRED :

1. Ordinary Portland cement of around 50gms. The sample is to be taken in accordance with the requirements of 1S:3535 and the representative sample of the cement selected is to be thoroughly mixed before testing.
2. Potable or distilled water.
3. Petroleum jelly.

PROCEDURE :

(1) About 50gm (W) of cement of known normal consistency (P) is weighed for each mould.
(2) The amount of water equal to $0.78P \times W$ is measured with the help of a measuring cylinder (where P & W are as defined above)
(3) The cement sample and water are mixed properly to form a paste.
(4) The brass spilt cylinder mould is placed on one glass plate and the above cement paste is filled up in it.
(5) Care is taken to keep the edge of the mould gently together, while filling the cement paste in the mould .
(6) The split cylinder with sample is covered with another piece of glass plate and the lead weight is placed over it.
(7) The above assembly is submerged in fresh and clean water maintained at a temperature of $27 \pm 2°C$ and kept it there for 24 hours.
(8) After curing, the distance separating the indicator points is accurately measured in mm.
(9) Again, the mould is submerged in water at the same above prescribed temperature in a water container or water bath.
(10) The water in the water bath is allowed to boil for 3 hours with the mould kept submerged in it by raising the temperature to boiling point in about 25to 30 minutes.
(11) Then the mould is removed from water, allowed to cool in natural manner and the distance between the indicator points is measured.
(12) The difference between the two measurements represents the Le- chetelier expansion of cement on hydration.

PRECAUTIONS :

(1) Weighing of the cement and measurement of the water is to be done very accurately.
(2) The edges of the split cylinder mould is to be kept together gently while filling it with the cement paste.
(3) Gauging time of 3-5 minutes is to be maintained from addition of water to the cement till the mould is filled up.
(4) Mould is to be handled carefully while conducting the test; otherwise the dimension of the specimen may change due to disturbance of the gap between the two jaws.
(5) The temperature of water in the bath is to be correctly maintained.

OBSERVATION AND CALCULATION :

Sl. No.	Particulars of specimen	Specimen No		
		1	2	3
1	Weight of the cement sample(W)	50		
2	Normal consistency of the sample cement(P)	30 %		
3	Amount of water added to the sample=0.78P×W	11.7		
4	Time at which the sample is put in water at 27 ± 2°C			
5	Time when water is brought to the boiling point			
6	Distance between the pointer ends before heating(D_1) mm	1·3 mm		
7	Time of boiling (heating)	3 hr.		
8	Distance between the pointer ends after heating(D_2) mm	1.4 mm		
9	Difference(D_2-D_1) in mm	1 mm.		

RESULT :

Average value of Le-Chatelier expansion of the cement has been found to be _____mm.

CONCLUSION :

(Comment on the result by comparing with standard values)

DISCUSSION :

The expansion of the cement as measured by the Le- Chetelier apparatus is not to be more than 10mm for ordinary port land cement, rapid hardening cement, low heat port land cement and blast furnace slag cement.

REFERENCE :

(1) I.S: 4031 – Method of physical tests for hydraulic cement – (Part –III) Determination of soundness of cement.

SHORT TYPE QUESTION :

1. ***What do you mean by soundness of cement ?***

Ans.

2. ***When the cement is said to be unsound ?***

Ans.

3. ***What are the methods of available for finding the soundness of cement ?***

Ans.

4. ***Why the sample is boiled in water bath after curing ?***

Ans.

5. ***What is the significance of soundness test ?***

Ans.

Date : ..... **Roll No:**..... ***Signature of the Student***

Compressive Strength of Cement 5

AIM :

To determine the compressive strength of the cement mortar cubes.

SCOPE OF THE TEST :

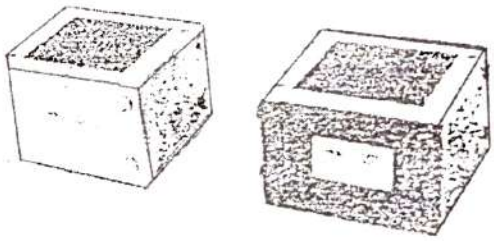
The result of this test is used for finding the grade of cement and compressive stress to be used in mix design of concrete. This test also enables to distinguish rapid hardening cement from the low heat and ordinary cement.

THEORY :

The compressive strength of cement is measured by determining the compressive strength of 70.6mm size cement mortar cubes of 1:3 proportion with a water- to- cement ratio of {(P+12)/100} where p is the normal consistency of cement . The fine aggregate used in the preparation of mortar is standard sand (Ennore sand), washed, cleaned and dried at 100°C to 110°C & cooled. This test can be considered as a final check on the quality of cement and can be calculated by measurement of applied load on the contact area of the cube. Different cements have varying minimum specified strength at different specified ages. Ordinary Portland cement should have minimum compressive strength of 16Mpa, 22Mpa and 33Mpa at 3,7and28 days respectively. 28 days compressive strength of cement is referred to as grade of cement (without mention of the unit Mpa) i.e. cement of 33, 43 or 53 grade.

INSTRUMENTS / EQUIPMENTS REQUIRED :

(1) Cube moulds 7.06cm size – 9nos
(2) Enamel trough
(3) Measuring cylinder -100ml/200ml capacity
(4) Non porous plate
(5) Trowel
(6) Vibration machine for cement cube
(7) Weighting balance of accuracy 0.02g
(8) Compression testing machine.
(9) Grease or lubricating oil
(10) Thermometer



Cast Iron Cube Mould
Fig. 5.1

SPECIMEN / MATERIAL REQUIRED

(1) Cement
(2) Standard sand (as per IS: 650) – (equal weight mixture each of grade –I, grade –II and grade – III).
(3) Distilled water/ potable water.

PROCEDURE :

(A) Preparation of mortar for the cubes :

(1) The interior surface of the cube moulds (9 nos) are oiled.

(2) One of the assembled moulds are placed on the table of vibration machine and firmly held in position by means of suitable clamps.

(3) A hopper of suitable size and shape are attached securely at the top of the mould to facilitate filling and this hopper should not be removed until completion of vibration period.

(4) For the preparation of mortar cubes, cleaned appliances shall be used and the temperature of the water and that of the room shall be 27°C ± 2°C.

(5) The sample of cement (about 200gm) and standard sand (about 600gm) are placed on a non –porous plate in the proportion of 1:3 by weight and mixed dry with a trowel for one minute.

(6) Then it is mixed with distilled / potable water (p/4 +3) % of combined weight of cement and sand, where p= normal consistency of cement in % until the mix is of uniform colour.

(7) The gauging time should not be less than 3 minutes and should not exceed 4 minutes. If it exceeds, the mixture is rejected and operation repeated.

(8) Immediately after mixing the mortar as specified above, the mortar is placed on the hopper of the cube mould and the same is compacted by vibration for a period of about 2 minutes at a speed of 1200 ± 400 vibrations / min.

(9) The cubes are kept at a temperature at 27°C ± 2°C in an atmosphere of at least 90% relative humidity for 24 hours after completion of vibration and other cubes are cast following the same procedure.

(10) At the end of such periods, cubes are removed from the mould and immediately submerged in clean fresh water at 27 ± 2°C. The cubes are kept there until taken out just prior to testing in compression machine, the period being reckoned just after completion of compaction in the vibration machine.

(11) Although 28 days strength only is used to identify the grade of a cement, the following period may be observed for different types of cement as a minimum.

(a) Ordinary Portland cement : 3 days and 7 days

(b) Rapid hardening port land cement : 1 day and 3 days

(c) Low heat port land cement: 3 days, 7 days & 28 days.

(B) Testing :

1. The test cube is placed on the platform of compression testing machine (by keeping any of its transverse surfaces horizontal) co- axially without any packing between the cube and the steel platens of the testing machine.
2. The load is applied steadily and uniformly stating from zero at the rate of 35 Mpa / min till the cube fails and the reading at failure is recorded.
3. Three cubes at a particular age (period) are tested and the corresponding readings are recorded.

PRECAUTIONS :

(i) All the appliances should be neat and clean.

(ii) While assembling the mould, the joints between parts of the mould should be covered with a thin film of petroleum jelly in order to ensure that no water escapes during vibration.

(iii) The water used for curing should be renewed after every 7 days and the cubes should not be allowed to dry up before testing ;however the free water from the surface should be removed with jute or a piece of dry cloth .

(iv) The mixture that takes more than 4 minutes of mixing before starting of cube casting should be rejected.

(v) Load on the specimen should be applied gradually.

OBSERVATION :

Details of cube example:

(i) Date of casting- -Room temp - - - - - - - - - -°C

(ii) Time of casting - - - - - - - - - - - - - - - - -hrs - - - - - - -min. Water temp - - - - - - - - - -°C

Compressive strength test for cement	Specimen								
Weight of the cement (gm.)	I	II	III	IV	V	VI	VII	VIII	IX
Weight of standard sand (gm.)									
Quantity of water (ml)									
Size of specimen (L) mm									
(B) mm									
(H) mm									
Area of specimen (A)mm^2									
Load at fracture(P) in N at the age of 3 days									
7 days									
28 days									

RESULT :

Average strength in N/ mm^2 at the age of

3 days	7 days	28 days

CONCLUSION

Compressive Strength of Brunt Clay Building Bricks

6

AIM :

To determine compressive strength of burnt clay building bricks.

SCOPE OF THE TEST :

To assess the suitability of bricks for different types of construction and classify bricks as per their strength.

THEORY :

Burnt clay bricks are the most commonly used building blocks used in construction works as masonry walls, paving bricks or in floorings where these are primarily subjected to compressive stresses. The strength of masonry wall is dependent upon the basic strength of bricks as well as mortar. Therefore it is imperative to test the bricks for their compressive strength to assess the load carrying capacity of structural units constructed out of them. The compressive strength of common brunt clay bricks varies from 3.5N/mm^2(35kg/cm^2)to 35 N/mm^2(350kg/cm^2)and bricks having compressive strength less than 5N/mm^2(50kg/cm^2) are not used for structural works .

The common brunt clay bricks are classified on the basis of their average compressive strength as given in the following table:

Class designation based on compressive strength	Average Compressive strength not less than	
	N/mm^2	Kg/cm^2(approx)
35	35	350
30	30	300
25	25	250
20	20	200
17.5	17.5	175
15	15	150
12.5	12.5	125
10	10	100
7.5	7.5	75
5	5	50
3.5	3.5	35

The bricks when tested are to have a minimum average compressive strength for various classes as given in the table. But the compressive strength of any individual brick tested is not to fall below the minimum compressive strength specified for the corresponding class of brick by more than 15 percent.

INSTRUMENTS / EQUIPMENTS / APPARATUS REQUIRED :

1. Compression testing machine having a platen with concentric spherical ball seating.
2. Trowel, tray, cloth, damp jute bags etc.

Compressive Strength of Brunt Clay Building Bricks

SPECIMEN/ MATERIALS REQUIRED :

1. Burnt clay bricks sampled as per IS:5454
2. Cement
3. Clean coarse sand of grade 3mm and down
4. Water

PROCEDURE :

1. Five bricks are taken at random out of the sample and their dimensions are measured to the nearest 1mm.
2. Any unevenness observed in the bed faces is removed to provide two smooth and parallel faces by grinding.
3. The bricks specimens are immersed in water at room temperature (25°C to 29°C) for 24 hours.
4. Then the specimens are removed and any surplus moisture is drained out or wiped off at room temperature.
5. The frogs (where provided) and all the voids in the bed face are filled flush with the cement mortar 1:1. (1cement, 1clean coarse sand of grade 3mm and down).
6. The bricks are stored under damp gunny (jute) bags for 24 hours followed by immersion in clean water for 3 days (72hours).
7. Then the bricks are removed from the water and any trace of moisture is wiped out.
8. The specimen (brick) is placed with flat faces horizontal and mortar filled face facing upwards between two 3 ply ply-wood sheets each of 3mm thickness and carefully centered between the plates of the testing machine.
9. The load is applied axially at a uniform rate of 14N/ mm^2 (140kg*f* / cm^2) per minute till failure occurs and the maximum load at failure is noted. [The load at failure is the maximum load at which the specimen fails to produce any further increase in the indicator reading of the testing machine.]
10. Average value of the compressive strength of five bricks are taken such that the strength of any individual brick is not less than 15% of the average.

PRECAUTIONS :

1. The frog and all the void spaces are to be properly filled with cement mortar so as to give a plane surface for loading.
2. The load is to be applied centrally and the specified rate of loading is to be maintained.

OBSERVATION AND CALCULATION :

$$\text{Compressive strength} = \frac{\textit{Maximum load at failure}}{\textit{Average area of bed faces}}$$

Sl. No.	Av. size of the specimen			Area of bed faces	Max^m load at failure	Compressive strength = Col(6) / Col(5)	Av. Compressive strength	Remarks
	L	B	H	(L × B)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.								
2.								
3.								
4.								
5.								

RESULT :

The average compressive strength of bricks = _____ N/mm^2 or Kg/cm^2

CONCLUSION :

(Comment on the result by comparing with standard values)

DISCUSSION :

Compressive strength test of bricks also acts as an indicator of durability of bricks. Generally clamp brunt bricks have less strength than kiln burnt bricks.

REFERENCE :

(1) IS: 3495- Methods of tests of burnt clay building bricks (Part-1); Determination of compressive strength.
(2) IS: 5454- Method of sampling for clay building bricks.
(3) IS: 1077- Common brunt clay building bricks – specification.

SHORT TYPE QUESTIONS:

1. ***Why the bed faces of the brick specimen are to be ground and voids / frog to be filled with mortar ?***

Ans.

2. ***Why the brick specimen is to be properly centered in the compression testing machine?***

Ans.

3. ***What is the proportion of the cement mortar to be used for frog filling ?***

Ans.

Why the compressive strength of the bricks is signif.cant ?

ns.

How the bricks are classified based on compressive strength ?

Signature of the Student

Date : .....

Roll No:.....

Specific Gravity of Sand

9

AIM :

To determine the specific gravity of fine aggregates (sand).

SCOPE OF THE TEST :

The specific gravity of fine aggregates is required for calculation of yield of concrete.

THEORY :

The specific gravity of an aggregate may be defined as the ratio of the mass of the given sample to the mass of an equal volume of water at a standard temperature. Since the fine aggregate or sand generally contains voids, there could be different types of specific gravities.

(i) The absolute specific gravity or specific gravity of solids refers to the volume of solid material excluding all pores and therefore is defined as the ratio of the mass of solids to the mass of an equal volume of water at stated temperature. This has application in soil mechanics and geology.

(ii) But if the volume of solid is deemed to include the impermeable pores but not the capillary ones, the resulting specific gravity is called 'apparent specific gravity'. The apparent specific gravity is then the ratio of the mass of oven dried fine aggregate (sand) to the mass of water occupying a volume equal to that of the solid including impermeable ones .

(iii) However, gross apparent specific gravity or simply the specific gravity based on saturated surface dry (SSD) condition is most frequently required in concrete mix design.

Of course, higher specific gravity of aggregate is indicative of heavier mineral origin and stronger material. If specific gravity differs much from the normally assigned value to a particular aggregate, there might be a change in the source material or overall shape and grading etc. Specific gravity of sand consisting of quartz particles lies between 2.63to 2.67.

INSTRUMENTS /EQUIPMENTS / APPARATUS REQUIRED :

The apparatus consist of the following

1. **Balance** - Of capacity not less than 3kg, readable and accurate to 0.5g and of such a type as to permit the weighing of the pycnometer containing the aggregate and water.
2. **Oven** – A well ventilated oven , thermo statically controlled , to maintain a temperature of 100 °C to 110° C.
3. **Pycnometer** – A water tight pycnometer of about one litre capacity having a metal conical screw top with a 6mm diameter hole at its apex
4. Hot air drier for supplying a current of warm air.
5. A tray of area not less than 325cm^2.
6. An air tight container large enough to take the sample.
7. Filter papers and funnel.
8. Steel or glass rod.

SPECIMEN / MATERIALS REQUIRED :

Fine aggregate (sand), distilled water.

PROCEDURE :

(1) A sample of about 500gms of fine aggregate (< 4.75mm) or sand is placed in the tray and covered with distilled water at a temperature of 22°C to 32°C.

(2) Soon after immersion, air entrapped in or bubbles on the surface of the aggregate is removed by gentle agitation with a steel or glass rod. The sample is kept immersed for 24±1/2 hours.

(3) Then the water is carefully drained from the sample by decantation through a filler paper; any material retained being returned to the sample.

(4) The fine aggregate including any solid matter retained on the filter paper is exposed to a gentle current of warm air to evaporate surface moisture and is stirred at frequent intervals to ensure uniform drying until no free surface moisture can be seen and the material just attains a free running condition.

(5) The saturated and surface dry sample is weighed.

(6) Then the fine aggregate (sand in SSD condition) is placed in the pycnometer which is filled with distilled water.

(7) Any trapped air is eliminated by rotating the pycnometer on its side, the hole of the apex of the cone being covered with a finger.

(8) The pycnometer is topped up with distilled water to remove any froth from the surface and so that the surface of the water in the hole is flat.

(9) The pycnometer is dried on the out side and weighed.

(10) The contents of the pynometer are emptied into the tray, care being taken to ensure that all the aggregate is transferred.

(11) The pycometer is refilled with distilled water to the same level as before, dried on the outside and weighed.

(12) Then the water is carefully drained from the sample by decantation through a filter paper and a material retained is returned to the sample.

(13) The sample is placed in an oven in the tray at a temperature of 100°C to 110°C for 24 ± ½ ho during which period it is stirred occasionally to facilitate drying.

(14) It is cooled in a air tight container and weighed.

(15) Generally, minimum of two tests are made and average value reported.

PRECAUTIONS:

1. While weighing the sample in SSD condition, care is taken to ensure that the free running cond is not passed.
2. The difference in the temperature of the water in the pycnometer during the first and second wei should not exceed 2°C.

OBSERVATION AND CALCULATION:

Sl. No.	Particulars	Sample – I	Sample
1.	Mass of saturated surface dry sample (A)		
2.	Mass of pycnometer containing sample and filled with distilled water (B)		
3.	Mass of pycnometer filled with distilled water only (C)		
4.	Mass of oven dried sample (D)		
5.	Apparent specific gravity = $\frac{D}{D-(B-C)}$		
6.	Specific gravity = $\frac{D}{A-(B-C)}$		

Bulking Factor of Sand

10

AIM :

To determine the percentage of bulking of a given sand.

SCOPE OF THE TEST :

This test covers the field method for determination of necessary adjustment for the bulking of fine aggregates to be used in volume batching of nominal mix concrete.

THEORY :

Bulking is defend as the increase in volume of given sand caused by films of surface water surrounding the particles resulting in pushing apart of sand particles as an effect of surface tension. Since fine sand has more number of particles per unit volume and consequently more surface area, fine sand particles bulk more than the coarse sand. With the moisture content of about 5 to 8 percent, the increase of volume of sand may vary from 20 to 40 percent depending up the fineness of sand. However, beyond this percentage of moisture content, bulking tends to decrease .For saturated sand, the volume is approximately the same, when it is measured under dry and loose state.

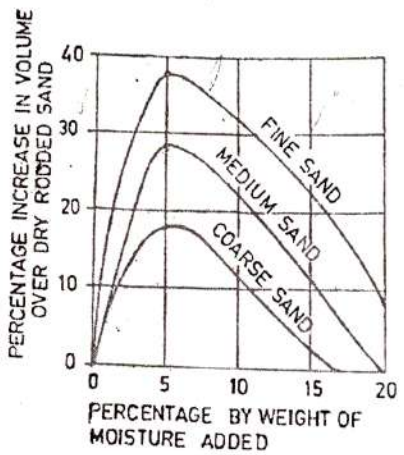


Fig. 10.1 Effect of bulking of sand with amount of moisture and type of sand grading.

During the volume batching of concrete mix where sand is measured by volume, bulking of sand results in smaller weight of sand occupying the fixed volume of measuring box. The concrete mix then becomes harsh or strong, deficient in sand and is prone to segregation .This leads to reduced yield of concrete. Therefore, while adding fine aggregate to the concrete mix by volume, the specified volume of sand based on dry condition is corrected by appropriately increasing its volume owing to bulking at moist condition.

Thus with volume batching, bulking has to be allowed for by increasing the total volume of (moist) sand used. If V_1 = volume of sand at saturated state (which is approximately equal to the volume of the dry loosely packed sand) and V_2 = initial apparent volume of the moist sand (i.e. the volume of the container)

Bulking Factor of Sand

Percentage of bulking is given by $\left[\frac{V_1}{V_2} - 1\right] \times 100$ Hence it is required to know either bulking factors corresponding to different moisture contents or a plot/ graph showing percentage of bulking vr. moisture content.

INSTRUMENT S/ EQUIPMENTS / APPARATUS REQUIRED :

1. A container / measuring cylinder (250cc) or higher volume
2. Steel rule
3. Steel rod 6mm diameter

SPECIMEN / MATERIALS REQUIRED :

Sample of sand, water etc.

PROCEDURE :

The procedure to be adopted may be varied, but broadly two methods are suggested by relevant I.S code .Both the methods, depend on the fact that the volume of inundated (fully saturated sand) is the same as if the sand were dry .For this purpose, specimens of moist sand can be prepared by adding different quantity of water starting from 3 upto 10 percent to surface dry sand or moist sand can be directly obtained from the field, the moisture content being subsequently determined.

Method – I :

1. Sufficient quantity of moist sand of known moisture content is loosely put into a container until it is about two –thirds full.
2. The top of the sand is leveled off and pushing a steel rule vertically down through the sand at the middle to the bottom , the height of loose sand 'h' is measured .
3. The sand is emptied out of the container into another container where none of it will be lost.
4. The first container is filled with water to about half of its volume.
5. About half of the volume of sand is put back and it is rodded with a steel rod of about 6mm in diameter so that its volume is reduced to a minimum.
6. Then the reminder of the sand is added and rodded it in the same way.
7. The top surface of the in undated sand is smoothened and leveled and its depth at the middle h' is measured with the steel rule.

Method – II :

1. The damp sand is poured in a 250 ml or higher volume measuring cylinder (consolidated by shaking) until it reaches near the 70 – 80 %mark (about 200 ml mark for 250 ml cylinder) and its volume 'x' is noted.
2. Then the cylinder is filled with the water and the sand is stirred well. (The water should be sufficient to submerge the sand completely.)
3. The sand surface is seen to be below its original level and its volume 'y' is noted.

PRECAUTIONS :

1. Consolidation by shaking is to be resorted to frequently while pouring sand into the cylinder.
2. Height of the inundated sand is to be measured correctly.
3. Care should be taken to be see that no sand is lost in transferring from one container to another.

OBSERVATION AND THE CALCULATION:

Method- I

Moisture content	Sl. No.	Height of loose sand(h)	Height of saturated sand(h′)	Percentage bulking $=\left(\frac{h-h'}{h'}\right)\times 100$	Average value
(1)	(2)	(3)	(4)	(5)	(6)
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				

Method-II

Moisture content	Sl. No.	Volume of loose sand (x)	Volume of saturated sand (y)	Percentage bulking $=\left(\frac{x-y}{y}\right)\times 100$	Average value
(1)	(2)	(3)	(4)	(5)	(6)
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				
	1				
	2				
	3				

Los Angeles Abrasion Value of Aggregate

17

AIM :

To test the abrasive resistance of aggregate

SCOPE OF THE TEST:

To find out the suitability of aggregates for its use in pavement construction as the test values have been correlated with performance studies.

THEORY :

The aggregates used in surface course of the high way pavements are subjected to wearing due to movement of traffic. Resistance to wear or hardness is hence an essential property for road aggregate especially when used in wearing course. Movement of the fast moving vehicles fitted with pneumatic tyres on the road causes abrasion of stone aggregates used as constituent of pavement surface. The steel tyred wheels of animal driven vehicles also cause considerable abrasion of road surface. Therefore road aggregate should be hard enough to resist abrasion due to various types of traffic. Thus determination of resistance of aggregates to the abrading action of traffic is very important. Of the various tests available for determining the abrasion value, the Los Angeles abrasion test is more commonly adopted.

The principle of Los Angeles abrasion test is to produce the abrasive action by the use of standard steel balls called abrasive charge which when along with the aggregates are rotated in a drum for specific number of revolutions also cause pounding action in addition to rubbing. The percentage wear of the aggregates by the action thus caused is determined which is known as Los Angeles abrasion value.

INSTRUMENTS / EQUIPMENTS /APPARATUS REQUIRED

(i) Los Angeles machine which consists of a hollow steel cylinder closed at both the ends with an internal diameter of 700mm and length 500mm and capable of rotating about its horizontal axis. It has a opening with removable cover for introducing the sample which is dust tight when properly clamped. A steel shelf projecting radially 88mm into the cylinder and extending for full length is mounted firmly on the interior of the cylinder. The shelf is placed at a minimum distance of 1250 mm from the opening in the direction of rotation.

(ii) Abrasive charge: Spherical cast iron or steel balls of approximately 48mm in diameter and each weighing between 390 to 455g- 12nos.

(iii) Sieve – I.S sieve size 1.70mm.

(iv) Balance of capacity 10 kg and accuracy ±1g.

(v) Thermostatically controlled oven

(vi) Metal tray, brush etc.

SPECIMEN / MATERIALS REQUIRED

The material for the standard test consists of clean aggregates dried in an oven at 105°Cto 110°C to substantially constant weight. The sample should conform to any of the gradings shown in the following table.

Los Angeles Abrasion Value of Aggregate

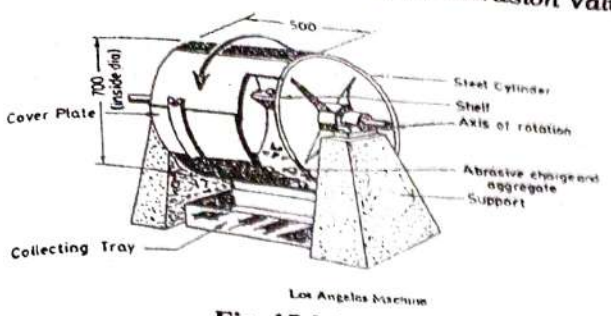


Fig. 17.1 (a)

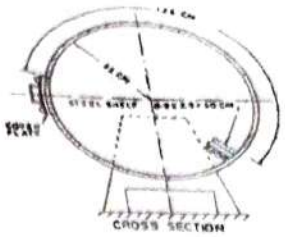


Fig. 17.1 (b)

Grading of test samples

Sieve Size(mm)		Mass in grams of test sample for grade						
Passing through	Retained on	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			

Tolerance of ± 2% permitted

PROCEDURE :

1. The grading to be used in the test is selected such that it is nearest to the grading to be used in the construction.
2. 5 kg sample for gradings A, B, C, D and 10 kg of sample (with ± 2% tolerance) for gradings E, F, G is taken.
3. The abrasive charge is selected as per the table below.

Selection of abrasive change

Grading	No of steel balls	Weight of charge in gram
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

4. The cover is opened, the aggregate and steel balls are fed into the cylinder and the cover is fix tight.

5. The machine is rotated at a uniform speed of 30 to 33 revolutions per minute. 500 revolutions are given for grading A, B, C, D or 1000 revolutions for grading E, F, and G.
6. The machine is stopped after desired number of revolutions, dust cover is removed and materials are taken out with the entire stone dust and steel balls.
7. The steel balls are separated and the material is sieved on a 1.7mm I.S sieve (However, for convenience the material may be separated into two parts by using a sieve of size larger than 1.70mm and the finer portion may be further sieved on a1.7mm, I.S. sieve).
8. The material coarser than 1.7mm I.S sieve is washed and dried in an oven at 105°C to 110° C to constant weight and weighed to an accuracy of 1 g.
9. The result is expressed as percentage wear and the average value of two tests may be adopted as Los Angeles abrasion value.

PRECAUTIONS :

1. The machine should be balanced and driven in such a way as to maintain uniform peripheral speed.
2. The cover should be fixed dust tight before rotating the machine.
3. Care should be taken to avoid loss of any part of the sample and the entire stone dust in taken out from the machine along with abraded stone and abrasive charges (steel balls).

OBSERVATION & CALCULATION

Grading selected _____	**Sample - I**	**Sample - II**
(1) Original mass of the aggregate (M_1), g		
(2) Mass of the aggregate retained on 1.70 mm I.S. sieve after the test (M_2), g		
(3) Loss in mass due to wear(M_2-M_1), g		
(4) Percentage wear $\frac{M_2 - M_1}{M_1} \times 100$	$\frac{M_2 - M_1}{M_1} \times 100$	

RESULT :

Los Angeles abrasion value = Mean of sample I & II = _____

CONCLUSION:

(Comment on the result by comparison with standard values.)

The aggregate is suitable / unsuitable for pavement construction as _____ layer.

DISCUSSION:

The test is more widely accepted because it simulates field conditions more closely by determining resistance to abrasion and impact simultaneously. Many agencies have specified the desirable limits of the test for different methods of pavement construction.

The maximum allowable Los Angeles abrasion values of aggregates as specified by Indian Road Congress for different cases are given in the following table.

Sl. No.	*Types of pavement layer*	*Maximum permissible Los Angeles Abrasion value*
1.	Water Board Macadam(WBM) sub-base course	60
2.	(i) WBM base course with bituminous surfacing	50
	(ii) Bituminous Macadam base course	
	(iii) Built up spray grout base course	
3.	(i) WBM surfacing course	40
	(ii) Bituminous Macadam binder course	
	(iii) Bituminous Penetration Macadam	
	(iv) Built up spray grout binder course	

Los Angeles Abrasion Value of Aggregate

4.	(i) Bituminous carpet surface course	35
	(ii) Bituminous surface dressing(single and two coats)	
	(iii) Bituminous surface dressing(precoated aggregates)	
	(iv) Cement concrete surface course(IRC)	
5.	(i) Bituminous/Asphaltic concrete surface course	30
	(ii) Cement concrete pavement surface course(ISI)	

REFERENCE :

IS : 2386 (Part– IV) Method of test for aggregates for concrete, Mechanical properties.

SHORT TYPE QUESTIONS :

1. ***What is the significance of Los Angeles test ?***

Ans.

2. ***Which mechanical properties of aggregate are determined by this test ?***

Ans.

3. ***What is the propose of providing a shelf inside the cylinder ?***

Ans.

4. ***How do you select the grading for 20mm size nominal aggregate? How many numbers of abrasive charges will you use for this grading ?***

Ans.

5. ***If two sample have LA abrasion values of 25 and33 respectively, then which sample is better and why ?***

Ans.

Signature of the Student

Roll No:.....

Date : .....

Impact Test of Aggregate

18

AIM :

To determine aggregate impact value of coarse aggregate.

SCOPE OF THE TEST :

This test is used to assess the suitability of an aggregate for pavement construction with respect to its toughness or resistance to impact simulating the field conditions. The test can be performed in a short time even at construction site or at the stone quarry as the apparatus is simple and portable.

THEORY :

Toughness may be defined as the property of a material to resist impact. Owing to the movement if the traffic on the roads, the road aggregates are subjected to the pounding action or impact of wheel loads which may result in the breaking down of the aggregate to smaller pieces. Therefore, the road aggregates are required to be tough enough so as to resist the fracture tendency under impact. The test designed to evaluate the toughness of stones i.e. the resistance of stones to with stand disintegration under repeated impact is called impact test for road aggregates.

Impact test may be either carried out on cylindrical stone specimen as in Page impact test or on stone aggregate as in the Aggregate impact test. The former has become obsolete now-a –days where as the later has been standardized by Bereau of Indian Standards.

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

The standard aggregate impact test is made on aggregate passing through 12.5mm and retained on 10mm IS sieve .The aggregate is placed in a cylindrical cup mould and subjected to specified number of blows by fre fall of a standardized hammer from a specified height .The material crushed to 2.36mm is separated and expresse as a percentage of original weight taken in the mould, which is referred to as aggregate impact value. So, it is numerical index and higher value of it indicates that the aggregate is more prone to get crushed under impa load .Therefore to achieve a high quality pavement; aggregate possessing a low impact value is to be preferr

Thus the aggregate impact value is used to classify stones in respect of their toughness property follows.

Aggregate impact value	*Classification*
<10%	Exceptionally strong
10-20%	Strong
20-30%	Satisfactory for road surfacing
>35%	Weak for road surfacing

INSTRUMENTS / APPARATUS /EQUIPMENTS REQUIRED :

The apparatus consists of an impact testing machine, a cylindrical measure, tamping rod, IS si balance and oven.

(a) Impact testing machine: - The machine consists of a metal base with a plane lower surface supp well on a firm floor without rocking .A detachable cylindrical steel cup of internal diameter 10.2c depth 5cm is rigidly fastened centrally to the base plate. A metal hammer of weight between 13

14.0 kg having the lower end cylindrical in shape, 10cm in diameter and 5cm long, with a 2 mm chamfer at the lower edge is capable of sliding freely between vertical guides and fall concentric over the cup. There is an arrangement for raising the hammer and allowing it to fall freely between vertical guides from a height of 38cm on the test sample in the cup, the height of fall being adjustable up to 0.5cm. A key is also provided for supporting the hammer while fastening or removing the cup.

(b) Metal measure – A cylindrical metal measure having internal diameter 7.5cm and depth 5cm for measuring aggregates.

(c) Tamping rod – A straight metal tamping rod of circular cross section, 10mm in diameter and 230 mm long rounded at one end.

(d) Sieve – The IS sieves of sizes 12.5, 10 and 2.36 mm.

(e) Balance – A balance of capacity not less than 500g, readable and accurate to 0.1g.

(f) Oven – A well ventilated and thermostatically controlled oven to maintain a temperature of 100 to 110°C.

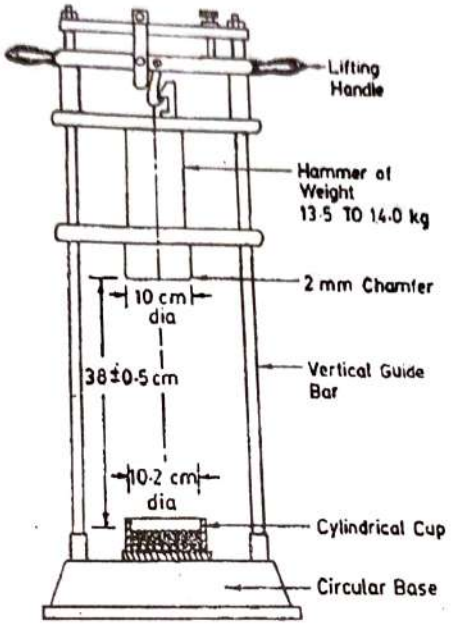


Fig. 18.1 Aggregate impact test set up

SPECIMEN/MATERIALS REQUIRED :

The material for the test sample consists of aggregates sized between 10mm to 12.5mm, dried by heating at 100 -110 °C in an oven for a period of 4hours and cooled to room temperature.

PROCEDURE :

(1) Oven dried test sample that passes through 12.5 mm and retained on 10mm IS sieve, of sufficient quantity to fill the metal measure is collected.

(2) The cylindrical metal measure is filled about one –third full with the aggregate and tamped with 25 stokes of the rounded end of the tamping rod.

(3) Again similar quantity of aggregate is added and a further tamping of 25strokes is given. Finally, the measure is filled to over flowing, the tamped 25 times and the surplus aggregate struck off, using the tamping rod as a straight edge.

(4) The net weight of the aggregate in the measure is determined to the nearest gram (Weight A) and this weight of the aggregate is used for carrying out the repeat test on the same material.

(5) The impact testing machine is placed with its bottom plate flat on the floor or pedestal so that the hammer guide columns are vertical.

(6) The cup is firmly fixed 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 a single tamping of 25 strokes of the tamping rod.

(7) The hammer is raised until its lower face is 38cm above the upper surface of the aggregate in the cup and allowed to fall freely on the aggregate. The test sample is subjected to a total of 15 such blows, each being delivered at an interval of not less than one second.

(8) The crushed aggregate is then removed from the cup and the whole of it is sieved on the 2.36mm sieve until no further significant amount passes.

(9) The fraction passing the sieve is weighted to an accuracy of 0.1g (Weight B). The fraction retained on the sieve is also weighted (Weight C).

(10) If the total weight of the fraction passing and retained on the sieve (B+C) is less than the initial weight (A) by more than one gram, the result is discarded and a fresh test is to be made.

PRECAUTIONS :

(1) The plunger is to be placed centrally so that it falls directly on the aggregate sample and does not touch the walls of the cylinder in order to ensure that the entire load is transmitted on to the aggregate.

(2) The tamping is to be done properly by gently dropping the tamping rod from a height of approximately 5cm and not by hammering action. Also the tamping should be uniform over the surface on the aggregates so that the tamping rod does not frequently strike against the walls of the mould.

(3) While sieving the crushed aggregates through 2.36mm sieve, the sum of the weights of fractions retained and passing the sieve should not differ from the original weight of the specimen by more than 1 gram.

OBSERVATION AND CALCULATION:

Two tests are made and the ratio of the weight of fines formed to the total sample weight in each test is expressed as a percentage, the result being recorded to the first decimal place .The mean of the two results is reported to the nearest whole number as the aggregate impact value of the tested material.

Sl. No.	*Particulars*	*Sample - I*	*Sample - II*
1.	Weight of dry sample(A)		
2.	Weight of fraction passing 2.36mm I.S sieve(B)		
3.	Aggregate impact value = $\frac{B}{A} \times 100$		

RESULT :

Aggregate impact value (mean) = _____

CONCLUSION :

(Comment on the result by comparing with standard values.)

DISCUSSION :

Impact value is observed to depend up on the shape of the aggregates in addition to quality of the parent rock. Well shaped cubical aggregates provide higher resistance to impact compared to flaky or elongated aggregates.

It has been found that for majority of aggregates, the aggregate crushing and impact values are numerically similar within close limits .But in the case of fine grained highly siliceous aggregates which are less resistant to impact than to crushing , the aggregate impact values are reported to be higher (on the average by about 5)than