SPECIFIC GRAVITY OF CEMENT

(IS: 269 -1989 AND IS: 4031-1988)

AIM: To determine the specific gravity of given sample of hydraulic cement.

APPARATUS: Physical balance, specific gravity bottle of 50ml capacity, clean kerosene.

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

PROCEDURE:

1. Clean and dry the specific gravity bottle and weigh it with the stopper (W1).
2. Fill the specific gravity bottle with cement sample at least half of the bottle and weigh with stopper (W2).
3. Fill the specific gravity bottle containing the cement, with kerosene (free of water) placing the stopper and weigh it (W3).
4. While doing the above do not allow any air bubbles to remain in the specific gravity bottle.
5. After weighing the bottle, the bottle shall be cleaned and dried again.
6. Then fill it with fresh kerosene and weigh it with stopper (W4).
7. Remove the kerosene from the bottle and fill it with full of water and weigh it with stopper (W5).
8. All the above weighing should be done at the room temperature of 27c $\pm$ 1^0c.

OBSERVATIONS:

Description of item		**Trial 1**	**Trial2**	**Trail3**
Weight of empty bottle	W1 g			
Weight of bottle + Cement	W2 g			
Weight of bottle + Cement + Kerosene	W3 g			
Weight of bottle + Full Kerosene	W4 g			
Weight of bottle + Full Water	W5 g			

Specific gravity of Kerosene Sk = W4 - W1 / W5 - W1

Specific gravity of Cement Sc = W2 - W1 / ((W4 - W1)-(W3-W2))*Sk

Sc = (W2 - W1)* (W4 - W1) / ((W4 - W1)-(W3-W2))*(W5 - W1)

PRECAUTION:

1. Only kerosene which is free of water shall be used.
2. At time of weighing the temperature of the apparatus will not be allowed to exceed the specified temperature.
3. All air bubbles shall be eliminated in filling the apparatus and inserting the stopper.
4. Weighing shall be done quickly after filling the apparatus and shall be accurate to 0.1 mg.
5. Precautions shall be taken to prevent expansion and overflow of the contents resulting from the heat of the hand when wiping the surface of the apparatus.

RESULT: Average specific gravity of given sample of cement =

COMMENTS:

BULKING OF SAND

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

APPARATUS: 1000ml measuring jar, brush.

INTRODUCTION: 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 sand particles get 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 ratio of coarse to fine aggregate will not change from the specified value. Maximum increase in volume may be 20 % to 40 % when moisture content is 5 % to 10 % by weight. Fine sands show greater percentage of bulking than coarse sands with equal percentage of moisture.

PROCEDURE:

1) Take 1000ml measuring jar.
2) Fill it with loose dry sand upto 500ml without tamping at any stage of filling.
3) Then pour that sand on a pan and mix it thoroughly with water whose volume is equal to 2% of that of dry loose sand.
4) Fill the wet loose sand in the container and find the volume of the sand which is in excess of the dry volume of the sand.
5) Repeat the procedure for moisture content of 4%, 6%, 8%, etc. and note down the readings.
6) Continue the procedure till the sand gets completely saturated i.e till it reaches the original volume of 500ml.

OBSERVATIONS:

S.No	Volume of dry loose sand V1	% moisture content added	Volume of wet loose sand V2	% Bulking V2 – V1 / V1
1.	500 ml	2%		
2.		4%		
3.		6%		
4.		8%		
5.				
6.				

GRAPH: Draw a graph between percentage moisture content on X-axis and percentage bulking on Y-axis. The points on the graph should be added as a smooth curve. Then from the graph, determine maximum percentage of bulking and the corresponding moisture content.

PRECAUTIONS:

1) While mixing water with sand grains, mixing should be thorough and uniform.
2) The sample should not be compressed while being filled in jar.
3) The sample must be slowly and gradually poured into measuring jar from its top.
4) Increase in volume of sand due to bulking should be measured accurately.

RESULT: The maximum bulking of the given sand is -----------at -----------% of moisture content.

COMMENTS:

FINENESS MODULUS OF FINE AND COARSE AGGREGATE

AIM: To determine the fineness modulus of given fine and coarse aggregates.

APPARATUS:_IS test sieves, square hole perforated plate 75mm, 40mm, 20mm, 10mm, and fine wire cloth of 4800, 2400, 1200, 600, 300, and 150 Microns. Weighing balance (Sensitivity 0.1 percent) sieve shaker, tray plates.

INTRODUCTION: Fine aggregate is sand used in mortars. Coarse aggregate is broken stone used in concrete. The size of the fine aggregate is limited to maximum 4.75 mm (4800 microns) beyond which it is known as coarse aggregate. Fineness modulus is only a numerical index of fineness, giving some idea about, the mean size of the particles in the entire body of concrete. Determination of fineness modulus is considered as a method of standardization of grading of aggregates i.e. the main object of finding fineness modulus is to grade the given aggregate for the most economical mix and workability with minimum quantity of cement. It is obtained by sieving known weight of given aggregate in a set of standard sieves and by adding the percent weight of material retained on all the sieves and dividing the total percentage by 100.

PROCEDURE:

Coarse aggregate:

1. Take 5Kgs of coarse aggregate (nominal size 20mm) from the sample by quartering.
2. Carry out sieving by hand, shake each sieve in order 75mm ,40mm, 20mm, 10mm, and No's 480, 240, 120, 60, 30, & 15 .over a clean dry tray for a period of not less than 2 minutes.
3. The shaking is done with a varied motion backward and forward, left to right, circular, clockwise and anticlockwise and with frequent jarring.
4. So that material is kept moving over the sieve surface in frequently changing directions.
5. Find the weight retained on each sieve taken in order

Fine aggregate:

1. Take 1 Kg of sand from sample by quartering in clean dry plate.
2. Arrange the sieves in order of No. 480, 240, 120, 60, 30 and 15 keeping sieve 480 at top and 15 at bottom.
3. Fix them in the sieve shaking machine with the pan at the bottom and cover at the top.
4. Keep the sand in the top sieve no 480, carry out the sieving in the set of sieves and arranged before for not less than 10 minutes.
5. Find the weight retained in each sieve.

OBSERVATIONS:

Coarse aggregate: Wt. of coarse aggregate taken: Kgs.

S.No	Sieve size	Weight retained	% Weight retained	% weight passing	Cumulative % Weights retained
1.	75 mm				
2.	40 mm				
3.	20 mm				

4.	10 mm				
5.	4800 microns				
6.	2400 microns				
7.	1200 microns				
8.	600 microns				
9.	300 microns				
10.	150 microns				

Fine aggregate: Wt. of fine aggregate taken: Kgs

S.No	Sieve size	Weight retained	% Weight retained	% weight passing	Cumulative % Weights retained
1	4800 microns				
2	2400 microns				
3	1200 microns				
4	600 microns				
5	300 microns				
6	150 microns				

Fineness Modulus: Sum of Cumulative percentage Wt. retained /100

PRECAUTIONS:

1. The sample should be taken by quartering.
2. The sieving must be done carefully to prevent the spilling of aggregate.

RESULT: The fineness modulus of given fine aggregate:
The fineness modulus of given coarse aggregate:

COMMENTS: Limits of fineness modulus of aggregates.

Maximum size of aggregate	**Minimum retained**	**Maximum retained**
Fine aggregate	2	3.5
Coarse aggregate		
20 mm	6	6.9
40 mm	6.9	7.5
75 m	7.5	8.0
150 mm	8.0	8.5

SPECIFIC GRAVITY VOID RATIO POROSITY AND BULK DENSITY OF COARSE AND FINE AGGREGATES

IS 2386 PART III-1963

AIM: To determine the specific gravity, void ratio, porosity and bulk density of given coarse and fine aggregates.

APPARATUS: 10 Kg capacity balance with weights, cylindrical containers of 1 liter and 5 liter capacities, measuring jar of 1000ml capacity.

INTRODUCTION: The specific gravity of an aggregate is generally required for calculations in connection with cement concrete design work for determination of moisture content and for the calculations of volume yield of concrete. The specific gravity also gives information on the quality and properties of aggregate. The specific gravity of an aggregate is considered to be a measure of strength of quality of the material. Stones having low specific gravity are generally weaker than those with higher specific gravity values.
The bulk density of an aggregate is used for judging its quality by comparison with normal density for that type of aggregate. It is required for converting proportions by weight into proportions by volume and is used in calculating the percentage of voices in the aggregate.

1. **Specific gravity** is the weight of aggregate relative to the weight of equal volume of water.
2. **Void ratio** is the ratio of volume of voids to the volume of solids in an aggregate.
3. **Percentage of voids or porosity** is the ratio of volume of voids to the total volume of a sample of an aggregate.
4. **Bulk density** or unit weight is the weight of material per unit volume.

PROCEDURE: Coarse aggregate

1. Find the weight of the empty container W1.
2. Take coarse aggregate in the container up to approximately half of the container and find out the weight W2.
3. Fill the container with water upto the level of the coarse aggregates so that all void space inside the aggregate is filled with water. Find its weight W3.
4. Fill the container with water after emptying it from mix of coarse aggregate and water.
5. Water should be upto the mark, upto which coarse aggregate is filled. Find its weight W4
6. Repeat the same process for another trail by taking the aggregate upto the full of the container and by filling the water up to same point.

OBSERVATIONS:

S.No			Trail 1	Trail 2
1)	Weight of empty container	W1		
2)	Weight of container with material	W2		
3)	Weight of container + material + water	W3		
4)	Weight of container + water	W4		

i) Void ratio = Vol. of Voids / Vol of Solids

W3 - W1 / ((W4 - W1)-(W3-W2))

ii) Porosity = Vol. of Voids / Total Vol. of aggregate *100
W3 - W2 / (W4 - W1) * 100

iii) Specific gravity = W2 - W1 / ((W4 - W1) - (W3 - W2))

iv) Bulk density = W2 - W1 / (W4 - W1).

Fine aggregate: Void Ratio and porosity

1. Take 150 ml of dry sand (v1 ml) in clean measuring jar of 1000 ml capacity.
2. Add a measured quantity of 100 ml clean water to the above sample (v2 ml) i.e. v2=100 ml
3. Shake the jar thoroughly till all air bubbles are expelled.
4. Now note the readings against the top surface of water in the jar (V3 ml)

Void ratio = v1 + v2 - v3 / v3 - v2
Porosity = v1 + v2 - v3 / v1

Specific gravity of fine aggregates:

1. Weigh the empty measuring jar of 1000 ml capacity = W1
2. Take the weight of empty measuring jar with 150 ml of sand
   Empty jar + sand =W2
3. Take the weight of empty measuring jar with 150 ml of sand and 100 ml of water
   Empty jar + sand + water = W3
4. Remove the mix of sand and water from bottle and fill it with water up to volume V3 then weigh it.
   Empty jar + water = W4

Specific gravity = Weight of solids / Volume of Solids
W2 - W1 / ((W4 - W1) - (W3 - W2))

PRECAUTIONS: While filling the container with water in determining void ratio and porosity of coarse aggregate care should be taken that water should not be in excess of the level of course aggregate.

RESULT:

1) Specific gravity of course aggregate.
2) Void ratio of course aggregate.
3) Porosity of coarse aggregate.
4) Bulk density of course aggregate.
5) Specific gravity of fine aggregate.
6) Void ratio of the given fine aggregate.
7) Porosity of the given time aggregate.

COMMENTS:

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NON-DESTRUCTIVE TESTING OF CONCRETE
REBOUND HAMMER TEST

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

APPARATUS:

- Rebound Hammer instrument.
- Abrasive Stone

PROCEDURE:
Hold the instrument firmly so that the plunger is perpendicular to the test surface. Gradually push the instrument toward the test surface until the hammer impacts. After impact, maintain pressure on the instrument and if necessary depress the button on the side of the instrument to lock the plunger in its retracted position. Read the rebound number on the scale to the nearest whole number and record the rebound number. Take ten readings from each test area. No two impact tests shall be closer together than 25 mm (1 in). Examine the impression made on the surface after impact, and if the impact crushes or breaks through a near-surface air void, disregard the reading and take another reading.

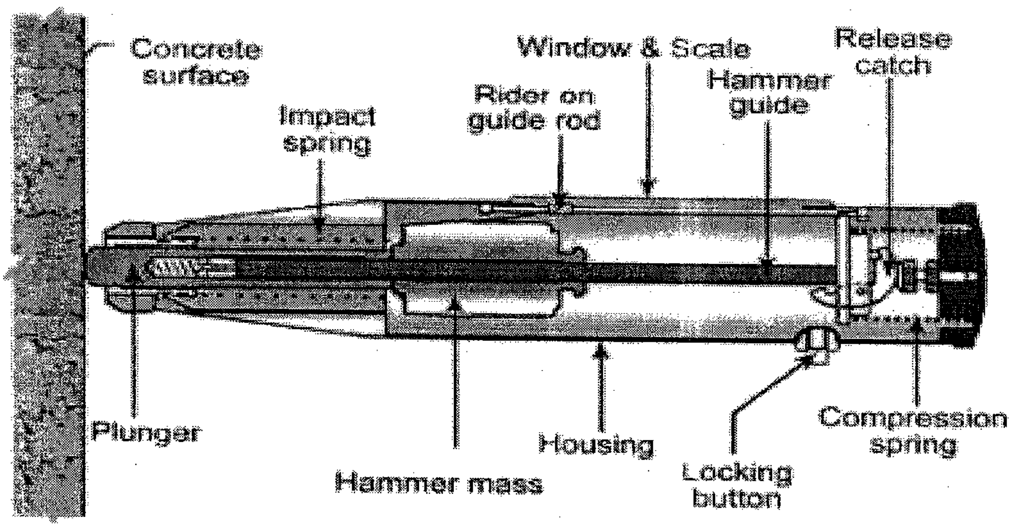

Fig.: Rebound Hammer

READING YOUR RESULTS:

Make at least ten readings from a concrete surface and discard the highest and lowest rebound numbers. Average the remaining eight numbers. If desired, take a few test readings before you complete your series of ten regular tests. Use the average rebound number to estimate the strength of the concrete. Compare your average rebound number to the chart shown on your Concrete Rebound Hammer.

Average Rebound Number	Quality of Concrete
>40	Very good hard layer
30 to 40	Good layer
20 to 30	Fair
<20	Poor concrete