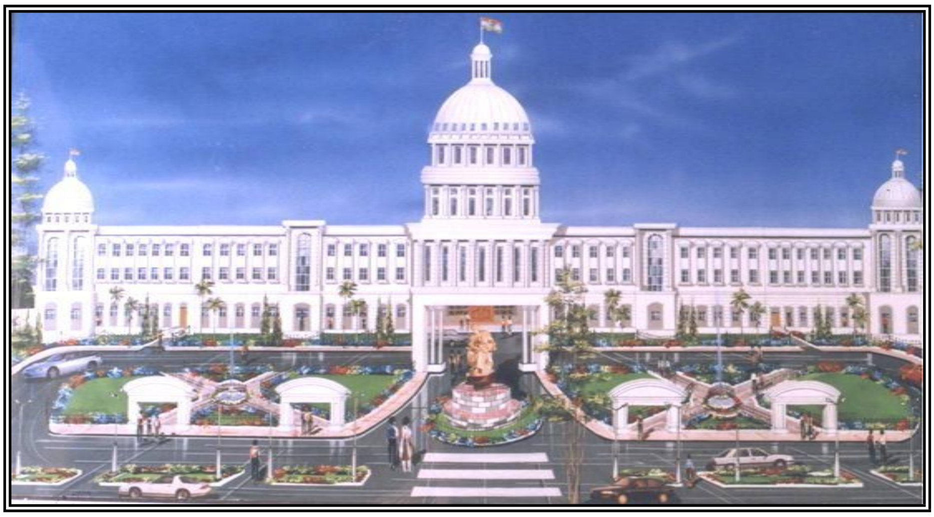
SESHADRI RAO

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute With Permanent Affiliation To JNTUK,kakinada)

***Seshadri Rao Knowledge Village*, GUDLAVALLERU-521356**



DEPARTMENT OF

CIVIL ENGINEERING

CONCRETE TECHNOLOGY LAB

II B.Tech - IISem

R20 Regulation

CONCRETE TECHNOLOGY LABORATORY

Name : ……………………………………………………………..

Regd. No :………………………………………………………………

Year & Semester: …………………………………………………………..

Academic Year : ………………………………………………………….

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EXPERIMENT NO:1 **DATE:**

NORMAL CONSISTENCY AND FINENESS OF CEMENT

(a) Normal Consistency of Cement

Aim: To determine normal consistency of cement by using vicat's apparatus.

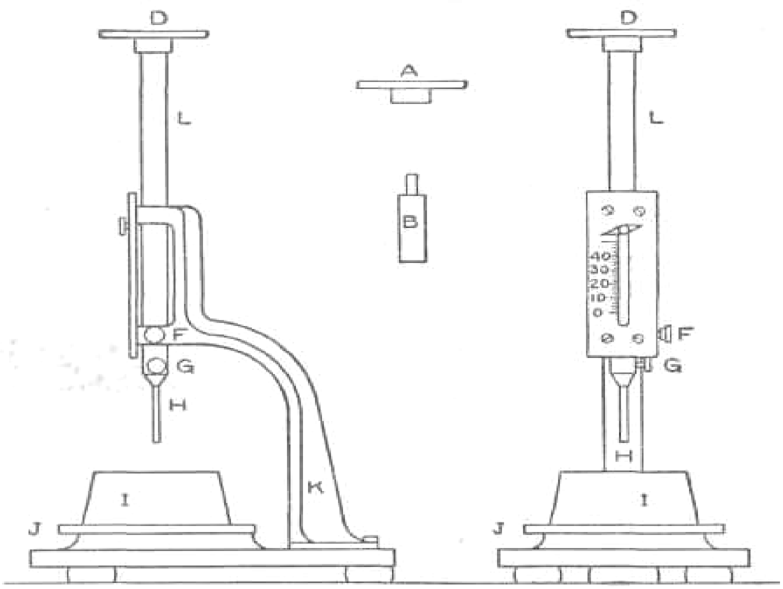
Reference: IS : 4031 (Pat 4) - 1988, IS : 5513-1976,

Apparatus: Vicat apparatus with plunger, balance, stopwatch, measuring jar.

Theory: The normal consistency of cement paste is defined as percentage of water required to produce a cement paste of standard consistency by penetrating the plunger of 10mm diameter and 50mm length to a depth of 5 to 7mm from the bottom or 33-35mm from the top of the mould.

Procedure:

1. Take about 500 gms of cement and prepare a paste with a weighed quantity of water (say 24 percent by weight of cement) for the first trail. The paste must be prepared in a standard manner and filled into the vicat mould with in 3-5minutes.
2. After completely filling the mould, shake the mould to expel air.
3. A standard plunger is attached and brought down to touch the surface of the paste in the test block and quickly released allowing it to sink into the paste by its own weight.
4. Take the reading by noting the depth of penetration of the plunger.
5. Conduct a second trial (say with 25 percent of water) and find out the depth of penetration of the plunger.
6. Similarly, conduct trials with higher water/cement ratio till such time the plunger penetrates for a depth of 33-35mm from the top of the mould(5-7mm from bottom of the mould).
7. That particular percentage of water which allows the plunger to penetrate only to a depth of of 33-35mm from the top is known as the percentage of water required to produce a cement paste of standard consistency. This percentage is usually denoted as 'p'. The test is required to be conducted in a constant temperature (27^0c $\pm 2^0$c) and constant humidity (90%)



Observations and Calculations:

Consistency is expressed as % of water required to produce a cement paste of standard consistency by penetrating the plunger of 10mm diameter and 50mm length to a depth of 5 to 7mm from the bottom or 33-35mm from the top of the mould.

S.No	Percentage of water added	Plunger reading

Precautions:

1. The experiment should be conducted at room temperature of $27^0 \pm 2^0$c at a relative humidity of 90%.

2. After ½ minute from instant of adding water, the paste should be thoroughly mixed with fingers for at least 1 min. A ball of this paste is prepared & then it is present into the test mould, mounted on the non porous plate. Plunger should be cleaned during every repetition of experiment.

Result: Normal consistency of cement is________

(b) Fineness of Cement

Aim: To determine the fineness of the cement of the given sample.
Apparatus: IS sieve 9 (90µ) confirming to IS 460-1972 with bottom pan, weighing balance, bristle brush.
Theory: The degree of fineness of cement is a measure of the mean size of the grains. The finer cement has quicker action with water and gains early strength without change in the ultimate strength. Finer cement is susceptible to shrinkage and cracking. A correction factor is to be applied for fineness of cement as all sieves are not exactly alike.
Procedure:

1. Accurately weigh 100 gm of cement sample and place it over the test sieve. Gently breakdown the air set lumps if any with fingers.
2. Hold the sieve with pan in both hands and sieve with gentle wrist motion, in circular and vertical motion for a period of 10 to 15 minutes without any spilling of cement.
3. Place the cover on the sieve and remove the pan. Now tap the other side of the sieve with the handle of bristle brush and clean the outer side of the sieve.
4. Empty the pan and fix it below the sieve and continue sieving as mentioned in the steps 2 and 3. Totally sieve for 15 minutes and weigh the residue (Left over the sieve)

Specification: Weight shall not exceed 10% for ordinary cement.

Precautions:

1. Air set lumps should be break down gently with fingers without rubbing on the sieve.
2. The sieve must be clean thoroughly before starting the experiment.
3. While sieving, care must be taken to prevent it the spilling of cement.

Observations:
Weight of cement taken =
Weight of cement retained (over the sieve) after sieving =

Result:

Fineness of the given sample is___________

EXPERIMENT NO:2 **DATE:**

INITIAL AND FINAL SETTING TIMES OF CEMENT

Aim: To determine initial and final setting times for cement by using vicat's apparatus.

Apparatus:

- Vicat's apparatus with needle
- Stop watch
- Balance
- 100ml measuring jar.

Theory:

Initial setting time: It is the time elapsed between the moment that the water is added to the cement, to the time that the paste starts losing its plasticity.
Final setting time: It is the time elapsed between moment the water is added to cement and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure.

Procedure:

1. Take 500 gms of cement sample and gauge it with 0.85 times the water required to produce cement paste of standard consistency(0.85p).
2. The paste shall be gauged and filled into the vicat mould in specified manner within 3-5 minutes.
3. Start the stopwatch the moment water is added to the cement.
4. The temperature of water and that of the test room, at the time of gauging shall be within 27^0c $\pm 2^0$c.
5. Lower the needle gently and bring it in contact with the surface of test block and quickly release. Allow it to penetrate into the test block.
6. In the beginning the needle will completely pierce through the test block. But after sometime when the paste starts losing its plasticity, the needle may penetrate only to a depth of 33-35mm from the top.
7. The time period elapsing between the time when water is added to the cement and the time at which the needle penetrates the test block to a depth equal to 33-35mm from the top is taken as initial setting time.
8. To determine the final setting time, replace the needle of vicat's apparatus by a circular attachment. The cement shall be considered as finally set when, upon, lowering the attachment gently cover the surface of the test block, the centre needle makes an impression, while the circular cutting edge of 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 than 0.5mm.

Observations:

S.No	Percentage of water adding(.85p)	Needle reading	Time in seconds	Remarks

Precautions:

1. The experiment should be conducted at the room temperature of 25-29^{0}c at the relative humidity of 90%.
2. After half a minute from the instant of adding water, the paste should be thoroughly mixed with fingers for at least one minute.
3. A paste is prepared and then it is pressed into best mould
4. For each repetition of the experiment, fresh cement is to be taken.

Result:

Initial setting time is _____
Final setting time is _____

EXPERIMENT NO:3 **DATE:**

SPECIFIC GRAVITY AND SOUNDNESS OF CEMENT

(A) Specific Gravity of Cement

Aim: To determine the specific gravity of cement by using Le-chatlier flask or specific gravity bottle.

Apparatus: Lechatlier's flask or specific gravity bottle, 100ml, capacity balance capable of weighing accurately up to 0.1gms.

Procedure:

1.Weigh a clean, dry, empty lechatlier's flask or specific gravity bottle with stopper (W_1).

2. Pour 1/3 rd of the cement into flask and weighed it along with its stopper (W_2).

3.Add kerosene (polar liquid) to that cement that taken above in flask till its flush meets the graduated mark of the flask. Now weigh the bottle (W_3).

4. Now remove the cement and kerosene and clean it thoroughly. Fill the bottle only with kerosene and weighed it (W_4).

Observations:

Weight of empty flask W_1=

Weight of empty flask + cement W_2=

Weight of empty flask + cement + keroseneW_3=

Weight of empty flask + kerosene W_4=

Specific Gravity of kerosene G_K=

Specific Gravity of cement = $\dfrac{w_2 - w_1}{(w_2 - w_1) - (w_3 - w_4)} \times G_k$

precautions:

1. The flask should be perfectly dry and clean and take weight along with lid.
2. Entrapped air must be expelled in the flask.
3. Cement should be free from lumps.

Result: Specific Gravity of cement =

(B) SOUNDNESS OF CEMENT

AIM : To determine soundness of cement by Le-chatlier's apparatus.

APPARATUS:

- Le-chatlier's apparatus
- Weighing balance accurate up to 0.1 gm.
- Water bath with electric heating arrangement
- Measuring cylinder
- Glass plates

THEORY: Unsoundness in cement is due to the presence of excess of lime than that could be combined with acidic oxide at kiln. This is also due to the inadequate burning or insufficiency in fineness of grinding or through mixing of raw materials.

PROCEDURE:

1. Prepare a cement paste formed by gauging cement with 0.78 times water to give a paste of standard consistency. The gauging time should not be less than 3 minutes nor greater than 4 min.
2. On the inner surface of mould , place the mould on glass sheet & fill it with cement paste taking care to keep the edges of the mould gently together cover the mould with another piece of glass sheet & place a small weight on this covering glass sheet & immediately put the whole assembly in water at a temp of 27^{0} c & keep it for 24 hrs.
3. Take out the assembly from water after 24 hrs measure the distance flow of the indicator points & record it as (D1).
4. Submerge the mould again in water and bring the water to boiling in 25 to 30 minutes & keep it boiling for 3 hrs.
5. Remove the mould from the water. Allow it to cool& measure the distance of the indicator points & record it as (D2). The difference b/w two measurements represents the expansion of cement.
6. The sample should be tested & average of the results should be reported

SPECIFICATIONS:

This must not exceed to 10 mm for ordinary, rapid hardening and low heat Portland cements. In case expansion is more than 10 mm as tested above, cement is said to be unsound.

RESULT:

The expansion of the cement in the Le-chatlier's apparatus is found to be______

EXPERIMENT NO.4 **DATE:**

COMPRESSIVE STRENGTH OF CEMENT

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

Apparatus:

1. Cube mould of size 7.07x7.07x7.07 cm with base plates.
2. Weighing balance accurate up to 0.1 gm.
3. Motored cube vibration machine.
4. Measuring cylinder.
5. Trowel and tray etc.

Materials:

Cement sample, water and standard sand.

Procedure:

Preparation of test specimen for each cube, take the quantities of materials (1:3) as follows

Cement = 185gms

Standard sand = 555gms (it shall conform to IS 650-1991)

Water = (P/4 +3.0) percent of combined weight of cement and sand.

Mix the cement and sand with trowel on non-porous plate for one minute. Then add water to the mixture of cement, sand and mix until the mixture of uniform colour is obtained. The time of gauging shall be in any case not be less than 3 minutes and nor more than 4 minutes.

1. Apply thin layer of oil to the interior faces of mould. Place it on the table of vibration machine, and firmly hold in position by means of clamps.

2. Place the entire quantity of mortar in the hopper of the cube mould and compact the same by vibrations(12000rpm) for period of about 2 minutes.

3. At the end of vibrations, remove the mould together with base plate from the machine and finish the top surface of cube in the mould by smoothing the surface with the blade of trowel. Engrave identification mark in cubes.

4. Keep the filled moulds in the atmosphere of at least 90% relative humidity for 24hrs, after completion of vibration. Also maintain a temperature at 27 ± 2^0c.

5. At the end of this period, remove cubes from moulds and immediately submerge in clean fresh water and keep there until taken out for testing.

Testing:

1. Place the test cube on the platform of compression testing machine without any packing, between cube and steel plates of the testing machine.

2. Apply the load on smooth surface on the cube steadily & uniform starting from zero at a rate of 35N/mm^2/minute till cubes fails

3. Test three such cubes at the end of three days of curing. Three cubes at end of 3 days, 7days and 28days of curing.
4. Record the crushing load.
5. Calculate the compressive load by strength of each cube by dividing crushing load by crushing area of cube. The compressive strength shall be average of the strength of three cubes for each period of curing.

BIS requirements:

As per IS:268, IS:8112, IS:12269 the average compressive strength of cement shall be as follows.

S.NO	GRADE OF CEMENT	AFTER 3 DAYS CURING N/mm^2	AFTER 7 DAYS CURING N/mm^2	AFTER 28 DAYS CURING N/mm^2
1	33 GRADE	16	33	22
2	43 GRADE	23	43	33
3	53 GRADE	27	53	37

Results:

The average compressive strength of cement sample is found to be

1. At the end of 3 days of curing =
2. At the end of 7 days of curing =
3. At the end of 28 days of curing =

Conclusion:

1. The compressive strength of given cement as per sample is__________________N/mm^2.
2. The cement is______grade cement according to BIS Requirements

EXPERIMENT NO:5 **DATE:**

SPECIFIC GRAVITY AND BULKING OF FINE AGGREGATE

A)specific gravity of fine aggregate

Aim: To determine the specific gravity of Fine aggregate.
Apparatus: pycnometer, weighing machine.
Theory: Specific gravity is the ratio of the weight of volume of the substance to the weight of an equal volume of the reference substance (water).
Procedure:
The pycnometer is used for aggregate less than **10mm** size.

1. Dry the pycnometer thoroughly& weigh it with the cap(W_1).
2. Pycnometer is filled with aggregate to about $1/3^{rd}$and weigh again(W_2).
3. Add sufficient water through top and allow the entrapped air to escape.
4. Gently tight the cap to avoid leakage of water.
5. Fill the pycnometer with water slowly up to top of cap without spilling (W_3) through the Pipe.
6. Clean the pycnometer by washing it with water thoroughly.
7. Fill the pycnometer with only water as alone and weigh it (W_4).
8. Repeat the test twice and take the average of 2trails.

Precautions:

1. The fine aggregate sample should be perfectly dry and clean.
2. The accuracies in weighing, failure to completely eliminate the entrapped air are the main source of error.
3. Gently tight the cap to avoid leakage of water.

Calculations:

Specific gravity of fine aggregate G = $\frac{W_2 - W_1}{(W_2 - W_1) - (W_3 - W_4)}$

W_1= Weight of empty pycnometer=

W_2= Weight of empty pycnometer +dry aggregate=

W_3= Weight of empty pycnometer + dry aggregate + water= W_4=Weight of empty pycnometer + water =

Result: The specific gravity of fine aggregate =

BULKING OF SAND

B)Bulking of sand

Aim: To study the behavior of sand grains under varying percentage of moisture content.

Apparatus: 250ml measuring cylinder, weighing balance etc.

Theory: In volume batching of concrete, dry quantity of fine aggregate is to be added, which depends upon the volume of cement. Free moisture forms a film around each particle. This film of moisture exerts what is known as surface tension which keeps the neighboring particles away from it. Therefore no point contact is possible between particles. This causes bulking of sand means increases in volume of sand.

Procedure:

1. Take 500gm of fine aggregate, pour It into a measuring jar and note the volume (V_1)
2. Keep the sample in an oven in a tray at a temperature of 100^0c – 110^0c for 24 hrs.
3. Cool the sand in air tight container and note the volume (V_2) for the water content of sample.

$$= ((V_2-V_1)/V_1)*100$$

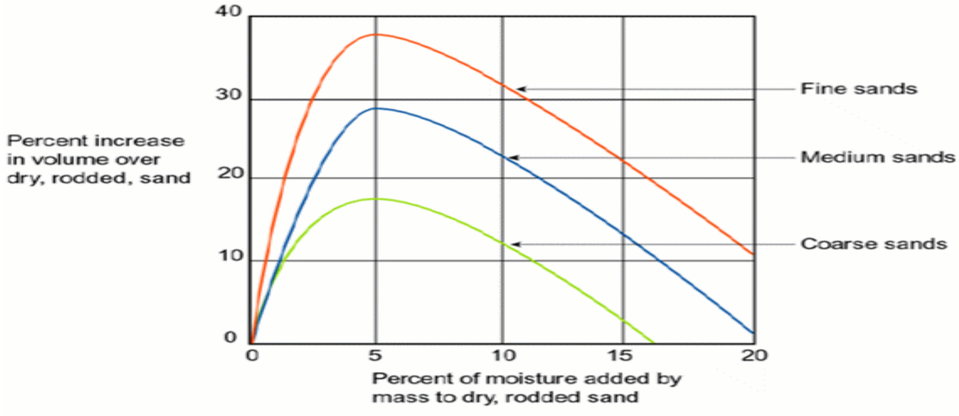
4. Take out about 250gm of sand and pour it in a measuring jar ,note the reading
5. Add 2% (by weight) water and mix it well.
6. Pour the sand sample into a 250ml measuring jar and consolidate by shaking.
7. Level the surface and read the volume in ml.
8. Take out the whole quantity of sand and continue the experiment by adding 2% water more each time and note the corresponding volume of sand until the dump sand volume starts decreasing.
9. Beyond this point, add 4% more water each time until the sample become fully saturated.
10. To standard cylinder sample in measuring cylinder, add 50ml water more and stir sample well and note down surface level of sand.

Observations:

Trail No	**% of water added**	**Initial volume**	**Final volume**	**% of bulking of sand**

Graph:

A graph is drawn with % of water content along X – axis and % bulking along Y – axis. From the graph pick out maximum % of bulking occurred, % of water content at maximum fulfilling of water content.



Results: (a) % of Bulking of Sand:

(b) % of water content at maximum bulking:

EXPERIMENTNO:6 **DATE:**

FINENESS MODULUS OF FINE AGGREGATE AND GRADING OF FINE AGGREGATE

Aim: To determine the fineness modulus of fine aggregate

Apparatus: Indian standard test sieves set , weighing balance , sieves, shaker pan , tray.

Definition: Fineness modulus is an index of coarseness or fineness of the material. It is an empirical factor obtained by adding the cumulative percentages of aggregate retained on each of the standard sieves ranging from 80mm -150micron and dividing this sum by an arbitrary number 100.

Theory: Fineness modulus is a numerical index used to know the mean size of particle in the total quantity of aggregate .

Fineness modulus is used to grade the given aggregate for most economical mix, workability with less assumption of cement lower FM, gives uneconomical mix and higher FM gives harsh mix.

Procedure:

1) Arrange the test sieves with larger openings at top and smaller openings at bottom and keep a pan at bottom of all the sieves.
2) Take 1 kg of sand into a tray and break the lumps, if any in case of fine aggregate and 1kg of samples in the case of coarse aggregate and mixed aggregate.
3) Keep the sample in the top sieve and allow it to pass through sequential order of sieves by continuous shaking of sieves, now collect the material retained on each sieve properly and weigh it.
4) Sieving should do for a period not less than 10minutes.

Precautions:

- Sample should be taken by quartering.
- Careful sieving must be done to prevent any spilling of aggregate

Graph: Draw a graph between IS sieve size (in log scale) taken along x-axis and %of passing taken along y-axis.

Fig 2: Particle Distribution Curve for Fine Aggregate

Specification: The following limits may be taken as guidance.

- Fine sand : F.M—2.2—2.6
- Medium sand : F.M—2.6—2.9
- Coarse sand:F.M—2.9—3.2

observation: Weight of sample for fine aggregate=

Observation: Fine aggregate

s.no	IS sieve size	Wt retained (Gm)	% of weight retained	% of weight passing	Cumulative % of weight Retained
1	4.75mm				
2	2.36mm				
3	1.18mm				
4	600 µ				
5	300 µ				
6	150 µ				

Result:

Fineness modulus of fine aggregate =

EXPERIMENT NO:7 **DATE:**

SPECIFIC GRAVITY OF COARSE AGGREGATE

Aim: To Determine specific gravity of coarse aggregates.

Apparatus: Pycnometer, weighing balance

Theory:

specific gravity test is used to calculate the specific gravity of a coarse aggregate sample by determining the ratio of the weight of a given volume of aggregate to the weight of an equal volume of water.

Procedure:

1. Dry the pycnometer thoroughly and weighed it with cap (**W1.**)
2. Pycnometer is filled with aggregate to about $1/3^{rd}$ and weights it again (**W2.**)
3. Add sufficient water up to the top and allow the entrapped air to escape.
4. Gently tight the cap to avoid leakage of water.
5. Fill the Pycnometer with water slowly up to top of cap without spilling (**W3**) through pipe .
6. Clean the Pycnometer by washing it with water thoroughly.
7. Fill the Pycnometer with only water and weighed it as (**W4**)
8. Repeat the test twice and take the average for 2trials.

Precautions:

1.The coarse aggregate sample should be perfectly dry and clean and take weight along with lid.

2.Expel the entrapped air in the bottle.

3.Cap of the Pycnometer with washer should be used gently to avoid leakage of water.

Calculations:

Specific gravity of aggregate G $= \dfrac{W2-W1}{W2-W1-(W3-W4)}$

W1 = weight of empty Pycnometer =

W2 = weight of empty Pycnometer + dry aggregate =

W3 = weight of empty Pycnometer + dry aggregate +

water = W4 = weight of empty Pycnometer + water =

Result: The specific gravity of coarse aggregate is______________

EXPERIMENT NO:8 **DATE:**

FINENESS MODULUS OF COARSE AGGREGATE

Aim: To determine the fineness modulus of coarse aggregate.

Apparatus: Indian standard test sieves set , weighing balance , sieves, shaker pan , tray.

Definition: Fineness modulus is an index of coarseness or fineness of the material.It is an empirical factor obtained by adding the cumulative percentages of aggregate retained on each of the standard sieves ranging from 80mm -150micron and dividing this sum by an arbitrary number 100

Theory: Fineness modulus is a numerical index used to know the mean size of particle in the total Quantity of aggregate.
Fineness modulus is used to grade the given aggregate for most economical mix, workability with less assumption of cement lower FM, gives uneconomical mix and higher FM gives harsh mix.

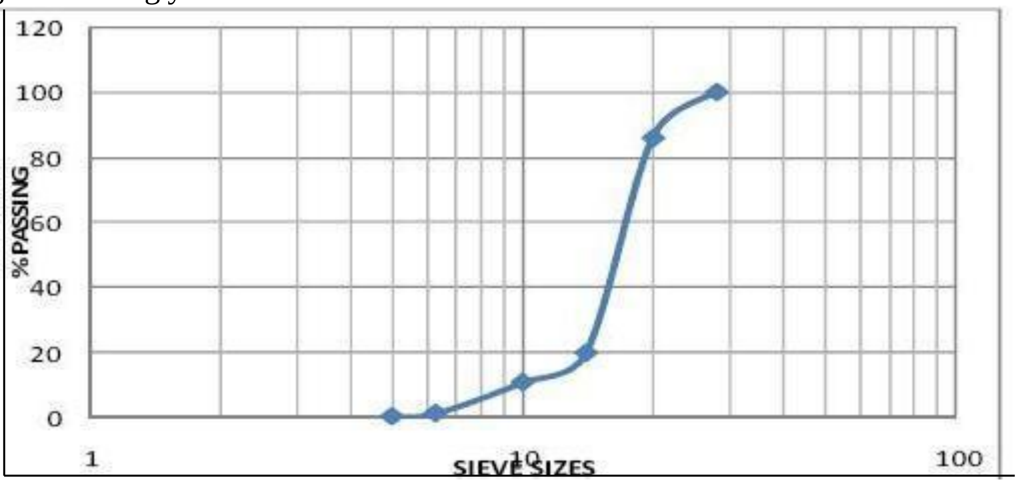
Procedure:

1. Arrange the test sieves with larger openings at top and smaller openings at bottom and keep a pan at bottom of all the sieves.
2. Take 1 kg of sand into a tray and break the lumps, if any in case of fine aggregate and 1kg of samples in the case of coarse aggregate and mixed aggregate.
3. Keep the sample in the top sieve and allow it to pass through sequential order of sieves by continuous shaking of sieves, now collect the material retained on each sieve properly and weigh it.
4. Sieving should do for a period not less than 10minutes.

Precautions:

- Sample should be taken by quartering.
- Careful sieving must be done to prevent any spilling of aggregate

Graph: Draw a graph between IS sieve size (in log scale) taken along x-axis and % of passing taken along y-axis.



Specification: The following limits may be taken as guidance.

- Fine sand : F.M—2.2—2.6
- Medium sand : F.M—2.6—2.9
- Coarse sand:F.M—2.9—3.2

observation: Weight of sample for coarse aggregate=

Observation: coarse aggregate

s.no	IS sieve size	Wt retained Gm	% of weight retained	% of weight passing	Cumulative % of weight Retained
1	80mm				
2	40mm				
3	20mm				
4	10mm				
5	4.75mm				
6	2.36mm				
7	1.18mm				
8	600 µ				
9	300 µ				
10	150 µ				

Result:

Fineness modulus of coarse aggregate=

EXPERIMENT NO:9 **DATE:**

FLAKINESS INDEX OF COARSE AGGREGATE

AIM: To determine flakiness index of given aggregate.

APPARATUS: Standard thickness gauges, I.S sieves of sizes 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3mm and a balance.

PROCEDURE:

1. Sample is sieved with sieves mentioned and 200 pieces of each fraction to be tested are taken and weighed as W_1 gr.
2. Flaky material is separated by a thickness gauge or sieves with elongated slots.
3. Width of slot used should be according standards for material.
4. The amount of flaky material is weighed to 0.1% accuracy of test sample.

CALCULATIONS:

1. Sum of weight of all fractions retained on different sieve sizes W =
2. Sum of weight of all fractions passing through different sieves w =

Sieve sizes	Wt. of aggregate (gr)	Wt. of flaky material (gr)
50		
40		
31.5		
25		
20		
16		
12.5		
10		
6.3		

Flakiness Index= (sum of weights of the flaky material/sum of weight of aggregates)*100=

RESULT: Flakiness index=

EXPERIMENT NO:10 **DATE:**

ELONGATION INDEX OF COARSE AGGREGATE

AIM: To determine Elongation index of the aggregate.

APPARATUS: The apparatus consists of the length gauge, sieves of the sizes specified in table 5.1 and a balance.

PROCEDURE:

The sample is sieved through the sieves specified in 5.1. A minimum of 200 pieces of each fraction is taken and weighed. In order to separate elongated material, each fraction is then gauged individually for length gauge. The gauge length used should be those specified in column 4 of the Table for the appropriate material. The pieces of aggregates from each fraction tested which could not pass through the specified gauge length with its long side are elongated particles and are collected separately to find the total weight of aggregate retained by the length gauge are weighed to an accuracy of atleast 0.1 percent of the weight of the sample.

CALCULATION:

In order to calculate the elongation index of the entire sample of aggregates, the weight of aggregates which is retained on the specified gauge length from each fraction is noted. As an example, let 200 pieces of the aggregate passing 40mm sieve and retained 24mm sieve weight W1g. Each piece of these are tried to be passed through the specified gauge length of length gauge, which is this example is

$$= \frac{(45+25)}{2} \times 1.8$$

With its longest side and those elongated pieces which do not pass the gauge are separated and the total weight determined= W1g. Similarly the weight of each fraction of aggregate passing and retained on specified sieves sizes are found. W1, W2, W3… and the total weight of sample determined = W1+w2+W3….= W g. Also the weight of material from each fraction retained on the specified gauge length are found = X1, X2, X3... and the total weight retained determined = X1+x2+X3+…= X g.

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

Elongation = =percent.

(W1+W2+W3+…   = W)

OBSERVATIONS:

SIEVE SIZES	WEIGHT	WEIGHT OF MATERIAL	PERCENTAGE OF ELONGATION
63-50			
50-40			
40-31.5			
31.5-25			
25-20			
20-16			
16-12.5			
12.5-10			
10-6.3			

RESULT: Mean percentage of elongation =

EXPERIMENT NO:11 **Date:**

WORKABILITY TEST ON CONCRETE BY COMPACTION FACTOR,SLUMP AND VEE-BEE CONSISTOMETER

AIM: To determine the consistency of concrete mixes by

1. Compaction Factor Test
2. Slump cone test
3. Vee-bee Consistometer

where the normal size of aggregate doesn't exceed 38mm

APPARATUS:

Conical mould, Tampering rod, Vee-Bee consistometer, Compaction Factor Apparatus, Flow Table, Steel scale, weighing balance, Measuring jar, Trowel, Stopwatch.

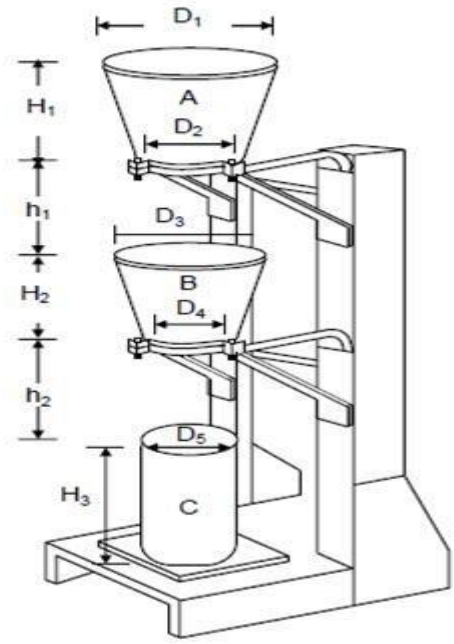
THEORY:

The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured. This difference in height in mm. is taken as *slump* of concrete.

Slump, vee-bee time, compaction factor are the names used to indicate the consistency and workability of concrete.

PROCEDURE:

a) COMPACTION FACTOR TEST:

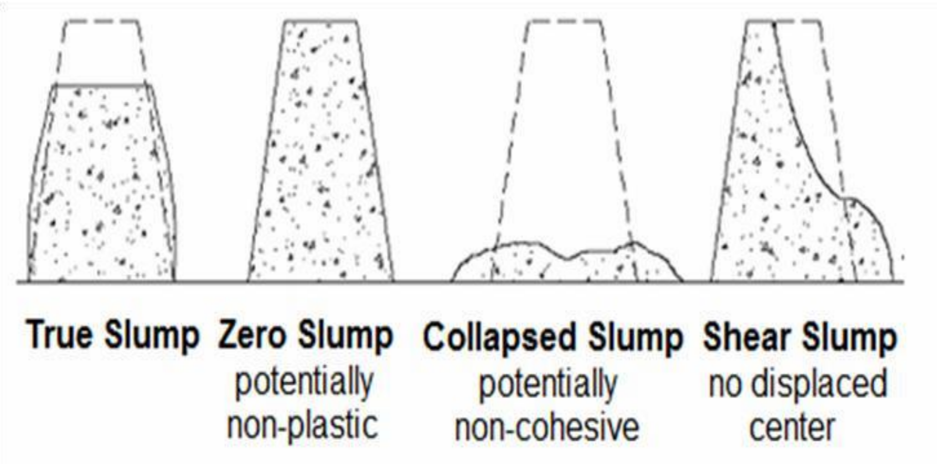


1) Apply grease to the inner surface of the hoppers and cylinders.
2) Fasten the hopper doors.
3) Weight the empty cylinder (w_1). Fix the cylinder at the centre of the hopper (i.e. insert in the appropriate holes)

4) Fill the upper hopper with freshly mixed concrete , without any compaction. After two minutes release the trap door, allowing the concrete to fall into the lower hopper and bringing the concrete into standard compaction.
5) As soon as the concrete comes to rest release the trap door of the lower hopper and allow concrete to fall into the cylinder. Remove the excess concrete above the top surface of cylinder with a trowel, without any compaction. Clean the sides of the cylinder and note the weight of the cylinder and taken as a partially compacted concrete **(w_2).**
6) Empty the cylinder and refill it with same sample of concrete with 5cm layers heavily compacting each layer to expel the air and to obtain full compaction of concrete, strike of the excess concrete and weigh the cylinder with fully compacted concrete**(w_3)**
7) The ratio of the weights of partially compacted concrete to fully compacted concrete **$(W_2-W_3)/(W_3-W_1)$** gives the compaction factor.

b) SLUMP CONE TEST:

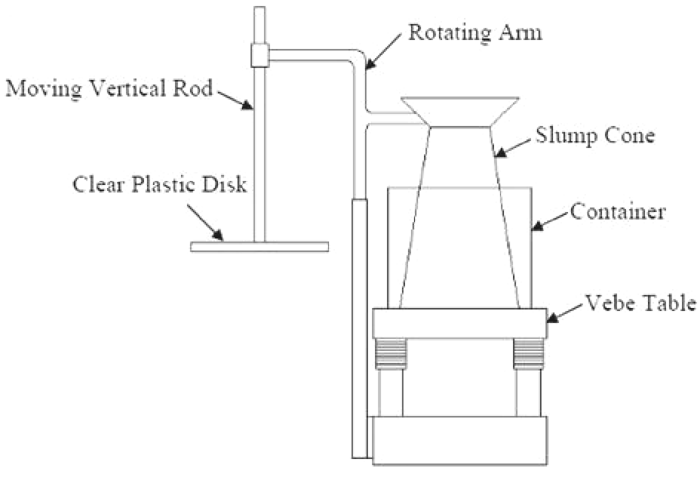
1. Weigh the constituents of concrete in dry state. First mix cement and sand thoroughly to get a uniform colour. Make a dip at centre of heap and pore some part of already weighed water.
2. Clean the internal surface of the mould and place it over a smooth, horizontal and non-absorbent surface.
3. Absorbent surface firmly held the plate in position and filled it with fresh concrete in four equal layers (each layer is $1/4^{th}$ of height of mould)
4. Using the tampering rod or a trowel strike of the excess concrete above the concrete in slump cone. Measure the vertical height of cone(h_1).
5. Slowly and carefully remove in the vertical direction. As soon as the cone is removed, the concrete settles in vertical direction. Place the steel scale above top of settled concrete in horizontal position and measure the height of cone(h_2).
6. Complete the experiment in two minutes after sampling.
7. The difference of two heights (h_1-h_2) gives the value of slump.



PRECAUTIONS:

1) The experiment should be completed in three minutes.
2) Care should be taken that not to cause subsidence by jarring the base.
3) Test must be conducted beyond the range vibration.

c) VEE-BEE CONSISTOMETER:



Vebe Consistometer

1) Clean the internal surface of the mould and place it inside the sheet metal cylindrical pot of the consistometer. Firmly held the cone in position and fill it with fresh concrete in four equal layers.
2) Tamp each layer of concrete with the tamping rod for 25 times distributing the blows in a uniform manner over the cross-section of mould. For the second and subsequent layer the tamping rod should penetrate into the preceding layers.
3) Using the tamping rod or a trowel strike off the excess concrete above the top of the cone. Attach the glass disc to the swivel arm. Place the glass disc over the slump cone and note the position.
4) Turn the swivel slowly and carefully remove the cone in the vertical direction as soon as the cone is removed, turn the swivel arm and place the glass plate over the concrete cone.

5) Switch on the electric vibrator of the vee-bee consistometer. Simultaneously, start the stop watch. Continue the vibration until the whole concrete surface uniformly adheres to the glass disc. At this stage, start the stop watch and note the elapse time in seconds.
6) Express the consistency of concrete in Vee-Bee time which is equal to the elapsed time in seconds.

RESULT:

1) Slump of concrete=
2) Vee-Bee time=
3) Compaction factor=

EXPERIMENT NO: 12 **DATE:**

COMPRESSIVE STRENGTH ,SPLIT TENSILE STRENGTH AND FLEXURAL STRENGTH OF CONCRETE

Aim: To determine the cube strength and split tensile strength of the given concrete.

Apparatus:

Compression testing machine confirming to IS: 516-1959, cube mould 15 cm ×15 cm × 15 cm in size, cylinder moulds with mean internal diameter 15 cm ± 0.2 mm and the height is 30 +/- 0.1 cm, prism moulds 10 cm ×10 cm ×50 cm, tamping rod, and weighing machine. The moulds should be made of stool or cast iron with an internal tolerance of ±0.025 mm. when the mould is properly assembled, its dimensions should be correct to ±0.2 mm &all internal angles b/w internal faces should be 90±0.5. The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03 mm. when the cylindrical mould is assembled for use, it should be at least 6.5 mm thick & such that they do not depart from a plane surface by more than 0.02 mm.

Procedure:

A) Preparation of test specimens:

1) Weigh the quantities of cement, fine aggregate, coarse aggregate and water for one batch of concrete, to an accuracy of 0.1% of the total weight of batch.

2) Mix the concrete by hand or preferably in laboratory batch mixer, avoiding loss of any material or water. The period of mixing should not be less than two minutes after adding all materials in drum, in case of machine mixing.

3) In case of hand mixing first mix cement and fine aggregate until a uniformly blended mixture is obtained. Add coarse aggregate to the earlier mix and mix all materials and until all materials are uniformly spread throughout the batch. Add water and mix the entire batch until all materials of concrete appears to be homogeneous and attain the required consistency.

4) Apply a thin coat of oil to the base plate and interior faces of the moulds, prevents the adhesion of concrete.

5) Fill the moulds with fresh concrete in layers approximately 5 cm deep, place the concrete with a trowel, moving it around top edge of the mould, allowing the concrete to slide in a symmetrical manner without any segregation.

6) In case of compaction by vibration, place the mould on vibration table &vibrate each layer of the concrete in the mould until the specified condition reached.

7) In case of hand compaction, each layer should be well tamped by using standard tamping rod, distributing over entire surface. The no. of blows required for each layer, to obtain specific conditions are

(a) 15 cm cubical moulds –not less than 35 blows

(b) Cylindrical specimens – not less than 30 blows. The strokes must penetrate into the underlying layer & it should be rodded throughout its depth. Tap the sides of mould to close the voids left by tamping.

8) After filling the moulds & compaction, remove the excess material by using trowel. Immediately after doing the above procedure, cover the moulds with wet mats.

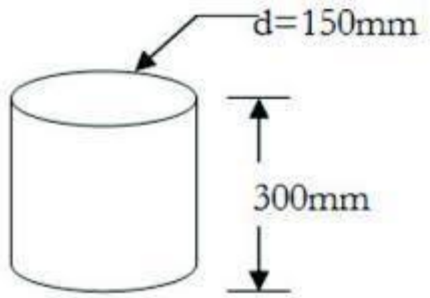
9) Prepare a rich & stiff cement paste, for about two to four hours before application on the specimens to avoid shrinkage. Cap the m by means of a glass plate, generally 2 to 4hrs or more often moulding.

10) Stone the test specimen for 24±1/2 hour in moist air of 90% relative humidity & at a room temp of 27±2®C. The measurement of time begins at the instant the water is added to dry ingredients. Then remove the specimens from the moulds & transfer to fresh water or saturated time solution, if tests are not require immediately.

B) Testing of specimens:

1) cubes & cylinders for compressive strength:

1) Before testing the ends of specimen, it should be capped with a material whose compressive strength is greater than that of concrete in the core.
2) Take the specimens from curing tank and wipe off the grift and surface water and remove projecting pins, -note the dimensions of the specimens to the nearest 0.2 mm & their weight.
3) Clean the bearing surfaces of the testing machine. Place the cubical specimens in such a manner that the load is applied to opposite sides of the cubes as cast. The cylinders should be placed in vertical direction. No packing should be used b/w the test specimen and stool plate of the testing machine.
4) Rotate the movable spherical seated block and rest over the top of the specimen with proper bearing. Now apply load without any shock and continuously increase at the rate of approximately at 140 kg/ sq cm per min until no greater load is sustained by the specimen. Note the max load applied to the specimen.
5) Calculate the cube strength or cylindrical strength as the ratio of max applied to mean c/s area of the specimen and express to the market kg/sq cm.
6) Average of three values should be taken as representative of the batch provided the individual variation is not more than +15%of the average unless ,repeat the tests.



Standard Specimen

2.Split tensile test:

1) After specified period of curing take the cylindrical specimens from curing tank & wipe off the grit & surface water. Note the dimensions of the specimens & their weights.
2) Draw a diametrical line on the two ends of the specimen using a suitable procedure.
3) Clean the bearing surfaces of the testing machine. Place one of the plywood strips centered along the centre of the lower plate.
4) Place the specimen on the strip in horizontal direction ,so that the diametric lines marked on the ends of the specimen are vertical & centered along the plywood strip.
5) Place the second ply wood strip on the cylinder in length wise & centered on the marked lines & fix the specimen by bringing down upper plates.
6) Gently apply the load without any shock & continuously increase the load at the rate to produce a splitting tensile stress of approximately 14 to 21 kg/ sq/ cm/ min until no greater load is sustained by the specimen. Record the max load applied to the specimen.

3.flexural strength of concrete

1. Sampling of Materials - Samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air-dried condition. The cement samples, on arrival at the laboratory, shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material.

2. Proportioning - The proportions of the materials, including water, in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work.

3. Weighing - The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of the batch

4. Mixing Concrete - The concrete shall be mixed by hand, or preferably, in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired number of test specimens.

5. Mould - The standard size shall be 15 × 15 × 70 cm. Alternatively, if the largest nominal size of the 67 aggregate does not exceed 19 mm, specimens 10 × 10 × 50 cm may be used

. 6. Compacting - The test specimens shall be made as soon as practicable after mixing, and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance.

7. Curing - The test specimens shall be stored in a place, free from vibration, in moist air of at least 90 percent relative humidity and at a temperature of 27° ± 2°C for 24 hours ± ½ hour from the time of addition of water to the dry ingredients.

8. Placing the Specimen in the Testing Machine - The bearing surfaces of the supporting and loading rollers shall be wiped clean, and any loose sand or other material removed from the surfaces of the specimen where they are to make contact with the rollers

9. The specimen shall then be placed in the machine in such a manner that the load shall be applied to the uppermost surface as cast in the mould, along two lines spaced 20.0 or 13.3 cm apart.

10. The axis of the specimen shall be carefully aligned with the axis of the loading device. No packing shall be used between the bearing surfaces of the specimen and the rollers.

11. The load shall be applied without shock and increasing continuously at a rate such that the extreme fibre stress increases at approximately 7 kg/sq cm/min, that is, at a rate of loading of 400 kg/min for the 15.0 cm specimens and at a rate of 180 kg/min for the 10.0 cm specimens.

12. The load shall be increased until the specimen fails, and the maximum load applied to the specimen during the test shall be recorded. The appearance of the fractured faces of concrete and any unusual features in the type of failure shall be noted.

Figure :

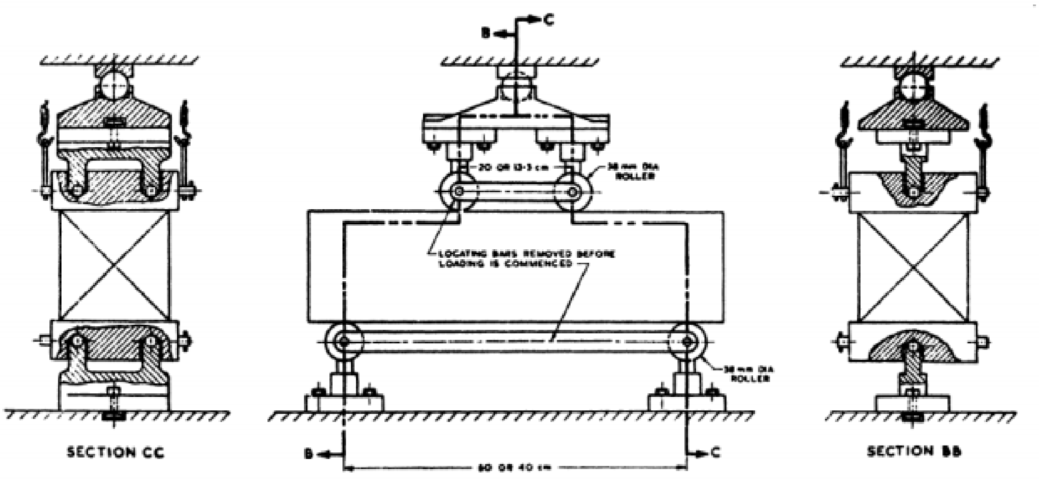


FIG. 3 ARRANGEMENT FOR LOADING OF FLEXURE TEST SPECIMEN

Observation :

Calculations of Mix Proportion

Mix proportion of concrete	For 1 cubic meter of concrete	For one batch of mixing
Coarse aggregate (kg)		
Fine aggregate (kg)		
Cement (kg)		
Water (kg)		
S/A		
w/c		
Admixture		

Sr. No.	Age of Specimen	Identification Mark	Size of Specimen (mm)	Span Length (mm)	Maximum Load (N)	Position of Fracture 'a' (mm)	Modulus of Rupture (MPa)
1	7 Days						
2							
3							
4	28 Days						
5							
6							

Calculation :

The flexural strength of the specimen shall be expressed as the modulus of rupture f_b, which, if 'a' equals the distance between the line of fracture and the nearer support, measured on the centre line of the tensile side of the specimen, in cm, shall be calculated to the nearest 0.5 kg/sq cm as follows:

$$f_b = \frac{P \times l}{a \times d^2}$$

when 'a' is greater than 20.0 cm for 15.0 cm specimen, or greater than 13.3 cm for a 10.0 cm specimen, or

$$f_b = \frac{3P \times a}{b \times d^2}$$

when 'a' is less than 20.0 cm but greater than 17.0 cm for 15.0 cm specimen, or less than 13.3 cm but greater than 11.0 cm for a 10.0 cm specimen

where

b = measured width in cm of the specimen,

d = measured depth in cm of the specimen at the point of failure,

l = length in cm of the span on which the specimen was supported,and

p = maximum load in kg applied to the specimen.

Result:

Avg cube compressive strength at 7 days=

Avg cube compressive strength at 14days=

Avg cube compressive strength at 28days=

Avg split tensile strength=

Average 7 Days Modulus of Rupture of concrete sample is found to be ….…….

Average 28 Days Modulus of Rupture of concrete sample is found to be ….…….

EXPERIMENT NO: 13 **Date:**

NON DESTRUCTIVE TETSING OF CONCRETE BY REBOUND HAMMER

OBJECT:

To test the concrete specimen by the non-destructive test methods i.e., rebound hammer.

THEORY:

In actual structure at a construction site, it is not possible to estimate the strength directly. Some estimate of quality of concrete as well as of the uniformity of casting of a structure can however be obtained by non-destructive technique such tests. Ultrasonic pulse is introduced by an electro – acoustic transducers on one side of concrete specimen. It travels through the material at a velocity which is dependent on the nature of the material. The velocity of pulse for an elastic homogeneous material is given by

$$V \Big| = \frac{E(1-u)}{\rho(1+u)(1-2u)}$$

Where E = youngs modulus of elasticity

ρ = density

u =Poissons ratio

The elastic constants E & V are affected by the nature, continuity of solid phase, porosity and presence of micro cracks.

The same parameters affect the strength of concrete. So the pulse velocity can give an estimate of modulus of velocity and compressive strength of concrete. Available data obeys the following relationship approximately, provided the same aggregate have been used. Compressive strength (s) of concrete varies with pulse velocity "v" as $s = A + B\ v^n$

Where V = ultrasonic pulse velocity

A, B = Constants, the exponent n " may have value ranging from 3-4.

Rebound hammer also called schmidth hammer impact hammer or scelerometer measure the hardness of material surface by the rebound of a standard ball after an elastic impact against the surface, the mass after this elastic impact expressed as a percentage of the original distance is seemed as rebound hammer. This rebound as an index relationship between the rebound number & concrete strength is available.

APPARATUS:

Schmidth hammer

NON DESTRUCTIVE TETSING OF CONCRETE

PROCEDURE:

1) The specimen to be tested should be kept and cured in such a way that the softening or hardening of the surface due to baching of calcium hydroxide. Corrosion or carbonation is avoided.
2) The specimen surface shall be deaned of dust or any loose material.
3) The specimen shall be held or fixed in such a way that it does not yield under the (important) impact of hammer.
4) The plunger or hammer always be kept perpendicular to the surface.
5) About 10-12 readings, shall be taken and then their average value can be calculated to get representative index of hardness.

All the readings which are to be compared shall be taken while keeping the hammer in a specified inclination with the vertical, with the hammer pointing always in the same direction.

For the same surface the readings taken vertically are likely to be different from those taken by keeping the hammer in the horizontal portion.

RESULT:

Compressive strength by rebound hammer =