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DEPARTMENT OF CIVIL ENGINEERING

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CE3412 – MATERIAL TESTING LABORATORY(REGULATION 2021)

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CE3412 - MATERIALS TESTING LABORATORY

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TENSION TEST ON STEEL ROD

Ex. No.: **Date:**

Aim:

To conduct a tension test on given mild steel specimen for finding the following:

1. Yield stress
2. Ultimate stress
3. Nominal breaking stress
4. Actual breaking stress
5. Percentage Elongation in length
6. Percentage Reduction in area.

Apparatus Required:

1. Universal Testing machine (UTM)
2. Mild steel specimen
3. Scale
4. Vernier caliper
5. Dot Punch
6. Hammer

Procedure:

1. Measure the length (L) and diameter (d) of the given specimen.
2. Mark the centre of the specimen using dot punch.
3. Mark two points P and Q at a distance of 150mm on either side of the centre mark so that the distance between P and Q will be equal to 300mm.
4.Mark two point A and B at a distance of 2.5 times the rod distance on the either side of the centre mark so that the distance between A & B will be equal to 5 times the rod diameter and is known as initial gauge length of rod. (li).
5. Insert the specimen in the middle cross head and top cross head grip of the machince so that the two points A and B coincide with grips.
6. Apply the load gradually and continue the applications of load. After sometime, there will be slightly pause in the increase of load. The load at this point is noted as yield point (Py).

7. Apply load continuously till the specimen fails and note down the ultimate load (Pa) and breaking load (P_b) from the digital indicator.

8. Remove the specimen from the machine and join the two pieces of the specimens.

9. Measure the distance between the two points A and B. This distance is known as final gauge length (li) of the specimen.

10. Measure the diameter of the rod at neck (dn).

11. Determine the yield stress, ultimate stress, nominal breaking stress, actual breaking stress, percentage elongation in length and percentage reduction in area using the following formula.

Observation and calculation:

1. Material of the specimen	=	
2. Length of the specimen, L	=	mm
3. Diameter of the specimen, d	=	mm
4. Initial gauge length of the specimen I_i	=	mm
5. Final gauge length of the specimen I_i	=	mm
6. Daimeter at neck d_n	=	mm
7. Yield load. P_y	=	kN
8. Ultimate load,P_u	=	kN
9. Breaking load, P_b	=	kN

1) Yield stress σ_y

$$\sigma_y = \frac{\text{Yield Point } (P_y)}{\text{Initial Area } (A_i)}$$

2) Ultimate stress σ_u

$$\sigma_u = \frac{\text{Ultimate load } (P_u)}{\text{Initial Area (Ai)}}$$

3. Nominal breaking stress, σ_{bn}

$$\sigma_{bn} = \frac{\text{Breaking load } (P_b)}{\text{Initial Area } (A_i)}$$

4. Actual breaking stress, σ_{bn}

$$\sigma_{bn} = \frac{\text{Breaking load (Pb)}}{\text{Neck Area } (A_n)}$$

5. % Elongation in length

$$= \left(\frac{\text{Final gauge length } (I_i) - \text{Initial gauge length (Ii)}}{\text{Initial gauge length (Ii)}}\right) \times 100$$

$$6\%\ \text{Reduction in area} = \left(\frac{\text{Initial area (Ai)} - \text{Neck area } (A_n)}{\text{Initial gauge length (Ii)}}\right) \times 100$$

Where Ai = Initial Area = $\pi d^2 /4$

A_n = Area at neck = $\pi d_n^2 / 4$.

Result:

Tension test for the given specimen was conducted and the results are as follows:

1. Yield stress, σy = N/mm^2
2. Ultimate stress, σ_u = N/mm2
3. Nominal breaking stress, σ_{bn} = N/mm^2
4. Actual breaking stress, σ_{bn} = N/mm^2
5. Percentage Elongation in length =
6. Percentage Reduction in area =

TORSION TEST

Ex. No.: **Date:**

AIM:

1. To determine the modulus of Rigidity of the sample.
2. To determine the yield strength of the sample.
3. To determine the modulus of rupture in Torsion of the sample.

APPRATUS REQUIRED:

Torsion testing machine, scale, micrometer etc.

PROCEDURE:

1. Using the micrometer, measure the diameter 'd' of the specimen in four places.
2. Accurately measure the length 'l' of the specimen after securing the specimen into the machine.
3. After selecting the suitable scale on the machine adjust the initial torque and angle of twist reading to zero.
4. Up to 100 angle of twist apply the Torque by hand and note down the Torque and the angle of twist.
5. From 100 to 200 angle of twist against apply the Torque by hand and note down the Torque for every increment of 20 of twist
6. There on the machine may be operated electrically and note the readings at 100 intervals.
7. Continue to note the readings until the specimen fails.

PRESENTATION OF DATE:

Specimen material:

Least count of micrometer: mm

Length of the specimen 'l': mm

Diameter of the specimen'd': mm

FORMULA :

1. Calculation polar moment of inertia & the radius of the specimen.
2. The theory of pure torsion.

T / J = fS / R = (G _) / L

Where T- Maximum twisting moment

J - Polar moment of inertia of the original cross section = K2 db3

Where K2 = d / b = 1 for rectangular specimen

K2 = 0.141 for circular specimen

fS – Shear stress N/mm2

R – Outer radius of the specimen in mm

G - Modulus rigidity of the specimen N/mm2

_ – angle of twist in radian

L– length of test piece in mm

The modulus of Rigidity of the specimen G = (T/ J) / (ɵ / L)

OBSERVATION :

Sl.No	**Torque**		**Angle of twist**	
	Kg f	cm N	m m	Degrees Radian

GRAPH:

Draw the graph with angle of Twist in radians in x –axis and the Torque in N –mm on y-axis.

CALCULATION

The modulus of Rigidity of the specimen $G = (T/J) / (\theta / L)$ N /mm^2

RESULT:

The results are tabulated below

S.No	Details	Value
1.	Diameter of the test piece	mm
2.	Modulus of rigidity	N/mm^2

DEFLECTION TEST

Ex. No.: **Date:**

Aim:

To determine the Young's modulus of the given specimen by conducting bending test.

Apparatus and Specimen required:

1. Bending Test Attachment
2. Specimen for bending test
3. Dial gauge
4. Scale
5. Pencil / Chalk

Procedure:

1. Measure the length (L) of the given specimen
2. Mark the centre of the specimen using pencil / chalk
3. Mark two points A & B at a distance of 350mm on either side of the centre mark. The distance between A & B is known as span of the specimen (l)
4. Fix the attachment for the bending test in the machine properly.
5. Place the specimen over the two supports of the bending table attachment such that the points A &B coincide with centre of the supports. While placing, ensure that the tangential surface nearer to heart will be the top surface and receives the load.
6. Measure the breadth (b) and depth (d) of the specimen using scale.
7. Place the dial gauge under this specimen at the centre and adjust the dial gauge reading to zero position.
8. Place the load cell at top of the specimen at the centre and adjust the load indicator in the digital box to zero position.
9. Select a strain rate of 2.5mm / minute using the gear box in the machine.
10. Apply the load continuously at a constant rate of 2.5mm/minute and note down the deflection for every increase of 0.25 tonne load up to a maximum of 6 sets of readings.
11. Calculate the Young's modulus of the given specimen for each load using the following formula:

Young's modulus, $E = \frac{Pl^3}{48I\delta}$

Where, P = Load in N

L = Span of the specimen in mm

I = Moment of Inertia in mm^4 ($bd^3/12$)

b = Breadth of the beam in mm.

d = Depth of the beam in mm

δ = Actual deflection in mm.

12. Find the average value of young's modulus that will be the Young's modulus of the given specimen.

Observation:

1. Material of the specimen =
2. Length of the specimen, L = mm
3. Breadth of the specimen, b = mm
4. Depth of the specimen, d = mm
5. Span of the specimen, l = mm
6. Least count of the dial gauge, LC = mm

S.No.	**Load in**		**Deflection in mm**		**Young's Modulus in N/mm^2**
	T	**N**	**observed**	**Actual**	
Average					

Result:

The young's modulus of the given wooden specimen = ---------------------N/mm^2

DOUBLE SHEAR TEST

Ex. No.: **Date:**

Aim:

To determine the maximum shear strength of the given bar by conducting double- shear test.

Apparatus and specimen required:

1. Universal Testing machine (UTM)
2. Mild steel specimen
3. Device for double shear test
4. Veriner caliper / screw gauge

Procedure:

1. Measure the diameter (d) of the given specimen.
2. Fit the specimen in the double shear device and place whole assembly in the UTM.
3. Apply the load till the specimen fails by double – shear.
4. Note down the load at which the specimen fails (P).
5. Calculate the maximum shear strength of the given specimen bu using the following formula:

   $$\text{Maximum shear strength} = \frac{\text{Load at failure (P) in N}}{\text{2 x cross – sectional area of the bar in mm}^2}$$

Observation:

1. Material of the specimen =
2. Diameter of the specimen, d = mm
3. Load at failure, P = Kn

Result:

The maximum shear strength of the given specimen = ---------------------- N/mm^2

CHARPY IMPACT TEST

Ex. No.: **Date:**

Aim:

To determine the impact strength of the given specimen by conducting charpy impact test.

Apparatus and specimen required:

1. Impact testing machine with attachment for charpy test.
2. Charpy specimen
3. Vernier caliper
4. Scale.

Procedure:

1. Measure the length (l), breadth (b), & depth (d) of the given specimen.
2. Measure the position of notch (i.e. groove) from one end (l_g), depth of groove (d_g) and top width of the groove (w_g) in the given specimen.
3. Lift the pendulum and keep it in the position meant for charpy test.
4. Adjust the pointer to coincide with initial position (i.e. maximum value) in charpy scale.
5. Release the pendulum using the lever and note down the initial reading in the charpy scale.
6. Repeat the step 3 and 4.
7. Place the specimen centrally over the supports such that the groove in opposite to the striking face.
8. Release the pendulum again using the lever and note down the final reading in the charpy scale.
9. Find the impact strength of the given specimen by using the following relation:
   Impact strength = (Final charpy scale reading – Initial charpy scale reading)

Observation:

1. Material of the given specimen =
2. Type of notch (i.e. groove) =
3. Length of the specimen, l = mm
4. Breadth of the specimen, b = mm
5. Depth of the specimen, d = mm
6. Position of groove from one end, (l_g) = mm
7. Depth of groove (d_g) = mm
8. Width of groove (w_g) = mm
9. Initial charpy scale reading = kg.m
10. Final charpy scale reading = kg.m

Result:

The impact strength of the given specimen is --------- Kg.m

IZOD IMPACT TEST

Ex. No.: **Date:**

Aim:

To determine the impact strength of the given specimen by conducting Izod impact test.

Apparatus and specimen required:

1. Impact testing machine with attachment for Izod test.
2. Given specimen
3. Vernier caliper
4. Scale.

Procedure:

1. Measure the length (l), breadth (b), & depth (d) of the given specimen.
2. Measure the position of notch (i.e. groove) from one end (l_g), depth of groove (d_g) and top width of the groove (w_g) in the given specimen.
3. Lift the pendulum and keep it in the position meant for charpy Izod test.
4. Adjust the pointer to coincide with initial position (i.e. maximum value) in the izod scale.
5. Release the pendulum using the lever and note down the initial reading in the izod scale.
6. Repeat the step 3 and 4.
7. Place the specimen vertically upwards such that the shorter distance between one end of the specimen and groove will be protruding length and also the groove in the specimen should face the striking end of the hammer.
8. Release the pendulum again using the lever and note down the final reading in the izod scale.
9. Find the impact strength of the given specimen by using the following relation:
   Impact strength = (Final izod scale reading – Initial izod scale reading)

Observation:

1. Material of the given specimen	=	
2. Type of notch (i.e. groove)	=	
3. Length of the specimen, l	=	mm
4. Breadth of the specimen, b	=	mm
5. Depth of the specimen, d	=	mm
6. Position of groove from one end, (l_g)	=	mm
7. Depth of groove (d_g)	=	mm
8. Width of groove (w_g)	=	mm
9. Initial charpy scale reading	=	kg.m
10. Final charpy scale reading	=	kg.m

Result:

The impact strength of the given specimen is --------- Kg.m

ROCKWELL HARDNESS TEST

Ex. No.: **Date:**

Aim:

To determine the Rockwell hardness number for the given specimen.

Apparatus Required:

1. Rockwell hardness testing machine
2. Indentor
3. Test specimen
4. Stop watch

Procedure:

1. Identify the material of the given specimen
2. Know the major load, type of indentor and scale to be used for the given test specimen from the following table.

Sl.No.	Material type	Major load	Indentor	Scale
1	Hardened steel	150kg	Diamond cone 120º	C
2	Mild steel	100kg	1.58mm dia, steel ball	B
3	Aluminum	100kg	1.58mm dia. Steel ball	B
4	Brass	100kg	1.58mm dia. Steel ball	B
5	Copper	100kg	1.58mm dia. Steel ball	B

3. Fix the indentor and place the given specimen on the anvil of the machine.
4. Select the major load from the knob available on the right of the machine.
5. Raise the anvil using the rotating wheel till the specimen touches the indentor and then slowly turns the wheel till the small pointer on the dial reaches the red mark position. Now the specimen is subjected to a minor load of 10kg.

6. Push the loading handle in the forward direction to apply the major load to the specimen and allow the load to act on the specimen for 15 seconds.

7. Release the major load by pushing the loading handle in the backward direction and keep the minor 10kg load still on the specimen.

8. Read the Rockwell hardness number either from ‘C’ or ‘B’ scale, as the case may be, directly on the dial and record it.

9. Release the minor load of 10kg by rotating the hand wheel and lowering the screw bar.

10. Repeat the experiment to obtain at least 3 different sets of observations for the given specimen by giving a gap of at least 3mm between any two adjacent indentations and 1.5mm from the edge.

11. Find the average value, which will be the rockwell hardness number for the given specimen.

Observation:

S.No.	Material	Major load	Indentor	Scale	Rockwell hardness number (RHC…… or RHB)
Average					

Result:

The Rockwell hardness number for the given specimen = RHC ----------- (or) RHB -------

BRINELL HARDNESS TEST

Ex. No.: **Date:**

Aim:

To determine the Brinell hardness number for the given specimen.

Apparatus Required:

1. Brinell hardness testing machine
2. Microscope
3. Indentor
4. Test specimen
5. Stop watch

Procedure:

1. Identify the material of the given specimen
2. Know the value of P/D^2 and diameter of the indentor (D) type to be used for the given test specimen from the following table.

S.No.	Material type	P/D^2 value in kg/mm^2	Diameter of steel ball (D) indentor in mm
1	Steel and cast iron	30	2.5
2	Copper and Aluminum Alloys	10	2.5
3	Copper and Aluminum	5	2.5
4	Lead, Tin and Alloys	1	2.5

Where, P = Major load in kg.

3. Calculate the major load to be applied for the given test specimen by knowing the value of PD^2 and D.
4. Select the major load from the knob available on the right of the machine.
5. Fix the indentor and place the given specimen on the anvil of the machine.
6. Raise the anvil using the rotating wheel till the specimen touches the indentor and then slowly turns the wheel till the small pointer on the dial reaches the red mark position. Now the specimen is subjected to a minor load of 10kg.
7. Apply the major load to the specimen by pushing the loading – handle in the forward direction and allow the load to act on the specimen for 15 seconds.
8. Release the major load by pushing the loading handle in the backward direction.

9. Release the minor load of 10kg by rotating the hand wheel and lowering the screw bar.

10. Measure the diameter of indentation (d) using the microscope.

11. Calculate the Brinell hardness number for the given specimen using the following

Formula:

$$\text{Brinell hardness number} = \frac{\text{Load in kg}}{\text{Spherical area of Indentation of mm}^2}$$

$$= \frac{P}{\pi D/2\,[d - \sqrt{D^2 - d^2}]}\ \text{kg/mm}^2$$

Where, P = Major load in kg.

D = Diameter of indentor in mm.

d = diameter of indentation in mm.

12. Repeat the experiment to obtain at least 3 different sets of observations for the given specimen by giving a gap of at least 3mm between any two adjacent indentations and 1.5mm from the edge.

11. Find the average value, which will be the Brinell hardness number for the given specimen.

Observation:

Sl.No.	Material	P/D^2 value in kg/mm^2	Major load (P) in kg	Diameter of steel ball indentor (D) in mm.	Dia of indentation (d) in mm	Brinell hradmess number (BHN) in kg/mm^2
Average						

Result:

The Brinell hardness number for the given specimen = ----------- kg/mm^2

TEST ON COMPRESSION SPRING

Ex. No.: **Date:**

Aim:

To determine the modulus of rigidity and stiffness of the given compression spring specimen.

Apparatus and specimen required:

1. Spring test machine
2. Compression spring specimen
3. Vernier caliper

Procedure:

1. Measure the outer diameter (D) and diameter of the spring coil (D) for the given compression spring.
2. Count the number of turns i.e. coils (n) in the given compression specimen.
3. Place the compression spring at the centre of the bottom beam of the spring testing machine.
4. Rise the bottom beam by rotating right side wheel till the spring top touches the middle cross beam.
5. Note down the initial reading from the scale in the machine.
6. Apply a load of 25kg and note down the scale reading. Increase the load at the rate of 25kg up to a maximum of 100kg and note down the corresponding scale readings.
7. Find the actual deflection of the spring for each load by deducting the initial scale reading from the corresponding scale reading.
8. Calculate the modulus of rigidity for each load applied by using the following formula:

$$\text{Modulus of rigidity, } N = \frac{64PR^3n}{d^4\delta}$$

Where, P = Load in N

R = Mean radius of the spring in mm (D –d /2)

d = Diameter of the spring coil in mm

δ = Deflection of the spring in mm

D = Outer diameter of the spring in mm.

9. Determine the stiffness for each load applied by using the following formula:

Stiffness, $K = P/\delta$

10. Find the values of modulus of rigidity and spring constant of the given spring by taking average values.

Observation:

1. Material of the spring specimen =
2. Outer diameter of the spring. D = mm
3. Diameter of the spring coil, d = mm
4. Number of coils / turns, n = Nos.
5. Initial scale reading = cm = mm

Sl.No.	**Applied Load in**		**Scale reading in**		**Actual deflection in mm**	**Modulus of rigidity in N/mm^2**	**Stiffness in N/mm**
	kg	N	cm	mm			
						Average	

Result:

The modulus of rigidity of the given spring = --------------------N/mm^2

The stiffness of the given spring = --------------------N/mm^2

TEST ON TENSION SPRING

Ex. No.: **Date:**

Aim:

To determine the modulus of rigidity and stiffness of the given tension spring specimen.

Apparatus and specimen required:

1. Spring test machine
2. Tension spring specimen
3. Vernier caliper

Procedure:

1. Measure the outer diameter (D) and diameter of the spring coil (D) for the given tension spring.
2. Count the number of turns i.e. coils (n) of the given specimen.
3. Fit the specimen in the top of the hook of the spring testing machince.
4. Adjust the wheel at the top of the machine so that the other end of the specimen can be fitted to the bottom hook in the machine.
5. Note down the initial reading from the scale in the machine.
6. Apply a load of 25kg and note down the scale reading. Increase the load at the rate of 25kg up to a maximum of 100kg and note down the corresponding scale readings.
7. Find the actual deflection of the spring for each load by deducting the initial scale reading from the corresponding scale reading.
8. Calculate the modulus of rigidity for each load applied by using the following formula:

$$\text{Modulus of rigidity, } N = \frac{64PR^3n}{d^4\delta}$$

Where, P = Load in N

R = Mean radius of the spring in mm (D –d /2)

d = Diameter of the spring coil in mm

δ = Deflection of the spring in mm

D = Outer diameter of the spring in mm.

9. Determine the stiffness for each load applied by using the following formula:

Stiffness, K = P/δ

10. Find the values of modulus of rigidity and spring constant of the given spring by taking average values.

Observation:

1. Material of the spring specimen =
2. Outer diameter of the spring. D = mm
3. Diameter of the spring coil, d = mm
4. Number of coils / turns, n = Nos.
5. Initial scale reading = cm = mm

Sl.No.	**Applied Load in**		**Scale reading in**		**Actual deflection in mm**	**Modulus of rigidity N/mm^2**	**Stiffness in N/mm**
	kg	N	cm	mm			
						Average	

Result:

The modulus of rigidity of the given spring = --------------------N/mm^2

The stiffness of the given spring = --------------------N/mm^2

DETERMINATION OF FINENESS OF CEMENT

Ex. No.: **Date:**

Aim:
To determine the fineness of cement by dry sieving

Apparatus :

a) Standard balance with 100gm weighing capacity.
b) IS : 90 micron sieve confirming to IS : 460-1962 and a brush

Procedure :

1. Break down any air set lumps in the cement sample with fingers.
2. Weigh accurately 100 gms of the cement and place it on a standard 90 micron IS sieve.
3. Continuously sieve the sample for 15 minutes.
4. Weigh the residue left after 15 minutes of sieving . This completes the test.

Limits:
The percentage residue should not exceed 10%

Precautions :

Sieving shall be holding the sieve in both hands and gentle wrist motion. This will involve to danger of spilling the cement, which shall be kept well spread out on the screen more or less continuous rotation of the sieve shall be carried out throughout sieving.

Washers shots and slugs shall not be used on the sieve the under side of the sieve shall be lightly brushed with a 25 or 40 mm bristle brush after every five minutes of sieving. Mechanical sieving devices may be used. But the cement shall not be rejected it it meets the fineness requirement when tested by the hand method.

<u>Calculation:</u>

The percentage weight of residue over the total sample is reported.

$$\%\ \text{weight of Residue} = \frac{\text{Wt of sample retained on the sieve}}{\text{Total weight of the sample}}$$

RESULT: The fineness of the given cement is ……………………

TEST FOR CONSISTENCY

Ex. No.: **Date:**

Aim:

To the standard consistency of the cement

Apparatus Required

1. Vicat apparatus with 10mm plunger and mould
2. Stop watch
3. Measuring jar
4. Trowel
5. Balance

Procedure:

1. Weigh 400gms of cement on a large non – porous platform and make it a heap with a depression in the centre to hold the mixing water.
2. Find out the volume of water to give a percentage of 25 by weight of dry cement and this amount carefully to the cement.
3. Mix the cement and water together thoroughly. The process of mixing shall include kneading and threading. The total time elapsed from the moment of adding water to the moment when mixing is completed shall not be less that four minutes.
4. Fill the mould completely with the cement paste and strike off the surplus paste and level with the top of the mould. Slightly tap the mould with the content to drive out any trapped air.
5. Keep the mould under the vicat plunger such that the plunger touches the surfaces of cement paste and support the moving rod by the plunger of the dash pot and then release the rod.
6. After the plunger has come to rest, note the reading against the index.
7. Repeat the experiment with trial paste varying the percentage of water till the plunger comes to rest between 5mm and 7mm from the bottom of the mould.
8. Tabulate observations and report the amount of water to permit the plunger to come to rest between 5mm and 7mm from the bottom as a percentage of dry weight of cement and express this as the percentage for standard consistency.

Result:

The standard consistency of the given cement paste is =

DETERMINATION OF SPECIFIC GRAVITY OF CEMENT

Ex. No.: **Date:**

Aim

Determination of specific gravity of cement (IS 4031 (Part 11) 1988)

Theory: The specific gravity of cement is the ratio of the weight of a given volume of substance to the weight of an equal volume of water. It is a number and denotes how many times a substance is heavy as water. To find the specific gravity of cement, it is required to find the weight of a certain volume cement and the weight of an equal volume of water. As cement reacts with water its specific gravity is determined with reference to a non-reactive liquid like kerosene.

Apparatus:

Le-Chatelier Flask (Specific gravity bottle), trowel, measuring jar, weighing balance, plate, rubber glove.

Le-Chatelier Flask

Procedure:

1. Weight of specific gravity bottle dry, W1
2. Fill the bottle with distilled water and weight it, W2
3. Dry the specific gravity bottle and fill it with kerosene and weight again, W3
4. Pour some of the kerosene out and introduce a weighted quantity of cement into the bottle.
5. Roll the bottle gently in the inclined position until no further air bubble rise to the surface. 6. Fill the bottle to the top with kerosene and weight it, W4.

Precautions:

1. Only kerosene which is free of water is to be used.
2. All air bubbles shall be eliminated in filling the apparatus and inserting the stopper.
3. Weighing is to be done quickly after filling the apparatus and shall be accurate to 0.1 mg. 4. Precautions are to be taken to prevent expansion and overflow of the contents resulting from the heat of the hand when wiping the surface of the apparatus.

Observation

Weight of empty dry bottle (W1) = ___________ g

Weight of bottle + water (W2) = ___________ g

Weight of bottle + kerosene (W3) = ___________ g

Weight of bottle + cement + kerosene (W4) = ___________g

Weight of cement (W5) = ___________ g

Specific gravity of kerosene, G = W5 (W3-W1) / (W5+W3-W4)(W2-W1) =

Result:

The specific gravity of cement is =

TEST FOR SETTING TIME

Ex. No.: **Date:**

Aim:

To determine the initial and final setting time of cement paste.

Apparatus Required

1. Vicat apparatus
2. Stop watch
3. Measuring jar
4. Trowel
5. Balance

Procedure:

1. Weigh 400gms of the sample of cement on to a non – porous platform and make it a heap with a depression in the centre
2. Calculate the amount of water required for gauging as 0.85 times the amount of water required to procedure a paste of standard consistency. Add this calculated quantity of water to heap and simultaneously start stop watch.
3. Gauge the cement and water together in a manner specified till the mould is completely filled. Strike the top level with the trowel and slightly tap the mould to the extent necessary to drive out all the entrapped air.
4. Place the mould under the vicat needle apparatus with 1mm square needle in position. Release the moving rod and note the reading against the index. Now, raise the moving rod, clear off the cement paste and wipe the needle clear.
5. Repeat the step No.4 at regular intervals of half minute till the reading becomes 5mm exactly.
6. Note the time elapsed from the moment of adding water to dry cement to the moment when the reading is 5mm.
7. Now remove the 1mmneedle fro the rod and the special needle for determine the final set.
8. As before allow the moving rod to travel downwards at every two minutes intervals. When the needle makes a move but the metal attachment fails to do so, note the total time elapsed.

9. Remove the needle, clean the appliances used and put them aside.

Result:

The initial setting time of cement is = min.

The final setting time of cement is = min.

SPECIFIC GRAVITY AND WATER ABSORPTION OF FINE AGGREGATES

Ex. No.: **Date:**

AIM

To determine the specific gravity and water absorption of Fine Aggregate .

Theory:

Specific gravity of an aggregate is defined as the ratio of the mass of solid in a given volume of sample to the mass of equal volume of water at 4 ^{o}c. However, all rocks contain some small amount of void and the apparent specific gravity includes this voids. The specific gravity of aggregates is an indirect measure of material's density and its quality. A low specific gravity may indicate high porosity and therefore poor durability and low strength. Some of the pores contained by aggregates are permeable while others are impermeable. Accordingly, two types of specific gravities are defined absolute specific gravity and apparent specific gravity. If both the permeable and impermeable voids are excluded to determine the true volume of solids, the specific gravity is called true or absolute specific gravity of the aggregate. But true specific gravity has not much of practical use as volume of impermeable internal pores is too difficult to determine. In contrast, for the determination of apparent specific gravity the impermeable internal pore is added to the effective volume of the aggregates (does not include the permeable pores). Mathematically:

Apparent Specific Gravity = mass of aggregate /mass of water occupying the volume equal to that of solids of aggregate excluding permeable pores

The apparent specific gravity is realistic one to use for concrete mix proportioning. The apparent specific gravity of most rocks lie between 2.6 to 2.7. Apparent specific gravity can be determined on the basis of surface dry condition (SSD) or oven dry condition (OD), according to the moisture condition of the aggregate

Apparatus:

Pycnometer, 1000-ml measuring cylinder, thermostatically controlled oven, taping rod, filter papers and funnel.

Material: Fine aggregates (500 g)

Procedure:

1. Place 500 g of fine aggregate in a tray and cover it with distilled water at a temperature of 22 to 32°C. Remove air entrapped in or bubbles on the surface of the aggregate by gentle agitation with a rod. Keep the sample immersed under water for 24 Hrs.

2. Carefully drain the water from the sample, by decantation through a filter paper. Air dry the aggregate and solid matter retained on the filter paper, to remove the surface moisture. When the material just attains a "free-running" condition, weight the saturated and surface-dry sample (A).

3. Place the aggregate in the pycnometer and fill the remaining space by distilled water. Eliminate entrapped air by rotating the pycnometer on its side, covering the hole in the apex of the cone with a finger. Weight the pycnometer with this condition (B).

4. Empty the contents of the pycnometer into a tray. Ensure that all the aggregate is transferred. Refill the pycnometer with distilled water to the same level as before and measure the weight at this condition (C).

5. Carefully drain the water from the sample, by decantation through a filter paper. Oven-dry the aggregate in the tray at a temperature of 100 to 110o C for 24 hrs. During this period, stir the specimen occasionally to facilitate proper drying. Cool the aggregates calculate its weight (D).

6. Calculate the specific gravity, apparent specific gravity and the water absorption as follows:

Where,

A = Weight in g of saturated surface-dry sample

B = Weight in g of pycnometer containing sample and filled with distilled water

C = Weight in g of pycnometer filled with distilled water only

D = Weight in g of oven dried sample only.

Observations:

Weight in g of saturated surface-dry sample (A)	
Weight in g of pycnometer containing sample and filled with distilled water (B)	
Weight in g of pycnometer filled with distilled water only (C)	
Weight of oven dried- sample only (D)	
Specific gravity $= \{D/[A-(B-C)]\}$	
Apparent Specific gravity $= \{D/[D-(B-C)]\}$	
Water absorption (in %) $= 100 \times [(A-D)/D]$	

Results and discussions:

Following results are obtained for the provided fine aggregate specimen:

a) Specific gravity: __________.

b) Apparent specific gravity: __________.

c) Water absorption: __________ %.

GRADATION OF FINE AGGREGATE

Exp No: **Date:**

Aim:

To determine the Gradation of Fine Aggregate by Sieve Analysis

Apparatus required:

Test Sieves conforming to IS : 460-1962 Specification of 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300micron, 150 micron, Balance, Gauging Trowel, Stop Watch, etc.

Sieve Apparatus or sieve set

- 500 gram sample of sand
- Triple beam balance
- Brittle brush
- Empty plate

Procedure:

- Take the sieves and arrange them in descending order with the largest size sieve on top. If mechanical shaker is using then put the ordered sieves in position and pour the sample in the top sieve and then close it with sieve plate.
- Then switch on the machine and shaking of sieves should be done at least 5 minutes.
- If shaking is done by the hands then pour the sample in the top sieve and close it then hold the top two sieves and shake it inwards and outwards, vertically and horizontally.
- After some time shake the 3rd and 4th sieves and finally last sieves.
- After sieving, record the sample weights retained on each sieve.
- Then find the cumulative weight retained. Finally determine the cumulative passing percentage retained on each sieves.
- The sample shall be brought to an air-dry condition before weighing and sieving. The air-dry sample
- Shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.
- The shaking shall be done with a varied motion, backward sand forwards, left to right, circular
- clockwise and anti-clockwise, and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions.
- Material shall not be forced through the sieve by hand pressure. Lumps of fine material, if present, maybe broken by gentle pressure with fingers against the side of the sieve.Light brushing with a fine camel hair brush may be used on the 150-micron and 75-micron IS Sieves to prevent aggregation of powder and blinding of apertures. On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

Observation:

S.No	Sieve size(mm)	Weight of retained sieve (gms)	% of weight retained	Percentage of weight passing	Cumulative % of weight passing
1	4.75 mm				
2	2.36 mm				
3	1.18 mm				
4	600 micron				
5	300 micron				
6	150 micron				
	Total				

Calculation:

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

Fineness modulus of fine aggregate = (Total Cumulative % of weight passing / 100)

Result:

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

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

Grading limit of fine aggregates IS 383-1970

Is sieve	Grading zone I	Grading zone II	Grading zone IV	Grading zone V
10mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100	96-100
1.18 mm	30-70	55-90	55-90	90-100
600 micron	15-34	35-59	35-59	80-100
300 microns	5-20	8-30	8-30	15-50
150 microns	0-10	0-10	0-10	0-15

COMPACTED AND LOOSE BULK DENSITY OF FINE AGGREGATE

EX NO: **Date:**

Aim

Determination of Bulk density and void of aggregates.

Apparatus Required:

1.Balance - Sensitive to 0.5% of weight of material

2.Cylindrical metal measure

03 litre capacity (for fine aggregate)

15 litre capacity for aggregate greater than 4.75mm and upto 40mm

30 litre capacity for aggregate more than 40mm

3.Tamping rod 16 mm dia and 60 cm long

Cylindrical metal measure used for bulk density and void test of aggregate

Procedure for Compacted Bulk density

- ✓ Measure the volume of the cylindrical metal measure (three times for average) by pouring water into the metal measure and record the volume "V" in litre.
- ✓ Fill the cylindrical metal measure about one-third full with thoroughly mixed aggregate and tamp it 25 times using tamping bar.
- ✓ Add another layer of one-third volume of metal measure and give another 25 strokes by tamping bar.
- ✓ Finally fill aggregate in the metal measure to over-flowing and tamp it 25 times.
- ✓ Remove the surplus aggregate using the tamping rod as a straightedge.
- ✓ Determine the weight of the aggregate in the measure and record that weight "W" in kg.

Calculation for Compacted bulk density:

Compacted unit weight or bulk density = W / V

Where,

W = Average Weight of compacted aggregate in cylindrical metal measure, kg

V = Average Volume of cylindrical metal measure, litre

Calculation of voids:

The percentage of voids is calculated as follows

Percentage of voids = $[(G - \Upsilon)/G] \times 100$

Where

G = Specific gravity of the aggregate
Υ = Bulk density in kg/litre

Procedure for Loose bulk density

- ✓ Measure the volume of the cylindrical metal measure (three times for average) by pouring water into the metal measure and record the volume "V" in litre.
- ✓ Fill the cylindrical measure to overflowing by means of a scoop, the aggregate being discharged from a height not exceeding 5 cm above the top of the measure
- ✓ Level the top surface of the aggregate in the metal measure, with a straightedge or tamping bar.
- ✓ Determine the weight (three times for average) of the aggregate in the measure and record the weight "W" in kg.

Calculation for loose bulk density

Loose unit weight or bulk density = W / V

Where,

W = Weight of loose aggregate in cylindrical metal measure, kg

V = Volume of cylindrical metal measure, litre

Calculation of voids

The percentage of voids is calculated as follows

Percentage of voids = $[(G - \Upsilon)/G]*100$

Where

G = Specific gravity of the aggregate

Υ = Bulk density in kg/litre

Result

The bulk density is reported in kg/litre to the nearest 0.01 kg The percentage of voids is reported to the nearest whole number. Mention whether the aggregate is

(a) oven dry,

(b) saturated and surface dry

(c) With a given percentage of moisture.

IMPACT TEST

Ex .No: **Date:**

Aim:

To determine the aggregate impact value of given aggregates

Apparatus required:

Impact testing machine, cylinder, tamping rod, IS Sieve 125.mm, 10mm and 2.36mm, balance.

Procedure:

1. The test sample consists of aggregates passing 12.5mm sieve and retained on 10mm sieve and dried in an oven for 4 hours at a temperature of 100ºC to 110ºC.
2. The aggregates are filled upto about 1/3 full in the cylindrical measure and tamped 25 times with rounded end of the tamping rod.
3. The rest of the cylindrical measure is filled by two layers and each layer being tamped 25 times.
4. The overflow of aggregates in cylindrical measure is cut off by tamping rod using it has a straight edge.
5. Then the entire aggregate sample in a measuring cylinder is weighed nearing to 0.01gm.
6. The aggregates from the cylindrical measure are carefully transferred into the cup which is firmly fixed in position on the base plate of machine. Then it is tamped 25 times.
7. The hammer is raised until its lower face is 38cm above the upper surface of aggregate in the cup and allowed to fall freely on the aggregates. The test sample is subjected to a total of 15 such blows each being delivered at an interval of not less than one second. The crushed aggregate is than removed from the cup and the whole of it is sieved on 2.366mm sieve until no significant amount passes. The fraction passing the sieve is weighed accurate to 0.1gm. Repeat the above steps with other fresh sample.
8. Let the original weight of the oven dry sample be W1gm and the weight of fraction passing 2.36mm IS sieve be W2gm. Then aggregate impact value is expressed as the % of fines formed in terms of the total weight of the sample.

Observation and calculations:

The weight of original sample, B = kg
The weight of material passing through 2.36 mm IS Sieve, A = kg

Aggregate impact value = (A/B) x 100

Result:

The impact value of given Aggregate is _____________%

SHAPE TEST (ELONGATION INDEX)

Ex .No: **Date:**

Aim:

To determine the Elongation index of the given aggregate sample.

Apparatus required:

Length gauge, I.S.Sieve

Procedure:

1. The sample is sieved through IS Sieve specified in the table. A minimum of 200 aggregate pieces of each fraction is taken and weighed.

2. Each fraction is the thus gauged individually for length in a length gauge. The gauge length is used should be those specified in the table for the appropriate material.

3. The pieces of aggregate from each fraction tested which could not pass through the specified gauge length with its long side are elongated particles and they are collected separately to find the total weight of aggregate retained on the length gauge from each fraction.

4. The total amount of elongated material retained by the length gauge is weighed to an accuracy of at least 0.1% of the weight of the test sample.

5. 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+……………..=Wg. Also the weights of the 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 gm.

6. 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.

$$\text{Elongation index} = \frac{(x1 + x2 + x3 + \ldots\ldots)}{(W1 + W2 + W3 + \ldots)} \times 100$$

Observation and calculation:

No of pieces =

Sl.no	Size of aggregate		Length Gauge $(C_1 + C_2/2)$ x1.8	Weight of the fraction consisting of at least 200 pieces in gm	Weight of aggregates in each fraction retained on length gauge in gm.
	Passing through IS Sieve (mm)	Retained on IS Sieve (mm)			

Result:

The elongation index of a given sample of aggregate is _____________%

SHAPE TEST (FLAKINESS INDEX)

Ex .No: **Date:**

Aim:

To determine the flakiness index of a given aggregate sample.

Apparatus required:

The apparatus consist of a standard thickness gauge, IS Sieve of size 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3 and a balance to weight the samples.

Procedure:

1. The sample is sieved with the sieves mentioned in the table.
2. A minimum of 200 pieces of each fraction to be tested are taken and weighed W1 (gm).
3. In order to separate flaky materials, each fraction is then gauged for thickness on thickness gauge, or in bulk on sieve having elongated slots as specified in the table.
4. Then the amount of flaky materials passing the gauge is weighed to an accuracy of atleast 0.1% of test sample
5. Let the weight of the flaky materials passing the gauge be W1gm. Similarly the weights of the fractions passing and retained on the specified sieves be W1, W2, W3, etc, are weighed and the total weight W1+W2+W3+…..= Wg is found. Also the weights of the materials passing each of the specified thickness gauge are found =W1, W2, W3…. And the total weight of the material passing the different thickness gauges = W1+W2+W3…=Wg is found.
6. Then the flakiness index is the total weight of the flaky material passing the various thickness gauges expressed as a percentage of the total weight of the sample gauged.

$$\text{Flakiness index} = \frac{(w1+w2+w3+\ldots\ldots)}{(W1+W2+W3+\ldots\ldots)} \times 100$$

Observation and calculations:

No of pieces =

Sl.no	Size of aggregate		Thickness gauge (0.6 times the mean sieve) mm $(C_1 + C_2/2) \times 3/5$	Weight of the fraction consisting of at least 200 pieces in gm	Weight of aggregates in each fraction passing thickness gauge gm.
	Passing through IS Sieve (mm)	Retained on IS Sieve (mm)			

Result:

The flakiness index of the given sample of aggregates is ___________%

AGGREGATE CRUSHING STRENGTH

Ex no: **Date:**

Aim:

To determine the crushing value of aggregate.

Apparatus required:

steel cylinder with open ends, cylindrical measure, steel tamping rod, balance, compression testing machine.

Procedure:

1. Take a sample of about 6.5 kg aggregate for 150mm diameter and 1 kg for 75 mm diameter cylinder, passing through 12.5mm and retained on 1mm sieve for 20mm down aggregate and passing through 6.3mm sieve and retained on 4.75mm sieve for 10mm down aggregate to provided two test sample.
2. Dry the aggregate the temperature of 100ºC to 110 ºC and then cool at room temperature. 3. Fill up the cylindrical measure in three equal depth layers by tamping each layer 25 times by tamping rod.
3. Take weight (A) of aggregate sample.
4. Add the test sample in three layers. Compact each layer by 25 strokes of tamping rod.
5. Level the surface of the aggregate and insert the plunger.
6. Place the apparatus with the test sample and plunger in position between the platens of the testing machine.
7. Apply uniform load, so that load is reached in 10 minutes. The total load shall be 40 tonnes for 20mm down aggregate and 10 tonnes for 10 mm down aggregate.
8. Release the load and remove the whole material from the cylinder.
9. Sieve the material on 2.36 mm sieve for 20 mm down aggregate and on 1.18mm sieve for 10 mm down aggregate.
10. Take weight (B) of material passing through is 2.36 mm sieve for 20 mm down aggregate and 1.18 mm sieve for 10mm down aggregate.

Aggregate Crushing value (%) = B/A * 100

Calculation:

Aggregate Crushing value (%) = B/A * 100

Result:

The aggregate crushing value is --------------------------

WATER ABSORPTION TEST ON COARSE AGGREGATE

Exp No: **Date:**

Aim:
To determine the water absorption of given coarse aggregate.

Apparatus required:

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

- Container, Balance, Electric Oven.

Procedure:

1. The coarse aggregate passing through IS 10mm sieve is taken about 200g.
2. They are dried in an oven at a temperature of 110º ±5ºC for 24 hours.
3. The coarse aggregate is cooled to room temperature.
4. Its weight is taken as (W1g)
5. The dried coarse aggregate is immersed in clean water at a temperature 27º±2ºC for 24 hours.
6. The coarse aggregate is removed from water and wiped out of traces of water with a cloth
7. Within three minutes from the removal of water, the weight of coarse aggregate W2 is found out.
8. The above procedure is repeated for various samples

Figure: specific gravity fine aggregate by wire basket (apparatus).

Observation and calculation

Sample no.	Weight of dried specimen W_1 g	Weight of saturated specimen W_2 g	Weight of water absorbed $W_3 = W_2 - W_1$ g	% of water absorption $W_3 / W_1 \times 100$

CALCULATIONS:

Specific gravity, apparent specific gravity and water &absorption shall be calculated as follows:

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

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

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

A - Weight of saturated aggregate in water (A1 - A2) B - Weight of the saturated surface - dry aggregate in air C - Weight of oven dried aggregate in air. A1-Weight of aggregate and basket in water A2- Weight of empty basket in water

Result:

Water absorption of the coarse aggregate is ____________

DETERMINATION OF SPECIFIC GRAVITY OF COARSE AGGREGATE

EX NO: **Date:**

AIM

To determine specific gravity of a given sample of coarse aggregate

Apparatus Required :

Pycnometer, A 1 000-ml measuring cylinder, well-ventilated oven, Taping rod, Filter papers and funnel, etc. Figure

Pycnometer Procedure

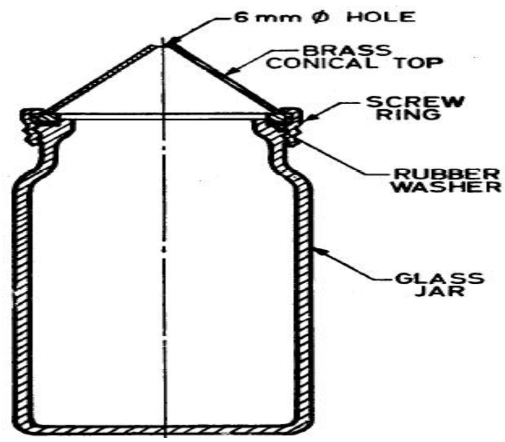
1. A sample of about 500 g shall be placed in the tray and covered with distilled water at a temperature of 22 to 32°C. Soon after immersion, air entrapped in or bubbles on the surface of the aggregate shall be removed by gentle agitation with a rod. The sample shall remain immersed for 24 ± l/2 hours.

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

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

4.The contents of the pycnometer shall be emptied into the tray, care being taken to ensure that all the aggregate is transferred. The pycnometer shall be refilled with distilled water to the same level as before, dried on the outside and weighed (weight C).

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



Calculation:

Specific gravity, apparent specific gravity and water & absorption shall be calculated as follows:

$$specific\ gravity = \left(\frac{D}{A-(B-C)} \right)$$

$$Apparent\ specific\ gravity = \left(\frac{D}{D-(B-C)} \right)$$

$$Water\ absorbtion = \frac{100(A-D)}{D}$$

A= weighting of saturated surface – dry sample,

B = weighting of pycnometer or gas jar containing sample and filled with distilled water,

C= weighting of pycnometer or gas jar filled with distilled water only

D = weight of oven- dried sample.

RESULT

The Specific Gravity of a given sample of coarse aggregate is found to be …….

COMPRESSIVE STRENGTH OF BRICKS

EX NO: **Date:**

Aim

To determines the compressive strength of bricks

Apparatus Required :

Compressive strength testing machine

Material required :

Bricks, Water, Sand, Cement, Trowel

Theory

Bricks are mostly subjected to compression and tension. The usual crushing strength of common hand moulded well burnt bricks is about 5 to 10 N/mm2 (50 to 100/kg/cm2) varying according to the nature of preparation of the clay. Pressed and machine moulded bricks made of thoroughly plugged clay are stronger than common hand moulded bricks from carelessly prepared clay.

Procedure:

- Eight bricks are taken for the compressive strength testing.
- The bricks are then immersed in water at room temperature for 24 hours.
- Then these are taken out of water and surplus water on the surfaces is wiped off with a moist cloth.
- The frog of the bricks is flushed level with cement mortar (1:3)
- The bricks are stored under damp jute bags for 24 hours followed by its immersion in water at room temperature for three days.
- The bricks are placed in the compression testing machine with flat faces horizontal and mortar filled face being upwards.
- Load is applied at a uniform rate of 14 N/ m2 per minute till failure.

Observation :

Sl No	Load at Failure (N)	Average area of back faces (mm^2)	Compressive Strength. (N/mm^2)	Remarks
1				
2				
3				
4				
5				

RESULT :

Average strength of bricks =

WATER ABSORPTION OF BRICK

EX NO: **Date:**

Aim
To determines water absorption of brick.

Apparatus Required:
a) Dry bricks
b) Weighing machine

Material required:
- Bricks

Theory

Brick for external use must be capable of preventing rain water from passing through them to the inside of walls of reasonable thickness. A good brick should absorb water maximum 1/7 th of the weight of the brick.

Procedure:
- 20 bricks are taken randomly from a stack.
- The bricks are put in an oven at a temperature of 1050C for drying.
- Bricks are weighed in a digital weighing machine and is record asW1
- The bricks are immersed in water at room temperature for 24 hours.
- After 24 hours immersion, the bricks are taken out of water and wiped with a damp cloth for 3 minutes.
- The bricks are weight again and recorded as W2.
- Water absorption in % is calculated as (W2−W1)W1×100

Sl No	Weight W_1 (Kg)	Weight W_2 (Kg)	Water absorption in %	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Result:

Thus the water absorption of brick =

AN EFFLORESCENCE TEST FOR BRICKS

EX NO: **Date :**

Aim

The objective of this test is to determine the efflorescence of bricks

Introduction:

The deposition of salts on the surface of clay or ceramic materials is called efflorescence. It is resulted from the migration and evaporation of aqueous saline solutions. The efflorescence is basically an aesthetic problem, but due to be a complex phenomenon with economic consequences it worries manufactures and building constructors. Raw materials, building materials, subsoil water, can be the source of soluble salts, which generate the efflorescence.

Material required :

Test specimens shall consist of 5 whole dry bricks which shall be tested for efflorescence as laid down in the following:

Procedure:

- Each bricks shall be placed on end in a shallow flat bottom non-absorbent dish keeping minimum clearance of 5 cm (2 inches) between two consecutive bricks.
- Distilled water shall then be poured to depth of 2.54 cm (1 inch) so that it surrounds each bricks by one inch only. The whole arrangement shall be allowed to stand in a well-ventilated room at about 15 degree C to 20 degree C.
- After a few days when the water has been absorbed and the bricks appear to be dry, as similar quantity of water shall again be poured in the dish and further drying period allowed.

The bricks shall then be examined for efflorescence

Result:

The tendency to efflorescence shall be reported as “Nil”, “Slight”, “Moderate”, “Heavy”, or “Serious” in accordance with the following definitions.

Nil: No perceptible deposit of salt.

Slight: Not more than 10 percent of the area of the bricks covered with a thin deposit of salt.
Moderated: A heavier deposit than under “Slight” and covering up to 50 percent of the area of the bricks surface but unaccompanied by powdering of flaking of the surface.

Heavy:A heavy deposit of salt covering 50 percent or more of the bricks surface but unaccompanied by powdering or flaking of the surface.

Serious: A heavy deposit of salt accompanied by powdering and/or flaking of the surfaces

SLUMP CONE TEST

Exp.No : **Date :**

Aim:

To measure the consistency of concrete by using slump cone.

Apparatus required:

Slump cone, tamping rod, metallic sheet.

Procedure:

1. The internal surface of the mould is thoroughly cleaned and freed from superfluous moisture and adherence of any old set concrete before commencing the test.

2. The mould is placed on a smooth, horizontal rigid and non-absorbent surface.

3. The mould is then filled in four layers each approximately 1/4 of the height of the mould.

4. Each layer is tamped 25times rod taking care to distribute the strokes evenly over the cross section. After the top layer has been rodded, the concrete is struck off level with a trowel and tamping rod.

5. The mould is removed from the concrete immediately by raising it slowly and carefully in a vertical direction.

6. This allows the concrete to subside. This subside is referred as slump of concrete.

7. 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.

8. The pattern of slump indicates the characteristics of concrete in addition to the slump value. If the concrete slumps evenly it is called true slump. If one half of the cone slides down, it is called shear slump. In case of a shear slump, the slump value is measured as the difference in height between the height of the mould and the average value of the subsidence. Shear slump also indicates that the concrete is non-cohesive and shows the characteristic of segregation.

Observations and calculations:

Unit weight of coarse aggregate =

Mix proportion =

Volume of slump cone, V = cm^3

Volume of coarse aggregate = cm^3

Volume of fine aggregate = cm^3

Volume of cement = cm^3

Weight of coarse aggregate = unit weight x volume of coarse aggregate

= gm

Weight of water = 0.4 x weight of cement = gm

Sl.no	W/C	slump (mm)	Type of slump

Result:

The slump value of the concrete is ----------------------------------

COMPRESSIVE STRENGTH OF CEMENT CONCRETE

Ex .No: **Date:**

Aim: To determine the cube / cylinder strength of the concrete of given properties.

Apparatus required: Moulds for the test cubes / cylinders, tamping rods.

Procedure:

1. Calculate the material required for preparing the concrete of given proportions.

2. Mix them thoroughly in mechanical mixer until uniform colour of concrete is obtained.
3. Pour concrete in the oiled with medium viscosity oil. Fill concrete is cube moulds in two layers each of approximately 75mm and ramming each layer with 35 blows evenly distributed over the surface of layer.
4. Fill the moulds in 2 layers each of approximately 50mm deep and ramming each layer heavily.
5. Struck off concrete flush with the top of the moulds.
6. Immediately after being made, they should be covered with wet mats.
7. Specimens are removed from the moulds after 24hrs and cured in water 28 days.
8. After 24hrs of casting, cylinder specimens are capped by neat cement paste 35 percent water content on capping apparatus. After 24 hours the specimens are immersed into water for final curing.
9. Compression tests of cube and cylinder specimens are made as soon as practicable after removal from curing pit. Test-specimen during the period of their removal from the curing pit and till testing, are kept moist by a wet blanket covering and tested in a moist condition.
10. Place the specimen centrally on the location marks of the compression testing machine and load is applied continuously, uniformly and without shock.
11. Also note the type of failure and appearance cracks.

Observation and calculations:

Sl. no	Size of Cube	Size of Cylinder	W/C ratio	Date of casting	Date of testing	crushing load kg	Compressive stress Kg/cm^2 for	
							Cubes	cylinder

1.compressive strength = Load/Area

2.Average compressive strength of cubes =

3. Average compressive strength of cylinder =

Result:

The compressive strength of cement concrete is ________________N/mm^2

FLOW TEST

Exp. No: **Date:**

Aim: To measure the flow and workability of the concrete by using flow table.

Apparatus required:

Flow table test apparatus.

Procedure:

The apparatus consists of flow table about 76cm. in diameter over which concentric circles are marked. A mould made from smooth metal casing in the form of a frustum of a cone is used with the following internal dimensions. The base is 25cm. in diameter upper surface 17cm. in diameter and height of the cone is 12cm.

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

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

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

4. The mould if lifted vertically upward and the concrete stands on its own without support. The table is then raised and dropped 12.5cm 15times in about 15 seconds.

5. The diameter of the spread concrete is measured in about 6 directions to the nearest 5mm and the average spread is noted. The flow of concrete is the percentage increase in the average diameter of the spread concrete over the base diameter of the mould.

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

$$\text{Flow, per cent} = \frac{\text{Spread diameter in cm} - 25}{25} \times 100$$

Observation

S.No	Description	Specimen	
		w/c=0.65	w/c=0.70

Result:

The flow percent of the concrete is ------------------------------

COMPRESSION TEST ON WOOD

Exp No: **Date:**

Aim: To determine the compressive strength of wood in given sample material.

Apparatus required:

Compression Testing Machine, Wooden specimen.

Procedure:

1. Calculate the material required for preparing the wood of given specification.
2. Immediately after being made, they should be covered with wet mats.
3. Compression tests of wood specimens are made as soon as practicable after removal from making factory. Test-specimen during the period of their removal from the making factory and till testing, are kept moist by a wet blanket covering and tested in a moist condition. 4. Place the specimen centrally on the location marks of the compression testing machine and load is applied continuously, uniformly and without shock. 5. Also note the type of failure and appearance cracks.

FORMULA USED:

THE COMPRESSIVE STRENGTH OF WOODEN SPECIMEN= LOAD /AREA

OBSERVATION AND TABULATION :

SPECIMEN	TRAIL 1	TRAIL 2	MEAN VALUE N/mm^2
LOAD ON WOOD KN			

RESULT: The compressive strength of wooden specimen ------------------- **N/mm^2**