Techno India NJR Institute of Technology

Course File

CIVIL ENGINEERING MATERIALS LAB (3CE4-24)

For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

Rakesh Yadav

(Assistant Professor)
Department of CE

3CE4-24: CIVIL ENGINEERING MATERIALS LAB

Credit: 01 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

List of Experiments

1. To determine properties of following materials:
   - A. STONE:
     - a. Compressive strength,
     - b. Water absorption,
     - c. Impact value,
     - d. Tensile strength;
   - B. Bricks:
     - a. Water absorption,
     - b. Compressive strength,
     - c. Dimension and Tolerance;
   - C. Tiles:
     - a. Water absorption,
     - b. Tolerance,
     - c. Impact value
   - D. Timber: Compressive and Tensile Strength of Timber across and along the Grain
2. To Study the Properties & Utilization of Fly Ash in Construction
3. To Study the Different Aluminum and Steel Sections
4. To Study the Manufacturing and Use of Concrete Hollow Blocks
5. To Study the Properties and Uses of Kota Stone and its Slurry

Course Overview:

Study the nature and performance of civil engineering materials and evaluation of their physical and mechanical properties. This course focuses on materials used in construction and maintenance of building and infrastructure such as ferrous and nonferrous metals, aggregates, Portland cement, concrete, masonry, asphalt and asphalt mixtures, wood and composites. Emphasis will be placed on selection criteria, design, applications and proper use of these materials. The objective of this course is to understand the nature, characteristics, performance, and behavior of civil engineering materials used in buildings and infrastructure and to evaluate their physical and mechanical properties. Students will learn how to select materials based on their properties and their proper use for a particular facility under prevailing environmental conditions.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	**Comprehension**	Explain about fly ash, different stones, different glasses, aluminum and steel sections.
2	**Application**	To memorize the various properties of cement.
3	**Analysis**	Student can distinguish the various building materials by visual inspection.
4	**Synthesis**	Identify the properties and utilization of fly ash, glass, timber, kota stone, aluminum and steel sections.
5	**Evaluation**	Understand the manufacturing and use of concrete hollow block

Prerequisites:

1. Fundamentals knowledge of chemistry.
2. Fundamentals knowledge of science.
3. Fundamentals knowledge of civil engineering.

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Course Coverage Module Wise:

Lab No.	Exp. No.	Name of Experiment
1	1	To determine Compressive strength of stone material.
2	1	To determine Water absorption of stone material.
3	1	To determine Impact value of stone material.
4	1	To determine Tensile strength of stone material.
5	1	To determine Compressive strength of Brick material.
6	1	To determine Water absorption of Brick material.
7	1	To determine Dimension and Tolerance of Brick material.
8	1	To determine Water absorption of Tile material.
9	1	To determine Tolerance of Tile material.
10	1	To determine Impact value of Tile material.
11	1	To determine the Compressive and Tensile Strength of Timber

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Faculty Lab Manual Link:
https://drive.google.com/file/d/19_r2yi18wx--9spIYiDXTTYkAUqbDgVS/view?usp=share_link

Viva QUIZ Link

1. https://www.indiabix.com/civil-engineering/building-materials/
2. https://quizizz.com/admin/quiz/5fcd823d41c265001b3d3de7/civil-engineering-material
3. https://www.objectivebooks.com/2016/04/building-materials-and-construction.html
4. https://www.examveda.com/civil-engineering/practice-mcq-question-on-building-materials/

Assessment Methodology:

1. Practical exam.
2. Internal exams and Viva Conduct.
3. Final Exam (practical paper) at the end of the semester.

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Academic Administration of Techno NJR Institute

LAB Syllabus Deployment

Name of Faculty	: Mr. Rakesh Yadav	Subject Code: 3CE4-24
Subject	: Civil Engineering Material Lab	
Department	: Civil Engineering	Sem: III
Total No. of Labs Planned: 15		

COURSE OUTCOMES HERE (3 OUTCOMES)
At the end of this course students will be able to:
CO1: To study about fly ash, different stones, different glasses, and aluminum and steel sections.
CO2: To determine the various properties of cement
CO3: To identification of building materials by visual inspection

Lab No.	Exp. No.	Name of Experiment
1	1	To determine Compressive strength of stone material.
2	1	To determine Water absorption of stone material.
3	1	To determine Impact value of stone material.
4	1	To determine Tensile strength of stone material.
5	1	To determine Compressive strength of Brick material.
6	1	To determine Water absorption of Brick material.
7	1	To determine Dimension and Tolerance of Brick material.
8	1	To determine Water absorption of Tile material.
9	1	To determine Tolerance of Tile material.
10	1	To determine Impact value of Tile material.
11	1	To determine the Compressive and Tensile Strength of Timber

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Sl no	Name of the experiment	Date	Page no	Remarks
01	Shape and size of supplied brick.			
02	Water absorption of brick.			
03	Compressive strength of bricks.			
04	Fineness of cement.			
05	Soundness of a given cement.			
06	Specific gravity of cement using Le-Chatelier Flask.			
07	Standard consistency of cement.			
08	Initial and final setting time of cement.			
09	Fineness modulus of coarse and fine aggregates			
10	Crushing value of coarse aggregate			
11	Compressive strength of cement mortar			

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EXPERIMENT NO-01

Objective :
To determine the shape and size of the supplied brick.

Apparatus :
Scale

Material required :
Bricks

Procedure :

(i) 20 bricks are taken randomly from a stack. The bricks should be rectangular in shape with sharp edges and smooth surface.

(ii) Dimension i.e. length, breadth, &height of the bricks are measured by scale and recorded.

(iii) For good quality bricks, the dimension of 20 bricks should be within the following limits.
Length 3680 mm to 3920 mm
With 1740 mm to 1860 mm
Height 1740 mm to 1860 mm

Observation :

SL NO	Length (mm)	Breath(mm)	Height(mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			

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18			
19			
20			

Calculation **:**

Sum of the length of 20 bricks = mm
Sum of the breadth of 20 bricks = mm
Sum of the height of 20 bricks = mm

Conclusion **:**

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EXPERIMENT NO-02

Objective :
To determines water absorption of brick.

Apparatus :
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 aborb water maximum 1/7 th of the weight of the brick.

Procedure :
(i) 20 bricks are taken randomly from a stack.
(ii) The bricks are put in an oven at a temperature of 105^0C for drying.
(iii) Bricks are weighed in a digital weighing machine and is record as W_1
(iv) The bricks are immersed in water at room temperature for 24 hours.
(v) After 24 hours immersion, the bricks are taken out of water and wiped with a damp cloth for 3 minutes.
(vi) The bricks are weight again and recorded as W_2.
(vii) Water absorption in % is calculated as $\frac{(W_2-W_1)}{W_1} \times 100$

Observation :

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				

13				
14				
15				
16				
17				
18				
19				
20				

Calculation :

Conclusion :

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EXPERIMENT NO-03

Objective :

To determines the compressive strength of bricks.

Apparatus :

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 pugged clay are stronger than common hand moulded bricks from carelessly prepared clay.

Procedure :

(i) Eight bricks are taken for the compressive strength testing.

(ii) The bricks are then immersed in water at room temperature for 24 hours.

(iii) Then these are taken out of water and surplus water on the surfaces is wiped off with a moist cloth.

(iv) The frog of the bricks is flushed level with cement mortar (1:3)

(v) The bricks are stored under damp jute bags for 24 hours followed by its immersion in water at room temperature for three days.

(vi) The bricks are placed in the compression testing machine with flat faces horizontal and mortar filled face being upwards.

(vii) Load is applied at a uniform rate of 14 N/ m^2 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				

6				
7				
8				

Calculation :

Average strength of bricks =

Conclusion :

Signature

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EXPERIMENT NO-04

Objective :
To determines fineness of cement.

Apparatus :
a) 90μ sieve
b) Tray
c) Digital weighing balance

Material required :
Cement

Theory
Control of particle size of cement is important in practice because it has an influence on the behavior of the cement. Cement which is more finely ground hardens more rapidly and has a higher rate of heat evolution at early ages. Fineness of grinding is of more importance in relation to the workability of concrete mixes. Greater fineness improves the cohesiveness the a concrete mix and the quantity of water rising to the surface of the concrete known as bleeding is reduced. Shrinkage cracking is related to the rate of development of strength of concrete. In general cements which gain more strength rapidly are more apt to cracking. Increasing the fineness of any particular cement, raises its rate of development of strength and so indirectly increases the risk of shrinkage crack formation.

Procedure :
(i) 100 grams of cement is weighed W_1.
(ii) The weighed cement is sieved in a 90μ sieve thoroughly for five minutes.
(iii) The residue is weighed W_2 and expressed as a percentage of total weight cement and the value is reported as the fineness of cement

Observation :
Weight of cement taken = W_1 =
Weight of residue after sieving = W_2 =

Calculation :
Fineness of cement = $\frac{W_2}{W_1} \times 100$

Conclusion :

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EXPERIMENT NO. 05

Objective:

To determine the soundness of a given cement.

Apparatus:

a) Le Chatelier apparatus - It consists of a small split cylinder of spring brass of 0.5 mm thickness, forming a mould 30mm internal diameter and 30mm high. On either side of the split are attached two indicators with pointed ends AA the distance from these ends to the center of the cylinder being 165mm. The mould shall be kept in good condition with the jaws more than 0.5mm apart.
b) Tray
c) Measuring flask
d) Digital weighing balance
e) Scale

Material required :
Cement, Water

Theory

Once of the most important properties of cement is its soundness. Unsoundness in cement is caused by undue expansion of some of the constituents like free lime produced in the manufacturing process of cement. Another possible case of unsoundness is the presence of too high a magnesia content in the cement. As the cement absorbs moisture, free lime expands to many times its original volume and develops considerable force when hydrated, its delayed hydration may readily disrupt the mass. One advantage of slow setting cement is that more time is given to hydrate the lime before the mass becomes rigid. In the soundness test a specimen of hardened cement paste is boiled for a fixed time so that any tendency to expand is speeded up and can be detected.

Procedure:

a. The mould is placed on a glass sheet and filled with cement paste formed by gauging cement with 0.78 times the water required to give a paste of normal consistency.

b. The mould is then covered with another piece of glass sheet, a small weight is placed on this covering glass sheet and the assembly is immediately submerged in water at a temperature of 27ºC and kept there for 24 hours.
c. The distance separating the indicator points is measured and the mould was again submerged in water at the temperature prescribed above.
d. The water is then brought to boiling, with mould kept submerged for 25 to 30 minutes, and is kept there for three hours.
e. The mould is removed from water, allowed to cool and the distance between the indicator points is measured.
f. The difference between these two measurements is found and reported as the expansion of cement.

Calculations:

Type of Cement : Konark Portland slag cement

Normal Consistency = P =

Water required for soundness test = 0.78 x P =

Initial distance = mm

Final distance = mm

Expansion of cement = mm

Conclusion:

The soundness of cement is found to be mm.

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EXPERIMENT NO-06

Objective :

To determines the specific gravity of cement using Le-Chatelier Flask.

Apparatus :

(i) Le-Chatelier Flask

(ii) Digital weighing balance

Material required :

Cement, Kerosene

Theory

The specific gravity of a cement is not a property normally determine for its own sake, but it is required in the measurement of its specific surface. The specific gravity is defined as the ratio between the weight of a given volume of cement and weight of an equal volume of water. The test for finding the specific gravity of Portland cement was originally considered to be of much importance in view of the fact that other tests lead to more definite conclusions. The most popular method of determining the specific gravity of cement is by the use of a liquid such as water free kerosene. Which doses not react with cement. A specific gravity bottle or a standard Le-chatelier flask may be used.

Procedure :

(i) Weight of specific gravity bottle dry W_1

(ii) The bottle is filled with distilled water and the bottle is weighted W_2

(iii) The specific gravity bottle is dried and it is filled kerosene and weighted W_3

(iv) Pour some of the kerosene out and introduce a weighted quantity of cement into the bottle. Roll the bottle gently in the inclined position until no further air bubble rise to the surface. The bottle is filled to the top with kerosene and it is weighted W_4.

Observation :

Weight of empty dry bottle (w1) = gms

Weight of bottle + water (W2) = gms

Weight of bottle + kerosene (W3) = gms

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

Weight of cement (W5) = gms

Specific gravity of kerosene $g = \frac{W_3 - W_1}{W_2 - W_1}$

Specific gravity of cement $G = \frac{W_5(W_3 - W_1)}{(W_5 + W_3 - W_4)(W_2 - W_1)}$

Calculation :

Conclusion :

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EXPERIMENT NO-06 (a)

Objective :

To determines the specific gravity of cement using Le-Chatelier Flask.

Apparatus :

(iii) Le-Chatelier Flask

(iv) Digital weighing balance

Material required :

Cement, Kerosene

DESCRIPTION APPARATUS

The Le-chatelier flask is made of thi glass having bulb (having nearly 250 ml capacity) at the bottom. The diameter of the bulb is 78mm. The stem is graduated in milliliters. The zero mark is placed at a distance of 8mm from the top of the bulb. Then from zero a distance of 10mm is measured and divided into ten parts. After leaving 10mm distance more, there is another bulb of length 35mm and having capacity of 17mls. The total capacity of stem and bulb is 24 mls. The portion above 24mls mark is in the form of a funnel having top diameter equal to 50mm. A glass nipple is fitted in the stem to cover the flask.

Theory

The specific gravity of a cement is not a property normally determine for its own sake, but it is required in the measurement of its specific surface. The specific gravity is defined as the ratio between the weight of a given volume of cement and weight of an equal volume of water. The test for finding the specific gravity of Portland cement was originally considered to be of much importance in view of the fact that other tests lead to more definite conclusions. The most popular method of determining the specific gravity of cement is by the use of a liquid such as water free kerosene. Which doses not react with cement. A specific gravity bottle or a standard Le-chatelier flask may be used.

Procedure :

(i) The dried Le-chatelier flask is taken and the kerosene is filled to a point on the stem between zero and one ml.

(ii) The inside of the flask is dried above the level of the liquid.

(iii) The flask is immersed in a constant temperature water bath maintained at room temperature for sufficient nme.

(iv) The level of the kerosene oil in the flask is recorded as initial reading.

(v) Introduce about 60 gms of cement into the flask so that the level of kerosene rises to about say 22 ml mark. Splashing should be avoided and cement should not be to allowed to adhere to the sides of the flask above the liquid.

(vi) The glass nipple is inserted into the flask and it is rolled gently in an inclined position to free the cement from air until no further air bubble rises to the surface of the liquid.

(vii) The flask is kept again in Constant temperature water both andnote down the new liquid level as final reading.

Observation and Calculations :

(a) Air temperature = ^{0}c

(b) Weight of cement used = gms

(c) Initial reading of flask = mls

(d) Final reading of flask = mls

(e) Volume of cement particles (d-c) = mls

(f) Weight of equal volume of water = gms

$$\text{Specific gravity} = \frac{Weight\ of\ cement\ of\ given\ volume}{Weight\ of\ equal\ volume\ of\ water}$$

Precautions

(a) While pouring cement in the specific gravity bottle or Le-chatelier flask, care should be taken the avoid splashing and cement should not adhere to the inside of the flask above the liquid.

(b) The kerosene or Naptha should be completely free from water.

(c) The specific gravity bottle or Le-chatelier flask should be kept in a constant temperature water bath sufficiently long to ensure same temperature before each weighing is made.

(d) Duplicate results of specific gravity should agree within 0.01.

Calculation **:**

Conclusion **:**

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EXPERIMENT NO-07

Objective :

To determine the standard consistency of cement.

Apparatus :

a) Vicat apparatus
b) Tray
c) Trowel
d) Measuring cylinder
e) Weighing machine

Material required :

Cement, Water

Theory

Since different batches of cement differ in fineness, paste with the same water content may differ in consistency when first mixed. For this reason the consistency of the paste is standardized by varying the water content until the paste has a given resistance to penetration, when it is first mixed. When testing the Portland cement it is necessary to carry out trial mixes until a mix of the required consistency is obtained. The quantity of water required to produce a paste of standard consistency, is needed for the determination of the water content of tensile test, soundness test and setting time test.

Procedure :

(i) 300 gm of cement is taken.
(ii) A percentage (p) of water by weight is added with water. Initially the percentage is taken as……..
(iii) Water and cement is mixed thoroughly on a non-porous surface.
(iv) The mould of Vicat apparatus is filled with the paste and made. The surface is made smooth and level.
(v) The plunger A is attached to the moveable rod of Vicat apparatus.
(vi) The plunger is gently lowered over the cement paste & released quickly.
(vii) The reading of the attached scale is noted.
(viii) If the penetration is between 5mm to 7mm from the bottom of the mould, the water added is correct.
(ix) If the penetration is not proper, the process is repeated with different percentage of water till the desired penetration is obtained.

Observation :

Sl No	Weight of Sample in gm	Percentage of water is added	Penetration in mm	Remark

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Conclusion :

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EXPERIMENT NO-08

Objective :

To determines initial and final setting time of cement.

Apparatus :

a) Vicat apparatus
b) Tray
c) Trowel
d) Measuring cylinder
e) Weighing machine

Material required :

Cement, Water

Theory

It is essential that cement set neither too rapidly nor too slowly. In the first case there might be insufficient time to transport and place the concrete before it becomes too rigid. In the second case too long a setting period tends to slow up the work unduly, aso it moght postpone the actual use of the structure because of inadequate strength at the desired age. Setting should not be confused with hardening, which refers to the gain in mechanical strength after the certain degree of resistance to the penetration of a special attachment pressed into it. Two periods of times are used to asses the setting behavior. These are called the "initial setting time".

Procedure :

A) Initial Setting Time

(i) 300 gm of cement is taken and it is mixed with percentage of water as determined in consistency test i.e. 30% (90 ml water).
(ii) The cement paste is filled in the Vicat mould.
(iii) The square needle of cross section 1mm× 1mm is attached to the moving rod of the Vicat apparatus.
(iv) The needle is quickly released and it is allowed to penetrate the cement paste. In the beginning the needle penetrates completely.
(v) Then it is taken out and dropped at afresh place.
(vi) The procedure is repeated at regular intervals till the needle is failed to penetrate t 5mm measured from the bottom.
(vii) The time interval between the addition of water to cement and the stage when needle ceases to penetrate5mm from the bottom of the mould.

B) Final Setting Time

(i) The cement paste is prepared as described for initial setting time.(A)
(ii) The needle with annular collar is attached to the moving rod of the vicat apparatus. This needle has a sharp point projecting in the center with annular collar.

(iii) The needle is gently released.The time at which the needle makes an impression on test block and the collar fails to do so is noted.

(iv) The final setting time is the difference between the time at which water was added to cement and time as recorded in (C).This time should be about 10 hours for ordinary cement.

Observation :

Calculation :

Conclusion :

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Experiment No. 09

Objective:

To determine fineness modulous of coarse and fine aggregates

Apparatus:

Set of Indian standard sieves, Digital weighing balance, Sieve shaker, Tray, riffle box, etc.

Material required :

Coarse aggregate, Fine aggregate

Theory

The aggregate most of which passes IS 4.75 mm sieve is classified as fine aggregates. The fine aggregates obtained from natural disintegration of rocks and deposited by streams are knows as natural sands. Fine aggregates resulting from crushing of hard stone and natural gravel are known as crushing stone sand and crushing gravel sand respectively.

Aggregate most of which is retained on IS 4.75 mm sieve is known as coarse aggregate. It may be in the form of uncrushed gravel or stone resulting from natural distegration of rocks

Procedure:

A) Coarse Aggregates

i. 5 kg of coarse aggregate was taken from a sample of about 50 kg by quartering or through riffle box.
ii. The relevant sieves were arranged one above the other with the sieve size increasing from the top. The pan was put at the bottom. The sample was placed in the top sieve and covered.
iii. The set of sieves were shaken for 2 to 3 minutes in a sieve shaker.
iv. The amount of aggregate retained on each sieve was weighed along with the pan.

B) Fine Aggregates

i. 2 kg of coarse aggregate was taken from a sample of about 50 kg by quartering or through riffle box.
ii. The relevant sieves were arranged one above the other with the sieve size increasing from the top. The pan was put at the bottom. The sample was placed in the top sieve and covered.
iii. The set of sieves were shaken for 2 to 3 minutes in a sieve shaker.
iv. The amount of aggregate retained on each sieve was weighed along with the pan.

Observations:

A. Coarse Aggregate :

Weight of empty tray = kg

Weight of tray + coarse aggregate = kg

Weight of coarse aggregate = 5 kg

Sl. No.	Sieve Size (mm)	Wt. Retained	% of wt. Retained	Cumulative % of wt. Retained	Remarks
1.	80				
2.	40				
3.	20				
4.	12.5				
5.	10				
6.	4.75				
7	1.18 mm				
8	600 µ				
9	300 µ				
10	150 µ				

B. Fine Aggregate :

Weight of empty tray = kg

Weight of tray + fine aggregate = kg

Weight of fine aggregate = kg

Sl. No.	Sieve Size (mm)	Wt. Retained	% of wt. Retained	Cumulative % of wt. Retained	Remarks
1.	80				
2.	40				
3.	20				
4.	12.5				
5.	10				
6.	4.75				
7	1.18 mm				
8	600 µ				
9	300 µ				
10	150 µ				

Calculation :

Fineness modulus = ΣF / 100

For coarse aggregates

For fine aggregates

Conclusion :

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EXPERIMENT NO. 10

Objective :

To determine the crushing value of coarse aggregate

Apparatus :

a) An open-ended 150mm cylindrical cell appropriate base plate and plunger, metal measure and tamping rod confirming relevant IS-standard,

b) Digital weighing balance

c) IS sieve of sizes 12.5mm, 10mm, 2.36mm.

d) A compression testing machine.

Material required :

Coarse aggregate

Procedure :

i. The aggregate sample consisted of particles passing a 12.5mm sieve and retained on a 10mm sieve. When aggregate of required size was not available, test may be conducted on the available sample, the specification for cylinder and sieve separating the fines was taken from Table1 of code.

ii. The quantity of aggregate was such that the depth of the material in the cylinder after tamping shall be about 10cm of the cylindrical measure. The appropriate quantity may be found conveniently by filling in three layers of approximately equal depth; the layers are tamped 25 times with the round end of the tamping rod and finally leveled off. The weight of the tamping comprising the test sample should be determined (weight A) and same weight of the sample was taken for repeat test.

iii. The cylinder of the test apparatus was put in position on the base plate and the test sample was added in thirds, each part being subjected to 25 strokes from the tamping rod. The surface of the plunger should be carefully leveled and the plunger inserted so that it rests horizontally on this surface; care was taken to ensure that cylinder does not jam in the cylinder.

iv. The apparatus with the test sample and plunger in position was than placed between the plates of the test machine and loaded at a fairly uniform rate so that the total load of 40t is reached in 10 minutes.

v. The load was released and the whole of the material removed from the cylinder and sieved on a 2.36mm IS-sieve or the appropriate sieve if the sample size is not a standard one. The fraction passing the sieve was weighed (weight B).

vi. Two tests were made.

Calculations :

Initial weight of sample (A) in Kg	
Weight of portion passing on 2.36mm sieve (B) in Kg	
Aggregate crushing value =B/A*100	

Aggregate crushing value =

Conclusion:

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EXPERIMENT NO-11

Objective:

To determine the compressive strength of cement mortar

Apparatus:

a. Cube moulds- Moulds for the cube specimens of $50cm^2$ face area, shall be metal not amenable to attacked by cement mortar, and there shall be sufficient material in the sides of the moulds to prevent spreading and warping. The moulds shall be rigidly constructed in such a manner as to facilitate the removal of the moulded specimen without damage. The moulds shall be machined so that when assembled, the dimensions and the internal faces shall be accurate to the following limits.

b. Poking rod.

c. Digital weighing balance

d. Measuring flask

e. Compression testing machine

Material required :

Cement, sand, water

Procedure:

Mix Proportions and mixing

i) Clean appliances shall be used for mixing. The temperature of water and that of the test room shall be 27 +_2 ^{0}C

ii) Place on nonporous plate a mixture of cement and standard sand in the proportion of 1:3 by weight.

Mix it dry with towel for one minute and then with water until the mixture is of uniform colour. The time of mixing shall in any event be not less than 3 minutes and should the time taken to obtain a uniform colour exceed 4 minutes the mixture shall be rejected and operation shall be repeated with a fresh quantity of cement, sand and water.

The material for each cube shall be mixed separately and the quantity of cement, standard sand and water shall be as follows:

Cement	200g
Standard sand	600g

Water (P/4 + 3.0) percent of combined weight of cement and where P is the percentage of water required to produce a paste of normal consistency.

Moulding Specimens

In assembling the moulds ready for use, cover the joints between the halves of the mould with a thin film of petroleum jelly and apply similar coating of petroleum jelly between the contact surfaces of the bottom of mould and its base plate in order to ensure that no water escapes during vibration. Treat the interior faces of the mould with a thin coating of mould oil.

Place the assembled mould on the table of the vibration machine firmly hold it in position by means of a suitable clamp. Securely attach a hopper of suitable size and shape at the top of the mould to facilitate filling and this hopper shall not be removed until the completion of the vibration period.

Immediately after mixing the mortar place the mortar in the cube mould and prod with the rod. The mortar shall be prodded 20 times in about 8 seconds to ensure elimination of entrained air and honey combing. Place the remaining quantity of mortar in the hopper of the cube mould and prod again as specified for the first layer and then compact the mortar by vibration. The period of vibration shall be two minutes at the specified speed 12000+_400 vibrations per minute.

At the end of the vibration remove the mould together with the base plate from the machine and finish the top surface of the cube in the mould by smoothing the surfaces with the blade or a trowel.

Curing

Keep the filled mould at a temperature of 27+2`c in an atmosphere of at least 90% relative humidity for 24 hours after completion of vibration. At the end of that period remove them from mould and immediately submerged in clean fresh water and keep there until taken out just prior to breaking. The water in which the cubes are submerged shall be renewed every 7 days and shall be maintained at temperature of 27+_2°c after they have been taken out and until they are broken the cubes shall not be allowed to become dry.

Testing

Test the three cubes for compressive strength at the periods mentioned below, the periods being reckoned from the completion of vibration. The cubes shall be tested on their without any packing between the cube and the steel platens of the machine. One of the platens shall be carried on a base and shall be self adjusting and the load shall be steadily and uniformly applied, starting from zero at the rate of 350 kg/cm^2/minute.

Calculation:

Sl. No.	**Load** in kg.	**Area** in sq cm	**Strength** in N/mm^2	**Remark**
1.				
2.				
3.				

Average strength = N/mm^2

Conclusion:

From the above experiment compressive strength of the cement mortar is found to be N/mm^2.

Signature

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