LABORATORY MANUAL

011617P: Design of Concrete Structure-I Laboratory

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CONTENTS

SYLLABUS

DESIGN OF CONCRETE STRUCTURE-I LABORATORY

1. Casting of Concrete Specimens

2. To determine the compressive strength of cube concrete specimens.

3. To determine flexural strength of concrete using simple beam with third-point loading.

4. To determine tensile strength of steel.

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Course objectives:

This course will enable students to

1. Able to cast concrete cube
2. Determine thecompressive strength of concrete
3. Determine the flexural tensile strength of concrete
4. Determine the tensile strength of steel.

Course outcomes:

After a successful completion of the course, the students will be able to

1. Understand characteristics compressive strength.
2. To find compressive strength of concrete and also perform the same.
3. To perform and calculate flexural tensile strength of concrete.
4. To perform and calculate tensile strength of steel.

Do’s

1. Bring observation note books, lab manuals and other necessary things for the class.
2. Use tools for mixing concrete and water
3. Check the instruments for proper working conditions while taking and returning the same.
4. Thoroughly clean your laboratory work space at the end of the laboratory session.
5. Maintain silence and clean environment in the lab

Don’ts

1. Do not operate the machines without the permission of the staff
2. Do not put hands or head while equipment is in running condition.
3. Do not fix or remove the test specimen while the main is switch on.
4. Do not spill the concrete and aggregates on the floor.

List of Experiments

EXPERIMENT NO. 1 **DATE: _____**

Casting of Concrete Specimens

Aim: Casting of Concrete Specimens

Apparatus Used:

- Concrete Mixer
- Vibratory table
- Set of scoop
- Set of trowel
- Water curing tank

Required Mix Design Quantity:

- Cement
- Coarse aggregate
- Sand
- Water (w/c= 0.40)

Theory:

Casting or Preparation of concrete specimens is required prior to the testing of compressive and flexural strength or any other test on concrete. For both tests, students will be divided into two groups and they will jointly cast the concrete specimens. For compressive strength test, total 4 Cylinders (having 100 mm diameter and 200 mm height) and 4 Cubes (100 mm) will be prepared. Each group will test either 3 Cubes or Cylinders while one specimen will be cast extra. For Flexural strength test, 3 Beams (100 x100 x 500 mm) will be prepared.

Procedure:

- Bring all the required moulds to the concreting site and make sure that the moulds are assembled properly.

- Lubricate all the moulds from inside with the help of oil and brush.
- Weigh all the ingredients of concrete as per mix design and quantities depending on volume of concrete.
- Prepare concrete mix.
- If the mixing is carried out in the mixer, put the mould on the vibrating table and fill each mould with concrete in two layers by scoop and vibrate each layer for 10 seconds holding the moulds by hand or clamping.
- If the mixing is carried out by hand in the tray (usually in case of small mix), fill each mould with concrete in two to three layers by scoop and consolidate each layer 25 times with the help of tamping rod or by vibrating table.
- After about 24 hours, carefully de-mould all the specimens.
- Submerge the concrete specimens into the water tank with care.
- After 28 days of water curing, take out the specimens from the tank and place on to the table.
- Specimens are ready to test now.

(a) **(b)**

Fig.1 (a) Vibratory table (b) Water curing tank

EXPERIMENT NO. 2 **DATE: _____**

Determination of compressive strength of concrete cube specimen

Aim: To determine compressive strength of concrete cube.

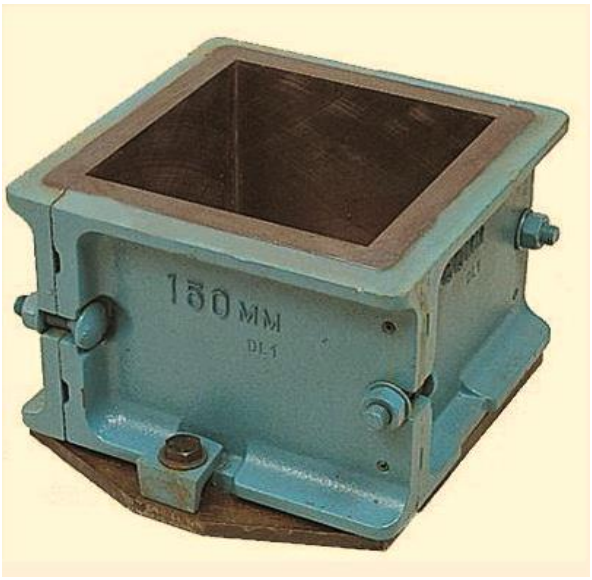
Apparatus Used:

- Weighing machine
- Mixer
- Tamping rod
- Concrete cube mould (Size 150 mm)
- Compressive testing machine

Theory:

Compressive strength is the ability of material or structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates. For cube test two types of specimens either cubes of 15cm X 15cm X 15cm or 10cm X 10cm x 10cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15cm x 15cm x 15cm are commonly used. This concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of this specimen should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen.

(a)



(b)

(c)

(d) **(e)**

Fig.2 (a) Compression testing machine (b) Compression testing mould (c) Casting concrete cube (d) Compressive strength test for M25 (e) M25 concrete failure under compressive loading

Procedure:

- Remove the specimen from water after specified curing time and wipe out excess water from the surface.
- Measure the dimension of the specimen.
- Clean the bearing surface of the testing machine
- Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
- Align the specimen centrally on the base plate of the machine.
- Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
- Apply the load gradually without shock and continuously at the rate of 140 kg/cm^2/minute till the specimen fails

- Record the maximum load and note any unusual features in the type of failure.

Observation Table:

Sample number	Failure load (P_f) (in N)	Area of specimen (mm^2)	Compressive strength (N/mm^2)
1			
2			
3			
Average			

Calculation:

Area of specimen = 15x15 = 225 mm^2

Compressive strength = Failure load/ Area of specimen

Result:

Average compressive strength of the concrete cube = ……N/ mm^2 (at 7 days)

Average compressive strength of the concrete cube =……N/mm^2 (at 28 days)

EXPERIMENT NO. 3 **DATE: _____**

Determination of flexural strength (modulus of rupture) of concrete

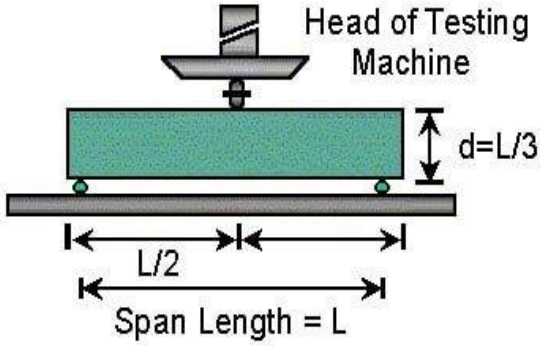
Aim: To determine the flexural strength (modulus of rupture) of concrete.

Apparatus Used:

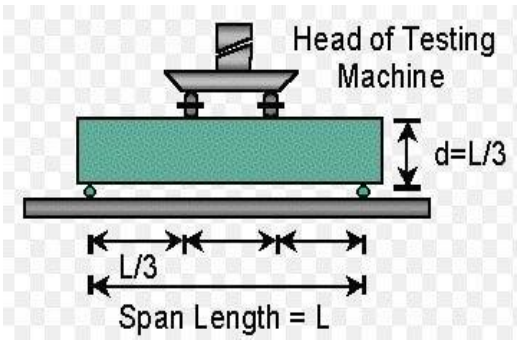
- Weighing machine
- Mixer
- Tamping rods
- Flexural strength testing machine
- Steel prism moulds of size 100mm x 100mm x 500mm
- Scoop
- Trowel

Theory:

When concrete is subjected to bending, tensile and bending compressive stresses and in many cases, direct shear stresses are developed. The most common plain concrete structure subjected to flexure is a highway pavement and the strength of concrete for pavements is commonly evaluated by means of bending test. Flexural test intended to give the flexural strength of concrete in tension. The flexural test is also more easily carried out and may even be more convenient than the crushing test use in field, since in this test much smaller loads are required.



(a)



(b)

(c)

Fig.3 (a) Centre point load test (b) Three point load test (c) Flexural test machine

Procedure:

- The test should be conducted on the specimen immediately after taken out of the curing condition so as to prevent surface drying which decline flexural strength.
- Place the specimen on the loading points. The hand finished surface of the specimen should not be in contact with loading points. This will ensure an acceptable contact between the specimen and loading points.
- Center the loading system in relation to the applied force.
- Bring the block applying force in contact with the specimen surface at the loading points.
- Applying load on the specimen.
- Eliminate any gap greater than 0.10mm using leather shims and it should extend the full width of the specimen.
- Capping or grinding should be considered to remove gaps in excess of 0.38mm.

- Load the specimen continuously without shock till the point of failure at a constant rate.

Observation Table:

Sample number	Failure load (N)	Average load (N)

Calculation:

Flexural strength = $3PL/2bd^2$

Where,

P is the average load at the failure of specimen in N

L is length of specimen in mm

b is width of specimen at the fracture in mm

d is depth of specimen at fracture in mm

Generally size of the specimen is taken as 150mm width, 150mm depth and the length should not be at least three times the depth of the specimen. Indian standard determined the size of the concrete specimen as 150mm width, 150mm depth, and span of 700mm.

Result:

The average flexural strength (modulus of rupture) of specimen…….. N/mm²

EXPERIMENT NO. 4 **DATE: _____**

Determination of tensile strength of steel

Aim: To determine the tensile strength of steel.

Apparatus Used:

- Universal testing machine(UTM)
- Gauge length maker
- Vernier Calliper
- High tensile steel/ Mild steel

Theory:

Tensile test is one of the most common tests for steel. The test involves straining a test piece by tensile force, generally to fracture, for the purpose of determining tensile strength, yield strength, ductility and reduction of area. The objective of this test is to understand how the tensile test performed practically and to develop an understanding of stress- strain relationship.

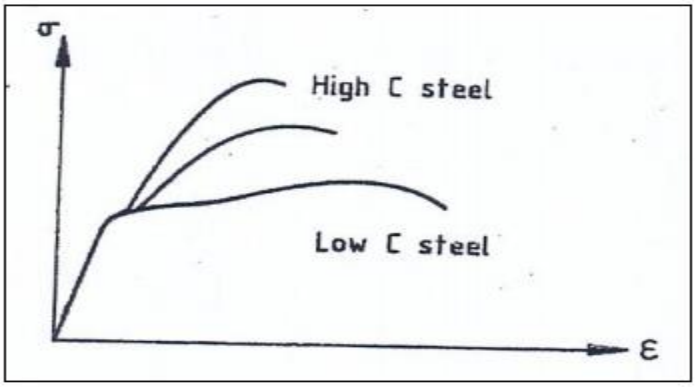


Fig.3 Stress-Strain relationship

Fig.5 Universal Testing machine

Procedure:

- Measure the dimension of specimen.
- Fix the specimen in testing machine
- Load the specimen gradually and take simultaneous readings of the load (P) and the change in length (deformation ΔL) and record the data.
- Continue applying the load until the specimen fails.
- Record the load at failure.
- Remove the pieces and fit them back together to measure the final length and diameter.

Observation Table:

Initial diameter of specimen (d_o) = ---------- mm

Initial length of specimen (L_o) = ---------- mm

Final length of specimen (L_f) = ---------- mm

Final diameter of specimen (d_f) = ---------- mm

Initial area of specimen (A_o) = ---------- mm^2

Final area of specimen (A_f) = ----------mm^2

Load at failure (P_f) = ---------- N

S.No.	Load (N)	Deformation (mm)

Calculation:

Result: The tensile strength of specimen ----------N/mm^2