Tests on Hardened Concrete:

Flexural Strength Test

Objective

To determine the flexural strength or (modulus or rupture (MR)) of hardened concrete

Standards: BS EN 12390-5 and ASTMC 293 or ASTM C78

Principle:

- Flexural test evaluates the tensile strength of concrete indirectly. It tests the ability of unreinforced concrete beam or slab to withstand failure in bending.
- In flexural test, a plain (unreinforced) concrete beam is subjected to flexure using symmetrical *two-point loading* until failure occurs. Because the load points are spaced at one-third of the span, the test is called a *third-point loading* test.
- The theoretical maximum tensile stress reached in the bottom fibre of the test beam is known as the *modulus of rupture*.
- British Standard BS EN 12390-5 : 2000 prescribes third-point loading on 150 by 150 by 750 mm beams supported over a span of 450 mm but 100 by 100 mm beams can also be used, provided the beam side is at least three times the maximum size of the aggregate.

Apparatus :

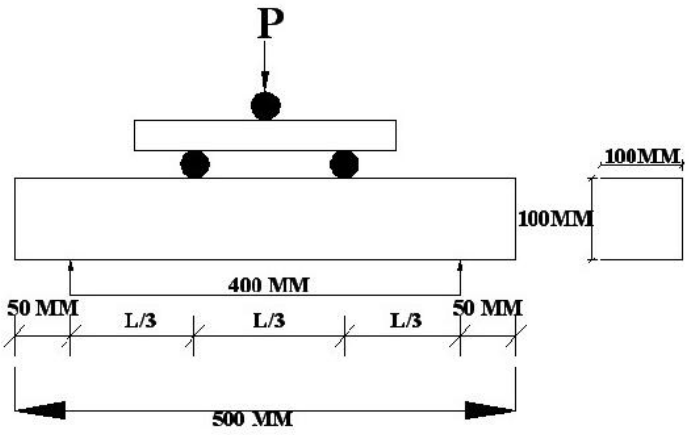
1-Balance.
2- Tools and containers for mixing.
3- Tamper (16mm dia & 600mm height) for compaction or vibrating table.
4- Testing machine.
5- Three prismatic samples (100*100*500mm) or (150*150*750mm).

Materials

Concrete mix (cement, sand, gravel and water)

Test Procedure

1. Prepare a concrete mix with the proportions.
2. Prepare three testing prisms; make sure that they are clean and greased or oiled thinly.
3. Metal molds should be sealed to their base plates to prevent loss of water.
4. Fill the prism in three layers, tamping each layer with (25) strokes using a tamper or fill the mold completely and compact concrete using vibration table.
5. Fill the molds completely, smooth off the tops evenly, and clean up any concrete outside the prisms.
6. Leave the specimens in the mould for 24 hours at room temperature.
7. After that open the molds and immerse the concrete prism in a water tanks for different curing periods (7, or 28 days).
8. Before testing, ensure that all testing machine bearing surfaces are wiped clean.
9. 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. Figure (1) is an example of test arrangements for sample size (100×100*×500mm).
10. Center the loading system in relation to the applied force.
11. Bring the block applying force in contact with the specimen surface at the loading points.
12. Apply the load continuously at a nominal rate until failure (until no greater load can be sustained).
13. Record the load and note the failure mode.



TWO POINT LOADING SETUP IN FLEXURE TEST

Figure (1)

Calculations

- If fracture occurs within the central one-third of the beam, the modulus of rupture is calculated on the basis of ordinary elastic theory, and is thus equal to:

$$\text{Flexural strength or modulus of rupture (MR)} = \frac{Pl}{bd^2}$$

- If, however, fracture occurs outside the load points, say, at a distance *a* from the near support, *a* being the average distance measured on the tension surface of the beam, but not more than 5 % of the span, then the modulus of rupture is given:

$$\text{Flexural strength or modulus of rupture (MR)} = \frac{3Pa}{bd^2}$$

Where,

a = the distance between the line of fracture and the nearer support, measured on the center line of the tensile side of the specimen

b = width of the beam (mm)

d = depth of the beam (mm)

l = supported length (mm)

P = max. Load (N)