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Concrete Testing

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DETERMINATION OF COMPRESSIVE STRENGTH

STANDARD: IS: 516 (Part-1, Sec-1) 2021

- ❖ This standard covers the procedure for determining the compressive strength of cement concrete.

APPARATUS

1. Batch mixer.
2. Vibrating table.
3. Cube moulds.
4. Tamping rod
5. Compression testing machine.
6. Steel scale
7. Balance



PROCEDURE

- ❖ Test specimens shall be either from Laboratory mix or from mix produced by Batching plant.

Preparation of Mix in the Laboratory

- ❖ Collect representative samples of the materials for use in the particular concrete design by careful sampling.
- ❖ Bring all the materials to room temperature, preferably $27\pm 3^{\circ}\text{C}$ before the mixing.
- ❖ Store the cement in a dry place, preferably in air tight metal containers.
- ❖ Samples of aggregates for each batch of concrete shall be of the desired grading and in air dried condition.
- ❖ Weight the portion of materials including water as required for specified mix design to an accuracy of 0.1% of the total weight of the batch.
- ❖ Each batch of concrete shall be of such a quantity as to give about 10% excess after casting the described of test specimens.
- ❖ When mixing is done by machine introduce all the mixing water in to the drum

before the solid materials.

- ❖ Load the drum with one half of the coarse aggregate, then with the fine aggregate, then with the cement and finally with the remaining coarse aggregates.
- ❖ The period of mixing shall not be less than 2 minutes after all the materials are placed in the drum and shall continue till the resulting concreting is uniform in appearance.
- ❖ After thoroughly mixing pour the concrete on a water tight non-absorbent platform and fill in to the moulds before segregation occurs.

Casting of Specimens

- ❖ Fill the concrete in to the mould in layers approximately 5cm deep.
- ❖ When compacting by hand use standard tamping rod and each layer is subjected to 35 strokes uniformly distributed.
- ❖ When compacting by means of table vibrator each layer shall be vibrated until the specified vibration is obtained.
- ❖ In both the cases has been compacted finish the surface of the concrete in level with the top of the mould using a trowel and cover with a glass or metal plate to prevent evaporation.
- ❖ Store the test specimens in a place free from vibration, in moisture of at least 90 percent relative humidity and at a temperature of $27 \pm 2^{\circ}\text{C}$ for $24 \pm 1/2$ hours from the addition of water to the dry ingredients.
- ❖ After this period, mark the specimens and remove from the mould sand unless required for test within 24 hours.

Curing

- ❖ Immediately submerge the cubes in a clean, fresh water or saturated lime solution and keep them until taken out just prior to test.

- ❖ Renew the water or solution in which the specimens are submerged for every seven days, and the temperature of water is maintained with the specified limits.
- ❖ Conduct testing at recognized ages of the specimens, the most usual being 7 and 28 days.
- ❖ When it may be necessary to obtain the early strength, conduct tests at the ages of $24 \pm 1/2$ hours and 72 ± 2 hours.
- ❖ Calculate the ages from the addition of water to the dry in gradients.
- ❖ Test at least three specimens preferably from different batches at each select edge.

Testing

- ❖ The time between the extraction of the specimen from the curing tank, and the testing, shall be as short as possible or not more than 2 h. During the time the specimen is outside the curing tank, it shall be protected from drying, may be by covering with wet cloth.
- ❖ Record the weight and dimensions of the specimens to the nearest 0.2 mm.
- ❖ Wipe the bearing surface of the testing machine clean and dry.
- ❖ Place the cube specimens in the machine in such a manner that the load is applied to opposite sides of the cubes as cast, that is, not to the top and bottom.
- ❖ Carefully align the axis of specimen carefully with the center of the thrust of the spherically seated platen.
- ❖ Do not use any packing between the faces of the test specimen and the platens of the testing machine.
- ❖ The load shall be applied without shock and shall be increased continuously at a constant rate of 14 N/mm²/min until no greater load can be sustained. The maximum load indicated shall be recorded.

- ❖ For cube specimens, if the failure is satisfactory, unsatisfactory, this fact shall be recorded. If the failure pattern is unsatisfactory, this fact shall be recorded and the type of failure recorded using the pattern number in closest to that observed.

-- End of SOP --

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COMPRESSIVE STRENGTH OF CONCRETE USING PORTIONS OF BEAMS BROKEN IN FLEXURE

STANDARD: IS: 516 (Part-1, Sec-1) 2021

- ❖ This standard covers the procedure for determining compressive strength of concrete using portions of beams broken in flexure.

APPARATUS

1. Flexural Moulds.
2. Tamping rod
3. Flexural Testing machine.
4. Balance



TEST SPECIMENS

- ❖ The length of the broken portions of the beams selected for the compression test shall be at least 5 cm greater than the depth of the beam.
- ❖ The broken portions shall be free from cracks, chipped surfaces or other obvious defects within the length to be tested.

PROCEDURE

- ❖ The specimen shall be examined and any abnormalities shall be reported. For specimens stored in water, excess moisture shall be wiped from the surface of the specimen before placing in the testing machine.
- ❖ The time between the extraction of the specimen from the curing tank until the test shall be as short as possible or not more than 2 h.
- ❖ During the time the specimen is outside the curing tank, it shall be protected from drying, like by covering with wet cloth. The test specimen shall be placed in the machine, correctly centred with the longitudinal axis of the specimen at right angles to the longitudinal axis of the upper and lower rollers. The reference direction of loading shall be perpendicular to the direction of casting of the specimen.

- ❖ The bearing surfaces of the supporting and loading rollers shall be wiped clean, and any loose sand or other material removed from the surfaces of the specimen where they are to make contact with the rollers. The specimen shall then be placed in the machine in such a manner that the load shall be applied to the uppermost surface as cast in the mould.
- ❖ The load shall not be applied until all loading and supporting rollers are resting evenly against the test specimen. The load shall be applied without shock and shall be increased continuously at a constant rate until no greater load can be sustained. The load shall increase at a rate $0.7 \text{ N/mm}^2/\text{min}$ (rate of loading being 4 kN/min for 150 mm specimens and 1.8 kN/min for 100 mm specimens).
- ❖ The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

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-- End of SOP --



DETERMINATION OF CONCRETE SLUMP

STANDARD: IS: 1192(part-2)-2018

- ❖ This standard covers the procedure for determining the workability of concrete.

APPARATUS

- ❖ Mould for the test shall be in the form of the frustum of a cone having the following internal dimensions bottom diameter-20cms, top diameter-10cms, height-30cms.
- ❖ The mould shall be made of metal (Brass or Aluminum shall not be used) of at least 1.6 mm thickness and the top and bottom shall be open and at right angles to the axis of the cone.
- ❖ The mould shall have a smooth surface.
- ❖ It shall be provided with suitable foot pieces and also handles to facilitate lifting it during the test in a vertical direction as required.
- ❖ Tamping rod shall be of steel or other suitable material, 16mm diameter, 0.6 m long rounded at one end with graduations of least count 1mm.

SAMPLING IN THE FIELD

- ❖ If the test is to be conducted in the fields collect the true representative sample of the batch not less than 0.02 m³ in volume.
- ❖ Mix the sample on a non-absorbent base either with a trowel or by other suitable implements to ensure uniformity.
- ❖ Use the sample immediately for the purpose of carrying out the test.
- ❖ In the case of concrete containing aggregate of maximum size more than 38 mm wet sieve the concrete through 1½ inch screen to exclude aggregate particles bigger than 38 mm.

SAMPLING FROM LABORATORY MIX

- ❖ If the slump is to be checked in the laboratory mix the sample homogeneously and take the representative sample.

PREPARATION OF THE MOULD

- ❖ Thoroughly clean the internal surface of the mould free from superfluous moisture and

any set concrete.

- ❖ Place the mould on a smooth, horizontal rigid and non-absorbent surface such as a carefully leveled metal plate and held the mould firmly in the place while it is being filled.

PROCEDURE

- ❖ Fill the mould in four layers each approximately one quarter of the height of the mould.
- ❖ Prod each layer with twenty-five strokes of the rounded end of the tamping rod.
- ❖ Distribute the strokes uniformly over the cross section of the mould such that the second and subsequent layers shall penetrate into underlying layer.
- ❖ Prod the bottom layer throughout its depth.
- ❖ After the top layer has been prodded, struck off the concrete in level with the slump cone with a trowel or with the tamping rod, so that the mould is exactly filled.
- ❖ Clean the mortar if any, which has been leaked out between the mould and base plate.
- ❖ Remove the mould from concrete immediately by raising it slowly and carefully in a vertical direction.
- ❖ Measure the slump immediately by determining the difference between the height of the mould and that of the highest point of the specimen.
- ❖ Complete the whole process within a period of 2 minutes after sampling.

PRECAUTION

- ❖ Carry out the slump test at a place free from vibration or shock and within a period of 2 minutes after sampling.

-- End of SOP --

DETERMINATION OF SPLIT TENSILE STRENGTH

STANDARD: IS: 516(part-1, sec-1):2021

This standard covers the procedure for determining the splitting tensile strength of moulded concrete cubes and cylinders.

APPARATUS

1. Testing Machine
2. Jigs
3. Steel loading strips
4. Standard Weights



DIMENSION FOR CUBE

Cube specimen shall be of size not less than four times the maximum size of the coarse aggregate and not less than 150 mm.

DIMENSION FOR CYLINDER

The cylindrical specimen shall have diameter not less than four times the maximum size of the coarse aggregate and not less than 150 mm. The length of the specimens shall not be less than the diameter and not more than twice the diameter.

PROCEDURE

- ❖ At least three specimens shall be tested for each age of tests. Specimens when received dry shall be kept in water for 24 h before they are taken for testing.
- ❖ Unless other conditions are required for specific laboratory investigation specimen shall be tested immediately on removal from the water whilst they are still wet.
- ❖ Surface water and grit shall be wiped off the specimens and any projecting fins removed from the surfaces which are to be in contact with the packing strips.
- ❖ The mass and dimensions of the specimen shall be noted before testing. The sides of the specimen, lying in the plane of the pre-marked lines, shall be measured near the ends and the middle of the specimen and the average taken to the nearest 0.2mm.
- ❖ The bearing surfaces of the testing machine and of the loading strips shall be wiped clean.

- ❖ The test specimen shall be placed in the centring jig with packing strip and/or loading pieces carefully positioning along the top and bottom of the plane of loading of the specimen.
- ❖ The jig shall then be placed in the machine so that the specimen is located centrally.
- ❖ The load shall be applied without shock and increased continuously at a nominal rate within the range 1.2 N/ (mm²/min) to 2.4 N/ (mm²/min).
- ❖ Maintain the rate, once adjusted, until failure. On manually controlled machines as failure is approached the loading rate will decrease; at this stage the controls shall be operated to maintain as far as possible the specified loading rate. The maximum load applied shall then be recorded.

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DETERMINATION OF HARDENED CONCRETE CORES

STANDARD: IS: 516 (Part 4):2018

- ❖ This Test covers the principal for the determination of Hardened Concrete Cores.

APPARATUS:

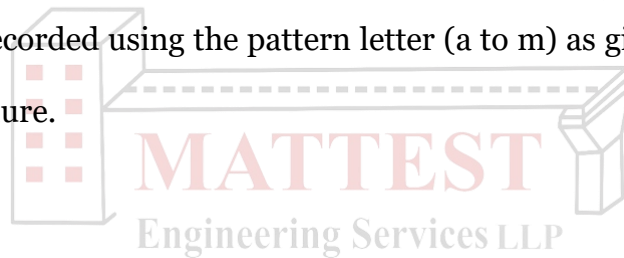
1. Core Drill,
2. Compression Testing Machine
3. Balance
4. Callipers and/or Ruler,
5. Gauge



PROCEDURE:

- ❖ Cores may be tested generally in saturated condition except if specifically required to be tested in air dry condition. For the saturated condition, soak in water at $27 \pm 3^\circ\text{C}$ for a minimum of 40 h and maximum up to 48 hrs before testing Core
- ❖ shall be removed from the water and tested while it is still wet but remove all excess surface grit and water by wiping off. If it is required to test the core specimen in air-dry conditions, store in laboratory air for a minimum of 40 h and maximum up to 48 h prior to testing,
- ❖ Record the storage time, ambient temperature and relative humidity of the storage conditions during air-dry storage of the specimens.
- ❖ Before placing the core specimen in testing machine, weigh it and also determine its length. The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the core specimen which are to be in contact with the compression platens.
- ❖ The core specimen shall be placed in the machine in such a manner that the load shall be applied to the top and bottom prepared surfaces.

- ❖ The axis of the core specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. with the centre of thrust of the spherically seated platen. As the spherically seated block is brought to bear on the core specimen, the movable portion shall be rotated gently by hand so that uniform seating may be obtained.
- ❖ The load shall be applied without shock and increased continuously at a rate of approximately **14 N/mm²/min** until the the core specimen breaks down and no greater load can be sustained. The maximum load applied to the core specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.
- ❖ For core specimens, if the failure is satisfactory (see Fig. 2), this fact shall be recorded. If the failure pattern is unsatisfactory, this fact shall be recorded and the type of failure recorded using the pattern letter (a to m) as given in Fig. 3, closest to the observed failure.



Calculation:

- ❖ The measured compressive strength of the core specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area, calculated from the mean dimensions of the section and shall be expressed to the nearest N/mm².
- ❖ The product of correction factor for core diameter (cores having diameter less than 100 mm) as given below, and the measured compressive strength shall be known as the corrected compressive strength: Diameter of Core 75 ± 5 Correction Factor 1.03 and < 70 Correction Factor 1.06

- ❖ The correction factor according to the l/d ratio of core specimen after capping shall be obtained from the following equation: $F = 0.11N + 0.78$ F = correction factor, and N = length /diameter ratio
- ❖ The product of this correction factor and the measured compressive strength or the corrected compressive strength for diameter as per 8.4.1, shall be known as the corrected cylinder strength, this being the equivalent strength of a cylinder having a height/diameter ratio of two. The equivalent cube strength of the concrete shall be determined by multiplying the corrected cylinder strength by 5/4.

-- End of SOP --

