Transport Roads & Maritime Services

NSW GOVERNMENT

Test method T312

Drying shrinkage of concrete

OCTOBER 2012

Revision Summary

Ed/Rev Number	Clause Number	Description of Revision	Authorisation	Date
		Reformatted and Revision Summary Added	D.Dash	May 1999
		Date on Test Method Revised to Agree with Date on Revision Summary	D.Dash	Feb 2001
Ed 2/ Rev 0	All	Reformatted RMS template	J Friedrich	October 2012

Note that Roads and Maritime Services is hereafter referred to as 'RMS'.

The most recent revision to Test method T312 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T312

Drying shrinkage of concrete

1. Scope

The test method sets out the procedure for determining the length changes of concrete specimens due to drying in air.
The method provides for tests on specimens in which the nominal maximum size of the aggregate does not exceed 25 mm and which have been prepared in the laboratory or sampled in the field. The method conforms with that described in the Australian Standard 1012, Part 13.

2. Apparatus

(a) Moulds of metal substantial enough to hold their form without distortion and without leaking during the moulding of the specimens. The faces of the moulds are to be machined to a smooth finish. Each mould is to comprise a base plate to which two end plates are securely fastened; two side plates which are fastened to the end plates; and two partially loose end plates referred to as gauge stud holders. The gauge stud holders are to be machined to fit snugly inside the end of the mould and to locate and secure a gauge stud during the setting period of the concrete. The gauge stud holders are to be held in position against the end plate by a retaining screw and shall be capable of release after compaction of the concrete.

The dimensions of the moulds and a recommended method of construction are set out in AS 1012, Part 13.

(b) Gauge studs of 316 stainless steel or equivalent conforming to the dimensions given in AS 1012, Part 13, radius of the gauge ends being approximately 5 mm.

(c) A length gauge, for checking the nominal length between the gauge studs, made of metal with a diameter of approximately 6 mm and a length of 250 ± 0.2 mm.

(d) A tamping bar for compacting the concrete in the moulds, straight, rectangular prismatic, with a 25 mm x 10 mm cross section and approximately 300 mm long with the ramming face square to the axis

(e) An external vibrator of a table type with a frequency of vibration of at least 3000 cycles per minute

(f) A vertical length comparator fitted with a high grade dial gauge or micrometer screw gauge graduated to read in 0.001 or 0.002 mm units, accurate to within 0.002 mm in any 0.10 mm range and with a travel of at least 10 mm.

The frame of the comparator is to be sufficiently rigid to prevent distortion when handled or when supporting the specimen, with means provided to ensure that the length of the specimen is measured along its longitudinal axis.
The upper and lower measuring anvils are to be of tungsten carbide, each with concave surface of radius approximately 25 mm to locate the specimen vertically; the upper anvil being fitted to the stem of the dial gauge and also having a tightly fitting collar extending down 1.2 to 1.4 mm to retain the specimen.
The dial gauge is positioned so that the centre of travel of the gauge corresponds approximately to the overall length to be measured, namely 295 mm. The frame clearance is to be sufficient for the specimen to be rotated freely when located in the comparator.

(g) A specific reference bar, consisting of invar or equivalent, approximately 16 mm in diameter and with an overall length of 295 ± 1.5 mm is to be used with the comparator. The bar is to be constructed as specified in Clause 2.7 of AS 1012, Part 13.

(h) The bar is to be used for checking the precision of the comparator and the competence of the operator by carrying out the recording of the difference in length between the bar and a typical specimen 20 times.

(i) A lime saturated bath.

(j) A drying room with the temperature regulated to $23 \pm 2^{\circ}C$ and the humidity maintained at 50 ± 5 percent. The flow of air through the room is to be regulated so that the rate of evaporation of water from a 400 mL low-form beaker of internal diameter of 78 ± 5 mm initially containing approximately 375 mL of water is 10 ± 4 mL per hour.

3. Test Specimens

The test specimens shall consist of prisms 75 mm by 75 mm in section, by approximately 285 mm long. Stainless steel gauge studs are cast into the ends of the specimen so that their principal axes coincide with the principal axis of the test specimen and they extend into the specimen approximately 16 mm.

At least three specimens are to be prepared for each composite sample of concrete.

4. Moulding Specimens

(a) Assemble the apparatus, after treating the whole of the inside surface of each mould with a thin coating of light mineral oil.

(b) Oil the threading of the gauge stud holder and screw the gauge stud into it, making sure that no mineral oil or other contaminant remains on the surface of the stud which comes into contract with the concrete.

(c) Set the effective gauge length (which is the length between the innermost ends of the gauge studs) to 250 mm as measured by the setting bar.

(d) Take the composite sample of concrete and after a minimum of remixing to offset segregation place in the mould without delay.

(e) Place concrete in the mould in two approximately equal layers by means of a scoop. The first layer is to be thick enough to ensure that the studs are just covered when compaction has been completed. Distribute the concrete symmetrically and avoid segregation within the mould.

(f) Compact fully by hand or by vibration, without causing segregation or excess laitance.

Note: Do not use hand compaction for concrete with a slump of less than 60 mm and do not use vibration compaction for concrete with a slump greater than 100 mm.

5. Hand Compaction

(a) Compact each of the two layers fully by rodding with the tamping rod, the strokes being distributed uniformly over the area of the specimen. Care is to be taken to avoid striking the gauge studs.

(b) The number of strokes per layer required varies according to the type of concrete but in no case is the number of strokes to be less than 35.

(c) Compact the top layer round the gauge stud axis with the fingers, taking care not to loosen the gauge stud.

(d) Tap the sides of the moulds lightly to close any voids. Slightly overfill the mould and after the top layer has been compacted, strike off the surface and level with a wood float.

6. Compaction by Vibration

(a) Place all the concrete for each layer in the mould before vibrating the layer.

(b) Attach the mould rigidly to, or hold tightly against the vibrating surface of the external vibrator. Vibrate only long enough to compact each layer.

(c) After the top layer has been compacted, strike off level with a wooden float.

7. Curing the Specimens

(a) Immediately after moulding, place the mould containing the specimens on a rigid horizontal surface in the initial curing environment at a relative humidity of 95 percent and a temperature of $23 \pm 2^{\circ}C$ and leave undisturbed for not less than 21 hours.

(b) Loosen the gauge stud holder retaining screws to prevent restraint of the gauge stud during the initial shrinkage of the concrete.

8. De-moulding and Moist Curing

(a) De-mould the specimens with extreme care at an age of 24 ± 2 hours, ensuring that the gauge stud is not disturbed while the gauge stud holder is being unscrewed from the stud.

(b) Mark each specimen for identification and for subsequent positioning in the comparator using an indelible ink which is not removed by soaking in water.

(c) Place the specimens in lime saturated water at 23 ± 2°C within one hour of de-moulding.

(d) Keep immersed until and age of 7 days has been reached, when the initial replicate measurement is taken.

Note:

(a) Change the water at regular intervals to avoid excessive build-up of alkalis or other deleterious materials.

(b) It is advisable to carry out the initial moist curing inside the drying room in a covered container and to make all measurements inside the room.

9. Air Drying of Specimens

Remove the specimens one at a time from the water, wipe with a damp cloth to remove excess water and measure for length within 5 minutes.
Store the specimens in racks so that there is a gap at least 50 mm on all sides.

Make length measurements after a total period of air drying at 2, 3, 4 and 8 weeks and if necessary 16 and 32 weeks.

10. Length Measurement

(a) Set the dial gauge of the length comparator by use of the reference bar at least at the beginning and the end of the readings made within half a day. (If variations of more than 0.005 mm are noted, make more frequent checks).

(b) Record the length reading for each specimen as the difference in length between the specimen and the average of the reference bar reading.

(c) Take the reference reading by rotating the reference bar slowly in the comparator holding the bar lightly with the fingers near the lower anvil and recording the minimum reading of the dial.

(d) Always place the reference bar in the comparator with the same end up.

(e) Measure each specimen by locating it centrally in the comparator whilst rotating the specimen slowly and record the minimum reading. Always place the specimen in the comparator with the same end up.

11. Calculations and Reporting

(a) The drying shrinkage of each specimen after any period is the difference between the initial length when taken immediately before exposure to the drying environment and the length reading at the particular time

(b) Express the shrinkage as a strain by dividing by the original effective gauge length (taken as 250.0 mm)

(c) Report the strain, supplying the following information:

(i) Identification of the concrete

(ii) Date of moulding

(iii) Drying shrinkage for each specimen

(iv) Compressive strength of the concrete

(v) Any variations from normal conditions