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Methods of testing concrete

Method 8.4: Method for making and curing concrete—Drying shrinkage specimens prepared in the field or in the laboratory

AS 1012.8.4:2015

1 SCOPE

This Standard sets out a method for preparing concrete drying shrinkage specimens. It provides for preparation of specimens in the laboratory or in the field, in which the nominal size of aggregate in the concrete, in accordance with AS 2758.1, does not exceed 40 mm.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS		
1012	Methods of testing concrete	
1012.1	Method 1:	Sampling of concrete
1012.2	Method 2:	Preparing concrete mixes in the laboratory
1012.3.1	Method 3.1:	Determination of properties related to the consistency of concrete—Slump test
1012.3.2	Method 3.2:	Determination of properties related to the consistency of concrete—Compacting factor test
1012.3.3	Method 3.3:	Determination of properties related to the consistency of concrete—Vebe test
1012.3.4	Method 3.4:	Determination of properties related to the consistency of concrete—Compactibility index
1012.3.5	Method 3.5:	Determination of properties related to the consistency of concrete—Slump flow, T_{500} and J-ring test
1012.4.1	Method 4.1:	Determination of air content of freshly mixed concrete—Measuring reduction in concrete volume with increased air pressure
1012.8.1	Method 8.1:	Method for making and curing concrete—Compression and indirect tensile test specimens
1012.13	Method 13:	Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
2758	Aggregates and rock for engineering purposes	
2758.1	Part 1:	Concrete aggregates

3 DEFINITIONS

For the purpose of this Standard, the definitions below apply:

3.1 Standard moist curing conditions

As required by AS 1012.8.1 for lime-saturated water.

NOTE: Standard temperate conditions are required for a minimum of 24 h prior to initial measurement.

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3.2 Self-compacting concrete (SCC)

Concrete that is able to flow and consolidate under its own weight, and completely fill the formwork or bore hole even in the presence of dense reinforcement, whilst maintaining homogeneity and without the need for additional compaction. SCC is also known as 'self-consolidating concrete' and 'super-workable concrete'.

4 APPARATUS

The following apparatus shall be used.

4.1 Moulds

4.1.1 *General*

Moulds shall be made of non-absorbent material which does not react with cement paste and their internal surfaces shall have a smooth finish. The moulds shall be substantial enough to hold their form without distortion and shall be substantially leak-proof.

Each mould shall be provided with a base plate to which two end plates are securely fastened by screws, two side plates which are fastened to the end plates by screws, and two partially loose end plates which act as gauge stud holders. Each gauge stud holder shall fit inside the end of the mould and shall locate and secure a gauge stud during the setting period of the concrete. Each gauge stud holder shall be held in position against the end plate by a retaining screw and shall be capable of release after compaction of the concrete. The opposite side plates shall be parallel and the distance between them shall be 75 ±1 mm. The inside height shall be 75 ±1 mm.

4.1.2 *Construction of the mould*

The construction of the mould shall be aligned coaxially along the central axis of the moulded specimen, with the distance between the inner ends of the two studs being 250 ±0.5 mm, and that between the outer ends 295 ±1 mm. Gauge studs shall protrude from the gauge stud holders to a distance of 15 ±1 mm. A suitable form of construction of the moulds is shown in Figure 1.

4.2 Gauge studs

Gauge studs shall be of stainless steel and shall comply with the dimensions shown in Figure 2. The radius of the gauge stud end shall be as follows:

(a) Horizontal comparator .....approximately 150 mm.

(b) Vertical comparator .....approximately 5 mm.

Gauge studs for horizontal and vertical comparators shall not be interchanged.

NOTE: As gauge studs are not interchangeable, it is recommended that the preparing laboratory confirm that the proposed gauge studs are compatible with the measuring laboratory's equipment.

4.3 Length gauge

A length gauge shall be provided for checking the nominal length between gauge studs. The length gauge shall be made of metal and shall have a diameter of at least 6 mm and a length of 250 ±0.2 mm. The ends of the bar shall be flat and perpendicular to its length.

4.4 Tamping bar (hand compaction)

The bar used for compacting concrete in the moulds shall be a straight metal rectangular bar having nominal dimensions of 25 mm × 10 mm × 300 mm long with a ramming face square with the axis.

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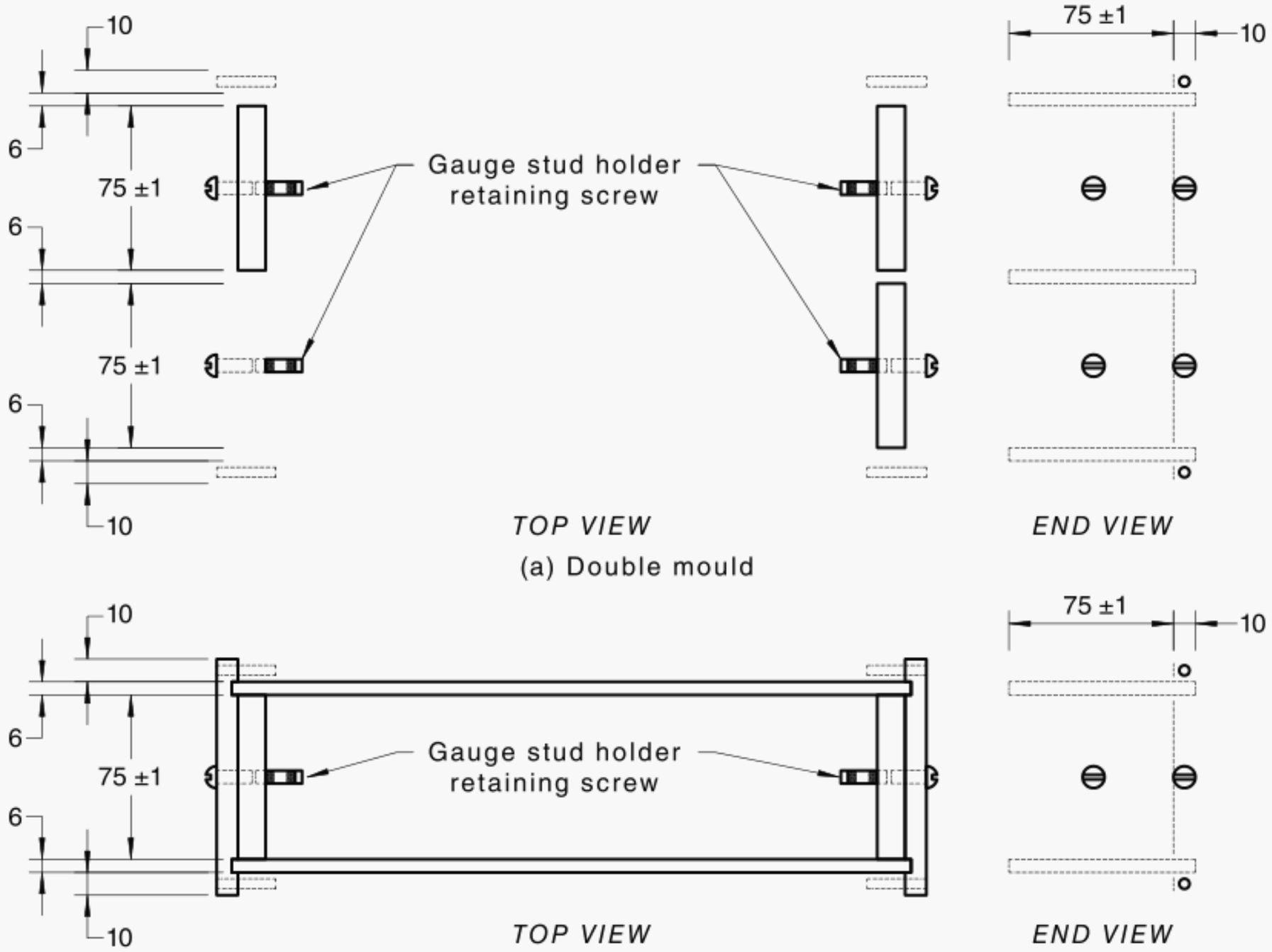

NOTE: Dimensions of 280 mm is approximate because of positioning requirements of gauge studs.

DIMENSIONS IN MILLIMETRES

FIGURE 1 DETAILS OF A TYPICAL MOULD

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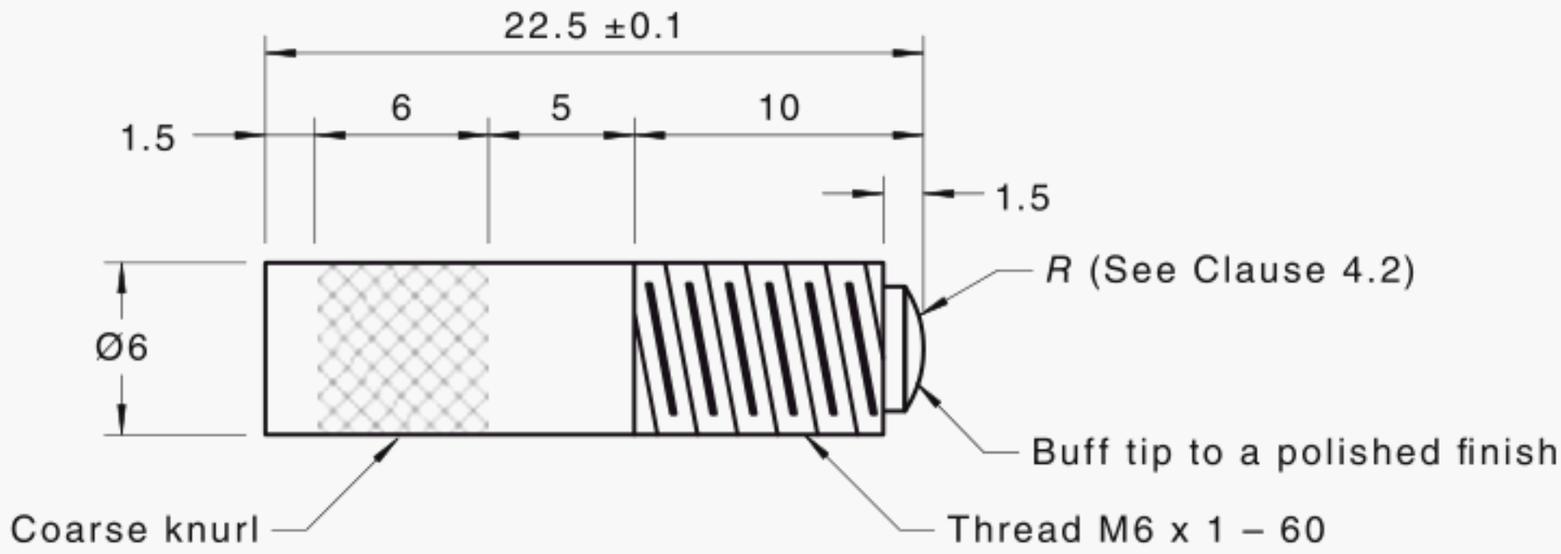

DIMENSIONS IN MILLIMETRES

FIGURE 2 GAUGE STUD DETAILS

4.5 Vibrator

The external vibrator used to compact concrete in the moulds shall be a table type with provision for clamping of the mould. Internal vibrators shall not be used.

NOTE: A vibrating table with a nominal frequency of vibration of 50 Hz is usually suitable.

4.6 Mallet

The mallet used in the moulding of specimens shall comply with the relevant requirements of AS 1012.4.1.

4.7 Wooden float

A wooden float is the flat surfaced tool that is used for smoothing the surface of the moulded specimens.

5 SAMPLING AND TEST SPECIMENS

5.1 General

Specimens may be prepared either in the laboratory or in the field. Particular care should be taken to ensure sampling and preparation are strictly in accordance with this Clause (5) as these activities are crucial to the accuracy and repeatability of the test. Full records shall also be kept for inclusion in the report (see Clauses 7 and 8).

5.2 Sampling

5.2.1 *Field sampling*

For concrete sampled in the field, the concrete sample shall be obtained in accordance with AS 1012.1.

5.2.2 *Laboratory sampling*

For concrete made in the laboratory, the concrete sample shall be prepared in accordance with AS 1012.2.

5.3 Preparation of test specimens

5.3.1 *General*

At least three specimens shall be prepared for each sample of concrete. The nominal size of the aggregate in the concrete, in accordance with AS 2758.1, shall not exceed 40 mm.

5.3.2 *Size and shape of standard test specimens*

The test specimen shall be a prism 75 mm × 75 mm and approximately 280 mm long. A stainless steel gauge stud shall be cast into each end of the specimen. The gauge studs shall be cast so that their principal axis coincides with the principal axis of the test specimen, and shall extend into the specimen approximately 15 mm.

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5.3.3 *Identification of specimens*

Each specimen shall be identified by the mould marking or by other means which will not adversely affect the concrete. Scratch markings shall not be used.

NOTE: The use of permanent markings on the external face of the mould is recommended.

6 PROCEDURE

6.1 Measurement of consistence

The procedure is as follows:

(a) Measure slump and, if required, other consistence, in accordance with AS 1012 Methods 3.1, 3.2, 3.3, 3.4, 3.5, as appropriate.

(b) Record the temperature of the concrete at the time of moulding.

6.2 Moulding specimens

6.2.1 *Moulding procedure*

The apparatus and the specimen are prepared as follows:

(a) Treat assembled drying shrinkage moulds to prevent adhesion of the concrete by the use of a thin coating of mineral oil or other suitable release compound applied to the whole of the inside surfaces of each mould.

(b) Prepare the gauge stud assembly as follows:

(i) Lubricate the threading of the gauge stud holder.

(ii) Screw the gauge stud into the gauge stud holder, taking care that no mineral oil or other contaminant remains on the surface of the gauge stud which comes into contact with the concrete.

(iii) Using the length gauge (see Clause 4.3), set the effective gauge length, i.e. the length between the innermost ends of the gauge studs, at 250 mm.

(c) Take the sample of concrete as quickly as possible to the place selected for moulding the specimens.

(d) After a minimum of mixing to offset any segregation that has occurred during transportation, commence moulding without delay.

(e) Complete moulding within 30 min of the completion of obtaining the test sample.

NOTE: This may not always be possible for concrete sampled in the field. Where this is the case, variations should be noted in the report.

(f) Using a scoop, place concrete in the mould in two approximately equal layers ensuring symmetrical distribution of the concrete within the mould.

(g) Compact the concrete by tamping or vibrating, as appropriate, as described in Clause 6.2.2 or Clause 6.2.3 without causing segregation or excessive laitance.

NOTE: The object is to achieve full compaction. Compaction by tamping is not recommended for concrete with a slump less than 40 mm, nor is vibration recommended for concrete with a slump greater than 100 mm.

6.2.2 *Compaction by tamping*

The procedure for the compaction of specimens by tamping is as follows:

(a) Compact each of the two layers with the tamping bar, the tamping strokes being distributed uniformly over the area of the specimen. Take care to avoid striking the gauge stud.

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(b) The number of tamping strokes per layer required to produce adequate compaction will vary according to the type of concrete used. The total number of tamping strokes per layer shall be not less than 35.

(c) As the top layer of concrete is being placed, ensure that the concrete around the gauge studs is adequately compacted. Take care not to loosen the gauge studs.

(d) Close any holes remaining in the surface of each layer by lightly tapping the sides of the mould with the mallet.

(e) Slightly overfill the top layer of the mould. After the top layer has been compacted, strike off and smooth the surface of the concrete with a wooden float.

6.2.3 *Compaction by vibration*

The procedure for the compaction of specimens by vibration is as follows:

(a) Fill the moulds in two approximately equal layers. Rigidly attach the mould to the vibrating table.

(b) Vibrate each layer until the surface becomes relatively smooth in appearance. Do not prolong vibration beyond the point at which mortar commences to collect on the surface.

(c) After the top layer has been compacted, strike off and smooth the surface of the concrete with a wooden float.

6.2.4 *Compaction of self-compacting concrete*

The procedure for compaction of specimens with self-compacting concrete is as follows:

(a) Place concrete in the mould using a scoop, ensuring symmetrical distribution of the concrete within the mould.

(b) Tap the mould with the mallet until all entrapped air is removed.

(c) Strike off and smooth the surface of the concrete with a wooden float.

6.3 Curing of specimens

6.3.1 *Initial curing in moulds*

6.3.1.1 *General*

Immediately after the test specimen has been moulded, place the mould containing the specimen in the initial curing environment and loosen the gauge stud holder retaining screws so as to prevent restraint of the gauge stud in case of shrinkage of the concrete during initial curing.

6.3.1.2 *Initial curing under standard conditions*

Store the specimens in a saturated condition (minimum 95% relative humidity), undisturbed in their moulds on a rigid horizontal surface in air at the following temperatures until demoulded:

(a) Standard temperate zone ..... 23 ±2°C.

(b) Standard tropical zone ..... 27 ±2°C.

NOTES:

1 The standard temperature zones referred to above are as specified in AS 1012.8.1.

2 Saturated conditions can be maintained either by moisture retaining covers applied to the moulds, or by placing specimens in a humidity controlled environment.

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6.3.1.3 *Storage of specimens in the field*

In the field, store specimens for a period of not less than 18 h from moulding, nor more than 24 h as follows:

(a) In a covered location adjacent to the moulding site, preferably indoors and protected from wind and extremes of temperature.

(b) Undisturbed in their moulds on a rigid horizontal surface, with lids fitted so as to prevent the loss of moisture from the specimen.

NOTE: The aim is to provide conditions for test specimens which give a maximum of protection from extremes of temperatures and loss of moisture during their storage in the field.

6.3.1.4 *Non-compliance with initial curing conditions*

When standard moist-curing does not commence within 27 h of moulding, the test results shall be liable to rejection. Under these circumstances the following data shall be recorded:

(a) The reason for the delay.

(b) The length of time between moulding and commencement of standard moist-curing.

(c) The ambient maximum and minimum temperatures in the locality of the curing.

NOTE: Unless otherwise specified, the temperatures from the nearest Bureau of Meteorology weather station are adequate.

6.3.1.5 *Initial curing under non-standard conditions*

As soon as is practicable after a period of 18 h from moulding, transport specimens stored under non-standard conditions shall be transported to the laboratory for demoulding, such that they are placed under standard moist curing conditions within 24 h of moulding.

6.3.2 *Demoulding of specimens*

6.3.2.1 *General*

Demould specimens within 24 ±3 h from the time of moulding. Where variations to this time period are necessary, standard moist curing conditions shall be maintained during any additional curing period and full details shall be noted in the report.

Minor damage to the gauge studs may be repaired; however, the extent of this damage and details of any repairs carried out shall be noted and reported.

Take extreme care to ensure that the gauge stud is not disturbed while the gauge stud holder is being unscrewed from the stud.

NOTES:

1 Some grades of concrete with specified compressive strength less than 10 MPa at 28 days will need at least 48 h after moulding before demoulding to avoid damage to the specimens.

2 If the damage to the gauge studs is restricted to dislodgment of one or both gauge studs, the studs may be carefully cemented in place by means of a suitable fast-setting cement, e.g. a catalyzed epoxy or polyester. It is, however, essential that the cement be allowed at least 24 h to harden before initial measurement.

6.3.2.2 *Acceptance criteria*

Specimens may be rejected if there is evidence of poor compaction or damage, e.g. cracks, loose studs.

6.3.2.3 *Identification of specimens*

As it is removed from its mould, mark each specimen with a suitable indelible marker to show identification.

NOTE: Specimens may also be marked at this time for orientation. The specimen is to be placed when measuring the shrinkage as detailed in AS 1012.13.

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6.3.3 *Standard moist curing*

Except where minor repairs are necessary, place specimens in standard moist curing conditions (see Clause 3.1) within 15 min of demoulding. Maintain these conditions until seven days from moulding, subject to the alternative requirements for transport set out in Clause 6.3.4.

Demoulded specimens may be transported from the preparing laboratory to the measuring laboratory (see Clause 6.3.4) during the standard moist curing period after a minimum period of 24 h in standard moist curing conditions in the preparing laboratory (see Clause 6.3.1).

Store all specimens in standard temperate moist curing conditions at the measuring laboratory for a minimum of 24 h prior to initial measurement.

6.3.4 *Transport of specimens to the measuring laboratory*

6.3.4.1 *Specimens transported from the field to the laboratory*

When specimens are transported to a laboratory, they shall be carried in such a way that physical damage is avoided, loss of moisture is minimized and temperature extremes are prevented.

NOTE: Demoulded specimens should be protected during transportation by means such as wrapping in wet hessian or wet newspaper, and packing in plastics bags within sealed stout containers.

6.3.4.2 *Specimens transported from a storage laboratory to a testing laboratory*

When specimens are moved from a storage laboratory to a testing facility they shall be transported with extreme care to avoid physical damage, moisture loss or temperature variations outside those permitted in Clause 9.3 of AS 1012.8.1. When specimens are transported to a laboratory, they shall be carried in such a way that physical damage is avoided, loss of moisture is minimized and temperature extremes are prevented.

Upon arrival at the receiving laboratory, an inspection of the specimens shall be carried out to ensure no damage has occurred and they are still in a moist state.

Record the time the specimens are outside the standard laboratory curing conditions, any damage and, if possible, the maximum and minimum temperatures during transportation.

7 RECORDS

The following information concerning the specimens shall be recorded:

(a) Identification of specimen.

(b) Date and time of moulding.

(c) Any deviation from the required time for moulding.

(d) Slump and, if required, other consistence determination of the concrete.

(e) Field or laboratory sampled.

(f) Temperature of concrete immediately prior to moulding.

(g) Method of compaction.

(h) Initial curing history of specimens, i.e. standard or non-standard including, if non-standard—

  (i) the maximum and minimum temperatures to which the specimens have been subjected; and

  (ii) the dates and times of despatch and receipt of transported specimens.

(i) Date and time of demoulding.

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8 REPORT

Where the measuring laboratory is not the preparing laboratory, each laboratory shall prepare separate reports, which, when combined, shall constitute the complete report, as follows:

(a) Identification of specimen.

(b) Field or laboratory sampled.

(c) Date of moulding.

(d) Job site or laboratory where moulded.

(e) Initial curing period:

  (i) Standard; or

  (ii) Non-standard—include details of deviations from standard.

(f) Date of demoulding.

(g) Where applicable, any damage to the specimen and details of any repairs carried out.

(h) Date and time of despatch.

(i) Such other information contained in the records as may be requested.

(j) Transportation history if the specimens have moved after standard moist curing conditions commenced.

(k) The number of this Australian Standard, i.e. AS 1012.8.4.

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NOTES

NOTES

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