Transport Roads & Maritime Services

NSW GOVERNMENT

Test method T133

Durability of road materials modified or stabilised by the addition of cement

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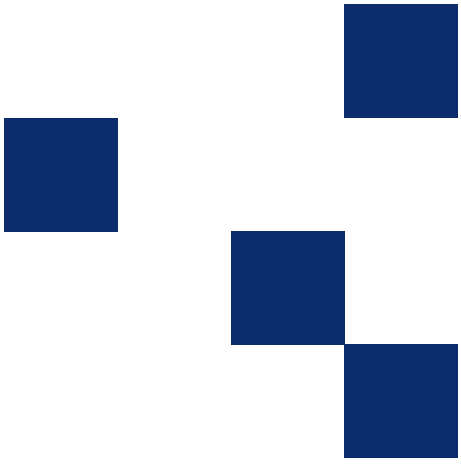

Revision Summary

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	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 T133 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T133

Durability of road materials modified or stabilised by the addition of cement

1. Scope

This test method sets out the procedure for the determination of the durability of soil, gravel or crushed rock material modified or stabilised in the laboratory by the addition of cement.

This method is applicable to materials passing a 19.0 mm AS sieve.

2. Apparatus

(a) A cylindrical metal mould having an internal diameter of 105 mm and an internal effective height of 115 mm (a volume of 1 litre), fitted with a detachable base plate and a removable collar assembly approximately 60 mm high, both of which can be firmly attached to the mould, A suitable design is shown in AS 1289.

(b)

(i) A metal rammer with a 50 mm face diameter and a drop mass of 2.7 kg, equipped with a suitable device to control the height of drop to a free fall of 300 mm.

(ii) A metal rammer with a 50 mm face diameter and a drop mass of 4.9 kg, equipped with a suitable device to control the height of drop to a free fall of 450 mm.

Suitable forms of hand apparatus are shown in AS 1289. Mechanical forms of the apparatus may be used provided the essential dimensions are adhered to.

(c) A rigid foundation on which to compact the specimen, e.g. a concrete floor or a cubical concrete block of at least 100 kg mass

(d) A metal mixing and quartering tray

(e) Mixing apparatus such as a trowel and palette knife and quartering apparatus such as metal plates approximately 400 mm by 125 mm and 200 mm by 125 mm.

(f) Sample dividers (riffle boxes) of appropriate size openings. (Optional)

(g) A thermostatically controlled oven with good air circulation, capable of maintaining a temperature within the range of 105°C to 110°C

(h) A thermostatically controlled oven with good air circulation capable of maintaining a temperature within the range of 65°C to 70°C

(i) 37.5 mm, 19.0 mm and 4.75 mm AS sieves

(j) A balance of at least 6000 g capacity accurate and readable to 0.5 g within the operating range

(k) A jack, lever and frame or other device suitable for extruding compacted specimens from the mould. A suitable form of apparatus is shown in AS 1289.

(l) A bowl suitable for thoroughly mixing increments of water with the test sample. A mixing machine (11 litre capacity) may be used.

(m) Moisture measurement tins, at least 500 mL capacity, with press-on lids or other suitable seal.

(n) A measuring cylinder, 100 mL

(o) A steel straightedge, a suitable size being about 300 mm long, 25 mm wide and 3 mm thick preferably with a bevelled edge.

(p) A 300 mm rule

(q) a porcelain mortar, approximately 180 mm diameter, and a rubber pestle.

(r) Metal dishes, approximately 225 mm and 350 mm diameter.

(s) A humidity cabinet capable of maintaining a humidity of not less than 90% at a temperature within the range of 21°C to 25°C. Alternatively, a water bath equipped with a snug fitting lid and perforated metal false bottom with supports to provide a 50 mm space below the perforated plate.

(t) A water bath

(u) A wire scratch brush.

3. Preparation of Sample

(a) Allow the sample to dry sufficiently to enable it to be crumbled. If necessary, dry the sample at a temperature not exceeding 50°C.

(b) Break up any aggregations of particles in such a way as to avoid crushing any discrete particles. All aggregations of particles are to be broken down so that if the sample was screened on a 4.75 mm AS sieve only discrete uncrushed particles would be retained. A rubber pestle should be used to avoid breaking down sound pieces of mineral matter. Adhering material should be brushed from coarse pieces. When in doubt as to whether lumps are to be broken, place some in water and boil. If slaking occurs, the material should be broken further with the rubber pestle.

(c) Screen the sample on a 37.5 mm AS sieve. Discard material retained.

(d) Screen the remaining sample on 19.0 mm and 4.75 AS sieves. Material passing the 37.5 mm AS sieve and retained on the 19.0 mm AS sieve shall be removed and replaced by an equal mass of material passing the 19.0 mm AS sieve and retained on the 4.75 mm AS sieve from another portion of the sample.

(e) Thoroughly re-mix all material passing the 19.0 mm As sieve, and reduce, as necessary, by quartering or riffling, to provide not less than 5000 g of material for each cement content.

4. Cement

(a) Cement used in laboratory investigations should be the same type from the same source of supply or manufacture as the cement proposed for use in the field.
Unless otherwise specified or approved, the cement should be Type A. - Ordinary or Normal Cement complying with the requirements of AS 1315 - Portland Cement.

(b) Where Blended Cements are specified or approved for investigation in stabilisation works, they should comply with the respective requirements of AS 1317 - Blended Cements.

(c) Cement should be stored in sealed containers and protected from moisture until used. Cement should not be used for laboratory investigations after being stored for a period of three months.

5. Procedure

(a) Obtain, by quartering or riffling, two 2500 g portions of the sample prepared in *Preparation of Sample (e)* above.

(b) Weigh the mould and record the mass (M_2) to the nearest 5 g.

(c) Assemble the mould, collar and base-plate and place the assembly on the rigid foundation.

(d) Take one of the 2500 g portions and determine the mass to the nearest 1 g. Screen on a 4.75 mm AS sieve. All material retained on the 4.75 mm AS sieve shall be soaked for at least one hour and then surface dried.

(e) Add the required amount of cement, calculated as a percentage of the dry mass of the sample determined in *Procedure (d)*, to the material passing the 4.75 mm AS sieve and thoroughly mix the dry materials to a uniform colour. Add a small quantity of water (approximately 5 percent by mass for sandy or gravelly materials and 8 percent for clayey materials) and mix. Incorporate the saturated surface dry material retained on the 4.75 mm AS sieve and re-mix. Cover the mixture and allow to stand for not less than five minutes but not more than 10 minutes. Thoroughly re-mix the material.

(f) Compact the mixture into the mould at the optimum moisture content for the specified compactive effort, as determined by Test Method T130. Unless otherwise specified, use standard compaction.

(i) Standard Compaction: Compact the mixture into the mould in three layers not varying compacted thickness by more than 5 mm. Subject each layer to 25 uniformly distributed blows of a 2.7 kg rammer falling freely from a height of 450 mm.

(ii) Modified Compaction: Compact the mixture into the mould in five layers not varying in compacted thickness by more than 5 mm. Subject each layer to 25 uniformly distributed blows of a 2.7 kg rammer falling freely from a height of 300 mm.

(g) Use only sufficient material to slightly overfill the mould leaving not more than 5 mm to be struck off after removing the collar. Free the material from around the collar and then carefully remove the collar.

(h) Level the compacted material to the top of the mould by means of the straightedge. Patch with smaller sized material any holes developed in the surface by removal of coarse material.

(i) Remove the base plate and weigh the mould plus compacted material and record the mass (M_1) to the nearest 5 g.

(j) Carefully extrude the sample from the mould.

(k) Cure the specimens for 7 days from the time of compaction at not less than 90% humidity at a temperature within the range of 21°C to 25°C.

(l) Repeat *Procedure (b)* to *(j)* for the other portion. Only one cylinder (SPECIMEN 1) shall be used in subsequent testing for volume and moisture content changes and the other cylinder (SPECIMEN 2) shall be used in subsequent testing for loss by abrasion.

(m) Immerse the cylinders in a water bath at room temperature for five hours. On removal from the water the cylinders shall by weighed to nearest 5 g and the height and diameter measured to the nearest 5 mm to obtain the volume.

(n) Place the cylinders in an oven at 65°C to 70° C for 42 hours.

(o) Remove the cylinders from the oven.

(i) Weigh SPECIMEN 1, measure the diameter and height and determine moisture content and volume changes.

(ii) Abrade SPECIMEN 2 with two firm strokes with a wire scratch brush on each part of the side and ends of the cylinder. The brush shall be applied to the full length and breadth of the specimen. Approximately 18 to 20 vertical strokes are necessary on the side and 2 are required on each end of the cylinder. Weigh the specimen after abrasion and compute the loss in mass as a percentage of the original mass.

(p) Repeat the procedure set out in *Procedure (m)* to *(o)* for another 11 cycles.

(q) On completion of the 12 cycles dry the cylinders to constant mass (M_4) at 105°C to 110°C and determine the moisture content (w) of each specimen.

(r) Repeat the procedure for each of the specified cement contents.

6. Calculations

(a) Calculate the mass of compacted material (M) after compaction, as follows:

$$M = (M_1 - M_2)\ \text{g}$$

(b) Calculate the change in volume of SPECIMEN 1 (as a percentage by volume) as follows:

$$V = \frac{1000 - V_{12}}{10}\ \%$$

Where V = volume change

V_{12} = Volume of specimen after completing of 12 cycles of wetting and drying (cm^3)

(c) Calculate the change in mass of SPECIMEN 1 (as a percentage by mass) as follows:

$$M_c = \frac{M - M_{12}}{M}$$

Where M_c = change in mass (%)

M = mass material after compaction (g)

M_{12} = mass of material after 12 cycles of wetting and drying (g)

(d) Calculate the loss in mass of SPECIMEN 2 (as a percentage by mass) after abrasion as follows:

$$M_A = \frac{M - M_{12}}{M} \times 100\ \%$$

Where M_A = loss of mass (%)

M = mass of material after compaction

M_{12} = mass of material after 12 cycles of wetting and drying

(e) Calculate the final moisture content of specimens (as a percentage by mass) as follows:

$$w = \frac{M_{12} - M_4}{M_4} \times 100\ \%$$

Where w = moisture content

M_{12} = mass after 12 cycles of wetting and drying (g)

M_4 = dry mass after 12 cycles of wetting and drying (g)

(f) Calculate the change in moisture content of the specimens as follows:

$$W = \frac{w - O_{mc}}{O_{Mc}} \times 100\ \%$$

Where W = change in moisture content

w = final moisture content from (e)

O_{Mc} = optimum moisture content as determined by Test Method T130.

7. Reporting

Report the following results for each cement content as appropriate:

(a) Type and source of cement

(b) Cement content as a percentage by mass.

(c) Compactive effort applied.

(d) Optimum moisture content

(e) Change in volume after 12 cycles of wetting and drying.

(f) Change in mass after 12 cycles of wetting and drying.

(g) Change in mass after 12 cycles of drying and abrasion.

(h) Change in moisture content.