

Australian Standard®

AS 5101.4—2008

Methods for preparation and testing of stabilized materials

Method 4: Unconfined compressive strength of compacted materials

1 SCOPE

This Standard sets out the method for determining the unconfined compressive strength of compacted specimens of unbound, bound and self-cementing materials.

This method is applicable to the control testing of field or plant mix materials and for the assessment of the strength of materials mixed in the laboratory.

The test is conducted on that portion of the material that passes the 19.0 mm sieve.

NOTE: The exclusion of a large proportion of stone coarser than 19.0 mm may have a major effect on the unconfined compressive strength determined compared with that obtainable with the material as a whole.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

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| 1141 | Methods for sampling and testing aggregates |
| 1141.1 | Method 1: Definitions |
| 1141.2 | Method 2: Basic testing equipment |
| 1152 | Specification for test sieves |
| 1289 | Methods of testing soils for engineering purposes |
| 1289.1.2.1 | Method 1.2.1: Sampling and preparation of soils—Disturbed samples—Standard method |
| 1289.2.1.1 | Method 2.1.1: Soil moisture content tests—Determination of the moisture content of a soil—Oven drying method (standard method) |
| 1289.5.1.1 | Method 5.1.1: Soil compaction and density tests—Determination of the dry density/moisture content relation of a soil using standard compactive effort |
| 1289.5.2.1 | Method 5.2.1: Soil compaction and density tests—Determination of the dry density/moisture content relation of a soil using modified compactive effort |
| 2193 | Calibration and classification of force-measuring systems |

3 DEFINITIONS

For the purpose of this Standard, the definitions in AS 1141.1 and those below apply.

3.1 Bound material

A material to which a binder, such as lime, cement, bitumen, or other binding agent has been added to produce structural stiffness.

3.2 Laboratory density ratio

The ratio of the dry density of a test specimen to the maximum dry density of that material as determined by test in accordance with AS 1289.5.1.1 or AS 1289.5.2.1, expressed as a percentage.

3.3 Laboratory moisture ratio

The ratio of the moisture content of a test specimen to the optimum moisture content of that material as determined by test in accordance with AS 1289.5.1.1 or AS 1289.5.2.1, expressed as a percentage.

3.4 Self-cementing material

A material that gains tensile strength with time without the addition of binder.

3.5 Unbound material

A material that is not self-cementing and does not contain a binder.

4 APPARATUS

The following apparatus, complying with the relevant provisions of AS 1141.2, is required:

- (a) *Balance*—of sufficient capacity, with a limit of performance not exceeding ± 5 g.
- (b) *Base*—a level rigid foundation on which to compact the specimen; for example, a sound concrete floor about 100 mm or more in thickness or a cubical concrete block of at least 100 kg mass.
- (c) *Cabinet*—a humidity cabinet capable of maintaining a humidity of not less than 90% at a temperature within the range required by the curing regime (usually 21°C to 25°C). Alternatively, a water bath equipped with snug-fitting lid and perforated metal false bottom with supports to provide a 50 mm space below the perforated plate and about 10 mm above the water surface.
- (d) *Dishes*—metal dishes.
- (e) *Equipment for measuring test specimens*—accurate to the nearest 0.5 mm.
- (f) *Materials and equipment for capping test specimens*—such as high-strength dental plaster.
- (g) *Mixing apparatus*—such as a trowel, palette knife and metal quartering plates.
- (h) *Mould*—a cylindrical metal mould having an internal diameter of 105 mm and internal effective height of 115.5 mm in accordance with AS 1289.5.1.1, Mould A. A split mould having the same dimensions may be used to facilitate removal of the compacted specimen.
- (i) *Rammer*—in accordance with AS 1289.5.1.1 or AS 1289.5.2.1, as appropriate for compacting to a defined compactive effort.

NOTE: A mechanical compactor may be used, provided the essential dimensions are adhered to and the rammer has a free vertical fall of the correct height. It is also essential that the design of the machine is such that the mould rests on a solid base.

Alternatively, a suitable electric or pneumatic vibrating hammer may be used when compacting to a predetermined laboratory density ratio.

- (j) *Rule*—300 mm readable to 1.0 mm.

- (k) *Sample dividers (riffle boxes)*—of appropriate size openings (optional).
- (l) *Sample extractor*—jack, level and frame, or other device, suitable for extruding compacted specimens from the mould (optional if split mould is used).
- (m) *Sieves*—19.0 mm and 4.75 mm, in accordance with AS 1152.
- (n) *Steel straightedge*—a suitable size being about 300 mm long, 25 mm wide and 3 mm thick, preferably with a bevelled edge.
- (o) *Testing machine*—a compression testing machine complying with the requirements for Grade B of AS 2193, with the upper bearing block of the machine having a spherical seat. The capacity of the testing machine shall be sufficient to test the strongest test specimen (a minimum capacity of 50 kN is recommended).

The testing machine shall be power operated and capable of applying the load at a uniform rate of 60 ± 6 kN per minute or to travel at a speed of 1.0 ± 0.1 mm per minute whilst under load.

- (p) *Tray*—a metal mixing and quartering tray of adequate size.

5 SAMPLING

Samples shall be obtained from the field in accordance with AS 1289.1.2.1. Samples shall be taken at the point of use as soon as practicable after completion of mixing. The samples shall be cured and compacted in the field or immediately placed in an airtight container and transported to the laboratory for immediate processing. The time of the addition of the binder and the time of sampling shall be recorded.

Samples from the laboratory shall be taken from the mixing bowl or the curing container.

6 PREPARATION OF TEST PORTIONS

6.1 General

Two test portions shall be prepared for each unconfined compressive strength test.

6.2 Field samples

Test portions shall be prepared as follows:

- (a) Reduce the sample by quartering or riffing to provide at least 6000 g of material that would pass a 19.0 mm sieve. Screen on a 19.0 mm sieve and determine mass of materials passing and retained on the sieve. Determine the amount of material retained as a percentage of total (wet) mass. Discard material retained on the sieve.
- (b) Thoroughly mix all material passing the 19.0 mm sieve.
- (c) Obtain by quartering or riffing two test portions, each of about 3000 g mass.

6.3 Laboratory samples

Laboratory samples shall be prepared as follows:

- (a) *Unbound and self-cementing material*—screen the material over a 19.0 mm sieve and subdivide the material by quartering or riffing to obtain a test portion of about 3000 g.
- (b) *Bound material*—screen the material over a 19.0 mm sieve and prepare material in accordance with the customer's instructions to obtain test portions of about 3000 g passing the 19.0 mm sieve.

6.4 Curing prior to compaction

Test portions shall be cured in accordance with the requirements of the works specification. When no curing time is specified, samples containing GP Portland cement shall be cured for at least 2 h but no longer than 3 h after the addition of cement prior to compaction; samples containing lime shall be cured for 48 to 72 h prior to compaction. Samples containing bituminous binders may not require additional curing. For other binders the curing period regime shall be specified.

7 PREPARATION OF TEST SPECIMENS

7.1 General

For each test portion a test specimen shall be prepared. The method used will depend on the compaction required. The underlying layer shall be scarified prior to placement of the subsequent layer.

7.2 Compaction to a constant compactive effort

The procedure shall be as follows:

- (a) Clean the mould, collar and baseplate. Inspect and clean the rammer and ensure that it is free in the guide.
- (b) Determine the mass (m_1) of the mould plus baseplate, except that where the mould has the baseplate attached to the compaction block, determine the mass of the mould alone.
- (c) Assemble the mould, collar and baseplate and place the assembly on the rigid foundation.
- (d) Compact the specimen using one of the following procedures (the selection of procedure depends upon the degree of compaction required):
 - (i) *Compacting using standard compactive effort* Take one portion of material, mix it thoroughly and compact it into the mould in three layers, so that the compacted height of the material in the mould is 38 mm to 43 mm in the first layer, 77 mm to 82 mm in the second layer and 116 mm to 120 mm in the third layer. Discard specimens that do not meet these tolerances. Do not re-use material from a previously compacted specimen.

Compact each layer by 25 uniformly distributed blows of the rammer falling freely from a height of 300 mm. Use only sufficient material, which is representative of the portion, to meet the layer heights specified in this Item (i).

- (ii) *Compacting using modified compactive effort* Take one portion of material, mix it thoroughly and compact it into the mould in five layers, so that the compacted height of the material in the mould is 23 mm to 28 mm in the first layer, 47 mm to 52 mm in the second layer, 70 mm to 75 mm in the third layer, 93 mm to 98 mm in the fourth layer and 116 mm to 120 mm in the fifth layer. Discard specimens that do not meet these tolerances. Do not re-use material from a previously compacted specimen.

Compact each layer by 25 uniformly distributed blows of the rammer falling freely from a height of 450 mm. Use only sufficient material, which is representative of the portion, to meet the layer heights specified in this Item (ii).

NOTE: The method of compaction will influence the result obtained and therefore should be reported.

- (e) Determine the moisture content of the remaining material in the test portion in accordance with AS 1289.2.1.1.