

SECTION 290 - LIME AND/OR CEMENTITIOUS STABILISATION OF EARTHWORKS MATERIALS

~~##This section cross-references Sections 173, 175 and 204. These sections must be included in the specification.~~

290.01 DESCRIPTION

This section covers the requirements for lime and/or cementitious stabilisation of earthworks materials. The requirements relate to preparation of the formation to be stabilised, quality of lime and cementitious binders, spreading, mixing, and compaction of the stabilised earthworks material.

This section shall be read in conjunction with Section 204 - *Earthworks*, and includes the requirements for stabilisation of earthworks materials, that are in addition to or override the requirements of Section 204.

290.02 STANDARDS

Table 290.021 Design and Material Standards, Test Methods and Codes of Practice

Australian Standards	
AS 1289.3.3.1	<i>Methods of testing soils for engineering purposes Soil classification tests - Calculation of the plasticity index of a soil</i>
AS 1672.1	<i>Limes and limestones Part 1 Limes for building</i>
AS 2350.12	<i>Methods of testing portland, blended and masonry cements - Preparation of a standard mortar and moulding of specimens</i>
AS 3582.1	<i>Supplementary cementitious materials for use with portland and blended cement – Fly ash</i>
AS 3582.2	<i>Supplementary cementitious materials – Slag - Ground granulated blast-furnace</i>
AS 3972	<i>General Purpose and blended cements</i>
AS 4489.6.1	<i>Test methods for limes and limestones Lime index - Available lime</i>
AS 5101.4	<i>Methods for preparation and testing of stabilized materials - Unconfined compressive strength of compacted materials</i>
VicRoads Test Methods	
RC 301.04	<i>Lime Stabilised Earthworks Materials - Available Lime, Assigned CBR and Swell</i>
RC 316.00	<i>Density Ratio and Moisture Ratio - Lot Characteristics</i>
RC 324.01	<i>Calculation of Assigned CBR and Assigned Percent Swell</i>
RC 326.01	<i>Weighted Plasticity Index – PI x Percent passing 0.425 mm sieve</i>
VicRoads Codes of Practice	
RC 500.16	<i>Selection of Test Methods for Testing of Materials and Work</i>
RC 500.20	<i>Assignment of CBR and Percent Swell to Earthworks Fill and Pavement Materials</i>

Section 175 details the revision dates of the relevant references to Australian Standards (AS), VicRoads Test Methods and Codes of Practice referenced in this section.

290.03 DEFINITIONS

Available Lime

The amount of Calcium Oxide (CaO) or Calcium Hydroxide (Ca(OH)₂) contained in Quicklime or Hydrated Lime respectively.

Available Lime Index (ALI)

The Calcium Oxide or Calcium Hydroxide content of quicklime or hydrated lime respectively, expressed as a percentage of the total mass of lime determined in accordance with AS 4489.6.1.

Cement

A cementitious material that complies with AS 3972 for general purpose (GP) and blended (GB) cements.

Cementitious Binder

A cementitious material capable of being uniformly mixed into a material to bind the particles together to increase its strength. Cementitious binders includes cement, or a blend of fly ash (AS 3582.1), ground granulated blast furnace slag (AS 3582.2), hydrated lime (AS 1672.1), alkali activated slag or other pozzolanic material supplied in accordance with this specification.

Design Distribution Rate of Available Lime

The spread rate of pure Calcium Oxide or Calcium Hydroxide.

Fly Ash

A fine powder of pozzolanic material extracted from the flue emissions produced from the burning of black coal.

Lime

Lime is either Hydrated Lime (Calcium Hydroxide) or Quicklime (Calcium Oxide).

Hydrated Lime

Hydrated lime is a powdered form of lime consisting primarily of calcium hydroxide, also referred to as slaked lime.

Lime Spreading Rate

The required spread rate of lime determined from the Design Distribution Rate of Available Lime corrected for the ALI of the lime to be used.

Maximum Allowable Working Time for Cementitious Binder

The maximum allowable working time for a cementitious binder as determined in accordance with the relevant VicRoads Test Method or Code of Practice, applicable to earthworks material.

Pozzolan

A siliceous or aluminosiliceous material when finely ground can be mixed with lime or cement to form a cementitious material.

Quicklime

Quicklime is a fine granulated powder consisting primarily of Calcium Oxide that can be readily slaked by the application of water after it has been evenly spread to form Calcium Hydroxide.

Slag (Ground Granulated Blast Furnace Slag)

Ground Granulated Blast Furnace Slag (GGBFS) is a pozzolan produced by fine grinding of slag produced as a by-product from the smelting of iron ore.

Slaking

The addition of water to quicklime, with the purpose of fully hydrating the quicklime.

Stabilising Binder

Lime, cementitious binder or a blend of binders used for the stabilisation of earthworks.

Working Time

The time required to mix, fully compact and trim the stabilised layer after the addition of the stabilising binder.

290.04 CONFORMITY WITH DRAWINGS

Further to the requirements of Section 204 stabilised layers shall be finished to conform within the following limits to the levels, lines, grades, thicknesses and cross sections specified or shown on the drawings:

(a) Depth of Stabilisation

The depth of stabilised material shall not at any point be less than the depth specified in Clause 290.17(a) or (b).

(b) Alignment

Stabilised earthworks carried out in a boxed formation shall extend to the full width of the boxing. If there is no boxed formation, the edges of the stabilised material shall not be inside the specified offset from centreline or design line.

(c) Width

The width of the stabilised material shall not be less than the specified width.

290.05 MATERIALS

Materials supplied under the Contract shall comply with the following properties:

(a) Lime

Quicklime and hydrated lime shall meet the requirements of AS 1672.1.

All quicklime and hydrated lime supplied to the job shall be provided with delivery dockets showing an assigned ALI at the start of each production week. The assigned ALI shall be determined by averaging the six most recent test results for ALI. A test certificate for determination of the ALI shall be made available on request

Lime shall be stored in a moisture free environment and shall be re-tested for compliance with AS 1672.1 if stored for more than 14 days after receipt from the manufacturer.

(b) Cementitious Binders

(i) Cement

The Contractor shall nominate the type, brand and source of cement proposed. GP or GB cement complying with AS 3972 may be used.

(ii) Slag/Lime Blends

Slag and hydrated lime may be used in blended combination as a stabilising binder. The requirements for hydrated lime shall be as specified in Clause 290.05(a). Slag shall be Ground Granulated Blast Furnace Slag (GGBFS) meeting the requirements of AS 3582.2. The Contractor shall nominate the type, brand and source of the GGBFS to be used

Slag/lime shall be blended uniformly in the ratio of 85% slag to 15% hydrated lime unless laboratory testing indicates that superior strength of the stabilised mixture is achieved by using a different ratio. If the blend is to be varied, the proportion of lime shall not be less than 10%. The Contractor shall provide evidence that the blend ratio has been met for all material supplied to the job.

The slag/lime blend shall have a 7 day compressive strength of 10 MPa and 28 day compressive strength of 16 MPa. The test shall be the same test specified in AS 5101.4. The cement to water ratio shall be adjusted to match the consistency of mortar produced for the compressive strength test for GB cement in accordance with AS 2350.12.

(iii) Other Blends

Other cementitious blends nominated by the Contractor for use may be considered by the ~~Superintendent~~ Council.

(c) Water

Water added to the material shall be potable water.

290.06 SELECTION OF STABILISING BINDER

The use of cementitious binders in capping layer or verge material is not permitted.

Unless otherwise specified, the stabilising binder shall be selected in accordance with Table 290.061.

Table 290.061 Permitted Stabilising Binder

Particle Size	More than 25% Passing 0.075 mm			Less than 25% Passing 0.075 mm		
	Plasticity Index (PI) ¹ Weighted PI (WPI) ²	PI ≤ 10	10 < PI < 20	PI ≥ 20	PI ≤ 6 WPI ≤ 60	PI ≤ 10
Stabilising Binder Type						
Lime	Not Permitted	Permitted		Not Permitted		Permitted
Cementitious binders	Permitted	Not Permitted		Permitted		

Notes on Table 290.061

1 – PI is to be determined in accordance with AS 1289.3.3.1

2 – WPI is to be determined in accordance with RC 326.01

290.07 INVESTIGATION AND DETERMINATION OF STABILISING BINDER DESIGN SPREADING RATE**(a) General**

If stabilisation of earthwork material is proposed to provide Type A material, the requirements specified in Table 204.041 shall apply. If stabilisation of earthwork material is proposed to provide Type B material, the requirements specified in clause 204.04(c) shall apply.

The determination of the stabilising binder rate, Assigned CBR and Assigned Swell shall be in accordance with clauses 290.07(b), (c) and (d), as appropriate.

(b) Lime

If the Design Distribution Rate of Available Lime is not specified in clause 290.17(b), the Contractor shall carry out site investigation and perform laboratory testing to determine the Design Distribution Rate of Available Lime in accordance with RC 301.04. The Design Distribution Rate so determined shall satisfy all the requirements for the stabilised material as specified in clause 290.07(a) or clause 290.17(a) as appropriate to achieve the required CBR and Assigned Swell.

(c) Cementitious Binder

If the design distribution rate of the cementitious binder is not specified in clause 290.17(b), the Contractor shall carry out site investigation and perform laboratory testing to determine the Design Distribution Rate of the Cementitious Binder to meet the requirements of clause 290.07(a) or clause 290.17(a), as appropriate. The Assigned CBR and Assigned Swell shall be determined in accordance with RC 324.01. The design distribution rate of cementitious binder shall be the greater of 1.5% or that determined to achieve the required Assigned CBR and Assigned Swell.

(d) Lime and Cementitious Binder Stabilisation

Stabilisation of earthworks material with lime followed by stabilisation using a cementitious binder is allowed where the lime stabilised material has been shown to meet the requirements of Table 290.061 permitting the use of cementitious binder. If the design distribution rate of the cementitious binder is not specified in clause 290.17(b), the Contractor shall carry out site investigation and perform laboratory testing to determine the Design Distribution Rate of the Cementitious Binder to meet the requirements of clause 290.07(a) or clause 290.17(a) as appropriate. The Assigned CBR and Assigned Swell shall be determined in accordance with RC 324.01. The design distribution rate of cementitious binder shall be the greater of 1.5% or that determined to achieve the required Assigned CBR and Assigned Swell.

290.08 COMMENCEMENT OF WORK

- HP** The Contractor shall not commence work until all mix design details including the stabilising binder spreading rates have been presented to the ~~Superintendent~~ Council for review. If the Contractor is required to determine the Design Distribution Rate of the stabilised binder(s), evidence shall be produced to show that the material properties specified in clause 290.07(a) or clause 290.17(a) as appropriate have been met.

290.09 CONSTRUCTION PLANT

The Contractor shall provide and operate sufficient spreading, mixing, watering and compaction plant to complete the work in accordance with the requirements of this section.

(a) Spreader

A purpose built mechanical spreader capable of accurately regulating the discharge of the stabilising binder directly to the roadbed shall be used such that the Design Distribution Rate of the stabilising binder is uniformly met in accordance with the requirements of clause 290.13(a).

The spreader must have calibrated load cells and be capable of uniformly spreading the stabilising binder using a fixed bulk bin feeding a mechanical or hydraulic driven spreading rotor to varying widths.

(b) Mixing Machine

A purpose built mixing machine designed for in situ stabilisation of roadworks shall be used to pulverise and uniformly mix the earthworks formation material with water and the stabilising binder for the specified depth of stabilisation. The mixing machine must have a centrally mounted mixing chamber, a water system capable of varying the total flow rate and an ability to control individual water jets for variable materials or mixing overlaps. The stabilising machine shall be capable of mixing the stabilising binder uniformly throughout the layer within its enclosed mixing chamber.

Rotary hoes and other types of agricultural machinery, including skidsteer machines with attachments shall not be used. Mixing with a grader blade or tynes is not permitted.

After pulverisation and mixing, all stabilised material shall be capable of passing a 37.5 mm sieve, other than isolated hard rock particles up to a nominal size of 75 mm.

(c) Watering Plant

Watering plant or any purpose designed watering system incorporated within the mixing machine shall be capable of uniformly distributing sufficient water to hydrate quicklime and if required add more water to increase the moisture content to aid compaction of the stabilised material.

(d) Compaction Plant

Compaction plant shall be of such mass and configuration as to be capable of compacting the stabilised layer to the minimum density ratio throughout the entire depth of the stabilised layer.

290.10 CONSTRUCTION

(a) General

Construction includes the preparation of the earthworks formation, spreading of the stabilising binder, slaking of quicklime, mixing, compaction, trimming and curing of the stabilised material.

The construction methodology shall include provision for how the requirements of clause 290.04 will be achieved.

Unless otherwise specified, stabilisation work undertaken each day shall be completed across the full pavement width.

Stabilisation operations may continue during light rainfall if the moisture content of the in situ pavement material can be maintained below standard optimum moisture content.

If it is proposed to stabilise the earthworks material with both lime and cement, simultaneous mixing of the stabilising binders is not permitted. Each stabilising binder shall be mixed in accordance with the specified requirements. The lime stabilised material shall be rolled with a smooth drum or wheeled roller to protect it from adverse weather, prior to it being cementitiously stabilised. The requirements of Clause 290.10(h) shall also apply.

HP If Type GP is proposed, the Superintendent Council shall be first notified and evidence provided to show that the earthworks material can be mixed and compacted to the specified density within the Maximum Allowable Working Time for Type GP Cement.

(b) Pre-treatment of Earthworks

The material to be stabilised shall be pre-treated by scarifying or pulverising to the specified depth to provide an even surface capable of being trimmed to meet the requirements of clause 290.04. Any hard rock particles larger than 75 mm shall be removed from the scarified material.

(c) Spreading of Stabilising Binder

The spreading of the stabilising binder shall not be carried out at times when the binder could become air borne or dispersed in such a way as to become a nuisance or a hazard to persons, property or livestock.

If the required spreading rate for the stabilising binder exceeds 15 kg/m², it shall be spread in two equal spreading runs with material from the first spreader run being fully mixed into the material prior to the second spreading run being undertaken.

Immediately following the completion of spreading of the stabilising binder, the Contractor shall check and record the Average Spreading Rates and the Uniformity of Spread in accordance with clause 290.13.

(d) Spreading of Lime

Lime shall be spread uniformly over the prepared surface at the Lime Spreading Rate calculated using the appropriate formula (i) or (ii) below.

- (i) If hydrated lime has been used in the laboratory testing to determine the Design Distribution Rate of Available Lime and it is proposed to use quicklime at the job site, the Lime Spreading Rate shall be determined from:

$$\text{Lime Spreading Rate} = 0.76 \times \frac{\text{Design Distribution Rate of Available Lime}}{\text{ALI of Lime to be Used (\%)}}$$

- (ii) If the same type of lime (hydrated lime or quicklime) is to be used at the job site as has been used in the laboratory tests to determine the Design Distribution Rate of Available Lime, the Lime Spreading Rate shall be determined from:

$$\text{Lime Spreading Rate} = \frac{\text{Design Distribution Rate of Available Lime}}{\text{ALI of Lime to be Used (\%)}}$$

The minimum Design Content of Available Lime shall be 1.5% by mass as determined under RC 301.04. The 1.5% by mass minimum design content of Available Lime only applies when a design strength is being targeted and does not apply when lime stabilisation is being undertaken to only dry back material.

(e) Slaking of Quicklime

Quicklime shall be slaked with sufficient water to allow full hydration to take place. Full hydration will be deemed to have been achieved when all quicklime that has been spread has changed from a cream coloured granulate to a fine white powder and there is a cessation of rising vapours.

(f) Mixing of Lime Stabilised Material

If quicklime is used, mixing shall not commence until full hydration has been achieved.

All lime shall be mixed to the specified depth within six hours of spreading regardless of the number of spreading and mixing runs required. If lime stabilised material contains non-friable wet clay lumps with a nominal size in excess of 75 mm after the initial mixing run, the lime stabilised material shall be allowed to stand for up to 72 hours to allow sufficient time for clay lumps to dry out and react with the lime.

Once the lime stabilised material is friable it shall be remixed prior to compaction. Remixing shall proceed until all stabilised material other than isolated hard rock particles up to a nominal size of 75 mm, is capable of passing a 37.5 mm sieve and a minimum of at least 60% is capable of passing a 9.5 mm sieve when shaken without forcing material through the openings. The stabilised material shall be visually inspected for uniform mixing by excavating test holes for the full depth of the loose material at six random locations within each compaction test lot as defined in clause 290.14(a).

The number of mixing runs undertaken after the completion of the spreading of lime shall not be less than two

(g) Spreading and Mixing of Cementitious Stabilised Material

The cementitious binder shall be spread uniformly over the prepared surface at the Design Distribution Rate of the cementitious binder.

Mixing shall commence as soon as practical after spreading of the cementitious binder and shall continue until all the earthwork material and cementitious binder are uniformly blended throughout the full depth of the stabilised earthworks.

The moisture content of the earthworks material prior to addition of the cementitious binder shall be within the range 80% to 100% of the optimum moisture content. Additional water shall be added to hydrate the cementitious binder.

If it is proposed to stabilise the earthworks material with both lime and cement, simultaneous mixing of the stabilising binders is not permitted. Each stabilising binder shall be mixed in accordance with the specified requirements.

The number of mixing runs undertaken after the completion of the spreading of the cementitious binder shall not be less than two.

(h) Cementitious Stabilisation of Lime Stabilised Material

Cementitious stabilisation of a lime stabilised material is permitted to commence the next calendar day after the completion of the mixing of the lime into the earthworks material.

Prior to the addition of cementitious binder, the requirements of clause 290.10(b), (c), (d), (e) and (f) shall be met. Spreading and mixing of the cementitious stabilised material shall be undertaken in accordance with clause 290.10(g).

The number of mixing runs undertaken after the completion of the spreading of the cementitious binder shall not be less than two.

(i) Compaction

Compaction of the stabilised layer shall commence immediately after mixing, but only after the requirements of clause 209.10(f) or (g) or (h), as appropriate, have been met.

Compaction equipment shall work as close as practicable behind the mixer to maximise the time available for compaction. Compaction and trimming shall be carried out in a continuous operation.

All compaction shall be completed within the times specified in Table 290.101 after addition of the stabilising binder.

If necessary during compaction, the Contractor shall water the material to maintain the moisture content within 80% to 100% of the stabilised material's optimum moisture content.

Table 290.101 Maximum Allowable Working Time after Mixing for Various Stabilising Binders

Binder Type	Maximum Allowable Working Time (hours)	
	Construction between October and April	Construction between May and September
Lime		
Hydrated Lime and Quicklime	12	24
Cementitious		
Medium Setting Type GB Cements	3	5
Rapid Setting Type GP Cement	2	3

(j) Maximum Layer Thickness

The maximum compacted layer thickness for any stabilised material shall not exceed 250 mm, unless otherwise approved by the Superintendent Council.

(k) Trimming

The surface may be further trimmed before or during compaction to meet the requirements of clause 290.04(a) and (c).

On completion of initial rolling, the stabilised material shall be trimmed to the specified surface tolerances. Light applications of water may be applied during this operation to replace evaporated moisture and to assist in rapid achievement of a tightly knit surface.

All surface irregularities which do not conform to the requirements of clause 290.04 shall be rectified by the Contractor within the maximum working time for the stabilising binder used as specified in Table 290.101.

The material trimmed off shall be either cut to waste and if necessary, removed from site or, alternatively it may be transported to another location to be incorporated into a stabilised layer.

290.11 PRELIMINARY TRIAL

~~If specified in clause 290.17(c), the Contractor shall carry out a preliminary trial of the proposed stabilising operation.~~

~~The trial shall determine the:~~

- ~~(a) effectiveness of the construction plant~~
- ~~(b) number of passes of the stabilisation machine necessary to achieve uniform pulverisation and mixing~~
- ~~(c) field moisture content required to achieve the specified compaction requirements~~
- ~~(d) rolling routine required to meet the specified compaction requirements~~
- ~~(e) uniformity of mixing of six random test holes.~~

~~The trial section shall be located within the Works area. If there are multiple earthwork material types being stabilised and/or different stabilising binders, separate trials will be required for each combination of material and stabilising binder.~~

~~The length of each trial section shall be between 100 and 200 metres over the full width of the area proposed for stabilisation, or other length as approved by the Superintendent.~~

~~**HP** Stabilisation shall not proceed outside the trial sections until the Superintendent has reviewed all aspects of the work. If the Specification requirements are not met for the trial, the Superintendent may direct that another trial be undertaken or that the work be re-stabilised and presented for re-assessment.~~

290.12 TEST ROLLING

All stabilised material shall be test rolled in accordance with Section 173 of the Specification. Any unstable areas detected by test rolling shall be rectified by the Contractor.

If ~~the Superintendent~~ Council considers that a completed stabilised earthworks layer has been affected by rain or damaged in some way before a successive layer is placed, further test rolling shall be carried out by the Contractor on the layer immediately prior to being covered by a succeeding layer.

290.13 REQUIREMENTS FOR TESTING AND ACCEPTANCE OF STABILISING BINDER SPREADING RATE**(a) Mat or Tray System**

The average spreading rate of stabilising binder shall be ascertained by dividing the mass of the binder used by the area over which the binder has been spread. If the average spreading rate is less than specified, additional binder shall be spread over the surface to bring the average spreading rate up to at least the specified rate. The Contractor shall check the uniformity of the spreading of the binder at the frequency specified in Table 290.151.

The following procedure shall be used to determine the uniformity of the spreading rate:

- (i) place a minimum of three mats or trays with a plan area not less than 1 m² in total, in the path of the spreading vehicle at an equal spacing of not less than 25% of the length of the spreading run;
- (ii) divide the mass of binder deposited on each mat or tray by the plan area of the mat or tray;
- (iii) if the binder spreading rate so determined for any mat or tray is less than the specified rate by more than 10%, additional binder shall be spread over the part or all of the area over which the binder has been spread.

The Contractor shall check the uniformity of the spreading of lime at the frequency specified in Table 290.131 by placing a minimum of three mats or trays with a plan area not less than 1 m² in the path of the spreading vehicle at an equal spacing of not less than 25% of the length of the spreading run. The Lime Spreading Rate over each mat or tray shall be calculated by dividing the mass of lime deposited on each mat or tray by the plan area of the mat or tray. Where the Lime Spreading Rate so determined for any mat or tray is less than the specified rate by more than 10%, additional lime shall be spread over the part or all of the area over which the lime has been spread.

(b) Continuous Weighing System

The mass of the stabilising binder spread over the surface may be measured and recorded by a spreader fitted with a fully calibrated computerised electronic weigh scale system capable of continuously measuring and recording the mass of binder at intervals of not more than 100 m of forward travel. If requested by ~~the Superintendent~~ Council, the Contractor shall produce the print out of the actual binder spreading rate.

The Contractor shall have a current certificate of calibration for the computerised spreading equipment and shall produce evidence of the actual running spread rate when requested by ~~the Superintendent~~ Council.

290.14 REQUIREMENTS FOR ACCEPTANCE OF COMPACTION AND MATERIAL**(a) Lot Testing Requirements**

If Scale A or B compaction standard is specified in Table 290.171, compaction is to be accepted by density testing in lots of similar material and work. Unless otherwise specified, the maximum lot size shall be the area of work completed on the same day up to 4,000 m² provided that the whole of the lot is essentially a uniform material similar to material used for the relevant mix design applicable to the lot.

If the maximum binder working time requires a lot to be completed over multiple days, each daily sub-section shall be treated as a separate lot.

If the material is too variable to be able to assign a single maximum dry density for the lot, a separate reference density shall be determined for each test site.

~~If a compaction scale is not specified in Table 290.171, the Scale C compaction procedure shall be adopted.~~

The calculation of density ratio determined in accordance with RC 316.00 shall be based on Standard compactive effort of the laboratory prepared sample for reference density containing the design rate of the stabilising binder.

The work shall be assessed for compliance with ~~Scale A, B or C~~ requirements for testing and acceptance of compaction as specified in clauses 290.14(b) or (c).

For work to be tested for compliance with Scale A or Scale B requirements, the number of randomly selected test sites per lot shall be six, unless the option of clause 173.04(d) for testing of small areas is applicable.

Sampling for CBR testing shall be undertaken after field compaction, including samples for grading and PI.

(b) Lime Stabilised Material

For stabilised earthworks incorporating lime only, density testing shall be undertaken within 24 hours after completion of compaction. Unless otherwise directed by ~~the Superintendent~~ Council, remoulding of compacted specimens for determination of the laboratory reference density at each test site shall be completed within 24 hours after extraction of samples from the stabilised material.

The calculation of the characteristic or mean density ratio shall be based on Standard compactive effort. Lime stabilised material shall be compacted to comply with the requirements of Table 290.141.

For lime stabilised material, if the characteristic density ratio is not achieved, the material shall be immediately reworked and/or re compacted as specified in clause 290.10 to meet specification requirements.

Table 290.141 Lime Stabilised Material Compaction Requirements

Stabilised Material Type	Scale A	Scale B	Scale C
	Minimum Value of Characteristic Density Ratio (%)		
Lime Stabilised Material	99.0	98.0	Acceptance of work will be based upon on compaction plant to be used, compaction routine and a density monitoring procedure using a nuclear gauge (with three tests per lot to have a minimum mean value of 98.0%) and proof rolling as specified or agreed between the Superintendent and the Contractor.

(c) Cementitious Stabilised Material

(i) General

For stabilised earthworks incorporating any cementitious binders, density testing shall be undertaken within two hours after completion of compaction. The remoulding of extracted samples of stabilised material at each test site shall be completed within 12 hours after extraction from the stabilised layer.

The calculation of the characteristic or mean density ratio shall be based on Standard compactive effort. Cementitiously stabilised material shall be compacted to comply with the requirements of Table 290.142.

For cementitiously stabilised material, if the characteristic density ratio is not achieved, the Contractor shall submit a proposal to rectify the works, to the satisfaction of ~~the Superintendent~~ Council.

Table 290.142 Cementitious Stabilised Material Compaction Requirements

Stabilised Material Type	Scale A	Scale B	Scale C
	Minimum Value of Characteristic Density Ratio (%)		
Cementitious Stabilised Material	97.0	95.0	Acceptance of work will be based upon on compaction plant to be used, compaction routine and a density monitoring procedure using a nuclear gauge (with three tests per lot to have a minimum mean value of 95.0%) and proof rolling as specified or agreed between the Superintendent and the Contractor.

(ii) Determination of the Density Ratio

The determination of the reference density for the test site shall be within 24 hours of the time of addition of the cementitious binder and shall be in accordance with RC 316.00, utilising the appropriate Density Decay Correction Factors from (A) or (B) below.

The following procedure shall be used to determine the Density Ratio for each test site:

1. measure field density on completion of compaction
2. extract samples and transport to an offsite laboratory
3. determine the reference density for the laboratory compacted samples as soon as practicable but not exceeding 24 hours after addition of cementitious binder
4. calculate a density ratio at time t (DR_t) based on the results of items 1 and 3
5. determine the test site Density Ratio (DR) from: -

$$DR = DR_t \times DDCF$$

Where:

DR_t = Density Ratio calculated using the reference density determined at time (t)

DDCF = Density Decay Correction Factor determined from (A) or (B) below, as appropriate

- (A) For individual jobs using cementitious stabilisation of more than 20,000 m² where Type A material properties are required, or 50,000 m² where Type B material properties are required, the Contractor shall determine and apply a job specific DDCF determined in accordance with the relevant Test Method specified in RC 500.16.
- (B) For individual jobs using cementitious stabilisation of less area than (A) above, the Contractor shall select and apply the appropriate Density Decay Correction Factor from Table 290.143 corresponding to time (t), the binder type and the time of year that construction is being undertaken.

Table 290.143 Density Decay Correction Factors

Time (t) from Addition of Binder to Completion of Laboratory Compaction (hours)	Cementitious Binder (construction between October and April)		Cementitious Binder (construction between May and September)	
	Medium Setting	Rapid Setting	Medium Setting	Rapid Setting
1 to 2	1	1	1	1
2 to 4	1	0.994	1	1
4 to 6	0.982	0.987	1	0.988
6 to 10	0.954	0.964	0.969	0.967
10 to 18	0.932	0.946	0.963	0.952
18 to 24	0.910	0.931	0.957	0.938

(d) Material CBR Requirements

The initial lot of the stabilised material shall be tested to determine the Assigned CBR in accordance with RC 500.20. Unless otherwise approved by the Superintendent Council, sampling for CBR testing shall be undertaken after field compaction of the initial lot.

290.15 MINIMUM TESTING FREQUENCY

(a) General

The Contractor shall carry out testing at a frequency which is sufficient to ensure that the materials and work supplied under the Contract complies with the specified requirements but which is not less than that shown in Table 290.151.

(b) Frequency of Density Testing for Assessment of Compaction

The Contractor shall initially test every lot for acceptance of compaction in accordance with the requirements of the Specification. ~~Density testing of every lot shall continue until three consecutive lots of like material or work have achieved the specified standard when tested for the first time. The Contractor shall reduce the frequency of density testing to the minimum testing requirements specified after satisfying the above requirement.~~

~~If the Contractor has satisfied the above requirement and is density testing lots at the minimum test frequency and any lot fails to achieve the specified standard, the Contractor shall test all subsequent lots until three consecutive lots of like material or work have achieved the specified standard, at which time the frequency of density testing shall again be reduced to the minimum frequency.~~

For the purposes of this sub-clause, acceptance of compaction for small areas as defined in Section 173 will not be regarded as satisfying the initial testing requirements stated above.

Table 290.151 Frequency of Testing

Test	Clause	Minimum Frequency of Testing
Available Lime / Available Lime Index for Lime	290.05(a)	One test per production day at the point of manufacture.
Uniformity of Mixing	290.11(e)	For each compaction lot – visual inspection of six random test holes excavated for the full depth of the loose material after mixing of the binder prior to commencement of compaction.
Uniformity of Spreading Rate	290.13(a)	A mat or tray test (minimum of three mats or trays as specified in Clause 290.13(a) for each separate continuous spreading run except where calibrated load cell computerised spreading devices are fitted with a system to continuously monitor the binder spreading rate every 100 m.
Average spreading rate for stabilising binder	290.13(b)	Each continuous spreader run with no breaks or pauses in spreading.
Characteristic or Mean Density Ratio	290.14(b) and (c)	Every second compaction lot subject to the qualifying period as defined in Clause 290.14(b) or (c), as appropriate.
CBR of stabilised material (Sampled after stabilising binder has been added then re-compacted in the laboratory within working times specified in Clause 290.10(i))	290.14(d)	Every second compaction lot or a minimum of one per 8,000 m ² of stabilised earthworks. First lot to set assigned value, needs 6 tests.

290.16 CURING AND PROTECTION OF COMPACTED LAYERS

The surface of the compacted layer shall be kept continually moist, and free from contamination until the succeeding layer is placed.

*** If the stabilised material overlies an expansive material with a percentage swell exceeding 2.5%, the stabilised material shall be maintained at a minimum characteristic moisture ratio of ##:90%.

290.17 SCHEDULE OF DETAILS

REFER TO DRAWINGS

*** ~~(a) Job Details and Design Requirements ##(strikethrough this clause if the design distribution rates of available lime and design spreading rate for cementitious binder if applicable are to be specified in Clause 290.17(b)):~~

~~— Job details and design requirements are shown in Table 290.171.~~

Table 290.171 Job Details (Contractor Design) ##(delete all # symbols. Limit after # symbol may be changed or deleted if not required):

Road	Location		Minimum CBR Strength	Maximum Swell %	Maximum Permeability m/sec	Minimum Depth of Stabilisation (mm)	Compaction Assessment (Scale A, B or C)
	From	To					
##:	##:	##:	##:	##:1.5%	##:5 x 10 ⁻⁹	##:	##:

*** ~~(b) Job Details and Design Distribution Rates ##(strikethrough this clause if the contractor is to determine the design distribution rate of available lime or cement or cementitious binder, as applicable, from the job details and design requirements specified in Clause 290.17(a) above):~~

~~— Job details and Design Distribution Rates of Available Lime are shown in Table 290.172.~~

Table 290.172 Design Distribution Rates of Stabilising Binder (VicRoads Design) ##(insert values as appropriate and delete all # symbols):

Road	Location		Design Distribution Rate of Available Stabilising Binder (kg/m ²)	Minimum Depth of Stabilisation (mm)	Compaction Assessment (Scale A, B or C)
	From	To			
##:	##:	##:	##: Binder Type to be Nominated*	##:	##:

* For lime, this figure is to be used to determine the Lime Spreading Rate in the formula given in Clause 290.10(d) once the Available Lime Index of the lime to be used on the job is known.

— In the paragraph below, strikethrough inapplicable word(s)

— In the table, nominated binder type as required:

*** ~~(c) A preliminary trial ##is: is not required.~~