SECTION N

LIME STABILISED SUBGRADE

INDEX TO CLAUSES

SECTION N

LIME STABILISED SUBGRADE

N.1 DESCRIPTION

This section covers the requirements for materials and construction for lime stabilised subgrade. The requirements relate to preparation of soil, quality of lime, spreading and mixing of lime, and compaction of the stabilised layer.

N.2 DEFINITIONS

Quicklime	Quicklime is a granular form of lime consisting primarily of calcium oxide and which can be readily slaked.
Hydrated lime	Hydrated lime is a powdered form of lime consisting primarily of calcium hydroxide.
Equivalent calcium oxide content	Equivalent calcium oxide content (E.C.O.C) is the amount of calcium oxide, expressed as a percentage by mass, which: (a) in quicklime produces calcium hydroxide after slaking; (b) in hydrated lime is chemically proportional to the amount of calcium hydroxide available after slaking.

N.3 CONFORMITY WITH DRAWINGS

Lime 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) **Level**

The level of the top of the lime stabilised layer shall not differ from the specified level by more than 20mm.

(b) **Thickness**

The thickness of the lime stabilised layer at any point shall not be less than the thickness specified in Clause N.10 by more than 15 mm. The average thickness of the layer as determined from measurements over any 100 m on any lane shall be not less than the specified thickness.

N.3 CONFORMITY WITH DRAWINGS (cont'd)

(c) **Alignment**

Where the lime stabilised layer is placed against a boxing edge, the layer shall abut that edge. Where there is no edging, the edges of the lime stabilised layer shall be not deviate by more than 50mm from the designed offset from centre line or design line.

(d) **Width**

Other than between boxing edges, the width of the lime stabilised layer shall be not less than that specified or shown on the drawings.

(e) **Shape**

No point on the surface of the lime stabilised layer shall lie more than 15 mm below a 3 m straight edge laid in any direction, except across a crown.

N.4 MATERIALS

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

(a) **Quicklime**

The equivalent calcium oxide content (E.C.O.C) of quicklime shall be not less than 60%.

The residue of quicklime after slaking shall not exceed 30%.

At the time of spreading, quicklime shall comply with the grading requirements specified in Table N.4.1.

Table N.4.1

AS Sieve Size	Test Value (% passing)
9.5	100
4.75	95 - 100
2.36	85 - 100

N.4 MATERIALS (cont'd)

(b) **Hydrated Lime**

The equivalent calcium oxide content of hydrated lime shall be not less than 60%.

Bulk hydrated lime shall be dry and shall have been produced not more than 14 days before delivery.

At the time of spreading, hydrated lime shall comply with the grading requirements specified in Table N.4.2.

Table N.4.2

As Sieve Size (mm)	Test Value (% passing)
4.75 0.600 0.075	100 95 -100 85 - 100

Prior to procurement, the Contractor shall confirm to the Superintendent the source from which lime will be obtained.

(c) **Water**

Water shall be clear and substantially free from detrimental impurities such as oils, salts, acids, alkalis and vegetable substances.

N.5 CONSTRUCTION

(a) General

Construction includes the preparation of soil, spreading of lime, slaking of quicklime, mixing of lime and soil, and compaction, trimming and curing of stabilised soil

(b) Preparation of Soil

The soil to be stabilised shall be scarified to a depth equal to the specified thickness of the stabilised layer.

Any stones larger than 75mm shall be removed from the scarified soil and the scarified soil shall be compacted sufficiently to provide a reasonably even surface.

Rotary hoes and other agricultural type machinery shall not be used.

(c) Spreading of Lime

Spreading shall not be carried out during windy periods if lime could be dispersed or become a nuisance or a hazard to persons, property or livestock.

Lime shall be spread uniformly over the prepared surface at a rate determined as follows:

$$\text{Spreading rate} = \frac{\text{Specified distribution rate} \times 100}{\text{Equivalent calcium oxide content}}$$

The specified distribution rate is that rate specified in Clause N.10.

The Contractor shall check and record the uniformity of spreading of lime by placing mats with a plan area not less than 1 m^2 in the path of the spreading vehicle and dividing the mass of lime deposited on each mat by the plan area of the mat, or by other approved method.

Immediately following completion of spreading of lime, the Contractor shall check and record the average spread rate of lime by dividing the mass of lime spread by the area over which lime has been spread.

HP Slaking of quicklime or mixing of hydrated lime shall not commence without review by the Superintendent.

N.5 CONSTRUCTION (cont'd)

(d) **Slaking of Quicklime**

Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking.

(e) **Mixing**

Where quicklime is used, mixing shall not commence until slaking is complete.

All lime spread shall be mixed into the soil to a depth equal to the specified thickness of the stabilised layer within 6 hours of spreading. Mixing shall proceed until all material other than stones can pass a 37.5 mm AS sieve and at least 60% of such material can pass a 9.5 mm AS sieve and the lime is uniformly mixed throughout the soil. Rotary hoes and other agricultural type machinery shall not be used.

HP Where the required degree of breakdown of the soil is not achieved on the day of commencement of mixing, the Contractor shall notify the Superintendent and any action to be taken shall be submitted to the Superintendent for review.

The moisture content shall be adjusted as necessary during the mixing process to maintain the moisture content within the range 85% to 115% of the Standard optimum moisture content as determined by test using Standard compactive effort for the fraction of the stabilised material that passes the 37.5 mm AS Sieve.

(f) **Compaction**

Compaction shall be completed within 48 hours of the addition of lime.

(g) **Trimming**

The finished surface shall not be trimmed after completion of compaction.

(h) **Treatment of High or Low Areas**

HP Where on completion of compaction the level of any area differs by more than 20 mm from the specified level, the Contractor shall notify the Superintendent and, any action to be taken shall be submitted to the Superintendent for review.

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N.6 TEST ROLLING

The stabilised layer shall be compacted to withstand test rolling and shall be test rolled in accordance with the procedure below.

(a) **General**

HP The Contractor shall submit to the Superintendent for review a test rolling procedure to be used where specified or directed. The procedure submitted by the Contractor shall include details of when test rolling will be undertaken, the method of preparing an area for test rolling and the extent of test rolling.

Plant which is nominated for use in test rolling procedures shall comply with the following requirements:

(i) Static smooth steel wheeled rollers shall have a mass of not less than 12 tonnes and a load intensity under either the front or rear wheels of not less than 6 tonnes per metre width of wheel.

(ii) Pneumatic tyred plant shall have a ground contact pressure under either the front or rear wheels of not less than 450 kPa per tyre. The area over which this ground contact pressure shall be applied shall not be less than 0.035 m^2 per tyre.

(iii) Water tanker with a load capacity of 12,000 litres.

(b) **Testing**

HP Test Rolling shall be undertaken in accordance with the accepted procedure in the presence of the Superintending Officer.

(c) Compliance

Compliance with the test rolling requirements shall be when an area withstands test rolling without visible deformation or springing.

If required by the Superintendent, further test rolling shall be carried out by the Contractor on the layer prior to being covered by the succeeding layer. No additional payment will be made for any requirement to carry out such further test rolling.

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N.7 REQUIREMENTS FOR ACCEPTANCE OF COMPACTION

(a) **General**

Density testing shall be carried out not less than 48 hours, and not more than 72 hours, after the addition of lime.

The work shall be assessed for compliance with Scale A, Scale B or Scale C requirements for lot acceptance of compaction as specified in Clause N.7 and as provided in Clauses N.7 (b), (c) and (d). The calculation of density ratio shall be based on Standard compactive effort.

A lot shall consist of a single layer of work (see Clause N8(c)).

For work to be tested for compliance with Scale A or Scale B requirements, the number of tests per lot shall be six.

For work to be tested for compliance with Scale C requirements, the number of tests per lot shall be three.

(b) **Scale A Requirements for Lot Acceptance of Compaction**

The work represented by the lot will be accepted as far as compaction is concerned if the characteristic value of density ratio of the lot is not less than 99.0%.

If the characteristic value of density ratio of the lot is less than 99.0%, but greater than or equal to 94.0%, the work represented by the lot may be accepted by the Superintendent as far as compaction is concerned but payment for the whole of such work will be made at a rate calculated using the formula:

$P = 4 R_c - 296$

in which R_c is the characteristic value of density ratio of the lot and P is the rate of payment expressed as a percentage of the relevant scheduled rate for construction of lime stabilised layer including supply of lime provided the value of P shall not exceed 100.

Where the Contract is a lump sum contract the relevant rate will be that shown in the schedule for variation purposes.

N.7 REQUIREMENTS FOR ACCEPTANCE OF COMPACTION (cont'd)

(c) Scale B requirements for lot acceptance of compaction

The work represented by the lot will be accepted as far as compaction is concerned if the characteristic value of density ratio of the lot is not less than 98.0%.

If the characteristic value of density ratio of the lot is less than 98.0%, but greater than or equal to 93.0%, the work represented by the lot may be accepted by the Superintendent as far as compaction is concerned but payment for the whole of such work will be made at a rate calculated using the formula:

$P = 4 R_c - 292$

in which R_c is the characteristic value of density ratio of the lot and P is the rate of payment expressed as a percentage of the relevant scheduled rate for construction of lime stabilised layer including supply of lime provided the value of P shall not exceed 100.

Where the contract is a lump sum contract the relevant rate will be that shown in the schedule for variation purposes.

(d) Scale C requirements for Lot Acceptance of Compaction

The work represented by the lot will be accepted as far as compaction is concerned if the mean of the individual density ratio test values of the lot is not less than 98.0%.

If the mean of the individual density ratio test values for the lot is less than 98.0% but greater than or equal to 93.0%, the work represented by the lot may be accepted by the Superintendent as far as compaction is concerned but payment for the whole of such work will be made at a rate calculated using the formula:

$P = 4 R_m - 292$

in which R_m is the mean of the individual density ratio test values for the lot and P is the rate of payment expressed as a percentage of the relevant scheduled rate for construction of lime stabilised layer including supply of lime provided the value of P shall not exceed 100.

Where the Contract is a Lump Sum Contract the relevant rate will be that shown in the schedule for variation purposes.

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N.8 MINIMUM TESTING REQUIREMENTS

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 below:

(a) **Lime Properties (Clause N.4)**

Initially before work commences, one test for each property and thereafter at the following minimum frequency:

Equivalent Calcium Oxide Content:	1 test for each day of work.
Grading:	1 test per 200 tonnes of lime supplied.
Slaked residue of quicklime:	1 test per 200 tonnes of lime supplied.

(b) **Lime content (Clause N.5 (c))**

Uniformity of spreading:	3 tests per each separate area of work.
Average spread rate:	Each separate area of work.

(c) **Compaction Testing**

Acceptable lot size in a single layer of work:	5000 m^2 or one day's production whichever is the lesser.
Lots to be tested:	100% minimum

Compaction testing of lime and/or lime/cement stabilised layers shall be carried out as follows:-

(i) Within 24 hours of mixing in the case of any layer with cement added (including lime and cement) and between 24 hours and 72 hours in the case of any layer with lime only added, carry out field density determination in accordance with the appropriate method as outlined in AS.1289.

N.8 MINIMUM TESTING REQUIREMENTS (cont'd)

(ii) At each field density location obtain a sample of sufficient size to determine the density ratio and moisture ratio following AS.1289, 5.7.1. Laboratory testing must be completed within the time limits given in (i) above.

The above method does not apply to cement treated crushed roc. Density ratio of plant mixed cement treated crushed rock shall be determined in accordance with AS.1289, 5.8.1 and AS.1289, 5.4.2.

For earthworks and pavement construction any lot which has a surface area less than 500 m^2 shall be treated as a small area. When testing a small area as a lot and where test requirements are based on characteristic value of density ratio, acceptance of the lot shall be based on the mean value of 3 individual tests. In this case the lot will be accepted as far as compaction is concerned if the mean value of the individual tests exceeds by 2.0% or more the appropriate compaction scale requirement for the characteristic value of density ratio for six tests per lot. The compaction scale requirements for re-rolling shall also be increased by 2.0% accordingly.

N.9 CURING AND PROTECTION OF COMPACTED LAYERS

The surface of the compacted layer shall be kept moist, in good order and condition and free from contamination until the succeeding layer is placed. Construction or other traffic shall not use a compacted layer where damage to the surface may occur. Placing and compacting of any subsequent layer under the Contract shall be carried out within 48 hours of density testing subject to the stabilised layer complying with all other specified requirements.

HP If placing and compacting of any subsequent layer under the Contract is not carried out within 48 hours of density testing, the Contractor shall notify the Superintendent and any action to be taken shall be submitted to the Superintendent for review.

N.10 SCHEDULE OF DETAILS - REFER TO ADDENDUM