# STABILISATION AND MODIFICATION

DIPL Roadworks Master – July 2023

## Standards and Publications

Conform to the following Standards and Publications unless specified otherwise:

**AUSTRALIAN STANDARDS**

|  |  |
| --- | --- |
| **Table – Australian Standards** | |
| Use Standards, and their amendments, current as at the date for the close of tenders except where different editions and/or amendments are required by statutory authorities, including, but not limited to, NATA and the National Construction Code including the Building Code of Australia. | |
| **Designation** | **Title** |
| AS 1141 | Methods for sampling and testing aggregates. |
| AS 1160 | Bitumen emulsions for construction and maintenance of pavements. |
| AS 1289(series) | Method of testing soils for engineering purposes. |
| AS 1478.1 | Chemical admixtures for concrete, mortar and grout – Admixtures for concrete. |
| AS 1672.1 | Limes and lime stones - Limes for building. |
| AS 2157 | Cutback bitumen. |
| AS 3550.4 | Waters, Part 4: Determination of solids – Gravimetric method (Withdrawn, available) |
| AS 3972 | General purpose and blended cements. |

**NT TEST METHODS AND MANUALS**

NTMTM NT Materials Testing Manual accessible via <https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/materials-testing-manual> .

NTTM NT Test Methods

## Definitions

| **Table - Definitions - Stabilisation and Modification** | |
| --- | --- |
| **TERM** | **DEFINITION** |
| **Bound Materials** | Materials including natural gravels, crushed materials or insitu materials stabilised with an introduced binder, such that substantive tensile strength is imparted to the treated material. |
| **Optimum Moisture Content** | The amount of water by mass, expressed as a percentage of the dry mass of the material, at which maximum modified dry density is obtained with the stabiliser added. |
| **Modification** | A lighter form of stabilisation that treats an unbound material with small quantities of binder or granular material, to improve its unbound properties. |
| **Stabilisation** | Process used to enhance material properties for pavement design purposes to overcome deficiencies in available materials, by incorporation of a binder or granular material (or both). |

## Materials

### Binders

#### Lime

Use Calcium Hydroxide (hydrated lime/lime slurry), as Ca(OH)2 .

Obtain Superintendent’s approval for use of Calcium Oxide (quicklime), as CaO.

Do not use dolomite limes (CaMg(CO3)2). Do not use agricultural lime (Calcium Carbonate (CaCO3)).

Conform to AS 1672.1

[Other limes such as dolomite limes (Calcium/Magnesium Oxide) are not as effective. Do not use agricultural lime (Calcium Carbonate)]

#### Cement

Use type GP (general purpose Portland cement) or GB (general purpose blended cement).

Supply and store in a manner that protects against the weather and moisture.

Conform to AS 3972.

#### Bitumen

Conform to bitumen classes in SPRAY SEALING clauses for straight run and emulsion grades.

### Granular Modification

For pavement layers, final blended material to conform to requirements of PAVEMENTS AND SHOULDERS clauses in the finished condition.

For subgrade and fill layers, final blended material conform to requirements of EARTHWORKS clauses, in the finished condition.

### Additives

Obtain Superintendent’s approval for additive use.

Follow manufacturer's recommendations when using retarders and water reducing additives.

### Water

Ensure water is clean and free from oil, alkali, organic matter and other deleterious substances, and that it conforms to:

* a total soluble salts content of less than 3,000 mg/litre (total dissolved salts), and
* 1% maximum by mass of undissolved solids, in accordance with AS 3550.4 (withdrawn, available)

[The maximum salt content may need to be amended in Alice Springs and Tennant Creek. Refer to the Regional Project Officer]

## In Situ Stabilisation and MODIFICATION

### Preliminary Field Trial

[Delete preliminary trial for small projects – less than 1000m2 of treated area.]

Locate trial section within the works area.

Carry out a preliminary trial of the proposed operation to determine:

* effectiveness of mechanical plant;
* passes necessary to achieve the specified mixing;
* optimum curing time between preliminary and final mixing (lime binder only); and
* field moisture content and plant pattern to achieve final compaction.
* Carry out all necessary process control testing for this purpose.

Conform to Dry Density Ratios specified in the ***Table - Dry Density Ratios For Conformance*** in the CONFORMANCE TESTING Section.

### Preparation of Layer

Scarify existing pavement sections and new material, where necessary, full depth before spreading binder or granular modifier.

Tyne the surface lightly when quicklime is used.

Compact lightly to reveal irregularities in the spread material and to permit the stabilising equipment to traverse the area without excessive displacement of the surface.

Shape and trim the surface to the alignment, levels and cross‑sections necessary to produce the final levels and compacted thickness.

### Commencement and Continuity of Work

Complete full width stabilisation/modification in one day.

Cease stabilising during the following conditions:

* Wet weather or if rain is likely to fall.
* Windy periods which could cause loss of binder, or dust nuisance.

### Binder Spreading

[Amend for small jobs where bag spotting is necessary]

#### Binder Field Application Rates – Hold Point

The Contractor is responsible for determining the binder field application rate.

Use PROCESS CONTROL TESTING, in accordance with NTTM 204.7 (with project field samples, source binder and field water) to determine field application rate, for layer specified, to achieve the following 28 day strength, as applicable in the RFT:

|  |  |
| --- | --- |
| **Table – Binder Rate Design Criteria** | |
| **Layer Treatment** | **Laboratory Test Parameters** |
| Cement Stabilised Layer (Bound) | UCS between 1.5 and 2.0MPa |
| Cement Modified Layer | UCS between 0.7 and 1.5MPa |
| Lime Modified Layer | Lime demand test to determine quantity to reduce PI and increase CBR to limits in PAVEMENTS AND SHOULDERS for natural gravel. |

**Hold Point** - Determine field application rate for spreading based on laboratory testing of materials. Obtain the Superintendent's approval of the field application rate for each source material for the project.

#### Spread Rates for Tender Purposes

Adopt the following binder spread rates for tender purposes (based on a 200mm thick layer):

Cement Stabilisation: 10 kg/sq.m.

Cement Modification: 5 kg/sq.m.

Hydrated Lime Modification: 12 kg/sq.m.

[Generally for:

Cement: 2 to 8 kg/sq.m - (if not known - default for tender 6 kg/sq.m)

Hydrated Lime: 2 to 14 kg/sq.m - (if not known - default for tender 8 kg/sq.m)]

#### Spreading Requirements

Calibrate mechanical spreader and check spread rate prior to commencement.

Spreading must be visually uniform throughout each spreader run.

Obtain approval from the Superintendent for bag spotting and spreading.

QUICKLIME

Water the spread material sufficiently to allow full slaking.

Avoid overwatering and avoid underwatering.

LIME SLURRY

Initial mixing in separate paddle mixer or similar.

Use mechanical sprayer with agitation to maintain a lime/water ratio within ±10% of initial ratio.

Lime/water ratio to be [enter information].

[Insert rate. Lime/water ratio between 1:2 and 1:0.8 (by mass) equivalent to 1 tonne of hydrated lime mixed with 2,000 and 800 litres of water respectively]

### Binder Mixing

Use plant capable of:

[For small works allow the use of rotary hoes or graders]

* mixing the binder with the nominated layer of material uniformly over the full depth to be treated; and
* adding water uniformly to the materials while mixing with application rate between 0 to 10% (by mass) of the material being mixed.

Resultant mix to be uniform in colour and free of lenses, pockets or clumps of binder.

Prevent segregation.

Pulverise clayey material until at least 90% passes 19 mm sieve.

Add water to the materials during mixing to achieve a moisture content suitable for compaction.

#### Cement Treated Layers

Commence compaction and finishing immediately following satisfactory mixing.

#### Lime Treated Layers

Shape the treated layer to the approximate cross-section after satisfactory mixing, and lightly compact.

Cure for a period of 24 to 72 hours.

Commence final mixing.

Add water during mixing to achieve moisture content suitable for compaction.

Resultant mix to be uniform in colour and free of lenses, pockets or clumps of lime.

### Granular Modification – Hold Point

The Contractor is responsible for determining the blending ratios of materials to achieve the requirements of the PAVEMENT AND SHOULDERS clauses, in the finished condition.

Use PROCESS CONTROL TESTING.

**Hold Point** - Determine blending ratios based on laboratory testing of materials. Obtain the Superintendent's approval of determined blending ratio.

### Compaction

Compact parallel to the centre line of the pavement and for the full depth of the treated layer.

Commence compaction at the lower edge of the pavement and work progressively towards the crown or the higher edge.

Allow for progressive and uniform overlap between passes.

Wet the surface lightly after compaction to reduce moisture loss and lay the dust when necessary.

CEMENT STABILISATION

Complete the mixing, compacting and finishing within two hours of adding binder and water, or within working time limits, whichever is the lesser.

### Finishing

Final surface shall be smooth, dense, closely knit, free from compaction planes and cracks and finished to the tolerances specified.

Filling or addition of material to the surface of the pavement to meet tolerance requirements will not be permitted.

Maintain the surface material at not less than its specified optimum moisture content during all finishing operations.

Reconstruct non‑complying areas at no cost to the Principal.

### Construction Joints

LONGITUDINAL JOINTS

Minimise longitudinal joints by stabilising the full width of traffic lanes or wider as one continuous operation.

Joints to be straight or follow road curvature as appropriate.

TRANSVERSE JOINTS

Form joints following any break in excess of two hours in the continuity of the stabilisation operations.

Cut the end of the material to a plane face at an angle not exceeding 45 degrees from the vertical.

Check the surface adjacent to the joint with a straight edge prior to recommencement and further cut back the joint as necessary to achieve surface tolerance.

### Curing of Cement Treated Layers

For cement treated layers (stabilised or modified), cure using either of the following methods:

* Keep the finished surface damp (without leaching) until further construction or other curing operations are carried out.
* Alternatively cure by applying a bitumen emulsion or a bitumen primer as specified.

[Ensure that bitumen emulsion and cutback bitumen are specified]

For bituminous curing, apply the bituminous curing membrane as soon as possible after mixing and compaction but no later than 24 hours after relative compaction results are available.

Use:

* Bitumen emulsion ARS Grade 320, or
* Cut‑back bitumen Class AMC 2 or Class AMC 3.

Application rate for bitumen emulsions to be 0.3 to 0.45 litres per square metre.

Maintain clear of vehicular traffic for four days.

## Plant Mix Stabilisation

### Binder Content – Hold Point

Adopt a cement content of [enter information]% for tender purposes.

[Insert a percentage]

**Hold point** - Assess the cement content based upon test results of materials to be stabilised. Obtain the Superintendent's approval for the cement content.

### Preliminary Trial

[Delete preliminary trial for small projects – less than 1000m2 of treated area]

Locate trial section within the works area.

Carry out a preliminary trial of the proposed operation to determine:

* effectiveness of mechanical plant; and
* field moisture content and plant pattern to achieve final compaction.

Test stabilised material for conformance to the ***Table - Dry Density Ratios for Conformance*** in the CONFORMANCE TESTING Section.

### Commencement and Continuity of Work

Complete full width stabilisation of pavement in one day.

Do not stabilise during wet weather or if rain is likely to fall.

### Care of Existing Surface

Avoid damage to existing surface on which the mix is placed.

Repair any damage.

### Mixing

Mixing plant to be capable of maintaining the mix proportions.

Add cement and water to material to be stabilised and mix for a minimum period of 30 seconds.

Material to be uniform and without segregation.

BATCH MIXER

Scales used for weighing cement for batching plants must be used solely for that purpose.

Proportion the dry materials by mass.

CONTINUOUS MIXER

Proportion the dry materials by volume.

Use a continuous feeder which allows feed rate of different aggregate sizes to be adjusted separately.

### Delivery

Minimise segregation during loading and unloading and discharge directly into the hoppers of paving machines without spillage.

Provide open trucks with tarpaulins.

### Laying

PAVING MACHINE

Deposit and spread the pavement material in one operation using self-propelled mechanical tamper‑spreader.

Lay material uniformly without segregation to produce a uniform surface texture and required thickness.

Grader Laying

[Use only for minor jobs]

Spread the material in one layer not less than 75 mm nor more than 200 mm compacted thickness.

### Compaction, Finishing, Construction Joints and Curing

Conform to the requirements specified for in situ stabilisation.

## Conformance

### Tolerances

For stabilised and modified layers, conform to the tolerances specified in the PAVEMENTS AND SHOULDERS Section and with the following:

|  |  |  |
| --- | --- | --- |
| **Table – Stabilised and Modified Layer Conformance** | | |
| **Attribute** |  | **Requirement** |
| Dry Density Ratio: |  | Refer to the ***Table - Dry Density Ratios For Conformance*** in the CONFORMANCE TESTING Section. |
| Binder Application Rate/Content |  | ±10% of the field application rate averaged for each lot |
| Binder Distribution: | [i] | Binder content shall not vary by more than 0.5% absolute between top and bottom half of a layer at any location as determined in accordance with NTTM 204.8. |
| [ii] | Binder content shall not vary by more than ±0.5% from the field application rate in any point. |
| Moisture Content during Compaction: | [i] | ±1.5% of moisture content determined at preliminary trial. |
| [ii] | ±1.5% of optimum moisture content. |
| [i] apply if a preliminary trial is carried out (i.e. total area over 1000m2)  [ii] apply if a preliminary trial is not carried out (i.e. areas under 1000m2)  Take samples for Liquid Limit, Plastic Limit, Linear Shrinkage, California Bearing Ratio from the unstabilised pavements. | | |

[Adjust Stabiliser Distribution value for other types of stabilising agentl]

[Delete (i) if no preliminary trial.

Delete (ii) if there is a preliminary trial]

### Conformance Testing – Hold Point

Refer to the CONFORMANCE TESTING Section for Test Frequencies.

Correct application deficiencies by the application of additional stabiliser and remixing if mixing has already commenced.

BINDER CONTENT

The Superintendent will carry out conformance testing of the layers in the finished condition

COMPACTION

The Superintendent will carry out conformance testing.

Check areas for level tolerance and layer thickness before testing.

Only the finished compacted pavement will be tested.

Dry Density Ratios will be determined 24 hours after final compaction.

Backfill test holes within 24 hours of testing with new stabilised material.

**Hold point** - Superintendent to approve conformance of stabilised layer prior to commencing surfacing work.

* + 1. **Surface Roughness Requirement**

Surface Roughness: IRI less than 2.4.

Test Method: NTCP 107.1A

Surface Roughness requirements represent an absolute upper limit and all lane roughness values to be less than value specified.

Lotting and averaging out of field values not permitted.

Rectify all areas where Surface Roughness exceeds specified value.

Exclusions are listed in Test Method NTCP 107.1A

Ordering procedures; refer to the CONFORMANCE TESTING section for test ordering procedures.

When lots fail to meet the conformance criteria, rejection of the lot or payment adjustments will be applied. Refer to ***Table - Rate of Payment Adjustments*** in MEASUREMENT AND PAYMENT, **Rate of Payment Adjustment** sub-clause.