

Model Specification for Insitu Stabilisation of Local Government Roads using Cementitious Binders including Lime

Version D2 – 2006



Australian Stabilisation Industry Association
LIMITED

Aust **Stab**

Preface

In situ stabilisation is a proven technique for both new construction and rehabilitation of existing roads. Performance studies of existing roads in excess of 20 years have shown that Councils achieve excellent value-for-money results from this pavement technique.

A lack of design details, poor specification clauses, and poor construction practices by contractors with little knowledge of the process, quality control and materials may cause early distress of roads. Also, one of the problems faced by contractors during tendering is the variation of specifications. For example, in situ stabilisation specifications are likely to change from one region to another region or State. It is frustrating to find that one council would specify binder content by volume and another by weight. This all leads to confusion and may lead to insufficient binder content in the pavement material.

In attempt to minimise problems with road stabilisation AustStab has sought to produce a model specification for use by Councils and Shires. A working group in AustStab was formed to prepare this model specification aimed at specifying in situ stabilisation of local roads for both urban and rural areas. It also gave consideration to practices adopted in all regions of Australia, such that specifiers would not require tedious amendments.

In the specification there are options to include and deleted paragraphs and clauses based on the contractual requirements and practices by Councils and Shires in Australia. At the end of the specification is a schedule of rates that is required to be completed by the contractor in their submission to the tender documents.

The six-page specification and commentary contained in this document is available on disk and on the AustStab Internet web site at www.auststab.com.au. The disk copy has various word processing formats and it is recommended that the readme.txt file is printed to ensure that the best file is opened for your computer setup. Amendments to the specification will be on the AustStab web site or you may telephone AustStab.

It is hoped that the model specification and commentary will be widely used and the Association looks forward to your feedback, such that further amendments will reflect best practice.

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AustStab Model Specification for Insitu Stabilisation of Local Government Roads using Cementitious Binders including Lime

1 General

The purpose of this specification is for the construction of new or existing lightly-trafficked roads by insitu stabilisation with a cementitious binder, including cement, fly ash, slag or lime. Incorporation of the binder shall be accomplished using a purpose built calibrated “spreader” for binder spreading and mixing with a purpose built stabiliser or an approved integrated spreader/stabiliser machine.

This specification shall be used with a schedule of rates.

The Council shall carry out detailed inspection of the site for services and asphalt patching greater than 75 mm in thickness. Council shall be responsible for all service alterations that are necessary before stabilisation commences.

2 Description

The stabilised pavement shall be composed of a combination of soil and binder uniformly mixed, moistened and compacted in accordance with this Specification and shaped to conform to the lines, grades, thicknesses and typical cross-sections shown on the plans, or as directed by the Engineer.

Stabilisation shall be undertaken by using the equipment described in this specification with a minimum of two mixing operations to ensure sufficient uniformity of the binder in the pavement material. The stabilised pavement shall be cured prior to sealing with asphalt or final seal.

3 Materials

3.1 Binder

The binder shall be one of the following components or blends; Portland cement Type GP, blended cement Type GB, Low Heat cement Type LH, hydrated lime, quicklime, a blend of ground granulated blast furnace slag (GGBFS), hydrated lime, fly ash, alkali activated slag (or other pozzolanic material) supplied in accordance with this specification [*Delete types not used*]

All binders, including components of blends, shall be supplied by the Contractor, and shall comply with the following Australian Standards:

<u>Binder</u>	<u>Australian Standard</u>
GP & GB Cement	AS 3972
Lime	AS1672.1
Fly ash	AS3582.1
Slag	AS3582.2

When required by the Engineer, the Contractor shall furnish documentary or other acceptable evidence of the quality and date of manufacture of the binder, and any binder that is not satisfactory shall be rejected. Binder that is more than three months old from date of manufacture shall not be used in the works.

3.2 Water

[Delete paragraph that is not applicable]

The water used for the modification work shall be supplied by the Contractor and shall be potable. Where the water is drawn from natural sources, an efficient filter is to be provided on the suction pipe to ensure freedom from weeds, roots, etc., which could cause blockage of jets in the stabiliser.

[OR]

The Council shall supply the water used for the work.

3.3 Granular Materials

[Delete if not applicable]

If additional granular pavement material is required to improve the existing pavement material or correct pavement levels, this material shall be supplied by the Council and spread by the Contractor to the specified levels.

[Delete if not applicable]

If additional granular pavement material is required to improve the existing pavement material or to correct pavement levels, this material shall be supplied and spread by the contractor to the specified levels.

4 Lowering of Services

Council shall lower all services and utilities as necessary.

5 Initial Surface Preparation and Milling

[Delete if not applicable]

The surface of the insitu material shall be given a light compaction or proof rolling to reveal any irregularities in the surface of the material, and to allow the stabilising equipment to traverse the area without excessive displacement of the surface.

The surface shall then be trimmed to the required alignment, levels and cross-sections necessary to produce the required final compacted thickness of stabilised material.

If the Council has identified thick in-fill layers of asphalt the contractor is required to mill the asphalt and evenly spread the milled asphalt onto the surface of the existing pavement to minimise the need for imported granular material.

6 Spreading of Binder

The binder shall be uniformly spread at a controlled mass by area rate (kg/m^2) across the pavement. The rate of spreading shall be such as to provide the specified binder content in the compacted material. The spreader shall be equipped with gates to allow variable widths of binders to be deposited onto the pavement surface.

The contractor shall record the area of spread, tonnage of binder used per run, and mat or tray results at regular [at least daily] intervals, and keep these records as recommended in the Quality Manual. The construction tolerance for the spread rate is $\pm 10\%$ of the specified value.

Once the binder has been spread, the only traffic that may travel over the area to be stabilised, shall be construction plant employed for the stabilisation work.

Binder shall not be spread when the wind speed exceeds 25km/hr, if rain is imminent or the binder may be subject to run off due to water flows. All binder spread shall be incorporated into the pavement on the same day as it is spread.”

If the binder is quicklime slaking shall be carried out before mixing.

7 Mixing

The total specified quantity of binder required for the full depth of the treatment shall be uniformly spread over the surface to be treated prior to the mixing process, or incorporated in the pavement by an approved controlled mechanical feed in one operation in a manner satisfactory to the Engineer. No equipment except that used in spreading and mixing will be allowed to pass over the freshly spread binder until mixing operations are complete.

Water shall be added during the mixing process by means of a controlled pressure feed distributor located inside the mixing chamber. The moisture content shall be uniformly distributed through the pavement material.

The mixing equipment shall be so operated that the mixed depth of stabilised pavement shall be to the full-specified depth. Mixing using graders, profilers, rotary hoes and other agricultural type implements shall not be approved for stabilisation work.

For GP, GB and most cement blends, two passes of the stabiliser are required to be performed to obtain an even mixture of the binder throughout the pavement depth.

[Delete next paragraph if not applicable]

The number of passes for lime stabilisation to obtain adequate mixing has been noted in the schedule of rates.

Mixing shall proceed in lanes working from one side of the pavement to the other, without intervening lanes of unmixed material.

8 Moisture Content

The moisture content of the material immediately after mixing shall be 80% to 110% of the moisture content specified by the Engineer and not greater than the optimum moisture content.

9 Compaction

Compaction of the material in the pavement shall commence within thirty [30] minutes after the addition of water to the mix.

The compaction achieved, as determined by tests of the insitu material, shall not be less than 98% standard of the maximum dry density.

10 Finishing

The finished surfaces shall be true to line and level, with correct crossfall, and free from loose pockets, holes, bumps and flakes of material.

[Delete next paragraph if not applicable]

The finished surface shall be 25 mm (+10mm or - 5mm tolerance) below the adjacent lip of the gutter and/or the edge of the sealed pavement to allow for a 25 mm thick layer of asphalt.

[OR]

Where a bitumen seal is to be used as the wearing course the pavement surface is to be finished to a straight uniform profile from the crown of the pavement to the lip of the gutter (+10mm or - 5mm tolerance) in the case of full width stabilisation.

The finished stabilised pavement shall not vary by more than 10 mm in any direction when tested with a 3 m straight edge.

Where shoulders only are to be stabilised, the finished profile shall comprise a straight uniform crossfall from the edge of the existing pavement to the outer edge of the construction.

All final trimming shall be cut to waste or reused in other applications as directed by the engineer.

11 Curing

The stabilised pavement shall be protected from moisture loss for a period of 4 days or until a wearing surface or further pavement layer is applied; whichever the earliest.

This curing may be attained by:

- keeping the pavement damp by means of water spray
- applying a sprayed bituminous curing membrane consisting of either a rapid-setting bitumen emulsion or a cutback bitumen within 24 hours of the finishing operations.

[Delete correct situation] The Council/Contractor shall carry out the necessary curing works.

12 Provision for Traffic

[Delete not applicable paragraph]

The work shall be carried out in such a manner that the road is open to traffic at all times, and so that there is a minimum of interference to the passage of traffic by the Contractor's plant and equipment. All traffic management shall be carried out in accordance with AS1742 and the State Road Authority Code of Practice.

[OR]

The contractor shall be permitted to carry out a full road closure during the work.

The work shall be executed so that each section is completed to the full width at the end of the day's works.

The provision of traffic management shall be the responsibility of the *[Delete to show correct situation]* Council/Contractor. All traffic management shall be carried out in accordance with AS1742 and the State Road Authority Code of Practice

13 Sampling and Testing

13.1 General

The Contractor shall use a NATA certified testing company to carry out compaction control testing and the cost shall be included in the unit rate for compaction tests. Other control testing for binder addition, shape, depth etc shall be carried out by the Contractor and the cost shall be included in the appropriate unit rate.

13.2 Spread rate

The spread rate shall be verified as per AustStab National Guideline *Verification of binder spread rate* once in every lot or as directed by the engineer.

13.3 Depth

The depth of stabilisation shall be verified by measuring the depth of “cutting” adjacent to an existing pavement material in at least two locations within the lot and measured to the nearest 5 mm. The construction tolerance for the stabilised and compacted depth is ± 20 mm.

13.4 Density

The density of stabilisation shall be verified by testing in at least two locations within each lot in accordance with AS1289 Method 5.4.1 and Method 5.3.1 or by Nuclear Density Gauge in direct transmission mode to AS 1289.5.8.1.

13.5 Other Tests

Other tests, such as Unconfined Compressive Strength (UCS) and moisture content, as required by the Engineer shall be at the Councils expense.

14 Acceptance/Rejection Criteria

Where the binder addition, compaction, shape or stabilised depth does not meet the specified requirements, the Engineer and Contractor shall resolve the disposition by negotiation. Such disposition may include acceptance as is, acceptance with conditions, or rework of the affected area.

Schedule of Rates

The following rates are exclusive of GST.

Description	Unit	Qty	Rate (\$)
<i>Operations:</i>			
Spread, mix and supply water cart(s)	m ²		
Supply, spread, mix, compact and curing	m ²		
<i>Testing:</i>			
Compaction Tests	No.		
<i>Variation of Rates:</i>			
Additional binder at ***kg/ m ²	m ²		
Rip or mill asphalt patches	m ²		
Dispose of surplus material	tonne		
Number of mixing passes for lime stabilisation	1 or 2		

Project Cost _____
 (from sum of rates and quantities)
 GST (10%) _____
 Total Cost _____

Commentary to AustStab's Model Specification for Insitu Stabilisation of Local Government Roads using Cementitious Binders including Lime

Introduction

The purpose of this commentary is to provide a background to the clauses in the model specification to assist the specifier in completing the document ready for tendering. The model specification was prepared by the members of AustStab and provides best practice. This commentary makes reference to various **AustStab National Guidelines** and these are available from members or the AustStab Web site at **www.auststab.com.au**

The specification allows for part or full-service contracts. A full service contract is defined where the contractor will supply all materials and equipment, trim and cure.

The aim of this specification is for Council to specify the same construction principles around Australia and the specification may be used for new or existing lightly-trafficked roads. Binders that are suitable with this specification include cementitious materials, including cement, fly ash, slag or lime. The appropriate binder for a soil is an important decision and suggested binders for soil types are listed in references 1 and 2.

The council or shires representative for the work is described as the council engineer in this document. Other terms used in this document are defined in the AustStab National Guidelines.

The format for this commentary follows the same number and title sequence as the specification.

Amendments to the specification will be available through AustStab members, listed in *AustStab News* and the AustStab web site.

2 General

Road stabilisation involves the use of specialised equipment that operate to the specified depth plus construction tolerances. The powerful equipment can damage services and therefore, the council engineer should identify if any services that have to be lowered before work commences. The un-expected service that is higher than estimated in the initial inspection should be immediately repaired to not cause significant delay in the mixing or compaction of the stabilised pavement.

Reclaimers and stabilisers are manufactured with the mixing box located centrally or at the rear. These purpose built machines, such as shown in Figures 1 to 3 incorporated special rotors aimed at mixing the material within the mixing hood. The use of agricultural equipment, profilers, rotary hoes and graders are not substitutes for insitu stabilising as they tend to have very poor mixing properties that result in cracking of the pavement.

Large reclaimer/stabilisers have the ability to pulverise existing asphalt to depths of about 100-mm and incorporate the asphalt in the final mix. In fact, the existing asphalt in many local streets is 20 to 40mm in thickness and contains very good aggregates to enhance the strength of the stabilised layer.



Figure 1 Conventional stabiliser. Note the centrally mounted mixing chamber.



Figure 2 Conventional-sized reclaimer/stabiliser.



Figure 3 Large reclaimer/stabiliser.

2 Description

The general construction process is

- (a) Levels should be adjusted prior to the stabilisation process
 - (i) where levels are to be increased granular material to meet the new road profile or supplement the existing pavement material is evenly spread on the prepared road surface. In most urban areas this is not normally required.
 - (ii) where levels are to be reduced the pavement may be pulverised in conjunction with the removal of the excess material prior to stabilising.
- (b) Binder shall be spread upon the prepared pavement
 - (i) where a conventional stabiliser is used for the mixing, the pavement needs to be pre-tynd to the depth of stabilising prior to spreading the binder. This tyning should not exceed the depth of the stabilising. Where pre-pulverising has been used in conjunction with level alterations pre-tyning may not be required
 - (ii) where a reclaimer/stabiliser is used for the mixing there is no need for pre-tyning prior to spreading the binder. The binder is spread directly on the pavement as long as the levels are correct.
- (c) The binder and soil is then mixed to achieve the compacted depth and degree of pulverisation specified. This stage allows for the binder to mix with the soil in the mixing chamber with the materials relatively dry.
- (d) A second pass is then carried out with the required quantity of water. This stage then enhances the mixed material and water to provide optimum uniformity of mixing of the materials.
- (e) As soon as material is sufficiently compacted, grading must commence and be carried out in conjunction with compaction until a smoothly graded finish is obtained.
- (f) The stabilised pavement should undergo curing process.

- (g) Final surface layer is constructed, and this may consist of a sprayed-seal or thin layer of asphalt.

The description above is for a two-pass process especially for cementitious stabilisation. Two passes ensures good uniformity of mixing and enables the quality of mixing which was attained in the laboratory in the design process to be attained in the field.

3 Materials

3.1 Binder

All binders used for road stabilisation should comply with an Australian Standard as noted in the specification. However, they should be proven in laboratory trials. More information on binders may be sought from references 1 and 2.

A three-month limit is introduced in this clause as experience has shown that cementitious binders lose their cementing action when aged over 3 months.

3.2 Water

The water used for stabilisation should be potable. The characteristics of the water that is sought are that it is soft, reasonably clean, and free from oil, acid, alkali, organic or other impurities. Sea water has been used for insitu stabilisation on several occasions around Australia and found to provide satisfactory performance. The use of a specific seal when using sea water should be investigated. In addition, the amount of water and binder should be established by laboratory testing.

3.3 Granular Fill

In urban roads granular material was traditionally used for the main carriageway and natural soils were used for the shoulders. With increasing traffic, the stabilisation of the shoulder, along with the main carriageway, can be satisfactorily achieved by “cross-blending” the two materials. In some instances additional granular material may be required.

The application of a granular fill will assist the contractor with achieving a better ride quality if the existing road is out of shape. In this clause there is an option for the Council or Contractor to supply the granular fill material.

4 Lowering of Services

AustStab member experience with many projects has indicated that Council staff are in a better position to organise and/or to carry out the work to lower all services and utilities as necessary.

5 Initial Surface Preparation and Milling

In existing pavements a failure of the subgrade is not always apparent and it is suggested, where possible, that the surface of the insitu material be given a light compaction to reveal any irregularities. Should a weak area of the subgrade be identified, strengthening of this material will be required. The responsibility for this subgrade strengthening should be clearly stated in the tender documents.

When conventional stabilisers are used it may be necessary for the insitu material to be ripped to a depth not exceeding the depth of stabilisation, to assist in the cutting and pulverising action of the stabiliser.

6 Spreading of Binder

The stabilising binder is specified in terms of its weight by area (kg/m^2) across the pavement. This may be determined from the following equation:

$$\text{Spread rate} = \frac{\text{Density of compacted soil (kg/m}^3\text{)} \times \text{\% of binder required}}{\text{depth of stabilised layer (m)}} \text{ (kg/m}^2\text{)}$$

For example, if the density of the compacted soil is 1.8 t/m^3 , the binder content is determined at 4% and the stabilised depth is 200 mm, the spread rate is $1800 \times 0.04 \times 0.2 = 14.4 \text{ kg/m}^2$. A simple table is also available in reference 4.

Typically the contractor has computer-controlled devices on board the spreader that calculates the spread rate of the binder as the spreader moves along the pavement. In addition, the contractor always keeps a record of the linear metre of spread at the width of the gate opening and the tonnage of binder used per run. This data allows back calculation of the average spread rate for each run.

Mats or tray are used at least daily intervals to verify the computer-collected data. The method to carry out this test is listed in reference 4.

The binder may be spread over the full width of the working area or directly in front of the operating stabiliser/reclaimer to minimise disruption to residential traffic.

7 Mixing

Uniform mixing of the binder and water is paramount to the success of the stabilised pavement, and therefore, it has been previously noted that specialised machines should only be used in this process.

For the mixing process to be effective water is added through the mixing chamber with spray bars under a controlled pressure feed distributor. The use of a spray bar behind a water truck is an unacceptable method to distribute water into the pavement.

For local government roads with stabilised layers up to 250mm the mixing and compaction process is carried out in one layer, that is full depth. The construction of multiple layers is uneconomical.

The number of passes for lime stabilisation to obtain adequate mixing is based on the type of soil and experience by the contractor, and therefore, the number of passes needs to be noted in the schedule of rates.

All AustStab contractors work to a well planned and proven procedure based on their quality manual. Unfortunately, wet weather conditions, plant breakdown or other causes may prevent the binder from being uniformly incorporated into the pavement in accordance with the above procedure. A table is offered in the specification to determine the additional GP cement binder if hold ups occur. With slow setting binders, it is unlikely that additional binder is required and advice should be sought from the binder supplier.

Mixing generally proceeds in lanes working from one side of the pavement to the other, without intervening lanes of unmixed material. Typically the overlap is 100 to 200mm and additional binder should not overlap beyond this region, as it may cause pavement cracking. Joints are deemed to be fresh when the pavement materials on both sides of the joint have been stabilised and compacted within the nominated working time.

Where joints are completed within the nominated working time for the mix the outside 300 mm of material from the first run should be left uncompacted until the adjacent material is placed. In addition, the joint is kept moist during this period.

Joints, other than fresh joints, are formed by cutting back into the previously stabilised and compacted work. The material disturbed during cutting back is re-mixed to full depth and incorporated into the new work. The minimum distances of cutback into previously stabilised material is typically:

- (a) longitudinal joints - 75 mm
- (b) transverse joints - 2 metres.

The contractor sets a layout of all joints based on the following requirements:

- (a) Minimise the number of joints to be formed.
- (b) Transverse joints are formed at right angles to the road centreline.
- (c) Longitudinal joints are formed on the separation lines of the travel lanes and a minimum of 300 mm outside the edge lines in the shoulder area.
- (d) Internal longitudinal joints are formed such that each is at a constant offset to the road centreline.

For major municipal roads the longitudinal joints should be offset by at least 300mm from design location of wheel paths.

8 Moisture Content

The moisture content of the material immediately after mixing is set at a range of 80% to 110% of the moisture content specified by the Engineer, and less than the optimum moisture content. A contractor has to monitor the moisture content during mixing and this is carried out by feeling the soil in the palm of the hand. Experienced staff follow the stabiliser and bring problems to the operators attention.

9 Compaction

Compaction of the material in the pavement is best carried out immediately so that final trimming can be achieved. The slower setting binders allow more flexibility with compaction times. In colder climates, a “cool” soil may slow the setting of a cementitious binder and this should be taken into consideration in the design stage.

Selecting the right compaction equipment is typically carried out by the stabilisation contractor and for further details refer to reference 5.

It is also recommended that traffic be allowed onto the pavement immediately after trimming as the repetition of wheel loading provides ongoing surface compaction which has been found to relieve cracking in cement stabilisation.

10 Finishing

Two options are provided in this section of the specification, namely to trim to a specified level below the existing kerb and gutter profiles or to a specified crown with cross fall, such as in a rural area.

All final trimming should not be incorporated into the surface and recompact as studies have shown that the trimmed material becomes an unbonded layer and it is likely to strip under traffic loading. To prevent false pavement problems all trimming should not be incorporated into the pavement and should be taken to another site.

11 Curing

Curing of a stabilised pavement is important to ensure that hydration of the cementitious binder takes place. Poor curing or lack of curing can create a “granular” type surface that may rut under loading. Curing may be attained by:

- ❑ keeping the pavement damp by means of water spray
- ❑ applying a sprayed bituminous curing membrane consisting of either a rapid-setting bitumen

emulsion or a cutback bitumen within 24 hours of the finishing operations.

- ❑ Applying an overlying layer that may be part of the overall pavement design.

12 Provision for Traffic

The provision of traffic signs and flagman during construction should be established by the council engineer so that signs and procedures do not hinder the safety of construction crew and the road users [Ref. 6]. In some instances the road may require full-closure to expedite the work.

Typically the work is executed so that each section of roadway is completed to the full width at the end of the days works.

13 Sampling and Testing

13.1 General

Ongoing road stabilisation in a council area or shire by the specified procedure provides a low-cost road construction solution. Testing is sometimes considered necessary in new areas of the council or shire. However, testing is an additional cost to the project and therefore, selecting the type and frequency of tests should be carried out with experience.

13.2 Spread rate

AustStab has prepared a test procedure to verify spread rate and refer to reference 4 for more detail.

13.3 Depth

The depth of stabilisation is normally established by comparing the depth of the insitu material with the depth of cut made by the stabiliser.

13.4 Density

Density of the stabilisation material is very important to its performance. The attainment of good density is dependent on the use of suitable rollers and good compaction practices [Ref.5].

The sand replacement or Nuclear Density Gauge (in direct transmission mode) methods may be used for density measurement testing. If there is a requirement for density testing the responsibility for the testing should be clearly stated.

13.5 Other Tests

Other tests, such as UCS and moisture content, may be carried as direct by the engineer and are used to establish “soft” spots in the pavement or unexplained failure in the pavement after curing.

