Model Specification for insitu stabilisation of local government roads using insoluble dry powdered polymers

Version A – 2007

Australian Stabilisation Industry Association LIMITED

AustStab

Preface

Insitu stabilisation is a proven technique for both new construction and rehabilitation of existing roads and improving subgrades. Performance studies of existing roads in excess of 20 years have shown that road authorities 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 insitu stabilisation specifications are likely to change from one region to another region or State. It is frustrating to find that one road authority 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 an attempt to minimise problems with road stabilisation AustStab has sought to produce a model specification for use by road authorities, council and shires, and earthmoving contractors. A working group in AustStab was formed to prepare this model specification aimed at specifying insitu stabilisation of main 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 delete paragraphs and clauses based on the contractual requirements and practices by road authorities 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 specification and commentary contained in this document is available in a Word file and on the AustStab Internet web site at **www.auststab.com.au** 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 Insoluble Dry Powdered Polymers

[Version A – 17th March 2007]

1 General

The purpose of this specification is for the construction of new or existing roads by insitu stabilisation of a pavement material with a water insoluble dry powdered polymer. Incorporation of the binder shall be accomplished using a purpose built calibrated spreader 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 pavement material 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. If the existing pavement is found to consist of highly variable materials then pre-mixing with one mixing operation shall be carried out to ensure sufficient material uniformity prior to stabilisation operations. The stabilised pavement shall be primer sealed with cutback bitumen prior to final seal or asphalt.

3 Materials

3.1 Binder

The binder shall be a high grade water insoluble dry powdered polymer. The constituent materials contained in the insoluble dry powdered polymer blend and binder types shall be supplied by the Manufacturer/Contractor, and shall comply with the following Australian Standards:

Binder	Australian Standard
Lime	AS1672.1
Fly ash	AS3582.1

When required by the Engineer, the Manufacturer/Contractor shall furnish documentary or other acceptable evidence of the quality and date of manufacture of the constituent materials, and any binder type that is not satisfactory shall be rejected**.**

3.2 Water

[*Delete paragraph that is not applicable*]

The water used for the stabilisation 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 surface shall be lightly tyned and lightly sprayed with water before spreading and mixing takes place.

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 ±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 open-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. Binder which is incorporated via an integrated spreader/stabiliser machine is not subject to wind speed constraints. All binder spread shall be incorporated into the pavement on the same shift as it is spread.

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 may be added to a pavement that has been tyned prior to spreading the binder. 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.

A minimum of two passes of the stabiliser are required to be performed to obtain an even mixture of the binder throughout the pavement depth.

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 70% to 90% of optimum moisture content (OMC) of the unstabilised material.

If after mixing the moisture content is found to be higher than 90% of OMC, additional full depth dry mixing shall be carried out to reduce the moisture content to conform to the specification. The stabilised pavement can be remixed full depth at any time to incorporate additional water to conform to the specification.

9 Compaction

Compaction of the material in the pavement shall commence within ten [10] minutes of the final mixing pass.

[*Delete next paragraph if not applicable*]
The compaction achieved, as determined by tests of the insitu material, shall not be less than 100% 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

Curing of the insoluble dry powdered polymer stabilised pavement is not required. The stabilised pavement shall be kept moist for the purpose of dust control under traffic or until the application of primerseal or the next layer.

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 ultimate centre line of the formation or 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 -0mm/+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 CBR 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.

15 Reworking

Reworking of the stabilised pavement can be carried out at any stage without time constraints. The stabilised pavement can be remixed to full depth to incorporate additional binder and/or water, dry-back, specified compaction or correction of shape and/or levels.

Schedule of Rates

The following rates are exclusive of GST.

Description	**Unit**	**Qty**	**Rate ($)**
Operations:			
Supply and deliver binder to site	tonne		
Spread, mix, compact, trim and keep moist	m^2		
Or			
Supply, deliver, spread, mix, compact, trim and keep moist	m^2		
Testing:			
Compaction Tests	No.		
Variation of Rates:			
Additional binder at ***kg/ m^2	m^2		
Rip or mill asphalt patches	m^2		
Dispose of surplus material	tonne		

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 Insoluble Dry Powdered Polymers

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, Construction Tips** 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. Accredited stabilisation contractors should be used in the tender and construction process.

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 various pavement materials are found in the Austroads publications (Austroads, 2006 and AustStab, 2007).

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.

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

Figure 2 *Conventional-sized reclaimer/stabiliser.*

Figure 3 *Large reclaimer/stabiliser.*

1 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.

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 may need to be pretyned 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.
(iii) It is recommended that the pavement be wetted up prior to open spreading of the binder. This will aid in keeping down the binder if moderate winds are present at the time of spreading.

(c) The binder and pavement material is then mixed to achieve the compacted depth and degree of pulverisation specified. This stage allows for the binder to mix with the pavement material in the mixing chamber with the pavement materials previously wetted up.

(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 does not require curing. It is only recommended that the pavement be kept moist for the purpose of dust control under traffic or until the application of primerseal or the next layer process.

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

The description above is for a two-pass process for insitu 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. . The binder type and spread rate should be determined in accordance with AustStab Technical Note 3.

At this stage there is no Australian Standard for setting the requirements for the supply of insoluble dry powdered polymers and the engineer should review the quality assurance documents from the manufacturer. In addition, the binder supplier should provide a material data safety sheet for the safe use of the binder.

If hydrated lime is blended with the dry powdered polymer, the minimum Available Lime should be 80%.

Current knowledge is that there is no time limit for aging of the binder as moisture does not penetrate the insoluble dry powdered polymer.

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 is 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 mass by area (kg/m^2) across the pavement. This may be determined from the following equation:

Spread rate (kg/m^2) = Density of compacted soil (kg/m^3) x % of binder required x depth of stabilised layer (m)

For example, if the density of the compacted soil is 1.8 t/m^3, the binder content is determined at 2% and the stabilised depth is 200 mm, the spread rate is 1800 x 0.02 x 0.2 = 7.2 kg/m^2. A simple table is also available found AustStab's guideline on spread rates (AustStab, 1997).

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 at daily intervals to verify the computer-collected data (AustStab,).

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 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 250 mm the mixing and compaction process is carried out in one layer, that is full depth. The construction of multiple layers is uneconomical.

A minimum of two mixing passes shall be carried out once the binder has been open-spread or incorporated through integrated injection into the pavement. 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. 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 200 mm 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 day.

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 300 mm from design location of wheel paths.

8 Moisture Content

The moisture content of the material immediately after mixing is set at a range of 70% to 90% of the optimum moisture content of the untreated material unless laboratory tests show the material moisture content should be increased. 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.

Experience has shown that the moisture content after mixing will reach the equilibrium moisture content. However, if the pavement is exposed to rainfall prior to sealing, the moisture content should be assessed and reduced by dry remixing until the average (with depth) of insitu pavement moisture content is about 70% of OMC.

9 Compaction

Compaction of the material in the pavement is best carried out immediately so that final trimming can be achieved.

Selecting the right compaction equipment is typically carried out by the stabilisation contractor and for further details refer to work by Mayfield and AustStab (Mayfield, 1994 and AustStab, 2007).

It is also recommended that traffic be allowed onto the pavement immediately after trimming as the repetition of wheel loading provides ongoing surface compaction.

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 recompacted 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 the stabilised pavement is not required however for dust control and traffic vision safety the following is recommended:

- keep the pavement moist by means of light water spray, or
- apply a sprayed bituminous curing membrane consisting of a cutback bitumen within 24 to 48 hours of the finishing operations, or
- keep the pavement moist before 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 (HB81, 2003). 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 (AustStab, 1997).

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.

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.

14 Acceptance/Rejection Criteria

Where the compaction standard or stabilised depth falls well short of that required it is common for the Council engineer and the Contractor to negotiate payment. Typically this is done at a unit rate of area stabilised. Alternatively, acceptance/rejection and any form of payment deductions/bonuses shall be clearly stated in the specification.

References

Australian Standards (2003) *Field guide for traffic control at works on roads* HB81 (series) Sydney.

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Mayfield, M, Symons, MG and Collins, JR (1994) *Guide to the Selection of Vibratory Rollers for Road Construction* Structural Materials and Assemblies Group, University of South Australia, Adelaide.