Model Specification for Insitu Stabilisation of Local Government Roads using Bituminous Binders

Version C2 – 2006

AustStab Limited

AustStab
Pavement Recycling and Stabilisation Association

Preface

Insitu 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 insitu stabilisation specifications are likley 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 insitu 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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Members of AustStab

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AustStab Model Specification for Insitu Stabilisation of Local Government Roads using Bituminous Binders

1 General

The purpose of this specification is for the construction of new or existing lightly-trafficked roads by insitu stabilisation with a bituminous binder, with or without a supplementary binder, such as cement, cement flue-dust, fly ash, slag or lime. Incorporation of the binder shall be accomplished using a purpose built calibrated "spreader" for supplementary binder spreading and mixing with a purpose built "stabiliser" or an approved integrated spreader/stabiliser machine. The bitumen or emulsion shall be added via the stabiliser. This specification is applicable to both emulsion and foamed bitumen stabilisation.

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.

3 Materials

3.1 Binder

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

Binder	Australian Standard
Bitumen	AS 2008
Emulsion	AS 1160
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**.** Supplementary binders shall not be older than 3 months from the time of manufacture.

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 to 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 Application of Binder

6.1 Bituminous Binder

The binder shall be uniformly incorporated by a controlled device that provides calibration to the application rate in litres/m^2 of residual bitumen. The rate of application shall be such as to provide the specified binder content in the compacted material. In addition, for foamed bitumen the minimum expansion rate shall be 10 and the minimum half-life shall be 20 seconds.

Mixing uniformity shall be continuously inspected visually by the contractor and work shall stop when bitumen streaks or blotches are observed.

The mixing chamber spray system shall allow variable widths of binder to be incorporated into the pavement material.

The reclaimer / stabiliser to be used for the stabilisation works shall satisfy the following requirements:

- a minimum power capability of 300 kW (400 hp) to ensure adequate mixing of materials, and

- to ensure accurate application rates irrespective of the forward speed of the stabiliser, two separate pumping / injection systems shall be employed for metering the bitumen and water (i.e. for increasing the pavement material moisture content) and these systems are regulated by the ground speed of the reclaimer/stabiliser.

For foamed bitumen stabilisation the reclaimer/stabiliser shall also meet the following requirements:

- an inspection or test jet must be fitted to ensure the flow of bitumen and that the required expansion and half-life qualities of the bitumen are being achieved, and
- bitumen jets must be self cleansing and bitumen lines must be heated for reasons of safety of operators and field staff.

The contractor shall record the area of application and tonnage of binder used per run. For foamed bitumen stabilisation the inspection nozzle shall be used to verify the foaming characteristics for every bitumen tanker load. These records shall be kept as recommended in the Quality Plan. The construction tolerance for the application rate is ±10%.

6.2 Supplementary Binders

Supplementary binders shall be uniformly spread with the use of a spreader equipped with calibrated electronic load cells to ensure that a controlled mass is spread 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 Plan. 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.

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

Mixing using graders, profilers, rotary hoes and other agricultural type implements shall not be approved for stabilisation work.

If, due to weather conditions, plant breakdown or other causes, the binder cannot be uniformly incorporated in the pavement in accordance with the above procedure before becoming damp, then additional binder shall be spread before final mixing.

7 Joints

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

The overlap at joints shall be 100 to 200 mm, and additional binder should not overlap beyond this region. Joints are deemed to be fresh when the pavement materials on both sides of the joint have been stabilised and compacted.

Where joints are completed the outside 300 mm of material from the first run should be left uncompacted until the adjacent material is placed.

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.

For foamed bitumen the water shall only be applied through the mixing chamber to meet the moisture content.

9 Compaction

Compaction of the material in the pavement shall commence after the addition of bitumen to the mix.

The compaction of the pavement, 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 – 5 mm 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 pavement to the lip of gutter (+10mm or - 5mm tolerance) with 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 compacted and trimmed foamed bitumen stabilised pavement may be opened to traffic immediately. Bitumen emulsion stabilised pavements shall be protected from heavy-traffic until the bitumen emulsion stabilised material has cured or until the next pavement layer is constructed.

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 as appropriate*] 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

[*Delete any not applicable clause*]

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 Application and Spread Rate

The bitumen application rate shall be verified through dipping of the tanker at the start and finish of the run, using the AustStab National Guideline *Verification of Application Rate*.

The supplementary binder application rate shall be verified as per AustStab National Guideline *Verification of Spread Rate* once in every lot or as directed.

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 for each lot in accordance with AS 1289 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 Repeated Load Trial Axial Test (RLTT), Materials Testing Apparatus Test (MATTA) 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 use Council or 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 ($)**
[*Delete not applicable rates*]			
Supply bitumen at ***kg/m^2	m^2		
Supply supplementary binder at ***kg/m^2	m^2		
Supply water	litre		
Supply granular overlay material	tonne		
Operations:			
Spread and trim granular overlay material	m^2		
Spread supplementary binder	m^2		
Mix and incorporate binders	m^2		
Compact and trim	m^2		
Testing:			
Compaction tests	No.		
Variation of Rates:			
Additional or reduction of bitumen application at ***kg/ m^2	m^2		
Addition or reduction in supplementary binder application 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 Bituminous Binders

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.

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 operates 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 commence. The time required to lower services should be considered in the engineers program of works.

The unexpected service that is higher than identified in the initial inspection should be immediately repaired to not cause significant delay in the mixing or compaction of the stabilised pavement.

Reclaimers/stabilisers are manufactured with the mixing box located centrally. These purpose built machines, such as shown in Figures 1 and 2 incorporate 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 a reduction in the pavement life [Ref.4].

Large reclaimer/stabilisers have the ability to pulverise existing asphalt to depths of about 75 mm and incorporate the asphalt in the final mix. In fact, the existing asphalt in many local streets is 20 to 40 mm in thickness and contains very good aggregates to enhance the strength of the stabilised layer.

Figure 1 *Conventional-sized reclaimer/stabiliser.*

Figure 2 *Large reclaimer/stabiliser.*

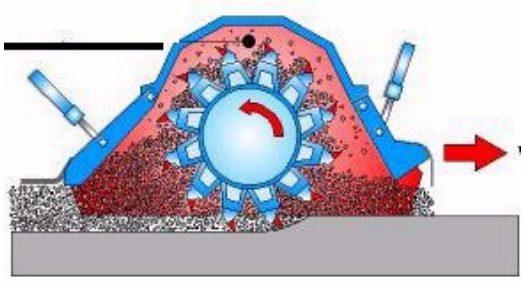

Figure 3 *Part view of drum to Wirtgen WR2500 with both reclaiming and stabilising actions.*

This specification has been written such that it can be applied for both emulsion and foamed bitumen stabilisation construction techniques. Bitumen emulsion stabilisation is such that the emulsion consist of bitumen (about 60%), emulsifying agents and water (about 40%). The emulsion is delivered by tanker at normal water temperatures and applied in the mixing chamber as shown in Figure 4. Supplementary binders are usually used with bitumen emulsion stabilisation to enhance short-term properties of compacted material.

The foamed bitumen process is where hot bitumen (about 180°C) comes in contact with cold water in precise quantities to create a foaming of the bitumen as shown in Figure 5. The reduced viscosity of the foam bitumen and its larger volume enables it to be uniformly mixed with the pavement material. Most bitumen products have anti-foaming agents and therefore, additives are commonly used with the bitumen to allow the foaming process to take place.

In Australia, bitumen emulsion stabilisation is also used in conjunction with a supplementary binder, such as cement, cement flue-dust, fly ash, slag or lime, to improve the short-term properties of the stabilised material for trafficking. This specification assumes that the use of supplementary binders is in the low binder range of less than 2% by weight of the pavement material. Lime is also used to enhance the adhesion of the aggregates and to improve the PI of the material (refer to referecence 9).

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) When a supplementary binder is required it is spread upon the prepared pavement and the reclaimer/stabiliser is used for the mixing. The binder is spread directly on the pavement as long as the levels are correct. When slaking lime some consideration should be given to the control of the slaked lime on the surface of the pavement.

(c) The bitumen and soil is then mixed to achieve the compacted depth and degree of pulverisation specified. This stage allows for the bitumen binder (and supplementary binder if used) to mix with the soil in the mixing chamber with the materials relatively dry. With bitumen emulsion the water with the bitumen contributes to the total fluid content and allows the moisture content to sometimes exceed the optimum levels to meet compaction requirements.

(d) 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.

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

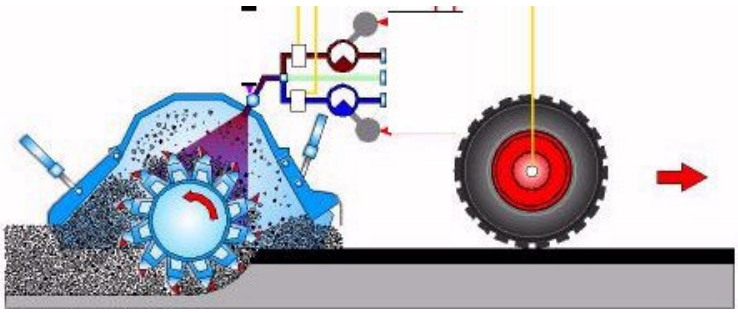

Figure 4 *Long-section of mixing chamber of reclaimer/stabiliser showing entry of bitumen for bitumen emulsion stabilisation.*

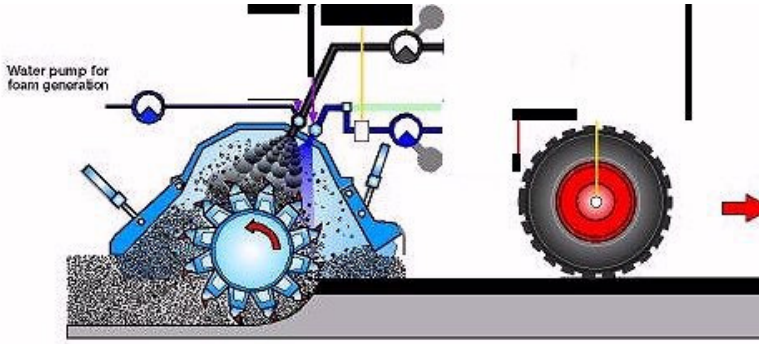

Figure 5 *Long-section of mixing chamber of reclaimer/stabiliser showing entry of foamed bitumen and water, for foamed bitumen stabilisation.*

It is considered poor construction practice to spray bitumen on the pavement and stabilise the material using a conventional stabiliser or stabiliser/reclaimer as this practice creates a lack of uniform control of the bitumen application rate. In some cases the bitumen is likely to run down the grade creating non-uniformity of the stabilised material.

3 Materials

3.1 Binder

All bitumen and supplementary 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 to 3.

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. In addition, the amount of water and binder should be established by laboratory testing. Sea water should not be used for bituminous stabilisation.

3.3 Granular Materials

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 to improve the grading of the pavement material.

In local government roads granular material is either crushed rock from an established quarry or recycled asphalt pavement (RAP) material. The grading requirements for these materials are based on the grading of the parent material and the availability of the local quarry material.

4 Lowering of Services

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. The lowering of services should meet the guidelines set by utility companies and they should be carried out such that there is sufficient cover for brittle pipe work.

The lowering of services needs to be programmed into the works schedule such that onsite delays are minimised.

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. This light compaction is referred to as proof rolling in some regions of Australia.

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.

Thick-layers of asphalt patching are usually identified from Council records or from the pavement management system (PMS). Whilst records indicate that a patch may be 75 mm in thickness, AustStab members note that on most occasions the patch depth is well over the recorded measurement. In some instances where these patches are extensive, it may be prudent to not mill this patch and stabilise the surrounding pavement.

6 Application of Binder

It has been noted previously that incorporation of the bitumen for both emulsion and foamed bitumen techniques can only be carried out by the use of specially manufactured spray bars located in the mixing hood (see Figures 4 and 5).

The application of the bitumen emulsion in the mixing hood is achieved by a single spray bar with the bitumen tanker travelling in front of the reclaimer/stabiliser as shown in Figure 6.

For bitumen stabilisation, the application rate is the residual bitumen in the pavement material as a measure of kg/m^2, where the area is the stabilised area produced by the reclaimer. This approach is consistent with AustStab recommendations with the spreading and mixing of cementitious binders.

Figure 6 *View of tanker in front of stabiliser/reclaimer during mixing operation.*

The application rate may be determined from the following equation:

Application rate = Density of compacted soil (kg/m^3) x (kg/m^2) % 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 application rate is 1800 x 0.02 x 0.2 = 7.2 kg/m^2. This can now be related to tonnage of bitumen emulsion in the tanker for a specific run using the following relationship:

Tonnage of emulsion used = Residual bitumen (kg/m^2) x W (m) x L (m) / Bitumen content / 1000

For example, most reclaimers operate at 2.4 m width and a typical run is 500 m. The bitumen content in an emulsion varies, but 60% is a common value. Therefore, the tonnage used is 7.2 x 2.4 x 500 / 0.60 = 14.4 t. This may also be converted to litres using an specific gravity of 1.0 (ie 14.4 t ≈ 14,400 litres).

Typically the contractor has computer-controlled devices on board the reclaimer that calculates the application rate of the binder as the reclaimer moves along the pavement. In addition, AustStab members have the equipment set up such that the application width of the sprays can accommodate less than the full width of the reclaimer for work on shoulders.

Dipping in the tanker before and after a run confirms the computer-collected data. For supplementary binders, mats or tray are used at least daily intervals to verify the computer-collected data from calibrated electronic load cells on the spreader. The method to carry out this test is listed in reference 5.

For foamed bitumen operations, two key parameters are specified in clause 6.1. The *expansion ratio* is defined as the ratio of the maximum volume of the bitumen in its foamed state to the volume of bitumen once the foaming has completely subsided. In foamed bitumen stabilisation for local government roads, a suggested minimum expansion ratio of 10 is specified.

The other term used in foamed bitumen stabilisation is *half-life* and this is defined as the time taken (measured in seconds) for the foamed bitumen to settle to one half of the maximum expansion volume. Experience has shown that the half-life measured in the field and laboratory differ greatly and the engineer has to measure half-life in the field.

Both of these parameters are important to foamed bitumen stabilisation to ensure that during the mixing operation there is sufficient time to coat the pavement particles in the mixing chamber. Too short a half-life and insufficient bitumen coating of the particles leading to low strength.

Any supplementary binder is spread over the full width of the working area or directly in front of the operating stabiliser/reclaimer to minimise disruption to residential traffic.

The mixing of the bitumen for foamed bitumen and supplementary binders shall take place within two hours if the exisiting material has a high PI. Otherwise experience shows that the supplemenatry binder could be mixed into the exisiting material a day prior to the foamed bitumen mixing operation [Ref.9].

Uniform mixing of the binder 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 depths up to 250 mm a 300 kw (400 hp) stabiliser/reclaimer is required to ensure that there is sufficient power in the machine to cope with potential surges in operation due to variable parent material, such as moving from "hard" to "soft" material, and constructing on uphill grades with a bitumen tanker attached the reclaimer. It is also important to have sufficient power to carry out the mixing at a uniform longitudinal rate.

It is also recommended that a minimum 375 kW (500 hp) machine be used for stabilised depths exceeding 250 mm in depth. Where equipment does not meet this minimum engine power requirement, it is suggested that a prepulversing run (ie without bitumen) of the pavement material is carried out at 70% to 90% of the specified depth to ensure that any potential hard spots are negated for the foamed bitumen run.

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.

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. With the use of bitumen it has been found that the material can be reworked for up to 7-days after initial mixing.

7 Joints

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.

Where joints are completed 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 80% to 110% of the moisture content specified by the Engineer. A contractor has to monitor the moisture content during mixing and feeling the soil in the palm of the hand carries this out. Experienced staff follows the stabiliser and brings problems to the operator's attention.

For bitumen emulsion stabilisation the water in the emulsion provides a source to increase the moisture content of the stabilised pavement. In some instances, the moisture content may exceed 110% of the specified content and this may not be detrimental to achieving the specified compaction requirements.

9 Compaction

Compaction of the material in the pavement is best carried out immediately so that final trimming can be achieved. The slower setting nature of bitumen binders allows more flexibility with compaction times. In colder climates, a "cool" soil may slow the setting and therefore, the use of a supplementary binder, such as GP cement, should be taken into consideration in the design stage.

The minimum compaction is set at 98% (standard) of the maximum dry density to allow a greater scope in the use of marginal materials for lightly-trafficked roads. With better parent material a higher minimum compaction should be achieved by the contractor.

Selecting the right compaction equipment is typically carried out by the stabilisation contractor and for further detail, refer to reference 6.

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 "weak" pavement layers all trimming should not be incorporated into the pavement and should be taken to another site.

11 Curing

Curing of a bituminous stabilised pavement occurs very slowly and studies have shown that the maximum stiffness may be reached in about 1 year.

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.7]. 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

It will be necessary for the specifier to delete any non-relevant clauses in Section 13.

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 Application and Spread Rate

The verification of the application rate for lightly trafficked roads is normally carried out by dipping in the tanker. It is from AustStab members' experience that this approach has been an accepted practice for local government roads. More precision verification can be carried out by a bitumen extraction test of a soil sample and several tests are required in a typical street to get some statistical analysis. The cost for the bitumen extraction test using the oven dry procedure is expensive and not commonly used. The engineer should also be cautious of the results when RAP material has been used to supplement the parent pavement material.

AustStab has also prepared a test procedure to verify spread rate of the supplementary binder and refer to reference 5 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 the required density is dependent on the use of suitable rollers and good compaction practices [Ref.6].

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.

One of the outcomes of the Dandenong ALF trial in 1996/97 [Ref.8] was to limit the compaction level of stabilised marginal materials at about 95% MDD to ensure that over compaction did not "break-down" the particles leading to lower than anticipated material density.

13.5 Other Tests

Other tests, such as the repeated load triaxial test (RLTT), Unconfined Compressive Strength (UCS) and moisture content, may be carried out as directed by the engineer and are used to investigate unexplained failures in the pavement after construction.

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.

References

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6. Mayfield, M, Symons, MG and Collins, JR *Guide to the Selection of Vibratory Rollers for Road Construction* Structural Materials and Assemblies Group, University of South Australia, March, 1994.
7. Australian Standards HB8 *Handbooks for Traffic Control Devices on Roads* (six volumes)
8. Moffatt, MA et al *The performance of insitu stabilised marginal sandstone pavements* APRG Report No. 22, May 1998.
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