TNZ B/5: 2008

SPECIFICATION FOR IN-SITU STABILISATION OF MODIFIED PAVEMENT LAYERS

1. SCOPE

This Specification shall apply to the in-situ stabilisation of granular pavement layers using cement, lime, bitumen emulsion or foamed bitumen. This Specification shall apply to the stabilisation of sub-base or base layers to produce a modified material.

The pavement layer shall be constructed in accordance with the levels, grades and cross-sections shown in the drawings of the Project Specifications.

2. DEFINITIONS

Definitions of terms that are used in these specifications are described in the Notes to these Specifications.

3. MATERIALS

Imported aggregates, if any, shall comply with the Project Specifications.

4. STABILISING AGENTS

4.1 Chemical Stabilising Agents

Chemical stabilising agents shall be either one, or a combination, of the following:

4.1.1 Lime

Lime shall comply with TNZ M/15.

4.1.2 Cement

Cement shall comply with NZS 3122 Specification for Portland and blended cements (general and special purpose) for:

- General purpose Portland cement – Type GP;
- General purpose blended cement – Type GB; or
- Special purpose low heat cement – Type LH.

General purpose Portland cement, type GP, shall be used unless otherwise specified in the Contract documents. Note that high-early strength cement, type HE, shall not be used as a stabilising agent.

Cement shall be stored and handled to provide protection against deterioration or contamination. Cement that is more than 3 months old, or is suspected of not being stored in a way that protects it from deterioration, shall be tested for loss of ignition in accordance with AS 2350.2 or Appendix B of NZS 3122.

Type GP cement with a loss of ignition test result greater than 3.0% shall not be used.

Types GB and LH cement with a loss of ignition test result greater than that determined by the cement manufacturer shall not be used.

4.2 Bituminous stabilising agents

All bituminous stabilising agents shall be heated, stored and handled strictly in accordance with *The Safe Handling of Bituminous Materials used in Roading*[1], the manufacturer's requirements, and as set out in clause 7.4 of this Specification.

Bituminous stabilising agents shall be either of the following stabilising agents, and shall comply with the relevant specification:

4.2.1 Foamed bitumen

Foamed bitumen shall be produced from 80/100 or 180/200 penetration-grade bitumen as specified in the Project Specifications. The bitumen shall comply with TNZ M/1 and shall be able to achieve a minimum expansion of 10 times its original volume and a minimum half-life of 6 seconds. Refer to the definitions in the Notes to this Specification and RNZ Technical Note 001[2] for an explanation of expansion and half-life.

4.2.2 Bitumen emulsion

Bitumen emulsion shall be produced from 80/100 or 180/200 penetration-grade bitumen as specified in the Project Specifications. The bitumen shall comply with TNZ M/1. The bitumen emulsion shall be produced so that breaking of the bitumen emulsion occurs during compaction of the stabilised material, not before.

5. WATER

The Contractor shall be responsible for ensuring that the water for stabilisation, construction and curing of stabilised layers is free from impurities that may deleteriously affect the setting, hardening or strength of the stabilised material.

Water from sources other than public supply may have its suitability established to the satisfaction of the Engineer by repeating the final laboratory-based mix design tests with the water considered for use. The results of these mix design tests shall be greater than 90% of the final results from the mix design. In addition, work shall be stopped if any discolouration or residue is observed when adding or sprinkling water into or onto the material.

6. PLANT AND EQUIPMENT

All plant shall be supplied and operated so that it will uniformly spread, or add, the stabilising agent and thoroughly mix it to the specified depth with the in-situ material.

Stabilising and spreading plant shall be purpose-built by a manufacturer having a demonstrable track record and manufacturing history for the equipment used. Plant and equipment not meeting this requirement shall not be allowed on site.

6.1 Plant for supply of stabilising agents

Stabilising agents shall, for areas greater than 500 m^2, be delivered to the site in bulk tankers or trucks unless otherwise approved by the Engineer. Each bulk tanker shall be issued a *Certificate of Loading* that contains the following information and shall be part of the project quality plan:

- Tanker's identification details including certification number;
- Product identification;
- Name of the supplier;
- Batch number and date of manufacture (if possible);
- Date, time and place of loading;
- Comments on the state of the tanker at the time of loading in terms of cleanliness, details of the previous load carried, and whether any residual product from the previous load remains;
- Details of any chemical or other substance added to the product before, during or after the loading procedure, if any; and
- Net weight of product before and after discharge into the mechanical spreaders.

When stabilising with foamed bitumen, the bulk delivery tanker shall, in addition to the above, include the following features:

- A thermometer that records the temperature at which the product was loaded;
- A built-in thermometer (calibrated within the last 6 months) and heating facilities to ensure that the bituminous stabilising agent is maintained within the handling and application temperatures specified.

6.2 Plant for spreading chemical stabilising agents

Transfer of all stabilising agents into the spreading equipment shall be undertaken in such a manner to ensure that no contamination of the environment occurs. Where pressurised lime or cement powder is transferred, release filters shall be utilised to contain dust.

The spreading equipment shall be capable of varying the spread width to cater for different road widths. Where the chemical stabilising agent is applied directly to the surface of the road before stabilising, the spreader unit shall be a purpose-built calibrated belt or pneumatic rotor spreader incorporating adjustable spreader curtains.

6.3 Plant for stabilisation (mixing process)

Mixing using graders, profilers, or asphalt milling machines and agricultural type implements, shall not be permitted.

As a minimum, the stabilising machine shall have the following features:

- A capacity that has adequate rating for maintaining a constant rotor and forward speed, in addition to a capability for stabilising to the specified depth.
- A stabilising drum that rotates upwards into the direction of advance, located between the axles, which shall achieve at least 2.0 m of cut width in a single pass and shall have a level control system that maintains a depth of stabilising within a tolerance of -5 mm and +15 mm of the required depth during continuous operation.
- Where the milling depth exceeds 200 mm, the mixing chamber shall have an effective volume that can increase in relation to the depth of the cut, in order to accommodate additional material generated by increasing the depth of cut. This is achieved by the stabilising mixing drum being independent of the mixing chamber housing.
- An adjustable exit gate.

To mix the milled material with water (if required) and chemical stabilising agents, the mixing equipment shall include the following features:

- A controlled pumping and metering system to regulate the application of water and/or fluid stabilising agent(s) in relation to travel speed and mass of material being stabilised. The pumping systems shall be calibrated to deliver within a tolerance of ± 5 % by volume.

- A system of nozzles that promotes a uniform application of water and/or fluid stabilising agent(s) across the full width of treatment. The application systems shall be capable of adjustments for varying widths of treatments.

When stabilising with foamed bitumen the mixing equipment shall, in addition to the above, include the following features:

- A test nozzle capable of producing a replicate sample of the foamed bitumen being injected into the stabilised material to ensure that the required expansion and half-life qualities of the bitumen are being achieved.
- An electrically heated, self-cleaning nozzle system that promotes a uniform application of foamed bitumen across the full width of treatment.
- A calibrated bitumen flowmeter to control the injected bitumen in relation to the forward speed and mass of material being stabilised.
- A power output and mixing drum width that have a relationship greater than 150 kW/m for stabilising pavements that have thin chipseals or thin asphalt-surfaced roads, and greater than 200 kW/m for stabilising pavements that have previously strongly cemented or thick (>100 mm) asphalt layers. This is to ensure effective mixing of materials.

For safety reasons the bitumen shall not be pumped back into the bitumen tanker.

7. CONSTRUCTION

7.1 Limitations

7.1.1 Weather limitations

Temperature

Work shall not be started if the temperature is below the temperature of the component set out in Table 1:

Table 1: Minimum working temperature for the stabilising process

Stabilising process	Component to measure	Min. temp. (°C)
Cement	Ambient air temperature	5
Lime	Ambient air temperature	10
Cement / Lime	Ambient air temperature	10
Bitumen emulsion	Stabilised material before compaction	20
Foamed bitumen	Stabilised material before compaction	20

If, during construction, the governing component's temperature drops below the limits set in Table 1 above, then no further work, other than compaction and finishing, shall be permitted.

Dryness, wind

Spreading of powdered chemical stabilising agents on the road ahead of the recycling machine shall not continue when the chemical stabilising agent becomes a dust problem or when the wind speed exceeds 25 km/hr, except if the mixing and spreading is carried out in one unit that effectively contains the chemical stabilising agent.

Rain

No spreading of binding agents shall commence if it is raining. If rain is likely to start before the binding agent(s) can be mixed into the aggregate, then spreading of the binding agent(s) shall not take place.

7.1.2 Time limitations

The maximum time period, from mixing of the materials to primary compaction of the stabilised layer, shall be determined by the type of stabilising agent(s) used, as follows:

- Cement: two (2) hours;
- Lime: four (4) hours;
- Bitumen emulsion: before the emulsion breaks;
- Foamed bitumen: four (4) hours.

Where two or more stabilising agents are used, the time limitation shall be that of the shorter of the individual agents. Where the time limit is exceeded, details of the remedial actions taken by the Contractor shall be submitted to the Engineer for approval.

7.2 Before stabilisation commences

7.2.1 Surface preparation

Before any work commences, the surface of the area to be stabilised shall be prepared by:

- Cleaning all vegetation, detritus and other foreign matter;
- Removing any standing water;
- Pre-hoeing or pre-milling where high spots are to be removed (as directed by the Engineer);
- Accurately pre-marking the proposed longitudinal cut lines on the existing road surface; and
- Installing lift pegs if required by the Project Specifications.

In addition, if not detailed in the project drawings, the Contractor shall record the location of all road markings that will be destroyed in the stabilising process.

Scarification of the existing seal layer(s), if specified by the Project Specification, shall be carried out in such a way to end up with a particle size ≤50 mm.

The area to be stabilised shall be formed to final longitudinal and transverse shape, at an appropriate level so that the nominal compacted thickness of stabilised material is achieved to the tolerances as specified in clauses 7.8 and 7.9. The aggregate to be stabilised shall be compacted to prevent visible displacement while the spreading and mixing operations take place. The stabilising process and materials shall not be used to make good deficiencies in shape or thickness; such improvements shall be achieved before commencing stabilising operations.

7.2.2 Production plan

Before start of work every day, the Contractor shall prepare a production plan detailing their proposals for the forthcoming day's work. This plan shall indicate:

- The overall layout of the length and width of road intended for stabilising during the day, provided in a sketch, broken into number of parallel cuts required to achieve the stated width, and the overlap dimensions at each joint between cuts;
- The sequence and length of each cut to be stabilised before starting on the adjacent or following cut;
- An estimate of the time required for spreading the binder(s), mixing and compacting each cut. The layout sketch shall also show the time when the completion of each cut is expected;
- The location where samples have been taken to determine the in-situ moisture contents, together with the results of the tests;
- Proposed water addition for each cut, and the location at which any change is to be made within that sequence;
- The source and quantity of material to be imported;
- The amount and type of stabilising agent, or agents, to be applied to each cut;
- The proposed quality control testing programme;
- The proposed locations/timings of joints which, where possible, shall avoid joints on wheel paths;
- The number of passes to achieve sufficient mixing of the binder;
- Locations of existing services and mitigation/contingency plan to avoid conflict with the stabilising operation;
- Other information as requested by the Engineer.

The Contractor's site representative shall keep the daily production plan on site at all times.

7.2.3 Supply of aggregate to site

The supply of aggregate to the site and any stockpiling or other movement of aggregate before its placement on the road shall be controlled to avoid contamination and segregation. Contaminated or segregated aggregate shall be removed from site.

Where the Project Specification calls for material to be imported for the purpose of shape correction, the material shall be spread, compacted and shaped to the design levels before stabilising.

Where the Project Specification calls for material to be imported for the purpose of altering the particle size distribution of the stabilised material, or effecting mechanical modification, the material shall be spread evenly on the existing road surface as a layer of uniform thickness before stabilising.

7.3 Spreading of lime and/or cement

The stabilising agent shall be uniformly spread at the specified application rate across the pavement to the two tolerances set out in Table 2:

Table 2: Tolerance for spreading Lime and/or Cement

Test	Frequency	Tolerance
Mat test: (1 m^2 canvas)	Every 400 m^2	Within ±0.5 kg/m^2 of the specified rate
Average usage test: Compare tonnes used (from delivery docket) with measured area	Upon emptying the spreader and bulk tanker	Within ±2.5 % of the specified rate

The type of binder(s) and application rate(s) shall be specified in the Project Specifications.

The Contractor shall record and keep records of the tonnage of lime and/or cement used per area, including the Mat results.

During the operation the utmost care shall be exercised to ensure that all run-off is contained on the road. In the event of any binding agents entering any waterways the Engineer and the environmental authority for the region shall be notified immediately.

7.3.1 Slaking of burnt lime

Slaking of burnt lime shall be carried out using a purpose-fitted offset and pressurised spray bar on a water tanker to ensure thorough water penetration into the burnt lime. Slaking shall continue until no further reaction with additional water is visible and the slaked lime is completely converted to powdered form. Precautionary measures shall be taken to ensure that the public will not be exposed to unslaked lime blown by the wind or at any time during the slaking operation.

7.4 Addition of bituminous stabilising agents

Bituminous stabilising agents shall be sucked from the mobile bulk tankers during the hoeing process. A system that controls the addition of bituminous stabilising agent in relation to the continuously calculated weight of the stabilised material and to the tolerances set out in Table 3 shall be used.

Table 3: Tolerance for spreading bituminous stabilising agents

Test	Frequency	Tolerance
Flow meter and Operator's display readings	Continuous by operator and ground person	Within ±5% of the specified rate
Microprocessor's reading: compare tonnes used (from hoe's processor) with calculated area	At the end of each run	Within ±3% of the specified rate
Average usage/use test: compare tonnes used (from delivery docket) with measured area	Upon emptying the bulk tanker	Within ±2.5% of the specified rate

The type of binder(s) and application rate(s) shall be specified in the Project Specifications.

The Contractor shall record the tonnage of bituminous stabilising agent used per area and shall keep these records as specified.

Any bitumen that has been heated above the maximum temperatures set out in Table 4 shall not be used and shall be removed from the site.

Table 4: Temperature limits for storage and application of bitumen

Material	Maximum storage temperature (°C)		Application temperature (°C) (within 2 hours of use)	
	> 24 hours	< 24 hours	Minimum	Maximum
80/100 Pen grade	125	175	175	190
180/200 Pen grade	120	170	170	185

The foaming characteristics, which are expansion and half-life, shall be checked at the test nozzle of the stabilising machine within five minutes of starting with each new bitumen tanker load. The minimum expansion and the minimum half-life shall be as specified in clause 4.2.1.

7.5 Addition of water

Sufficient water shall be added during the stabilising process. A system that controls water addition in relation to the forward speed of the stabilising machine shall be used. Particular care shall be taken to prevent any portion of the work from excessive wetting.

The optimum water content (OWC) of the stabilised materials shall be determined by NZS 4402, test 4.1.3, *New Zealand vibrating hammer compaction test*.

The water content during compaction shall be in the range of 90% to 100% of the material's optimum water content.

7.6 In-situ mixing

The stabilising equipment shall be set up and operated to ensure that the following key requirements are met:

7.6.1 Control of cut depth

The project specifications shall specify the thickness of stabilised layer required. The actual depth of the cut shall be physically measured at both ends of the stabilising drum at least once every 200 m along the cut length. Maximum variation from the specified depth of cut is –5 mm and +15 mm.

7.6.2 Overlap on longitudinal joints

To ensure complete stabilisation across the full width of the road, longitudinal joints between successive cuts shall overlap by a minimum of 100 mm or half the layer thickness, whichever is the greater.

Unless stated to the contrary in the Project Specifications, longitudinal joints shall be planned to coincide with each and every change in crossfall across the road width, regardless of the implications of overlap width. The overlap width shall be marked out before starting each cut sequence. Water and stabilising agent(s) shall only be applied to the overlap during the last cut to the overlap.

All joints, including joints to existing unstabilised sections of pavement, shall be mixed, compacted and finished satisfactorily so that the final surface does not have permeable or loose patches.

7.6.3 Continuity of stabilised layer

The exact location of the end of the cut shall be carefully marked. This mark shall coincide with the position of the centre of the mixing drum at the point at which the supply of stabilising agent ceased. To ensure continuity of the stabilised layer, the next successive cut shall be started 1 m behind this mark in the case of cement or lime, and 5 m in the case of bituminous stabilising agents.

All joints, including joints to existing unstabilised sections of pavement, shall be mixed, compacted and finished satisfactorily so that the final surface does not have permeable or loose patches.

The stabilised area shall be squared off at the end of the day's production, and the location shall be recorded on the production plan for that day.

7.6.4 Particle size distribution of stabilised material

The forward speed of the recycling machine, rate of rotation of the stabilising drum, and the positioning of the gradation control beam, shall all be adjusted to ensure that the in-situ material is broken down to a particle size distribution as specified in the Contract documents, and thoroughly mixed with the stabilising agent(s). Excessive breakdown of aggregate shall be controlled and, if possible, prevented.

To ensure that design requirements are met, the freshly hoed material shall be visually assessed within the first 20 m run of each section, and then at an ongoing frequency as required, based on the variability of in-situ materials. The freshly hoed aggregate particle size distribution shall be assessed for uniformity and degree of aggregate breakdown. Where breakdown is considered excessive and stabilising speed and/or drum configuration cannot be adjusted to achieve a satisfactory particle size distribution, the works shall be suspended immediately and the Engineer notified.

7.7 Compaction

The objective of the compaction process is to ensure that the stabilised layer is compacted to a uniform, dense, stable condition. The procedure for determining the dry density and optimum water content targets for the in-situ stabilised layer, taking into account the likely variability in the in-situ materials, shall be as follows:

- Before the stabilisation operation is undertaken on site, the Contractor shall use representative samples of the materials to be included in the stabilised layer, to carry out laboratory tests according to NZS 4402: test 4.1.3 to determine the optimum water content and likely maximum dry density targets for the expected stabilisation mixes which include the stabilising agent(s). In addition the Solid Density of the representative stabilised material shall be determined according to NZS 4407: test 3.7.1.

- During the construction of in-situ stabilised pavements the Contractor and the Supervising Engineer shall work together to understand the likely variables that can occur on a construction site, thereby ensuring that the best possible construction outcomes are achieved on site for all parties. These variables can include changes in the type and relative quantities of the in-situ pavement materials that are making up the stabilised layer. Such changes could affect the Contractor's ability to meet the requirements outlined in this Specification.

In particular, non-conforming fluctuations in density and moisture content within the stabilised pavement layer may be either due to *"unavoidable" or "avoidable"* factors.

Unavoidable factors*:* usually ratified as such by the Engineer's Supervisor during construction. This could be the case where materials are highly variable, and some compromise is necessary on the amount of water to be applied, or how to make best use of target densities. Liability and risk of failure will thus reside with the Principal.

Avoidable factors: may be explained through:

- Poor workmanship by the Contractor (e.g. mill left standing with taps open, saturating a localised area), or
- Machinery inaccuracy/breakdown (e.g. over- or under-cement application caused by blocked gates, wet cement, poor maintenance, etc.); or
- Poor compaction management, or use of inappropriate plant; or
- Poor water control management; or
- Poor management of the site (including traffic control and unnecessary work programmed under inclement weather conditions).

Such occurrences shall be formally recorded by both the Contractor and the Engineer's Supervisor, and notified to the Engineer within 24 hours. Liability and risk of failure shall, in areas where avoidable factors occur, rest with the Contractor for the duration of the Defect Liability period.

During construction, the Contractor will measure indicative water contents over the site using an IANZ-endorsed NDM (Nuclear Density Meter) operating behind the mill. The Contractor and the Engineer's Supervisor will then work together to agree the amount of water to be added to the milling process (if necessary). This will usually be the difference between the insitu water content and the assessed OWC for the material being stabilised (including make-up metal), refer to the notes for determining the amount of water to add when using emulsions. If necessary this assessment of compaction conditions will need to be repeated if material variability is encountered.

So that the estimate of additional water required is accurate, the Contractor's plant and personnel must be particularly well organised and consistent in the timing of this phase of the work. If the site is left open unnecessarily, gross changes can occur in water content because of the drying effects of the wind and sun. Inconsistency by the Contractor will make the additional water estimates inaccurate and affect the quality of the finished product. As described above, such *Avoidable Factors* will result in the contractor assuming full liability for the stabilisation process.

The Contractor shall then add sufficient water to bring the water content up to the OWC as agreed with the Engineer's Supervisor. The Contractor shall not increase the moisture content of the material beyond that agreed with the Engineer's Supervisor. From then on during the compaction process, the Contractor shall measure both in-situ moisture contents and dry density achievements to quantify the ongoing compaction achievements on site.

If required by the Engineer, the Contractor shall be able to demonstrate that the water injection equipment being used can evenly distribute water throughout the un-compacted material (refer clause 7.5 in this Specification), if necessary before establishing on site.

The compaction targets (MDD) at the agreed optimum water content (OWC) shall be achieved by the minimum necessary number of passes of the compaction plant. To avoid deformation of the uncompacted layer, compaction shall be achieved by the compaction equipment, not by the traffic. Details of the plant used during the compaction works shall be recorded in the daily production plan.

During compaction, the Contractor shall undertake plateau density tests for the purpose of determining the minimum, and possibly the maximum, number of roller passes required to achieve the maximum possible target dry density (MDD). Repeated plateau density tests shall be undertaken when the material changes visibly (refer clause 7.7.1).

Compaction plant shall include type (i) for primary compaction, and type (ii) and (iii) for the final compaction of the top portion of the layer, as defined below:

Type (i) Vibratory single-drum roller

Type (ii) Smooth double-drum roller

Type (iii) Pneumatic-tyred roller (PTR) having a minimum weight when operating of greater than 7 tonnes, spread over at least seven-rubber-tyred pneumatic wheels over two axles.

Type (ii) and (iii) rollers may be replaced with a combination roller, which has one smooth drum at the one axle and rubber-tyred pneumatic wheels across the full width at the second axle of the roller.

7.7.1 Acceptance criteria for stabilised layer compaction

During construction, the agreed maximum dry density (MDD) for the stabilised material shall be determined by the Contractor and the Engineer's Supervisor using the test data obtained from the laboratory testing before construction, and the in-situ plateau density during construction.

The laboratory-based target optimum water content (OWC) and target maximum dry density (MDD) shall be determined for each stabilised layer at minimum frequency of one OWC/MDD test per 5000 m^2 of material stabilised. If the aggregate source (if applicable), the processing method, or the stabilised materials are expected to change then a new OWC and target MDD shall be determined and the Engineer informed.

During construction, testing for the target plateau dry density, at the assessed OWC, shall be carried out in lots. A lot is defined as a section where the pavement layer appears homogeneous and evenly compacted. The area of a lot shall not exceed 1000 m^2. The degree of compaction for each lot shall be determined by testing at least five randomly selected areas.

The Engineer may also carry out independent compaction testing to assist the Contractor and Engineer to reach agreement on what the required target dry density for each stabilised layer should be.

Once the required target dry density (at the assessed OWC) has been agreed between the Engineer's Supervisor and the Contractor, the Contractor shall confirm, using ongoing density testing, that the compaction acceptance requirements shown in Table 5 have been met.

Table 5: Mean and minimum degree of compaction as a percentage of agreed target MDD

Degree of compaction	Sub-base pavement layer	Basecourse pavement layer
Mean value	≥95%	≥98%
Minimum value	≥92%	≥95%

Should the requirements of Table 5 not be achieved, the Engineer shall investigate the compaction equipment, compaction procedures, and the variability of the material type and moisture content, to verify that adequate and timely compactive effort has been undertaken. Where this is deemed to be inadequate the Engineer may instruct the material to be reworked, or that other remedial works are to be carried out before the specified time limits are exceeded.

7.7.2 Control testing during and after construction

During construction, when agreed with the Engineer, the Contractor shall take representative samples of the mixed and stabilised materials from behind the mill (just before starting compaction) and shall have these samples prepared into compaction moulds (preferably on site to avoid changes in moisture content). The compacted samples shall then be returned to the laboratory for controlled curing. Future testing should then include Unconfined Compression and Density testing, in accordance with recognised test methods. The collection of these ongoing test results should enable both the Contractor and Engineer's Supervisor to refine their understanding of the desirable OWC and MDD targets for a range of stabilised material mixes, thus improving the ongoing decision process required under clause 7.7 of this Specification.

7.8 Surface shape

The surface shape of the completed pavement layer shall be such that, when all loose aggregate is removed, it conforms to the shape specified within the tolerances in Table 6. The standard of smoothness shall be such that no point in the surface varies more than 10 mm from a 3-m straight edge placed on the road, and any deviation from the straight edge is gradual. No area of the completed surface shall have any depression that will allow water to pond where lateral or longitudinal fall is greater than 1%.

The vehicle ride provided by the final surfacing layer shall comply with the maximum roughness value specified in the Project Specification. The ride quality may be measured by the use of a response-type meter calibrated in accordance with standard ARRB Transport Research operating procedures, or by the use of laser-profiling equipment validated against a class 1 roughness measuring device, e.g. the ARRB Walking Profiler.

Table 6: Maximum vertical variations

Pavement layer	Between pavement centreline and pavement edge (mm)	
	without concrete channel	**with concrete channel**
Sub-basecourse	-25 +5	-25 +5
Basecourse with Asphalt surfacing	-15 +5	Varies, see Notes (i) & (ii)
Basecourse with Chipseal surfacing	-5 +15	Varies, see Notes (i) & (iii)
Note: (i) at or close to the lip of channel –5 +5 mm (ii) at other locations on pavement –15 +5 mm (iii) at other locations on pavement –5 +15 mm		

7.9 Crossfall

The crossfall between two points more than 2 m apart, transverse to the centreline, shall not depart from the crossfall shown in the documents by more than 0.5%. Where the crossfall is not explicitly defined it shall not be less than the existing crossfall at start of construction.

7.10 Surface finish

The basecourse surface finish, as distinct from the surface shape, shall present a tightly consolidated surface when swept in which:

- The large aggregate is held in place with a matrix of smaller aggregates;
- The smaller aggregate is held firmly in place by fine material; and
- The matrix does not displace under normal trafficking or sweeping.

The standard of sweeping shall be sufficient to remove all loose aggregate, dirt, dust, silt, and other deleterious matter.

7.11 Protection and maintenance before sealing

The Contractor shall protect and maintain the completed stabilised layer until the next layer or surfacing is applied. In addition to the curing of the stabilised layer by frequent light watering, maintenance shall include the immediate repair of any damage to or defects in the layer, and shall be repeated as often as it is necessary. Any remedial grading after the time limitations set out in clause 7.1.2, shall be cut to waste. Any defects or damage of any nature, occurring during the construction or maintenance of the pavement layer before the seal is applied, shall be made good immediately by the Contractor. Where rutting or potholes occur in the unsealed pavement, it shall be fixed by re-stabilising the layer with the addition of a suitable stabilising agent as directed by the Engineer.

Until the section is sealed, construction work shall include:

- Channelling traffic, by the use of cones and flagmen, so that wheel loads are applied across the whole cross-section of road, and to avoid creating wheel paths, by vehicles tracking over the same line.
- Providing non-vibratory, secondary rolling (e.g. PTRs).
- Providing additional running course (use clause 10 of TNZ B/2 as a guide).
- Keeping surface damp but not wet to prevent dry out and unravelling.
- Drag-brooming the whole surface keeping a balanced distribution of running course.

This work should continue for a minimum period of 24 hours working time before sealing.

7.12 Presealing requirements

Before sealing, the Contractor shall advise the Engineer that the pavement surface has been prepared in accordance with clause 7.10 although final sweeping may not have been performed. The Engineer shall be given the opportunity to inspect the site. Additional testing in accordance with clause 7.8 may be required at this time.

Water content testing of the basecourse layer shall be carried out in lots. A lot is defined as a section where the pavement layer appears homogeneous and evenly compacted. The area of a lot shall not exceed 1000 m^2.

The degree of saturation (DOS) for each lot shall be determined by testing at least five randomly selected areas. No area in a lot may exceed the requirements of this clause. The seal coat shall not be applied unless the water content at each test point of the basecourse layer is such that the DOS is less than 80%. Pavement layer compaction test results may be used for this purpose where the Engineer is satisfied that the water content has not had a chance to increase between testing and sealing (i.e. it has not rained or additional watering has not been applied to the pavement).

$$\%\,\text{saturation} = \text{DOS} = \frac{\text{dry density x \%water}}{1 - \dfrac{\text{dry density}}{\text{solid density of particles}}}$$

8. QUALITY PLAN

Compliance with the requirements of clauses listed in Table 7 shall be checked by the Contractor, included in the project's Quality Plan, and records made available for inspection by the Engineer.

Table 7: Summary of stabilisation tolerances

Construction / Stabilisation activity	Clause reference
Addition of chemical stabilising agents	7.3 – Table 2
Addition of bituminous stabilising agents	7.4 – Table 3
Stabilisation depth	7.6.1
Compaction	7.7
Surface shape	7.8
Crossfall	7.9
Degree of Saturation before sealing	7.12

Measurements of crossfall should not be necessary unless indications are that the requirements of this specification have not been met. If the surface subsequently

deteriorates so that finished surface levels may be affected, then the Contractor shall carry out further measurement of the construction dimensions to confirm compliance.

9. BASIS OF PAYMENT

If not included in the contract documents, the basis of payment shall be as follows:

All miscellaneous items, lodgings, supervision, setting out, contingencies, conveyance of plant, and other incidental work, general overhead administration and maintenance shall be incorporated in the unit rates listed in the schedule.

9.1 Preparation of surface (cubic metres)

If any special treatment is required to the existing pavement other than those described in this Specification, it shall be specified in the Project Specifications.

Payment will be made on the solid volume measured in cubic metres of inferior pavement removed and/or the area measured in square metres cleared to the satisfaction of the Engineer.

9.2 Supply and placing of imported aggregate (cubic metres)

Payment for each section of the works specified in the contract documents shall be made on the total compacted volume in cubic metres (m^3) of material measured. Measurement shall be calculated from the difference between the surveyed profile of the existing road and the finished levels or imported quantity specified.

The scheduled rate shall include allowance for supply, cartage, placing, watering, pre-compaction, and obtaining a finish so that the stabilisation can meet the thickness tolerances as specified.

9.3 Pre-treatment (square metres)

Payment for each section of the works specified in the Contract documents will be made on the specified area pre-treated by hoeing (m^2) to a specified depth (mm). Measurement shall be in area (m^2) of the finished dimensions of the pre-treated area as shown on the drawings or those directed and marked on site by the Engineer. In the case of the later, the dimensions shall be agreed before stabilisation commences.

9.4 Stabilising (square metres)

Payment for each section of the works specified in the Contract documents will be made on the specified area stabilised (m^2) to a specified depth (mm) at a specified stabilising agent application rate (kg/m^2). Measurement shall be in area (m^2) of the finished dimensions of the stabilised layer shown on the

drawings or those directed and marked on site by the Engineer. In the case of the later, the dimensions shall be agreed before stabilisation commences.

The scheduled rate shall include allowance for the supply and spreading/injecting of all specified stabilising agents, water, mixing, compacting, trimming and finishing, to the specified tolerances.

9.5 Extra over or under clause 9.4 for the supply and spreading of cementitious stabilising agents (tonnes)

Extra or lesser payment for any section of the works specified in the Contract documents where the Engineer requires a variation to the amount of the cementitious stabilising agent that would have been used in clause 9.4 above, as specified in the original Project Specifications. Measurement shall be in tonnes (t) of agent.

The scheduled rate shall include allowance for supply and cartage of the cementitious stabilising agents.

9.6 Extra over or under clause 9.4 for the supply and injection of bituminous stabilising agents (tonnes)

Extra or lesser payment for any section of the works specified in the Contract documents where the Engineer requires a variation to the amount of the bituminous stabilising agent that would have been used in clause 9.4 above, as specified in the original Project Specifications. Measurement shall be in tonnes of agent (t).

The scheduled rate shall include allowance for supply and cartage, heating to the specified temperature and, if necessary, the production of the bituminous stabilising agent.

REFERENCES

[1] Roading New Zealand. 2006. The safe handling of bituminous materials used in roading. (Status as at April 2006: Provisional) *RNZ Code of Practice 9904:2006.* Roading NZ Inc., Wellington, New Zealand.

[2] Roading New Zealand. 2007. Foamed bitumen treated materials. *Roading NZ Technical Note 001.* Roading New Zealand Inc., Wellington.

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