Engineering Construction Specification

C07 Stabilisation

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1 General

1.1 Responsibilities

1.1.1 General

Requirement: Provide stabilisation of subgrade and pavement courses, courses using the specified materials and processes as documented.

1.2 Cross references

1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *C02 Quality management (Construction)*
- *C03 Control of traffic*
- *C06 Earthworks (Road reserve)*
- *C08 Flexible pavement base and subbase*

1.3 Standards

1.3.1 General

Standard: To Austroads AGPT04D.

1.4 Interpretation

1.4.1 Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- DPP: Dry powdered polymer.
- CBR: California bearing ratio.
- OMC: Optimum moisture content.
- TIPES: Transport infrastructure product evaluation scheme.
- UCS: Unconfined compressive strength.
- PI: Plasticity index.

1.4.2 Definitions

General: For the purposes of this worksection the following definitions apply:

- Allowable working time: Measured from the commencement of incorporating/mixing the first application of the supplementary stabilisation binder into the unstabilised pavement materials to the completion of trimming.
- Bitumen emulsion stabilising: The mixing of bitumen emulsion into the upper pavement layer to increase pavement strength.
- Bulking: The increase in volume of a layer designated for stabilisation resulting from preliminary pulverisation and/or incorporation of secondary or primary stabilisation binder.
- Foamed bitumen: The mixing of atomised water with hot bitumen at 180 to 190C with a foaming agent for use for use in stabilising granular materials.
- Expansion ratio: The ratio of the maximum volume of the bitumen in its foamed state to the volume of the bitumen once the foaming is completely subsided.

- Half-life: The time taken for the volume of the foamed bitumen to settle to half of the maximum volume achieved.
- Pozzolan: A siliceous or aluminous siliceous material, which in itself possesses little or no cementitious value but which in finely divided form may be mixed with lime or Portland cement to form a cementitious material.
- Residual bitumen: Residual bitumen is the net bitumen in the stabilised material remaining after the water has evaporated.
- Stabilent: A stabilent is any material mixed/ added to the pavement for improvement in pavement qualities.
- Stabilisation: The process by which the intrinsic properties of a pavement material are altered by the addition of a stabilisation binder and/or granular material to meet performance expectations in its operating, geological and climatic environment.
- Stabilisation binders: Materials that are used for the purpose of improving the properties of a subgrade or pavement. They are categorised in terms of their main constituents.
- Stabilised material: Any material which has been stabilised.
- Stabiliser: A specialised plant/machine with a centrally mounted mixing chamber, that can be connected to a watercart for moisture control and allows uniformity of mixing and depth control during the stabilisation process.

1.5 Tolerances

1.5.1 Cementitious blends

Mass of components of the nominated cementitious blend: ± 3% from the blend percentages in the nominated mix.

1.5.2 Application of stabilisation binder in a stationary mixing plant

Application rate tolerances: ± 10% from nominated rate.

1.5.3 In-situ application of stabilisation binder

Spread rate tolerances: ± 10% from nominated rate.

1.5.4 Width

Minimum width measured at any point of the stabilised layer: Not less than the documented width by more than 50 mm.

1.5.5 Levels

Surface levels: Conform to the following:

- Subgrade: ± 20 mm.
- Subbase: ± 15 mm.
- Base: – 5 mm, + 10 mm of design levels.

1.5.6 Surface quality

Maximum deviation from a 3 m straightedge: - 10 mm, after secondary trimming and immediately before sealing.

1.5.7 Layer thickness

Subbase: ± 10 mm of the documented layer thickness.
Base: Within 0 and + 20 mm of the documented layer thickness.

1.6 Submissions

1.6.1 Approvals

Submissions: To the Superintendent's approval.
Proposed Workplan.
Stabilisation mix.
Materials: Cement, Quicklime, Hydrated lime, Ground granulated blast furnace slag, Fly ash, Blended stabilising agents, Water.
Submit stabilisation calculations, including depth, percentage and CBR of stabilised material.
General:
Application rate.
Unconfined compressive strength.
CBR test results

1.6.2 Certification

Stabilisation mix(es): Submit details and certification from a registered testing authority as evidence of conformity of the mix and its constituent materials to the nominated mix design.

- Materials proposed Submit details of source and certificates of compliance from a registered testing authority as evidence that the materials conform to documented requirements.

1.6.3 Execution details

Proposal for construction: Submit details of proposed method, equipment and procedures.
Trial section: Submit documentation demonstrating conformity of the trial section including:

- Record data of actual spread rate (in situ) or incorporation rate (mixing plant) to verify conformance to the nominal rates.
- Compaction test results from a registered testing authority verifying the required relative compaction has been achieved for the trial section.
- Submit UCS test results
- Submit CBR test results
- Depth check records showing compacted thickness of stabilised layer for in situ stabilisation.
- Survey report of compacted thickness for stationary plant mixed pavements.
- Survey report of finished levels.
- Record data of straightedge test.

Joints: Submit details of location and types of construction joints.

1.6.4 Records

Stationary mixing plant – application of stabilisation binder:

- Application rate: Submit record data for incorporation of stabilisation binder.

In situ application of stabilisation binder:

- Spread rate: Submit record data from tray/mat tests or on-board load cells for spread of stabilisation binder.

In situ application of bituminous binders:

- Foaming test: Submit the following:
  - Record data confirming all bitumen foaming nozzles are operating.
  - Record data of expansion ratio and half life.
- Application rate: Submit record data for application of bituminous binder for each run.

- Daily record sheet.

In situ mixing:

- Stabilised layer depth: Submit record data of stabilised layer depth.
- Submit weight of material used and area to verify percentage.

Trimming:

- Survey report of finished levels.
- Survey report of compacted thickness for stationary plant mixed pavements.

Completion:

- Surface quality: Submit record data of straight edge test.

1.6.5 Tests

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES**.

Other tests:

- Lime demand test: To RMS T144 or VicRoads RC 131.01.
- Minimum pH: 12.4.

1.6.6 Variations

Nominated mix design: Submit details if the source, nature or type of any constituent material, or the proportion of any constituent materials is varied from the nominated mix design for correction or adjustment.

Documents

Submit the following for approval:

Drawing, calculations and submissions as required under HOLD POINTS and WITNESS POINTS.

Field working period:

Calculations as required under HOLD POINTS and WITNESS POINTS.

1.7 Inspections

1.7.1 Notice

Give notice so that inspection may be made of the following:

- Trial section: Location, materials, methods, equipment, procedures and joint construction.

2 Materials

2.1 Cement

2.1.1 General

Standard: To AS 3972.

2.1.2 Storage and transport

Storage period: Re-test cement that has been stored for a period in excess of three months from the time of manufacture.

Transport: Transport cement in water tight packaging and protect from moisture until used. Do not use caked or lumpy cement.

2.2 Quicklime

2.2.1 General

Standard: To AS 1672.1.

2.2.2 Properties

Available lime - calcium oxide: Not less than 85%.
Active slaking time: Not greater than twenty minutes.
Temperature rise on slaking: Not less than 40°C in six minutes.

Particle size distribution of quicklime table

AS sieve size (mm)	% passing
13.2	100
9.5	96–100
4.75	70–100
2.36	0–90

2.3 Hydrated lime

2.3.1 General

Standard: To AS 1672.1.

2.3.2 Properties

Available lime - calcium hydroxide: Not less than 80%.
Form: Dry powder.
Residue on a 300 µm sieve: Not more than 2%.

2.4 Ground granulated blast furnace slag

2.4.1 General

Standard: To AS 3582.2.

2.5 Flyash

2.5.1 General

Standard: To AS/NZS 3582.1.

2.6 Cementitious blends

2.6.1 General

Requirement: Conform to the blend proportion and constituents in the nominated mix design in the **ANNEXURE – STABILISATION SCHEDULES.**

2.6.2 Handling and storage

Requirements: Conform to the supplier's handling and storage recommendations.

2.7 Cationic or Anionic Bitumen emulsion

2.7.1 General

Standard: To AS 1160.

Grade: Use slow setting grades.

2.7.2 Materials for Cationic or Anionic Emulsion Stabilisation

Standard: To AS 1160 for bitumen emulsions classes depending on the materials being stabilised. Conform to the following:

- Use either cationic or anionic slow setting grades to AS 1160.
- Conduct mix design testing to check the suitability emulsion grade which provides best retained strength modulus for the candidate materials.
- Add cement with insitu stabilisation to achieve early strength increase and breaking of the emulsion.

2.7.3 Dust Laying with bitumen emulsions directly on an existing surface

Application rates: Conform to the following:

- Application rate for diluted emulsion is about 1.0 litres per square metre.
- Reduce the rate of application if surface runoff occurs.
- Use lower application rates and higher concentrations of emulsions on impermeable hard surfaces.
- Use higher application rates and lower concentration mixtures on softer and more permeable surfaces.

Operations:

- Shape and sweep the surface to remove excessive dust and loose material.
- Dampen the surface with watercart to increase effectiveness and reduce intervals between applications of emulsion.
- Use diluted emulsions.
- Check compatibility of water before diluting emulsion add the water to the emulsion and not the other way around. Heat the diluted emulsion to 60ºC before spraying to facilitate quick breaking of the emulsion.
- Close the road until the emulsion is fully broken and the surface is dry. This is usually 2 to 3 hours.

Life expectancy:

- Follow up the initial dust laying treatment with a second application after 2 to 3 days, and a 3rd application after 3 to 4 weeks.
- Effective service can range from several weeks to 6 months or more.

2.7.4 Dust laying with bitumen emulsion using soil stabilisation techniques

General: Do not use stabilisation with surface scarification and bitumen emulsion for fine grained soils and materials with high PI.

Preparation: Scarify and incorporate water into the existing surface gravel by tyning surface with a grader, or by using a stabiliser machine.

Optimum Moisture Content (OMC):

- If soil is dry add water with a water cart connected to the stabiliser so that the insitu moisture of the material with the emulsion is at OMC.
- Use a calibrated pressurised sprayer to apply the emulsion on the scarified material from preparation.
- Before carrying out final compaction spray a diluted emulsion on the upper surface to form an enriched surface.

Application rates: Vary from 1% to 3% of binder without dilution compared to the mass of soil being stabilised. Lower rates are used with well graded granular soil; high rates for sandy soil.

2.8 Foamed bitumen

2.8.1 General

Standard: To AS 2008.

2.8.2 Materials for Foam Bitumen Stabilisation

General: Use foamed bitumen stabilisation for gravels with high fines and high plasticity.
Requirement: The following are required:

- Bitumen, Class 170 is commonly used and usually between 3 and 4%.
- A bitumen foaming agent additive (Teric 311 or equivalent), to ensure suitable foaming.
- A secondary binder such as hydrated lime and/or GP cement.
- Potable water.

Supplementary binder:

- Hydrated lime: Conform to HYDRATED LIME. Use hydrated lime if the PI is above 7.
- Quicklime: Conform to QUICKLIME.
- Cement: Conform to CEMENT.

Supplementary binder limit: ≤ 2%.
Foaming agent if required: ≤ 2% of bitumen by mass.

2.8.3 Properties

- Expansion ratio: ≥ 10.
- Half-life: ≥ 20 seconds.

2.9 Chemical binders

2.9.1 General

Certification of non-traditional binders: Certificate of registration from ARRB TIPES.

2.9.2 Insoluble dry powdered polymer (DPP)

Grade: High.
Dry powdered polymer: Blended with hydrated lime or dry fine ground lime:

- Hydrated lime: To AS 1672.1.
- Available lime – calcium hydroxide: Not less than 80%.
- Testing for suitability: To test suitability of DPP for stabilisation test for plasticity index, Atterberg gradings, maximum dry density and optimum moisture content. Test for waterproofing as per AS C08.53 absorption, swell and capillary rise (treated and untreated comparison). Test to assess CBR strengths, soaked, and elastic modulus RLT test (treated and untreated comparison).

2.9.3 Design pavement thickness with dry powdered polymer

Design ESA's	Standard pavement and subgrade conditions	Floodways, expansive subgrades
Low to moderate traffic ≤ 5 x 10^6	150 mm to 200 mm	200 mm to 250 mm
Moderate to high traffic ≥ 5 x 10^6 and ≤ 9 x 10^7	200 mm to 300 mm	250 mm to 300 mm
Source: AustStab Pavement Recycling and Stabilisation Guide		

2.10 Dust Suppression additives and treatments

2.10.1 Dust suppression additives for unsealed roads

General: Select an appropriate dust suppressant option based on the site conditions:

2.11 Granular material additive

2.11.1 General

Additional granular material: To **ANNEXURE – STABILISATION SCHEDULES, Granular stabilisation.**
Granular stabilised material: To **Unbound base and subbase materials** in *C08 Flexible pavement base and subbase*.

2.12 Water

2.12.1 General

Requirement: Use clean water, free from harmful amounts of materials such as oil, salt, acid, alkali and organic or vegetable matter. Potable water will not require testing for conformity.
Content: Provide water with less than the following:

- 600 parts per million of chloride ion.
- 400 parts per million of sulphate ion.
- 1% by mass of undissolved solids.

2.13 Testing

2.13.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

3 Execution

3.1 General

3.1.1 Weather conditions

Moisture content: Do not proceed with the stabilisation of pavement materials during wet weather or if rain is likely to occur during any stage of the stabilisation process so as to change the resultant moisture content and its uniformity in the mix.
Wind: Do not proceed with spreading during windy conditions which may cause loss of stabilisation binder, or cause nuisance or danger to people or property.
Stabilisation with foamed bitumen: Do not carry out stabilisation when the temperature measured at a depth of 50 mm in the pavement is below 10°C.

3.2 Allowance working time

3.2.1 General

Requirement: Incorporate/mix the stabilisation binder into the subgrade or pavement material to be stabilised, trim and shape the surface to level and fully compact the layer to the required density ratio within the maximum allowable working time, as documented.

3.2.2 Maximum allowance working time table

Binder	**Maximum allowable working time (hours)**
Slow setting	
Hydrated lime and quicklime Slag/lime blends Foamed bitumen	10 10 10
Medium setting	
Type GB Cements Cementitious blends[1]	4 As documented
Rapid setting	
Type GP Cement[2]	2
Notes: 1. Cementitious blends allowable working time: Conform to **ANNEXURE – STABILISATION SCHEDULES.**	

3.3 Trial section

3.3.1 General

Trial section: If required, construct 50 m long trial section for the width of the proposed works and incorporate in the finished works.

Materials and methods: Construct the trial stabilisation using the materials, equipment and methods for placing and finishing the same as would be used for the entire stabilisation works.

Binder application rate in a stationary mixing plant: To **ANNEXURE – STABILISATION SCHEDULES**.

In situ application rate of stabilising agent: **To ANNEXURE – STABILISATION SCHEDULES**.

Compaction requirement: To **COMPACTION**.

Width, level, shape and layer thickness requirement: To **TOLERANCES, Width/Level/Shape/Layer thickness.**

Joints: Demonstrate the methods proposed for the construction of joints to conform the documented requirements.

Non-conformance: Assess the non-conforming trial section for fitness for purpose and determine appropriate disposition.

3.4 Stationary mixing plant

3.4.1 General

Type: Purpose-made for the process of mixing road making materials.

Plant capability: Able to process at least 100 tonnes/hr.

Plant calibration: Calibrate the mixing plant to determine the rate of addition of the stabilising binder at various plant speeds.

Plant maintenance: Maintain and calibrate all equipment to provide a uniformly mixed product without segregation of the aggregate material.

3.5 Stationary mixing plant – application of stabilisation binder

3.5.1 Cement, hydrated lime, cementitious blends and dry powdered polymer

Incorporation of constituent materials: Mix into the approved plant at a steady continuous rate.
Application rate: Incorporate binder at the nominated application rate.
Spillage: Remove any spillage of the stabilising binder as soon as practicable within the same work shift that the spillage occurred.

3.6 Stationary mixing plant - mixing

3.6.1 Cement or cementitious blends

Water: Control and meter the addition of water into the mix.
Mixing: Add mix constituents to the plant at a steady continuous rate. Mix for a minimum of 30 seconds after all constituents have entered the plant, until stabilising binder has been evenly distributed.
Requirement: Uniform mixture to design requirements.
Moisture content of the mix delivered on site: 60% and 90% of the OMC as determined for the nominated mix. Cover the load during transport to minimise moisture loss.

3.6.2 Placing of pavement materials produced in a stationary mixing plant

General: Transfer and spread in a concurrent operation. Place without visual signs of any significant segregation.
Placing: Conform to **PLACING** of *C08 Flexible pavement base and subbase*.

3.7 In situ stabilisation – Initial surface preparation

3.7.1 Subgrade stabilisation

Initial shaping: Trim the surface to the required alignment, levels and shape necessary to produce the required final compacted thickness of stabilised material.

3.7.2 Pavement stabilisation

Pre-milling: If asphalt will be placed as a wearing course and the finished surface levels are to match existing kerb and gutter, pre-mill using a profiler. If asphalt patches are in the existing pavement, pre-mill and cross blend and remove excess material or material not suitable for stabilisation from site.
Material not suitable for stabilisation: Remove and dispose of material not suitable for stabilisation including asphalt patches where the total asphalt thickness is greater than 50 mm.
Pavements with asphalt and cement treated patches: If preliminary sampling and pavement design allow for the incorporation of asphalt and cement treated patches, incorporate in the pavement by pre-milling and cross blending materials uniformly across the full pavement.
Pre-pulverisation of existing material: Pulverise the material to be stabilised with an approved stabiliser or profiler to 50 mm less than the design depth of the stabilised layer. Control the depth of cut during the initial pulverising pass so that this thin layer of the existing material remains for recycling in the second stabilising pass. Add water so that the material can be compacted and levels cut to provide the stabiliser with the correct surface shape for the second stabilising pass.

- Timing of pre-pulverisation:

- After the removal and replacement of material identified as material not suitable for stabilisation.
- Before the addition of shape correction material, if required.
- Before the application of binder.
- Before the application of supplementary binder, if required in stabilisation using foamed bitumen.

- Any additional material not suitable for stabilisation that is identified during pre-pulverisation: Remove or pulverise lumps which would otherwise be retained in a 53 mm sieve. Replace the volume of any large size material removed from the site with an equivalent volume of suitable granular material.

Additional granular material: Supply and spread to improve existing pavement material or to correct pavement levels as required.
Surface condition before in situ application of stabilisation binder: Shape, compact and trim the existing surface to facilitate stabilisation, compaction and trimming to the documented alignment, levels and shape.

3.8 In situ application of stabilisation binders

3.8.1 General

Construction traffic restrictions: Do not allow construction traffic or equipment, except for the centrally mounted mixer and watercart, to pass over the spread binder until incorporated into the pavement.

3.8.2 Quicklime, cement, cementitious blends or dry powdered polymer

Spreading: Use an approved load calibrated mechanical spreader from a rear or centrally calibrated drop chute capable of recording the output rate at which the binder is applied. Do not use agricultural or tipper-style spreaders.
Spread rate: Spread stabilisation binder at the nominated spread rate.
Record: Document the spread rate.

3.8.3 In situ lime slaking

Timing: If quicklime is used, commence slaking within 30 minutes after spreading, before mixing.
Hydration: Apply water uniformly to produce a material at least 80% hydrated. Do not concentrate water into ruts or hollows, or over water to produce a wet hydrate.
Fully slake quicklime: Use either of the following methods to verify slaking:

- A thermometer to assess the maximum rise in temperature as calcium oxide is converted to calcium hydroxide.
- A visual observation of the change from a granular material to a fine powder. Assess by rubbing the lime between the thumb and finger and confirming the lime is no longer gritty. Use appropriate protective equipment when handling quicklime.

Safety equipment: Use appropriate personal protective equipment during in situ lime slaking.

3.8.4 Equipment for Cationic or Anionic Emulsion Stabilisation

Emulsion stabilisation: Used with low fines and low plasticity (PI) gravels.
Plant and equipment: Use a reclaimer/stabiliser conforming to the following:

- Centrally mounted mixer.
- Minimum power capability: 300 kW (400 hp) for adequate mixing of materials.

- Two separate pumping/injection systems regulated by ground speed of the reclaimer/stabiliser for metering the bitumen and water.
- Fitted with a controlled device that calibrates the application rate in litres/m2 of residual bitumen.

3.8.5 Equipment for Foam bitumen stabilisation

Requirement: Provide the following equipment:

- Suitable bitumen foaming equipment capable of manufacturing foamed bitumen with an appropriate expansion ratio and half-life as defined in AGPT/T301.
- A metal discharge container for checking the foamed bitumen discharge timer.
- Mechanical mixing equipment, e.g. pugmill capable of ensuring a uniform distribution of foamed bitumen and hence a homogeneous mixture. The mixing equipment should be designed so that foamed bitumen is shielded from the operator when it is discharged into the mixing chamber.

3.8.6 Bituminous binders

Plant and equipment: Use a reclaimer/stabiliser conforming to the following:

- Centrally mounted mixer.
- Minimum power capability: 300 kW (400 hp) for adequate mixing of materials.
- Two separate pumping/injection systems regulated by ground speed of the reclaimer/stabiliser for metering the bitumen and water.
- Fitted with a controlled device that calibrates the application rate in litres/m2 of residual bitumen.

Additional plant requirements for foamed bitumen stabilisation:

- An inspection or test jet fitted to allow the flow of bitumen and the required expansion and half life qualities of the bitumen.
- Self cleansing bitumen jets.
- Appropriate pressure rating and temperature rating of bitumen lines for safety reasons.
- Mixing chamber for variable widths of binder to be incorporated into the pavement material.

Application rate: Incorporate bituminous binder at the nominated application rate.

3.9 In situ road mixing

3.9.1 General

Rate of work: Complete lane by lane or full width of carriageway in the one day operation.
Continuity: Start stabilisation from any end of the work and continue without gap to completion.
Pavement bulking: Take into account the degree of bulking to meet documented pavement thickness and finished levels.
Minimum mixing passes: 2.
Minimum mixing pass for unsealed pavements: 1.
Additional mixing: If required, carry out additional passes by the mixing equipment to improve visual uniformity of the mix and/or the moisture content.
Stabilised layer: Uniform over the full depth without lenses, pockets, lumps or granules of stabilisation binder.

3.9.2 Quicklime, cement, cementitious blends or dry powdered polymer

Mixing equipment: Conform to the following:

- Centrally mounted mixer with moisture control.
- Capable of mixing to the documented depth for the layer to be stabilised.
- Capable of mixing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised.
- Capable of supplying a calibrated amount of water to the area being agitated by the mixer to provide a uniformly moist mix to the documented moisture content.
- As mixing blades or tynes wear, replace to maintain mixing efficiency consistent with that demonstrated during the trial section.

Mixing procedure: Conform to the following:

- In the first pass, mix the binder into the material to 90% of the documented pavement depth.
- Carry out mixing of the second or final pass to the full documented pavement depth.
- Add water after mixing to shape, compact and trim within the allowable working time.

3.9.3 Bituminous binders

Mixing supplementary binders:

- Start mixing after spreading of supplementary binder.
- Mix binder into material to 90% of documented pavement depth.
- Add water to achieve the required moisture level.
- If the supplementary binder is quicklime, carry out slaking before mixing.

Foamed bitumen mixing: To AGPT/T302 procedure for adding foam bitumen to a granular material to produce foamed bitumen stabilised material (100% granular material passing the 37.5mm sieve)

- Bitumen temperature: Incorporate bitumen at a temperature between 180°C and 190°C.
- Add water only through the mixing chamber.
- Carry out mixing to the documented thickness in one or more passes.
- If bitumen streaks, blotches or masses form within the mix, cease mixing.

Moisture content immediately after mixing: 80% to 100% of the documented moisture content.
Record: Document the mixing in a Daily record sheet and include details of materials applied.

3.10 Compaction

3.10.1 General

Requirement: Compact the stabilised layer over the entire area and depth not less than as detailed in the following:

- Subgrade stabilisation: To C06 Earthworks (Road reserve).
- Pavement stabilisation: To C08 Flexible pavement base and subbase.

Compaction equipment for unsealed roads:

- Vibrating smooth drum roller:
  - Compacting thickness up to 200 mm: Minimum mass of 15 tonnes.
  - Multi-tyre roller: Minimum mass of 12 tonnes.

Timing:

- Start compaction after mixing.
- Complete compaction within the allowable working time.
- Carry out compaction and trimming in a continuous method.

Compacted surface: Keep compacted layer moist, free from contamination and in good condition, until an overlying layer is constructed.

3.10.2 Compaction - bituminous binders

Compaction equipment for foamed bitumen stabilisation: Conform to the following:

- Vibrating padfoot roller:
  - Compacting thickness up to 200 mm: Minimum mass of 18 tonnes.
  - Compacting thickness up to 300 mm: Minimum mass of 21 tonnes.
- Vibrating smooth drum roller:
  - Compacting thickness up to 200 mm: Minimum mass of 18 tonnes.
  - Compacting thickness up to 300 mm: Minimum mass of 21 tonnes.
- Multi-tyre roller: Minimum mass of 12 tonnes.

3.10.3 Compaction - dry powdered polymers

Moisture content of material for compaction: 2 to 3% dry of OMC.
Test: To AGPT/T303 procedure for compacting cylindrical test specimens suitable for use in the determination of physical properties.

3.11 Trimming

3.11.1 General

Primary trimming: After mixing, trim and compact the layer conforming to *C08 Flexible pavement base and subbase* to produce a tight dense surface parallel with the finished wearing surface levels.
Secondary trimming: Trim the layer to meet shape and level requirements in preparation for the primer seal. Do not use surface slurrying or methods which lead to laminations in the pavement.
Trimmed material: Use trimmed material cut to waste as fill or spoil.
Surface quality: Provide finished surface as follows:

- True to line and level without any loose pockets, holes, bumps and flakes.
- Crowned pavements adjacent to gutter: Straight uniform profile from the crown of the pavement to the lip of the gutter.
- Stabilised road shoulders only: Finished profile that is straight and uniform in crossfall from the edge of the existing pavement to the outer edge of the new pavement.

3.11.2 Levels and thickness control methods

General: Provide controls so that the pavement layer thickness is not reduced during secondary trimming and that the pavement levels are within the documented tolerance.
Level and thickness control methods during construction: Determine levels using either survey or stringline measurements from survey pegs taken at close intervals to reduce longitudinal roughness.
Levels after trimming: Survey finished levels for conformity to the documented tolerances.
Layer thickness after trimming: Check layer thickness for conformity using the following methods:

- Stationary plant mixed pavements: Survey layer after secondary trimming.
- In situ stabilisation: Measure the stabilised layer depth from a cutting adjacent to the stabilised pavement in at least two locations within the lot.

3.11.3 Straightedge test

General: Undertake immediately before sealing or before the agreed practical completion of any work component.

3.12 Joints

3.12.1 General

Requirement: Conform to the following:

- Form all joints by cutting back into the previously stabilised and compacted sections.
- Remove cut off material and keep joint area clean.
- Maintain cut face of the previous run in a damp condition.
- When compacting the fresh mix, support the roller partly on the previously compacted run.
- Level and shape of the joints: Within the documented limits.

3.12.2 Longitudinal joints

General: Minimise the need for longitudinal joints. If required, demonstrate that joints are unavoidable. If compaction of adjoining runs cannot be achieved within two hours of incorporating stabilisation binder, form a longitudinal joint between runs.

- Locate along lane marking line or midway between lane marking lines.
- Minimum longitudinal overlap of mixing runs: 100 mm.

3.12.3 Transverse joints

General: Form joints under the following circumstances:

- Before start of the day's stabilising process.
- After any delay in excess of 2 hours in the continuity of the stabilisation process.
- Minimum overlap of transverse joints: 1.5 m.
- Remix the material disturbed during cutting back at full depth and incorporate into the new work.

3.12.4 Joints - bituminous binders

General: Conform to the following:

- Undertake mixing in lanes. Work from one side of pavement to the other and do not interfere with lanes of unmixed material.
- Overlap: 100-200 mm.
- Completed joints: Keep area within 300 mm of joints uncompacted until adjacent material is mixed.
- Longitudinal joints: Avoid longitudinal joints by finishing a full carriageway width each day. If required, locate at a lane line or in the centre of carriageway.
- Transverse joints: Conform to the following:
  - Location: At works halted at the end of each day.
  - If joints are not made within 4 hours, cut back the adjoining stabilised surface to at least 1.5 m.

3.13 Curing

3.13.1 General

Traffic: Protect from heavy traffic until cured or the next pavement layer is laid.
Drainage: Maintain drainage for water run-off.

3.13.2 Curing method

Requirement: Cure stabilised material using one of the following methods:

- Water curing: Protect the stabilised work against rapid drying out by keeping it continuously wet or damp during the period before the provision of a subsequent layer or the application of a prime or primer-seal. Provide frequent light uniform spray that does not produce significant run off or flooding on sections of the area. Avoid slurrying of the surface or leaching of the stabilising agent.
- Bituminous surfacing.
- Constructing the next layer.

Bitumen stabilised pavements: Curing by wetting the surface is not required.
Curing period: As documented.

3.14 Testing

3.14.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

3.14.2 Site tests

Stabilised materials mixed in a stationary mixing plant:

- Strength test: Confirm performance by monitoring the unconfined compressive strength and the CBR (if required) of production, to AS 5101.4.

In situ spread rate testing: Test spread rate using either of the following methods:

- Weigh the contents of a suitable 4-sided tray placed on the pavement and between the wheels of the mechanical spreader. Calculate the rate of stabilising agent spread by dividing the mass collected (kg) by the area of the tray (m2).
- If spreading vehicles are fitted with load cells, ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run.

In situ mixing: Measure stabilised layer depth using either of the following methods:

- By measuring the depth of cutting adjacent to an existing pavement in two areas within the lot and measure to nearest 5 mm. Use a stringline to assess the depth of stabilised layer as the difference between finish surface level and the bottom of stabilised layer.
- Survey.

Compaction tests: Conform to the following:

- Test method: Sample and test the lots for true relative compaction assessments within the nominated allowable working time.
- Laboratory density:
  - Unbound and modified layers: Test samples to determine maximum dry density (modified compactive effort) in a laboratory to AS 1289.5.2.1.
  - Bound layers: Test samples to determine the maximum dry density (modified compactive effort) to RMS T130 within two hours of adding stabilisation binder to the mix.
- Field density testing: Use either of the following methods:
  - Sand replacement method: Test the compacted material to AS 1289.5.3.1 or AS 1289.5.3.2 or AS 1289.5.3.5.
  - Nuclear density meter: Test compacted material to AS 1289.5.8.1.
- Relative compaction: To AS 1289.5.7.1.

3.14.3 Site tests, Bituminous binders

- Foaming test: Confirm that all bitumen foaming nozzles are operating by conducting a foaming test adjacent to the site. Do not incorporate this material in the works.
- In situ application rate of bituminous binders: Verify through dipping the tanker at the start and finish of each run.

3.14.4 Completion tests

Straight edge test: Take measurements with a 3 metre straightedge at a minimum of 10 randomly selected stations so as to represent each 200 metre lane length or part thereof.

4 Annexures

4.1 Annexure - Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection	Submission/Notice details	Process held
C07-HP01	SUBMISSIONS, Certification, Stabilisation mix(es) and its constituents	H	Details and certification of stabilisation mix(es) and its constituents	14 working days before commencement of works	Stabilisation mix design
C07-HP02	SUBMISSIONS, Certification, Materials proposed	H	Evidence of material conformance	14 working days before commencement of works	Ordering of materials
C07-HP03	SUBMISSIONS, Variations, Nominated mix design	H	Details and certification of new stabilisation mix(es) and its constituents.	14 working days before commencement of works	Stabilisation mix design
C07-HP04	SUBMISSIONS, Execution details, Trial section (where required)	H	• Record data of actual spread rate (in situ) or application rate (mixing plant). • Compaction test results from a registered testing authority. • Survey report of finished levels. Depth check records showing compacted thickness of stabilised layer for insitu stabilisation. • Survey report of compacted thickness for stationary plant mixed pavements. • Record data of straightedge test.	2 working days before commencement of remaining stabilisation works	Commencement of remaining stabilisation works
C07-HP05	SUBMISSIONS, Execution details, Joints	H	Details of location and types	2 working days before construction of joints.	Construction of joints.
C07-HP06	SUBMISSIONS, Execution details Compaction	H	Test results from a registered testing authority	2 working days before placement of subsequent layers or bituminous surfacing	Placement of subsequent layer; Bituminous surfacing
C07-HP07	SUBMISSIONS, Execution details	H	• Survey report of finished levels. Depth	2 working days before placement of	Placement of subsequent

Reference No:	Clause and description	Type*	Submission/Inspection	Submission/Notice details	Process held
	Trimming		check records showing compacted thickness of stabilised layer for insitu stabilisation. • Survey report of compacted thickness for stationary plant mixed pavements. • Record data of straightedge test.	subsequent layers or bituminous surfacing.	layer; Bituminous surfacing.
C07-HP08	INSPECTIONS, Notice Trial Section (where required)	H	Location, materials, equipment, methods and joint construction	2 working days before construction of trial section.	Construction of trial section. For development inspections book through "MyInspect".
	*H = Hold Point W = Witness Point				

4.2 Annexure - Maximum lot sizes and minimum test frequencies

4.2.1 Stabilisation table

Activity	Key quality verification requirements		Maximum lot size	Minimum test frequency	Test method
Material supply	Material quality – Supplier's documentary evidence and certification of:				
	• Cement		1 contract	1 per 100 t	AS 3972 and AS 2350 (various)
	• Quicklime		1 contract	1 per 100t	AGPT/T303
		Available lime (CaO content)	1 contract	1 per 100 t	AS 4489.6.1
		Slaking rate	1 contract	1 per 100 t	RMS T432
		Particle size dist'n	1 contract	1 per contract	AS C08.11.1
	• Hydrated lime				
		Available lime ($Ca(OH)_2$)	1 contract	1 per 100 t	AS 4489.6.1
		Residue on sieving	1 contract	1 per contract	AS 4489.2.1
	• Ground blast furnace slag		1 contract	1 per month	AS 3582.2
	• Fly ash		1 contract	1 per month	AS 3582.1
	• Cementitious blends		1 contract	1 per 100 t	RMS 3211 part of R75/M
		Blend proportion	1 contract	1 per mix	RMS 3211 part of R75/M
	Foamed bitumen		1 contract	1 test per mix	AGPT/T301, AGPT/T302 AGPT/T303 AGPT/T305
		Expansion ratio	1 contract	1 per tanker load supplied	RMS T153
		Half life	1 contract	1 per tanker load supplied	RMS T153
	• Water				
		Chloride ion content Maximum 600 parts per million	1 contract	1 per contract per source of water	AS 3583.13 and RMS T1004 RMS R75
		Sulphate ion content Maximum 400 parts per million	1 contract	1 per contract per source of water	AS 1289.4.2.1 and RMS T1014 RMS R75

Activity	Key quality verification requirements		Maximum lot size	Minimum test frequency	Test method
		Undissolved solids Maximum 1% by mass	1 contract	1 per contract per source of water	AS3550.4 and RMS R75
Lime Demand Test	Lime	pH equals 12.4	1 contract	1 per contract	Test method Q133 (TMR)
Mix design	Certification of registered testing authority– Supplier's documentary evidence and certification		1 mix	1 per mix	As provided by the suppliers selected.
Stationary mixing plant	Application rate of stabilising agent		1 day's production	1 per 100 t	
	Unconfined compressive strength (UCS) of product		1 day's production	1 per 100 t	AS 5101.4
In situ spreading	Spread rate		1 layer 1,000 m²	1 per lot or 1 per 500 m²	
	Mix uniformity		1 layer 1,000 m²	1 per 500 m²	Visual
Insitu emulsion binder	Cationic per square metre		1 layer per 1000 m^2	1 per 500 m^2	
	Anionic per square metre				
In situ application – bituminous binders	Foaming test		1 day's production	1 per tanker load supplied	
	Application rate		1 layer 1,000 m²	1 per lot or 1 per 500 m²	
Mixing	Stabilised depth		1 layer 2,000 m², max. 1 day's placement	1 per lot	
Trimming and compaction	Finished levels		1 layer 2,000 m², max. 1 day's placement	One cross section per 25 m	Survey
	Surface quality		1 layer 2,000 m², max. 1 day's placement	10 per 200 m lane length *	3 m straight edge
	Average layer thickness		1 layer 2000 m², max. 1 day's	1 per lot	Survey (Stationary plant mixed pavements). Measure (In situ

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
		placement		stabilisation).
	Average width	1 layer 2,000 m², max. 1 day's placement	1 per lot	Measure/survey
	Relative compaction/moisture content	1 layer 2,000 m², max. 1 day's placement	3 per lot	AS 1289.5.7.1 AS 1289.5.8.1 AS 1289.5.3.1 AS 1289.5.3.2 AS 1289.5.3.5

* Note: or part thereof, per lot.

4.3 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS C08		Methods for sampling and testing aggregates
AS C08.53	1996	Methods for sampling and testing aggregates - Absorption, swell and capillary rise of compacted materials
AS 1160	1996	Bitumen emulsions for construction and maintenance of pavements
AS 1289		Methods of testing soils for engineering purposes
AS 1289.4.2.1	1997	Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1289.5.2.1	2017	Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort
AS 1289.5.3.1	2004	Soil compaction and density tests - Sand replacement method using a sand-cone pouring apparatus
AS 1289.5.3.2	2004	Soil compaction and density tests - Sand replacement method using a sand pouring can, with or without a volume displacer
AS 1289.5.3.5	1997	Soil compaction and density tests- Determination of the field dry density of a soil - Water replacement method
AS 1289.5.7.1	2006	Soil compaction and density tests- Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)
AS 1289.5.8.1	2007	Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode
AS 1672		Limes and limestones
AS 1672.1	1997	Limes for building
AS 2008	2013	Bitumen for pavements
AS 3350		Waters Determination of solids
AS 3350.4	1990	Gravimetric method
AS/NZS 3582		Supplementary cementitious materials
AS/NZS 3582.1	2016	Fly ash
AS 3582.2	2016	Slag - Ground granulated blast-furnace
AS 3583		Methods of test for supplementary cementitous materials for use with portland cement
AS 3583.13	1991	Determination of chloride ion content
AS 3972	2010	General purpose and blended cements
AS 5101		Methods for preparation and testing of stabilized materials
AS 5101.4	2008	Unconfined compressive strength of compacted materials
Austroads AGPT		Guide to pavement technology
Austroads AGPT04D	2006	Stabilised materials
Austroads AGPT/T301	2017	Determining the foaming characteristics of bitumen
Austroads AGPT/T302	2017	Mixing of foamed bitumen stabilised materials
Austroads AGPT/T303	2017	Compaction of test cylinders of foamed bitumen stabilised materials Part 1: Dynamic compaction using marshall drop hammer
Austroads AGPT/T305	2017	Resilient modulus of foamed bitumen stabilised materials
RMS 3211	2018	Cements, binders and fillers
RMS R75	2015	Insitu pavement stabilisation using slow setting binders

RMS T130	2012	Dry density/moisture relationship of road construction materials (blended in the laboratory with cementitious binders)
RMS T144	2012	Hydrated lime for road construction materials (Lime demand test)
RMS T1004	2012	Quantitative determination of chloride ion in water
RMS T1014	2012	Quantitative determination of sulfate ion in water
VicRoads RC 131.01	2013	Lime saturation point of soil (pH method)